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MOBILITY OF *ITALIA DI MEZZO*

A methodological approach and a relevant case study

Federico De Angelis

matricola 994991

Relatore: Paolo Beria

Correlatore: Chiara Nifosì

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Abstract

In recent years, urban policies have focused on two distinct territorial areas. On the one hand, on large cities and metropolitan conurbations, with the aim of making them increasingly sustainable from both an environmental and social point of view. On the other hand, on remote and internal territories, with the aim of contrasting their constant depopulation and mitigating inequalities in relation to the most virtuous and attractive areas. Little or nothing has been formulated regarding all those intermediate and "in-between" territories, which often represent the national industrial and urban backbone, mainly of many European countries.

This work intends to bring these territories back to the center and does so by exploring the Italian case from the point of view of mobility. Mobility strategies in Italy, especially from the point of view of rail transport, have concentrated on the large metropolitan hubs. On the one hand they have been a field of experimentation for a mobility and urban planning model alternative to the car-centric one. On the other hand, resources and institutional efforts have been concentrated over the years to create and strengthen direct connections between them, especially high-speed ones. Those areas that make up the Italia di Mezzo have been left behind, often considered only as an extension of metropolitan commuting areas and with little functional autonomy.

The thesis intends to offer a double contribution. On the one hand, to define what is Italia di Mezzo from the point of view of people's mobility, through the construction of a methodology for classifying Italian municipalities based on the characteristics of commuting mobility. On the other hand, to analyze more closely an exemplary case of Italia di Mezzo, i.e. the area of southern Lazio, where two infrastructural corridors deeply mark the provinces of Frosinone and Latina and connect the cities of Naples and Rome. For the Colleferro-Frosinone-Cassino railway transect and in general for the whole provincial area, the thesis proposes some work suggestions that serve as guidelines for the drafting of a possible Integrated Strategic Plan for Sustainable Mobility.

Abstract

Negli ultimi anni le politiche urbane si sono concentrate su due ambiti territoriali distinti. Da una parte sulle grandi città e le conurbazioni metropolitane, con l'obiettivo di renderle sempre più sostenibili sia dal punto di vista ambientale che sociale. Dall'altra sui territori remoti e interni, con l'obiettivo di combatterne l'ormai costante spopolamento e attenuarne le disuguaglianze nei confronti delle aree più virtuose e attrattive. Poco o nulla è stato formulato riguardo tutti quei territori intermedi e "di mezzo", che rappresentano spesso l'ossatura industriale e urbana nazionale, principalmente di molti paesi europei.

Questo lavoro intende riportare al centro questi territori e lo fa esplorando il caso italiano dal punto di vista della mobilità. Le strategie per la mobilità in Italia, soprattutto dal punto di vista del trasporto su ferro, sono andate concentrandosi sui grandi poli metropolitani. Da una parte sono stati un campo di sperimentazione di un modello di mobilità e di pianificazione urbana alternativo a quello automobile-centrico. Dall'altra si sono negli anni concentrati risorse e sforzi istituzionali per realizzare e potenziare le connessioni dirette tra essi, soprattutto quelle ad alta velocità. Sono state lasciate indietro quelle aree che vanno a costituire l'Italia di Mezzo, spesso considerata solo come estensione delle aree di pendolarismo metropolitano e dotata di scarsa autonomia funzionale.

La tesi intende offrire un duplice contributo. Da una parte definire cos'è Italia di Mezzo dal punto di vista della mobilità delle persone, attraverso la costruzione di una metodologia di classificazione dei comuni italiani in base alle caratteristiche della mobilità pendolare. Dall'altra analizzare più da vicino un caso esemplare di Italia di Mezzo, ossia l'area del basso Lazio, là dove due corridoi infrastrutturali segnano profondamente le province di Frosinone e Latina e connettono le città di Napoli e Roma. Per il transetto ferroviario Colleferro-Frosinone-Cassino e in generale per l'ambito territoriale del frusinate, la tesi propone alcune linee di lavoro che siano da guida per la stesura di un possibile Piano Strategico Integrato della Mobilità Sostenibile.

1. Sustainable mobility and intermediate territories

In this section, we will first reconstruct the state of the art relating to the theories and practices of sustainable mobility. This is a concept that is often understood in a purely technological sense, i.e. relating to all those solutions that will make it possible in the long term to make the entire production and operational cycle in the transport field less impactful. These "post-carbon" approaches that intend to question the car-centric model from a technological point of view have recently been integrated with more radical theories, which contrast with the model with which we have traditionally planned mobility and the city together with it. This new paradigm has generated many urban theories and practices guided by the concept of accessibility and proximity, with a long-term perspective that makes the car less and less necessary for traveling in large cities.

In the second part of the chapter we will try to formulate the actual thesis question, testing the different concepts of sustainable mobility in contexts that are not strictly densely urban and accessible and to which they are usually applied. These are precisely those in-between territories that will first be approached with a review of the international research and then brought into the Italian dimension. We will first present a historical reconstruction of how the Italian in-between territories have long been part of the economic-geographical discourse about the "forgotten territories" in Italy. Finally, we will present the most recent research trajectories for the new formalized category of *Italia di Mezzo* (In-between Italy) and how this thesis intends to relate and contribute to this new line of research.

1.1 Approaches to sustainable mobility. State of the art.

There is no doubt that for years the predominant model of urban development has seen the automobile as the absolute protagonist. Cities were planned and built according to it, while at the same time a sort of "right to individual motorized mobility" was taking root in the urban way of life, as well as, for obvious reasons, the idealization of the motorized vehicle as a consumer goods and social self-representation. It should not be surprising then that in the Technical Implementation Rules (NTA) of the General Town Plan (PRG) of Rome of 1962 it is written: "...the entity "motorized man" is becoming established: this means that the car participates intimately in the life of man as regards his work, his travels, his leisure". With premises of this type, the plan choices and the consequent implementations and realizations can only have produced the legacy of the twentieth-century city as we know it today.

This model, which has enjoyed rather long-lasting success, probably represents the last great technological leap that has been able to influence urban development and planning practices in relation to transport modes at the roots. After the model of the factory-city inextricably linked to the element of the railway and the train, the improvement and above all the mass marketing of private motor vehicles marked the leap towards the definitive widespread urbanization of the territory, both from the point of view of private mobility of people and of the transport model of goods and services. At the same time, following this technological development, the planning model of large and small cities was being remodeled, aligning itself with a car-centric logic and consequently aimed at maximum optimization of travel time and the need to connect origins and destinations with large urban road arteries.

The traditional model is today being questioned, above all due to the negative impacts that it has produced and is continuing to produce at a local and global level, with cities finding themselves both the main cause of these impacts but also the main place where the negative effects are reflected. Mobility is in fact one of the sectors that generates the greatest loads of direct and indirect externalities on the urban and non-urban environment. For example, private mobility generates congestion and accidents and local but also global pollution, if we follow the chain of energy production and necessary technology. Other means of transport are no exception, including public transport, none exempt from causing negative externalities, however each with its own efficiency ratio in relation to the service offered.

On the other hand, mobility is also a field of innovation of the highest order, especially if we consider the more technological aspects linked to shared or collective modes of transport, but also to individual ones. These technological advances have mostly been concentrated on vehicles and mobility devices, rather than on infrastructure and territory (Carraro, 2017; Maheshwari, 2020). In particular, the recent and renewed push towards environmental sustainability have fueled technological development, but also a cultural and anthropological change towards the impacts caused by the traditional model of mobility in cities and in the territory.

1.1.1 Beyond the traditional model and first "post-carbon" approaches

Overcoming the traditional model is certainly not an aspiration of recent years. The first counter-narratives and criticisms almost immediately follow the advent and development of private motorized vehicles. Very often these are not criticisms of a technical-engineering nature - after all, it took time to ensure that we became fully aware of the negative impacts of the automobile spread - but rather regarding the aspects of city and regional planning that the private sector was starting to shape and on paper plans. The city that began to be planned after the automobile was made up of enormous asphalted surfaces, both for vehicle traffic but also for parking and a generalized lack of care for public space and sociality.

The first voices of alarm and criticism against the city of the automobile are being raised precisely against these elements. Many of these intend to bring to light the alternative dimension of the street, i.e. understood as a public space for social relations, meetings, a space to live in which one can carry out daily actions and take advantage of the services that the urban environment can offer . It is the road of play, of human relationships and of social networks that Jane Jacobs loudly evokes since the 1960s in contrast to the city of ring roads and motorized traffic conceived by Robert Moses. Other thinkers highlight how the street is also a visual experience, a fundamental ingredient of the way in which the urban landscape is perceived and experienced. Kevin Lynch (Lynch, 1961) moves in this direction with his "Image of the city", but also the urban plot rich in symbols and environments such as Robert Venturi's Las Vegas (Venturi et al., 1977). A broad line of research has questioned the role of urban design in the modernist city, hoping for a return to the design of public space as a place of relationship with the built environment, of quality and on a human scale (Woods, 1975; Krier & Porphyrios, 1984).

In recent years a new sensitivity has been growing within the discourse regarding the contrast to the car-centric model. In fact, collective awareness regarding the harmful effects of combustion engine vehicles has now taken root. This awareness was made even more urgent by the progressive increase in the effects of climate change. The topic of sustainability, especially environmental sustainability, has become increasingly alive or at least cumbersome, so much to push many cities to bring this new sensitivity into the field, with specific initiatives, but also with policies, plans and programs. The main objectives are to adapt to the negative impacts generated by motor vehicles, but also and above all to counteract the technological model upstream so that the causes generating pollution are reduced. (Carraro et al., 2017).

These objectives are to be considered at least at two scales, which is essential to consider simultaneously:

- on the one hand, the local dimension, linked to the pollution generated by the vehicles themselves during their operating cycle. It is probably the most evident and perceptible scale both for local administrators and for public opinion and citizens.
- On the other hand, a global dimension, linked to the pollution generated during the entire production cycle of motor vehicles and also by the road infrastructures on which they circulate. This scale is often kept too hidden and does not manifest itself in collective debate, above all because it is decidedly less perceptible to the inhabitants of the city. Furthermore, the model has increasingly evolved towards a massive delocalization of the heaviest production phases, thus also increasing the physical distance between producers and final consumers.

With these premises, the idea of alternative and sustainable mobility in an urban context very often tends to concern especially elements of technological or infrastructural innovation. We could define these approaches as "post-carbon", since they aim to achieve sustainability objectives by overcoming the current energy model, based mainly on the use of fossil fuels applied to the operation of the thermal engine.

In the short-medium term, this is certainly a convincing approach which, if decisively pursued on the largest possible scale, will truly be able to achieve environmental sustainability objectives and significantly reduce the causes and effects of ongoing climate change (Coppola et al., 2023). This is above all because transport represents one of the sectors that contribute most to climate-changing emissions, with a global value of 15% in 2019[1] and a European value of approximately 20% in 2014.[2]

In Italy - not taking into account international journeys - the transport sector was responsible for 25.2% of total greenhouse gas emissions and 30.7% of total CO2 emissions. Of these emissions, as much as 92.6% is attributable to road transport (Carraro et al., 2023). In addition, both at a global, European and Italian level, the transport sector, unlike others, has been constantly growing over the last 30 years in terms of the emission of climate-altering gases.

1 IPCC, 2023: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, 184 pp., doi: 10.59327/IPCC/AR6-9789291691647.

2 Sectoral greenhouse gas emissions by IPCC sector available at https://www.eea.europa.eu/data-and-maps/daviz/change-of-co2-eq-emissions-2/#tab-dashboard-01 [last seen: 10/2023]

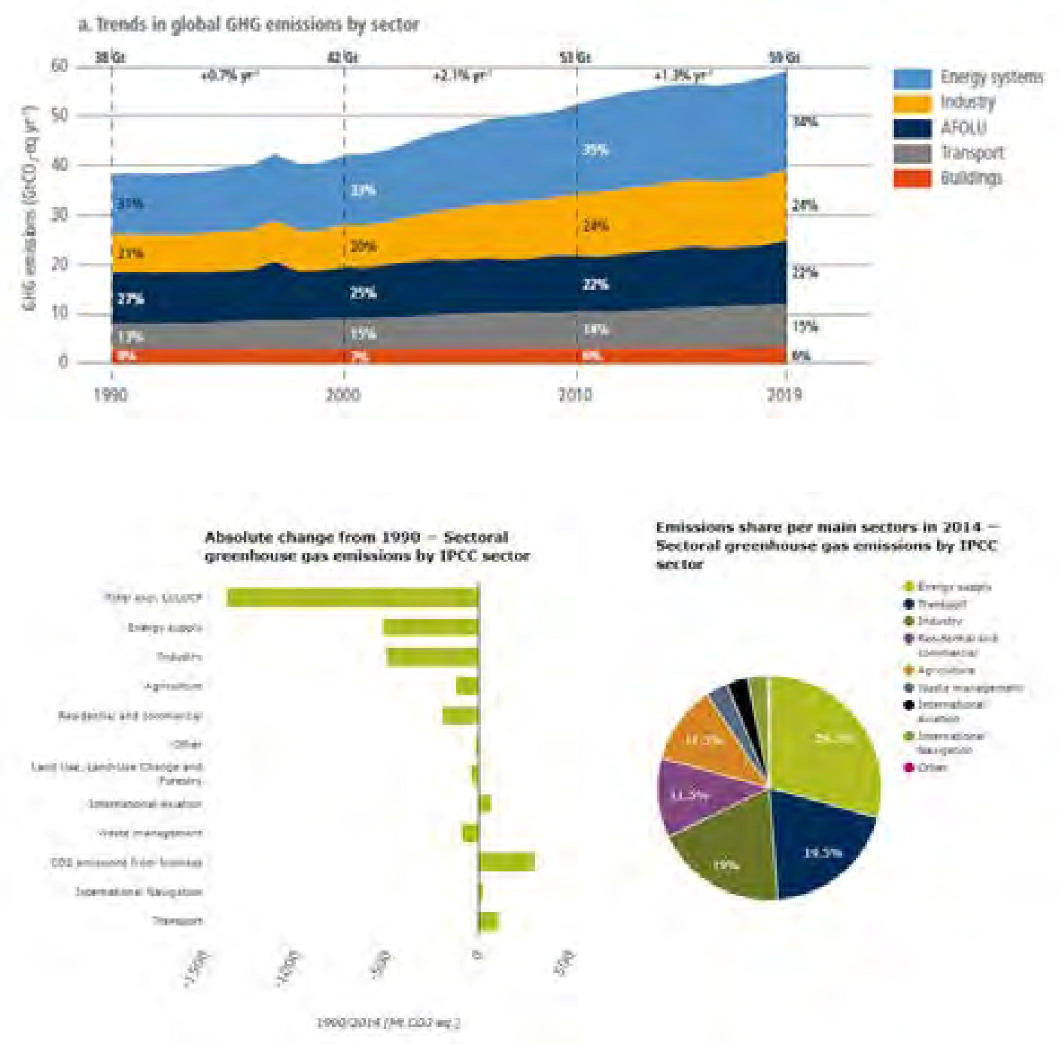

Fig. 1
Main data referred to climate-altering emissions

The main objectives of a post-carbon approach can be summarized as follows:

- Decarbonization or, where not possible, improvement of the efficiency of motor vehicles;
- Decarbonization of energy supply;
- Reduction of emissions related to the production of motor vehicles;
- Reduction of emissions relating to the construction of infrastructures;
- Strengthening alternative mobility systems to private and motorized road transport.

On the one hand, therefore, we find the idea of broadening the field of decarbonization not only to the operational phase of the vehicle, but to its entire life cycle starting from production and also to the creation of infrastructures. On the other hand, the necessary complementary relationship is being established between purely technological strategies linked to motor vehicles and others more focused on modal shift, so as to reduce their overall use.

In particular, from a technological point of view, some strategies considered most successful in the short-medium term are identified (Carraro et al., 2023). Among all, that of focusing more on the electrification of vehicles, a model that is not only less impactful than the current one, but also decidedly more efficient in terms of energy yield. Currently, in fact, it is estimated that internal combustion vehicles have an efficiency ranging between 20% and 30%, while an entirely electric engine would guarantee an increase in efficiency of up to 300% more.

However, an entirely electric model raises some intrinsic critical issues:

- although it practically eliminates local emissions during the operational phase of the vehicle, this does not guarantee that the necessary energy is obtained from sustainable sources. One of the prospects considered successful in the short-medium term is that of achieving significant electrification of vehicles only marginally powered by energy from renewable and sustainable sources.
- A further critical element is represented by the impacts generated by the entire production cycle of an electric vehicle. For the creation of an electric vehicle, in particular for some of its components such as batteries, a different production process is necessary, but still of an extractive nature. Structural changes are introduced in the supply chains of new and often rare raw materials, thus causing forms of land exploitation, as well as difficult geopolitical configurations on a global scale.

From a vehicle technology point of view, research focuses on two other main fronts:

- the first concerns technological developments whose ultimate goal is the fully self-driving vehicle, with the aim of reducing accidents and increasing road safety.
- The second instead attempts to increase and promote the shared use of the car, with benefits mainly linked to a more optimized use of urban public space dedicated to the car and a reduction in road congestion

These last two fronts, together with the progressive change of motor vehicles towards sustainable power models (electric but not only), can in a certain sense contribute to the achievement of environmental sustainability objectives in a post-carbon approach and rationalization of use of the automobile, but "even in the most optimistic scenarios these innovations will not in themselves make cities healthier, more livable, more inclusive or more engaging" (Coppola et al., 2023).

1.1.2 The new paradigm of sustainable mobility and the post-car city

An evolution of post-carbon perspectives is taking hold. With the blossoming of a new critical awareness, the debate has recently moved from a prevailing attention towards technological innovations linked to motor vehicles, to a more holistic vision of sustainable mobility. This vision was inspired precisely by the critical issues of an exclusively post-carbon approach. On the one hand, in fact, it is noted that a massive electrification of motor vehicles would not necessarily guarantee a mitigation of the effects of climate change, if it is not followed by (1) a decarbonisation of the entire vehicle production cycle and (2) a diversion of the current energy mix towards renewable sources with a lower impact on the environment. Secondly, critical issues are raised regarding self-driving vehicles, which could have negative effects on the greater availability of vehicles in large cities, thus exacerbating the separation between spaces for people and cars, with arterial roads even more congested traffic. (Coppola et al., 2023)

What is hoped for by this new vision is the transition towards a new paradigm of sustainable mobility, which will literally break the patterns and models rooted in current lifestyles, but also in the culture of mobility planning and land uses (Banister, 2008). Conventionally, in fact, mobility planning was based on two main assumptions: on the one hand the idea of demand as a derived component and on the other the principle of minimizing travel costs, considered as the criterion guiding mobility choices of people. The new paradigm of sustainable mobility is breaking this double assumption, on the one hand by modifying the rigid criterion of minimizing travel time towards a more flexible notion of "reasonable time", on the other by overturning the meaning of the demand for mobility, not only a factor derived from people's travel needs, but also the mirror of a new conception of travel as a pleasant and necessary activity to satisfy increasingly diversified and innovative leisure needs (ibid.).

The key is precisely the virtuous integration between mobility planning and urban planning and land use planning. In fact, if we begin to evaluate demand no longer as a given and derived component, we can begin to think in a certain sense of controlling it, also through urban planning. Urban schemes that promote functional mixite and density are the basis for a decisive shift from the traditional concept of mobility to the new one of accessibility and proximity. People no longer only have to satisfy the needs of moving from one point of the city to another, especially for study and work reasons, but can be influenced in their movements by the degree of accessibility to the main urban components in which they find themselves living.

It is in this new concept of accessibility that new practices of sustainable mobility can also be encouraged, both through the promotion of the modal shift from the car to public transport, but also by guaranteeing the presence of an urban fiber that is able to accommodate safely and pleasantness of active mobility and proximity practices. In summary, according to this new paradigm, to fully achieve the environmental sustainability objectives linked to urban mobility, it is not enough to act on vehicle technology and the energy model.

It is necessary to shift the point of view from a post-carbon perspective, in the sense of overcoming the current technological model of the car, to a post-car one (Coppola et al., 2023), i.e. truly "beyond the car", through a renewed culture of urban planning. This critical awareness is increasingly gaining ground in local administrations and in academic debate, but the interventions implemented are often poorly integrated with each other and clash with a predictable systemic resistance to change. It is about redirecting a consolidated urban planning model anchored to interests that often exceed the scale of the city itself. But it is also about conveying this paradigm into the minds and daily practices of city dwellers, most of whom were born and raised within the traditional paradigm.

Finally, the new paradigm of sustainable mobility has at least two other desired effects:

- on the one hand the idea of increasing the health of the inhabitants. In fact, not only will the negative local impacts of pollution and congestion be reduced, but we will also promote healthy and active lifestyles in which more and more people will resort to using their own legs or non-motorized vehicles to get around within one's own neighborhood and then within the cities.
- On the other hand, there is hope to fill the spatial injustices that are now consolidated around the car-centric model. Nowadays, very often living in a big city without being able to afford a car means finding yourself in an unequal situation compared to those who can have one. It means making use of public transport that is often inefficient and integrated, with which even very long journeys are made to reach the place of study or work, with the indirect consequence of making use of the neighborhood dimension only to go back to sleep in your own bed (Coppola et al., 2021).

We do not intend to dwell further on these aspects here, which could in themselves open up an entire new chapter of the dissertation but are beyond our research.

A final aspect to consider is that of the development of MaaS (Mobility as a Service) technologies. This is a new approach that considers mobility more holistically, as a service to the citizen in all its components. It started with some first forms of integration between mobility and ICT technologies for mobile devices that started to be used to use public transport and others means. Today the idea is to be able to sign up for a form of subscription that allows you to use the majority of collective and shared means of transport, even with a pay per use approach. The idea can be extended even further, also integrating different types of urban services with mobility ones and integrating costs and opportunities.

1.1.3 Sustainable mobility practices

If it is true that attempts to apply the model are still fragmented and with rather uncertain outcomes, it is also true that these have seen a marked increase in recent years and with two main approaches. The first, basically "bottom up", saw the promotion of activities and interventions on the urban space starting from experiments involving citizens, while the second, more "top down", focuses on the possible different forms of integrated transport and urban policies to promote development models that are alternative to the car-centric one.

The first macro-group of practices includes all those private but also public initiatives that arose from the will of citizens and local actors. Over the years, the car-centric model has generated a mono-functional urban environment in which the road is only the place where vehicular traffic flows. As already mentioned previously, there have been numerous attempts to subvert this paradigm from a theoretical and conceptual point of view. More recently, it has been the inhabitants of cities who have wanted to reclaim the road as a space for sociality and open to different uses and practices, only partly that of vehicular circulation. There are numerous examples of initiatives that started from the bottom, then remodeled and accepted by municipal institutions, which were created with the aim of taking space away from vehicular traffic and giving it back to people. This conceptual and practical shift from "streets for traffic" to "streets for people" (Bertolini, 2020) has laid the foundations for a rediscovery of the new functions of the street as a public space: commercial activities, social interaction, games and entertainment, free time, politics are some of the many.

These works have the experimental approach as a common trait. The idea is to implement "tactical urbanism" actions, carrying out low or very low cost works in the street space, to evaluate the effects of a possible permanent application. The street experiments have moved on 3 main application contexts (ibid.):

- in road intersections, with the aim of revitalizing the residual spaces created by urban road crossings as places of sociality and leisure. These are equipped with simple street furniture or paintings, in order to make them usable and attractive. The first cases of interventions of this type directly implemented by citizens were in Portland in 1997, followed by Barcelona and Paris. The Milanese case of "Piazze Aperte" is a further recent confirmation of this approach (Coppola et al., 2023).
- In parking areas, both to fill the gaps left by unused parking lots, but also to provocatively repurpose the lots actually occupied by cars. Also in this case there is the idea of regaining space dedicated to the car, more specifically parking. Beyond the experiments already carried out for years, including the emblematic case of San Francisco's "parklets" since 2015, these solutions were widely used by commercial

establishments in large cities during the first pandemic period, in order to increase outdoor space with dehors. These solutions were also favored and promoted by local administrations.

- In the actual road section, with the ultimate aim of modifying it in favor of forms of mobility that are not only vehicular. On the one hand, in fact, these actions can only involve part of the road section, which is remodeled by reducing the space for

Fig. 2
"Piazze Aperte" program in Dergano, Milan

Fig. 3
Pavement to plazas in New York

vehicular traffic, as in the case of the New York "pavement to plazas" program of 2007. On the other, the road section is entirely precluded to motorized traffic. This is the case of "play streets", i.e. the temporary closure of entire streets with the ultimate aim of encouraging children to play and increasing their safety in public spaces. These are solutions often applied in front of schools, as in the case of Via Milano in Bologna. Of a more general nature, however, are open roads, closed entirely to vehicular traffic, often in conjunction with local events.

Fig. 4
Parklets in San Francisco

Fig. 5
Via Milano open street in Bologna

It should be reiterated that these approaches are often the result of a synergy between citizen initiatives and the support and promotion of city administrations, which often systematize these interventions and transform them into concrete and integrated programs.

As regards top down practices, these are approaches and strategies that administrations are implementing with a view to sustainable mobility or which in any case, even if still only debated and theorized in the academic field, can only be implemented with large and complex actions and programs by the administrations. Two cases in particular will be presented here: TOD and "accessibility by proximity".

The history of TOD (Transport Oriented Development) is not recent. It is inspired in particular by illustrious models such as the anglo-saxon Garden Cities or the Finger Plan of Copenhagen of 1947 or even the Stockholm plan of 1946. However, a rediscovery of this idea with a view to sustainable mobility is quite recent. The basic idea is to exploit existing public transport strength lines -especially railway lines- to plan greater urban density around their stations. It is not just a question of density of buildings and residences, but also of other urban and mobility functions that can act as a feeder for the strength line, such as other local public transport lines but also a system that promotes active mobility. The concept of density can then be further expanded if considered together with those of diversity and design (Cervero & Kockelman, 1997). Diversity becomes an essential element if we want to allow people to use as many urban functions as possible within an accessible radius of the train station, while urban design becomes fundamental to create an effective pedestrian and cycling system.

The European evolution of the first US TOD approaches integrates the urban scale with a territorial and regional one (Coppola et al., 2023). A solely local and single-station TOD approach is not sufficient. Regional and large-area institutions should have the role of defining a hierarchy of nodes and their function within the supra-municipal scale, and then directing the implementation of local measures that promote density, diversity and design. The local scale should instead be the context in which local administrations put into practice the indications of supra-municipal bodies in order to concretely carry out interventions around the stations.

The challenge today is twofold. On the one hand we find an open question relating to governance, since it is essential that, to put into practice an effective TOD approach, there is a need for horizontal and vertical integration between the different actors in play, institutional and not. This integration is still rather limited, especially because a possible field of experimentation for this type of synergy between mobility and land use planning is still unclear. An interesting but still rather immature attempt can be made by relying on the metropolitan city bodies in the Italian context (ibid.).

The second problematic issue concerns the context of application. The TOD is in fact very effective in dense urban or metropolitan contexts, in which the stations always have a very high potential mobility demand basin, as well as a medium if not high build-up density. In dispersed or low-density contexts, or even in those contexts in which the railway lines do not optimally follow the morphology of the urbanization, it is much more complicated to put into practice a possible TOD scheme, especially on a regional or large-area scale. At the same time, these are contexts in which it could potentially bring significant benefits in terms of environmental sustainability.

Closely connected to the concept of TOD we find that of accessibility by proximity. The traditional paradigm is here inverted in a certain sense: mobility is no longer considered as an element defined upstream, but which is capable of being shaped through targeted land use planning. Long or medium-long journeys can be reduced, especially by car, if we are able to plan and build neighborhoods on a *human scale* in which the various urban functions are accessible, in the sense of *nearby*, so to allow short and targeted trips, promoting active mobility. A further effect is that, by promoting neighborhood mobility, it will also be promoted sociality and personal relationships within it.

We certainly cannot think of creating separate islands inside the city, a point on which, among other things, many of the criticisms of the model are based. At the same time we cannot think of including all urban functions within a single neighborhood. Their hierarchy forces us to think at different scales; the neighborhood can accommodate lower-ranking functions, while the public transport lines must connect the locations of medium or high-ranking services.

This family of approaches has generated much debate in recent years, especially when some cities have started to promote strategies and actions in this direction. This is the case of the now very famous model of the "15 minute city", promoted by Paris and then by many other European cities. To date it has taken on a varied range of names, especially based on the time to be considered, confirming the generic character that this approach can have. A great push towards this idea of the city was given by the pandemic period, when citizens discovered the true value of proximity to functions, but also to green areas or the active mobility network.

It is clear that it is necessary to promote a synergy between TOD and accessibility by proximity models, since they feed each other. Generating spatial accessibility and proximity of relationships is a key element for the success of TOD strategies around the main nodes of public transport. The real challenge today is to find the best ways to do this, especially in medium-low density contexts.

1.2 The challenge of sustainable mobility in intermediate territories: the Italian case

Beyond the intrinsic challenges that we are called to face when we talk about new paradigms of sustainable mobility, there is a further problem, namely the context of application of these paradigms. As we have already seen, it is clear that large metropolitan areas have always represented the field of experimentation and application of innovative mobility policies par excellence. This is not only because they already have a consolidated public transport network and a demand for broad and intense mobility, but also because they are often the places of concentration of capital and national wealth, both in terms of citizens' well-being and in terms of availability and concentration of public and private investments, as well as the places where it is easier to make use of financial resources and international best practices or those of other cities of equal standing.

Outside the largest and most virtuous urban centers we find everything that has been abandoned or forgotten. Territories that have almost always remained on the margins of the debate and innovation practices in the field of urban planning, but also of mobility planning. These are realities in which the demand for mobility is dispersed or not very concentrated in some minor hubs or, in the most extreme cases, almost absent. They are also territories in which financial, regulatory and political representation resources are very scarce or insufficient to generate an integrated innovative approach aimed at new practices or debates. In these dispersed small and medium-sized cities and in internal or remote areas, the only possibility of mobility, especially with respect to the daily needs of family and work, remains the private car.

However, within this large basket of "forgotten territories" there are some realities that are slowly returning to the center of the debate (Kërçuku, 2022). They are often represented, especially internationally, by the idea of the second-level city, the medium, "provincial" city. They are often industrial centers that were once thriving and driving forces of their respective nations, but which over the years have suffered from a profound economic and social crisis, with phenomena of continuous depopulation, especially in favor of the larger urban agglomerations. Places where targeted policies with a precise territorial focus rarely land, but which instead, in the best of cases, benefit from sectoral policies on a national or supra-local scale.

An important line of research has recently highlighted how these places that "don't matter" in the eyes of politics and institutions have been and continue to be the context in which the waves of populism that have characterized the political context have most easily found their way internationally from 2016 to today in the UK, USA and Europe (Rodríguez-Pose, 2018). It would be precisely the symptom of the actual and perceived abandonment felt by the inhabitants of these territories by public institutions and national politics, as well as by policies introduced in a sectoral manner. Instead, we need to return to having a place-based perspective when implementing public policies in these territories. It is necessary to rediscover its potential and the resources that can be introduced, as opposed to the apparently infinite development model of agglomeration economies that drive the growth of large cities (ibid.). It is necessary to formulate policies that are adequate for these territories and avoid to reapply the categories and approaches that we usually use in large urban and metropolitan areas. In this sense, mobility policies are no exception at all, as we will see in more detail later.

1.2.1 The potential of the intermediate dimension

The attention of international literature towards the intermediate dimension of the urban phenomenon takes on rather varied connotations. The first major aspect to take into consideration is what we are referring to when we talk about intermediate cities and territories. The term "intermediate" or "in-between" can in fact vary greatly based on what we place at the ends of the reference spectrum. It is possible that medium-sized cities have millions of inhabitants, if we consider metropolises of 10 or 20 million inhabitants. For this reason, giving a univocal definition remains a rather complex challenge. For the European context we can refer to a population range from 20 thousand to 500 thousand inhabitants (Bolay & Kern, 2019), but can we really define Bologna or Florence as a medium city?

The specificity of each country is not only related to the univocal definition of the intermediate size, but how the population is distributed within the various size classes of the cities (ESPON, 2006). In fact, we find countries in which the population is balanced between large cities with more and less than 100 thousand inhabitants, such as Italy, or others in which this is concentrated in large cities (UK) or in which an intermediate size is almost completely eroded (Greece or Denmark).

Even more relevant is to consider the absolute number of municipalities and not the overall population. There are countries like Italy where the abundance of small municipalities poses a rather evident issue from a political, administrative and organizational point of view.

Beyond an overall definition of cities and intermediate territories, much of the research on these realities has reconstructed the role that they can have within the urban network of a country but also in the network of international exchanges. Agglomeration economies, the prime movers of the largest and densest cities in the world, are not always the only components that determine the vitality and strength of a city.

Yet, these realities are often overshadowed by public opinion and find themselves at a

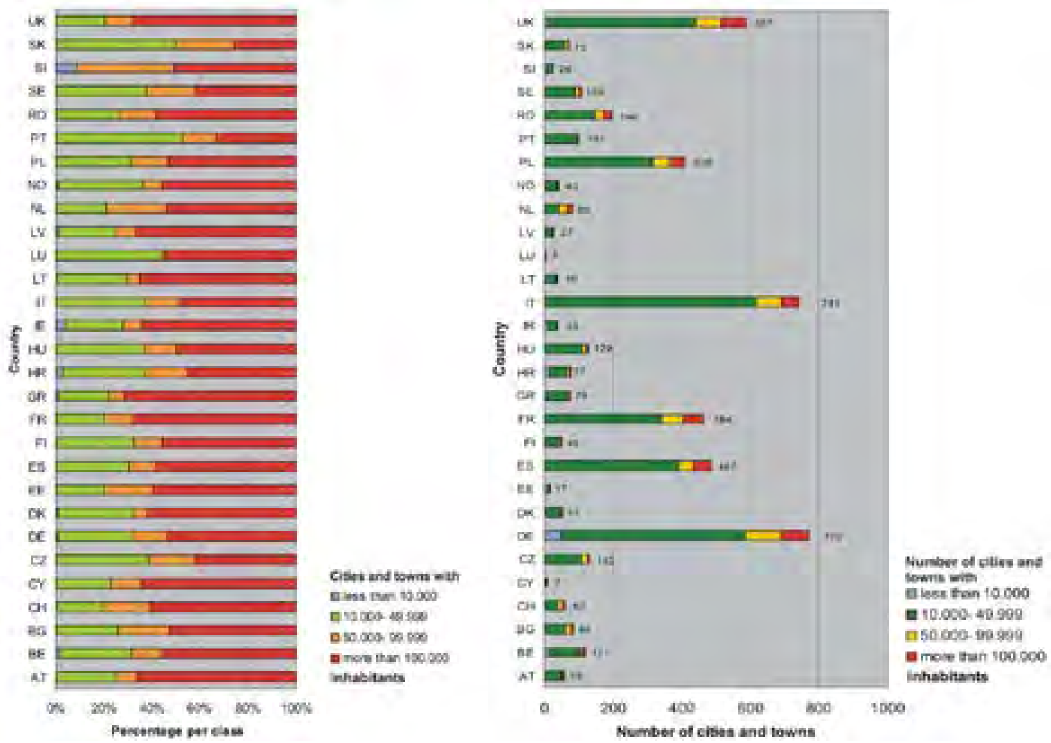

Fig. 6
City classes resident population and number

disadvantage on at least three main fronts (Rodríguez & Pose & Griffiths, 2021):

- from the point of view of knowledge, regarding the mechanisms of access to resources and how to contribute to the development of one's nation;
- from the point of view of recognition by the national public agency, which generally considers them less attractive in the allocation of resources or in the experimentation of innovative practices;
- from the point of view of financial resources, to the point that they often find themselves having to rely on the resources of the central state because they are not able to mobilize their own or from the local fabric of reference.

At the same time they offer a real alternative to the uncontrolled proliferation of mega-cities, especially in more recently urbanized countries. These are smaller entities, in which economies and diseconomies of scale can more easily find equilibrium points (Capello & Camagni, 2000).

It is no coincidence that medium-sized cities are increasingly becoming a destination for migration from below, that is, from rural and non-urbanized contexts, but also from above, from large cities, from which people move in search of a more livable, contained and quality urban dimension. It is also already proven that medium-sized cities are able to reduce the degree of poverty of inhabitants from rural contexts, more than large metropolises are able to (Rodríguez & Pose & Griffiths, 2021).

Through the evaluation of a series of components, such as the relationship with the

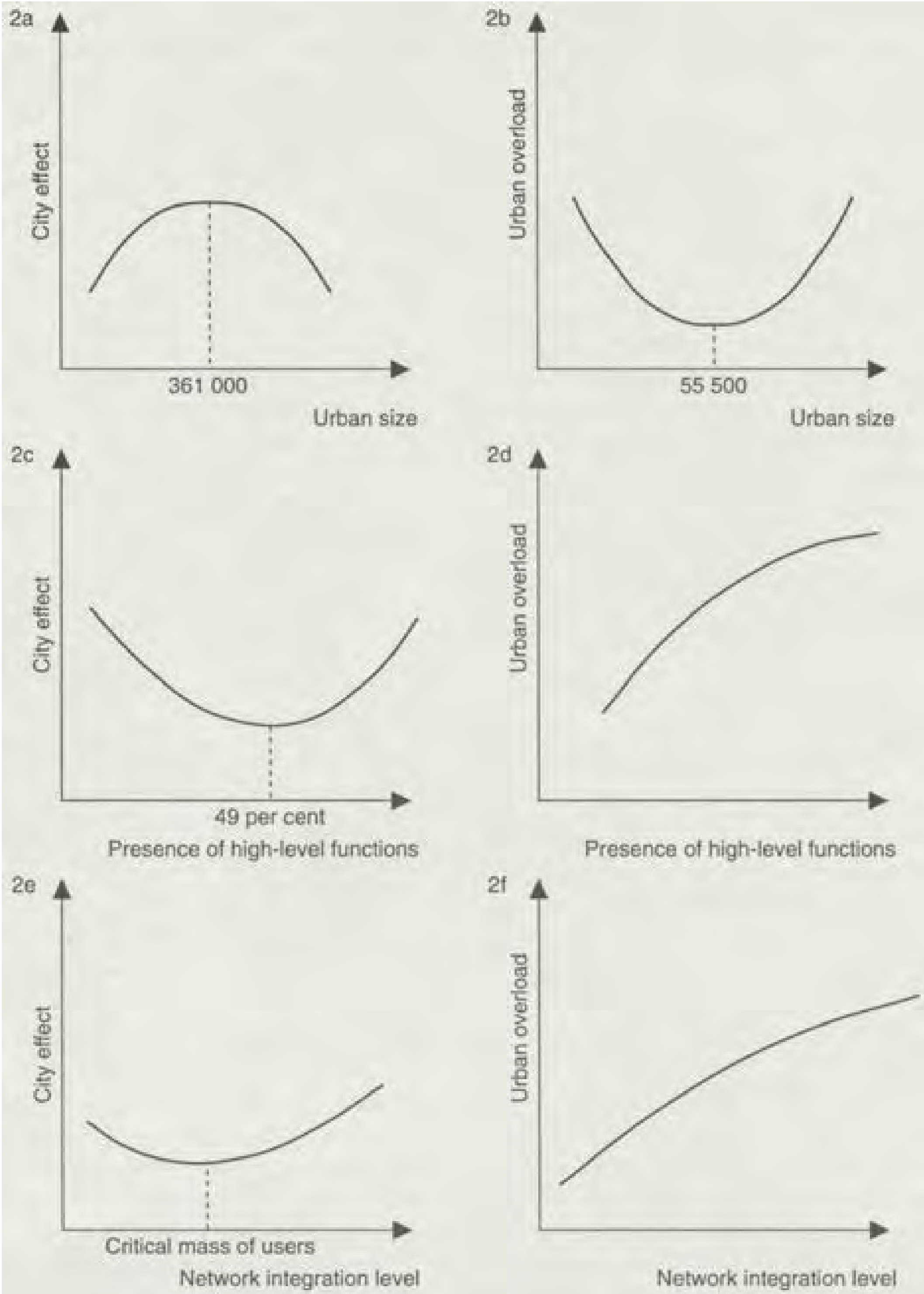

Fig. 7 Economies and diseconomies of scale in cities from Capello & Camagni, 2000

local context or the sphere of influence, medium-sized cities have been typified in (Bolay & Kern, 2019):

- intermediate cities in relation, with a predominant position within their territory and in close relationship with other local centres;
- intermediate satellite cities, as they have a complementary relationship with a

nearby large city, both in terms of workforce and infrastructure;

- remote intermediate cities, as they are in a situation of geographical and economic isolation.

They are centers capable of playing a key role in managing relations between large metropolises and rural and less urbanized environments and should therefore be a priority for regional and large-area planning. Territorial planning itself is called upon to deal with these realities and their potential. Recently, small and medium-sized cities have spontaneously adopted innovative development models, taking on the role of "niches" specializing in metropolitan functions, usually the prerogative of large cities. Functions not only typical of traditional industry, but also of services and creative activities (Lacour & Puissant, 2008).

1.2.2 The evolution of the Italian context

The Italian context is certainly one of the richest and most interesting as regards the presence of the "intermediate" urban dimension. Cities and intermediate territories have long been at the center of events linked to localized and national industrial developments and widespread migration phenomena within the country. Over the years, these elements have influenced the formation of different geographies of spatial inequalities on a national scale, between more virtuous regions and others less, between large cities and small centres. It is useful to retrace the way in which the intermediate dimension and more generally the "forgotten territories" have been shaped within the Italian economic geography

Already in the immediate post-unification period, the first interpretative categories were essentially based on the north-south dichotomy of the country, with the South inheriting an economic and land organization model that was in some ways diametrically opposed to that of the northern regions. For the first few years, therefore, the main issue remained the southern one, even if at the time it was not possible to consider southern Italy as a single homogeneous block. In fact, it was already clear that, despite the overall inequality between North and South, there were also more internal situations of imbalance. In fact, it was assessed that the large urban agglomerations of the south, almost all essentially along the coast, performed better than a hinterland that was still economically backward and decidedly less populous.

The Southern Question gave rise to a massive strategy of interventions by the central State, both direct fundings for the construction of works considered strategic, but also experiments in the legislative and bureaucratic field in order to streamline the procedures for their construction or to differentiate support approaches between the more developed and the more disadvantaged regions. The Southern Question passed through the fascist period and the two World Wars without much media coverage, only to urgently resurface after the Second World War. The interventions in support of the South intensified and were gathered at a financial level under the so-called Cassa per il Mezzogiorno, established by the central State at the beginning of the 1950s with the aim of financing numerous and ambitious modernization projects in southern Italy. It was renewed until 1965. These were years of real growth for the territories of the South, once marginal, not only industrial growth but also regarding real estate and urban planning, with cities experiencing periods of intense processes of speculative expansion, often not entirely regulated. However, they are also years of *growth without development*, i.e. of mostly targeted interventions in the industrial sector which have not really brought social and overall development to the South. With the crisis of the 70s and the changed economic and industrial scenario, these territories once again began a period of slow but constant recession, confirming to be over time as one of the least performing areas of the country.

Starting from the 1970s, a new Italian economic geography replaced the traditional North-South dualism. In fact, three large macro areas are recognized: the Industrial Triangle of the north-west, with a traditional industrial model linked to the large factory, a southern Italy once again in depression and generally disadvantaged and finally a Third Italy (Bagnasco, 1977), recognized as that portion of territory identifiable between the north-east of the country and the Adriatic coast of the Marche. These are essentially medium-sized cities and businesses and are in stark contrast to the models of industrialization of the large factory in the north-west or industrialization without development in the south of the country. It is that Italy of industrial districts and small-medium enterprises, or even of small entrepreneurs, artisans and traders. A portion of the country that gave life to a completely new model of capitalism (Piore & Sabel, 1987), entirely Italian, later also defined as "territorial" (Bonomi & Masiero, 2014). These territories were able to survive much more firmly the economic crisis of the 70s, which instead hit very hard the industrialized north-west and the south.

Meanwhile, the geography of marginality in Italy had been changing. At the beginning of the 90s the Italian state identified at least three areas in severe crisis: they were still Southern Italy, the most rural areas of the country and, for the first time, some of the historically most industrialized areas and cities and at that time in constant economic and demographic recession. Precisely in these same years of real urban crisis we are witnessing new phenomena of widespread urbanization, a direct consequence of the change in the traditional and Fordist model of capitalism towards a more flexible one. There are many territorial images with which these new parts of Italy are described: the aforementioned Third Italy, the "urbanized countryside" (campagna urbanizzata); in particular in northern Italy the "widespread city" (città diffusa) or the "Po Valley

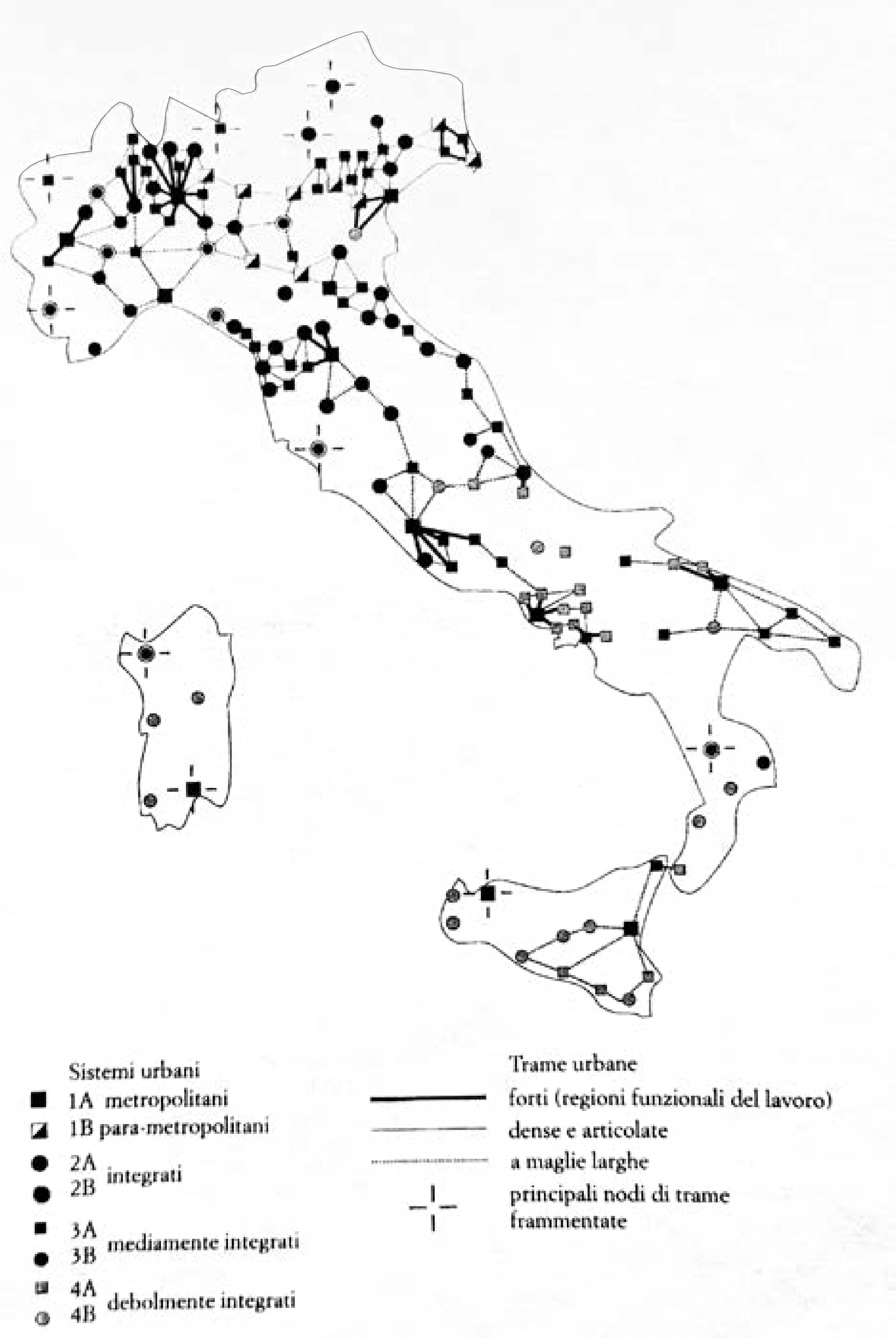

Fig. 8
Nodes and relations in the 70s Italy from Dematteis & Bonavero, 1997

megalopolis" (megalopoli padana). All images that attempt to describe a period of strong economic restructuring and urban development, in which the large industrial cities are in deep crisis and the economic model of the industrial district of small and medium enterprises and the medium and small sized city is in strong growth and development.

These are all dynamics which also significantly restructure the power relations between the various Italian poles, but also between the individual poles and their respective metropolitan belts, which in the period 1979-1991 were in constant demographic growth, unlike the centres, declining. A new network of more or less integrated Italian urban systems is therefore taking shape (Dematteis & Bonavero, 1997). A network that inherits some traditional characteristics of Italian urban development, such as the predominance of large conurbations and north-south dualism, but also introduces new ones, a consequence of the great geographical-economic transformations that began a decade earlier. Some strong infrastructural corridors are emerging along the coasts and beyond, while some multipolar territories are strengthening.

