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Mobility behaviours in peri-urban areas. The Milan Urban Region case study

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Abstract

The paper focuses on mobility practices and the emergence of new geographies of movements in Lombardy peri-urban areas, in order to investigate whether and if so how new processes of urban regionalization (Soja 2011, Brenner 2013, Young and Keil 2010) can be recognized through a plurality of forms and conditions of mobility behaviours. Enhancing, on the one hand, the contribution of Italian and French research on peri-urbanism and its different forms, and on the other hand following in a line of studies on "mobility turns", this paper proposes a comparative analysis of some peri-urban areas characterized by specific processes of urban sprawl, differentiated by age, morpho-functional features and settlements within the Milan Urban Region. The hypothesis to investigate is whether and if so how the specificity and diversity of the processes of urban sprawl belonging to different "generations" of peri-urbanism in Milan Urban Region affect the forms of mobility and lifestyles, showing different living habits and specific issues.

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Keywords: peri-urban area, mobility practices, post metropolitan model, mobile phone data

1. Introduction

The paper focuses on user behaviours, modal choice and mobility patterns as experienced in peri-urban areas, to investigate whether and how new processes of urban regionalization (Sennett, 2007; Soja, 2011; Brenner, 2013), can

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be better understood through a reorganization of the mobility practices and through the emergence of new geographies of movements, in Milan Urban Region[2].

Mobility practices in peri-urban areas are used as interpretative key to investigate the diversity of lifestyles characterizing such areas in Lombardy Region (North Italy), highlighting possible transformative scenarios.

New research evidence suggests that patterns linked to mobility, consumption and lifestyles in peri-urban areas are changing quickly, challenging the way we conceptualise the relationship that European city central areas entrain with their outer areas and suburbs.

In the international literature (Keil, Youn 2011, Phelps, 2012; Soja, 2011; Brenner, 2013), it is widely acknowledged that changing socio-economic conditions are calling for a parallel readjustment of the approaches adopted to assess such phenomena. This to a certain extent has been done, nonetheless knowledge in the field remains fragmented and scattered across a number of disciplinary domains.

In this framework, the paper introduces the relevance of peri-urban areas as a text-field and as a "vectors of experimentations" of "new processes of urban regionalization" (Soja, 2011) as well as the role of mobility as useful fact-finding tool to describe peri-urban transformations. Therefore (Section 3 and 4) the paper describes the experiential dimensions of commuting rhythms through an integration of traditional data and mobile phone data (provided by Telecom Italia) to investigate how in Milan Urban Region commuting is related to the transformation occurring in the peri-urban spaces where greatest residential growth in the last two decades, socio-economic transformations with obvious effects on mobility practices, bring into tension institutional boundaries and traditional transport policy too.

In the conclusion (Section 5), the processing of mobile phone data, by offering new maps of site practices and information on temporary populations and city usage patterns (daily/nightly practices, non-systematic mobility), made it possible to supporting and increasing the efficiency of urban policies and mobility services in Milan peri-urban areas.

2. Peri-urban areas as a text-field

Peri-urban areas feature a multiplicity of spatial and social dynamics, which often differ from place to place. Such dynamics are the product of specific legislative, planning, cultural, economic, social and political traditions, and are hence closely bound up with their local histories. Here consolidated habits linked to our way of commuting, living and consuming are progressing, giving way to new practices, only partly comprehensible on the basis of some of the internationally available theories and conceptualizations (Keil 2013, Brenner 2013, Young and Keil 2010, Walks 2013).

At the same time, peri-urban areas tend to share some key features that have by now attracted the attention of researchers and policy analysts alike (Nilsson et al. 2013, Tosics 2013, Phelps and Wu 2011).

- They are areas of relevant urban growth, mostly due to recent widespread decentralisation processes (see Intra Urban Dynamics in Espon FOCI Report 2010, Urban Audit);
- Recent socio-economic changes are radically altering the characteristics of such areas while also transforming the relationship these entertain with their urban core areas with effects also on mobility practices in terms of "commuting transition"[3] (Sultana and Weber 2014), accompanied by a multi-skilled and hyper mobility;
- Local administrative boundaries are frequently found to be out of kilter with the functional relationships they are asked to oversee (a factor often leading to institutional tensions and problems related to their governance);

[2] Milan Urban Region, as defined later, is a complex urbanized area, composed by a plurality of settlement and living environments which includes the Milan metropolitan area, as well as the municipalities of the Western Lombardy.

[3] According to Sultana and Weber (2014) study on commuting patterns, peri-urban areas of recent residential growth in American cities have longer commuting times than other parts of the city; furthermore, and parallel with the ageing of these areas, commuting time will go through a predictable commuting transition.

- Peri-urban areas provide a test ground where to evaluate the effectiveness of recently enacted policies aimed at containing urban sprawl[4]

The variety of spatial and social urban transformation processes observed in peri-urban areas, have led some authors to reconsider the concepts and notions commonly used to comprehend and study them.

The post-metropolis concept brought in by Soja (2011) as a "new phase of multi-scalar regional urbanization" (p. 680), and the "in-between spaces" by Young and Keil (2010) in a re-conceptualisation of the Sieverts' work (2003) on the emerging patterns of urbanization and the connections between various aspects of urbanity in the urban regions, as well as the socio-spatial transformations in planetary urbanization (Brenner and Schmid 2013, p. 161) help to clarify the meaning and significance of the new conceptualization of the peri-urban spaces.

They are conceived not simply as transitional areas located between town and country, but rather as new and emerging forms of 'urbanity', that bring into play new life styles, new mobility behaviours and new urban issues.

The multiplicity of "peri-urbanisms" is related to the diversity and plurality of peri-urban living (Dodier 2013), which are reflected in an increasing complexity of home-work mobility, overcoming the centre-periphery model and the dependency on one or several city centres.

Enhancing, on the one hand, the contribution of Italian and French research on peri-urbanism and its different forms, and on the other hand following in a line of studies[5] on mobility as "part of the process of social production of time and space" (Cresswell 2006, p. 5), as useful fact-finding tool to describe urban transformations, we propose a comparative analysis of some peri-urban areas characterized by specific processes of urban sprawl, differentiated by age, morpho-functional features and settlements within the Milan Urban Region.