With targeted funding since the beginning of the 2000s, policies intentionally aimed at large cities have been intensifying, especially by taking advantage of programs specifically designed by the European Union. In the meantime, the theme of the degradation of the peripheral areas of large cities is gaining ground throughout the European context, often with reasons that can be traced back to the beginning of the crisis of the traditional industrial model. Marginality therefore seems to be conceived and treated at an even finer scale of detail, that of the neighborhood, of the city area.

In the last ten years the field of investigation has decidedly changed its point of view. The dualism between north and south or between large cities and an undefined "rest of Italy", with the second categories almost always disadvantaged, has in fact evolved towards the recognition of some new fragile areas, the so-called "internal areas". This new major phase of research was inaugurated and fueled by the National Strategy for Internal Areas (SNAI), promoted in 2013 by the Agency for Territorial Cohesion. The strategy moves on two main fronts. On the one hand, to build a new observation lens towards the most fragile and internal areas of the country, therefore recognizing them univocally and studying their specificities. On the other hand, to formulate and finance programs aimed precisely at these areas, with an approach that is truly place-based, which is widely hoped for by those who, years after the SNAI strategy, highlight the issue of areas "that don't matter" (Rodríguez- Pose, 2018). The recognition criterion of SNAI Internal Areas is based on the idea of accessibility to the main services. In fact, we find some municipalities that are naturally hubs, that is, all those that are equipped with a series of essential services and then the municipalities are gradually categorized based on the travel time to reach the hub municipalities. The criteria will be analyzed in more depth in the next chapter.

1.2.3 New research trajectories for *Italia di Mezzo*

After two long seasons of research and funding for the most fragile areas of the country, first the problematic areas of the large cities and then the Internal Areas[3], a new phase of research is opening. The focus is in fact shifting towards everything that is simply found "in the middle" of the previous contexts.

If in some ways this new approach was also partly born in tension with the rigorous SNAI classification, it certainly cannot be said that the attention for *Italia di Mezzo* was born in recent years or is even being born now. Already many times, as we have seen, medium-sized cities have been described as virtuous poles and in clear contrast to the north-south and large city-rest of Italy dualism. They are the cradles of the new Italian capitalism (Piore & Sabel, 1987), but also the contexts that nourish the Italian industrial districts. They act as minor poles in a network of relationships, however dense and intense. Even in the 1990s, highly dynamic realities were confirmed, with an evolved economic structure and the ability to create a significant number of national and international relationships (Dematteis & Bonavero, 1997). They are also the entities mainly supporting the regional development that has characterized Italy from the 1970s onwards, with a clear relationship and contrast with the metropolitan areas. Today, *Italia di Mezzo* is in a position of the highest order, both from the point of view of the challenges that arise from there, but also from the great potential it offers, especially in relation to fundamental contemporary issues, first and foremost sustainability.

Recognizing what *Italia di Mezzo* actually is today is perhaps the first and most important challenge. We can approach a first definition by isolating this portion of the country from a demographic point of view. Simply by classifying Italian municipalities based on their resident population, it is possible to identify an intermediate band that lies between the large metropolises and the smaller municipalities.

The Italian population as a whole experienced a period of growth from approximately 2001 to 2013 and from then on began to decline at a constant and symmetrical rate compared to the previous 10 years. The smaller municipalities have been in a phase of continuous depopulation for twenty years now, while the cities with more than 100,000 inhabitants have experienced a phase of growth and then stagnation until 2020, albeit at rates always lower than the national average, while they are today in a phase of rather rapid decline. Small municipalities, with fewer than 10,000 inhabitants, have tended to be in line with the national trend. The intermediate municipalities represent a case in themselves. The municipalities between 10,000 and 100,000 show a constant increase above the Italian average from 2001 to the inflection year of 2013. From then on the decrease was rather limited and always less

3 See also *Riabitare l'Italia. Le aree interne tra abbandoni e riconquiste, (2018)*, (De Rossi A., a cura di), Barbera F., Barca F., Carrosio G., Cersosimo D., De Rossi A., Donzelli C., Lanzani A., Mascino L., Sacco P., Donzelli Editore

than the Italian trend. From this image it therefore seems that these municipalities are those that have had the best overall demographic trend in Italy.

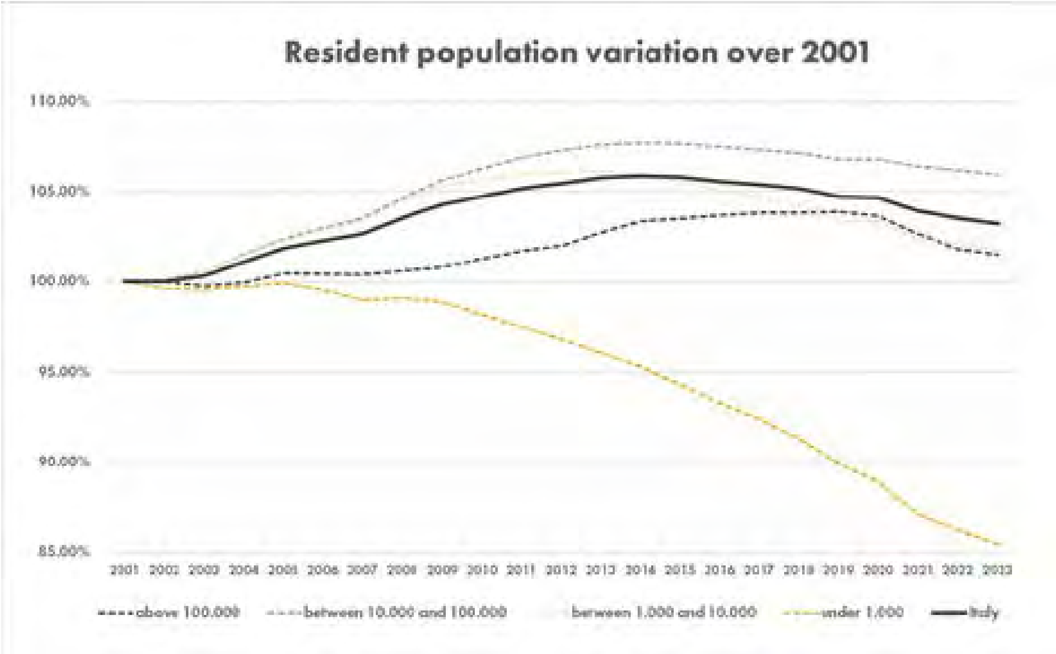

Fig. 9 Resident population variation over 2001 by population classes of municipalities

However, trying to describe this portion of the country only through demographic lenses appears to be a rather limited and insufficient exercise. It is not enough to identify *Italia di Mezzo* only as that Italy made up of intermediate cities from a point of view of size and demographic weight. A second possibility is to reconstruct how research has covered these territories over time, even calling them by different names (Curci et al., 2023). The authors acknowledge these research groups. A first group concerns studies on industrial districts and on the entrepreneurship of Italian territorial capitalism, which has always been formed in opposition to the traditional model of the factory-city and often in medium-sized cities and contexts.[4] A second group focused on the forms of widespread urbanization beyond the metropolitan belts, analyzing the phenomena of growth and recent contraction.[5] A third group studied the intermediate cities and their location within the Italian geographical-economic panorama.[6] A final group instead addressed the theme of the geography of discontent and how this was configured in the middle territories in relation to the most recent political events.[7]

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4 The authors refer in particular to Fua, Zacchia 1983, Garofoli 1991, Becattini et al. 2009, Calafati 2009, Lanzani et al. 2016, Bianchetti 2019, Tosi Tosi.

5 The authors refer in particular to Indovina 1990, 2009, Clementi et al. 1995, Munarin, Tosi 2001, Lanzani 2003, 2011, Bonomi, Abruzzese 2004, Fabian et al. 2012, De Rossi 2018, Curci et al. 2020

6 The authors refer in particular to Camagni 1993, Dematteis, Bonavero 1997, Trigilia 2014, Ifel 2019, Mascarucci 2020

7 The authors refer in particular to Vallerani, Varotto 2006, Bonomi 2008, Viesti, Simili 2017, Di Matteo, Mariotti 2021, Carrosio 2020

Italia di Mezzo as the result of the cumulative description of these lines of research today represents 56% of the Italian population and almost 50% of the country's surface area. From the point of view of the morphology of the settlements, *Italia di Mezzo* seems to be identifiable in three main conformations (ibid.):

- the Christallerian geography of medium and small cities networked together, which make up even very vast territories such as Puglia or the southern Po Valley.
- Linear territories, especially coastal ones, in which a series of smaller centers are ringed along a physical or infrastructural backbone.
- Territories dispersed outside metropolitan areas. This category contains within it a vast range of settlement geographies in relation to the degree of density of the urbanized area.

Italia di Mezzo also represents territories experiencing strong demographic decline and in which inequalities are worsening (Coppola et al., 2021). In fact, if we consider the medium-sized cities from a demographic point of view, we have been able to see in fig. 9 their good performance with regards to the demographic trend, especially in relation to the overall national trend. However, if the poles of Italia di Mezzo generally appear to be growing or experiencing a more limited contraction, the more marginal territories are in a phase of constant decline. Added to this is a general inability of these territories to restructure their economic base after the moments of crisis of the end of the 20th century. They are territories that are the result of an industrial or agricultural development often planned and assisted by the central state, which has left tangible traces on the territory and which today, since it stopped, has opened up a moment of generalized economic crisis.

They are also territories that present extensive and deep-rooted environmental problems, often the result of that model of intensive development promoted after the Second World War onwards. They are territories that have experienced profound dynamics of soil and water pollution and which still retain traces of those events, when they are not yet fully immersed in them. They are also areas deeply affected by phenomena of unregulated and extensive land consumption, which has also affected natural and protected areas. They are, in many respects, the places that large cities have exploited for years for the extraction of raw materials, for the localization of cumbersome and unwanted functions and for the expulsion of those segments of the population who are not able to afford the high costs of purely urban life. Phenomena of the past but often also of the present.

An operation of observation and approach to this Italy was initiated by the GRINS research group, to which this thesis work is connected and related both from a more generic and thematic point of view and from an operational and fieldwork one.[8]

8 GRINS (Growing, Resilient, INclusive, and Sustainable) research, funded by the Next Generation EU programme, is a three-year project carried out by an extended partnership involving 350

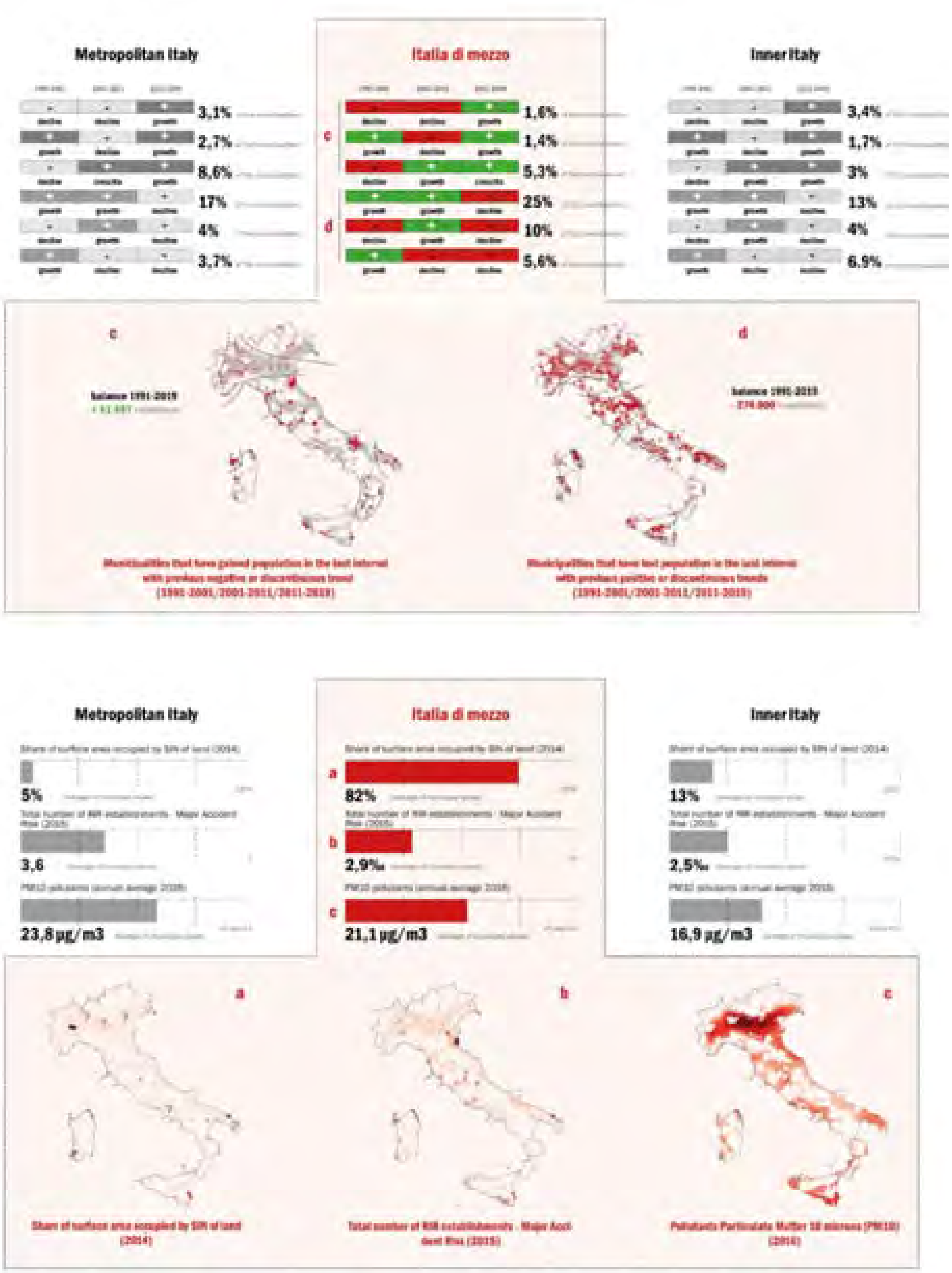

Fig. 10
Italia di Mezzo population trends and environtmental critical issues

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researchers from 25 different institutions (13 universities, 3 research centres, 9 other public and private entities). In particular, this work is part of the Spoke 7 - Territorial Sustainability research group of the DASTU Department of the Polytechnic of Milan, coordinated by Professor Arturo Lanzani.

1.2.4 Mobility of *Italia di Mezzo*

One of the most relevant issues for *Italia di Mezzo* is its mobility model. These territories in principle do not gravitate strongly around a significant metropolitan centre. We therefore do not expect to find intense commuting dynamics. At the same time, these are not even territories with little or not polarized mobility, as we would expect from the Inner Areas.

Intuitively we can also assign the same qualification of "intermediate" to mobility, even if it is difficult to describe its characteristics in detail in this way. This is an exercise strongly linked to the conformation of each of these intermediate territories. However, there are some traits that can be hypothesized as identifying the mobility of *Italia di Mezzo* and which will then be confirmed or not by this work, such as the dependence on private motorized vehicles or the scarcity of nodes in which potential demand is concentrated.

If from the point of view of describing mobility it is difficult to formulate a priori hypotheses, it is instead simpler to reconstruct how sectoral and territorial planning has approached these areas over the years and still approaches them today. It is not only a question of providing answers regarding the way in which mobility works in *Italia di Mezzo*, but also regarding the planning practices, policies and projects that must be adopted for these territories. It is necessary to subvert the categories with which we are used to approach large cities and metropolitan areas or more internal and remote areas.

Mobility planning almost always becomes a rather sectoral component and is formulated for rather precise and immobile scales and contexts. On the one hand, in fact, we find mobility planning for large cities or, in the most virtuous cases, for the large functional areas of the most attractive cities.[9] These become the main field of experimentation and innovation for forms of sustainable mobility, precisely because they combine a demand for intense and distributed mobility and an important availability of resources. On the other hand we find a national scale, which has always focused on planning the country's main network, in recent years also at high speed. For more than twenty years there has been an intense development of high-speed railway networks, created with the aim of quickly connecting Italian metropolises and representing a valid alternative to domestic air routes. If this challenge seems partially won today, those areas which are only crossed by the fast national network and which are trying in every way to "cling" to it have been left behind. Very often these are precisely those intermediate territories that represent the negative of the development of connections between large metropolises (ESPON, 2021).

This dualism between large urban areas and large national networks is not countered by an alternative narrative. What is missing is a vision that truly puts this significant portion of the country at the center and that formulates adequate policies for it. They should

9 Many Metropolitan Cities in Italy have already approved the metropolitan-scale SUMP, also following the adoption by the capital municipality of its own municipal-scale SUMP.

QUADRO DELLE MISURE E RISORSE (MILIARDI DI EURO):

24,77 Mld

Totale

Ambiti di intervento/Misure	Totale
1. Investimenti sulla rete ferroviaria	24,77
Riforma 1.1: Accelerazione dell'iter di approvazione del contratto tra MIMS e RFI	-
Riforma 1.2: Accelerazione dell'iter di approvazione dei progetti	-
Investimento 1.1: Collegamenti ferroviari ad Alta Velocità verso il Sud per passeggeri e merci	4,64
Investimento 1.2: Linee ad Alta Velocità nel Nord che collegano all'Europa	8,57
Investimento 1.3: Connessioni diagonali	1,58
Investimento 1.4: Sviluppo del sistema europeo di gestione del trasporto ferroviario (ERTMS)	2,97
Investimento 1.5: Rafforzamento dei nodi ferroviari metropolitani e dei collegamenti nazionali chiave	2,97
Investimento 1.6: Potenziamento delle linee regionali	0,94
Investimento 1.7: Potenziamento, elettrificazione e aumento della resilienza delle ferrovie nel Sud	2,40
Investimento 1.8: Miglioramento delle stazioni ferroviarie nel Sud	0,70

Fig. 11 The PNRR actions for mission 3

not be imposed from above and they should not readapt traditional practices as if they were just dealing with just many smaller cities. If we evaluate the latest version of the Italian National Recovery and Resilience Plan (PNRR), we find "Mission 3: Infrastructure for Sustainable Mobility". Of the total funds dedicated to the mission, almost 98% are dedicated to investments in the railway network. However, if we scroll through the various actions that make up the mission, we come across indications of a general nature, without a real vision for the various territories that make up the country. Reference is made to the network nodes to be strengthened, to some overall improvements in network performance and quality of service and once again to the strengthening of fast connections on a national and international scale.

Thinking about an Integrated Strategic Plan for the Sustainable Mobility for *Italia di Mezzo* can be an opportunity of absolute interest for the country, as well as an innovative and relevant planning exercise. This is not a direct operation, rather the outcome of a process of in-depth analysis of these territories. Precisely for this reason the thesis work will be structured as follows.

In a first phase it will offer a methodological approach for identifying those Italian territories that we can define as *di mezzo* from a mobility point of view. We have seen how some approaches, including the SNAI one, reconstruct different "Italies" starting from consolidated and non-relational categories, such as the socio-demographic dimension or that of territorial provision of services. In this work we will instead propose to reconstruct the geography of *Italia di Mezzo* starting exclusively from the relational data regarding the mobility of the Italian population. The picture of this Italy will be offered by describing its main characteristics, also in tension with existing classifications.

In a second phase the analysis will go down in scale and a relevant case study will be analyzed among those identified through the classification described in the first phase. The main aspects of this territory will be described, the detail of the distribution of mobility demand within it, the offer of collective transport services and the way in which planning at different scales focuses or does not focus on the geography of this territory of Italia di Mezzo from the point of view of mobility.

In conclusion, the analysis will focus on a railway corridor within the study area, analyzing its main characteristics and trying to formulate some guidelines for the drafting of a hypothetical Integrated Strategic Plan for the Sustainable Mobility for this corridor of *Italia di Mezzo*.

2. Looking for *Italia di Mezzo*

This chapter will show the construction and the results of a methodological approach useful for the classification of Italian municipalities based on mobility characteristics with the ultimate aim of identifying those portions of territory identifiable as *Italia di Mezzo* from a mobility point of view. The reference data is that relating to commuting mobility taken from the 2011 ISTAT matrix.

A first part will concern the construction of some relevant indexes useful for a synthetic description of Italian municipalities based on the way in which they express outgoing and incoming commuting mobility. A first group will consider these flows in an aggregate manner, a second group will evaluate them in a relational way between the different municipalities, while a last group will explore the geographical dimension of the movements, considering in particular their direction.

In the second part these indicators will be used in combination with each other in order to create a classification of the commuting mobility basins in Italy. A series of possible classifications will be proposed, each the result of a different combinations. These will then be discussed regarding the identification of possible territories of *Italia di Mezzo* and the type of mobility that makes them such.

2.1 Purpose of the research

In some ways it is possible to identify intermediate Italian territories. If we evaluate the accessibility to essential services, the build-up morphology, the demographic characteristics or other static descriptors of reality, it is possible to create a rather accurate classification of what makes a territory neither metropolitan nor internal. It would always be an operation by exclusion, made up of discrete and interpretative choices, which would recognize a category of territory for what it *is not*.

Therefore, if it is possible to define categories of "Italies" with regard to more stable territorial characteristics, the challenge becomes more complex with regards to the mobility of people. Since we are referring to a kind of data that is complex to analyze at any scale, considering it within a characterization on the scale of the entire nation seems necessary. In this way it could lead to original descriptions and also in tension with those conducted until now. Obviously, people's mobility is a complex and multi-scalar research field, which, thanks to recent data analysis methodologies, can offer the availability of data increasingly at a micro scale, both in terms of space and time.

The aim of the research and of this chapter in particular is precisely to present the work of building a methodology that is as complete and articulated as possible, in order to define the possible "Italie di Mezzo" exclusively with data relating to mobility demand. To build this methodology we relied on rather consistent and large-scale data, such as that relating to commuting and systematic mobility. With this choice we exclude all mobility linked to leisure, free time, the use of services and in general all that not related to going to the place of work or study, but on the other hand we are able to offer a first interesting and valid overview of how people usually move between Italian municipalities.

The type of data used will be specified later, i.e. the ISTAT "origin-destination matrix of travel for work or study reasons" of 2011. Although it is not a very recent and in some ways outdated dataset -especially not being able to grasp the changed post-pandemic mobility habits- we believe it is still a reliable source regarding the stable and consolidated dynamics of people's commuting mobility, which cannot have undergone major upheavals in the space of 10 years. In any case, this is the latest public data available at the moment on a national scale.

Although we are led to think that the majority of commuting mobility occurs mostly in metropolitan areas with a high density of urbanization and with a highly attractive central hub, there is no doubt that there are mobility patterns for going to places of study and work even in everything that is not strictly a metropolitan area. So if these patterns exist, how are they configured? What directions do they take? What consistency are they? Are they homogeneous or can they be categorized in a discrete and compact manner? Starting from these premises, the research work can be summarized in a very specific question: does a *Italia di Mezzo* exist from the point of view of people's commuting mobility? If so, what characteristics does it have? This section will try to answer these and other questions, with the double objective of trying to define a *Italia di Mezzo* from the point of view of commuting mobility, but also of trying to describe this kind of mobility in a more specific way.

2.2 Methodology and used data

The analysis will be structured in two main parts.

2.2.1 Datasets for creating indexes

First, the data relating to the ISTAT OD matrix (from now on "matrix") will be processed in order to obtain some significant indicators that can allow a first convincing and consistent exploration of the different "Italies". These indicators will be presented, spatialized and finally compared with some existing classifications. The latter will actually be used to estimate the quality of the indicators, but also to confirm or possibly deny some assumptions that they formulate regarding the various Italian territories.

We will also understand the potentialities and the limits of each of the indicators and we will see that they are able to provide a good description of different mobility territories inside Italy, but at the same time they are not enough to provide a clear and unique description of the different Italies we are looking for, especially *Italia di Mezzo*.

As we have already highlighted previously, in order to create the methodology in its entirety and in particular the part relating to the indicators, only the 2011 ISTAT dataset "origin-destination matrix of travel for work or study reasons" was used. This dataset is simply composed of a single table containing the relationships between all Italian municipalities understood as O-D flows, outgoing from a municipality i and incoming into another municipality j. Each of these flows is disaggregated according to a series of fields, which specify some characteristics. The 2011 version of the matrix in particular offers the possibility of processing a reduced version of the dataset, (excluding the fields which are marked in italics below). The complete version of the matrix will be used in the continuation of the research, at the transept scale.

- Type of residence (family or cohabitation)
- Sex
- Reason for moving (study or work)
- Place of study or work (in the same municipality of residence or in another municipality/foreign country)
- *Means of transport*
    - *train;*
    - *tram;*
    - *subway;*

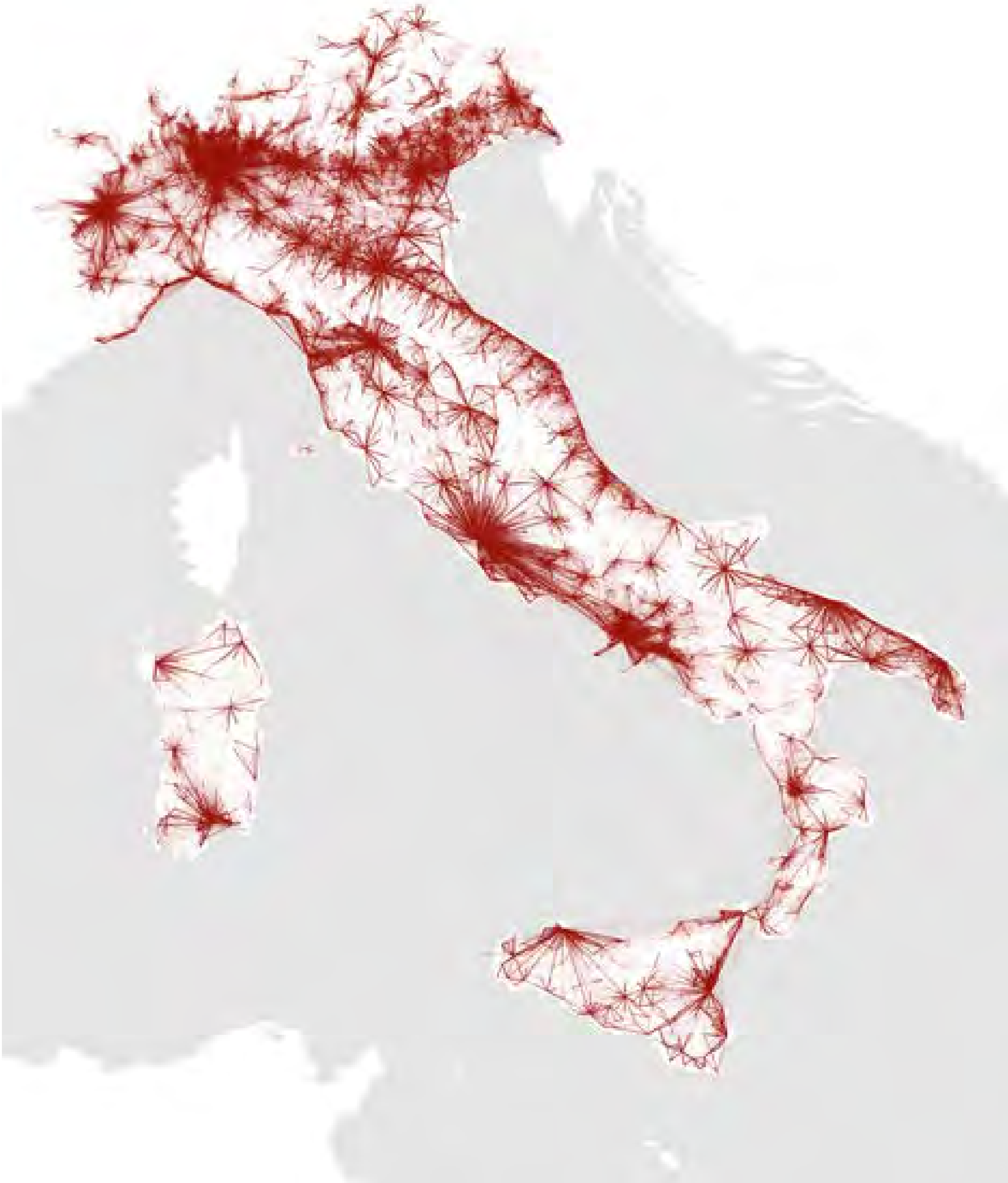


Fig. 12
An overall
representation
of the OD matrix

- *city bus, trolleybus;*
- *coach, extra-urban bus;*
- *company or school bus;*
- *private car (as driver);*
- *private car (as a passenger);*
- *motorcycle, moped, scooter;*
- *bicycle;*

- *other means;*
- *on foot;*

- *Exit time*
  - *before 7.15am;*
  - *from 7.15 to 8.14;*
  - *from 8.15 to 9.14;*
  - *after 9.14am;*
- *The time spent on*
  - *up to 15 minutes;*
  - *16 to 30 minutes;*
  - *31 to 60 minutes;*
  - *over 60 minutes;*

As regards the comparison data used, these will mainly refer to two research studies: on the one hand the SNAI classification of Italian municipalities from 2014, on the other the socio-demographic classification built within the GRINS working group, still in consolidation phase.

The SNAI classification identifies the internal areas starting from the definition of the poles, i.e. those municipalities in which there are located a series of public services considered essential and on which the rest of the municipalities are in a certain sense called upon to depend. From here, everything non-pole is classified based on the travel time needed to reach the nearest pole:

- belt areas, travel time less than 20 minutes;
- intermediate areas, between 20 and 40 minutes;
- peripheral areas, between 40 and 75 minutes;
- ultra-peripheral areas, with travel times exceeding 75 minutes.

For the SNAI strategy, all those areas that are neither a hub nor a belt are to be considered internal areas, therefore more than 60% of the Italian territory and approximately 23% of its population.
In order to make the comparison we will consider the subclasses of hub, inter-municipal hub, belt areas, intermediate, peripheral and ultra-peripheral areas.

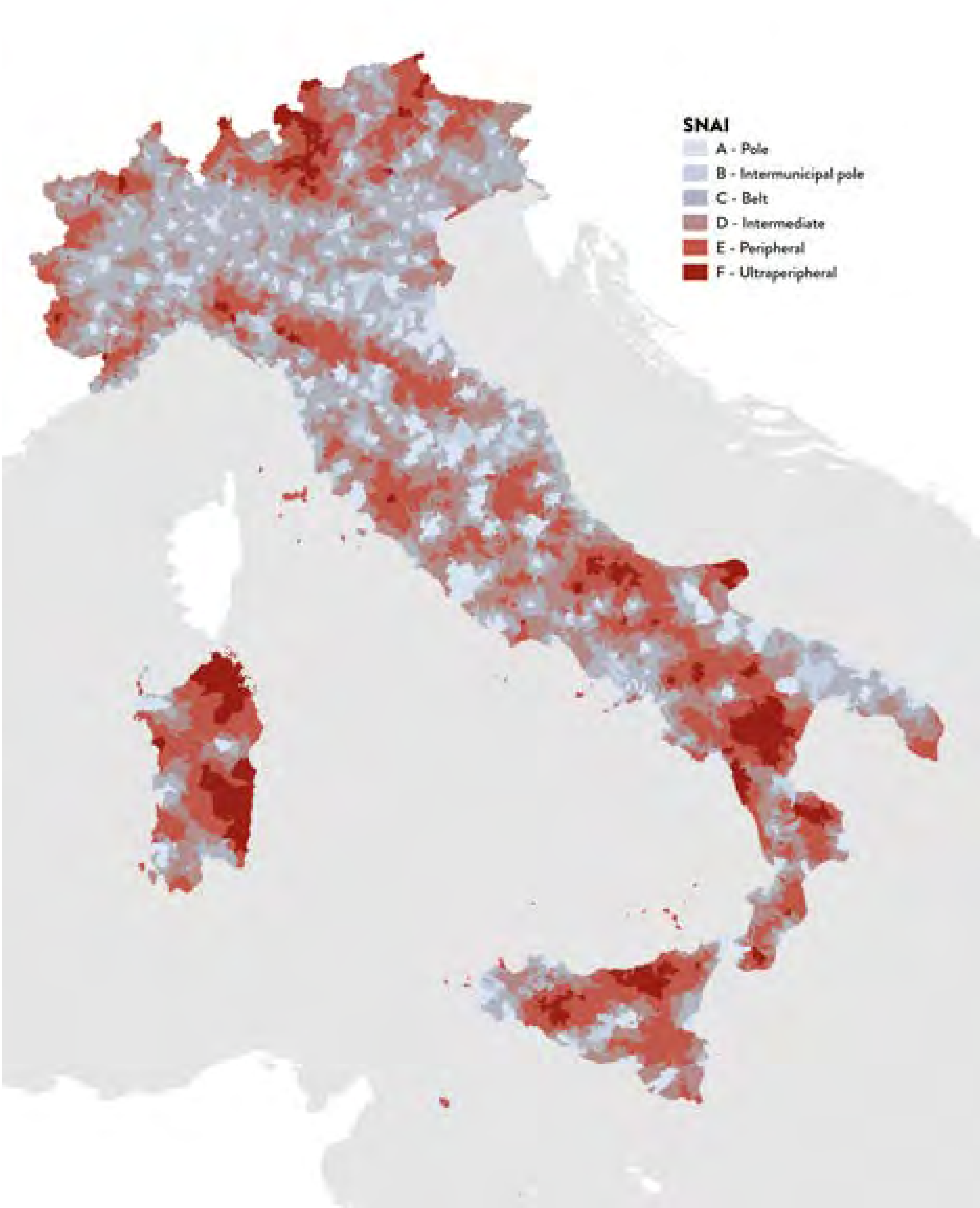


Fig. 13
The SNAI classification of Italy

The GRINS data instead refers to an initial classification work carried out through the direct comparison and overlap of some existing datasets. These datasets are provided by national or European sources and follow mainly sociodemographic criteria in order to classify Italian municipalities. In particular we find:

- SNAI classification
- Dataset concerning the functional urban areas (FUA), both for the type of municipality and for the commuting area
- Italian metropolitan cities or provincial capitals from ISTAT

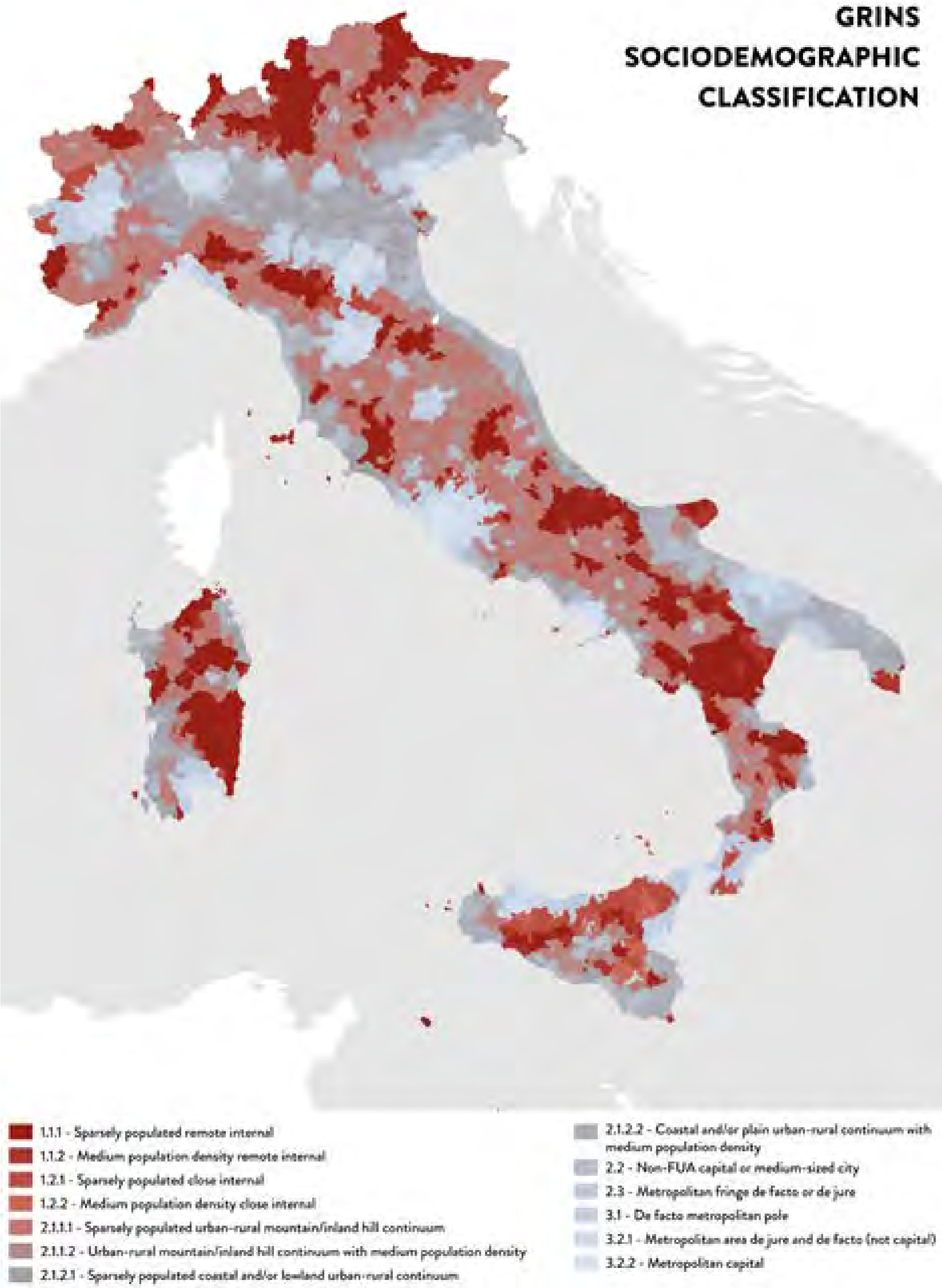


Fig. 14
The GRINS sociodemographic classification of Italy

- Degree of urbanization from ISTAT
- Altitude ranges from ISTAT

The overlapping work divided the Italian municipalities into some main categorizations. Inner Italy is mainly composed of the remote internal, *Italia di Mezzo* of the urban-rural continuum and medium-sized cities and Metropolitan Italy of the “de facto” and “de jure” metropolitan poles and the respective metropolitan areas and fringes. The real boundaries between the three macro-classes would seem not to be so sharp, but in order to use the data for a comparison with the mobility classification we will assume all the macro-classes and sub-classes separately.

2.2.2 Classification overview

As already mentioned, the indexes alone are not able to present such a clear and uniform picture as to be able to precisely define what is *Italia di Mezzo* from the point of view of commuting mobility. For this reason, in the second part, through an incremental process, we will proceed with the actual search for *Italia di Mezzo* of commuting mobility, using the indexes presented above but in a more compositional way. We will try to define this Italy again by exclusion, eliminating the metropolitan areas and the more internal and remote ones, always from the point of view of commuting mobility. The process will be explained more in detail in the dedicated section.

In the conclusive part we will discuss the main outcomes of the classification operation and we will also try to build some possible interpretative considerations about what kind of Italian territories make up the *Italia di Mezzo* of commuting mobility.

2.3 Indexes

In the first section, as already announced, the main indicators useful for the research work will be presented.

The main characteristics of the indexes will first be defined, then they will be represented spatially on a municipal scale and finally they will be compared with the SNAI and GRINS classifications through comparison tables.

The description and presentation of the indexes will follow a kind of evolution in the conceptualization and meaning of them. The indexes are indeed divided in three groups, each of them collecting indexes with the same type of premises and mathematical meanings. The first group collect all those indexes that only refer to the aggregate characteristics of the outgoing flows; in the second we find all those indexes that relate municipalities one to another; the third and last will contain an index and a original matrix representation that will describe in a compact way the geographical components of the flows, i.e. their direction.

2.3.1 Flow indexes

This category includes all those indexes that start from aggregate values of population movements, both outgoing and incoming. Although these quantities depend directly on the municipality's resident population and thus could lead to a distorted picture of actual mobility, relating them can yield dimensionless indicators that help us categorize municipalities in terms of how much they are attractors or generators, or in terms of how well they are able to contain within their boundaries the flows they do or do not generate.

Attractiveness index

The attractiveness index was defined as the ratio of inflows to outflows, in the form:

$$I_{ATT} = \frac{Incoming\ flows}{Outgoing\ flows}$$

This value returns us how much a municipality tends to be an attractor or generator of flows. In fact, 1 becomes a threshold value; below it we find municipalities that are increasingly generative and instead above it municipalities that are increasingly attractive.

Intuitively, we would expect to find higher values for municipalities known to be more attractors, such as large metropolitan centers and small local attractor centers, while to record lower values for municipalities that are attracted by these centers, mostly the first metropolitan belts or small municipalities that generate many more displacements

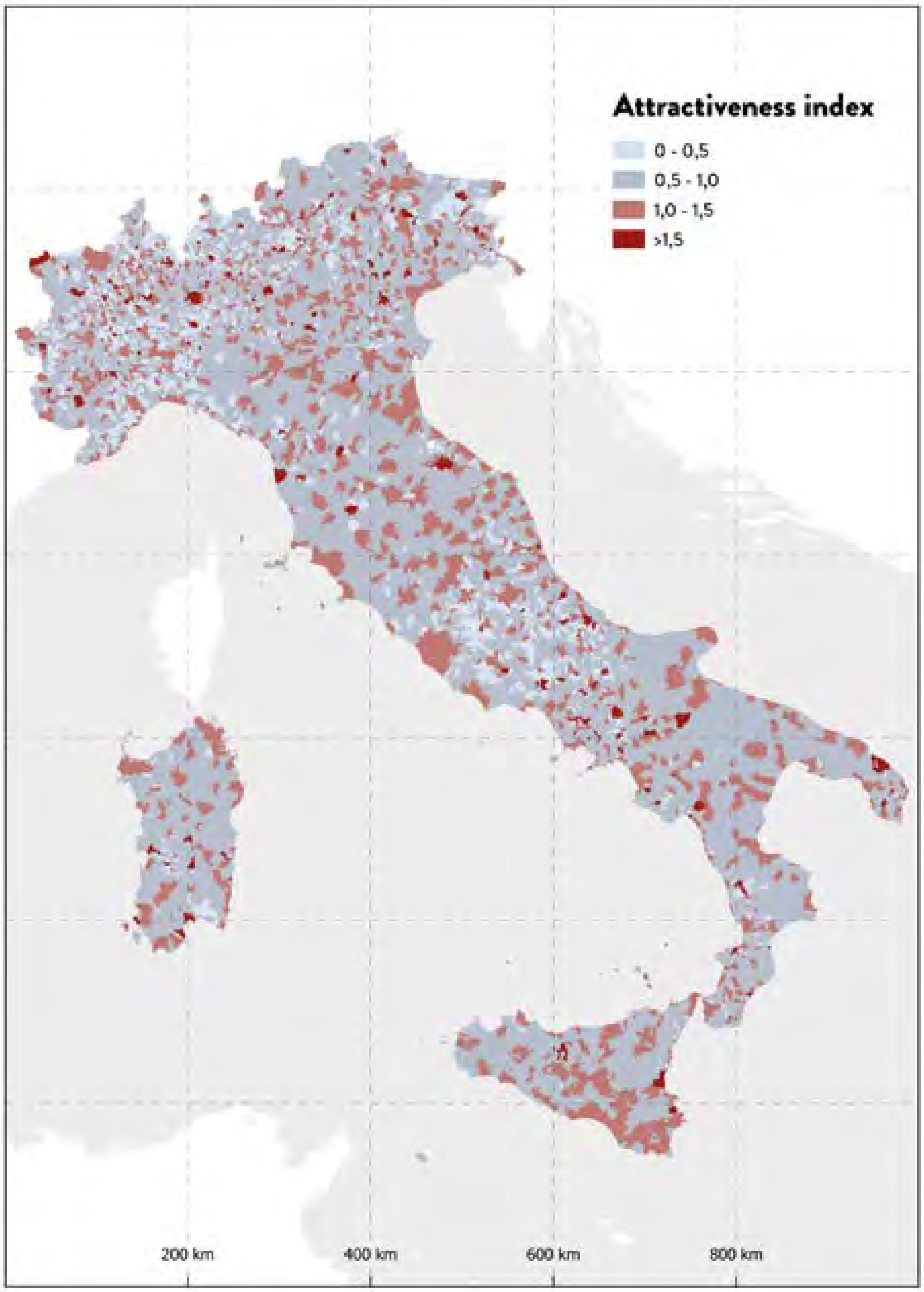


Fig. 15
Map of Italy by attractiveness index

than they attract, albeit in much smaller absolute value. All municipalities very close to 1 are neither attractors nor strong generators. These municipalities could be part of that *Italia di Mezzo* we are looking for, but assuming that a single indicator can return such a definite picture might be very risky at this stage.

The map thus brings out those municipalities that tend to attract commuting flows

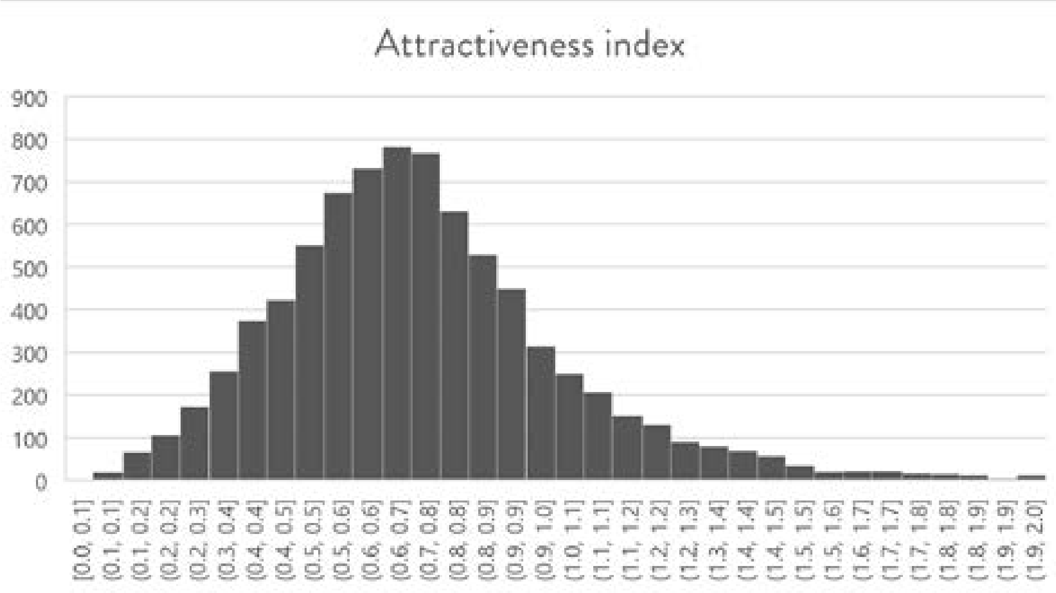


Fig. 16 Attractiveness index distribution

(in shades of red) and those that tend to generate them instead (shades of gray). In dark red we find some municipalities that are intuitively attractors, such as large de jure (regional or provincial capitals) or de facto metropolitan centers. However, we also find relevant outliers.

In fact, if we go to extrapolate the top 10 municipalities by attractiveness index, we do not find any relevant pole. Instead, we are almost always dealing with very specific cases of strong attractiveness of working employees in some peculiar and geographically concentrated activities, as in the case of the industrial area of Melfi or Atessa, the tourism sector for Portofino, the airport for Orio al Serio, the Assago shopping center, and the University of Salerno based in Fisciano. But this is not enough; in these cases it is clear that the weight of commuters generated is not enough to counterbalance the commuters attracted -due to the relative smallness of the municipality- so that in the overall the municipality becomes a strong attractor.

COMUNE	ATTRATTIVITA'	GENERATI	ATTRATTI
Roascio	9.75	32	312
Orio al Serio	5.82	977	5687
Pettoranello del Molise	5.09	180	917
Fisciano	4.22	6423	27130
Massello	3.67	5	18
Scarmagno	3.21	428	1372
Atessa	3.08	5278	16238
Portofino	3.04	193	586
Assago	2.96	5144	15204
Fiera di Primiero	2.95	241	712

Tab. 1 Top 10 municipalities by attractiveness index

We therefore go on to compare the indicator with existing classifications.

The comparison with GRINS confirms some initial assumptions but disproves

ATTRACTIVENESS INDEX		
GRINS Classification	Average	Std. Deviation
INNER ITALY	**0.7583**	**0.3120**
1.1.1 - Sparsely populated remote internal	0.7282	0.2962
1.1.2 - Medium population density remote internal	0.9344	0.4082
1.2.1 - Sparsely populated close internal	0.7704	0.2832
1.1.2 - Medium population density close internal	0.9481	0.2101
MIDDLE ITALY	**0.7367**	**0.3522**
2.1.1.1 - Sparsely populated urban-rural mountain/inland hill continuum	0.6555	0.3553
2.1.1.2 - Urban-rural mountain/inland hill continuum with medium population density	0.8047	0.3595
2.1.2.1 - Sparsely populated coastal and/or lowland urban-rural continuum	0.7183	0.3012
2.1.2.2 - Coastal and/or plain urban-rural continuum with medium population density	0.8460	0.2601
2.2 - Non-FUA capital or medium-sized city	1.3372	0.2556
2.3 - Metropolitan fringe de facto or de jure	0.7428	0.3683
METROPOLITAN ITALY	**0.7478**	**0.3105**
3.1 - De facto metropolitan pole	1.3772	0.2611
3.2.1 - Metropolitan area de jure and de facto (not capital)	0.7191	0.2827
3.2.2 - Metropolitan capital	1.3536	0.2191
Total	**0.7412**	**0.3428**

Fig. 17
Attractiveness index related to GRINS classes

others. It is clear that the municipalities with higher average values are the "poles," i.e., metropolitan capitals, de facto metropolitan poles, and medium-sized cities, all three, moreover, with the same value. On the other hand, those who seem to be in the opposite situation, those basically generators, are the sparsely populated urban-rural continuums, metropolitan areas and the sparsely populated remote interior.