The hypothesis to investigate is whether and if so how the specificity and diversity of the processes of urban sprawl belonging to different "generations" of peri-urbanism in Milan Urban Region affect the forms of mobility and lifestyles, showing different living habits and specific issues.

3. A complex geography of peri-urban spaces in the Milan Urban Region

Different forms of peri-urbanization inside the urban configurations have long been an object of study in the Italian literature (Indovina, 1990, Dematteis, 1992, Secchi, 1992, 1994, Lanzani 1991; 2003, Clementi et al 1996, Bianchetti, 2000). The "plural nature" of peri-urban areas and their evolution over time, provide a specific framework for interpreting the changes in the Italian urbanisation process which, in other countries, can be mainly attributed to a shift from the typically monocentric dualism of dense city and sprawling low-density suburbanization to a polycentric network.

In this context, also the Milan Urban Region, an extensive area which goes beyond the institutional borders of the metropolitan city of Milan ("Città Metropolitana di Milano"), is an alternative territorial organization to the metropolitan area, characterized by a more complex model of settlement, where a variety of places with socio-economical, functional and settling specifications emerges. The kaleidoscopic vision of this territory (Fig. 1) is made up of:

- Milano and the nearest municipal districts with high densities and presence of important services and equipment for metropolitan populations;
- the rural South where the major urban dynamics in the last twenty years have changed the old agricultural vocation, following a sprawled settlement model;
- the West part (Magentino and Castanese) characterized by a polycentric and reticular settlement structure;

[4] Among those, the 'retrofitting' of suburbs through the densification of residential areas in and around existing or new public transport hubs.

[5] According to an established literature (Urry, 2000; Kaufmann, 2002; Cresswell, 2006; Sheller and Urry 2006), presented also in the first chapter of this book, spatial mobility is a key to understand the transformations in contemporary city, as socio-spatial phenomenon capable of describing the complexity of urban processes and the rhythms in contemporary city.

- the Brianza Milanese, in the Northern of Milan, with an historical and specialized industrial tradition (furniture district, textile system) which is now decreasing and characterized by dense urbanization, organized in the north-western side of the region, along the historical infrastructure corridor constituting urban continuum (i.e. the Sempione road);
- the North-East part – the Vimercatese area – characterized by more recent settlement with low territorial density and extensive green open spaces, improving the environmental quality.

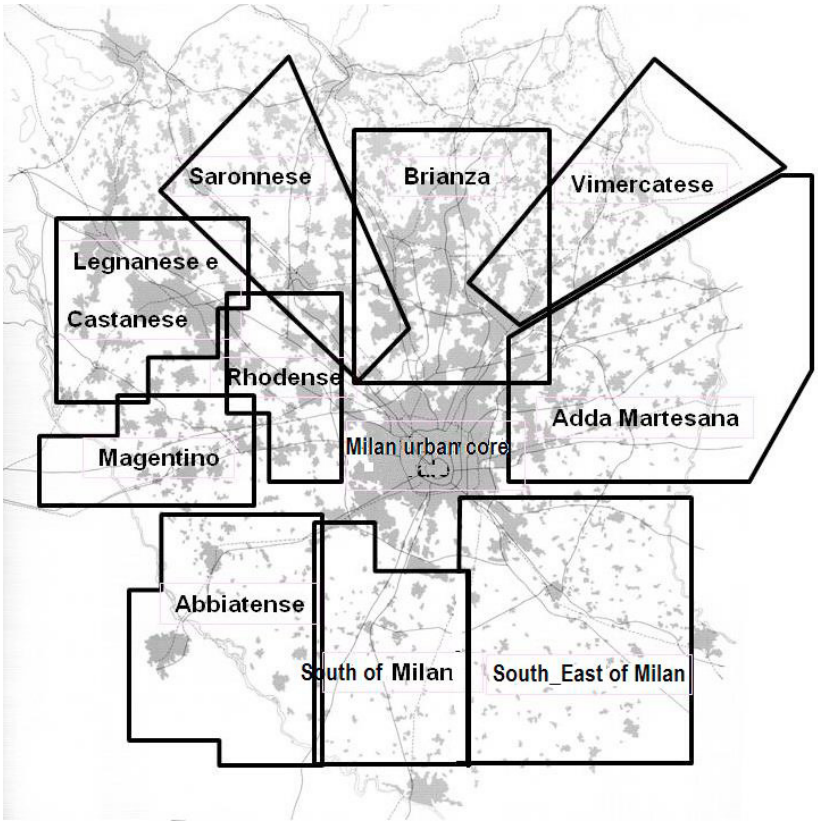

Fig. 1 – The kaleidoscopic vision of the Milan Urban Region

The complex geography of the territories in the Milan Urban Region is confirmed by the dynamics of daily mobility that show a widened and extensive use of the territories where the multi-directional mobility reflects a complex network of the relationships and places densely used: the increase in the transversal movements (orbital moves) defines a non-hierarchical system of relationships, even more in the dynamic areas (Fig. 2).

This dense and complex use of the territory is a consequence of a transformation in mobility behaviours: the difference of employment contracts, the diversification of the social time, as well as the weakening of the institutional ties (the timetables of work, school, public services and commercial concerns) produce an overlap between the time of the production, the time of the consumption and leisure time. In doing so, the obliged movements (work and study travel), characterized by fixed schedules and defined paths between an origin (home) and a destination (job / school), decrease in favour of growth in much more articulated movements in time and space, related to personal reasons, leisure time, purchases[6].

[6] In Lombardy Region the commuter flows are only 22% of the daily mobility flows (they were 25% in 2002). In the last decade the occasional displacements increased (24% in 2002; 26% in 2014) (Regione Lombardia, 2002 and 2015).

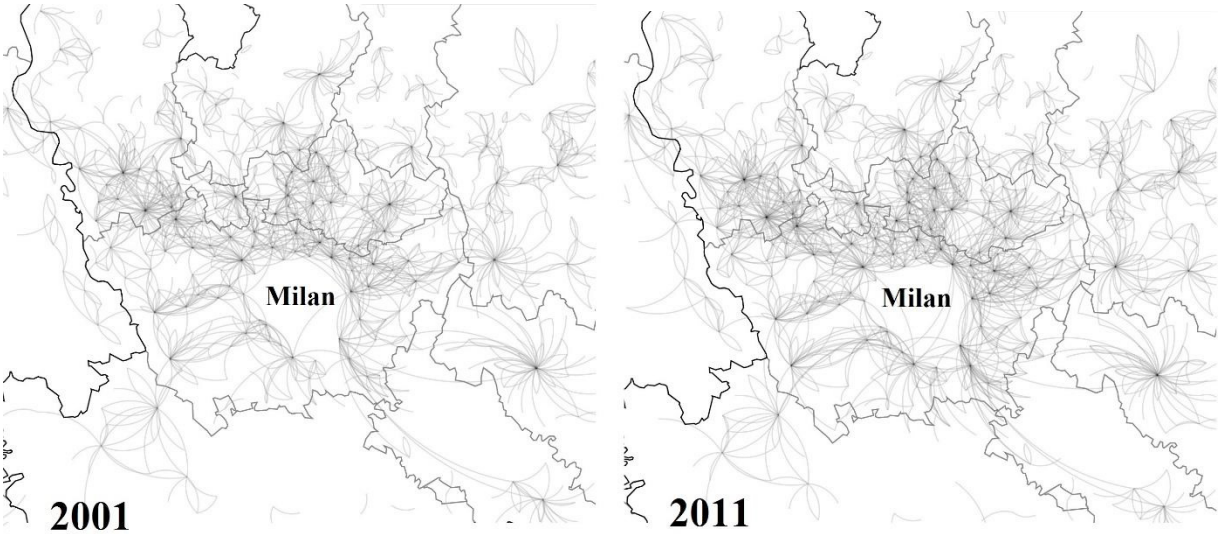

Fig. 2 – Origin_destination of commuter flows.

More than 100 units flows have been mapped, excluding flows to and from capital cities (sources: Dastu elaboration of Istat data).

These transformations are recognizable in the chain of daily moves[7] that becomes more articulated: more than 50% of the employees work in a municipality where they do not live, the daily rush hours are dilated (22% of the journeys are between 7 and 9 in the morning), the average time of displacement[8] increases as well as the average distances between work-place and home-place.

These trends affect also some industrial districts and local production systems where the historic integration between residence and work[9] dissolves, compared to growth in the job-dependence from other areas[10]. This process of progressive estrangement between work-place and home-place may be due to a residential migration from the Milan core area that has mainly affected towns in the South of the Milan Urban Region, where construction activity has been intense, with predominantly low density settlements, characterized by marked functional specialization (residency), often accompanied by few or no services and by a standardized time of use. On the other hand, the effects of the economic crisis in the labour market led to a lengthening of work-journeys.

A progressive weakening of local industrial system, characterized by a productive specialization and, up to now, with close integration between workplace and home-place, is accompanied by dynamic trends in the surrounding areas of Milan where mobility increases in proportion to the attractiveness of the job supply. The stable equilibrium of the Milan-bound commuter flows (Fig. 3), after a previous decade (1991-2001) characterized by a reduction of the catchment area of the capital[11] in favour of dynamic external territories, confirms a kind of faint "return to the centre"[12].

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[7] The daily average trips were 2.65 trips/day in 2002 and 2.5 trips/day in 2014. 91.2% of the sample performed two displacements sequentially (Regione Lombardia, 2002 and 2015).

[8] 14% of the daily commuting in Milan Urban Region is characterized by a travel time over 60 minutes; Lombardy regional average is 8.9%. Of these flows 75.6% are outflows (88.2% in Lombardy). On the contrary the flows under 15 minutes of travel time significantly decreased (-42.6%).

[9] This is calculated with self-containment index, as ratio between internal flows and all the employed in each municipality.

[10] This trend affects especially the "Pedemontana" area in the North of Milan (along Varesina and Sempione roads to Malpensa airport), and in the North-East (as Magentino and Castanese), where, in the previous decade, there were high values of integration between home-places and work-places.

[11] Milan catchment area - calculated as a percentage of commuter flows to Milan on total outflows generated by each municipality, excluding Milan - indicated in 2001 that 10.6% of outflows had as destination Milan, as compared with 8.13 % in 2011.

[12] The commuter flows attracted by Milan from the municipalities in Milan Urban Region were in decline between 1991 and 2001 (-12,1%), and steady between 2001 and 2011 (-0,04% %).

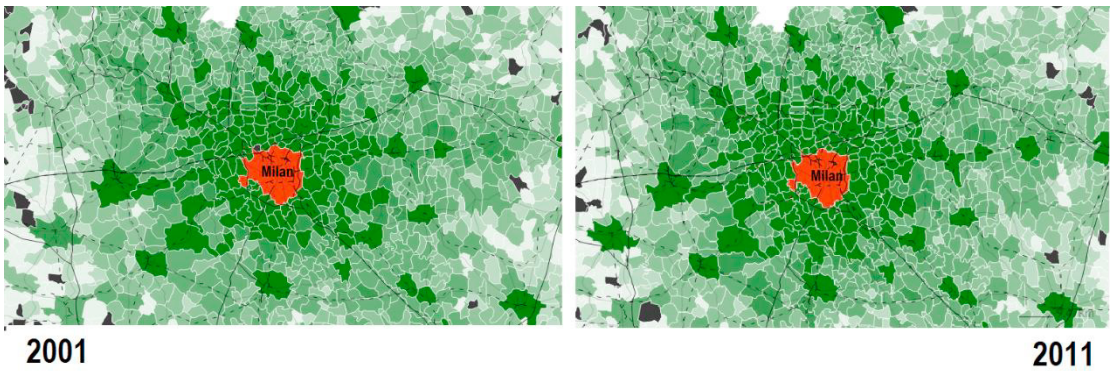

Fig. 3 – The catchment area of Milan (sources: Dastu elaboration of Istat data).
Percentage of commuter flows to Milan on total outflows generated by each municipality, excluding Milan.

These dynamics are also supported by mobile phone data. In the framework of our research (Pucci et al. 2015) and in collaboration with Telecom Italia (T-Lab), we work on aggregated Origin-Destination flows derived from mobile phone users, free from privacy restrictions and consisting in an aggregation of users' movements based on call detail records database[13] (CDR). We proposed an overview of these data in terms of "prevalent flows" of mobility, defined as the sum vector of all the flows of people moving from each zone. Origin and destination zones are the tessellation tiles proposed in our research, taking into account the spatial distribution of antenna and the administrative boundaries (Fig. 4).