This confirms on the one hand the "pole-periphery" dualism with regard to the degree of attractiveness of a municipality, but it decisively belies the supposed homogeneity of the three macro-classes, so much so that all three present a comparable average value. The real differences seem to be just within them, such that medium-sized cities and their commuting areas are comparable with metropolitan centers and metropolitan areas, in relative terms.

The SNAI classification undoubtedly makes the poles emerge more homogeneously, the only category with an average value above 1. The surrounding and intermediate municipalities, on the contrary, seem to be those that generate the most trips in relative terms, while the most peripheral municipalities present the most intermediate values,

ATTRACTIVENESS INDEX		
Classificazione SNAI	Average	Std. Deviation
CENTERS	**0.7653**	**0.3539**
A - Poles	1.2717	0.2590
B - Intermunicipal poles	0.9628	0.2705
C - Belt	0.7277	0.3350
AREE INTERNE	**0.7133**	**0.3318**
D - Intermediate	0.6916	0.3506
E - Peripheral	0.7319	0.3076
F - Ultraperipheral	0.7896	0.2786
Total	**0.7384**	**0.3436**

Fig. 18
Attractiveness index related to SNAI classes

not being relatively categorized either as attractors or generators.

Self-containment index

The self-containment index was defined as the ratio between the flows generated that remain in the municipality and the total flows generated, in the form:

$$I_{AUT} = \frac{Generated\ flows\ within\ the\ municipality}{Total\ generated\ flows}$$

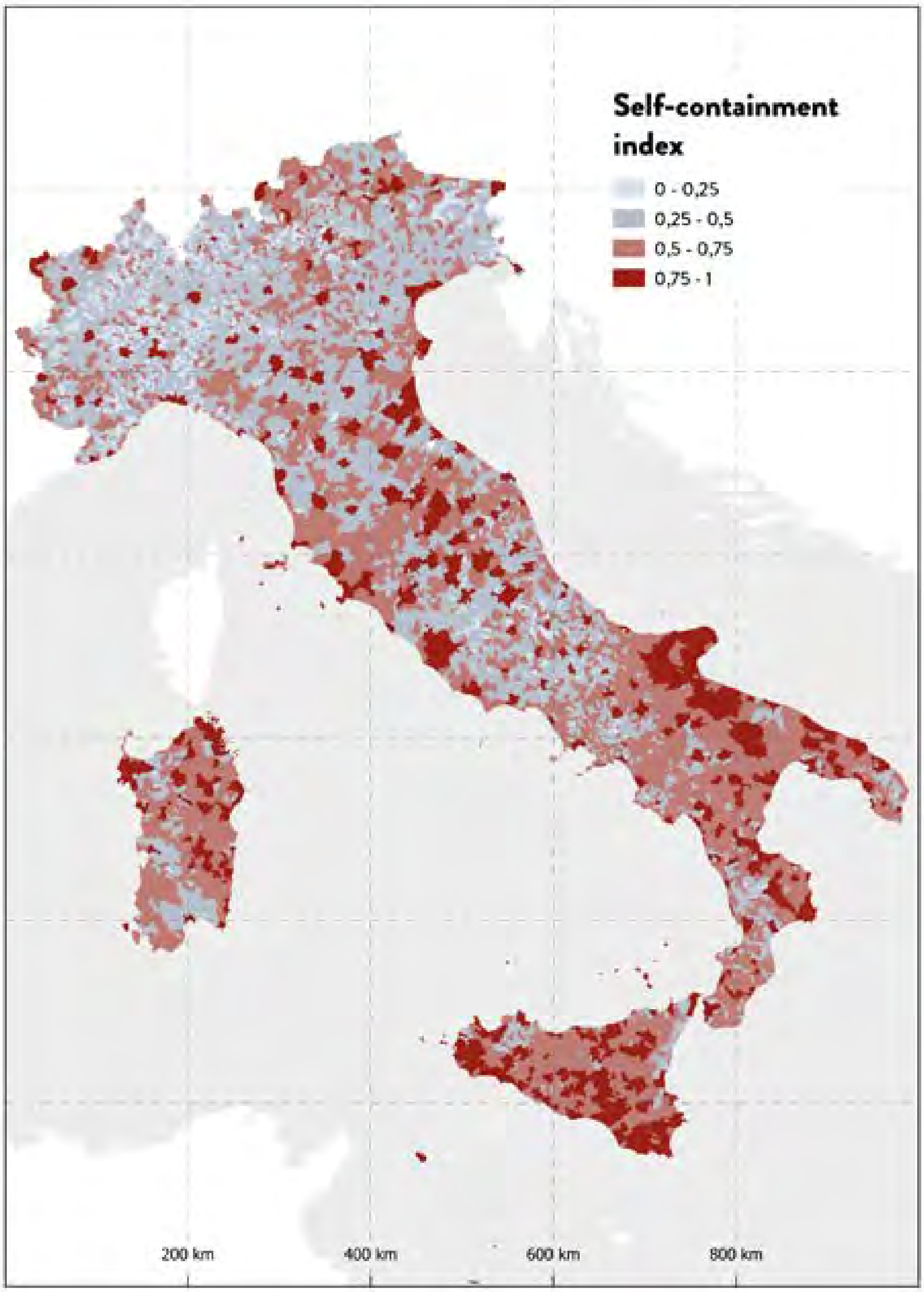


Fig. 19
Map of Italy by self-containment index

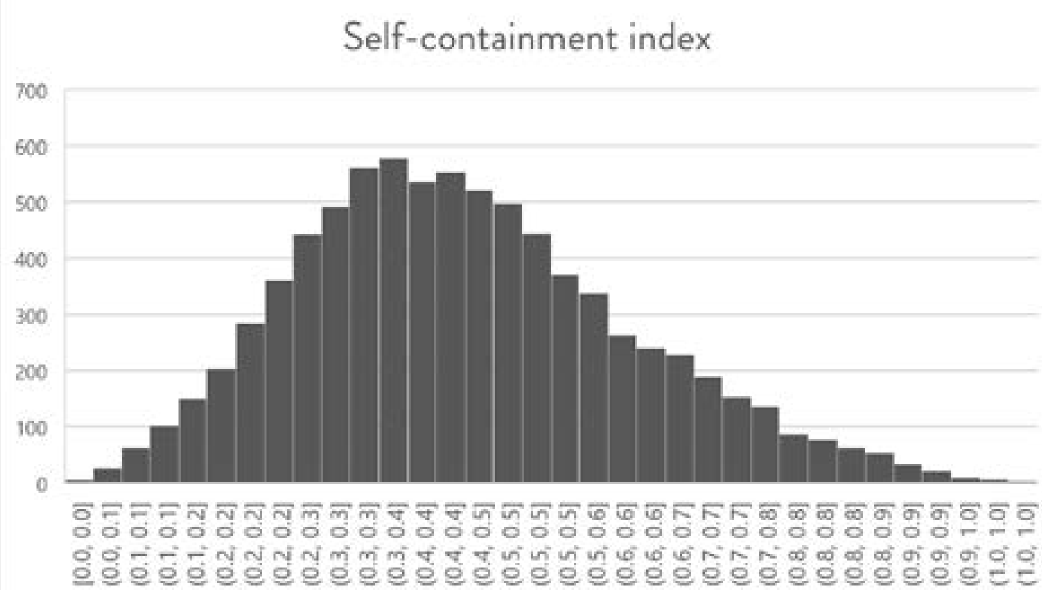


Fig. 20
Self-containment index distribution

The value describes how much a municipality retains the flows that are generated within its municipal borders or how much, on the contrary, its inhabitants are forced to move elsewhere to reach the place of study or work.

It is natural to relate this dimension to the presence or absence of school services and jobs within the municipal territory, precisely because these will mean that the inhabitants of the municipality may or may not be forced to leave it. From this simple assumption we can intuitively deduce that, also in this case, the highest values will represent those "self-sufficient" municipalities, from which the inhabitants are on average less inclined to leave, while the lowest values will represent those municipalities which the inhabitants are forced to leave to go to school or work.

If we spatialize the data, the attractor poles are quite recognizable, such as large metropolitan centres, but also medium-sized cities and smaller centres. On the contrary, the municipalities from which the inhabitants on average tend to get out from are affected by a more accentuated north-south dichotomy, with the south municipalities presenting higher values. This may be explained by a lower propensity of people to leave their own municipality, but also by a greater average size of southern municipalities, especially between Puglia and Campania, which means that the overall supply of places of study and work is greater in each municipality.

This is a rather consistent indicator, whose values fluctuate between 0 and 1 and which does not present any particularly relevant outliers. Its limit is not in the mathematical construction, but rather emerges from an ex-post evaluation, i.e. the evident imbalance between northern and southern Italy.

As regards the comparison with the GRINS classes, in this case we find the lower values for central and metropolitan Italy, both below the national average. Evidently the poles present in these bands, despite having relatively higher values, are unable to counterbalance the very low values of the metropolitan areas and fringes and of the urban-rural continuum, which is strongly dependent on its own poles reference. The case of inner Italy is different. It seems to perform better on average than the other two categories, thus demonstrating its relative independence from other municipalities, with values lower than the poles, but much higher than the fringes and the continuum. It is possible to hypothesize in this case that one of the reasons for this result is the fact of not having broken down the reasons for the shift between study and work, which will instead be explored through the next flow indicator.

SELF-CONTAINMENT INDEX		
GRINS Classification	Average	Std. Deviation
INNER ITALY	**0.5209**	**0.1904**
1.1.1 - Sparsely populated remote internal	0.5045	0.1859
1.1.2 - Medium population density remote internal	0.5971	0.2295
1.2.1 - Sparsely populated close internal	0.5295	0.1613
1.1.2 - Medium population density close internal	0.6937	0.1535
MIDDLE ITALY	**0.4053**	**0.1657**
2.1.1.1 - Sparsely populated urban-rural mountain/inland hill continuum	0.3815	0.1506
2.1.1.2 - Urban-rural mountain/inland hill continuum with medium population density	0.4027	0.1723
2.1.2.1 - Sparsely populated coastal and/or lowland urban-rural continuum	0.3752	0.1397
2.1.2.2 - Coastal and/or plain urban-rural continuum with medium population density	0.4868	0.1614
2.2 - Non-FUA capital or medium-sized city	0.8088	0.0818
2.3 - Metropolitan fringe de facto or de jure	0.3891	0.1567
METROPOLITAN ITALY	**0.3895**	**0.1454**
3.1 - De facto metropolitan pole	0.7836	0.1086
3.2.1 - Metropolitan area de jure and de facto (not capital)	0.3684	0.1080
3.2.2 - Metropolitan capital	0.9898	0.0540
Total	**0.4239**	**0.1745**

Fig. 21
Self-containment index related to GRINS classes

If we consider the SNAI classes, the symmetrical classification previously only mentioned becomes more evident here. Starting from the poles, in fact, which present the highest self-containment values, this gradually decreases, with the surrounding municipalities and the intermediate ones appearing to be the categories most likely to generate outward movements. A trend which, however, is once again inverted when it concerns peripheral areas.

SELF-CONTAINMENT INDEX		
SNAI Classification	Average	Std. Deviation
CENTERS	**0.3823**	**0.1607**
A - Poles	[illegible]	0.1262
B - Intermunicipal poles	0.5291	0.1642
C - Belt	0.3553	0.1303
AREE INTERNE	**0.4551**	**0.1801**
D - Intermediate	0.4165	0.1633
E - Peripheral	0.4921	0.1853
F - Ultraperipheral	0.5696	0.1906
Total	**0.4199**	**0.1748**

Fig. 22
Self-containment index related to SNAI classes

School mobility index

The school mobility index directly comes from the self-containment index, with two variations. On the one hand it does not consider all the flows generated but only those for study purposes, while on the other it estimates the share of outgoing flows:

$$I_{SCOL} = \frac{Outgoing\ generated\ flows\ due\ to\ study\ purposes}{Total\ generated\ flows\ due\ to\ study\ purposes}$$

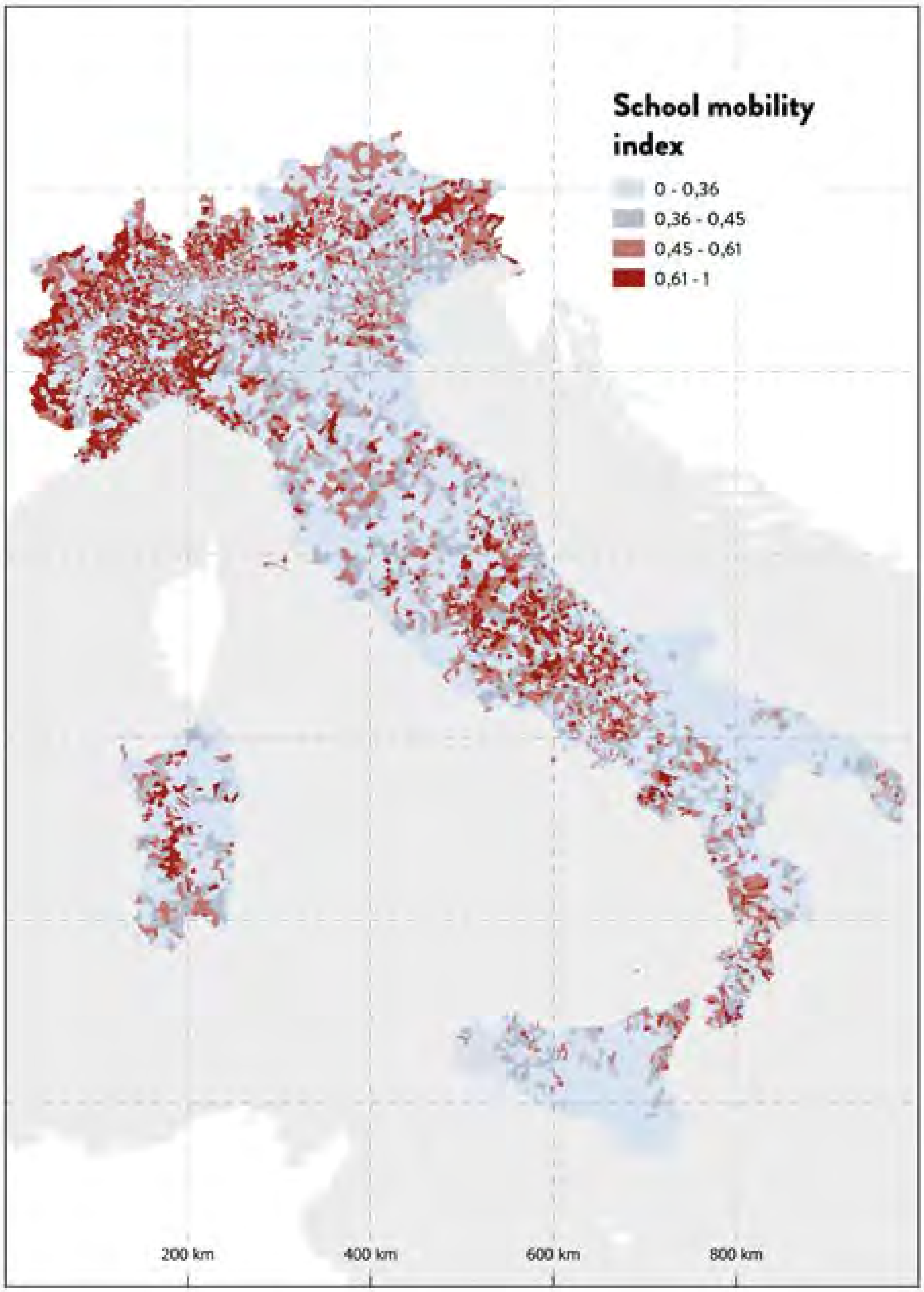


Fig. 23
Map of Italy by school mobility index

The indicator estimates how much, in each municipality, the population who moves for study purposes is forced to do so by leaving their municipality of residence. This is a more specialized version of the self-containment index which, considering only the study reason, in a certain sense links itself to the territorial provision of school services present in the various Italian municipalities. In fact, one can intuitively assume that, on average, municipalities that have adequate school facilities within their territory will present a lower value, since students will have less need to leave their municipality of residence.

The map presents a rather clear situation. In fact, it seems that the more inner territories, especially the mountainous territories, have a greater tendency to leave their municipality for study reasons. However, this is also visible in some portions of the Po Valley, especially in Veneto and in a large portion between Milan, Turin and Genoa, as well as in a good part of Friuli Venezia Giulia.

Interestingly, there is a significant portion of outliers, namely those municipalities in which practically all students are forced to go to a different municipality for study purposes. If we estimate the number of municipalities with a value greater than 0.9, we discover that in more than 9% of Italian municipalities, practically all students are forced to move to a different municipality to go to school.

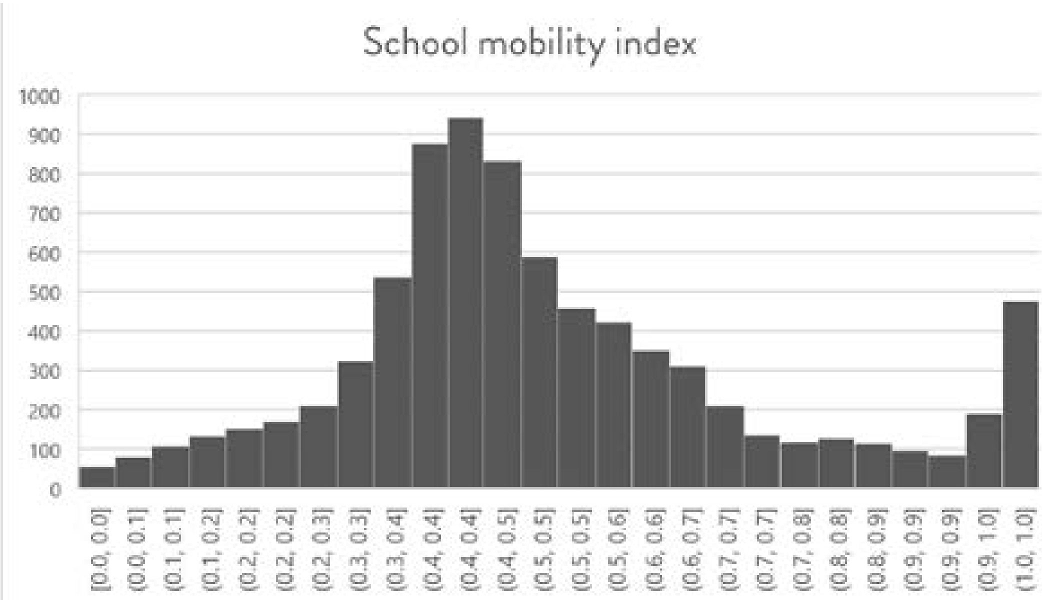


Fig. 24 School mobility index distribution

This is a relevant data and raises questions that are beyond the scope of this research. To this we must in fact add the variation over time of this phenomenon, from 2011 to today, which has only gotten worse and worse.

Finally, at least two main limitations of this indicator must be clarified:

- The study purpose includes a vast range of levels and types of educational institutions, from kindergartens to universities, with also training schools. This obviously standardizes the modes of travel and school dependence, that are sometimes diametrically opposed.
- It is not certain that a propensity to move from one's municipality of residence for study reasons is linked only to the adequate provision of school facilities. There may be cultural reasons, propensity or otherwise to commute to school, as well as geographical and structural impediments that limit the movement of students.

This indicator also clearly highlights the three categories of centers which present a very low share of students who leave for study purposes, always less than 1%. These are also clearly the situations with the largest school endowments. However, the situation is diametrically opposite for continuums and sparsely populated remote interiors, with values always around or over 50% of movements. More generally, central Italy is the one that performs worst among the three, but it should also be noted that inner Italy presents a greater dispersion around the average, therefore it includes a much more widespread series of situations.

SCHOOL MOBILITY INDEX		
GRINS Classification	Average	Std. Deviation
INNER ITALY	**0.4766**	**0.2583**
1.1.1 - Sparsely populated remote internal	0.5012	0.2565
1.1.2 - Medium population density remote internal	0.3068	0.2222
1.2.1 - Sparsely populated close internal	0.4989	0.2413
1.1.2 - Medium population density close internal	0.2447	0.1589
MIDDLE ITALY	**0.5028**	**0.2165**
2.1.1.1 - Sparsely populated urban-rural mountain/inland hill continuum	0.5810	0.2258
2.1.1.2 - Urban-rural mountain/inland hill continuum with medium population density	0.4497	0.1798
2.1.2.1 - Sparsely populated coastal and/or lowland urban-rural continuum	0.5413	0.1973
2.1.2.2 - Coastal and/or plain urban-rural continuum with medium population density	0.3645	0.1399
2.2 - Non-FUA capital or medium-sized city	0.0872	0.0488
2.3 - Metropolitan fringe de facto or de jure	0.4773	0.1820
METROPOLITAN ITALY	**0.4244**	**0.1464**
3.1 - De facto metropolitan pole	0.0224	0.0503
3.2.1 - Metropolitan area de jure and de facto (not capital)	0.4418	0.1249
3.2.2 - Metropolitan capital	[illegible]	0.0223
Total	**0.4926**	**0.2211**

Fig. 25
School mobility index related to GRINS classes

The SNAI classification in relation to the school mobility indicator is instead more linear, with the centers performing better and with the peak value being reached in the intermediate territories. Once again, albeit in a less accentuated way, it would seem that the peripheral areas regain some of the gap with the centres, positioning themselves in a situation similar to that of the surrounding municipalities.

SCHOOL MOBILITY INDEX		
SNAI Classification	Average	Std. Deviation
CENTERS	**0.4825**	**0.1984**
A - Poles	0.1384	0.0816
B - Intermunicipal poles	0.3044	0.1219
C - Belt	0.5101	0.1809
AREE INTERNE	**0.5121**	**0.2431**
D - Intermediate	0.5249	0.2284
E - Peripheral	0.5067	0.2608
F - Ultraperipheral	0.4297	0.2466
Total	**0.4978**	**0.2231**

Fig. 26
School mobility index related to SNAI classes

2.3.2 Dependency indexes

While for the first category of indicators we refer to the consistency of outgoing and incoming flows from individual municipalities, in this second group an element of complexity is added. In this case, in fact, the element of the actual O-D relationship is added, i.e. how each municipality generates and attracts flows towards other municipalities, in particular how many and which they are. This further step will allow us to define dependency indexes, precisely because we will be able to define the hierarchical relationships between municipalities, the weight of these hierarchies and their differentiation. The overall objective is to create indicators that consistently define if and how much municipalities are "dependent" on other municipalities or how much they do not depend on any particular municipality.

Primary dependency index

If we define and classify the attractors of each municipality based on the total number of flows that they attract from that municipality as A1, A2 and A3, the total of flows destined for the first three attractors over the total outgoing flows is defined as the primary dependency index:

$$I_{DEP1} = \frac{Flow_{A_1} + Flow_{A_2} + Flow_{A_3}}{Total\ outgoing\ flows}$$

Another obvious but important relationship must also be declared, namely that by construction:

$$Flow_{A_1} > Flow_{A_2} > Flow_{A_3}$$

The indicator aims to investigate the weight that the first three attractors of a municipality have towards that municipality. In territories very dependent on the poles, this indicator will be very high, both because the weight of the first attractor could be predominant, and because the weight of the first two could be predominant, and because the weight of all three could be predominant over the rest of the destinations. This happens precisely because it is impossible that:

$$Flow_{A_2} > Flow_{A_1}$$

or

$$Flow_{A_3} > Flow_{A_2}$$

The element that immediately captures attention is how the indicator is able to highlight some very strong areas of dependence, including the areas of Milan, Turin, Brescia or the centers of the Via Emilia axis. Interestingly, however, as we go south this precision is lost, thanks both to the increasingly larger grain of municipal geometries and to some changed dimensions of mobility. The case of Rome is evident, whose area of influence - if we can define it that way - is decidedly more extensive than that of the northern centers or the even more southern of Naples.

Obviously any description of the results starting from the attractor centers has a purely deductive matrix and observation of the proximity of the municipalities. In fact, the indicator does not give any information regarding which are the first three attractors

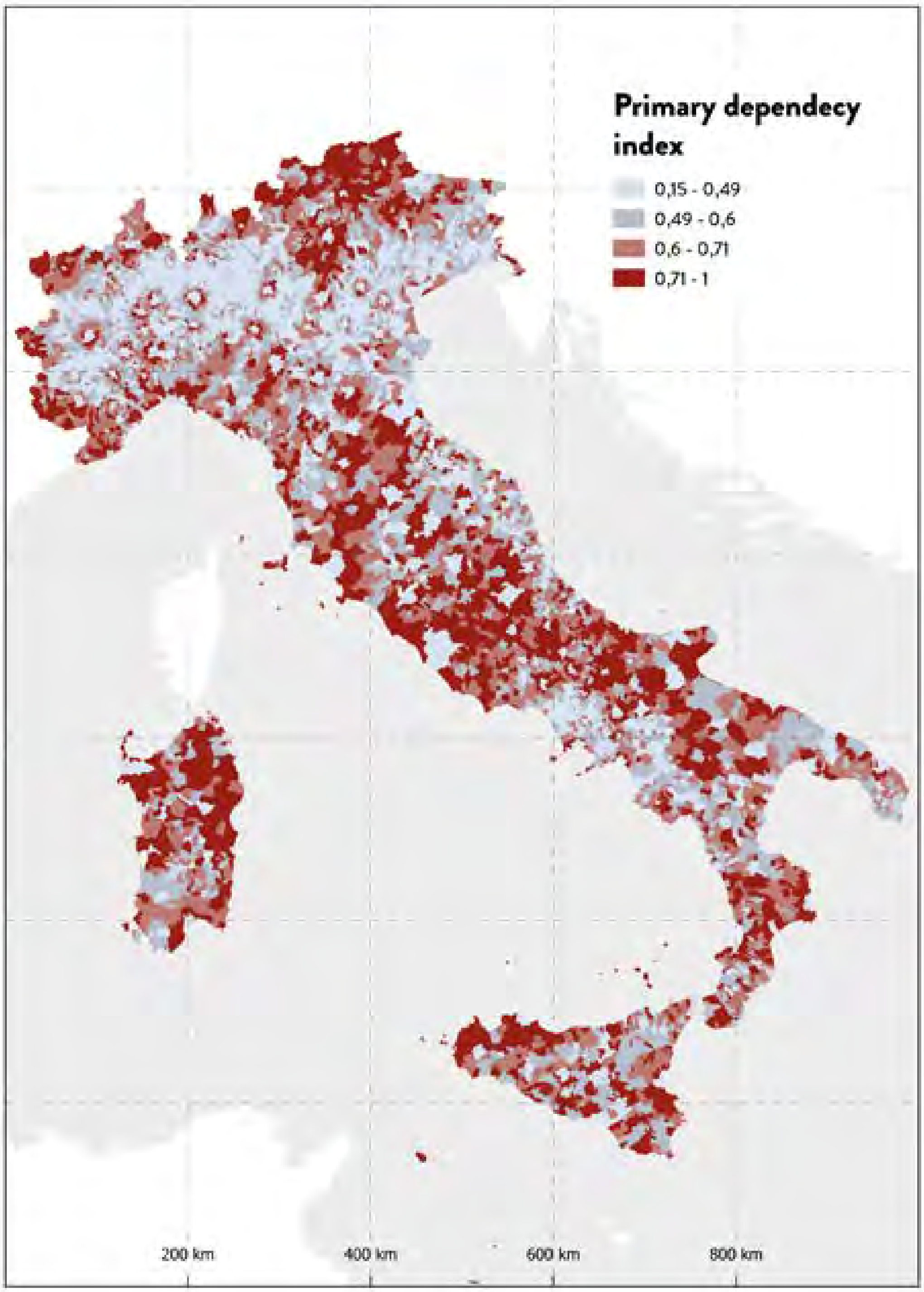


Fig. 27
Map of Italy by primary dependency index

or the first attractor, so it remains theoretically possible, although totally unlikely, that a small, highly dependent municipality nearby with a large attractor pole is not attracted to it.

Coming back to the meaning of the indicator, the municipalities in gray shade are those with the first three least prevalent destinations and therefore, presumably, with the most dispersed destinations compared to the rest of the municipalities. Interesting how, maintaining the same classification, most of the municipalities of the Po Valley are not so attracted by one or three predominant poles, until these are in sufficient physical proximity, while those territories that we municipality define as "inner", for example the Apennines shaft, are in reality very dependent on one to three poles.

It must be repeated that with this indicator we are not able to evaluate these various possible situations:

- The first attractor is predominant.
- The first and second attractors are predominant.
- All three attractors are equally dominant.

This limit will be partly exceeded by the following indicators.

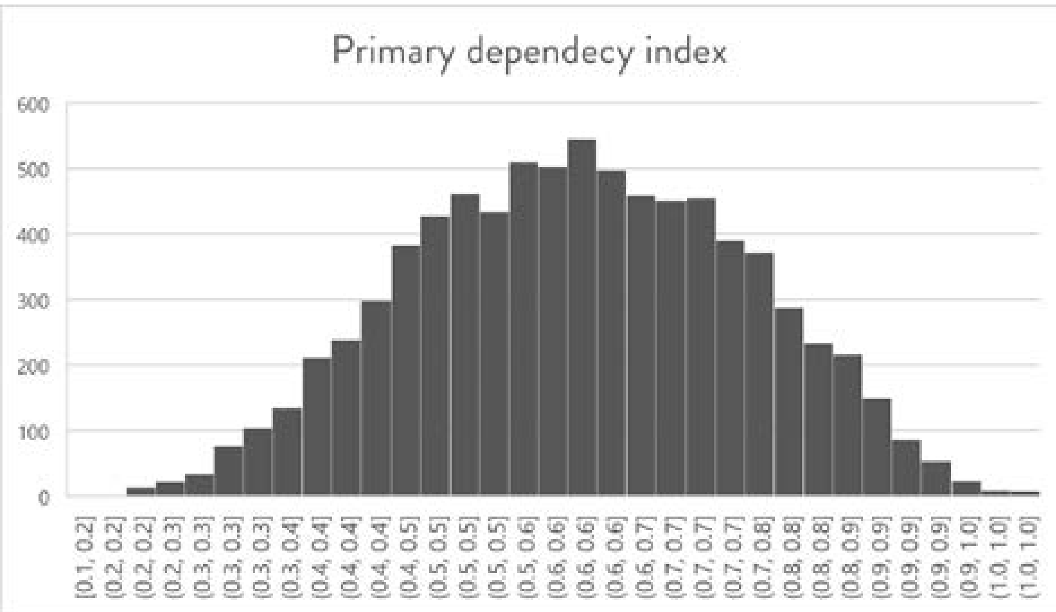


Fig. 28 Primary dependency index distribution

The comparison with GRINS is quite clear. We have an index value that increases as we move towards inner Italy. In fact, metropolitan Italy is polarized between the poles, with the lowest values, and the metropolitan areas, with the highest values, as the areas are most dependent on the poles themselves. If this is not surprising, it is interesting to note how, beyond the poles, the most "dispersed" and least dependent relationships are found precisely in *Italia di Mezzo*, with the exception of class 2.1.1.1 and that instead, the inner areas have on average a very concentrated mobility towards a few prevalent destinations and not dispersed, as one might intuitively think.

PRIMARY DEPENDENCY INDEX		
GRINS Classification	Average	Std. Deviation
INNER ITALY	**0.6384**	**0.1310**
1.1.1 - Sparsely populated remote internal	0.6476	0.1275
1.1.2 - Medium population density remote internal	0.5507	0.1246
1.2.1 - Sparsely populated close internal	0.6459	0.1295
1.1.2 - Medium population density close internal	0.6567	0.1476
MIDDLE ITALY	**0.5870**	**0.1479**
2.1.1.1 - Sparsely populated urban-rural mountain/inland hill continuum	0.6368	0.1341
2.1.1.2 - Urban-rural mountain/inland hill continuum with medium population density	0.5374	0.1545
2.1.2.1 - Sparsely populated coastal and/or lowland urban-rural continuum	0.5699	0.1347
2.1.2.2 - Coastal and/or plain urban-rural continuum with medium population density	0.5511	0.1538
2.2 - Non-FUA capital or medium-sized city	0.4362	0.1326
2.3 - Metropolitan fringe de facto or de jure	0.5724	0.1432
METROPOLITAN ITALY	**0.6386**	**0.1618**
3.1 - De facto metropolitan pole	0.3168	0.1331
3.2.1 - Metropolitan area de jure and de facto (not capital)	0.6526	0.1491
3.2.2 - Metropolitan capital	0.2496	0.1160
Total	**0.5995**	**0.1479**

Fig. 29 Primary dependency index related to GRINS classes

The comparison with the SNAI classification is more linear. In this case we find values that increase together with the degree of peripherality of the municipalities, so that the poles present the lowest values and the peripheral municipalities the highest values

PRIMARY DEPENDENCY INDEX		
SNAI Classification	Average	Std. Deviation
CENTERS	**0.5718**	**0.1515**
A - Poles	0.4371	0.1345
B - Intermunicipal poles	0.5626	0.1330
C - Belt	0.5804	0.1492
AREE INTERNE	**0.6253**	**0.1380**
D - Intermediate	0.6081	0.1408
E - Peripheral	0.6455	0.1303
F - Ultraperipheral	0.6577	0.1345
Total	**0.5995**	**0.1471**

Fig. 30 Primary dependency index related to SNAI classes

Secondary dependency index

The secondary dependence index tries to solve the possible bias coming from the weight of the first attractor and tries to distinguish the three ambiguity situations indicated above. In fact, only the second and third attractors are considered:

$$I_{DEP2} = \frac{Flow_{A_2} + Flow_{A_3}}{Total\ outgoing\ flows}$$

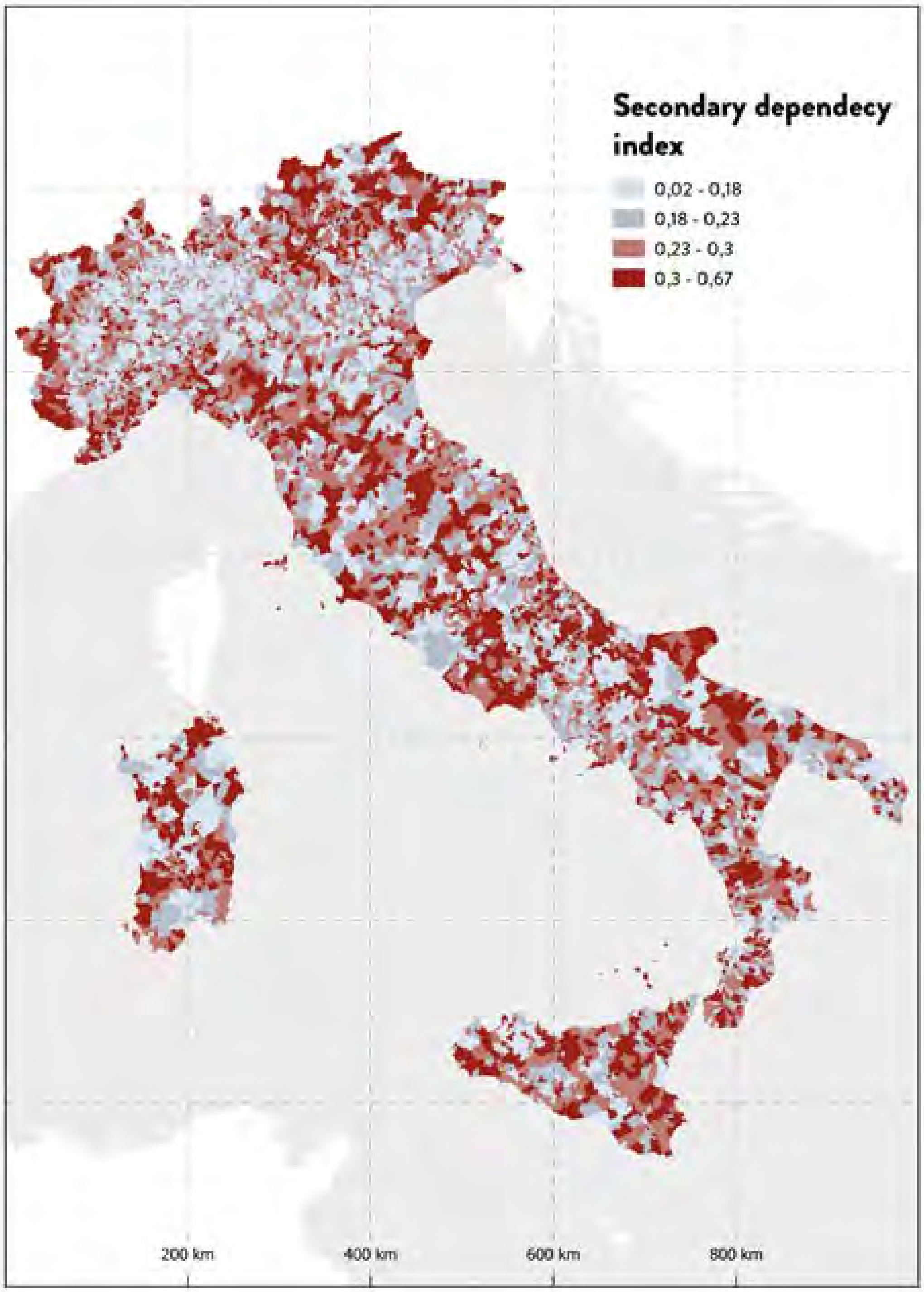


Fig. 31 Map of Italy by secondary dependency index

With again:

$Flow_{A_2} > Flow_{A_3}$

In this case, if this index was relatively low, we would find ourselves in a situation of double ambiguity:

- It could be a municipality strongly attracted by its first attractor.
- It could be a municipality with a distribution of destinations tending towards uniformity.

But, if this index was relatively high, we would necessarily find ourselves in the situation in which the first three attractors tend towards equilibrium, since, by construction:

$Flow_{A_1} > Flow_{A_2} > Flow_{A_3}$

And if the second and third are relatively high, the first must be greater than or equal to the second, therefore equally high.

The result highlights the two possible situations indicated above. On the one hand we have the territories with a low index; these are the metropolitan areas closest to the respective attractor center, since they will have a preponderant value of the first attractor compared to the rest of the attractors, including the second and third. Situations with a low index can also be a symptom of an increasingly high standardization of the attractors, with the consequence that all the values are very small.

On the contrary, high values of the indicator are a symptom of an increasingly greater balance between the first three attractors. This describes generally multipolar relationships, i.e. those municipalities which are attracted exclusively by the first three attractors but which none of the three tends to prevail.

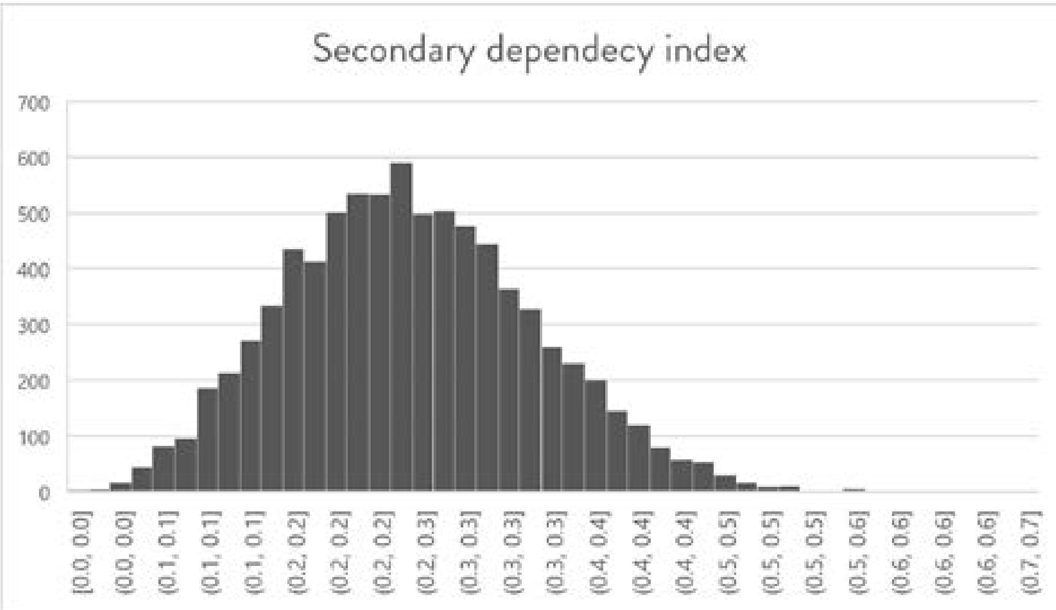


Fig. 32 Secondary dependency index distribution

The limits of this indicator have already been clarified and they can be visualized spatially. In fact, if we consider relatively low values, this describes at least two macro categories of municipalities. On the one hand, the municipalities strongly attracted by their first attractor, so much so that the second and third become irrelevant, on the other, the municipalities with equally distributed attractors, so much so that the second and third are low like all the others.

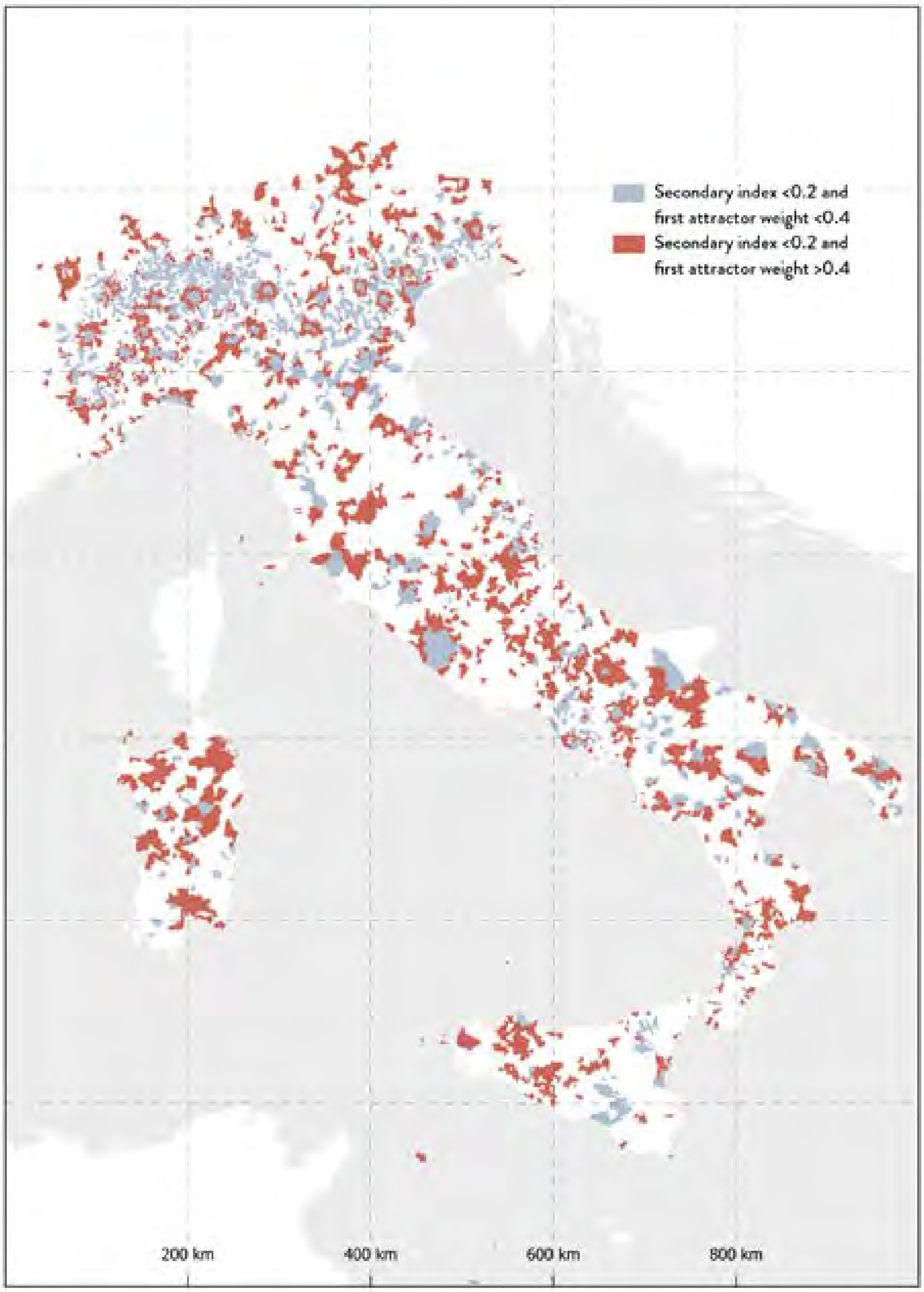


Fig. 33 Extreme cases of municipalities with low secondary dependency index

The comparison with GRINS offers an apparently linear picture, with the indicator gradually increasing as one moves from metropolitan areas to inner areas. Added to this is a certain homogeneity regarding *Italia di Mezzo*, although the differences between the classes are actually not very relevant for a value that we know takes on values between 0 and approximately 0.5. Furthermore, the standard deviations are all high on average.

SECONDARY DEPENDENCY INDEX		
GRINS Classification	Average	Std. Deviation
INNER ITALY	**0.2770**	**0.0864**
1.1.1 - Sparsely populated remote internal	0.2777	0.0885
1.1.2 - Medium population density remote internal	0.2489	0.0703
1.2.1 - Sparsely populated close internal	0.2933	0.0783
1.1.2 - Medium population density close internal	0.2767	0.0972
MIDDLE ITALY	**0.2324**	**0.0836**
2.1.1.1 - Sparsely populated urban-rural mountain/inland hill continuum	0.2458	0.0885
2.1.1.2 - Urban-rural mountain/inland hill continuum with medium population density	0.2135	0.0756
2.1.2.1 - Sparsely populated coastal and/or lowland urban-rural continuum	0.2252	0.0775
2.1.2.2 - Coastal and/or plain urban-rural continuum with medium population density	0.2237	0.0798
2.2 - Non-FUA capital or medium-sized city	0.2105	0.0661
2.3 - Metropolitan fringe de facto or de jure	0.2330	0.0832
METROPOLITAN ITALY	**0.2058**	**0.0870**
3.1 - De facto metropolitan pole	0.1497	0.0482
3.2.1 - Metropolitan area de jure and de facto (not capital)	0.2078	0.0879
3.2.2 - Metropolitan capital	0.1741	0.0534
Total	**0.2381**	**0.0864**

Fig. 34 Secondary dependency index related to GRINS classes

Even in the SNAI case we have a rather clear progression towards the peripheral areas, but with a minimal variation and an overall high standard deviation.