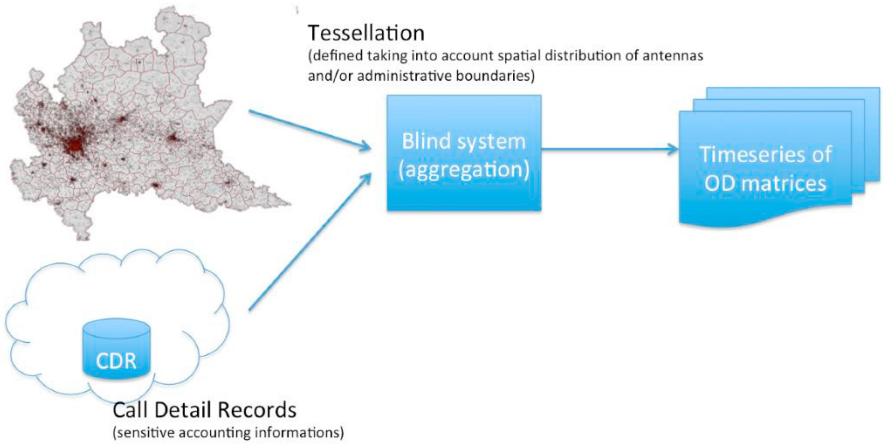

Fig. 4 - Blind extraction of time-series of aggregated Origin-Destination matrices (source: Manfredini et al. 2016)

[13] Telecom Italia implemented a system for automatic, blind extraction of data. Once fed with the CDR and a tessellation of a geographical region it outputs time series of Origin-Destination matrices (Pucci et al. 2015).

Figure 5 is the result of interpolating the sum vectors to obtain a regular vector field. The map processed with mobile phone data allows to observe the daily time in the density of flows related to individual habits as an effect of the diversified uses of the Milan Urban Region, where complex daily mobility patterns modify the hierarchical structure of this territory, revealing an increasing number of places frequented during the day, as well as diversified ways of use, reflecting daily life and job requirement transformations.

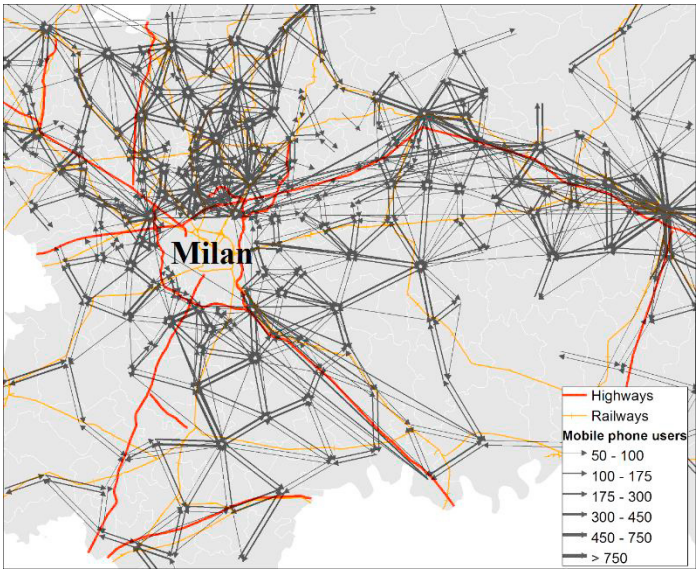

Fig 5 – Origin-destination flows of mobile phone users: 5 p.m., 19-10-2011 (source: Pucci et al. 2015)

These general trends take on different forms and intensity, confirming multiple geographies in Milan Urban Region, out of the binary discourses centre/peripheries.

3.1. The radial organization of the infrastructure system and its transformations

These complex mobility practices intensively use an infrastructure system strongly marked by a radial organisation: roads, railways and artificial waterways networks converging on Milan have been enhanced only in the last five years. The mutual interaction between the dynamics of settlement growth, the combination of new forms of decentralization and recentralization, more complex mobility practices and new road and rail infrastructures[14] are producing a progressive shift away from the original radial structure. New central places which are becoming generators of wide range of diversified relations, modify the radial-centric infrastructure scheme, generating new geographies in the North and in the South of Milan Urban Region. The road density (Fig. 6) is more significant in the northern districts of the Milan Urban Region, where the presence of historical radial roads - doubled or widened in order to face the increasing mobility demand - and the rail infrastructure with a high frequency of the stations, claimed an intense urbanization process that constitute an urban continuum as a linear conurbation of commercial, residential and productive settlings. In the South, the historical radial structure of the network has not been

[14] Among them, Pedemontana highway system in the North of Milan from Bergamo to Malpensa airport, Boffalora-Malpensa airport highway in West of Milan Urban Region; Bre.Be.Mi. highway from Brescia to Milan, a new east ring-road of Milan and the high-speed lines Torino_Milano_Bologna.

enhanced; while in the Eastern part of the Milan Urban Region new highways, recently realized (i.e. Brebemi, and a new east ring-road), have triggered important settlement transformations.

The structure of the railway network has remained unchanged (except for the realization of the high-speed lines), but the railway supply has been enhanced with the introduction of the Suburban Railway Lines, ensuring in each railway line two trains per hour in the connections with Milan. Even in this case, the uneven distribution of the railway stations, dense and inside the urban centers in the North, scattered and decentralized in respect to the urban settlements in the South, produces very different impacts on the modal split.

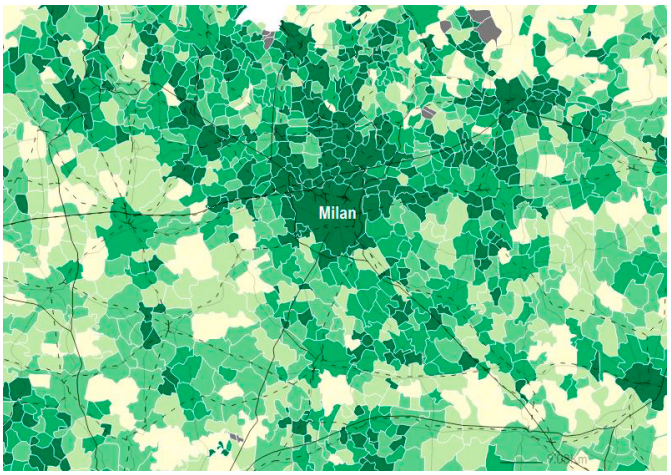

Fig. 6 – Road density (Km/Km^2) in Milan Urban Region (source: www.postmetropoli.it)

4. New emerging mobility patterns in Milan peri-urban areas

The analysis shows some dynamics of transition in the Milan Urban Region toward new urban density gradients, transforming the relationships between peri-urban areas and metropolitan core. In this framework, we will study if, and if so how the "post-metropolitan regional model" as defined by Soja (2000, 2011), is recognizable in our study area and if it can be interpreted as "an accelerated re-organisation and restructuring of the geography of movements that define the spatiality of human societies" (Soja 2004, p. 176).

Based on the features of the process of regional urbanization by Soja (2011) - density convergence, growing cultural and economic heterogeneity, social and political polarization - as well as the importance of the flows in the definition of in-between spaces (Young and Keil 2010), our study first tested correlations between housing density and mobility density, and then selected some micro-scale areas (e.g. neighbourhoods) to analyse the variability of the space-time practices, through mobile phone data.

The approach integrates traditional data (commuting national survey in 2001 and 2011, O/D matrix by the Lombardy Region in 2002 and 2014) with mobile data network provided by Telecom Italia company. The data processed are Erlang data. Erlang is a dimensionless unit used in telecommunications as a measure of the average number of concurrent contacts in a time unit. In our case, the data is a measure of mobile phone traffic intensity every 15 minutes. They were supplied by Telecom Italia in spatialized form; starting from the traffic recorded by each cell of the network, the provider distributed the measurements, by means of weighted interpolations, throughout a spatial tessellation of the Region in 250 x 250 square metres (Pucci et al. 2015).

With daily mobility indicators[15] it was possible to select some urban neighbourhoods to compare the density and variability of mobile phone traffic (Erlang date) with demographic and socio-economic data.

[15] Processed index are: *Self-containment index* calculated as ratio between internal flows and the employee in each municipality; this index shows

In these investigations, aggregated mobile phone data are the result of individual behaviours and habits. Hence they offer information on the time-space uses of the urban spaces. The processing of such data allows for visualization of the spatial distribution of mobility, highlighting the places where urban practices occur recursively, but also reflects the experiential dimensions of mobility practices (Pucci et al. 2015).

In this approach the infrastructure system and the transport supplies are considered both in terms of equipment[16] and in relation to their morphology.

4.1. Mobility index and housing density

For some years, authors and scholars have investigated the correlation between urban density and mobility, showing positions very far from each other with respect to the role that settlement density plays in the intensity of the daily commuting (Newman and Kenworthy 1996, Naess 2005, Gordon and Richardson 1991 and 1997, Ewing and Cervero 2001, Ewing and Cervero 2010, Echenique et al. 2012).

On the evidence of the role covered by density for interpretation of the dynamics of urban regionalization, we investigate whether there is a correlation between housing density (calculated as percentage of buildings with one and two floors) and mobility index (calculated as ratio between inflows+outflows and employees) at the municipality level in the Milan Urban Region.

Calculations, carried out on the Milan Urban Region, have pointed to four situations characterizing the municipalities and summarized in the figure below (Fig. 7)

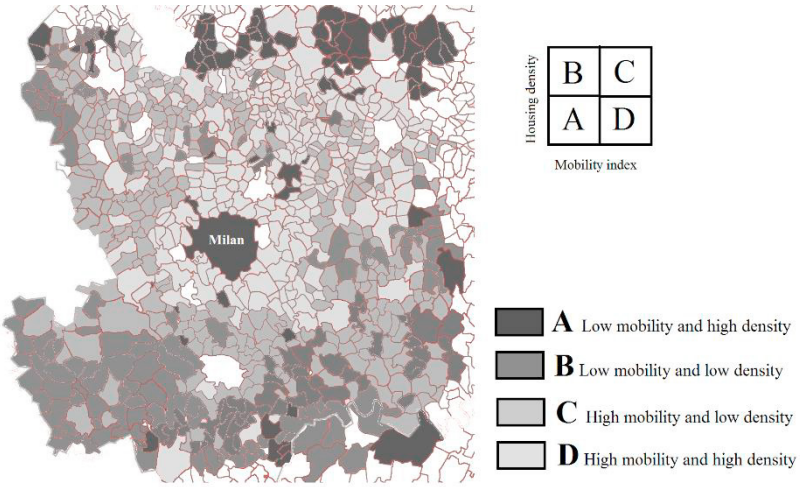

Fig. 7 - Mobility index and density of housing settlement: four profiles

The outcomes prove the relationship between high mobility and low housing density: most municipalities with low housing density have high values of mobility (C quarter). Most of them are localized in the North-West of Milan Urban Region (Castanese, Legnanese), and in the rural areas in the South-West (Abbiatense and South of Milan).

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the level of integration between workplaces and home-places at the municipality level. *Mobility index* is calculated as ratio between internal flows + outflows and the employees in each municipality. This index shows the density of displacements at the municipality level. *Dependence index* is calculated as ratio between the outflows and the employees in each municipality. This index shows the level of dependence for the offer of employment from other municipalities. The *index of attraction* is calculated as ratio between the inflows deducting the outflows and the employees in each municipality. This index shows the level of polarization and attraction for the supply of employment at municipality level (Pucci, 2010).

[16] The processed index is calculated by adding the standardized values (Z-score) of the following indicators: density of the road (ratio between km of national and provincial roads and surface of each municipality); number of railway stations in each municipality; number of highway junctions in each municipality.

The municipalities with low urban density and low mobility (B quarter) are a few urban centres in the North of Milan (Brianza) characterized, in the last decade, by a stable trend in population and employees. The municipalities with high housing density and low mobility index (A quarter) show very different situations: there are attracting polarities like Milan, being characterized by a high internal mobility but a low value in outflows, and Monza, as well as Basiglio, a small municipality in the South of Milan with among the highest per capita incomes in Italy. This trend depends on the index of mobility, calculated as the sum of the internal and outflows from each municipality (ratio employees). The municipalities with high values both in housing and mobility density (D quarter) are in the first belt around Milan and along the main infrastructure corridors with a good road accessibility.

Going more in depth into the correlation between housing density and mobility, we considered as an indicator of mobility also the self-containment index (inflows/employees), with the aim of understanding if mobility generated by low housing density is attributable to internal mobility to each town, therefore related to a short-range mobility with good integration between work-place and home-place.

The outcomes of these analyses enable us to identify different conditions, summarized below (Fig. 8).