SECONDARY DEPENDENCY INDEX		
SNAI Classification	Average	Std. Deviation
CENTERS	**0.2133**	**0.0789**
A - Poles	[illegible]	0.0665
B - Intermunicipal poles	0.2261	0.0790
C - Belt	0.2135	0.0795
AREE INTERNE	**0.2632**	**0.0860**
D - Intermediate	0.2545	0.0839
E - Peripheral	0.2728	0.0872
F - Ultraperipheral	0.2834	0.0883
Total	**0.2391**	**0.0863**

Fig. 35 Secondary dependency index related to SNAI classes

Destinations concentration index

The destinations concentration index tries to overcome the limits of the first two indicators and to do so it takes into account all the attractors of each municipality, calculating a Herfindahl-Hirschman concentration index:

$$HHI_D = \sum_0^n {q_{A_i}}^2$$

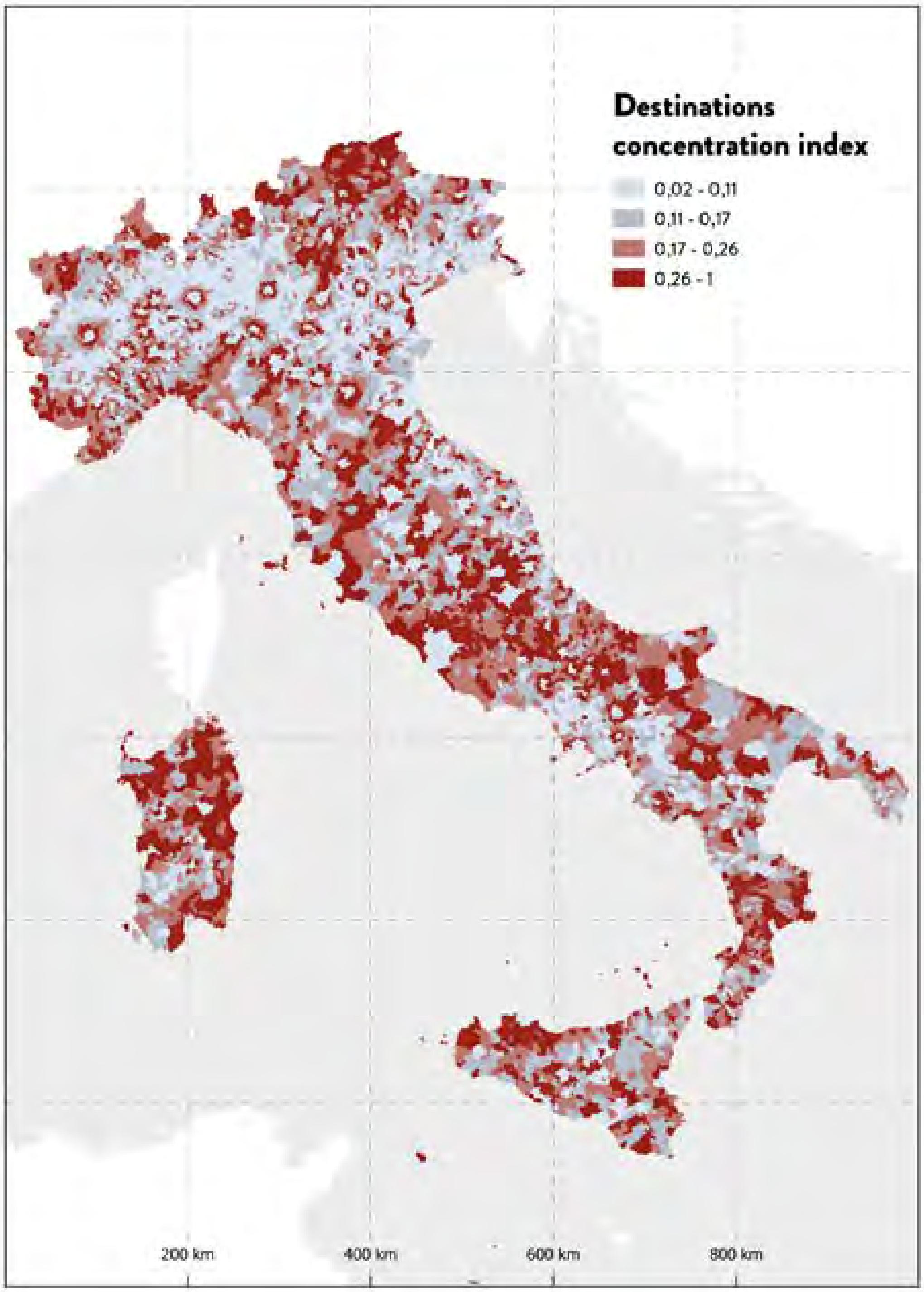


Fig. 36
Map of Italy by destinations concentration index

where:

$$q_{A_i} = \frac{Outgoing\ flow\ towards\ A_i}{Total\ outgoing\ flows}$$

Considering all the attractors, it is easier to interpret the indicator values. High values will indicate that the flows are relatively concentrated towards one or a few attractors, since these weigh more than the others, while lower values will be the result of a relative standardization of the outgoing flows which, by construction of the indicator, represent smaller shares overall.

The objective is to highlight, net of the position occupied by the attractors of a municipality, how much it is globally dependent on other municipalities and how much its relationships are spread across a multitude of different municipalities.

The figure obtained from the indicator once again highlights the poles, i.e. those municipalities with a low concentration surrounded by municipalities with a high concentration.

We then find other situations with a low concentration of destinations, such as Caserta and the lower Apennines, the Marche, or the more evident Po Valley region to the north, especially northern Milan and Brianza, the Cuneo area and between Veneto and Friuli. It can therefore be intuitively stated that these territories tend to have relationships that range from multipolar to almost equally distributed.

There are some limitations in this indicator, perhaps including the fact that it does not consider which and how many OD relationships have a greater weight on the others, but only whether these exist or not. In fact we are losing that detail that the first two indicators could offer us, but we are expanding the sample of attractors to the total, so

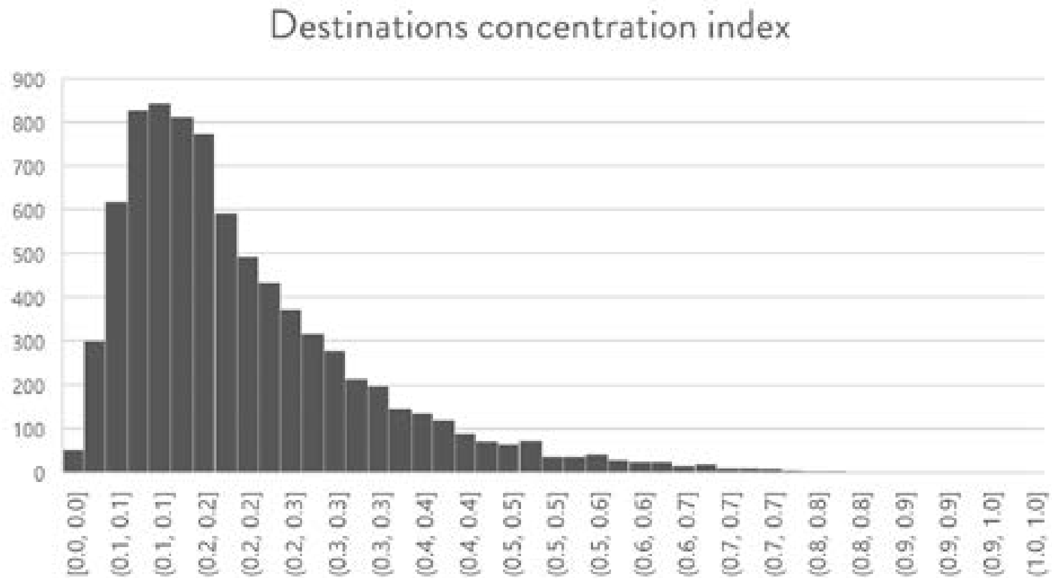


Fig. 37 Destinations concentration index distribution

as to have a more consistent and in a certain sense complete and precise picture and indicator.

Another very important limitation is that the indicator is rather sensitive to the number of OD relationships established, a value which on average tends to increase as the rank of the municipality increases.

The comparison with GRINS highlights some clear differences. First of all, we note the distinct presence of the poles, which show the lowest values, while on the contrary the highest values are recorded by the metropolitan areas, which suffer the strong attraction of their respective poles. In this sense, the macro-class of Metropolitan Italy is not well described by this indicator, precisely because it hosts both the municipalities with the lowest values and those with the highest values. Interestingly, *Italia di Mezzo* has the lowest values, after the poles, indicating a generalized propensity to travel with little dependency. In inner Italy we return to higher values, a symptom of the fact that the most remote and small municipalities have a high degree of attraction towards relevant poles. However, it is interesting to disprove a possible previous intuition, namely that movements in inner areas are generally few and scattered. They are obviously few, but on average they are directed towards small municipalities that we would not consider poles at the national scale, but they become relevant for the inhabitants of the inner territories.

DESTINATIONS CONCENTRATION INDEX		
GRINS Classification	Average	Std. Deviation
INNER ITALY	**0.2121**	**0.1122**
1.1.1 - Sparsely populated remote internal	0.2190	0.1141
1.1.2 - Medium population density remote internal	0.1561	0.0773
1.2.1 - Sparsely populated close internal	0.2094	0.1065
1.1.2 - Medium population density close internal	0.2305	0.1364
MIDDLE ITALY	**0.1974**	**0.1267**
2.1.1.1 - Sparsely populated urban-rural mountain/inland hill continuum	0.2290	0.1327
2.1.1.2 - Urban-rural mountain/inland hill continuum with medium population density	0.1724	0.1236
2.1.2.1 - Sparsely populated coastal and/or lowland urban-rural continuum	0.1863	0.1202
2.1.2.2 - Coastal and/or plain urban-rural continuum with medium population density	0.1755	0.1212
2.2 - Non-FUA capital or medium-sized city	0.1031	0.0632
2.3 - Metropolitan fringe de facto or de jure	0.1820	0.1115
METROPOLITAN ITALY	**0.2540**	**0.1558**
3.1 - De facto metropolitan pole	0.0678	0.0507
3.2.1 - Metropolitan area de jure and de facto (not capital)	0.2626	0.1539
3.2.2 - Metropolitan capital	0.0720	0.0393
Total	**0.2040**	**0.1275**

Fig. 38 Destinations concentration index related to GRINS classes

The comparison with SNAI only confirms the suggestions already offered in the first case. We find less differentiation between the values, especially regarding the belt areas, like the peripheral areas. The poles are once again separated in a more evident way.

DESTINATIONS CONCENTRATION INDEX		
SNAI Classification	Average	Std. Deviation
CENTERS	**0.1963**	**0.1316**
A - Poles	0.1004	0.0709
B - Intermunicipal poles	0.1793	0.1137
C - Belt	0.2023	0.1331
AREE INTERNE	**0.2096**	**0.1209**
D - Intermediate	0.2010	0.1229
E - Peripheral	0.2201	0.1170
F - Ultraperipheral	0.2341	0.1201
Total	**0.2032**	**0.1264**

Fig. 39 Destinations concentration index related to SNAI classes

Origins concentration index

The origins concentration index follows the same logic of the previous index, but it invert the point of view. We don't consider the outgoing flows in this case, but the incoming ones, in the form:

$$HHI_O = \sum_0^n {s_{A_i}}^2$$

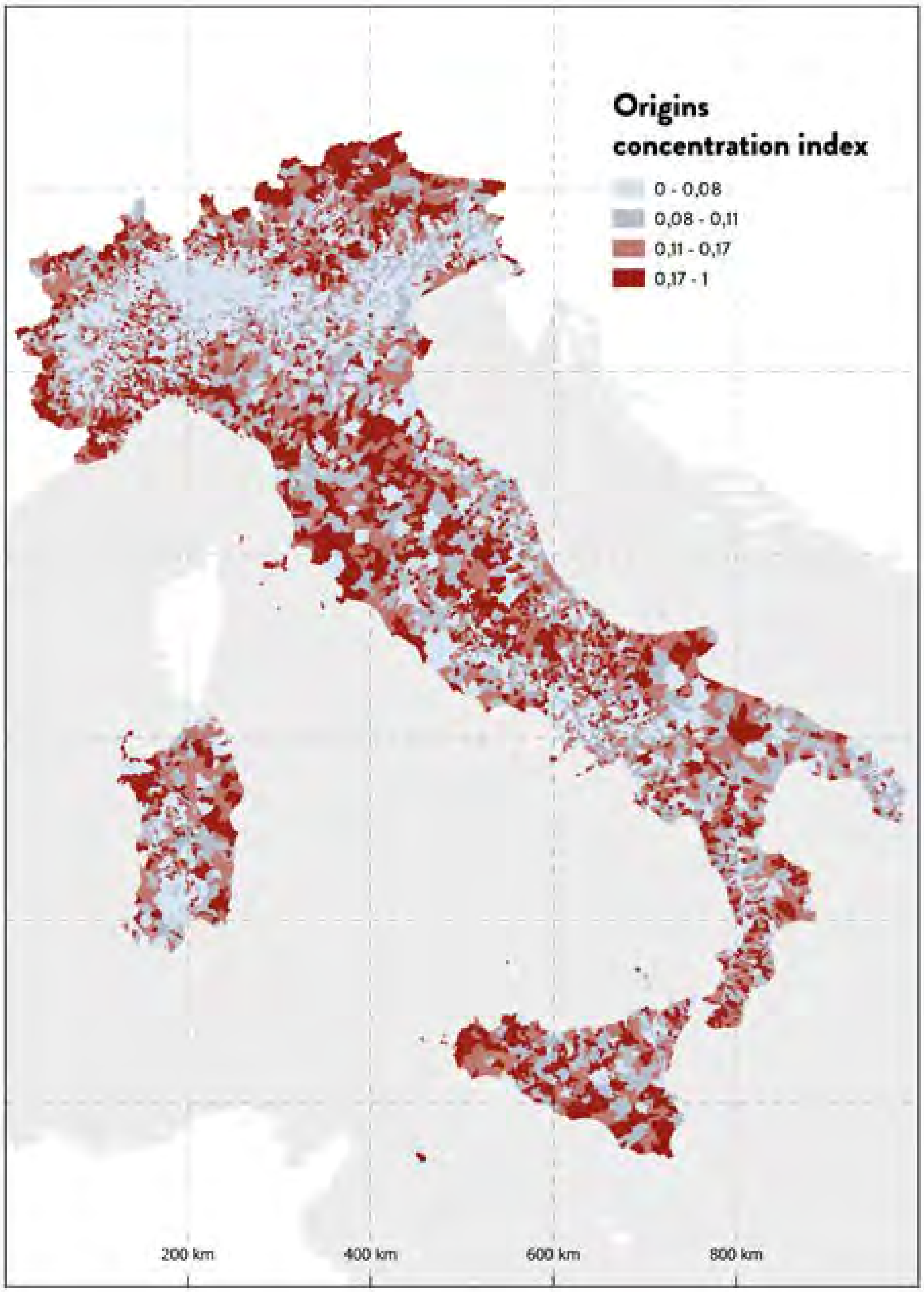


Fig. 40
Map of Italy by origins concentration index

where

$$s_{A_i} = \frac{Incoming\ flow\ from\ A_i}{Total\ incoming\ flows}$$

By inverting the point of view, we obtain a figure that is partly similar but also very different.

On the one hand, in fact, we find the poles, which have both a low concentration index of destinations and origins, therefore they are always represented in light blue. Especially in this case we have almost no doubt that a pole has a low value. While in the case of destinations it was possible that a pole was attracted in particular by another municipality pole or non-pole municipality, if we consider the origins we necessarily expect a low value, since, being a pole, it will attract flows from many municipality in a generally distributed manner.

Once again, the Po Valley area, especially the Milanese conurbation, is the place where we find the lowest values. On the one hand the first belt municipalities attract in a dispersed way, on the other we find territories that are naturally dispersed both in origin and in destination, such as northern Milan and Brianza.

Some poles are clearly visible, especially in the Po Valley area, others less since their belts do not have particularly high values. We can intuitively think that the highest values are to be attributed to all those municipalities with very concentrated incoming relations, coming from a few other municipalities or from a specific municipality.

Some important mathematical limitations coincide with that of the destinations indicator version.

In this case it must be added that the indicator is certainly less descriptive than the

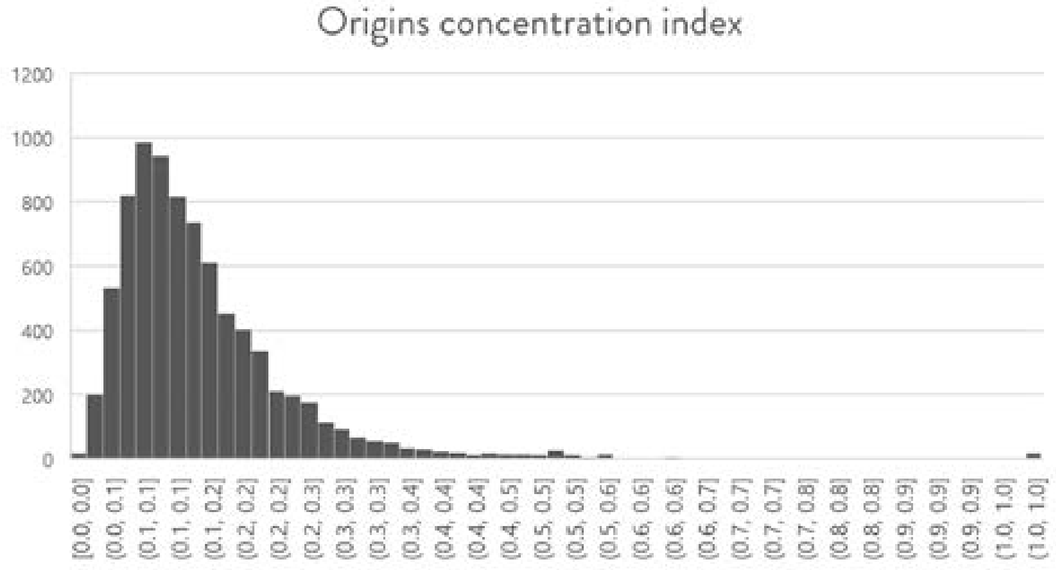


Fig. 41 Origins concentration index distribution

previous one, as it tends to standardize classes of municipalities that are even very different from each other and does not restore at a geographical level that precise distinction between poles and belts, that was instead appreciated before.

However, it is a very useful indicator in case we want to isolate the poles or the areas with dispersed relationships both incoming and outgoing.

The GRINS classes seem much more sensitive to the indicator than the cartographic representation. The poles are evidently those that present the lowest values, a result that is not surprising, while the metropolitan areas present rather varied cases, so much so that the overall value is surprisingly low. The variation is rather linear, therefore the inner areas present the highest values and *Italia di Mezzo* the intermediate values.

ORIGINS CONCENTRATION INDEX		
GRINS Classification	Average	Std. Deviation
INNER ITALY	**0.1759**	**0.1218**
1.1.1 - Sparsely populated remote internal	0.1826	0.1269
1.1.2 - Medium population density remote internal	0.1280	0.0797
1.2.1 - Sparsely populated close internal	0.1740	0.1119
1.1.2 - Medium population density close internal	0.1649	0.1052
MIDDLE ITALY	**0.1284**	**0.0868**
2.1.1.1 - Sparsely populated urban-rural mountain/inland hill continuum	0.1568	0.0999
2.1.1.2 - Urban-rural mountain/inland hill continuum with medium population density	0.1018	0.0610
2.1.2.1 - Sparsely populated coastal and/or lowland urban-rural continuum	0.1211	0.0732
2.1.2.2 - Coastal and/or plain urban-rural continuum with medium population density	0.1098	0.0747
2.2 - Non-FUA capital or medium-sized city	0.0607	0.0408
2.3 - Metropolitan fringe de facto or de jure	0.1129	0.0764
METROPOLITAN ITALY	**0.1065**	**0.0724**
3.1 - De facto metropolitan pole	0.0323	0.0174
3.2.1 - Metropolitan area de jure and de facto (not capital)	0.1100	0.0721
3.2.2 - Metropolitan capital	0.0321	0.0160
Total	**0.1350**	**0.0948**

Fig. 42 Origins concentration index related to GRINS classes

The comparison with SNAI only confirms the suggestions already offered in the first case. We find less differentiation between the values, especially regarding the belt areas, like the peripheral areas. The poles are once again separated in a more evident way.

ORIGINS CONCENTRATION INDEX		
SNAI Classification	Average	Std. Deviation
CENTERS	**0.1113**	**0.0738**
A - Poles	0.0640	0.0450
B - Intermunicipal poles	0.1016	0.0630
C - Belt	0.1145	0.0746
AREE INTERNE	**0.1583**	**0.1068**
D - Intermediate	0.1449	0.0947
E - Peripheral	0.1759	0.1213
F - Ultraperipheral	0.1748	0.1028
Total	**0.1356**	**0.0953**

Fig. 43 Origins concentration index related to SNAI classes

Demographic imbalance index

This last dependency index tries to answer one last research question, namely what is the weight ratio between a municipality and its attractors. To quantify this possibility, we compare the population of each municipality with that of its first attractor:

$$I_{DEM} = \frac{P}{P_{A_1}}$$

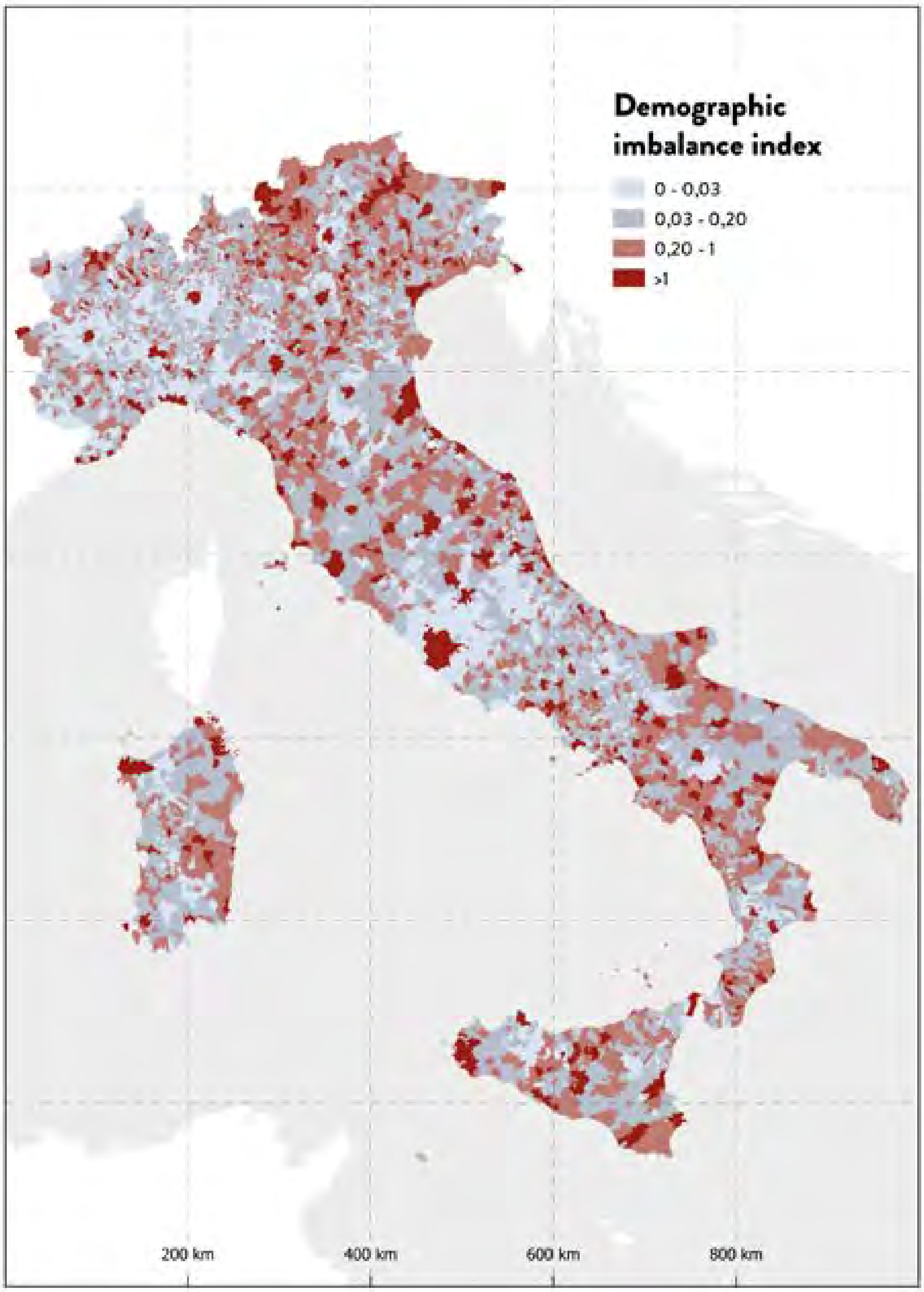


Fig. 44
Map of Italy by demographic imbalance index

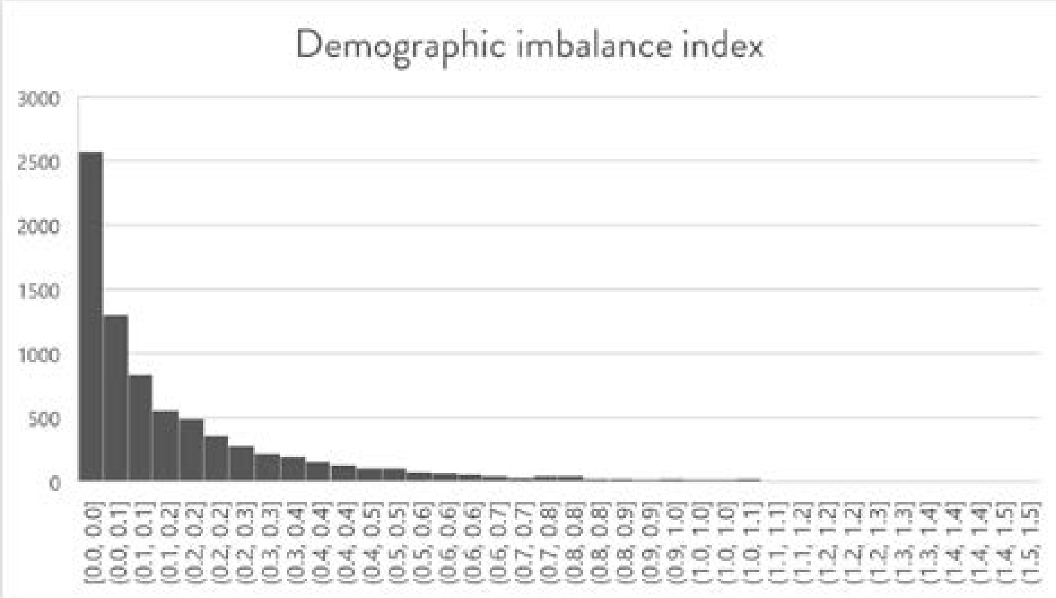


Fig. 45 Demographic imbalance index distribution

In fact, we could intuitively state that the middle territories are generally characterized not only by multi-pole or scattered relationships, but also between municipalities of similar rank. Instead, we expect to find very low values for all those municipalities that are attracted by municipalities that are much more populous than them and on the contrary very high values for the poles, which we expect to be attracted by municipalities that are less populous than them.

Some hypotheses are confirmed and others partially denied. On the one hand, we can highlight the poles, those situations in which the indicator takes on values >1, which represents a municipality larger than its first attractor, a typical situation of large metropolitan centers relatively isolated from other centres. On the contrary, the lowest values are taking on all municipalities attracted by centers much larger than them, a typical case of the metropolitan belts of large cities, such as Rome, Milan or Turin. However, not all attracting centers manage to exceed the value of 1. The case of the Via Emilia axis is interesting, because the strong proximity of the centers causes them to attract each other, thus giving rise to an auction of OD relations between poles of equal degree.

In the middle situations vary greatly. Veneto seems to show limited imbalances, with some evident poles but which, being relatively smaller in size, present basins that are not so less populous than them. The Cuneo area is always evident and above all the Po Valley area which, with the exception of some large basins such as Milan, Brescia or Verona, presents a dust of relationships between municipalities of the same level.

The possible correlation with GRINS is difficult to read, as it is decidedly spoiled by some relatively very high dispersions of values, especially in the case of the poles. In this situation, the variability in the number of inhabitants between the various poles is such as to make the average value substantially irrelevant. It is clear that higher values are expected for the poles but, for example, the value of the metropolitan capitals is certainly spoiled by the first Italian municipalities by population; you might expect something more similar to the other types of polo shirts.

Interestingly, the inner areas are the "medium areas" of this classification. These are attracted to poles of a not much higher rank. However, it must be highlighted that as one moves down in rank, the imbalances between municipalities become smaller and this effect is certainly present, even if not visible, in the indicator.

Polarized situation in *Italia di Mezzo*, with the metropolitan fringes and sparsely populated continuums presenting values comparable to each other and instead the medium density areas with values like the inner areas.

DEMOGRAPHIC IMBALANCE INDEX		
GRINS Classification	**Average**	**Std. Deviation**
INNER ITALY	**0.3255**	**0.5198**
1.1.1 - Sparsely populated remote internal	0.2896	0.3944
1.1.2 - Medium population density remote internal	0.7002	0.8828
1.2.1 - Sparsely populated close internal	0.2490	0.6822
1.1.2 - Medium population density close internal	0.4085	0.4547
MIDDLE ITALY	**0.2466**	**1.0165**
2.1.1.1 - Sparsely populated urban-rural mountain/inland hill continuum	0.1384	0.2461
2.1.1.2 - Urban-rural mountain/inland hill continuum with medium population density	0.3163	0.6281
2.1.2.1 - Sparsely populated coastal and/or lowland urban-rural continuum	0.1303	0.1925
2.1.2.2 - Coastal and/or plain urban-rural continuum with medium population density	0.3433	0.5176
2.2 - Non-FUA capital or medium-sized city	3.7973	6.7362
2.3 - Metropolitan fringe de facto or de jure	0.1437	0.2909
METROPOLITAN ITALY	**0.4480**	**2.9126**
3.1 - De facto metropolitan pole	3.8209	6.1561
3.2.1 - Metropolitan area de jure and de facto (not capital)	0.0512	0.1166
3.2.2 - Metropolitan capital	13.0463	12.2457
Total	**0.2747**	**1.2016**

Fig. 46 Demographic imbalance index related to GRINS classes

Similar situation for SNAI, with the poles having a high average, but a very high dispersion. Obviously belts and intermediates are the territories with the most unbalanced relationships.

DEMOGRAPHIC IMBALANCE INDEX		
SNAI Classification	**Average**	**Std. Deviation**
CENTERS	**0.3084**	**1.6384**
A - Poles	3.1971	6.2889
B - Intermunicipal poles	0.3618	0.5813
C - Belt	0.1413	0.2350
AREE INTERNE	**0.2383**	**0.4275**
D - Intermediate	0.1974	0.3776
E - Peripheral	0.2718	0.4584
F - Ultraperipheral	0.3885	0.5639
Total	**0.2722**	**1.1796**

Fig. 47 Demographic imbalance index related to SNAI classes

2.3.3 Geographical indexes

So far, some quantities relating to the OD matrix have been considered. In particular, we first considered the flows in an absolute manner and then how these flows create dependency relationships between the various municipalities. The gaze has always been analytical and statistical, while the geographical representation has always been the result of these operations, rather than the starting point.

However, if we begin to consider the physical and spatial reality of these movements, our point of view is forced to change. In order to more precisely evaluate the nature of these OD flows, a further element of complexity can be added. While we were able to estimate the dispersion of destinations with the HHI indicator, this is not able to actually tell us where these flows are directed.

For example, if we take as a reference two municipalities with a destination HHI index of less than 0.08, we would be led to think that their destinations are equally distributed. In a sense this is true; both have a high number of destinations and are rather distributed between them. However, what the indicator is not able to capture is the predominant direction of these flows. In the case of Ariano Irpino the predominance of flows towards the south/southwest is evident, while in the case of Reggio Emilia the flows cover almost every possible main direction.

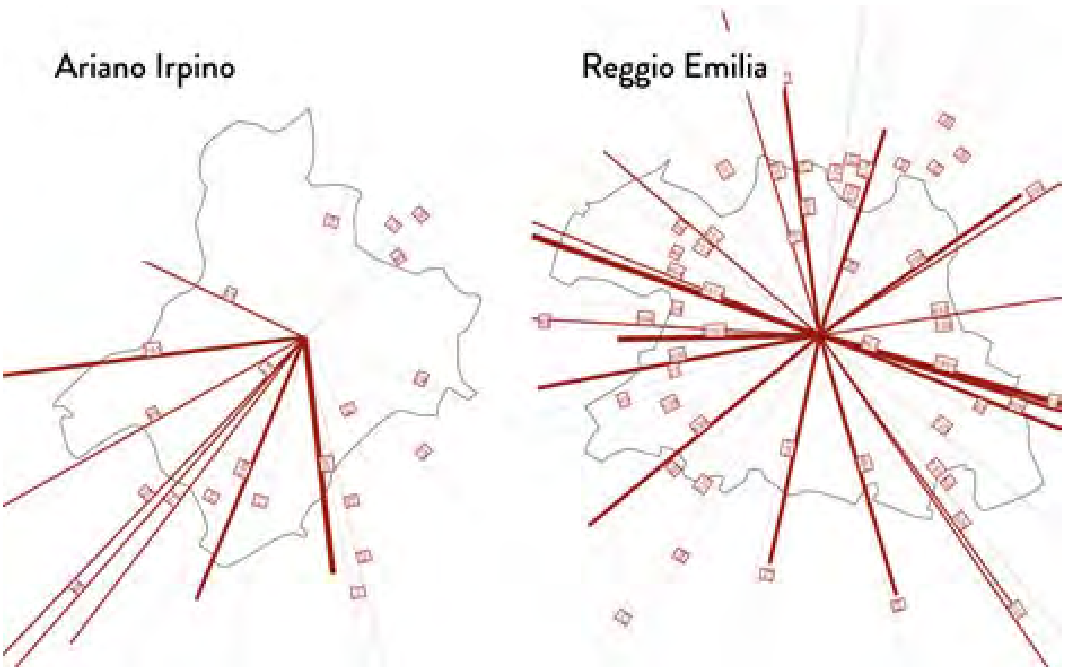


Fig. 48
Low HHI index but different directions of flows

It is important to grasp these differences, as they allow us to know whether the demand for outgoing mobility is directed towards a rather defined direction or whether, on the contrary, it is distributed equally towards several different directions. It is a question not only of redefining the different "Italies" based on this new category, but it's also a first attempt to define possible planning indications, that is, of the ways in which we can intercept mobility requests tending towards monodirectionality or, on the contrary, tending towards dispersion.

Monodirectionality index

We must therefore build a synthetic and consistent indicator, which is able to describe to what extent the directions of outgoing flows are concentrated towards a prevailing value or to what extent they tend towards dispersion.

To do this it is necessary to consider the matrix in the form of a multiline, i.e. composed of the vectors that unite the various municipalities based on the OD relations. By convention, the centroid of each municipal geometry was used to construct the lines.

To obtain a reliable measurement that estimates whether these flows are monodirectional, it is necessary to think about the single municipality from which these flows emerge. Intuitively, it is necessary to calculate the dispersion of the various inclinations of

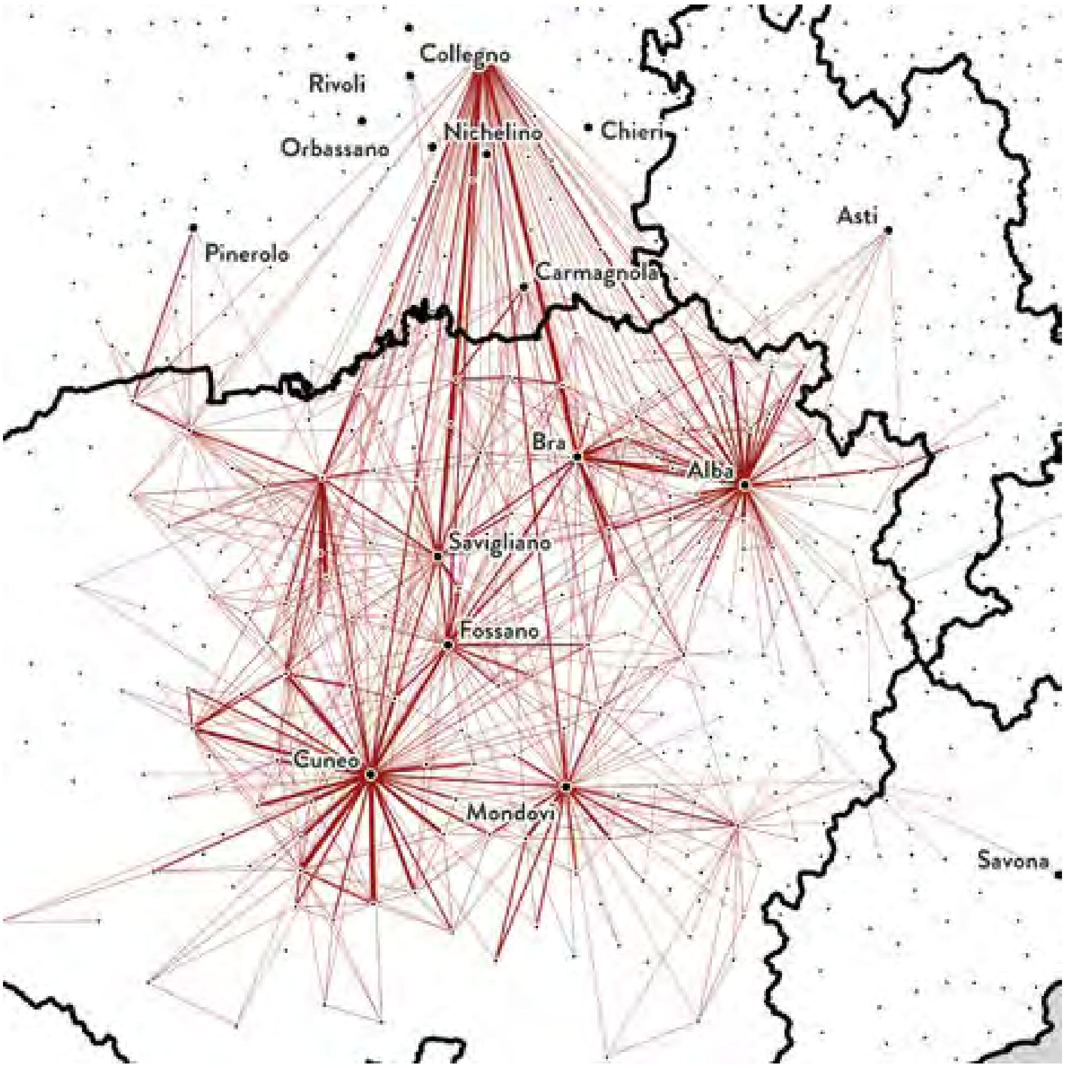


Fig. 49
The OD matrix representation of the flows going out from the Cuneo Province

the flows, so that the lower this dispersion, the greater the monodirectionality of the outgoing flows and vice versa.

When dealing with angles, however, we run into a basic problem that always arises when we come across the field of circular statistics, namely the periodicity of the value of the angles. In fact, we find a clear discrepancy between the geographical reality and the possible measures of statistical dispersion around the defined 0, since, while in reality two angles of 355° and 5° point towards a similar direction, on a statistical level they could not be more different.

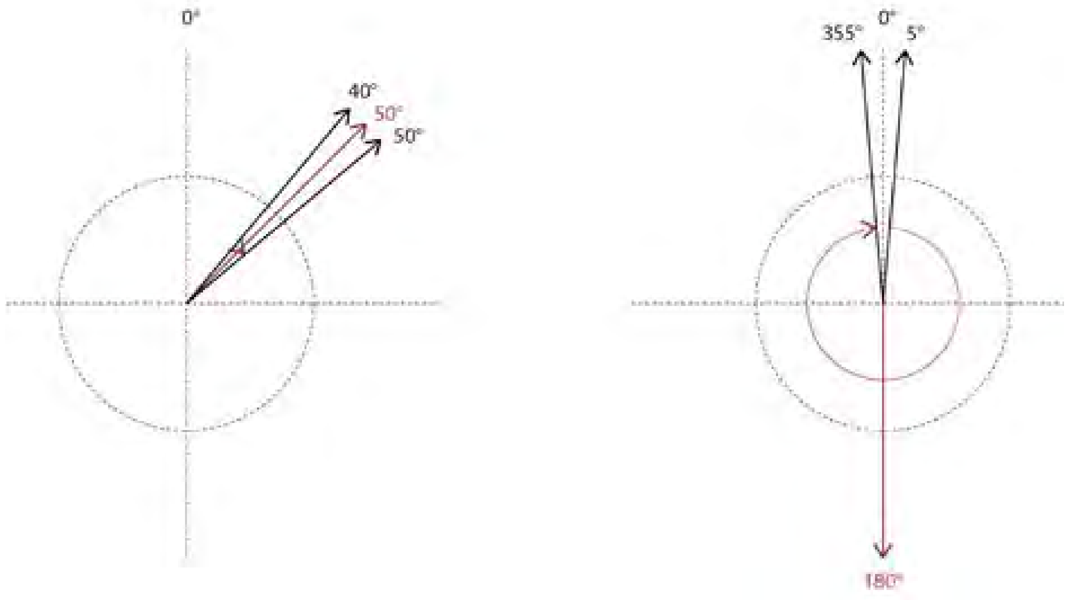


Fig. 50
Issues of circular statistics

This basic error therefore does not allow us to build an indicator starting directly from the angle of the directions. However, what is possible to do without running into the periodicity of the data is to break down the vector into its two x and y dimensions, so to be able to operate statistics on two linear dimensions and on the Cartesian plane.

Now suppose we find ourselves in a typical situation, as shown in the figure, with the directions out of the municipality represented as vectors. We can use these vectors in the same way as they are used to represent forces in physics and therefore use the concept of resultant to construct a global indication of all these "forces" acting on the point.

Intuitively, the greater the length of the resultant, the greater the degree of monodirectionality of the flows of a given municipality. On the contrary, if the resulting arrow were short, it would be a symptom of very different directions that tend to compensate each other.

However, two important corrections need to be made. On the one hand we must

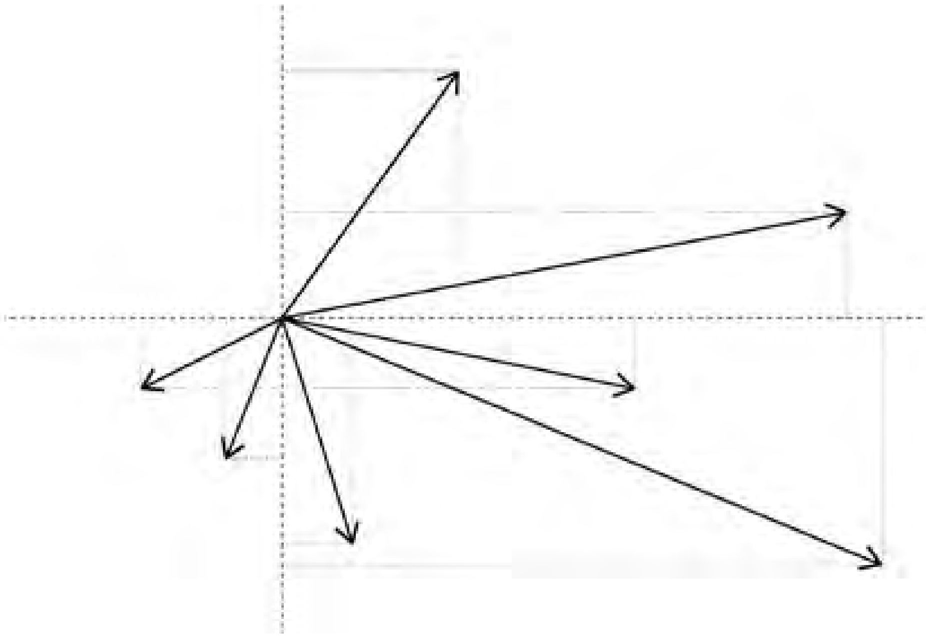


Fig. 51
x and y dimensions representation

consider the weight that these flows represent, defined by the number of trips that cover that OD relationship. We will therefore weigh each carrier with its relative weight in terms of trips on the total trips out of the municipality:

$$p_i = \frac{OD_i\ flow}{Total\ outgoing\ flows}$$

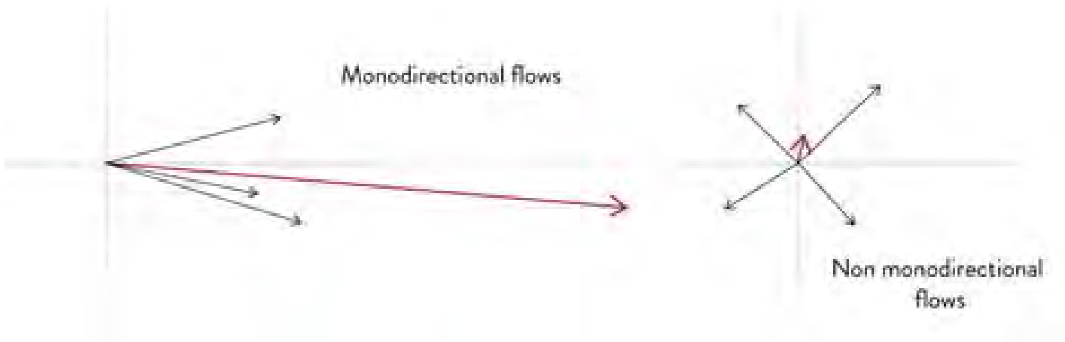


Fig. 52
Resultants of monodirectional flows and viceversa

Secondly, we must avoid that the distance of the movements distorts our result. It might seem counterintuitive, but to build the direction indicator it is necessary not to consider the length of the vectors. In fact, we could find a situation in which, while weighing the vectors, many small but very long vectors with an opposite direction perhaps to two or three main vectors, would create a resultant that is not really describing the reality of the situation.

To correct this distortion, it is necessary to consider a normalized OD matrix, i.e. made up of vectors that have unit length, but maintaining direction.

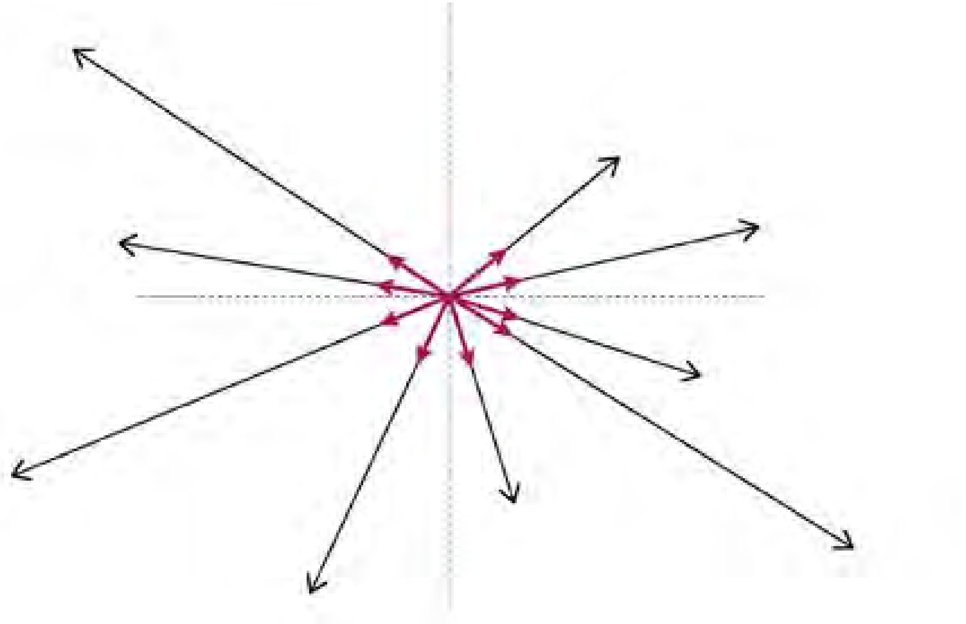


Fig. 53
The normalized outgoing flows

At this point, given all these premises, we can define our new monodirectionality index as the length of the resultant of the normalized outgoing vectors:

$$I_{DIR} = \sqrt{(\sum_0^n p_i cos(\theta))^2 + (\sum_0^n p_i sin(\theta))^2}$$

where:

$$cos(\theta),\ sin(\theta)$$

are the normalized x and y component of each vector respectively.

The indicator by construction would take on values between 0 and √2, but given that the weights are almost never equal to 1 and, even in this case, the vectors are never perfectly horizontal or vertical, in fact it never exceeds the value of 1.

Even if a very clear territorial figure does not emerge, some rather obvious situations can be circumscribed:

- The poles tend to be municipality with a low index, a symptom of the fact that their outgoing flows do not have a prevailing direction, rather they are dispersed.
- The Po Valley area is the territory of dispersed flows par excellence, as we find values which are widespreadly low and which only increase in proximity to the large metropolitan and medium-ranking centres, the only ones capable of attracting the municipalities around them.
- Not all metropolitan areas have the concentric circle pattern with the indicator decreasing as the distance from the metropolitan center increases. While on the one

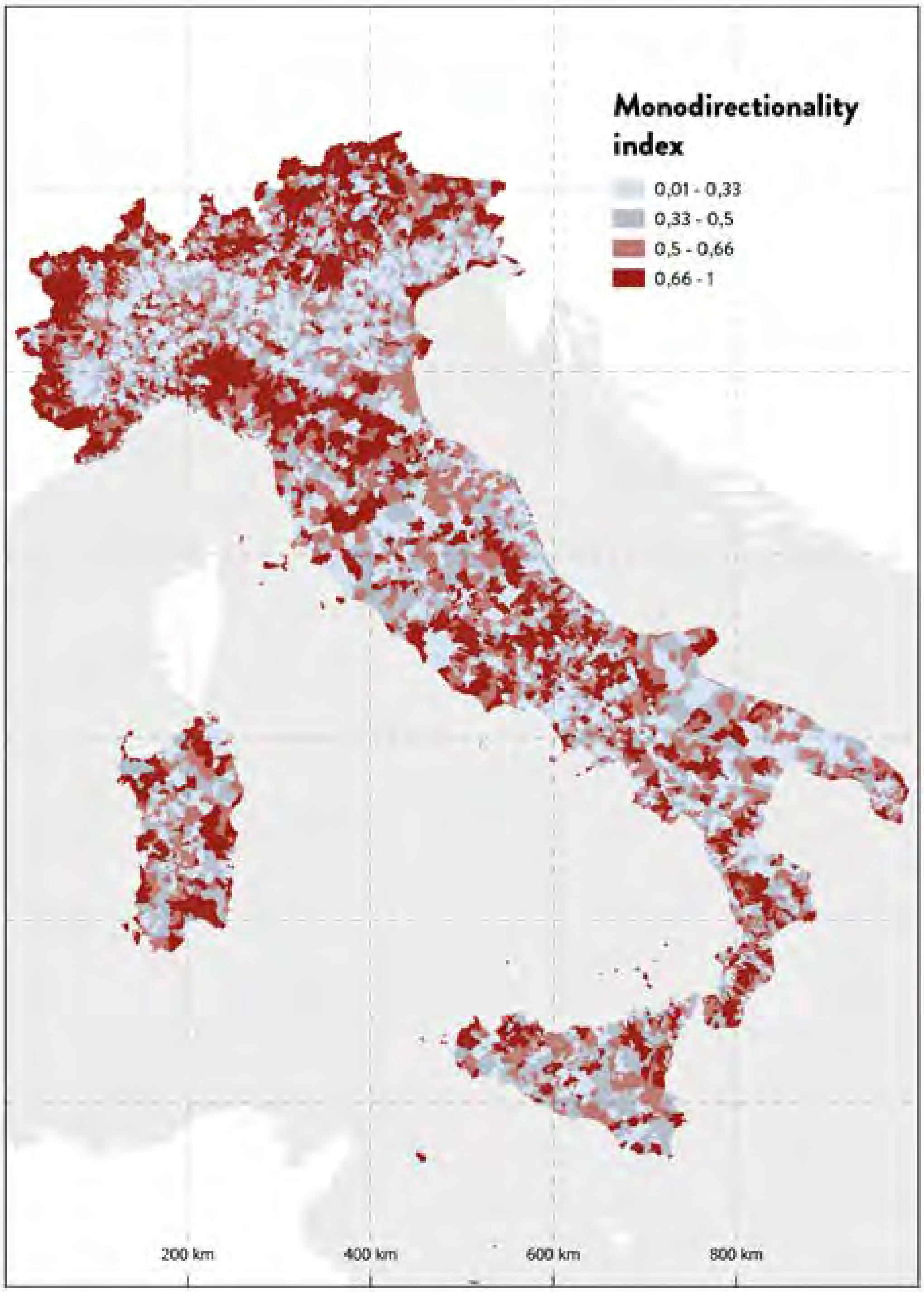


Fig. 54
Map of Italy by monodirectionality index

hand the Roman area seems to behave in this way, Milan attracts the municipalities to the south much more strongly than the northern conurbation and Brianza. Clearly the latter is made up of centers of such rank as to create strong intra-territorial relations, therefore the attraction of Milan is not relatively predominant.