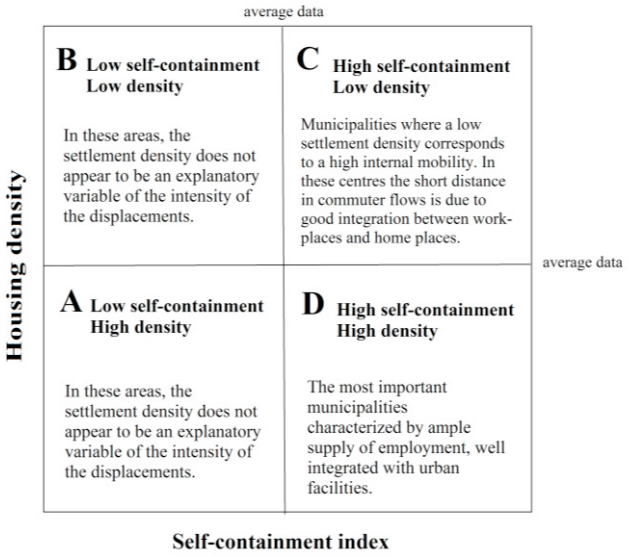


Fig. 8 - Correlation between self-containment index and housing density

C quarter (high self-containment/low density) includes municipalities with low housing density and high short distance mobility, due to closeness between workplace and home-place. In this case, low housing density does not seem to be the reason for intensive work-travel. This condition characterises urban districts where historically the local production system has played an important role at the local and regional level (Castanese e Legnanese, and some municipalities in Brianza).

D quarter (high self-containment and density) regards municipalities with high settlement density as well as high density of internal flows. These are the main polarities in the Milan Urban Region characterized by an ample supply of jobs and a high economic activity density, well integrated with the urban services (Milan, Monza, San Donato Milanese). More complex situations are to be seen in A and B quarters, both characterized by a low density of internal flows, but different housing densities.

In these cases, the settlement density does not appear to be an explanatory variable of the intensity of the displacements. Based on this and following the hypothesis that the settlement patterns, as relationship between infrastructure supply and settlement morphology, can affect the mobility, we identify three morphological patterns (linear, sprawled and gated settlements), and we select some sample of linear, sprawled and gated settlements inside the municipalities in B quarter (low self containment and housing density).

Fig. 9 - Morphological patterns: linear, sprawled and gates settlements

Comparing the mobility and socio-demographical dynamics of linear, sprawled and gated settlements, located in municipalities characterized by a low density of internal flows and low housing densities (B quarter), we search for possible correlations between urban morphology, settlement density, age of the building, socio-demographic profile of residents and intensity and modal distribution of mobility. In the outcome, even in the presence of low-density settlements, the linear settlements generate more intensive commuting flows directed towards other municipalities that the sprawled settlements in the North of Milan Urban Region. These linear settlements have a land use richer than the sprawled and gated settlements where the residence prevails.

In the South, the situation seems more complex: if the building density as well as the land use mix do not explain the dynamics of commuter mobility, an element that appears to be relevant in these cases-study, is the age profiles of residents. The settlements in the south of Milan Urban Region are more recent and inhabited by young worker people which has a high mobility.

Because the dynamics related to mobility practices are ascribable to socio-economic and lifestyle transformations we have chosen to deepen the analysis of mobility, using mobile phone data, as an effective source to analyzing the time-space variability of the urban practices.

4.2. Micro-scale mobility practices through mobile phone data

The areas of North and South Milan are characterized by different generation of peri-urbanism and now going through considerable transformation processes, related to the economic crisis and the restructuring of the local production system, reducing their urban and socio-economical complexity. In these areas we selected some sprawled peri-urban neighbourhoods (Fig. 10), defined by various morphological patterns and levels of integration between home and work places, influencing urban behaviour, life styles and the mobility practices of their inhabitants.

Within these different peri-urban neighbourhoods, using mobile phone data expressed in Erlang, we analysed the variability of trends on working days and during holidays. Erlang is a measure of mobile phone traffic intensity every 15 minutes.

Elaborating the typical daily curves of mobile phone activity (Erlang from January to October 2009), the first hypothesis to verify was whether these areas, characterized by marked functional specialization (residency), often accompanied by few or no services and by a standardized time of use, showed specific and peculiar Erlang trends compared with other urban areas, in line with the profile of these contexts, almost exclusively residential and with a high percentage of working population.

The Erlang trends highlight in these peri-urban areas very different trends on weekdays (Wednesdays) and on Sundays, confirming the profile of these areas: they are residential areas with a high percentage of the workers who, during the day, generally move to the workplace or school, and come back only in the evening.

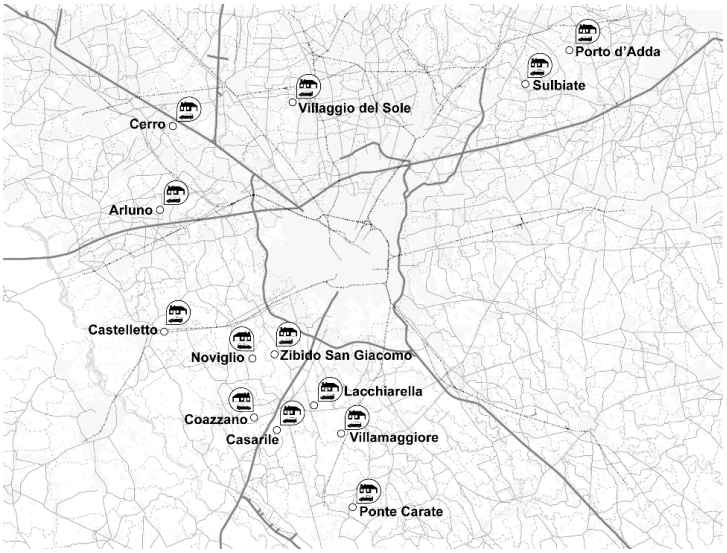
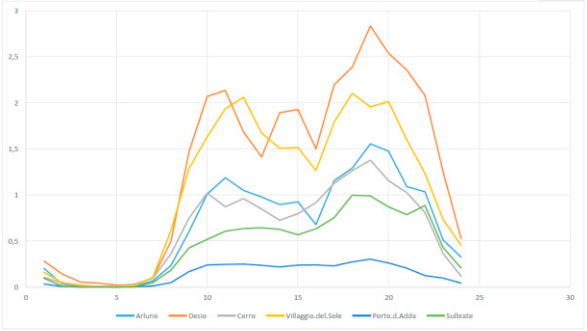
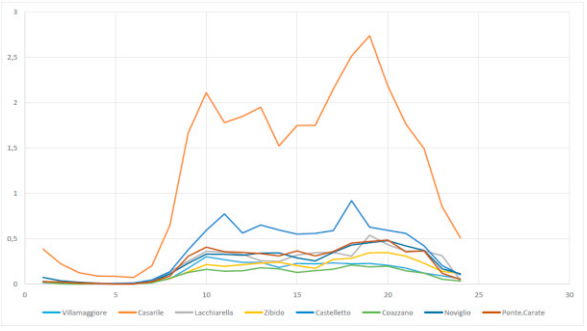