- The inner areas -or the presumed ones- are areas of strong monodirectionality of the flows. This hypothesis had already been suggested by some results of the dependency indexes and finds further confirmation here. Entire macro-areas, such as the Emilian Apennines, fall into the class of highest values, a symptom that their outgoing flows are very oriented towards a single direction.

From some of these comments it can be seen that the indicator alone is able to offer a reasonable interpretative framework but it also risks generating ambiguity. Precisely from the last comment regarding inner areas we can understand how these are very often similar to metropolitan areas, since they often present a strong degree of attraction towards their local pole and therefore we are not able to distinguish them using these indicators.

Another limit is certainly geographical. In fact, since we are dealing with flows that depart from and arrive in Italian municipalities, the very conformation of the peninsula will produce geographical barriers, as in the case of all those municipalities that are located on the northern borders[1] or along the coast, which will see a good part of the directions precluded from upstream and in fact present a higher value on average.

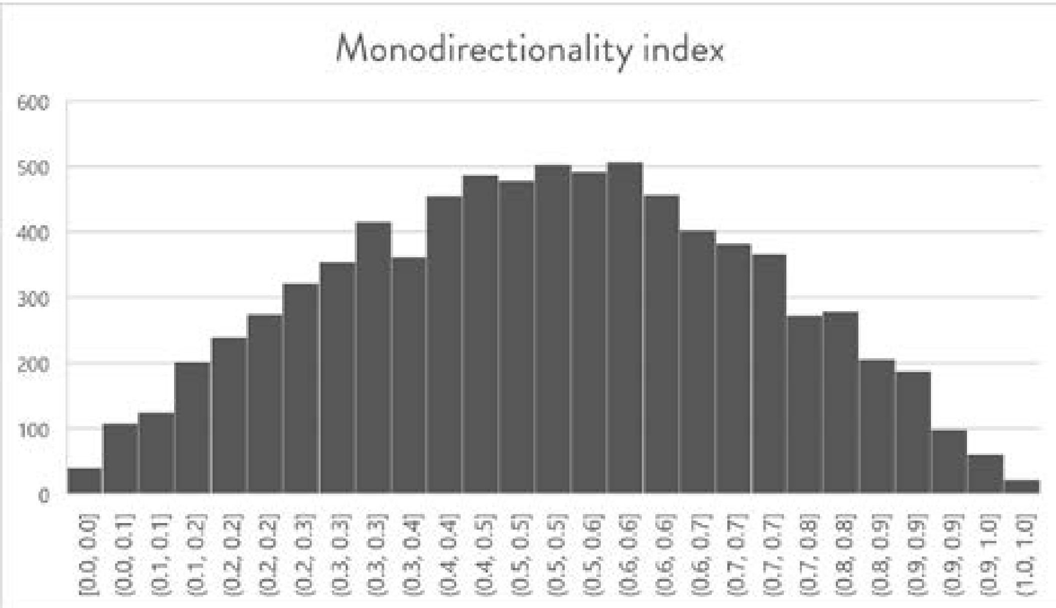


Fig. 55
Monodirectionality index distribution

Finally another limitation, which in a certain sense is precisely the result of an upstream construction choice, is the absence of the distance component. In fact, if this allows us to avoid the "disturbance" produced by excessively long but irrelevant relationships from a quantitative point of view, by doing so we are ignoring the distance people travel to go to their place of study or work. A component which, among other things, could act as a parameter of distinction between the aforementioned metropolitan

1 But this can be potentially exceeded enlarging the analysis area outside Italy

areas and inner areas.

Some interpretations provided by the map are confirmed by comparison with GRINS. The poles are realities with less concentrated flow directions, while the metropolitan areas, the fringes and Inner Italy are those with the highest values, a symptom of a monodirectional trend. *Italia di Mezzo* seems to be comparable in some ways to the poles, presenting widespread low values. This would therefore confirm the hypothesis of *Italia di Mezzo* as the territory of the most widespread and multi-directional relationships and, implicitly, also slightly unbalanced between them, since the indicator would tend to increase otherwise.

MONODIRECTIONALITY INDEX		
GRINS Classification	Average	Std. Deviation
INNER ITALY	**0.5579**	**0.2211**
1.1.1 - Sparsely populated remote internal	0.5682	0.2224
1.1.2 - Medium population density remote internal	0.4758	0.2067
1.2.1 - Sparsely populated close internal	0.5653	0.2159
1.1.2 - Medium population density close internal	0.5153	0.1999
MIDDLE ITALY	**0.4789**	**0.2116**
2.1.1.1 - Sparsely populated urban-rural mountain/inland hill continuum	0.5444	0.2169
2.1.1.2 - Urban-rural mountain/inland hill continuum with medium population density	0.4565	0.2042
2.1.2.1 - Sparsely populated coastal and/or lowland urban-rural continuum	0.4160	0.1901
2.1.2.2 - Coastal and/or plain urban-rural continuum with medium population density	0.3908	0.1893
2.2 - Non-FUA capital or medium-sized city	0.3660	0.1951
2.3 - Metropolitan fringe de facto or de jure	0.4888	0.1911
METROPOLITAN ITALY	**0.5596**	**0.1816**
3.1 - De facto metropolitan pole	0.3595	0.1377
3.2.1 - Metropolitan area de jure and de facto (not capital)	0.5700	0.1751
3.2.2 - Metropolitan capital	0.3954	0.1846
Total	**0.4983**	**0.2139**

Fig. 56 Monodirectionality index related to GRINS classes

A certain concentration of values can also be appreciated from the SNAI classes; the poles have a minor monodirectionality and as the degree of peripherality increases, this increases accordingly.

MONODIRECTIONALITY INDEX		
SNAI Classification	Average	Std. Deviation
CENTERS	**0.4619**	**0.2020**
A - Poles	0.3024	0.1832
B - Intermunicipal poles	0.4415	0.1822
C - Belt	0.4686	0.2022
AREE INTERNE	**0.5330**	**0.2192**
D - Intermediate	0.5172	0.2166
E - Peripheral	0.5546	0.2217
F - Ultraperipheral	0.5471	0.2171
Total	**0.4986**	**0.2140**

Fig. 57 Monodirectionality index related to SNAI classes

Aggregate resultants map

A final elaboration can be developed, especially if we intend to overcome the main limits of the monodirectionality indicator. As already seen, one of the main limits, but also one of the assumptions necessary for the indicator to be correctly constructed, is that of not considering the distance before starting to estimate the resultant, which is in fact a resultant of normalized vectors.

But what if we wanted to consider this distance instead? We have already had the opportunity to comment on how this element is equally important, especially when dividing long or short commuting relationships. For example, distance could provide us with a new element to define some areas as internal, or on the contrary it could reaffirm the role and characteristics of multi-pole relationships that are very spatially concentrated.

However, attempting to include distance within the mathematical cage of an indicator is rather complex, since each time a degree of information will be lost. Adding it to the monodirectionality index would mean losing part of the data on the prevailing direction and vice versa.

A second element obviously not representable through the monodirectionality indicator is the real prevailing direction of outgoing flows. In fact, we cannot obtain this element without resorting to some form of directed line in physical space.

To overcome these two limits, the spatial resultant is constructed by weighing each vector by the share of movements represented and is then represented in cartography. To this resultant we can add information relating to the monodirectionality index, via colour, and the total displacements generated by that municipality, via thickness.

By doing this we will obtain a 4-dimensional representation:

- The direction of the resultant will indicate the prevailing direction of outgoing flows, an element that obviously the indicator was not able to show;
- The length of the resultant will indicate both the degree of dispersion of the directions of all the flows and their overall length;
- The color of the resultant will refer to the degree of dispersion of the directions through the monodirectionality index;
- The thickness of the resultant will indicate the consistency of the total movements leaving that municipality.

This type of representation in itself does not have the robustness and synthesis capacity of a mathematical indicator, but offers, in its multidimensionality, a rather compact visualization.

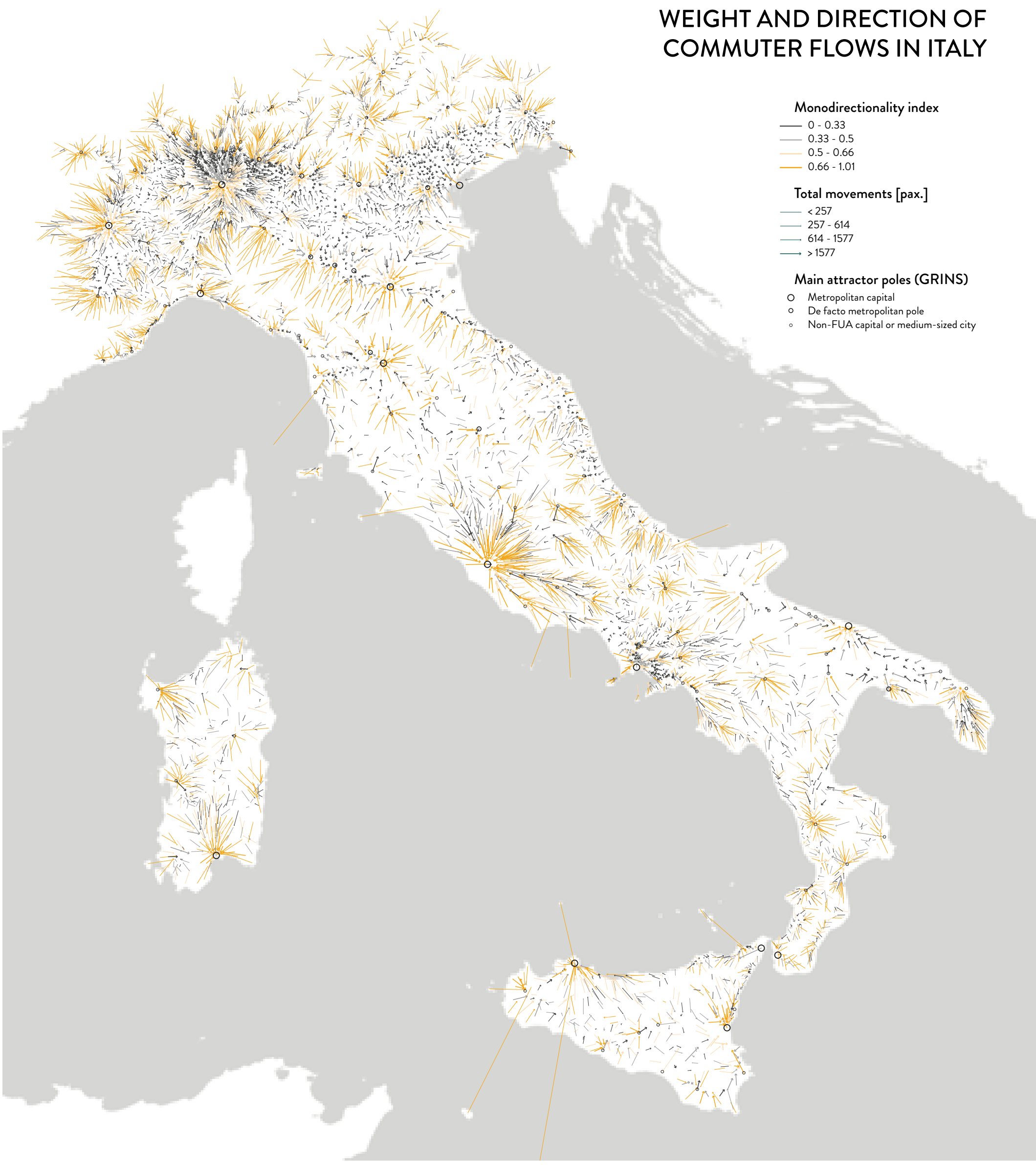


Fig. 58
Aggregate resultant map

We can observe that those municipalities in the belt or which are highly dependent on a municipality are very evident. They have long vectors and a high monodirectionality index. They are obviously around the poles of the Po Valley area and around the large poles of central and southern Italy. In particular, this representation highlights the influence of Rome on the rest of central Italy, especially in Lazio, but also with other rather distant poles that are attracted by the capital.

We then find other realities. For example, very large areas of internal municipalities that are strongly attracted by other municipalities and with very long distances. This is the case of the Emilian Apennines, strongly attracted by the infrastructural branch of the Via Emilia, or the internal municipalities of central Italy, of which many are strongly oriented towards local hubs, even very small ones.

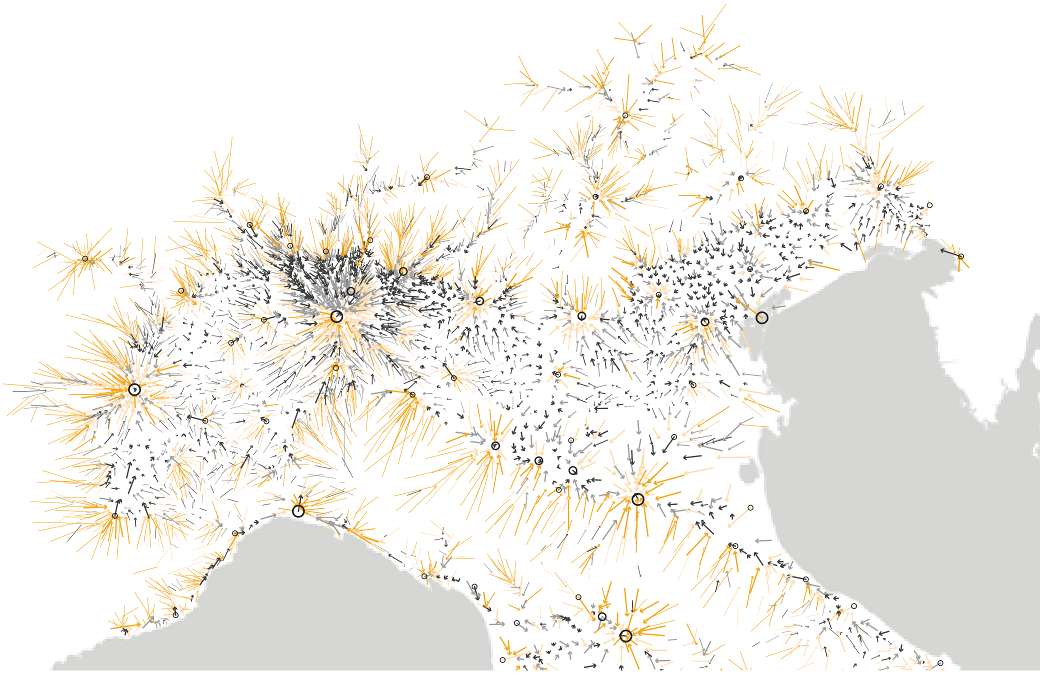


Fig. 59
North focus of the aggregate resultant map

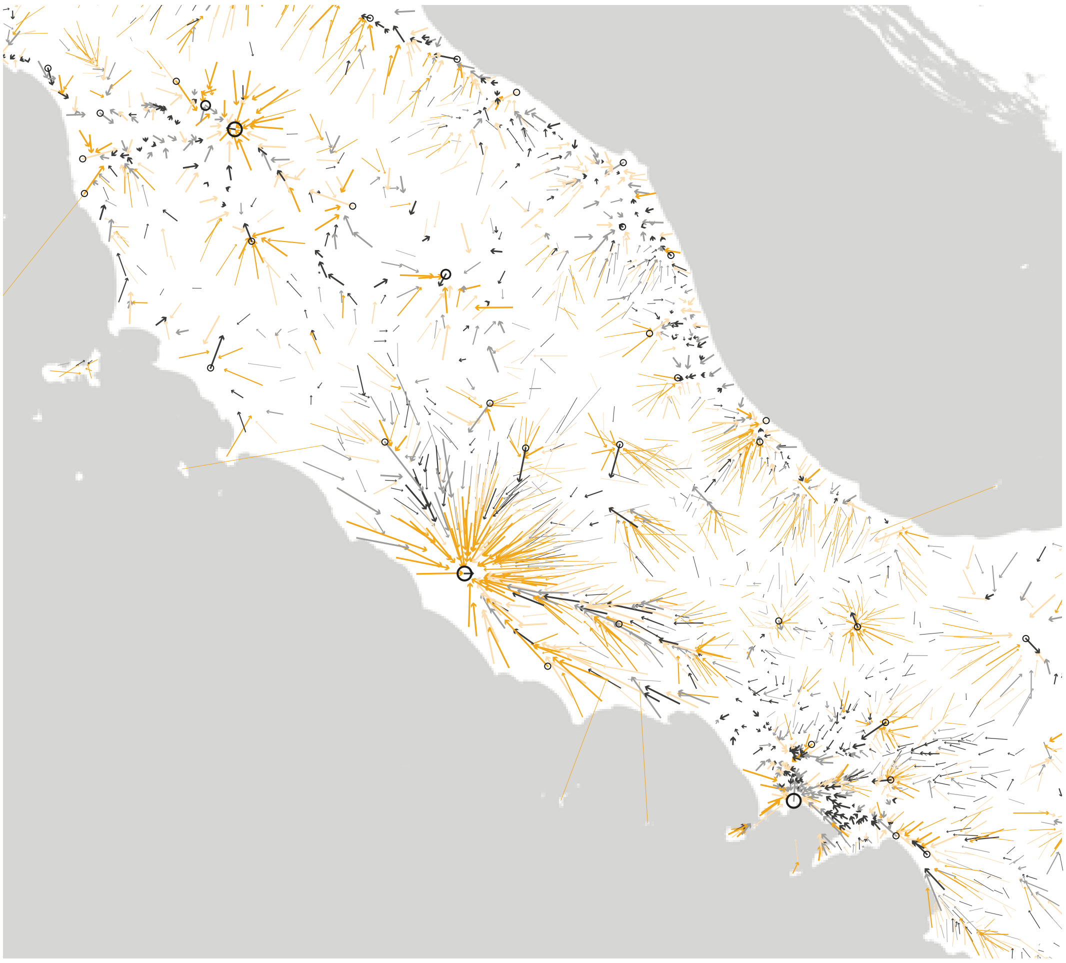


Fig. 60
Centre focus of the aggregate resultant map

The other side of the country is the one represented by the short and dark arrows, an indication of low monodirectionality. In fact, these are all those municipalities with outgoing flows with dispersed directions and probably also very short in terms of distance. The Po Valley area above all, especially the Veneto, but also and again the Caserta area, some parts of Puglia or the Adriatic infrastructural strip.

It is interesting how this representation is able to provide even more detail than the monodirectionality index. If we take the case of Brianza, we had already seen how the monodirectionality index was able to further specify the relationship with Milan. In fact, we found the central-southern belt to be very monodirectional and, on the contrary, the northern one, tending towards dispersion.

The aggregate results map adds even more. It describes the relations from the north of Milan which are actually still very dependent on the Lombard capital, since the directions of their results tend to be towards the south. At the same time, however,

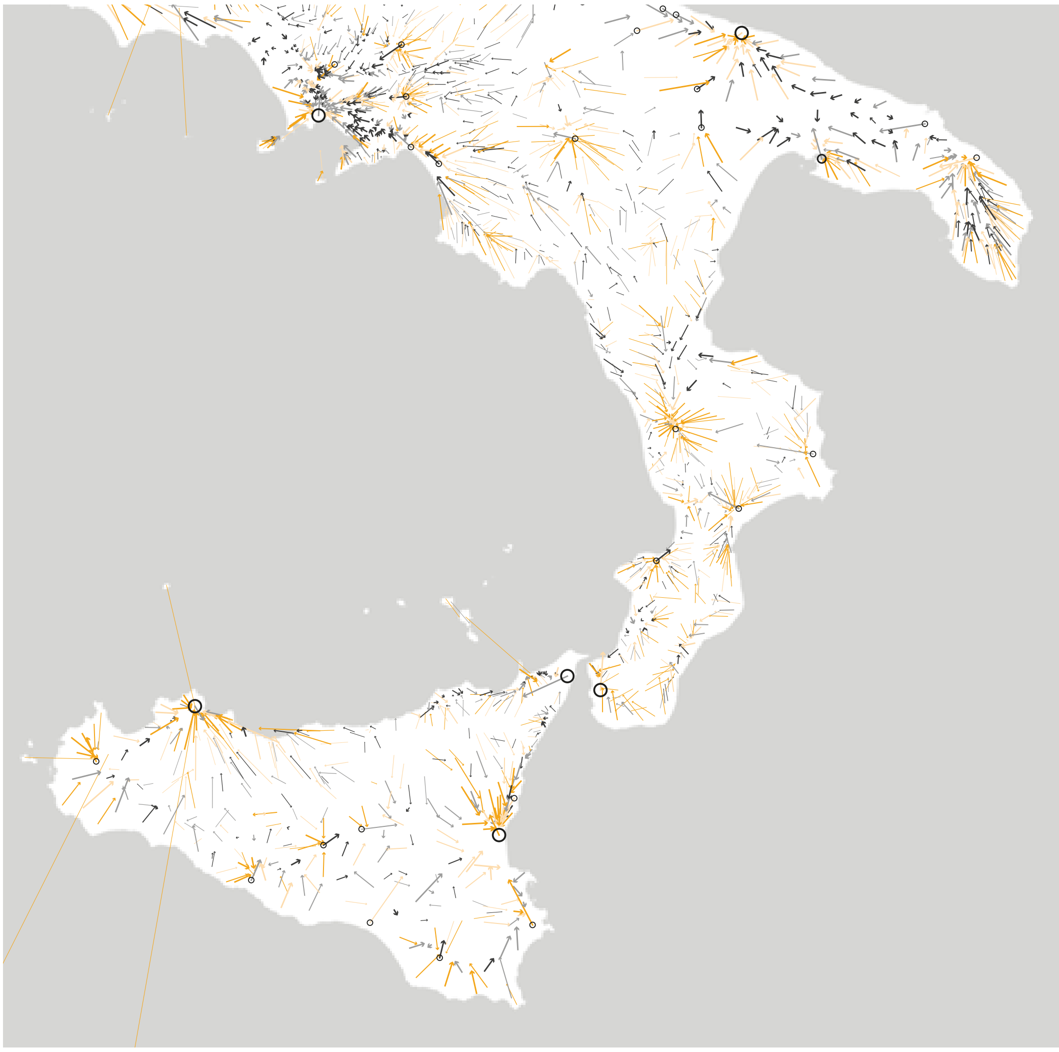


Fig. 61
South focus of the aggregate resultant map

they are shorter and obviously with a much lower monodirectionality index. In a certain sense we can say that Brianza and north Milan are rather dependent on the main pole, but at the same time they manage to create local relationships such that this dependence is less intense than the other areas of the milanese urban region.

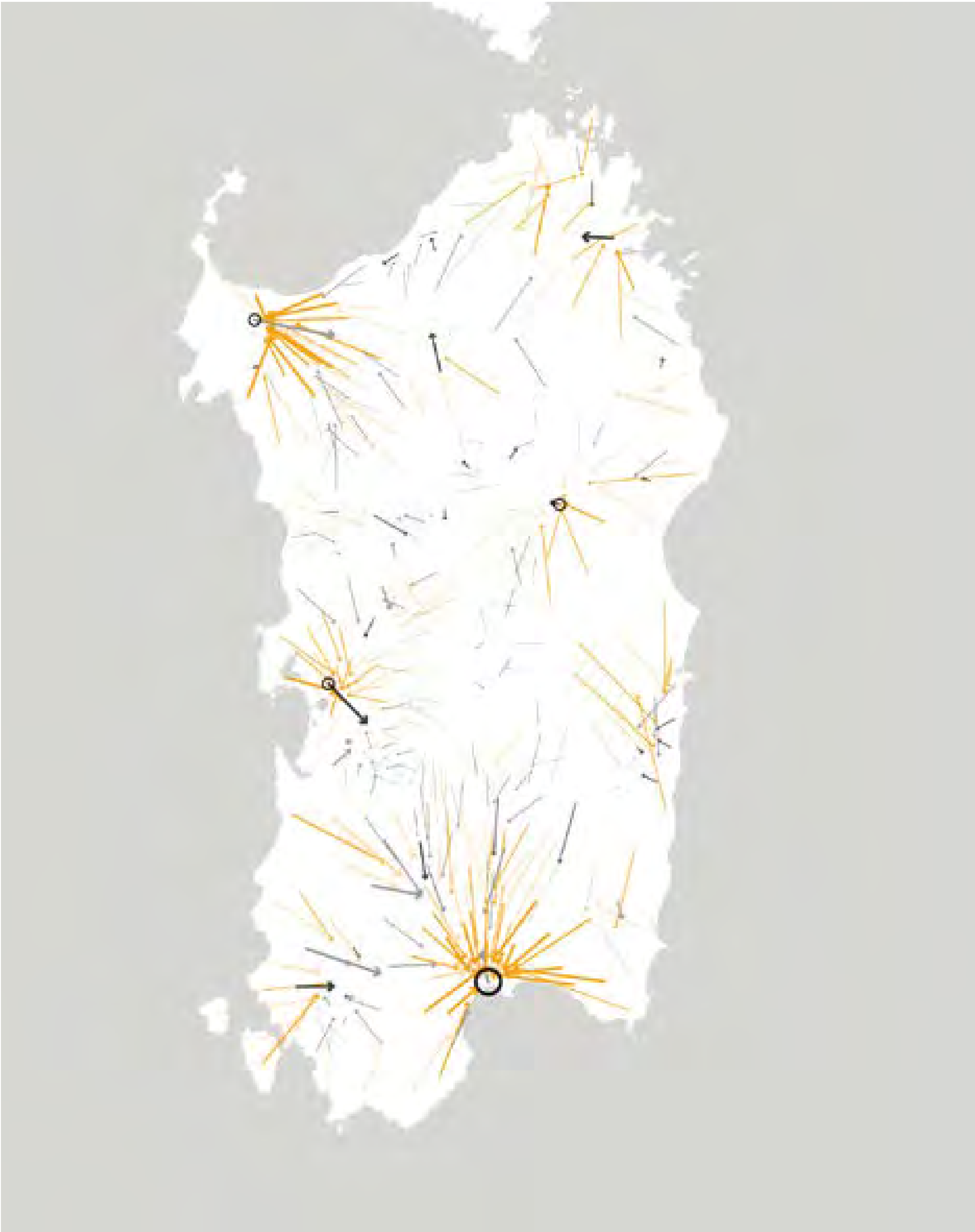


Fig. 62
Sardegna focus of the aggregate resultant map

TYPE	NAME	FORMULA
Flow indexes	Attractiveness index	$I_{ATT} = \frac{Incoming\ flows}{Outgoing\ flows}$
	Self-containment index	$I_{AUT} = \frac{Generated\ flows\ within\ the\ municipality}{Total\ generated\ flows}$
	School mobility index	$I_{SCOL} = \frac{Outgoing\ generated\ flows\ due\ to\ study\ purposes}{Total\ generated\ flows\ due\ to\ study\ purposes}$
Dependency indexes	Primary dependency index	$I_{DEP1} = \frac{Flow_{A_1} + Flow_{A_2} + Flow_{A_3}}{Total\ outgoing\ flows}$
	Secondary dependency index	$I_{DEP2} = \frac{Flow_{A_2} + Flow_{A_3}}{Total\ outgoing\ flows}$
	Destinations concentration index	$HHI_D = \sum_0^n {q_{A_i}}^2$ *where* $q_{A_i} = \frac{Outgoing\ flow\ towards\ A_i}{Total\ outgoing\ flows}$
	Origins concentration index	$HHI_O = \sum_0^n {s_{A_i}}^2$ *where* $s_{A_i} = \frac{Incoming\ flow\ from\ A_i}{Total\ incoming\ flows}$
	Demographic imbalance index	$I_{DEM} = \frac{P}{P_{A_1}}$
Geographical indexes	Monodirectionality index	$I_{DIR} = \sqrt{(\sum_0^n p_i cos(\theta))^2 + (\sum_0^n p_i sin(\theta))^2}$

	MEANING	STRENGHTS	LIMITS
	The capacity to attract flows	Good picture of poles and “feeders”	Too much affected by demographic weight and might indicate "false poles"
	The capacity to contain flows within the municipality	Good picture of poles and “feeders”	Affected by a north-south global trend
	The tendency of people to leave the municipality for study purposes	Good picture of internal Italy	Study purpose is too vast and ambiguous
	The weight of the first three attractors	Good picture of the metropolitan belts	Too many possible subcategories
	The weight of the second and third attractors	Good picture of the multipolar areas	Too much ambiguity for low values
	Relative concentration of outgoing flows	Good picture of the metropolitan belts and areas with dispersed flows	Very sensitive to the number of considered OD relationships
	Relative concentration of incoming flows	Useful to identify poles	Tends to standardize classes of municipalities
	Relative weight of the first attractor	Clearly highlights the relative weight between municipalities	Too much affected by demographic weight
	The relative concentration of the direction of outgoing flows	Specifies in geographical terms the image of the HHI index	Not affected by distance and too much affected by geographical features

2.4 Classification

2.4.1 Classification methodology

Having defined our indicators in a complete and detailed manner, we can proceed to create a possible classification of the various "Italies" from the point of view of commuting mobility, with the final objective of precisely defining those "in between" territories that have already been appointed by the studies mentioned and taken as a comparison model -GRINS and SNAI in particular-.

However, in that cases, the quantities of spatial, socio-demographic, and economic indicators were used, all of which have in municipality the fact, for example, of not relating the various municipalities to each other. Making this same division from the point of view of mobility is not a clear-cut operation that can be obtained from known and static rules. As already seen during the description of the indicators, many quantities that define commuting mobility habits do not follow well-defined patterns and are unable on their own to circumscribe well-defined and homogeneous areas of the country from this point of view.

Scrolling through the various indicator hypotheses we had positive feedback from all those dependence indicators that considered all or some outflows from the municipality data. In essence, it was not enough to know the consistency and characteristics of the outgoing or incoming flows from a given municipality, which was offered to us by the flow indicators, but also the destination and origin of each individual flow, obviously in the most aggregate possible.

The destination concentration HHI index, for example, returned a rather interesting picture. It has in fact clearly outlined the areas of maximum commuting towards the large attracting centers and at the same time highlighted all those territories that do not depend on any particular pole. However, what has emerged is how many of the areas already defined as "inner" behave in a rather similar way to the areas strongly attracted by metropolitan pole. In a certain sense, these inner areas are also strongly attracted by other municipalities. The hypothesis, therefore, that the inner areas of mobility are those with scarce flows and without a precise direction seems to be invalid.

At this point, in order to define the various mobility areas of the country as clearly as possible it is necessary to use more than one indicator. To do this, an exclusion approach will be used also in this case. The areas of strong commuting mobility towards a pole will be defined first, secondly the so-called "inner" areas and finally everything that does not fall into these two categories will enter into a new category that we can intuitively define as *Italia di Mezzo*.

The result of the classification work will be presented in this chapter. The work was carried out largely through progressive attempts, in order to achieve, through continuous adjustments, a consistent and clear result. In any case, even proceeding in this way, a single and definitive result is practically impossible to achieve. For this reason, more than one version will be presented, each achieved through the composition of a specific methodology to define the polarity areas, the inner areas and the consequent intermediate areas.

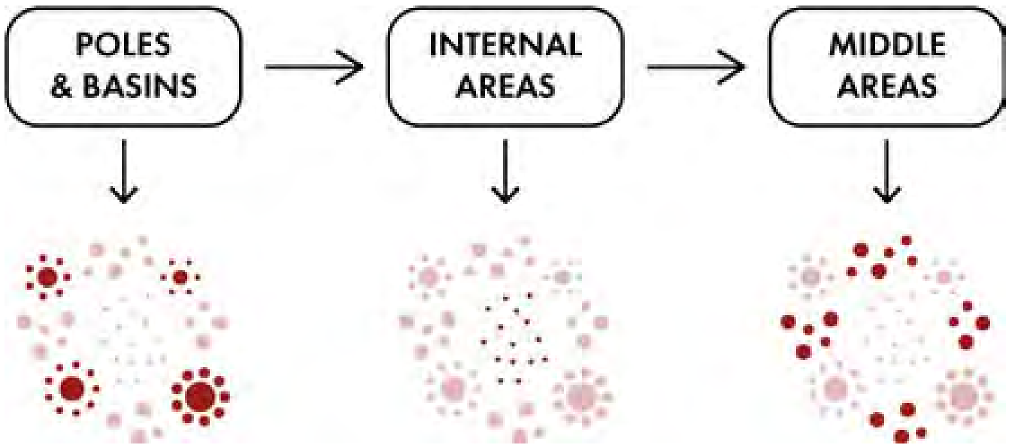


Fig. 63
The mechanism of research of Italia di Mezzo

Finally, it must be specified that, by convention, the classification operation has always been carried out following the same order: poles > inner > middle. This assumption allows us to avoid situations of ambiguity and facilitates the definition of the intermediate areas, which in this way are necessarily not belonging to the first two categories.

Initially, the methodologies relating to the classes of poles, inner and intermediate areas will be presented and then the various classifications deduced from the compositions of the latter.

Each classifications will therefore have as its name the composition of the three "sub-methods", in the formula P.x-INT.x-MED.x, respectively for the poles, the inner areas and the intermediate areas.

2.4.2 Looking for poles and basins

The first fundamental operation to carry out is to define the poles municipalities. Once these have been established, it will be possible to continue with the definition of the basin areas of these poles. In this way, that part of Italy characterized by intense commuting towards a significant attractor will be later on excluded.

The definition of these basins is not a straightforward operation. Indeed, numerous ambiguities arise:

- On the one hand, the definition of the poles itself, often made difficult by unbalanced demographic classes or by the presence of some significant local specificities that cannot be recognized and automatically removed from the indicators.
- On the other hand, the definition of commuting basins, which in reality cannot be constructed considering only the physical distance from the pole, but also the intensity and characteristics of the flows heading towards that pole from each municipality.

We will therefore present some different methods for defining the pole municipalities and their respective commuting basins, each with strengths and limitations, which will be commented on gradually.

P.1 Method

In this method, the demographic weight of the municipality in question is taken into account. Through the definition of very precise thresholds, a municipality will be a pole based on its ability or otherwise to attract flows but also based on its size.

Big attracting pole

In this case, a municipality defined as a "large attracting pole" has a population greater than 100,000 inhabitants and an attractiveness index greater than 1. In this way we are going to filter not only those demographically relevant municipalities but also those that attract relatively more displacements than what do not generate.

In this case we are going to manually include the exception of Livorno, which exceeds the population threshold and approaches the value of 1, with 0.98.

Small attracting pole

The second category of municipalities to be defined is the "small attractor pole", i.e. a municipality with a population between 30,000 and 100,000 inhabitants and an attractiveness index greater than 1. However, having reduced the demographic class, it is necessary to further filter all those municipalities which risk being included in the criteria but not being real commuting poles. These municipalities could be the

Fig. 64
Poles of P.1 method

headquarters of large industries or production areas or of higher-level services and therefore would attract a lot of travel without being a real pole. In short, we need to overcome the already highlighted limit of the attractiveness index. To do this we are going to add a double condition, i.e. that the HHI indexes of concentrations of origins and that of destinations are relatively low, so as to exclude all those municipalities that depend excessively on other poles or that attracts flows generated by one or two municipalities only.

Even with these additional adjustments, some changes need to be manually done.

The municipality of Cosenza has a concentration index of destinations greater than the defined threshold, but this is due to the fact that the university is located in the neighboring town of Rende, so as to create a predominant flow between the two municipalities. A similar case is that of Trapani, which sees many of its movements towards nearby Erice, which in fact, from a geographical and functional point of view, is partly merged with this center and therefore expresses "inner" movements which however are between two municipalities different. The case of a "work pole" that remains after the first filters is that of Milazzo, which attracts more than it generates due to the refinery.

Basin of large/small attractor pole

Once the attractor poles have been defined, it is necessary to establish criteria with which to trace the boundary of the area of influence of the poles themselves. A first category of municipalities attracted by the poles are those that are part of the basin, an area made up of all those municipalities that have a pole municipality as their first attractor and a relatively high attraction towards this pole. To achieve this, we are going to consider a high concentration index [> 0.19] but at the same time we are going to impose the condition that the second and third attractors are not relatively heavy compared to the first [<0.41]. In this way we will consider only those municipalities that are attracted in a truly predominant way by a municipality pole, obviously whether it is a large or a small pole.

P.2 Method

In this method a new element will be considered, which relates the municipalities to each other: the first attractor. The first attractor of each municipality, which is the municipality towards which the greatest number of people heads among all the attractors, becomes the yardstick for evaluating the presence or absence of a pole.

In fact, if a municipality finds itself being the first attractor of many other municipalities, this will undoubtedly indicate that it is a pole municipality. In this way we would exclude the demographic discriminant in the definition of a pole and we would only evaluate the ability of a given municipality to maintain an effective commuting basin around itself.

Strong/weak attractor pole

The P.2 type attractor pole category includes all those municipalities which are the primary attractor for at least 5 other municipalities and for which trips from these municipalities exceed at least 2000 units. Essentially, the idea is that the poles are those municipalities with a real and consistent basin.

A strong attractor pole is an attractor pole for which trips from municipalities for

Fig. 65
Poles of P.2 method

which it is the main attractor exceed the median [0.63] of total incoming trips. On the contrary, it will be a weak attractor pole.

The idea is to discriminate the pole municipalities according to their ability to mainly attract travel as first attractors. Large metropolitan centers such as Rome, Milan and Turin are therefore spontaneously strong attractors, but also, on the other side of the demographic spectrum, small and sometimes very small municipalities are local poles. Both, in fact, are able to create a very strong commuting basin around themselves, in which the majority of incoming trips are generated by municipalities for which they are the main attractor.

Basin of strong/weak attractor pole

The same criteria as in P.1 are used, but with the poles defined in P.2.

P.2.1 method

This method represents a variant of the P.2 method and divides the pole municipalities based on the degree of dependence between them.

Independent/dependent attractor pole

We therefore proceed to define the poles with the same criteria as in P.2 and then create two subclasses. The dependent poles will be those pole municipalities which in turn have a pole municipality as the first attractor, on the contrary they will be independent poles.

It is clear that this is a rather clear discretization of the two categories, but in this way we expect to highlight all those realities of poles which are in turn dependent on other poles, so as to create an attempt at relational hierarchization, albeit partial, between the various mobility poles in Italy.

Basin of independent/dependent attractor pole

The same criteria as in P.1 are used, but with the poles defined in P.2.1.

P.3 method

Again, starting from the concept of first attractor introduced in P.2, an attractor pole is defined as each municipality which not only has a certain number of municipalities for which it is the first attractor, but also for which it represents a certain minimum share of flows.

In fact, in this way the real attractor poles with an effective and consistent commuting basin are isolated, without the risk of considering seemingly valid situations to be ambiguous and not very close to the class in question.

Independent/dependent attractor pole

In this class we find every municipality with at least 10 municipalities for which it is the main attractor and of each of which at the same time it attracts 25% of the movements.

A dependent attractor pole is a pole municipality which has as its first attractor a municipality pole towards which at least 10% of the trips generated are destined. In all other cases the municipality is an independent attractor.

Basin of independent/dependent attractor pole

Fig. 66
Poles of P.2.1 method

The same criteria as in P.1 are used, but with the poles defined in P.3.

P.4 method

In this case the methodology tries to overcome the limits of the first attempts. In fact, the concept of major and minor poles is introduced, following a criterion that is halfway between purely relative ones and those that rely instead on absolute data that depend on the demographic weight of the municipality.

The criterion is again the number of municipalities for which a center is the main attractor. This value is taken to extremes to identify the major poles, i.e. those with

Fig. 67
Poles of P.3 method

a very large commuting basin around them. Minimum values, however, will identify minor poles, where we will expect to find both large poles in terms of scale and flows, but also and above all purely local poles.

Major Independent/dependent attractor pole

In this class we find every municipality with at least 20 municipalities for which it is the main attractor and of each of which at the same time it attracts 25% of the movements.

Again, a dependent attractor pole is a pole municipality which has as its first attractor

Fig. 68
Poles of P.4 method

a pole municipality towards which at least 10% of the trips generated are destined. In all other cases the municipality is an independent attractor pole.

Minor attractor pole

A minor attractor pole is a municipality that has between 5 and 20 municipalities for which it is the main attractor and for each of which it attracts at least 25% of the movements. An additional condition is that is must attract from these municipalities at least 1,000 trips. In this way we are avoiding to include all the hyper-local and very small poles, but this clearly remains an open question, for which please refer to the following chapter.

Basin of major/minor attractor pole

For the definition of a basin municipality, P.4 is based on assumptions that are at least relaxed compared to the previous criteria. A basin municipality is in fact defined as having a pole municipality as the first attractor, a high destinations concentration index [> 0.18] and a high weight of the first attractor [> 0.3].

P.5 method

The method is introduced in order to solve a quite huge misrepresentation of some northern parts of Italy, especially the Piemonte region, that are affected too much by the smaller dimension of the municipalities in relation to the Centre and South ones.

To do so the method creates the concept of "equivalent municipality", which is basically a unit of reference that is the average size of the italian municipalities. Instead of counting the different municipalities attracted by an aspiring pole, we will count the equivalent municipalities starting from the total surface, so that the trend is in a way reduced.

Major Independent/dependent attractor pole

To identify mayor poles we still consider the "25% attracted flows condition", but we also check if the equivalent municipalities are higher in number in respect to the real ones or not. In the first case, this means that the municipalities are generally larger than the italian average and we will consider a pole if the real municipalities number is higher than 20. In the second case, this means that the municipalities are generally smaller than the italian average and we will consider a pole if the equivalent municipalities number is higher than 20.

Again, a dependent attractor pole is a pole municipality which has as its first attractor a pole municipality towards which at least 10% of the trips generated are destined. In all other cases the municipality is an independent attractor pole.

Minor attractor pole

Minor poles uses the same criteria but they narrow the number between 5 and 20, adding two alternative conditions for removing irrelevant poles, one on the absolute number of flows and the other on the density of flows on the total surface considered.

Basin of major/minor attractor pole

For the definition of a basin municipality, P.5 is based on the same criteria of P.4. A basin municipality is indeed defined as having a pole municipality as the first attractor, a high destinations concentration index [> 0.18] and a high weight of the first attractor [> 0.3].

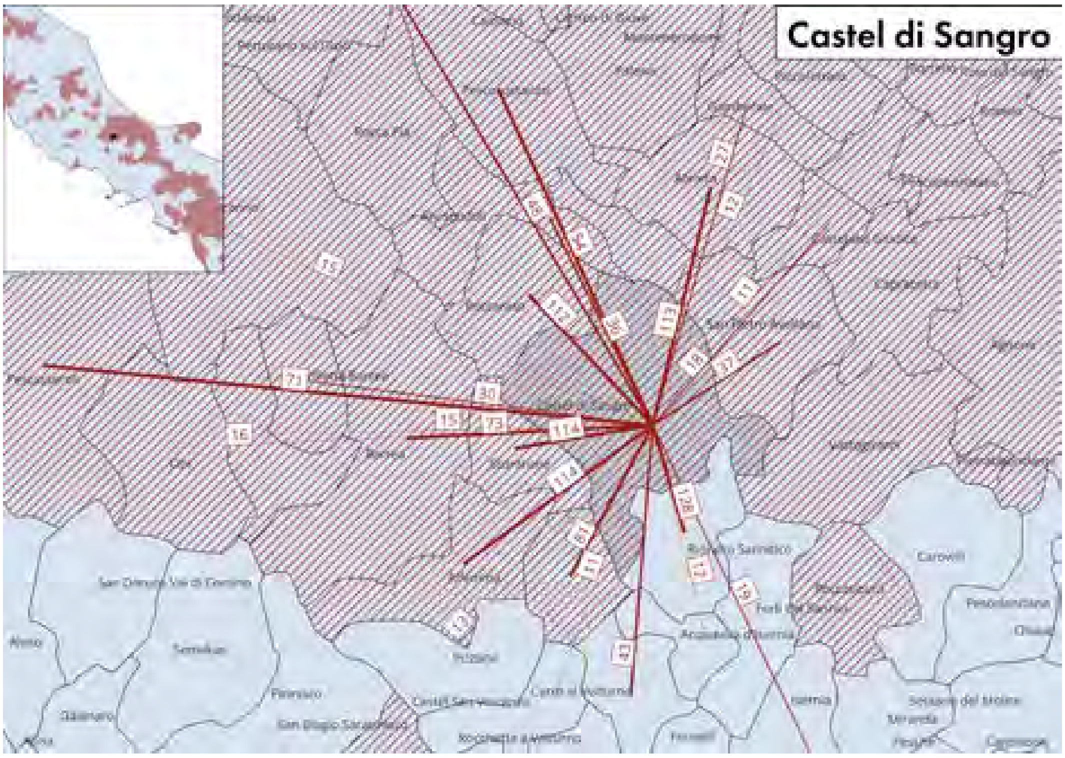
Fig. 69
Poles of P.5 method

2.4.2 Looking for inner areas

Once the first step has been completed and the poles and commuting basins of these poles have been identified, it is necessary to recognize and ideally remove another large category of municipalities, namely the inner areas.

As we have already seen through the analysis of the indicators, the inner areas seem in a certain sense to behave like commuting poles, obviously on a completely different scale. Let's take the SNAI classification as a reference and analyze two specific examples to better show this phenomenon.

If we consider the SNAI peripheral and ultra-peripheral areas (in shades of purple in fig. 70), we realize that there are many small poles in them that we would hardly consider as such even in this research work. Of course, these are poles that have the characteristic of being very insignificant, with small and marginal numbers of total flows, yet they are prime attractors for a considerable number of other municipalities,



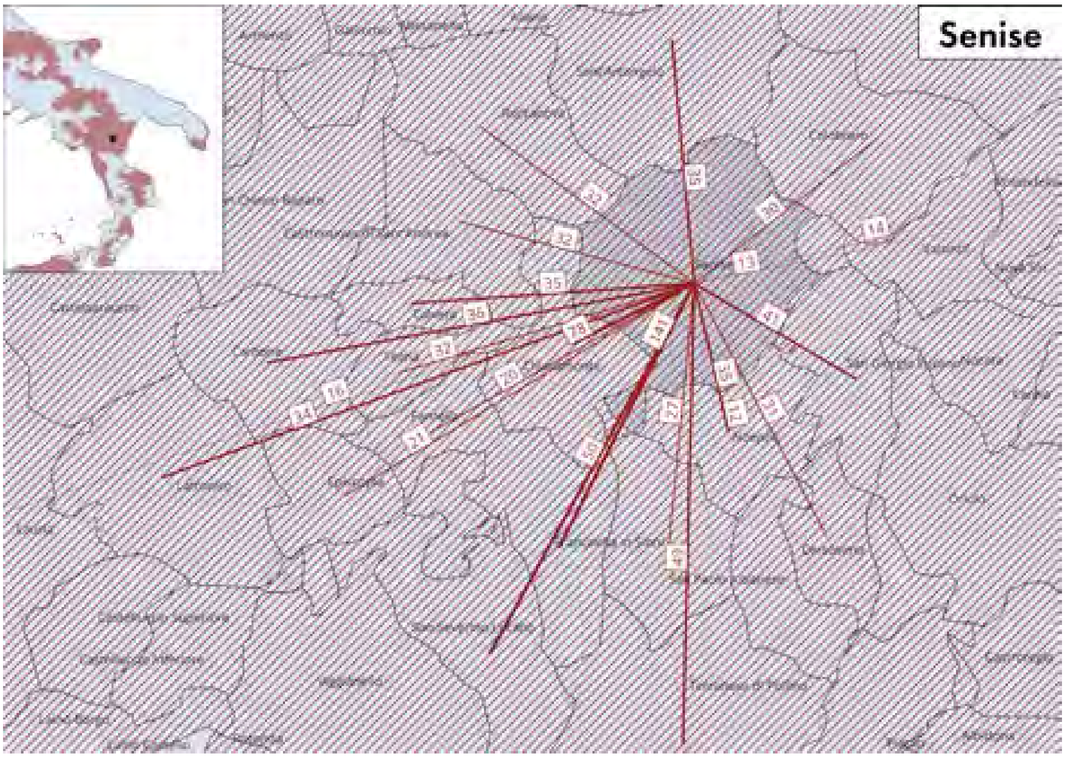


Fig. 70
Two example of small poles in SNAI inner Italy

even if the condition of 25% of total flows is imposed.

Castel di Sangro has its own small commuting basin, especially from the Abruzzo municipalities of the north and west, while the influence of Isernia is already present in the south-east. Senise, on the other hand, is immersed in the great Lucanian scrub classified as an inner SNAI area, yet, even more than the first case, it has its own small commuting basin coming from almost every direction.

Obviously, we don't want to demonstrate that all of Italy classified as an Inner Area by SNAI or by other works is actually made up of commuting poles and basins that propagate infinitely almost to form a fractal structure. It is in fact clear that there are also very frequent situations of one-to-one or one-to-few relationships, but it is in any case useful to clarify how only relative pole search criteria may risk leading to an almost infinite process (see fig. 71). For this reason, it is sometimes necessary to introduce some limits in absolute values, as in the case of 1000 movements for the P.4 method.

At this point it is necessary to define consistent criteria to identify inner areas from a mobility point of view. It is clear that you we a decisive advantage, namely the order of classification. The definition of the inner areas always follows that of the poles and commuting basins, so that any ambiguities generated by the similarity of the two categories in relative terms are led to be reduced if not eliminated altogether. Intuitively, once the attractive poles and commuting basins have been defined, we expect that the inner areas are not dependent on these areas. In fact, the inner areas can be dependent either on small local poles, which however have not been officially classified as such, or on other municipalities of the same rank which are not even de facto poles. However, what we expect from an inner municipality is that its trips, especially if they are few, are strongly directed towards one or at least a few municipalities. This is a phenomenon that had already become apparent when the destination concentration index was compared with the two GRINS and SNAI classifications, hence the idea that peripheral or inner municipalities, at least in relative terms, behave similarly to the first metropolitan belts.

INT.1 method

Following the premises on inner areas, the definition of inner area in this case derives from two characteristics.

- On the one hand, those municipalities that are not attracted either by pole municipalities or by basin municipalities.
- On the other hand, it is necessary to avoid including multi-pole or overly distributed relationships, since, as we have already had the opportunity to qualitatively evaluate with the indicators, inner areas often seem to be characterized by relationships that

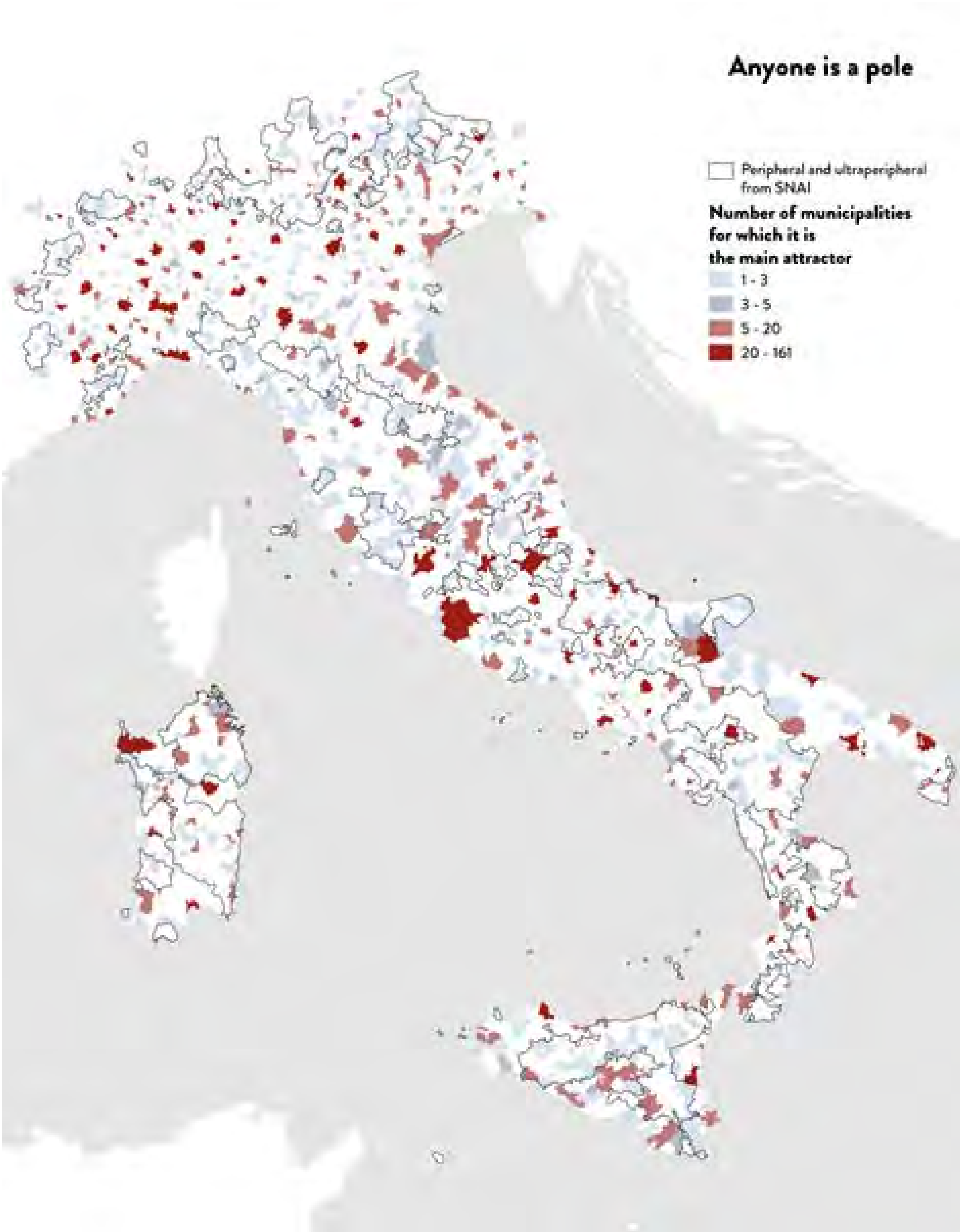


Fig. 71
The risk of an infinite pole classification without any ablosute criteria

are not very consistent and rather concentrated in one direction. In short, the overall idea is to intercept those very concentrated relationships between municipalities of the same rank or towards small local poles. The condition will therefore arise of having a relatively high concentration index of destinations [>0.12].

2.4.3 Looking for middle areas

It is now clear that, at this point, the middle areas will be made up of all those municipalities that are neither a pole or a basin nor an inner area.

However, it must be clarified that within this macro-category very different municipalities may be included, especially in relation to the method with which the poles and inner areas are defined. On the one hand, in fact, we could observe all those municipalities that are almost-basin municipalities, therefore very dependent on an attracting pole, as well as those municipalities that are generally not dependent on any pole or that are attracted by poles of comparable rank, thus generating multipolar but spatially concentrated relationships. We might also expect to find areas that we would define as inner from a sociodemographic point of view, but which have not been included in the category by the mobility classification.

In short, we need to try to establish some sub-categories within the large container of everything that is neither an attractor pole nor a basin nor an inner area.

MED.1 method

This method introduces the concept of fringe, i.e. that portion of territory strongly attracted by an attractor pole, but which at the same time is not attracted by it in such an exclusive way as to place itself in the category of commuting basin of the pole itself.

The concept can be presented with a specific example. Take the case of two municipalities located in the milanese urban area. If on the one hand we find Segrate, attracted by Milan to such an extent that 65% of outgoing trips go to the Lombard capital. Added to this is the fact that the other destinations from Segrate tend to be irrelevant compared to those for Milan, but still quite substantial and above all in limited numbers, so that the outgoing HHI index is 0.42. On the other hand, Gessate, with a greater and more distributed number of outgoing flows, with an outgoing HHI index of 0.14, yet with a weight of flows towards Milan of around 36%. Here, municipalities such as Gessate are considered fringe, since, despite having a greater distribution of destinations compared to basin municipalities such as Segrate, they still maintain an intense relationship with their first attractor. Obviously in this specific case a fundamental role is represented by the presence of the M2 metro line, just as we can expect specific local elements that create the fringes, especially from an infrastructural point of view.

Everything that isn't fringe falls into the last category of in-between territories. Here we really find all the municipalities that have not been classified up to that moment. From this group of municipalities, we want to extract all those realities with highly dispersed flows, especially in terms of directions.

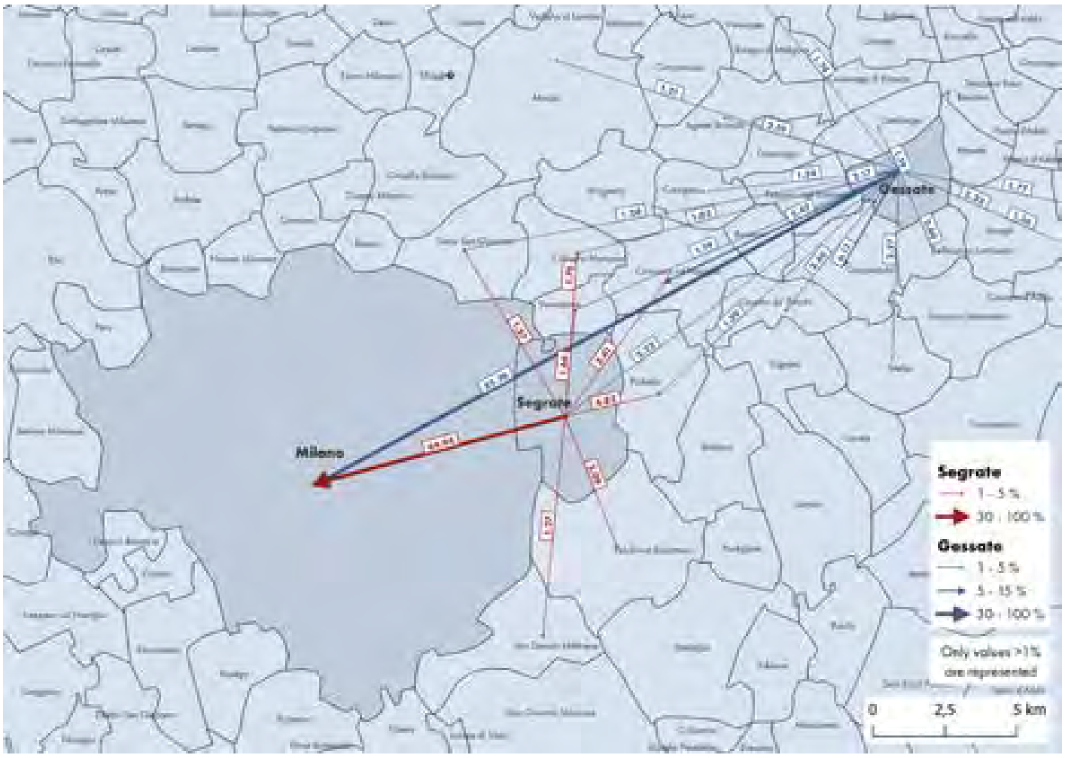


Fig. 72
A close scale example of a fringe municipality

Below is how all these categories have been specifically defined from a quantitative point of view.

Fringe of attractor poles

As already mentioned, the fringe municipalities are all those that are not pole basins, but which nevertheless have a pole as their first attractor and this pole has a significant weight on the total [> 0.3]. The idea of the fringe is useful for including all those municipalities that are halfway between being a basin area and a truly intermediate area. They are in fact strongly attracted to a pole, but due to distance from it and degree of dependence they do not fall within the actual commuting area.

Multidirectional intermediate territories

This category includes all those "residual" municipalities that have a relatively low monodirectionality index value. They can be defined as truly intermediate municipalities from the point of view of commuting mobility flows, since:

- they are municipalities which do not have a pole municipality as first attractor, but which at the same time have relationships distributed to such an extent that they do not fall into the category of inner areas.
- They are municipalities which do have a pole municipality as first attractor, but at the same time this pole has a relatively low weight for them in relation to the rest of the destinations.

- Furthermore, they are municipalities with flows directions that tend to be dispersed and equally distributed and this describes those territories that are highly multipolar or with equally distributed flows. In fact, territories in which we do not find a main attractor pole but which are not even inner areas.

Monodirectional intermediate territories

This category includes all those "residual" municipalities that have a relatively high management concentration value. This is a rather heterogeneous group of municipalities, the result of the fact that they are not included in the previous classifications.

Let's say that this group is in a certain sense the litmus test of the goodness of the classification, as the smaller the consistency of this last group of "residuals" will be and the greater the number of municipalities that will have found space in the previous categories.

2.4.4 Main obtained classifications

P.1-INT.1.MED.1 classification

The first form of classification consists of the first method of identifying the poles and the first methods for defining inner areas and intermediate areas.

Fig. 73 P1.-INT.1-MED.1 classification

The territorial figure that shows up is rather linear and compact, certainly the result of the demographic filter. In fact we find practically all the Italian provincial capitals as attractor poles. It is clear that this classification must be observed with the right lenses. In fact, there is no distinction based on the different degree of attractiveness of the municipalities, but only based on the demographic weight.

Obviously this representation has the advantage and strength of defining the poles in a clear and recognizable way, but at the same time it presents important limitations.

The most visible is probably the way in which the inner areas are defined. The clear case of the area between Abruzzo and Molise which is completely into inner areas is emblematic of the fact that the demographic criterion has its important weaknesses. In fact, in this case we find a series of municipalities that do not fall into the pole category only because they do not have 30 thousand inhabitants, as in the case of the capital Isernia.

More generally, the abundance of large inner areas is a symptom of excessive consideration of the latter and above all of the absence of local poles. Yet, these poles are quite recognizable, as they are often municipalities classified as multidirectional intermediate territories surrounded entirely by inner area municipalities. Some specific checks right away and subsequent classifications will confirm this hypothesis.

P.2-INT.1.MED.1 classification

This second classification uses method 2 of pole identification.

It is clear that by using method 2 we have significantly increased the number of poles, while the inner areas has been significantly reduced in number.

Fig. 74 P2.-INT.1-MED.1 classification

In this case the subclasses of poles are defined on the basis of the degree of attractiveness of a pole towards the municipalities for which it is the main attractor. Consequently we find strong attractor poles to be those capable of collecting the majority of flows from their commuting basins, for which we find both Rome and Milan but also local and very isolated poles such as Vallo della Lucania in Calabria or Tolmezzo in Friuli.

The demographic criterion seems to have been overcome, but once again we find situations of ambiguity, which however can also be considered interesting resources. This is the case, for example, of "poles without a basin": these are municipalities which evidently have at least 5 municipalities for which they are the main attractor but which, once the basin areas have been defined, are unable to create a area of effective dependence since these other municipalities are not attracted by them exclusively.

It is interesting, however, how these municipalities represent the attractor municipalities of areas apparently without a pole. An emblematic case is Brianza and the north-west of Milan, an area widely categorized as a multidirectional intermediate territory, but which has within itself some municipalities that are more attractive than others, such as Gallarate, Busto, Saronno or Cantù. Obviously the limit of this classification is to consider municipalities with a minimum pool of attracted municipalities as poles, so when we find ourselves in truly widespread situations and with equally relevant centres, this condition ceases.

P.2.1-INT.1.MED.1 classification

This second classification uses again method 2 of pole identification but with a little difference in poles sub-categorization.

Fig. 75
P.2.1-INT.1-MED.1 classification

In this case the only variation compared to the previous classification is the way in which the attractor poles are divided. The idea is to simply evaluate whether or not the poles have a pole as their first attractor. This is a rather simple operation but one that leads to interesting results.

In fact, very precise pole geographies appear, with the cases of Rome and Milan among the most relevant. In the case of Milan, in fact, the entire first belt of poles becomes dependent, precisely because it is attracted primarily by Milan. This effect reverberates as far as Brescia to the east, Novara to the west, the lake centers to the north, Cremona and Piacenza to the south-east, while to the south-west, beyond Tortona, it increasingly describes multipolar relationships between the various poles, which attract each other.

Rome, on the other hand, presents a less linear pattern. While to the east it manages to attract the Abruzzo center of L'Aquila, to the north Terni and Rieti are independent, to the north-west Viterbo dependent and to the south-west the influence of the capital stops at Cassino and Formia.

We find other interesting multipolar situations in Calabria and Salento, while the case of the piedmont Veneto is surprising, since the small poles that are present in the area do not tend to attract each other, as could be imagined from the first classifications.

P.3-INT.1.MED.1 classification

This classification uses method 3 of pole identification.

Fig. 76 P3.-INT.1-MED.1 classification

In this case the criteria of method 2 have been taken to extremes and consequently we have the first effect of reducing the number of poles, since we have lost all those municipalities that were on the margin of the number of municipalities attracted as the first attractor and of the weight of travel incoming from these municipalities.

Furthermore, we can appreciate how the 10% condition for determining whether or not a municipality is dependent has caused variations. In particular, around Milan, Brescia becomes an independent attractor pole, as does Cremona, effectively narrowing the field of influence of the Lombard capital.

In fact, there are two major critical issues with this classification:

- On the one hand, municipalities that had not previously been included start to emerge. These are mostly truly local poles, which have a large and well-structured basin but which attract, in absolute terms, a small number of flows. Are these really poles or are they those hyper-local poles that characterize parts of inner Italy? Locri, for example, is placed in the same category as Rome or Milan, because it evidently fulfills the same role as a pole as the two large cities, but for its neighboring municipalities, moreover finding itself in a position of relative geographical isolation.
- On the contrary, this classification omits some relevant medium poles, such as Grosseto or Ragusa, which are not included because they do not reach the sufficient number of attracted municipalities. However, we find out that these are really marginal situations, if we only think that Grosseto has 9 and not at least 10 municipalities attracted as the first attractor and with at least 25% of the flows from each.

P.4-MED.1 classification

This last classification uses method 4 of pole identification.

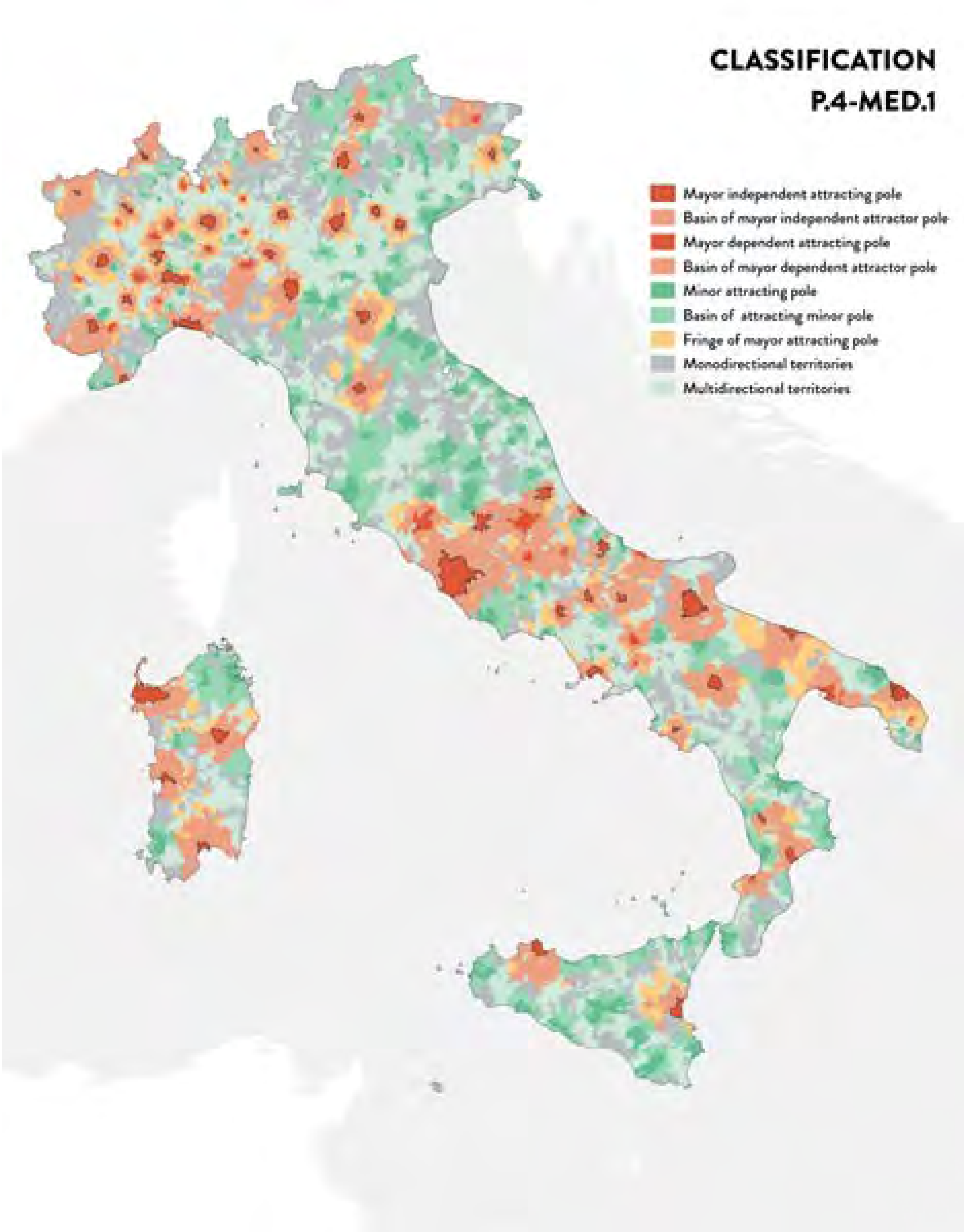


Fig. 77 P4.-MED.1 classification

This classification goes in a certain sense to subvert some logic that had been maintained until now, both from a logical and, consequently, chromatic point of view.

The main problem encountered so far has undoubtedly been the search for the best method for identifying the poles and the consequent definition of inner and intermediate areas. In this sense, we encountered at least two main problems:

- As already highlighted, the search for poles is potentially an infinite exercise, if it is not limited by one or more "absolute" criteria. At the same time, there is the risk of including too many minor poles, as well as excluding important ones, simply because the rules are too discrete to describe the reality of the facts. In a certain sense, a clear distinction is needed, between the strong attractors of commuting mobility and the smaller and poles.
- Inner areas are difficult to define unambiguously. As already widely seen, these are often areas that depend on hyper-local poles or which, on the contrary, strongly depend on municipalities that are not poles nor pole basins. Trying to define these areas every time is a job that risks leading to a series of important errors, especially in relation to the definition of intermediate areas.

The main innovations of this classification derive from these premises. On the one hand, the P.4 method of identifying the poles is used, so as to distinguish the major commuting poles, always divided into independent and dependent, and the so-called minor poles, which can be both local poles and poles with little catchment areas. On the other hand, the classification of inner areas is excluded and only what remains is considered as a middle area, with fringes and intermediate territories.

The resulting territorial figure is rather novel. In fact, we find the Po Valley area as the territory richest in major and independent centres, while central-northern Italy, between Tuscany and Marche, is very rich in minor poles. Central and Southern Italy, on the other hand, have more differentiated situations. Larger independent centers abound in central Italy, Sardinia and Puglia, while they tend to be less present in Calabria and Sicily.

It is clear that with this expedient of removing the inner areas the intention is also to increase the degree of possible interpretations of the classification. In fact, if the role of large commuting basins for the major poles is clear, everything that is residual is certainly open to different meanings. The minor poles themselves can be considered both the *Italia di Mezzo* poles par excellence, but also some hyper-local realities of inner Italy, especially along the Alpine arc and in the Lucanian-Calabrian area.

What is clear, however, is that some Italian areas remained in the same class from the first to the last classification attempt. Brianza and north Milan, for example, have always been multidirectional intermediate territories, as have many other Po Valley areas that are not sufficiently linked to the large mobility poles, such as the Cuneo area, the Mantova area or the Veneto foothills of the small local poles. Such well-defined examples of multi-region territories in the South are undoubtedly the upper Caserta area and the enormous conurbation immediately south of Vesuvius.

P.5-MED.1 classification

This last classification uses method 5 of pole identification.

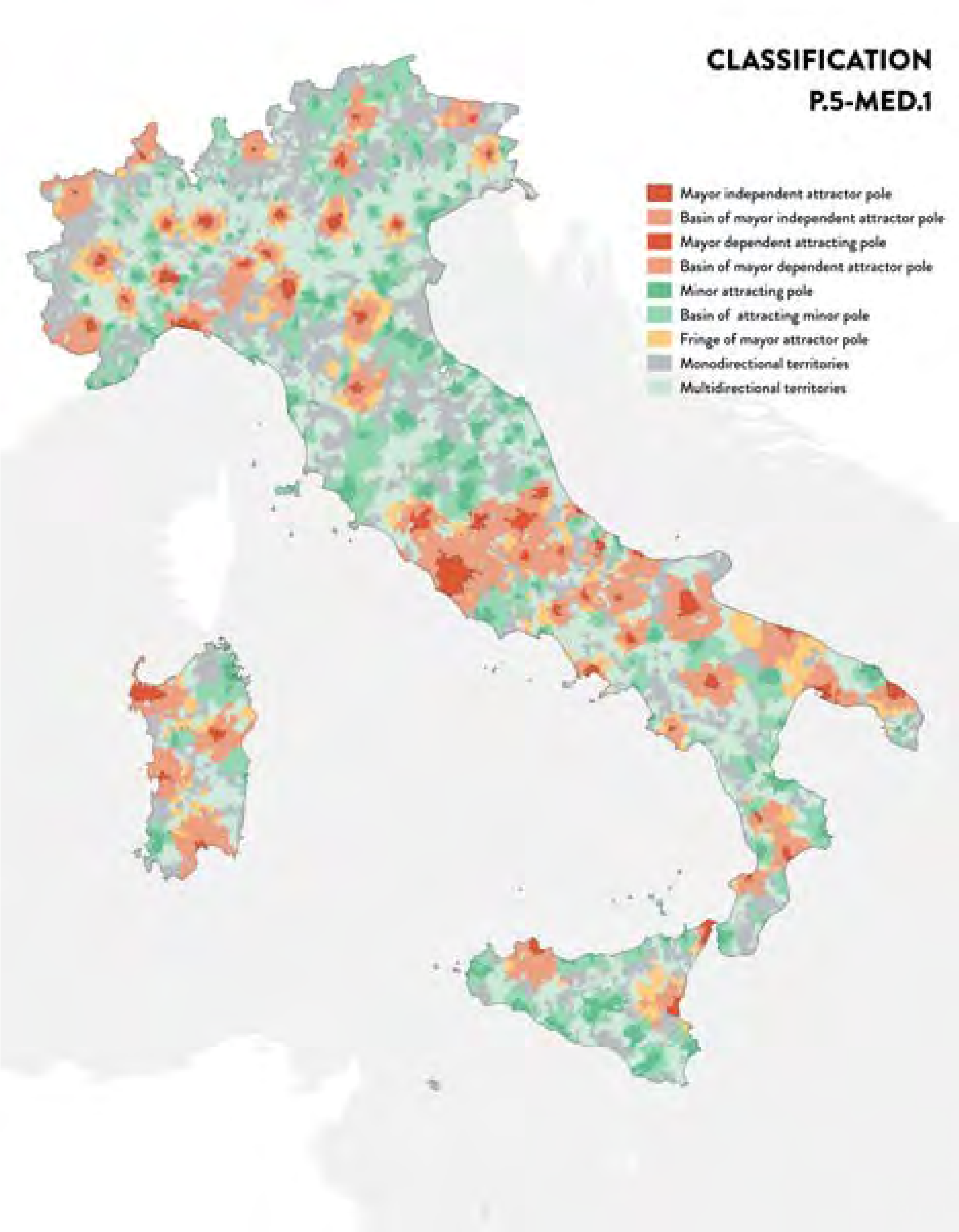


Fig. 78
P5.-MED.1
classification

This last classification represents the attempt to overcome the limits of the P.4. In particular we noticed some rather unexpected situations in the North West part of the country. In Piemonte, according to P.4, almost all the attractor poles were major poles. However, by evaluating the context more closely, we realized that a large part of these poles were medium or even medium-small cities, which were often strongly networked with each other. It was not possible for them being all major poles.

A factor that has not been highlighted so far was therefore considered, namely the size of the municipalities that make up the potential basin necessary for the identification of a pole. In fact, since it was a sum of very different territorial units, a bias was created between the municipalities of Northern Italy, which tended to be smaller, and those of the Center and South, which were larger. With the use of P.5 and the equivalent municipality this problem is overcomed, since the reference unit is now the same for all areas of Italy.

In fact, Piemonte is the area that changes its geography the most, with many of the centers identified as major becoming minor poles. Asti, Vercelli, Ivrea, Pinerolo and Biella among others.

Other significant changes can be found in Lomellina, with the downgrading of Pavia to a minor pole, but above all the disappearance of Vigevano as a pole and its new characterization as a fringe of Milan. This confirms the infrastructural axis and of intense mobility demand that from the south-west of Lombardia ends up in the regional capital.

The geography of Central and Southern Italy, however, remains rather stable, with the sole exception of Caserta, which loses its status as a hub and is instead inserted into the large dispersed territory north of Naples. It should be noted that Caserta becomes "almost a fringe" of Naples, on which it depends for 24% of outgoing travel.

For the rest of the country, the considerations already made regarding the previous version apply.

2.5 Which “Italie di Mezzo”? Some possible interpretations

It is clear that the result of the classifications is not unique and none of the classifications alone clearly defines what can be considered as *Italia di Mezzo* from a mobility point of view. On the contrary, each classification provides a unique and particular framework which, through the specific criteria adopted, returns a rather significant image of some portions of the Italian territory.

In fact, if we consider for example P.1 - INT.1 - MED.1, this perhaps provides the most intuitive and coherent picture of the poles. These are demographically relevant poles, municipalities that tend to be large in terms of population and which attract flows

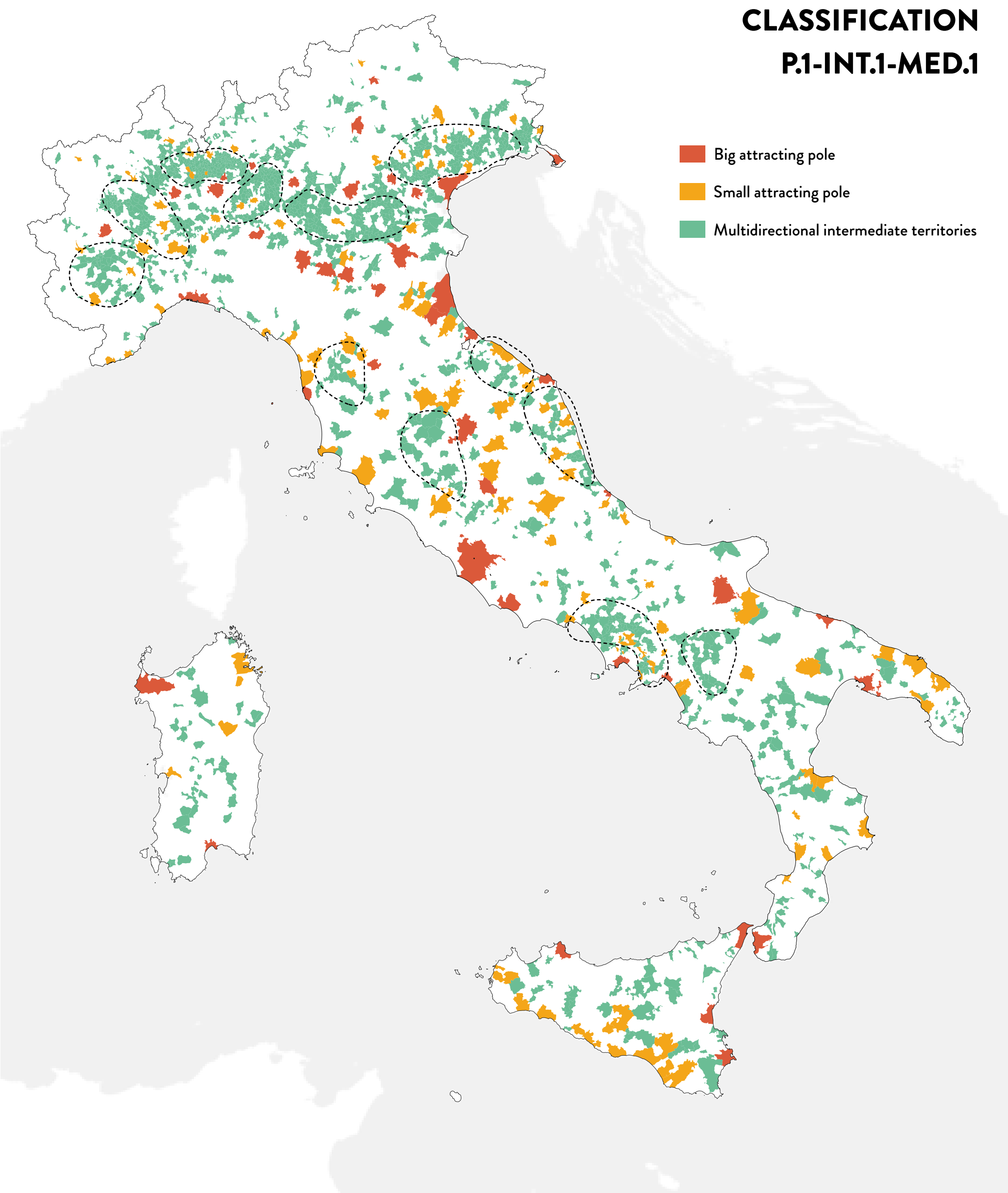


Fig. 79
P.1 Italia di Mezzo

from outside. The *Italia di Mezzo* that this version describes is certainly very present in the Po Valley area, and in some other few areas of concentration of multidirectional intermediate territories in Center or Southern Italy.

The decidedly more relevant aspect is how these multi-directional territories are in strong connection with the secondary or, in the case of P.1, "small" poles. In fact, it often happens that these territories have secondary poles within them which, due to their attractiveness and size, are unable to create effectively consistent basin areas around themselves.

The second classification to focus on is P.2.1 - INT.1 - MED.1. This undoubtedly gives

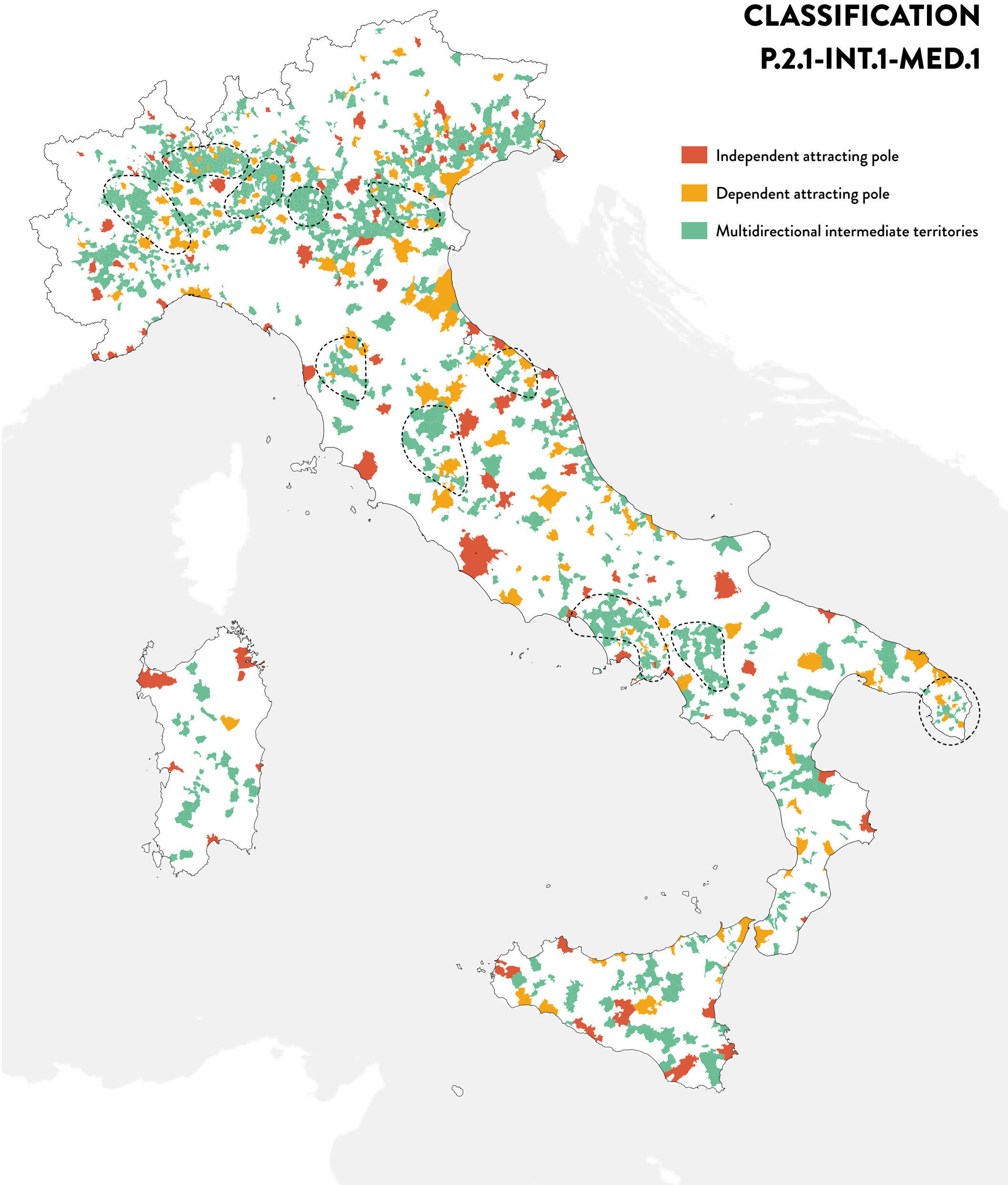


Fig. 80
P.2.1 Italia di Mezzo

a rather similar picture, but at the same time, given that the definition of dependent pole has been introduced, it is necessary to exclude some hypotheses of middle areas and at the same time introduce others. We begin to notice Salento or the southern Veneto, while the piedmont Veneto or Cuneo area are excluded. Net of this operation, some territories remain unchanged, such as the Brianza or Casertano, already mentioned several times. It is that part of Italy without real poles and highly dispersed, which slowly takes on its own specific connotation.

If we instead consider P.5 - MED.1, *Italia di Mezzo* certainly finds more space, since the idea of the minor pole is being introduced. In a certain sense, this is the evolution

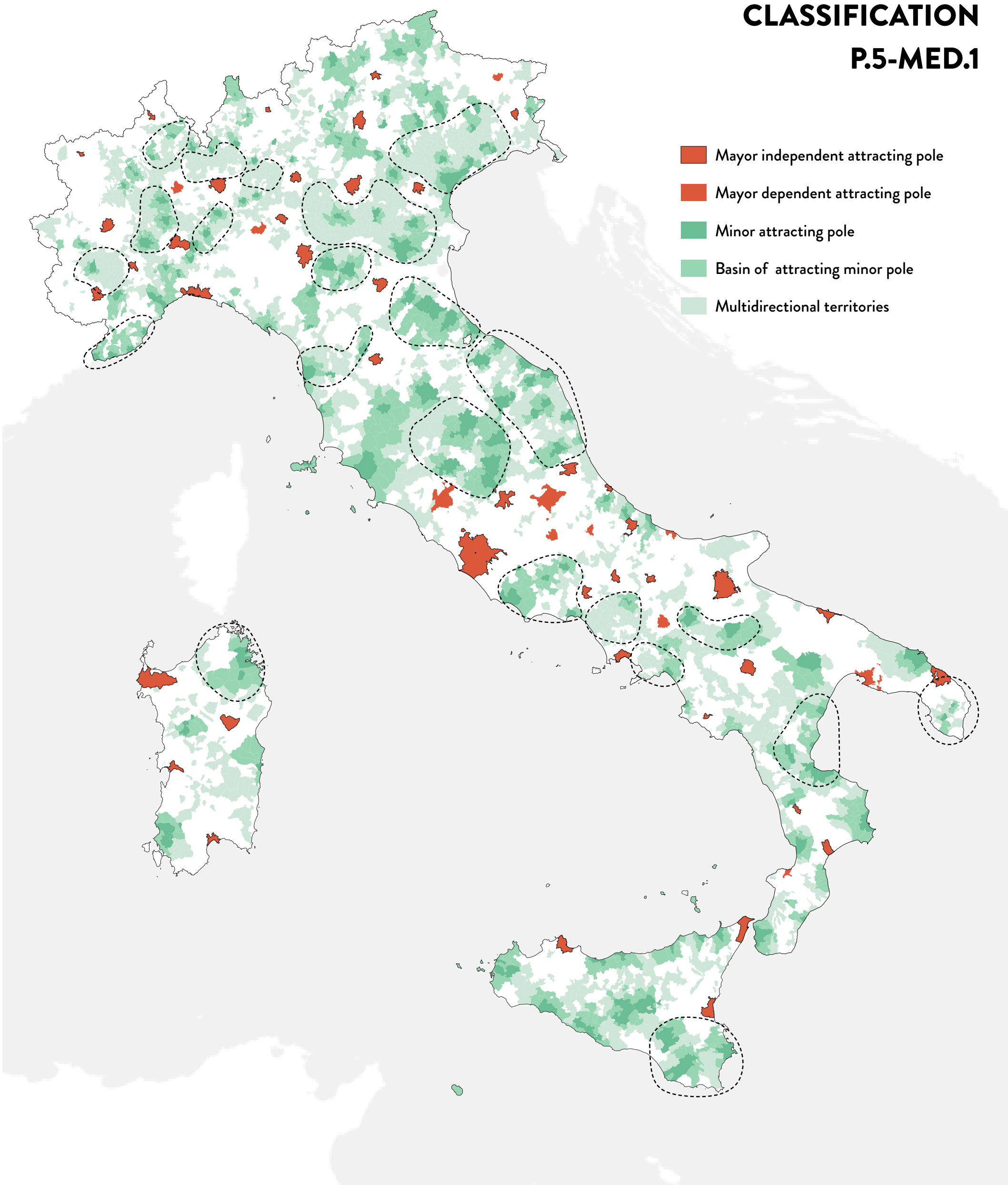


Fig. 81
P.5 Italia di Mezzo

of the poles of secondary rank of the previous classifications and which introduces the idea that *Italia di Mezzo* can also be made up of poles, albeit smaller and generally dependent on each other.

2.5.1 The role of infrastructures and 4 possible "Italie di Mezzo"

At this point a certain logical and consequently analytical leap is necessary. So far we have in fact considered data and consequent classifications relating to mobility demand, in fact the OD matrix itself. However, a new macro group of data can be added, i.e. those relating to the mobility offer, with which it is also possible to define

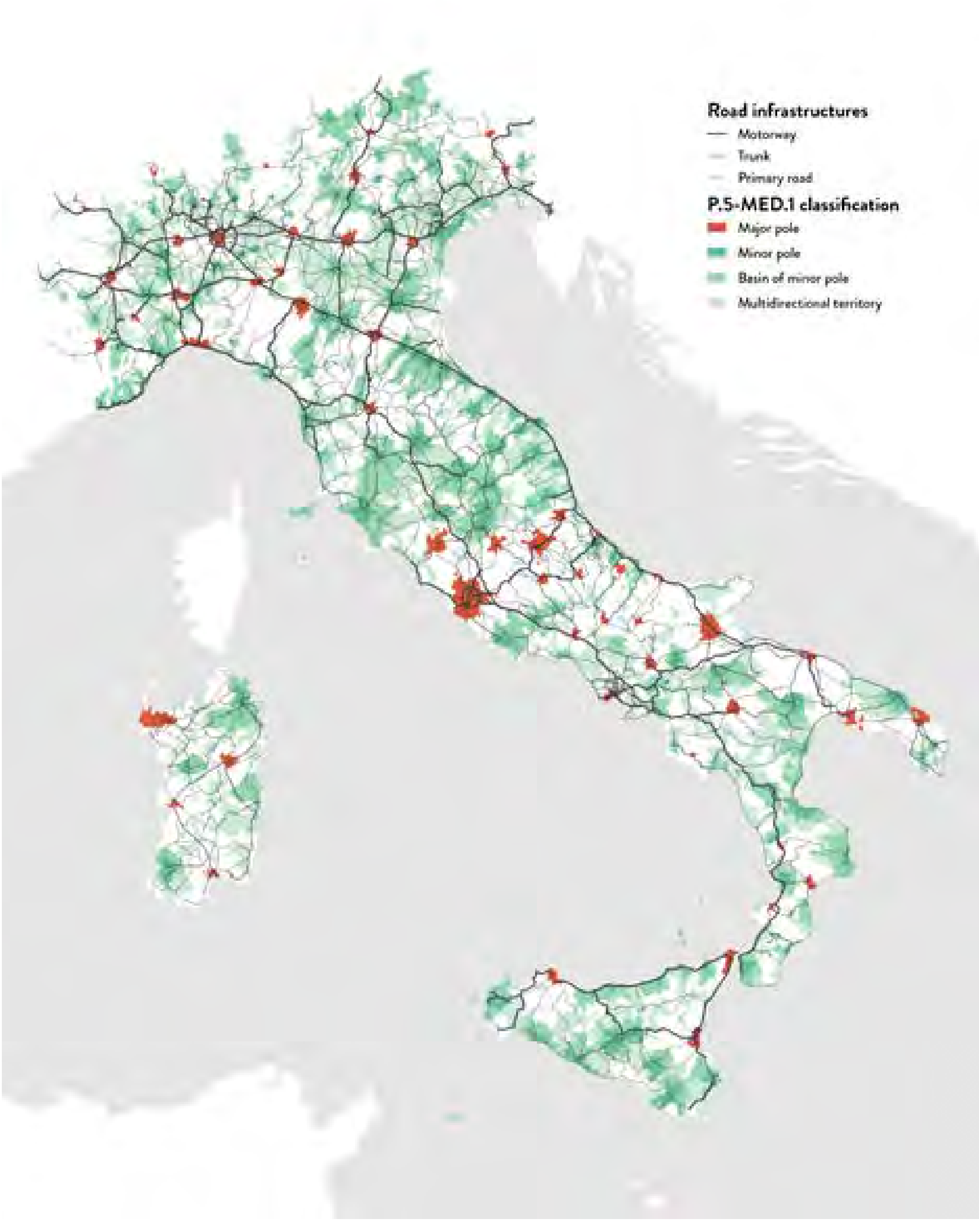


Fig. 82
Road infrastructures

in a more in-depth and richer way the various cases of *Italia di Mezzo* present on the national territory.

It is clear, in fact, how close the relationship is between infrastructure and mobility demand. The latter is undoubtedly strongly influenced by the presence or absence of mobility infrastructures in the area, which, moreover, define in a new way some portions of Italy that we would not be able to describe from demand analysis alone.

By introducing the element of supply we are in a certain way starting a process of approaching scale, since it is clear that to evaluate these territorial specificities more accurately, we will be led to bring our gaze closer to the contexts under examination, with a scale that is still supra-local but certainly no longer national.

Let us choose to consider the P.5 - MED.1 version, since it adapts well to our needs to have the widest possible interpretative possibility. We will first superimpose the fundamental Italian road network on this classification.

The figure thus obtained is quite interesting. On the one hand, in fact, the major poles are almost always nodes of the main road network, while the minor poles are mostly located along it, acting in a certain sense as minor nodes. This is quite evident along the central ridge of the A1 and along the Adriatic coast, or in the Po Valley, where there are not already many major poles.

In other cases we are faced with situations of deeper isolation of the minor poles. These are indeed in a marginal position with respect to the fundamental network, sometimes even as a node of the secondary network.

Further reasoning can arise from the comparison with the railway network, excluding, for obvious reasons, high-speed connections. Here we see very clearly how the major hubs are again often the fundamental nodes of the railway network. These frequently take on a central position in the classic star-shaped infrastructural conformation and consequently become the arrival and departure point of the main passenger services that are offered on the network.

Also in this case the minor hubs seem to take on the role of intermediate nodes of the railway system, perhaps even more clearly than the road network. Many infrastructural auctions between two major poles are characterized by the linear presence of minor poles, which follow the course of the railway.

Other times, however, the railway, especially the complementary network, is inserted into more multidirectional territories, almost devoid of real hubs. These are often territories crossed centrally by the main network, from which the complementary one branches off.

From the comparison with the infrastructural network, at least 4 possible hypotheses

Fig. 83
Rail infrastructures

of *Italia di Mezzo* of commuting mobility arise, as the result of the interaction between mobility demand and infrastructure supply.

Dispersed territories

The first possible *Italia di Mezzo* is the one that we have already highlighted several times during the analysis and is made up of all those territories with truly dispersed and multidirectional flows, sometimes even almost without real attractor poles. These territories can be identified especially in the Po Valley area and often, in addition to being characterized by dispersion of demand, they are innervated by the complementary or in any case second-level railway network, which evidently manages to guarantee a sufficient degree of connection between these municipalities and between themselves and the main network. Same logic as regards the road network. In fact, they are often crossed by motorways or trunks, but at the same time innervated by the primary network.