Fig. 10 - Localization of the selected peri-urban neighbourhoods in Milan Urban Region

The graphs (Fig. 11 and 12) clearly show similar trends in both the Southern and the Northern territories of the Milan Urban Region: the peak hours during morning and evening hours are more clearly visible during weekends when the amount of calling activity is much higher during the periods 9-12 a.m. and 7-10 p.m.

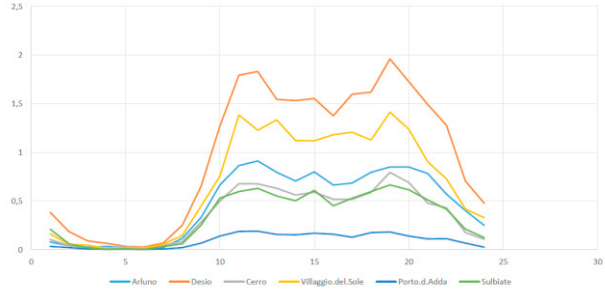


Neighbourhoods in the North of Milan Urban Region

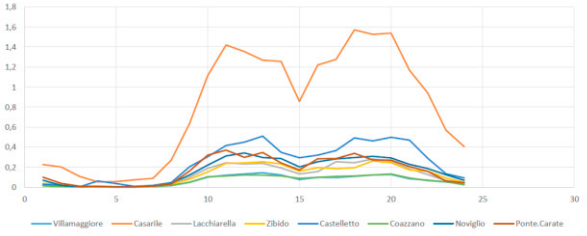


Neighbourhoods in the South of Milan Urban Region

Fig. 11 – Erlang curves in weekday (Wednesday)



Neighbourhoods in the North of Milan Urban Region



Neighbourhoods in the South of Milan Urban Region

Fig. 12 – Erlang curves during the weekend (Sunday)

Moreover, the different characters of the Northern and the Southern territories are also confirmed by the Erlang curves. For instance, calling activity in the Southern part of territory is much lower during weekdays and increases during holidays, whereas the North has strong calling activity throughout the week, implying that the population remain within their neighbourhoods; in other words, the selected areas in the northern part of Milan Urban Region offer more choices in terms of urban facilities and services which keep the inhabitants around place of habitation.

During Sunday, higher values of cell phone traffic are found, distributed fairly regularly throughout the day, although not related to the density of settlement. Comparing Erlang and statistical data[17] we see two interesting and "extreme" situations (Fig. 13).

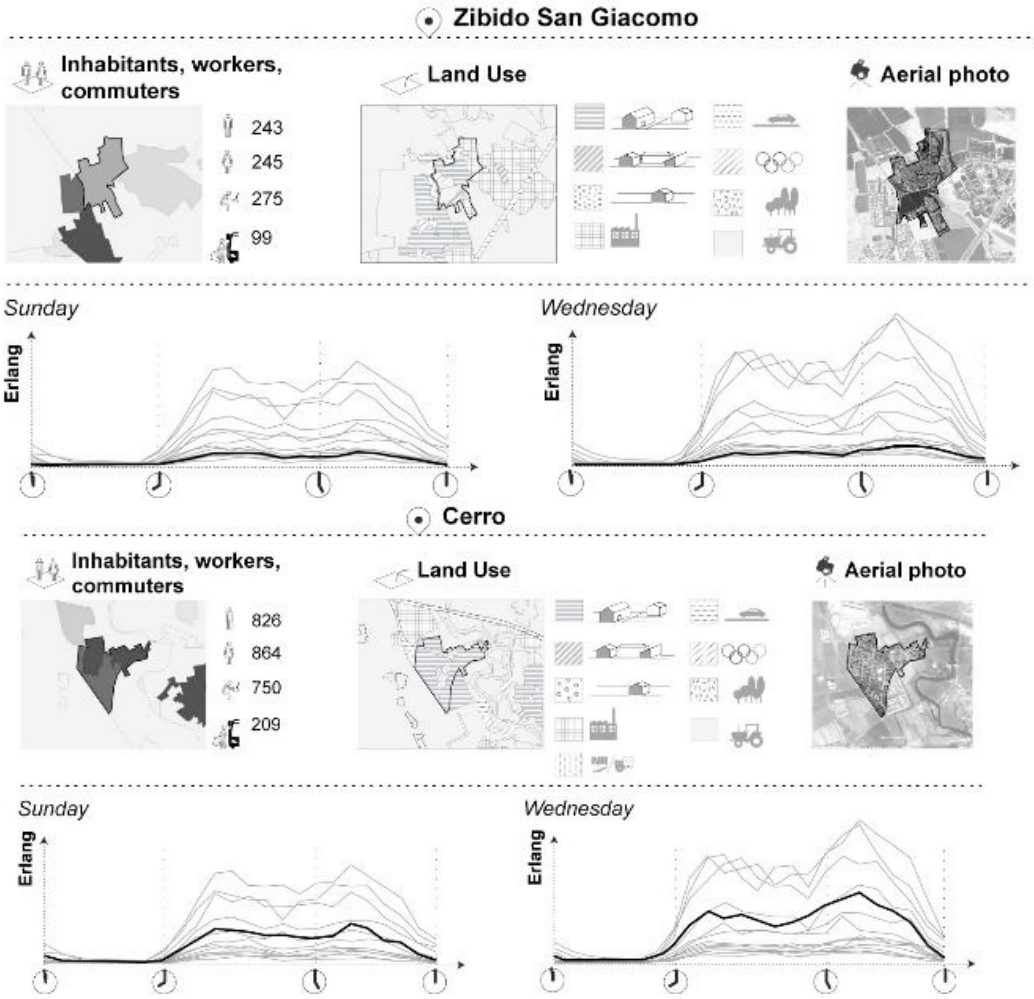


Fig. 13 - Erlang and socio-demographical trends in two peri-urban neighbourhoods: Zibido in the South and Cerro in the North of Milan Urban Region (source: Pucci at al. 2015)

[17] The socio-economic data are: inhabitants by sex and age; socio-professional profile of population; foreign population; commuter flows; employees and economical activities. In addition: land-use and buildings uses, age of the buildings.