Let us now try to investigate an area of this type more closely. Let's take as a reference an area that we have already mentioned very often in our work, that is, what we would generally refer to as *Brianza*, but which here roughly includes those municipalities between Milan and the Lombardy poles on the lakes.

It is a uniformly intermediate multi-directional territory, contained to the south by the

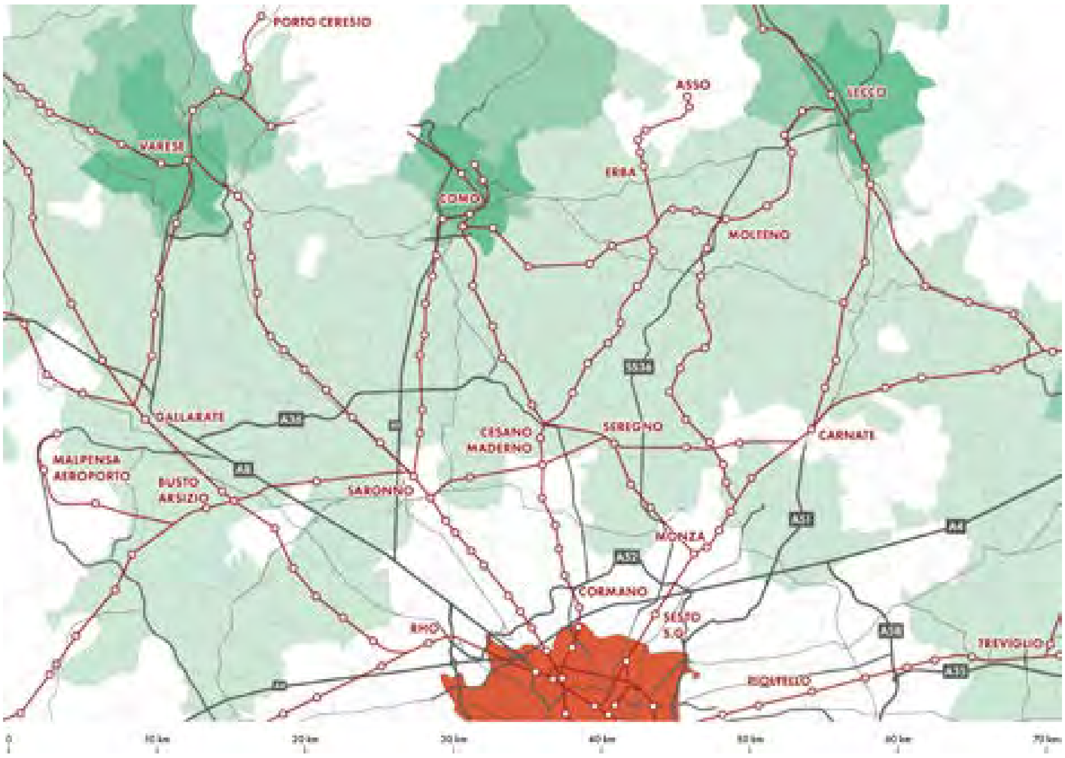


Fig. 84 Brianza dispersed territoty

major pole of Milan and to the north by the three minor poles of Varese, Lecco and Como. This is probably the ideal prototype of a dispersed territory: equally distributed demand is combined with a dense and widespread infrastructure. The main railway lines start from Milan and reach Varese, Como and Lecco, but at the same time we find numerous transversal axes or directed towards other radial destinations but still serving the territory. The road routes work in the same way, with the motorway axis towards Varese and Como and the state road 36 Valassina towards Lecco. The transversality of the road is demonstrated by the Pedemontana axis, partly already built and partly under construction.

In a certain sense this is a unique case of a dispersed territory, because it is affected by the presence of such an attractive center as Milan. Consequently, the forces that keep enough flows anchored to the local dimension are even stronger and more evident, such as to make the territory dispersed.

A series of further Italian territories can be included in this category, especially in the Po Valley area, but not only. Starting from the north-west towards the south-east we find the area between Bergamo, Brescia, Crema and Cremona and, immediately next to it, between Lake Garda and the Po; depending on the scale, the Veneto foothills can be included, which tends to be multidirectional with the exception of some poles such as Treviso and Bassano del Grappa; to the south, however, we find the Caserta area, more precisely the Campania part of what was once defined as "Terra di Lavoro" and the large conurbation that extends across the Pompeii plain, between Vesuvius and the "Monti Lattari".

Linear territories

The second category is the result of the strong interaction between the infrastructural elements and the demand for mobility. We have already had the opportunity to evaluate how the minor poles often find themselves in an intermediate situation between two major poles and along the infrastructural line that unites them. Other times they are secondary axes on which the intermediate territories are placed in series. This is the case of valley contexts, whether it is a road or even railway axis, or road or railway branches that go from a main line towards the hinterland.

It is clear that the poles will tend to be minor, as the relationships between them will be quite strong, also thanks to the high degree of connectivity guaranteed by the infrastructural axis. In any case, it is necessary to evaluate the individual cases, as it is obviously possible to appreciate strong local differences, for example based on the degree of importance of the axis or on the basis of whether it connects two major poles or is only a secondary branch of a primary axis.

One of the most evident cases are the coastal stretches, often crossed by the coastal road or motorway, which links a continuous series of minor poles. The case of the northern Marche coast is quite emblematic in this sense. Here we find the center of Ancona to the south and then along the A14 motorway and the Adriatic railway the centers of Senigallia, Fano and Pesaro. Continuing we could certainly identify another linear situation, namely the smaller centers up to Bologna; on a large scale we could even hypothesize that they are part of the same linear territory.

As well as the coast, we also begin to see the starting point of the axis of state road 76 and the railway towards Fabriano and therefore Umbria and Lazio, one of the main axes of central Italy, especially from a railway point of view. It also creates a rather

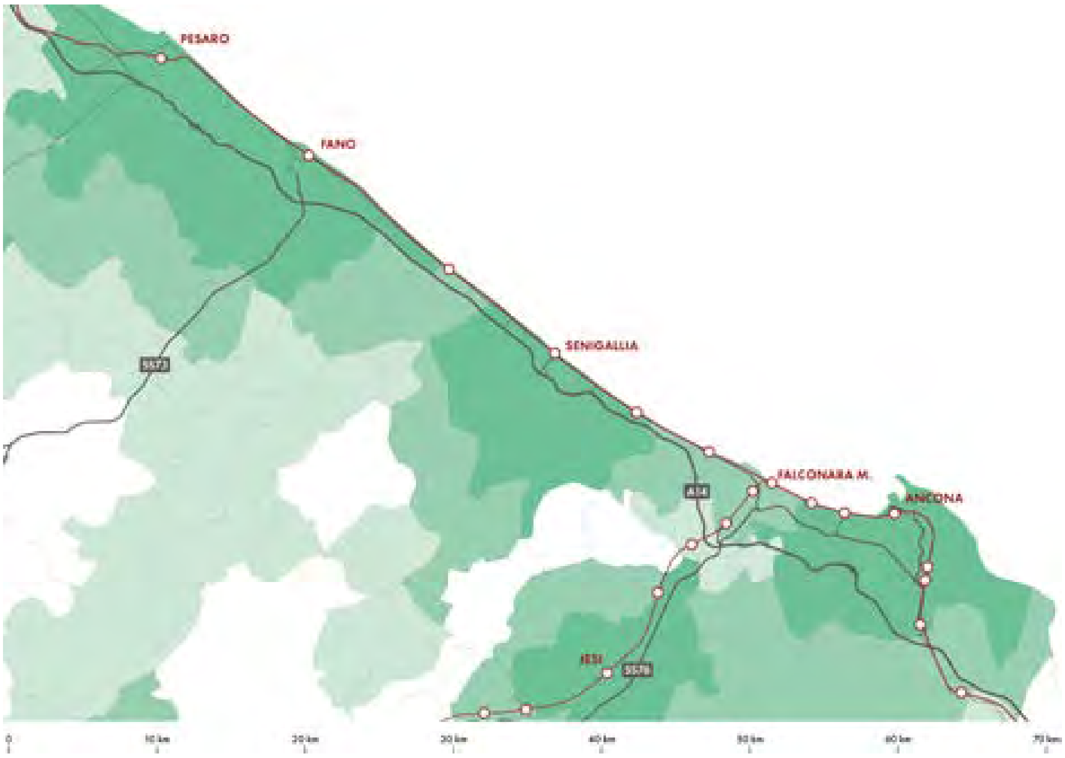


Fig. 85
Marche linear territory

obvious linear situation.

Defining other linear relationships of this type is possible, but it must be said that scale really plays an important role in this sense. In fact, if on the one hand we can identify linear micro-relationships in the north, such as along the Orta lake or in Val Camonica, it is more difficult to define linear territories along the large infrastructural relations of the country. We have seen the Marchigiano-Romagnolo case, which is rather emblematic, while immediately further north the center of the Emilian corridor, namely Reggio and Modena, could be defined in this sense, albeit with the necessary specificities and variability that emerge at the local scale. In the Center-South we can identify a corridor or, better say, two parallel corridors, which run between Rome and Naples, like that of Frosinone and Latina, albeit with a certain degree of variability when we go down in scale. A coastal situation, however, can be recognized in Sicily, between Messina and Palermo, where the motorway and railway link together a series of truly minor centers.

Multipolar territories

The category that very often overlaps with linear territories is that of multipolar territories. Intuitively, these are all those contexts characterized by the rather concentrated presence of minor hubs, often in strong relationships with each other, thanks also to the presence of a dense and significant network of road and railway infrastructures.

It is a category which, as already specified, depends greatly on the scale considered. It is in fact possible that some linear territories create a network and therefore a larger multipolar territory or that, on the contrary, territories that appear as multipolar are actually part of a larger infrastructural corridor.

The common characteristic is in any case that of representing a node of minor poles with their respective basins and that this network essentially rests on a multidirectional territory. The minor poles become the nodes of the infrastructural network, which then creates the structure on which other intermediate territories only partially attracted by these nodes rest.

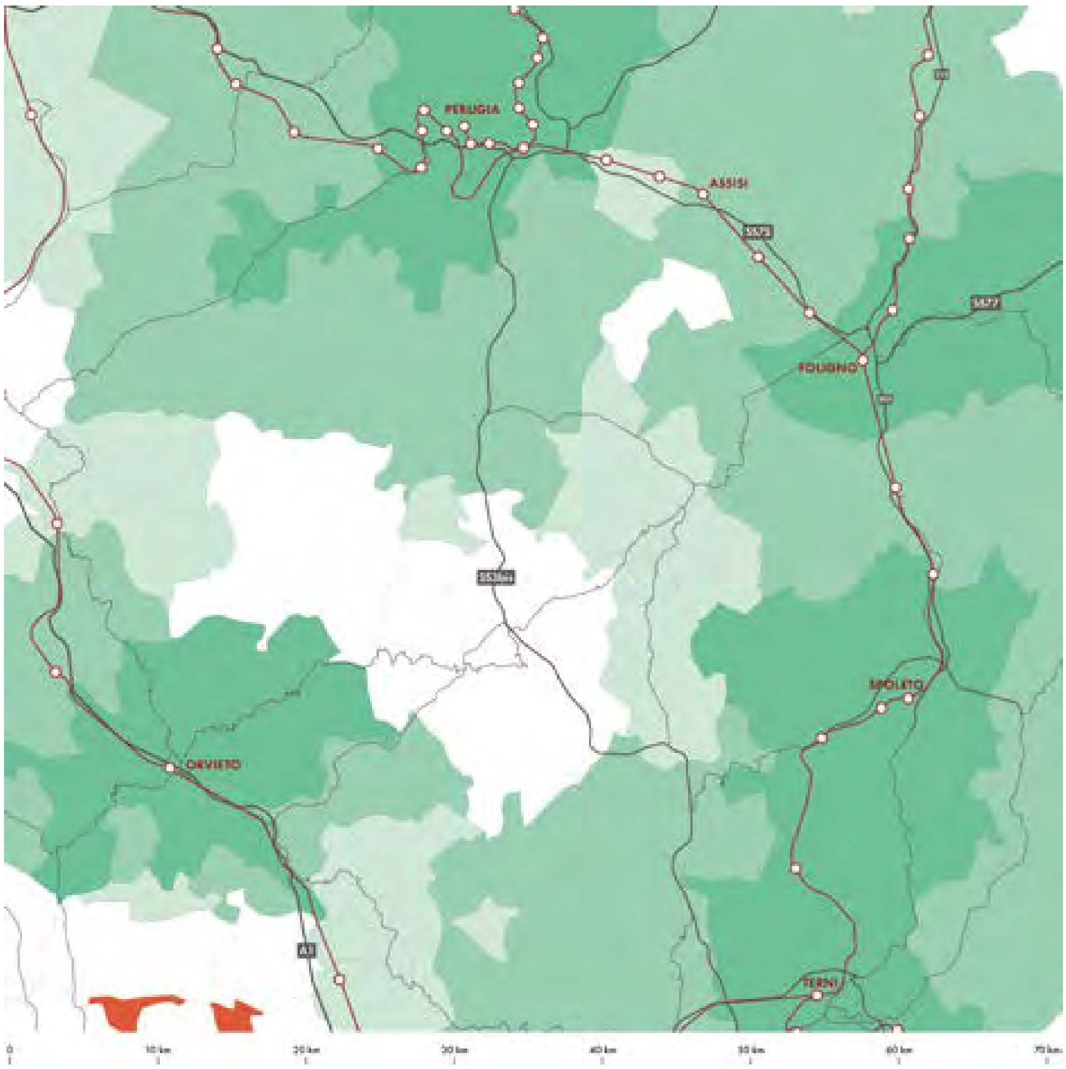


Fig. 86 Umbria multipolar territory

The Umbrian case is quite clear. In fact, we find a series of smaller hubs networked together and often united by the fact of being the hub of the infrastructural system. The line to Falconara and Perugia branches off in Spoleto, while the Rome-Florence line and the Ferrovia Centrale Umbra branch off in Perugia itself. The poles are then crossed by important infrastructural axes, such as the A1 motorway or the Via Flaminia.

As already mentioned, given that multipolar territories really depend on the scale at which they are considered, it is rather difficult to identify a single version of them in the Italian context. However, we can recognize some situations, albeit with different numbers and scales, in which we find a spatial concentration of two or more minor poles with a certain basin. For example, we find the Cuneo area, with the major center of Cuneo opening onto the smaller centers of Mondovì and Salluzzo, all connected by an important infrastructure network; Lomellina, with the smaller centers of Vigevano and Mortara and a dense infrastructure; we then find a rather large area, which goes from Mantova to Ferrara and Rovigo, characterized both by the presence of smaller network hubs and by a widespread multi-directional territory that is strongly connected at an infrastructural level; finally, other similar configurations seem to take place in Sicily, with the Enna-Caltanissetta duo-pole and, albeit on a rather large scale, the "baroque triangle" Syracuse-Ragusa-Caltagirone.

Isolated minor poles

We can simply assume that all the minor poles that do not fall into the previous ones fall into this category, but in fact there are minor poles that are rather isolated from a geographical but also infrastructural point of view. The fact that a minor pole is isolated, almost independent, could be considered a contradiction, but evidently this shows that it is unable to build a sufficiently consistent and vast basin around itself to be considered a mayor one.

It is not always true that an isolated minor center is disconnected from the infrastructural network. On the contrary, there may be cases in which the minor pole is located along a secondary infrastructural route or is its final destination, more rarely along or at the end of a primary route. It is particularly interesting to evaluate how approximately 90% of the smaller hubs are served by a railway station, confirming the significant role of railway services in the formation of attractive pole.

If we evaluate a specific case like that of Matera, we realize that local specificities matter. If on the one hand we see how the pole is the termination point of a railway line, it must be specified that it is a secondary line managed by FAL and which connects it in more than one hour to the city of Bari. There is still no direct connection with the southern side and the line of the state railways.

In general, Matera seems to be at the center of a system of infrastructural corridors which never cross it: the Bari-Taranto corridor, the axis of the Ionian state road and railway, the Basento valley and the Bari-Potenza relationship.

In a certain sense Matera, like other isolated minor poles, can become territories full

Fig. 87
Matera isolated minor pole

of opportunities from the point of view of mobility planning, since they may present an infrastructural under-provision, especially from a railway point of view, or simply a lack of integration into a system of transposition that is placed on the edges of these realities.

Other isolated poles appear to be: Gela and Trapani, rather isolated from the Sicilian infrastructure network, Benevento, despite being on the Naples-Bari corridor currently being upgraded, Grosseto, located along the Tyrrhenian route but decidedly disconnected from the rest of the Tuscan network, or some smaller valley centers in the Alpine arc, such as Clusone, Cavalese, Agordo, Chiavenna etc.

A univocal national image is rather difficult to define. We can indeed tentatively hypothesize the character of some Italian middle territories, without prejudice to the possibility that these are characterized by several possible at the same time.

We will thus have linear or multipolar situations, as in the Marche or in the double corridor between Rome and Naples, some isolated poles but which can be considered in relation with other isolated poles to form multipolar territories, as well as territories which appear multipolar on a geographical level but which then they are unable to express this characteristic due to a widespread lack of infrastructures.

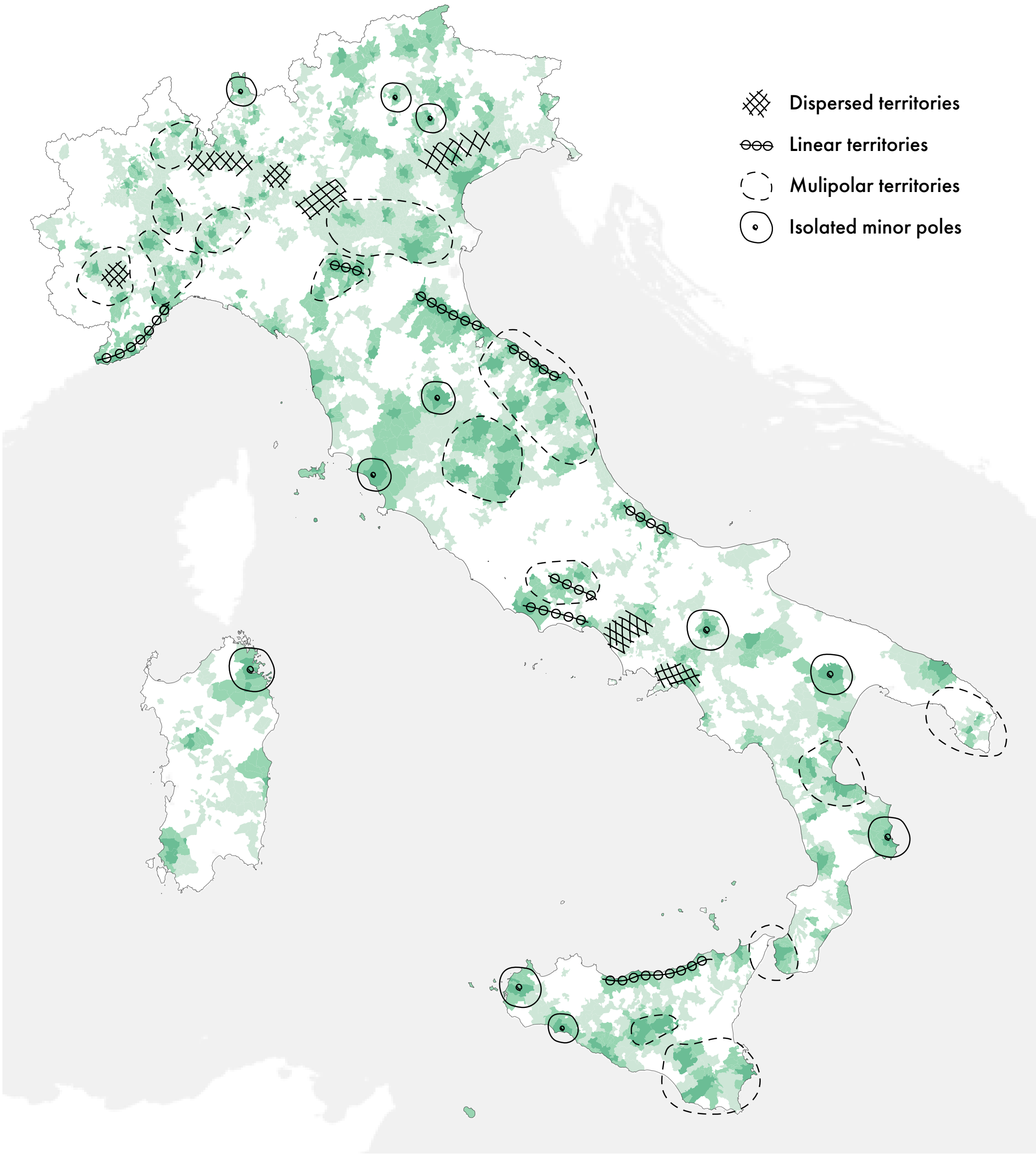


Fig. 88
Possible hypotheses for the Italia di Mezzo

3. A relevant case of *Italia di Mezzo*: the infrastructural bundle of southern Lazio

In this last chapter the analysis goes down in scale on a specific case recognized as *Italia di Mezzo* in chapter 2. It is that infrastructural bundle that connects the cities of Rome and Naples, in particular in the southern Lazio. In this context there are two main infrastructural corridors corresponding largely with the provinces of Frosinone and Latina. These are both rail and road corridors.

A first part of the work will explore these two territories more closely, identifying their specificities and common dynamics. In particular, we will delve into their trajectories of territorial, economic and demographic development and how infrastructures have shaped and continue to shape the landscape. The mobility of these two territories will also be described, both from the point of view of demand, supply and how local planning and projects are able to shape the future vision of the area.

In the second part of the chapter the northern railway corridor in the province of Frosinone will be further analyzed. The railway stations will be described based on some main aspects such as accessibility and the characteristics of the contexts in which they are inserted.

A final section will present some working guidelines for the drafting of a possible Strategic Integrated Plan for Sustainable Mobility in this area of *Italia di Mezzo*, offering a series of answers to some of the research questions formulated at the end of the first chapter.

3.1 Overview of the case study area

3.1.1 The infrastructural bundle between Rome and Naples

The examined territory largely coincides with the two provinces of Frosinone and Latina, in the Lazio region. It is located south-east of Rome, in an intermediate position between the capital and Naples. If we consider the national scale, it is essentially an infrastructural bundle made up of two corridors and which connects the two metropolitan areas. On a more local scale, however, we cannot properly speak of a single and homogeneous territory, both for physical-geographical and historical-cultural reasons.

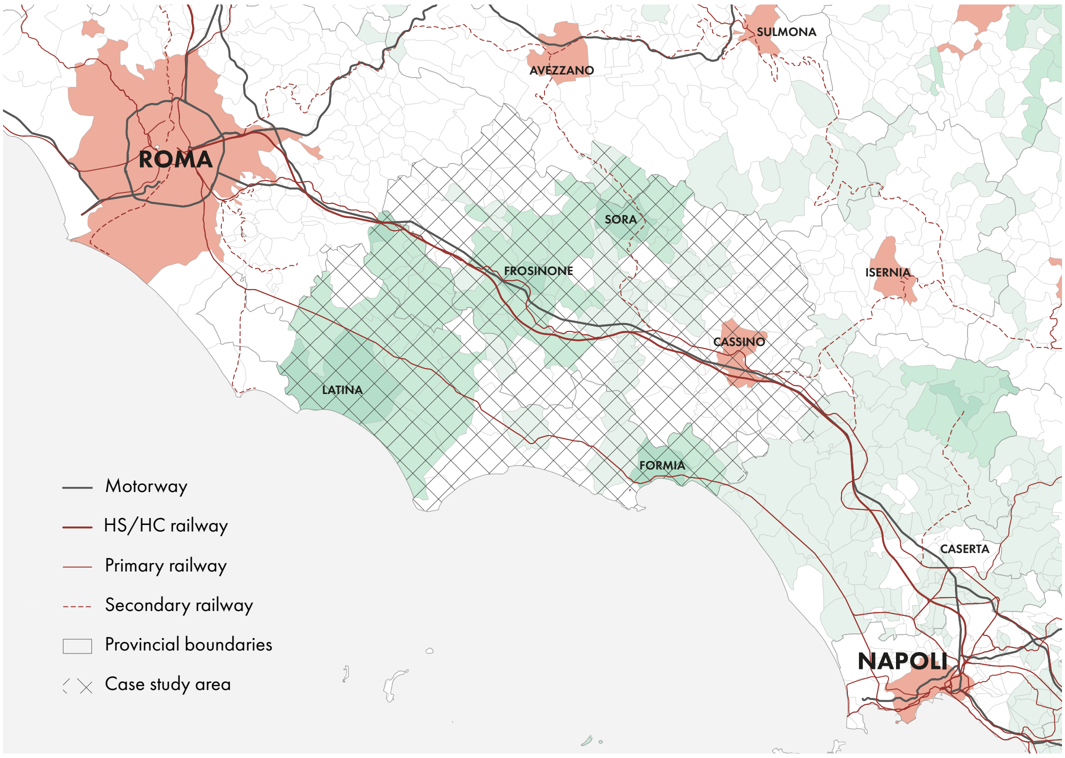


Fig. 89 The infrastructural bundle between Rome and Naples.

The northern corridor, in fact, branches off from Rome and crosses a geographical area often identified as "Ciociaria", a name that has been attributed over the years to the entire province of Frosinone.[1] Beyond the geographical or cultural definitions, the corridor follows the valley of the Sacco river, which rises east of Rome and continues its course with a west-east trend, to then flow into the Liri basin and eventually into the Tyrrhenian Sea, marking the border between Lazio and Campania regions.

1 The geographical definition of the territory defined as "Ciociaria" still remains not well clear. Sometimes it has even been used to define the entire southern Lazio, including the province of Latina, more often to refer only to the Sacco valley and the Frosinone area, therefore excluding the Liri valley and Cassino.

The northern corridor is essentially made up of three main infrastructures, a road one and two railways. The road axis is the A1 motorway, the main link designed to support the industrial development of the area, as well as obviously the main road connection between northern and southern Italy. Some secondary relationships branch off from the A1 axis, such as the recent highway that connects the town of Sora and the area between Lazio and Abruzzo, the highway that connects Frosinone to Latina and Terracina and finally the highway between Cassino and Formia, further south. The railway infrastructure consist of the traditional line connecting Rome and Naples passing through Cassino and the more recent high speed line that cut the territory along the valley and links the tho metropolitan areas in around one hour.

The southern corridor touches the Tyrrhenian Sea and it's essentially a railway corridor. The most recent Rome-Formia-Naples railway line runs parallel to the northern axis, taking a total of around 30 km less to connect the two regional capitals. Road connectivity is not designed to guarantee long relationships, but mainly to connect the main hubs with Rome. This is the case of the Pontina highway, which connects the main center of Latina with the capital. The other main artery is represented by the Appia state road, which crosses the entire territory. It is a road axis with formal characteristics such that it cannot be counted as a fast axis; in addition to having a limited road section and almost always grade-level crossing, it very often takes on the status of a local connecting road, as it crosses most of the consolidated nuclei of the municipalities.

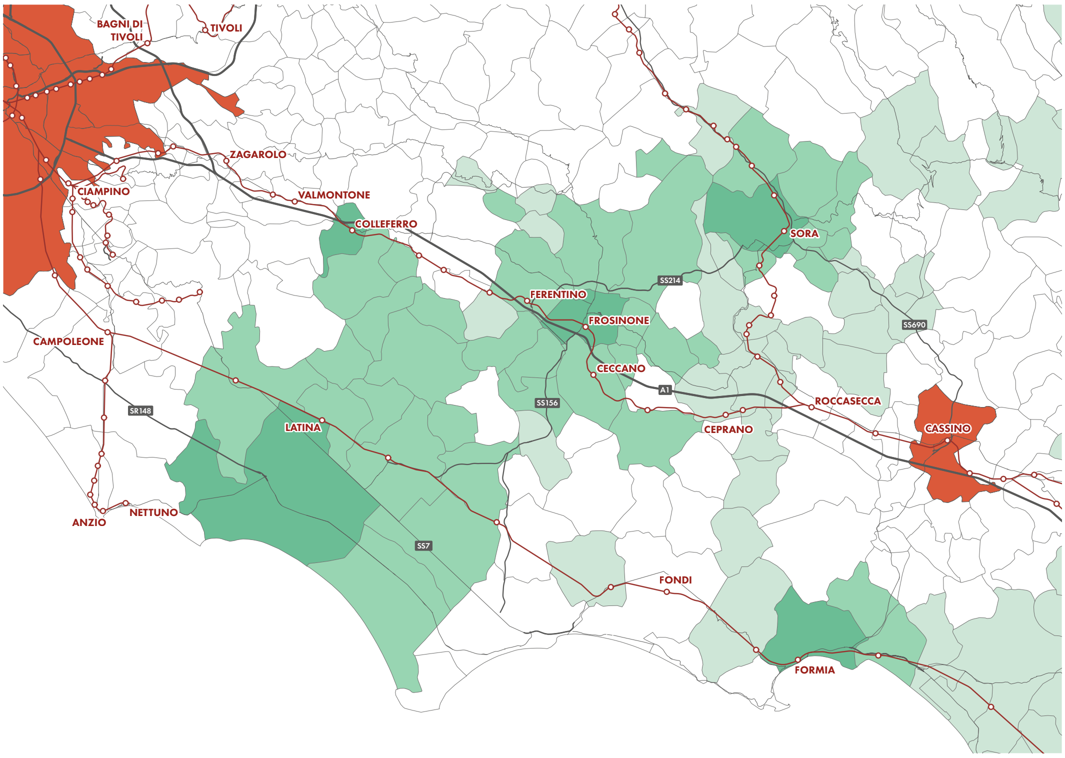


Fig. 90
The case study area

3.1.2 Specific geographical areas beyond the corridors

The infrastructure corridors cross very different territories. For the analysis of the case study of this research, the municipalities to be specifically analyzed were conventionally identified, based above all on the classification work carried out in chapter two.

Fig. 91
The administrative entities

In fact, we find a geography of *Italia di Mezzo* that tends to be multipolar, between the major center of Rome and that of Cassino, the first one to the south capable of fully fulfilling this role, while maintaining a purely local dimension of influence. The main centers of the northern axis are Cassino, as major hub, and then Frosinone, Sora and Colleferro, all minor hubs. In the southern axis we find the minor poles of Latina and Formia, each with their own respective basins. Below is a list of all the municipalities included in the analysis area. Of these, 91 fall in the province of Frosinone, 30 in that of Latina, 6 in that of Rome, 5 in that of Caserta and 2 in the province of L'Aquila.

MUNICIPALITY	PROVINCE	CORRIDOR	POP_2011	POP_2023	SURFACE[2]	DENSITY[3]
Frosinone	Frosinone	North	46649	43417	46.84	926.84
Cassino	Frosinone	North	33658	35092	83.42	420.67
Alatri	Frosinone	North	28609	27693	96.96	285.62
Sora	Frosinone	North	26247	24884	72.12	345.01
Ceccano	Frosinone	North	23098	22320	61.06	365.54

2 In square km
3 Referred to 2023 population

Anagni	Frosinone	North	21441	20734	112.81	183.79
Colleferro	Roma	North	21574	20536	26.99	760.9
Ferentino	Frosinone	North	20966	20048	81	247.51
Veroli	Frosinone	North	20763	19602	119.64	163.84
Pontecorvo	Frosinone	North	13223	12333	88.8	138.88
Mon. S. Giovanni Campano	Frosinone	North	12882	12009	48.71	246.53
Isola del Liri	Frosinone	North	11963	10735	16.01	670.35
Fiuggi	Frosinone	North	9645	10082	32.98	305.72
Segni	Roma	North	9101	8959	60.86	147.21
Boville Ernica	Frosinone	North	8811	8366	28.19	296.79
Ceprano	Frosinone	North	8740	8116	38.03	213.41
Paliano	Frosinone	North	8146	7901	70.64	111.85
Cervaro	Frosinone	North	7744	7780	39.41	197.42
Roccasecca	Frosinone	North	7536	6866	43.33	158.45
Arpino	Frosinone	North	7386	6684	56.24	118.85
Piedimonte San Germano	Frosinone	North	6036	6316	17.32	364.57
Sant'Elia Fiumerapido	Frosinone	North	6227	5690	41.1	138.43
Arce	Frosinone	North	5783	5439	39.52	137.62
Ripi	Frosinone	North	5346	5006	31.61	158.35
Aquino	Frosinone	North	5309	4932	19.24	256.38
Torrice	Frosinone	North	4608	4692	18.06	259.8
Supino	Frosinone	North	4893	4602	35.59	129.31
Castro dei Volsci	Frosinone	North	4903	4465	58.45	76.39
Piglio	Frosinone	North	4657	4375	35.38	123.65
Atina	Frosinone	North	4461	4133	29.89	138.28
Amaseno	Frosinone	North	4314	4094	77.73	52.67
Carpineto Romano	Roma	North	4649	4025	86.29	46.65
Pofi	Frosinone	North	4303	3920	30.68	127.77
Castrocielo	Frosinone	North	3969	3776	27.91	135.27
Esperia	Frosinone	North	3903	3549	108.56	32.69
Balsorano	L'Aquila	North	3655	3265	58.84	55.49
Morolo	Frosinone	North	3267	3195	26.57	120.24
Castelliri	Frosinone	North	3533	3183	15.32	207.76
Patrica	Frosinone	North	3084	3071	27.31	112.46
San Giovanni Incarico	Frosinone	North	3410	3049	24.71	123.39
Rocca d'Evandro	Caserta	North	3366	3023	49.53	61.03
San Giorgio a Liri	Frosinone	North	3166	3005	15.71	191.34
Mignano Monte Lungo	Caserta	North	3258	3004	53.1	56.58
Serrone	Frosinone	North	3069	2996	15.39	194.62
Fontana Liri	Frosinone	North	2993	2693	16.11	167.15
Broccostella	Frosinone	North	2807	2681	11.79	227.33
Pico	Frosinone	North	3004	2634	32.93	79.98
Villa Santa Lucia	Frosinone	North	2639	2502	17.77	140.82
Alvito	Frosinone	North	2852	2485	51.71	48.05
Casalvieri	Frosinone	North	2867	2436	27.27	89.33
Pignataro Interamna	Frosinone	North	2558	2425	24.41	99.36
Ausonia	Frosinone	North	2650	2409	19.64	122.67

Vallecorsa	Frosinone	North	2800	2407	39.28	61.28
San Vittore del Lazio	Frosinone	North	2679	2404	27.5	87.4
Sgurgola	Frosinone	North	2623	2370	19.22	123.3
Giuliano di Roma	Frosinone	North	2343	2317	33.54	69.07
Strangolagalli	Frosinone	North	2501	2306	10.57	218.21
Arnara	Frosinone	North	2379	2192	12.29	178.38
San Vincenzo Valle Roveto	L'Aquila	North	2433	2087	46.04	45.33
Vico nel Lazio	Frosinone	North	2256	2058	45.84	44.89
Montelanico	Roma	North	2152	2053	35.14	58.42
Galluccio	Caserta	North	2239	2036	32.11	63.4
Fumone	Frosinone	North	2180	1965	14.84	132.45
Gavignano	Roma	North	1956	1891	15.04	125.71
San Donato Val di Comino	Frosinone	North	2122	1888	37.63	50.17
Acuto	Frosinone	North	1910	1835	13.47	136.27
Sant'Apollinare	Frosinone	North	1931	1814	18.02	100.67
Colfelice	Frosinone	North	1853	1780	14.52	122.61
Trevi nel Lazio	Frosinone	North	1853	1718	54.32	31.63
Campoli Appennino	Frosinone	North	1749	1614	32.43	49.77
Trivigliano	Frosinone	North	1693	1613	12.64	127.61
Villa Santo Stefano	Frosinone	North	1707	1612	20.1	80.2
Coreno Ausonio	Frosinone	North	1671	1525	26.38	57.8
Guarcino	Frosinone	North	1658	1489	40.37	36.88
Pescosolido	Frosinone	North	1552	1424	44.89	31.72
Vallerotonda	Frosinone	North	1671	1396	59.66	23.4
Torre Cajetani	Frosinone	North	1388	1293	11.99	107.82
Sant'Andrea del Garigliano	Frosinone	North	1566	1292	17.11	75.53
Pastena	Frosinone	North	1528	1263	42.16	29.96
Fontechiari	Frosinone	North	1318	1237	16.15	76.6
Gallinaro	Frosinone	North	1246	1198	17.74	67.54
Santopadre	Frosinone	North	1410	1186	21.6	54.91
Conca della Campania	Caserta	North	1256	1154	26.47	43.6
Villa Latina	Frosinone	North	1286	1148	17.02	67.44
Prossedi	Latina	North	1233	1137	35.37	32.15
Picinisco	Frosinone	North	1255	1098	62.15	17.67
Posta Fibreno	Frosinone	North	1217	1021	9.8	104.14
Vallemaio	Frosinone	North	1002	892	18.54	48.12
Rocca d'Arce	Frosinone	North	971	885	11.58	76.41
Collepardo	Frosinone	North	975	884	24.68	35.82
Sant'Ambrogio sul Gar.	Frosinone	North	994	876	9.03	97.06
Castelnuovo Parano	Frosinone	North	902	858	9.88	86.83
San Pietro Infine	Caserta	North	949	838	13.72	61.09
Vicalvi	Frosinone	North	806	733	8.21	89.3
Settefrati	Frosinone	North	792	713	50.68	14.07
Belmonte Castello	Frosinone	North	778	678	14.05	48.24
Gorga	Roma	North	767	665	26.19	25.39
Colle San Magno	Frosinone	North	744	631	44.99	14.03
Casalattico	Frosinone	North	641	534	28.38	18.82

Filettino	Frosinone	North	551	516	78.07	6.61
Falvaterra	Frosinone	North	567	514	12.73	40.37
Viticuso	Frosinone	North	372	304	20.86	14.57
Terelle	Frosinone	North	460	303	31.64	9.58
San Biagio Saracinisco	Frosinone	North	361	297	31.21	9.52
Acquafondata	Frosinone	North	282	261	25.32	10.31
Latina	Latina	South	117892	127564	277.62	459.5
Terracina	Latina	South	44233	44720	136.59	327.41
Fondi	Latina	South	37180	39550	143.91	274.82
Formia	Latina	South	36331	37136	74.16	500.73
Cisterna di Latina	Latina	South	35551	36159	144.16	250.83
Sezze	Latina	South	24114	23697	100.47	235.86
Minturno	Latina	South	19472	20268	42.13	481.03
Sabaudia	Latina	South	18812	19434	145.37	133.68
Gaeta	Latina	South	20762	19423	29.2	665.1
Pontinia	Latina	South	13812	15046	112.1	134.22
Priverno	Latina	South	13891	13735	56.98	241.05
Cori	Latina	South	11025	10366	85.31	121.51
Itri	Latina	South	10460	10357	101.1	102.45
San Felice Circeo	Latina	South	8709	10137	32.63	310.66
Sermoneta	Latina	South	9129	10037	45	223.06
Sonnino	Latina	South	7279	7352	63.82	115.2
Santi Cosma e Damiano	Latina	South	6882	6885	31.61	217.81
Monte San Biagio	Latina	South	6144	6044	65.1	92.84
Roccagorga	Latina	South	4552	4169	24.49	170.21
Lenola	Latina	South	4155	4055	45.24	89.63
Castelforte	Latina	South	4401	4025	29.7	135.5
Norma	Latina	South	4035	3623	31.22	116.04
Sperlonga	Latina	South	3334	3050	19.49	156.49
Maenza	Latina	South	3078	2952	42.13	70.06
Spigno Saturnia	Latina	South	2903	2852	38.74	73.62
Bassiano	Latina	South	1580	1440	32.4	44.44
Rocca Massima	Latina	South	1094	1064	18.17	58.57
Roccasecca dei Volsci	Latina	South	1126	1043	23.5	44.38
Campodimele	Latina	South	638	560	38.38	14.59

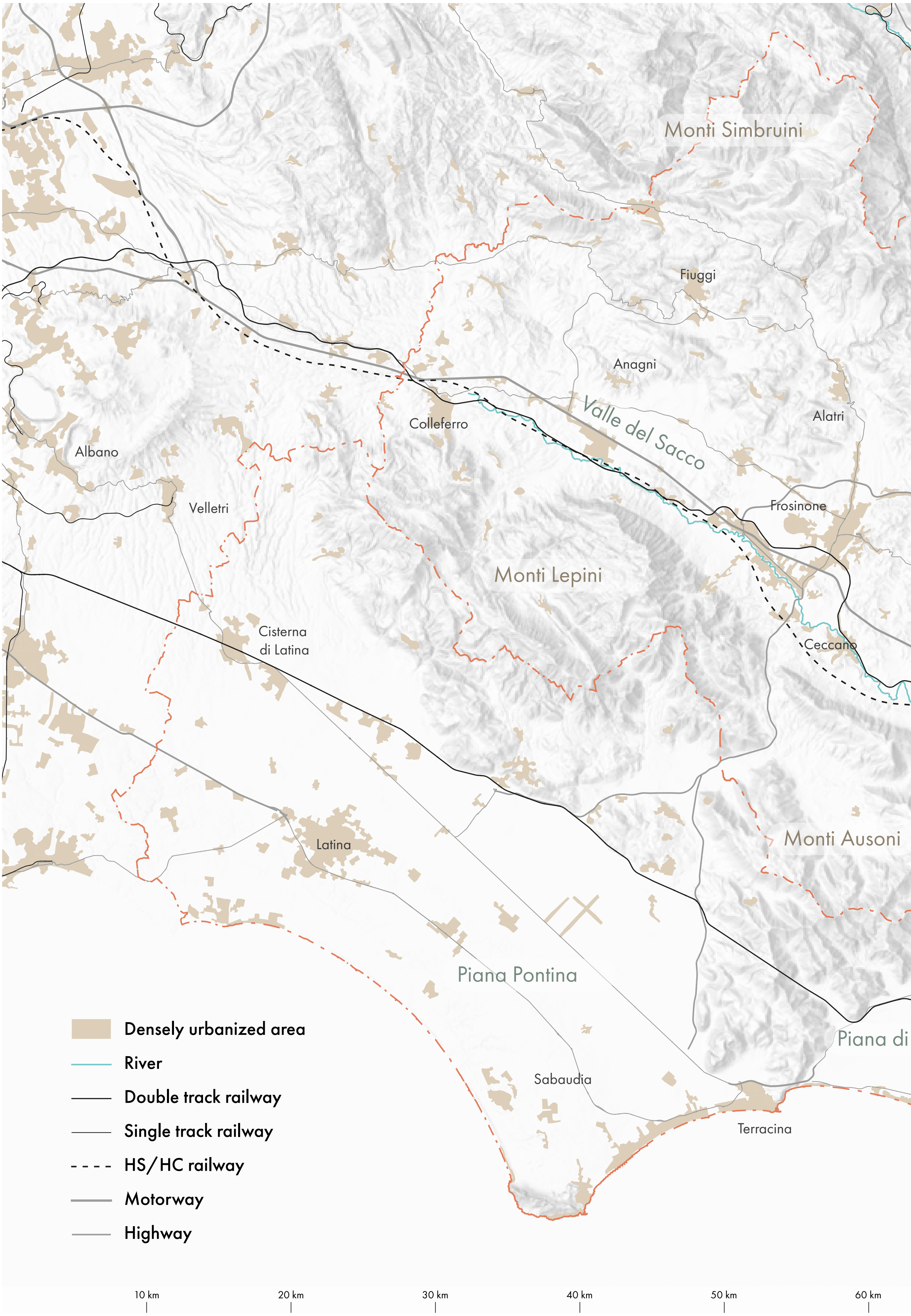
Tab. 2 The municipalities of the two corridors

In this context the influence of Rome becomes relevant. This aspect will be analyzed in greater detail later in chapter 3.2, but it is worth immediately highlighting how the capital exerts such an influence on this territory as to make almost all the poles smaller. The only one that manages to "break away" from this relationship and create a strong basin of its own is Cassino. In fig. 90 we can clearly identify an evident north-south sequence of "multidirectional territories" between Cassino and Frosinone, almost as if to mark this imaginary border.

The multipolarity of the area could suggest a unitary and compact conformation but, as already specified, this image is immediately denied by the geomorphology of the

Fig. 92
View of the Simbruini Mountains from the Colleferro countryside

territory. In fact, we find clear differences and an accentuated infrastructural isolation between the two corridors, but also important specificities within each of them. In particular, the two corridors are transversely separated by a continuous succession of mountain groups: starting from the north-west towards the south-east we find the Lepini, Ausoni and Aurunci mounts. On the coastal side the morphology is purely flat. We find the large Pontina plain, made habitable by the important reclamation works begun in the 1920s, which extends from the south-eastern quadrant of Rome to the municipality of Terracina. From here an offshoot of the Ausoni mounts separates it from the smaller Fondi plain, where the homonym municipality is located. Further south, the municipalities of Gaeta and Formia are located along the coast, downstream from the Aurunci mounts. On the internal side however, the orography follows rather precisely the course of the two main rivers: the Sacco and the Liri. The first creates a valley that extends from the municipality of Colleferro to the confluence with the Liri. The latter runs through the territory coming from Abruzzo region, crossing Sora and other important minor municipalities. The Liri, continuing its course westwards, reaches the Gari, from which it takes the name of Garigliano, up to its mouth in the Gulf of Gaeta. These valley contexts, which are the most urbanized, are contrasted by vast hilly and mountain areas, such as those that separate the Sacco valley and the coastal area, up to the first pre-Apennines reliefs.



Monti Simbruini
Fiuggi
Anagni
Alatri
Valle del Sacco
Colleferro
Albano
Velletri
Frosinone
Monti Lepini
Cisterna
di Latina
Ceccano
Monti Ausoni
Latina
Piana Pontina
Piana di
Sabaudia
Terracina
Densely urbanized area
River
Double track railway
Single track railway
HS/HC railway
Motorway
Highway
10 km
20 km
30 km
40 km
50 km
60 km

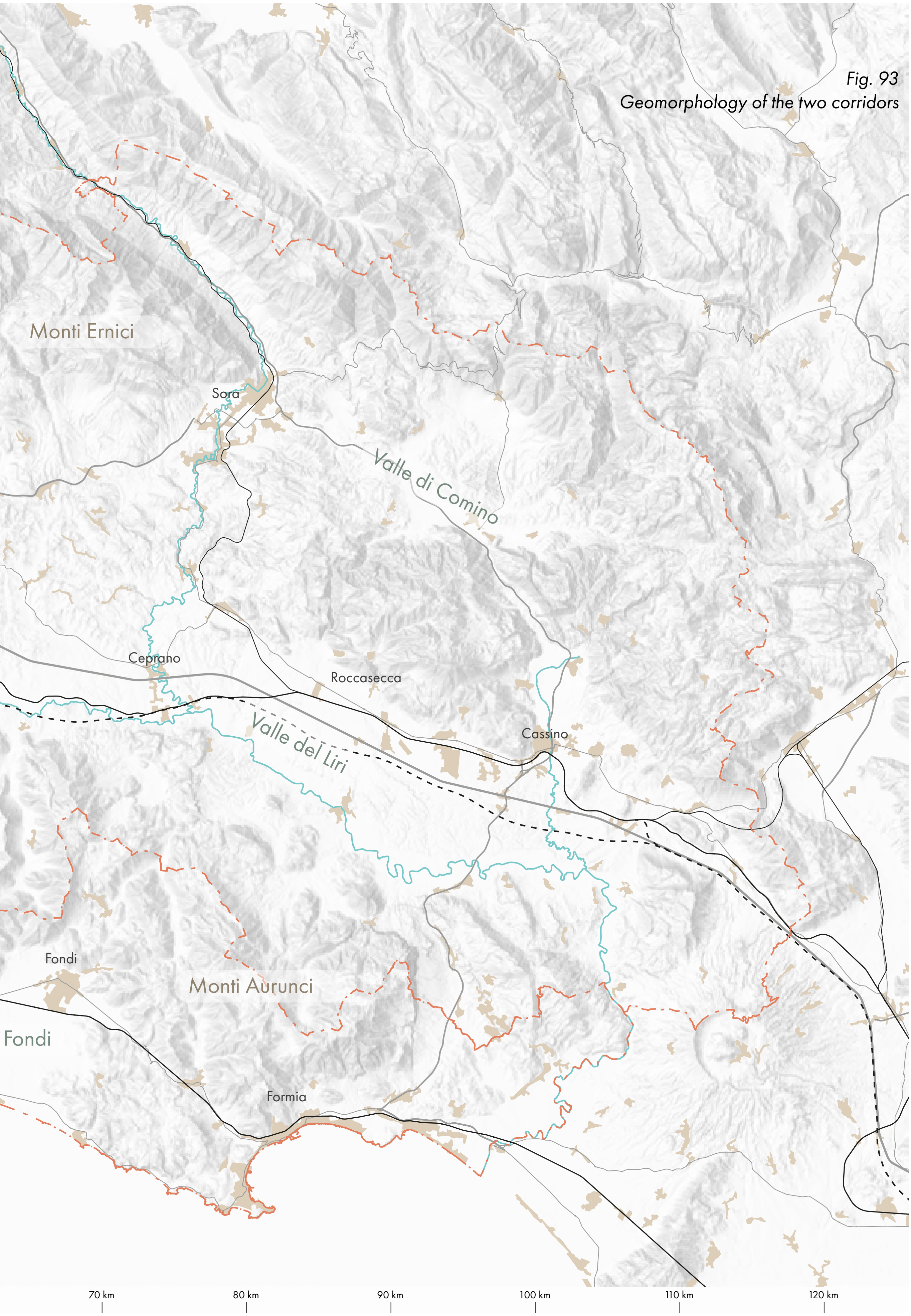


Fig. 93
Geomorphology of the two corridors

3.1.5 Two rhythms for the two corridors

We have already highlighted some main differences between the two corridors. Another fundamental component that marks a clear line of separation between the northern and southern corridors is the demographic one. In summary, it can be stated that the former is in a recent phase of constant recession, while the latter is in a phase of absolute development.