One of the least populous area among those considered (Zibido in the South of Milan) is one that has a density of mobile phone traffic peaking on Sunday and falling on Wednesday. This trend may be related to the profile of this area, characterized more significantly than other areas by the presence of young population, by an equally high percentage of the population under 14 years, as compared to the residents over 55 years, who are under-represented. This area is a recent urban settlement characterized by single plot houses and weak mixed land-uses.

The opposite situation - Cerro - is represented by the highest residential density in the urban context type considered, but with less intensity cell phone traffic on Sundays and indeed Wednesdays. These trends can be ascribed to the age profiles of residents (high density of population over 55 years).

Comparing the Erlang trend with the commuter out-flow data, in the areas with a strong dependence on other municipalities for the job-market (i.e. with most significant commuter out-flow density during the working day) the density of the call activities always remains more intense on Wednesdays than on Sundays, although with different time profiles.

With socio-demographic profiles of the inhabitants, land-uses, as well as the age of buildings as the result of different processes of peri-urbanization, we can interpret the variability of the Erlang curves and relate them with different urban behaviours and life-styles in our selected peri-urban areas.

The dynamics related to daily practices are ascribable to socio-economic and lifestyle transformations in peri-urban districts: the most recent urban settlement (Lacchiarella) is characterized by higher out-flow for work, which accounts for the low intensity of Erlang during working-days compared with the other districts and with Sundays. On the contrary the oldest urban settlement (Cerro) has the lowest value of outflows, confirming the "commuting transition paradigm" (Sultana and Weber, 2014) due to the age of these areas.

5. Conclusion: out of the general issues of post metropolitan model

The focus on post-metropolis is artificial: our research shows more complex dynamics in peri-urban areas, not related solely to the "post-metropolitan model". The original imprinting given to the settlements is still active and goes on guiding the process of urbanization at the regional scale.

The case of Milan Urban Region provides evidences on the new urban processes that question traditional pattern of density, attractiveness (peculiar density profiles, differentiated attractiveness dynamics…), as well as conditions of urbanity that go beyond the traditional centre-periphery relationships, but at the same time they are not simply ascribable to the post-metropolitan model. A strong interaction between the central city dynamics and the polycentric structure is a peculiar background in the process of regional urbanization in the Milan Urban Region.

In addition, some of these dynamics can be read as a result of the economic crisis rather than the growing complexity of the peri-urban areas. The economic crisis has played a part in influencing the evolutionary dynamics of these territories. The weakening of some local production systems in the North of Milan Urban Region where we can find a growing external dependence and a re-balancing of the relations with Milan, simplifies the historic polycentric system, showing a non-unique processes that we need to study more in depth, avoiding homogenizing descriptions.

The ability to understand the emerging needs and the relevant issues to the processes of structural crisis that some of these territories are going through and which overlap with important social changes and environmental problems, is needful.

At the same time, the kaleidoscopic vision of these territories, their "mutability" (Dias et al. 2008) and their resilience call for new descriptions as well as a pro active manner to planning these areas, changing the hierarchic and "mono-centric point of view", "re-scaling' the urban policy and assisting in the construction of new geographies of partnerships between different stakeholders.

The consequences of the regional urbanization processes make the gap between the institutional geography of governance and the socio-spatial dynamic more and more evident.

In this perspective, mobility practices offer a valuable support to understanding socio-spatial transformations in Milan Urban Region as well as to "re-scale" urban policy, as a tool for supporting and increasing the efficiency of urban and mobility policies (Pucci et al 2015).

In the words of Estèbe (2008, p. 17), deforming institutional boundaries, mobility practices define new geographies that can vary over time, even within one and the same urban area, showing how "all territorial governments exist in a condition of permanent dissociation between citizens, inhabitants and city users".

Through mobility practices we can better explain the dynamics of the "erosion" of institutional boundaries and indeed of the boundaries of public and private life, making possible to "re-scale" the hierarchies of intervention, and the territories of urban and mobility policies.

In our research, the experimental and operational use of mobile phone data offers a framework, able to improve knowledge about commuters' space-time movements. Knowing mobility practices, their space-time variability, through the use of mobile phone data can lead to the adoption of area-wide innovative transport solutions. Thanks to the potentialities of mobile phone data in explaining the spatial dimension of varying practices that have great impacts on the densities of use of the city and its services we can propose several possible applications in terms of:

- recognizing specific (in time and space) situations of deficit in public transport supply related to the effective concentration of population and uses;
- supporting and increasing the efficiency of urban policies and transport services with more detailed knowledge of the intensity of the use of the city (during the day, weekdays/holidays, seasons) linking them to the differences in the urban activity distribution at different hours, days and weeks;
- managing environmental and industrial risk protection with information deduced from mobile phone data used as a "proxy" of the population exposed to specific risks;
- managing large and special events (inflow, outflow, monitoring), also estimating the mobility demand and the spatial-temporal variation in population density, to offer guidance for future decisions on the provision of new urban services;
- developing an integrated research protocol based on the comparable and available data (traditional and digital data) and starting from definition of the main indicators, measures and successful criteria to be implemented at the local scale for the Local Authorities.

In doing so, mobile phone data can contribute in supporting a "re-scaling" of the hierarchies of intervention, and thus the governance of dynamic processes. The challenge is integrating traditional and new data sources and developing research protocols and a methodological toolkit capable of improving real-time investigation into the time-space variability of mobility patterns. The production of knowledge of mobile practices through approaches easily usable and replicable, also by the local authorities and by the end-users, can support appropriate policy and regulatory actions and lead to considerable advancement in the sphere of mobility policy design and governance in the peri-urban areas where emerging mobility needs and new claims call for new solutions in transport supply and urban services.

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