The demographic dynamics, even the most recent ones, are profoundly related to the different territorial and economic developments of the two provinces.

The province of Frosinone preserves an older urban history, made up of many urban centres, even small ones, and some medium-sized main centres. On the contrary, the province of Latina, especially in the Agro Pontino, has had a much shorter history, with a main center with more than 100 thousand inhabitants, Latina, and a few other medium-sized municipalities.

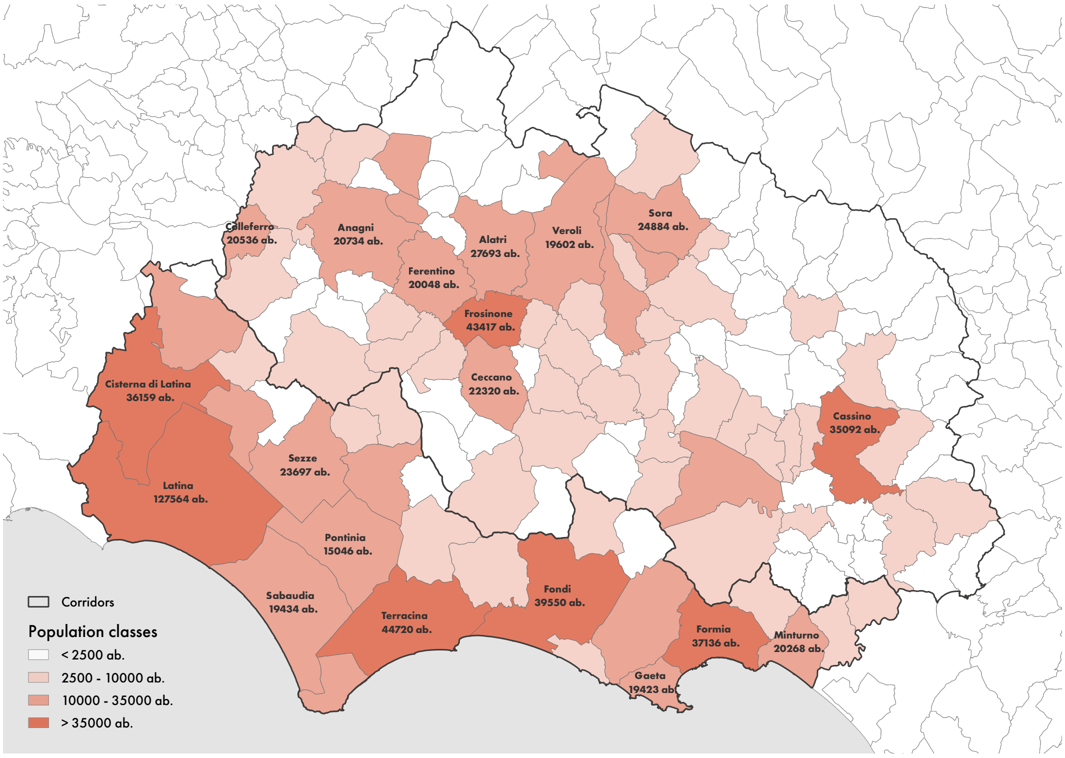
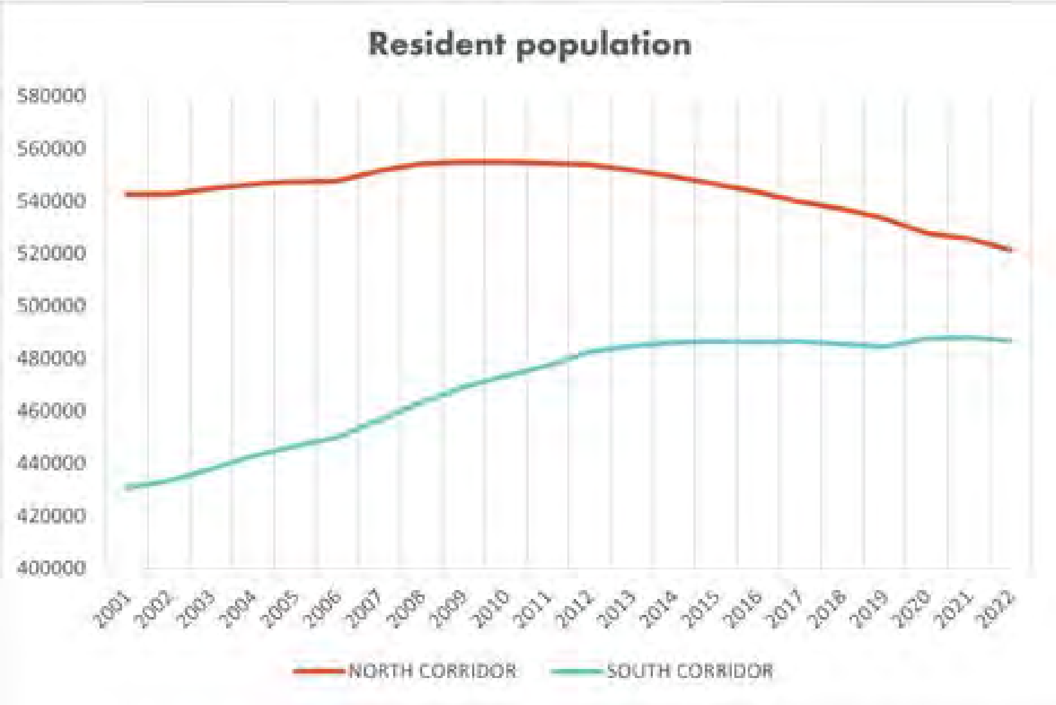


Fig. 94 Municipalities by population classes

Even without spatializing the data on the resident population from 2001 to 2022, we are able to evaluate how the northern corridor experienced a generally stable period until 2010, and then began a phase of continuous population decline. On the contrary, the south transept experienced a phase of rapid expansion until 2010, and then a certain stability until today. If we compare the relative increases with the national data, it is even more evident that the two transepts have completely different trends



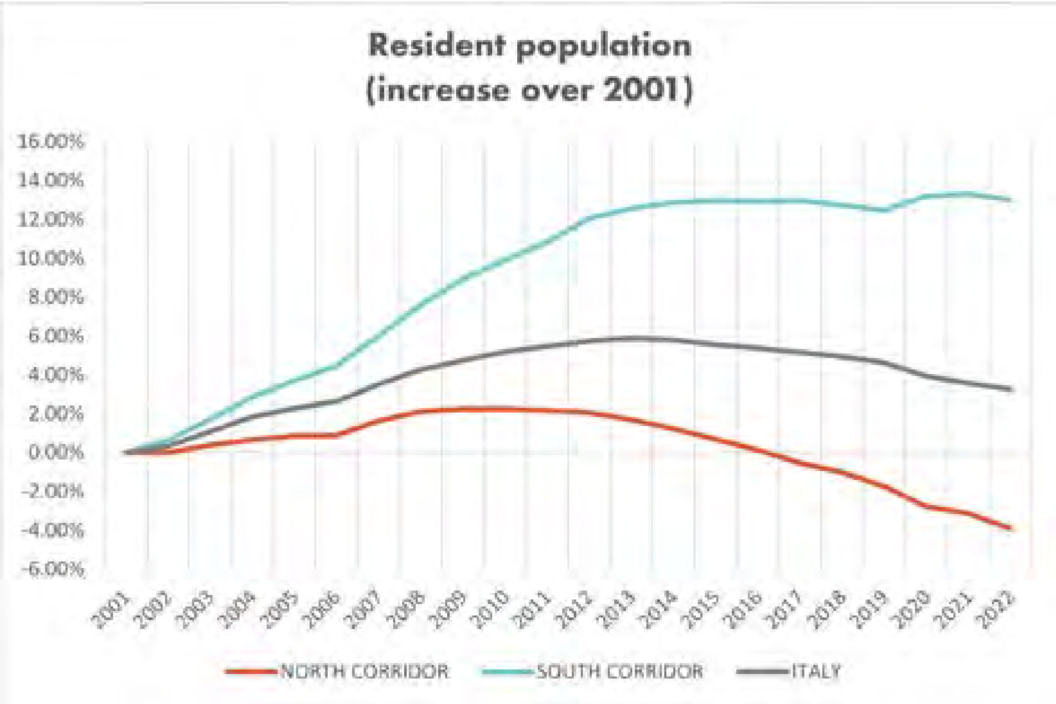


Fig. 95 Trend of the resident population (on top) and increase of the resident population over the 2001

By spatializing these trends, it is possible to detect the variation for each individual municipality. In the first representation, the total increase between 2001 and 2022 is considered, referring it to 2001. In the other two, the entire period is divided into two phases, evaluating only the presence of growth or decrease. For the first case, 2013 was chosen as the reference year, as it is the year of decline in the Italian curve. In the second, we wanted to evaluate a possible effect of the pandemic, setting 2019 as the threshold value.

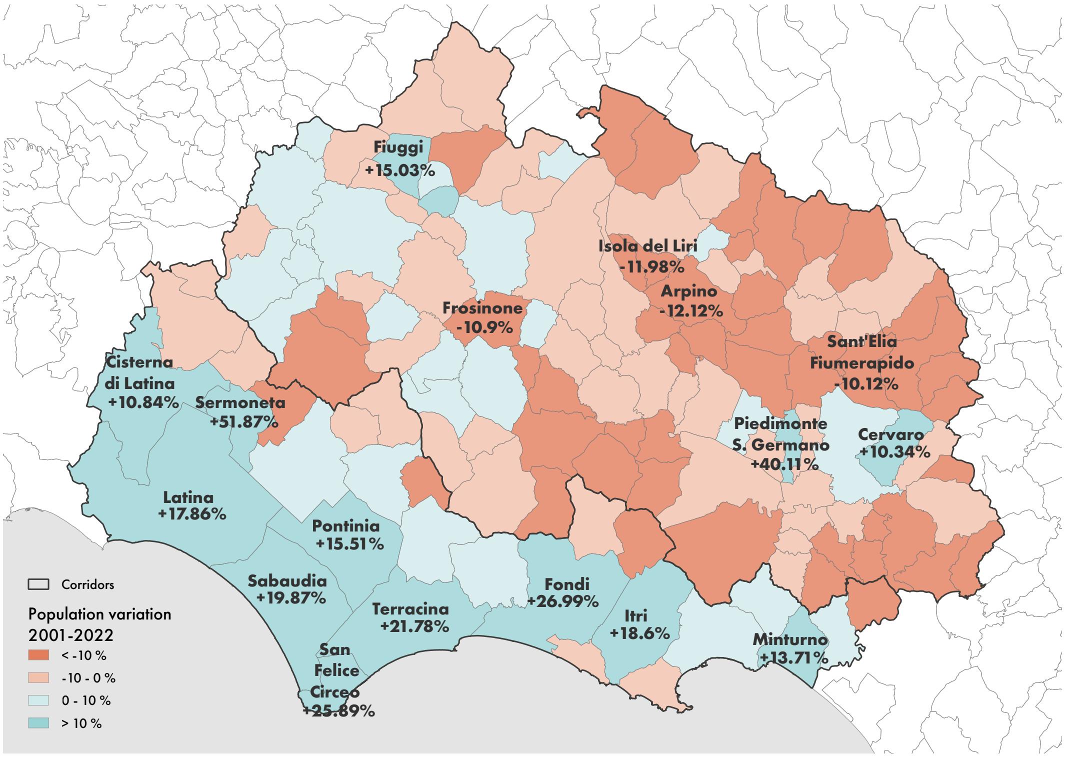


Fig. 96 Municipalities by population variation 2001-2023

All representations give a rather clear picture. The southern corridor has seen increases especially in the plain and coastal municipalities closest to Rome, while the hinterland and the Gaeta area present more heterogeneous variations. The situation in the northern corridor is very different, where not even the main centers have had constant increases in populations over the entire twenty years. The only exceptions are Cassino

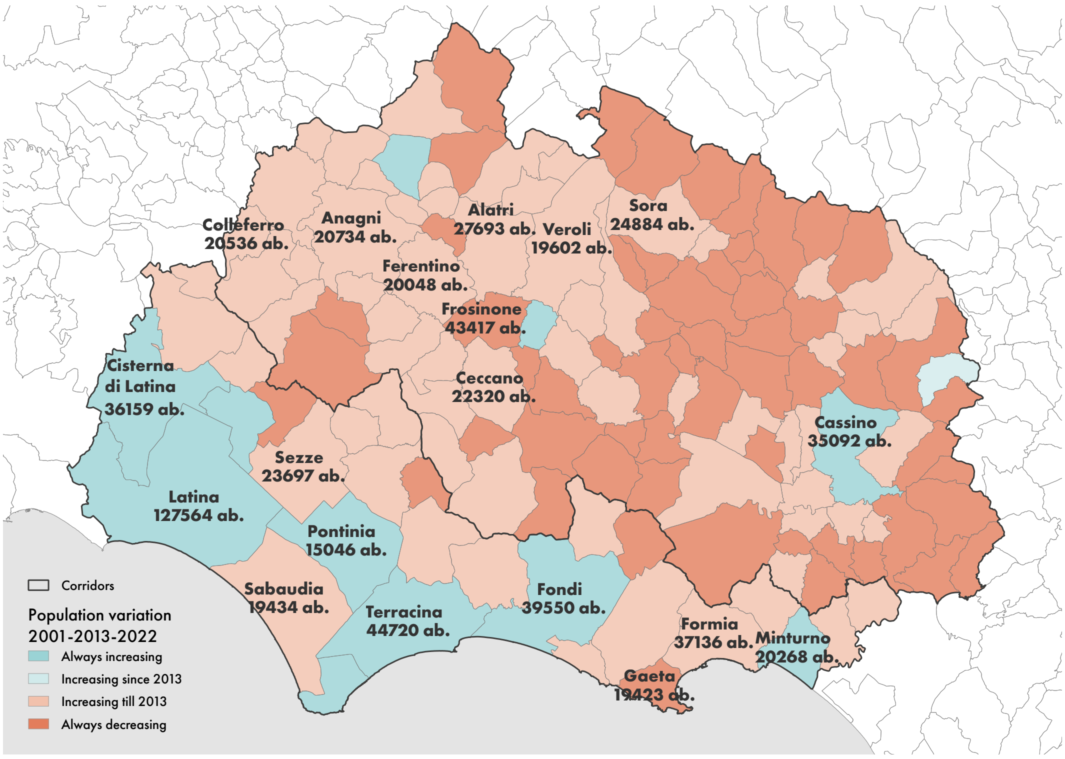


Fig. 97 Municipalities by population variation 2001-2013-2023

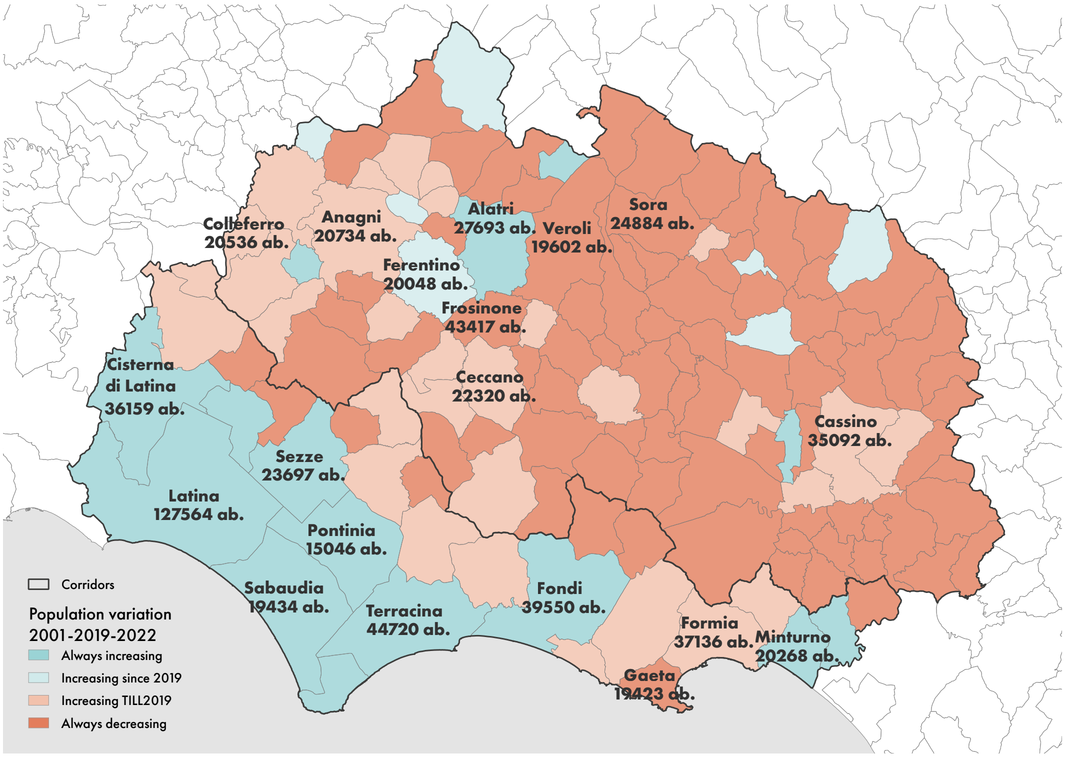


Fig. 98 Municipalities by population variation 2001-2019-2023

and Fiuggi, while all the other main centers have been decreasing since 2013 or even 2001. All the small hill and mountain municipalities are evidently in a constant phase of depopulation, especially if we consider the period 2001-2019- 2022.

The determinants of demographic increases appear to be two: the lowland or coastal location and the relative proximity to the city of Rome, plus the Cassino area. We can try to explain these variations with at least three main components.

- A natural balance of the population, i.e. the growth or decrease due to births and deaths;
- A migratory balance, in this case evaluated with the percentage of resident foreign population;
- An internal registry balance, among the population registered or canceled from or to another Italian municipality.

As regards the natural balance, if we evaluate a relative balance, we can compare the performance of the two corridors with the Italian one. These are very similar trends which reflect the decline in the Italian population starting from around 2013. However, we observe that the southern corridor constantly maintains higher values than the northern one, albeit with the same trend.

As regards the foreign population, the trends are quite different. Although almost always remaining below the national value, the share of foreign population in the northern transept had a constant growth until 2018, from which it suffered a decline.

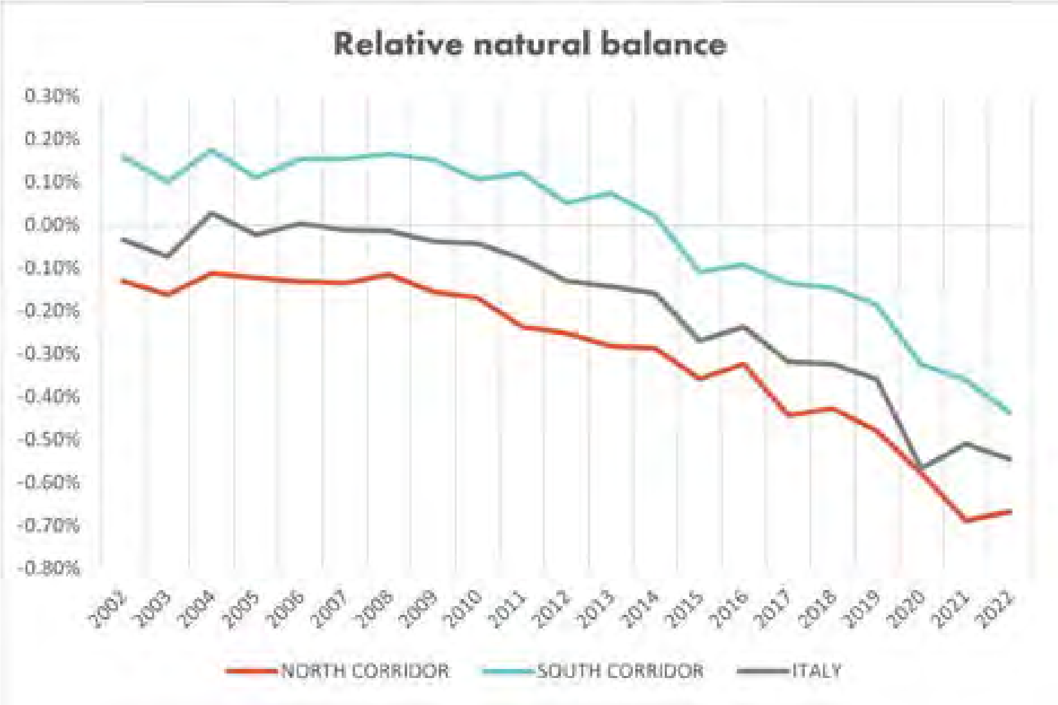


Fig. 99
Relative natural balance

The southern corridor, however, experienced an increase equal to that of the northern corridor until 2008, the year from which the increase significantly increased, to reach the Italian value in 2018. We can therefore explain a good part of the total demographic increase in the southern corridor with an increase in the foreign population.

Internal population movements, i.e. to and from other Italian municipalities, once again show a certain dualism. While for the northern corridor there is a constant

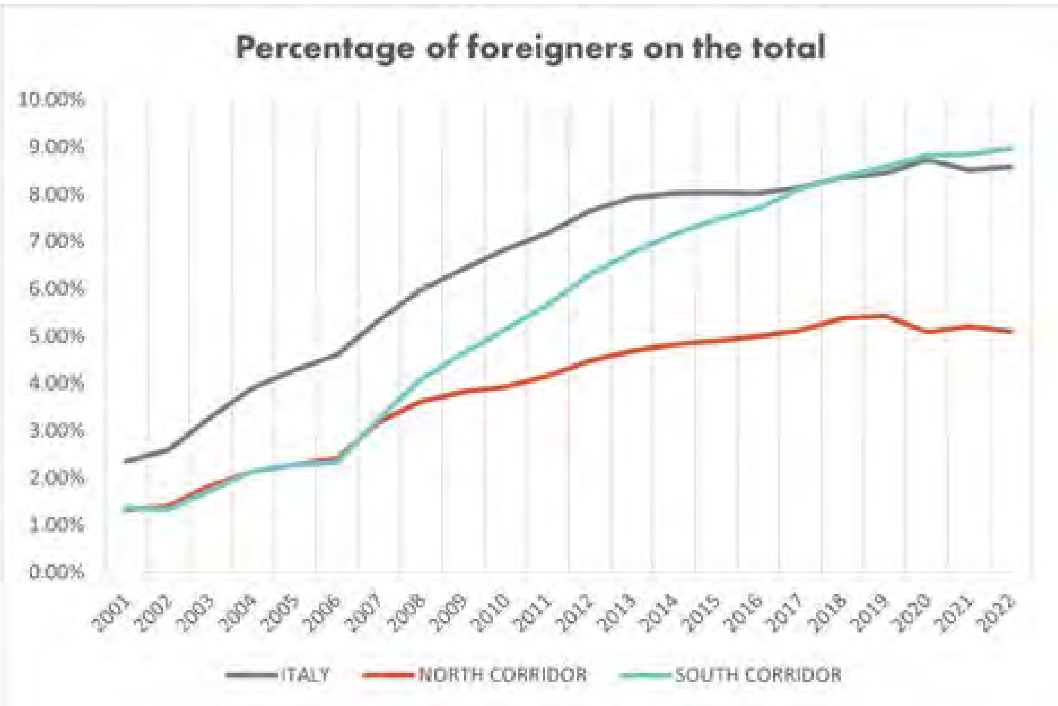


Fig. 100
Percentage of foreigners on the total

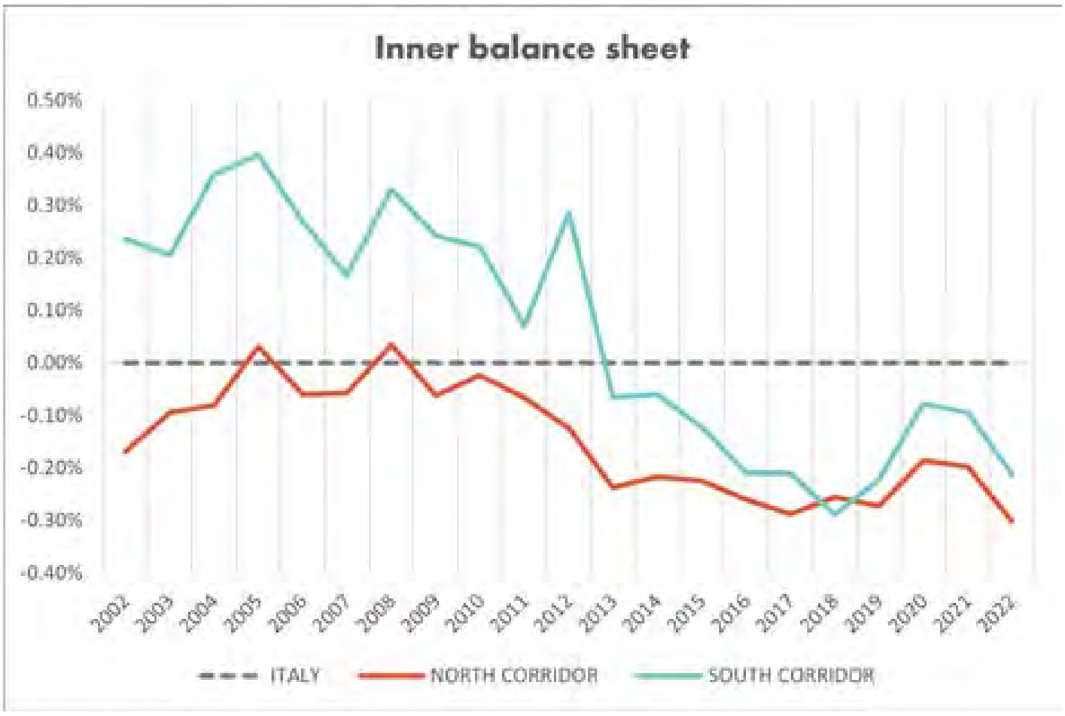


Fig. 101
Inner balance sheet

outflow of the resident population towards other municipalities, in the case of the southern corridor we find instead an opposite situation until 2013, the year in which the trend completely reversed. It is interesting to evaluate how from 2018 to 2020, for both corridors, there was a brief increase in point values which then started to fall again until today.

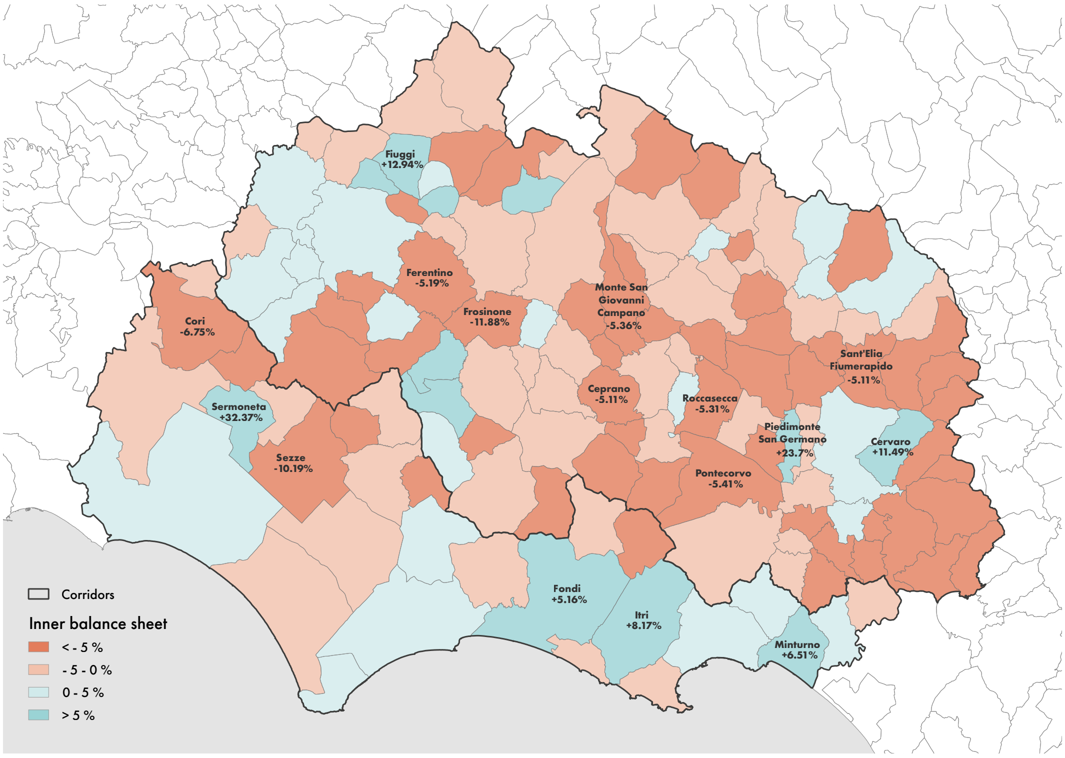


Fig. 102
Municipalities by inner balance sheet

If we further specify this information at the municipal scale, the picture is more complex. We could in fact intuitively imagine that the population has moved from small municipalities towards larger centres, but this is only partially true. On the one hand, in fact, we find hubs that have had a positive internal population balance, such as Fiuggi and Fondi, or municipalities located in the area of influence of a hub, as in the case of Cassino. Other hubs, however, present a negative balance: this is the case of Frosinone and Ferentino.

Although through a rather limited analysis we can draw some conclusions regarding the different components of the demographic balance. We can in fact state that the difference between the two corridors is essentially represented by:

- natural balance constantly higher for the southern corridor although decreasing for both;
- a foreign component that has represented the real gap between the two corridors since 2008, with the southern corridor reaching and slightly exceeding the national value;
- a positive internal population balance for the southern corridor until 2013, with both corridors overall currently experiencing a constant loss of population in favor of other Italian municipalities.

3.1.3 Infrastructure and industrialization of the territory

The history of the area, especially from modernity onwards, is inextricably linked to the waves of industrialization and infrastructure that have characterized it.

The north corridor has had a long pre-industrial history. Inhabited since the pre-Roman period, under the Roman Empire it was ideally placed in a strategic position between the Roman countryside and the Campania regions. Precisely this intermediate geographical position led to a new political division in the medieval and post-medieval ages. In particular, a clear division emerged between the areas further north, therefore the territories from Anagni to Frosinone, under the dominion of the Papacy as the "Frosinone district", and those further south, especially from the Liri Valley onwards, under the kingdom of Naples and then of the Two Sicilies, forming part of the Antica Terra di Lavoro (Ancient Work Land), with the "Sora district".

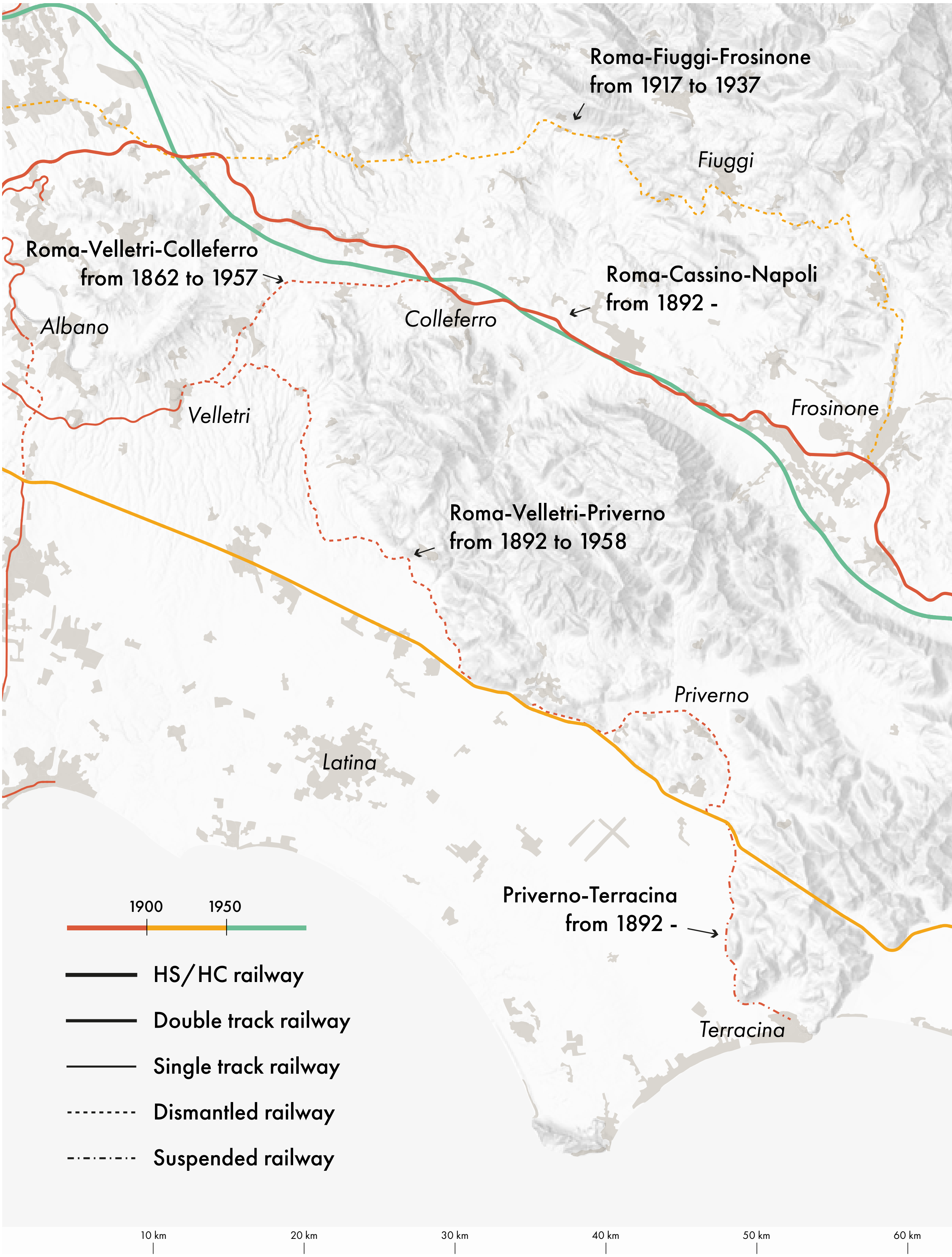
With the fascist reform of 1927, albeit the discontent of the local population, the Antica Terra di Lavoro was dismembered in order to increase the territory of the province of Naples. The Sora district was merged with that of Frosinone to form the new Province of Frosinone, also with some territories annexed from the district of Formia. At the turn of the Second World War, the territory was still clearly divided, especially on a social, cultural and linguistic level.

The southern corridor has known a partly very different history. In fact, its southern part, corresponding to the "Gaeta district", passed directly into the Province of Rome in 1927 and then into the newly formed Province of Latina in 1934, while the part closest to Rome, the actual "Agro Pontino", first underwent an intense period of land reclamation and was then annexed. The cycles of reclamation were followed by a period of rapid urbanization, with newly founded fascist cities, including the most important Littoria, today's Latina.

From an infrastructural point of view, the first initiatives took place around the time of the unification of Italy. The first axes of strength are undoubtedly represented by the railways. The intent was to create a direct connection between Rome and Naples and the choice was made to pass along the Sacco valley because the Pontina plain was still an unhealthy and marshy area. Immediately before the unification of Italy, only a few lines had been built south of Rome. They headed to the Castelli Romani area, while from Naples the line had reached Capua, which today is in Campania. The completion of the railway in its entirety took place in 1863, with the alternative branch between Ciampino and Colleferro then built in 1892. Almost at the same time, after the unification of Italy, the new Italian state built a new line which, branching off from the Naples-Rome line at Roccasecca, it follows the course of the Liri valley, passing Sora and arriving in Abruzzo. The line was built to guarantee a north-south connection

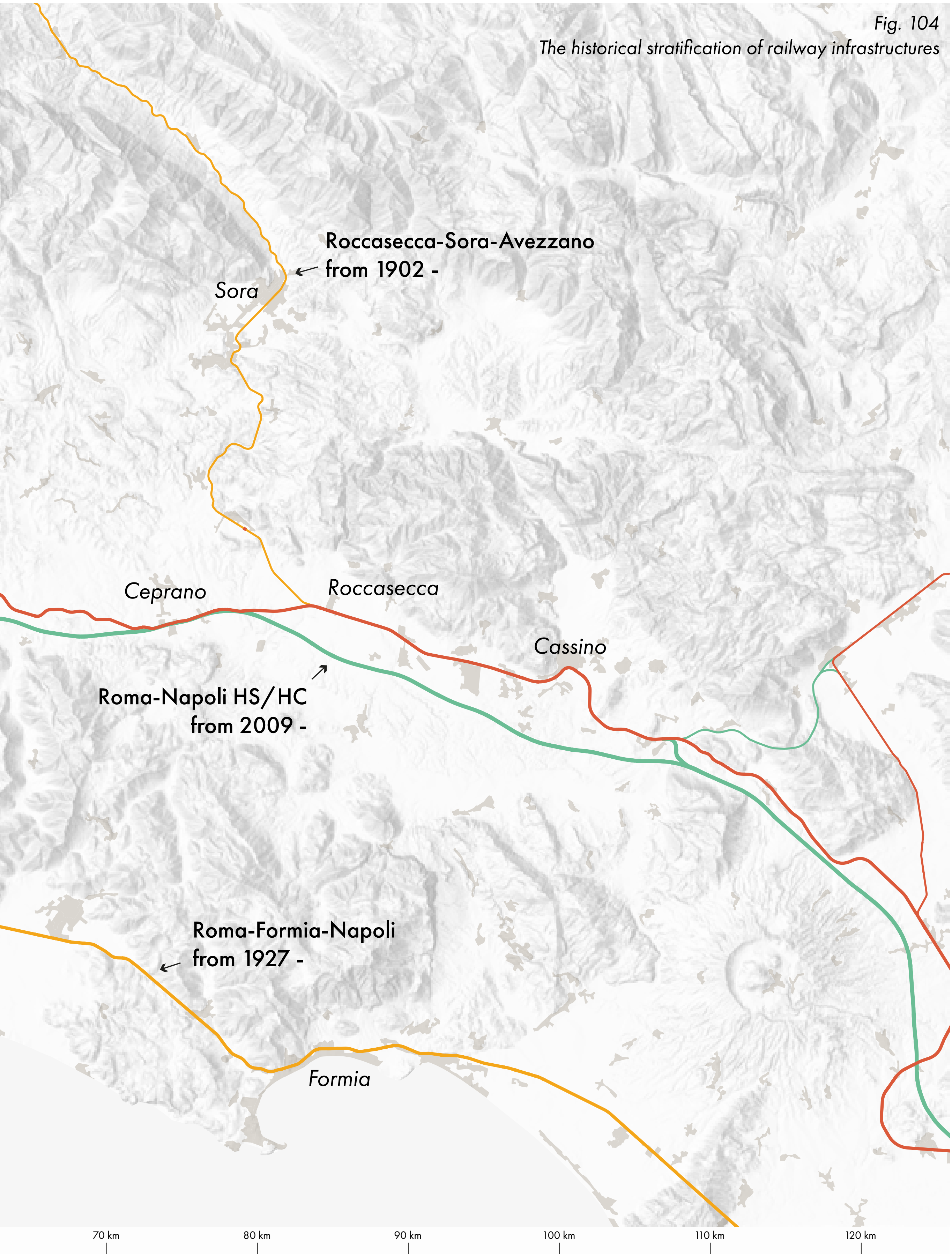

Atlante Geografico dell' Italia
PROVINCIA DI ABRUZZO
TERRITORIO ROMANO
FROSINONE
SORA
Vallecorsa
Fondi
Terracina
GAETA
PONZA IS
SCALE

Fig. 103
The ancient "Terra di Lavoro"



Roma-Fiuggi-Frosinone
from 1917 to 1937
Fiuggi
Roma-Velletri-Colleferro
from 1862 to 1957
Roma-Cassino-Napoli
from 1892 -
Albano
Colleferro
Velletri
Frosinone
Roma-Velletri-Priverno
from 1892 to 1958
Priverno
Latina
Priverno-Terracina
from 1892 -
Terracina
1900
1950
HS/HC railway
Double track railway
Single track railway
Dismantled railway
Suspended railway
10 km
20 km
30 km
40 km
50 km
60 km

Fig. 104
The historical stratification of railway infrastructures



with the Rome bypass, so as to be able to have an alternative while waiting for the evolution of the Roman Question.

To these two main lines a secondary narrow-gauge line is added, activated in 1917, which connected Rome to Frosinone passing through Fiuggi and therefore the hills north of the Sacco valley. This line was then decommissioned up to Frosinone in 1937 and up to Fiuggi in 1983. Today, the only active part is located in the urban area of Rome.

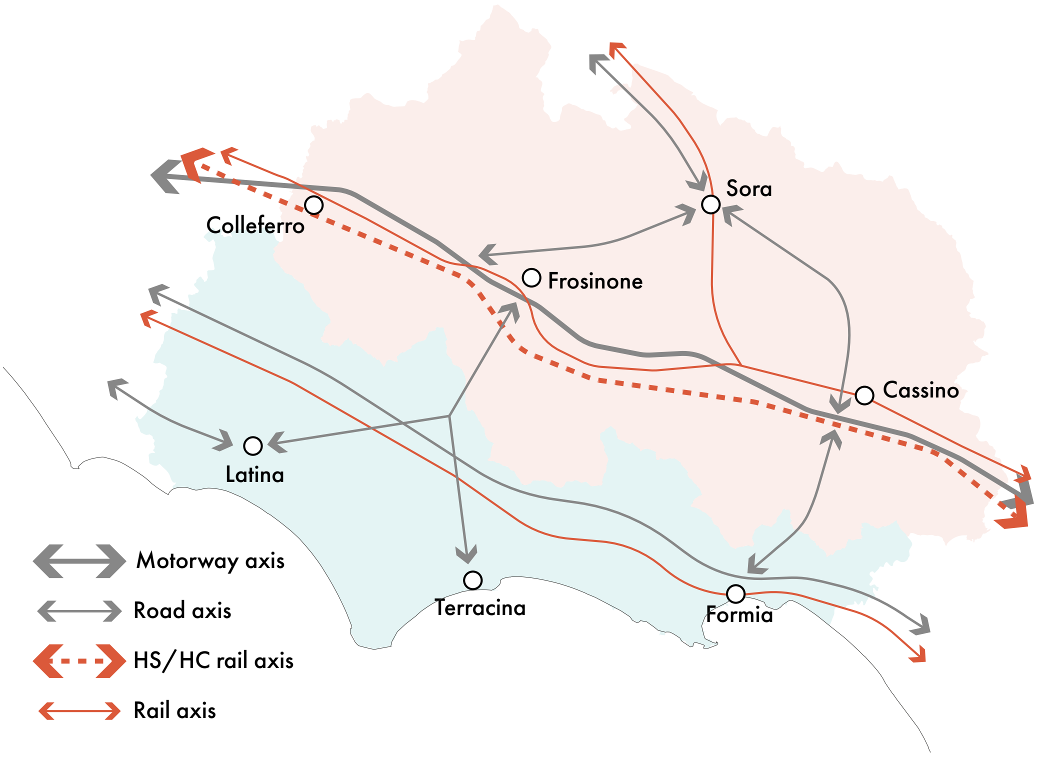


Fig. 105
The infrastructural scheme of the area

In the Piana Pontina, the presence of abundant swamp areas had immediately discouraged the construction of a railway between Rome and Naples, even though it was a potentially easier solution in a flat territory. The first line was a branch from Velletri which, passing along the edge of the swamps, ended in the town of Terracina. Later, following the reclamation works, the opportunity arose to create a Rome-Naples line as an alternative to the Cassino route, which was starting to generate safety problems and operational difficulties due to the more impervious crossed territories. After several years from the first planning phase, in 1927 the Rome-Naples line opened via Latina and Formia, also called "Direttissima". Slowly all fast connections between the two cities began to be routed along this line.

After the first period of major railway infrastructure realization, there was the one linked to motorization, symbolically represented by the construction of the A1 motorway in 1962, which cuts transversally the internal northern corridor. Following this important road work and in order to restructure the economic and productive sector of the territory, at that time still strongly rooted in an agricultural perspective, an intense period of industrialization of the entire northern corridor was launched. The decisive push from the financial point of view certainly came from the creation of the Cassa del Mezzogiorno, through which the central state began a work of massive industrialization of Southern Italy, with the aim of bridging the economic gaps between the depressed areas of the South and the rest of the country. In particular, along the northern corridor, with fundings from the Cassa, the ASI consortium of Frosinone comes to life, first with an industrialization nucleus in the provincial capital and then extending the scheme along the entire course of the Sacco and Liri rivers, adding four further nuclei.[4] At the same time the consortium was established, urbanization immediately outside of it was intensified. To the north, in the municipality of Colleferro, where the massive "Italcementi" plant and the war industry "Bomprini Parodi Delfino (BPD)" were already present, there was a significant industrial densification, while to the south FIAT was entering, building a large production plant in the area between Cassino and Roccasecca. Hand in hand with the phenomena of industrialization came those of urbanization. From a pre-industrial polycentric development, following the important interventions after the Second World War, the economic and infrastructural balance started to shift towards the major centers of the transept. It was a period of intense expansion of the suburbs towards the main infrastructural axes and mobility nodes.

From the 70s onwards, due to the economic crisis and industrial reorganization, many of the industries established in previous years entered into crisis, favouring a period of clear socio-demographic recession. In the 80s and 90s, in a context of slowdowns and uncertainty in the orientation of economic activities, settlement dynamics reduced and transformed. However, a linear development was maintained along the outgoing radials of the urban centers, which caused an increase in urbanized areas along the main infrastructural axes, to the point of creating real weldings between different municipalities (Sora-Isola Liri, Frosinone-Ferentino). In the meantime, settlement in extra-urban areas started to intensify again, driven by a demand for quality, low-cost residences or locations for local economic activities. The most recent infrastructural networks are created, especially roads and longitudinal connections to the main axis of the transept.

4 Industrial Development Areas (in italian ASI) are foreseen by Italian urban planning legislation and are identified as areas in which to plan industrial, commercial and business service settlements. They are planned by a "Consortium", a public economic body that also guarantees the presence of all the infrastructure necessary for the establishment of businesses in the area. The Consortium has the right to draw up a Territorial Masterplan for a large area which is binding with respect to the local planning of the municipalities included in the ASI.

Fig. 106
The FIAT production plant in Cassino-Piedimonte

Fig. 107
The first expansion of the outskirts in the municipality of Frosinone

Fig. 108
The Ferentino motorway toll booth

Fig. 109
Scattered, thread-like settlements on the hills behind Frosinone

In 1994 work began on the construction of the high-speed line between Rome and Naples. The line is part of the northern corridor and officially opened to passenger service in 2009.

3.1.4 The warehouse and the greenhouse landscapes

The economic and industrialization cycles have left very different traces on the territory of the two corridors. To the north, as we have already seen, top-down planning of industrial nuclei has created a dense industrial landscape in some specific areas. The most obvious component is the size of these areas, but also the size of the individual buildings, often not strictly dedicated to production, but instead to the storage of materials or for logistics operations. In the south, on the other hand, the greenhouse element abounds. It is the symbol of intensive agricultural production that characterizes much of the flat territory near the coast. Unlike the "shed" of the north, which is located in a concentrated manner, the greenhouse is an element that extensively covers the ground and creates a visually continuous landscape. In support of the greenhouse production are some high-level logistics and commercial hubs, among which the Fondi fruit and vegetable market (MOF) stands out.[5]

In this section we want to present, with a view from both above and below, some of these production landscapes that characterize the two corridors.

As already described, the development of the industrial areas to the north followed the direction of the 1971 ASI plan, a polycentric development on 5 main nuclei. To these nuclei is added that of Colleferro, not included in the plan as it is in the province of Rome.

The "industrial city" of Colleferro

Colleferro itself presents one of the most impressive industrial landscapes. The cement factory dominates the urban view, being in direct contact with the city centre. The rest of the factories and warehouses are located in the immediate vicinity of the urban center, with the exception of some of them. There is indeed a recently built logistics centre located about 3 km north of the city core, beyond the motorway toll booth. The area is mainly affected by the presence of a brand new Amazon warehouse. In this context, the landfill also found space, currently closed, but for years it served first the municipality of Colleferro and then gradually other neighboring municipalities, first and foremost that of Rome.

The events related to the pollution of the Sacco river are inextricably linked to the industrial landscape of Colleferro. During the period of rapid industrialization starting

5 The MOF is the largest and most modern Italian center for the concentration, conditioning and sorting of fresh fruit and vegetables.

Fig. 110
Colleferro industrial context

in the 1960s, many of the local companies began to illegally dispose of processing waste, either by burying it in drums but also by pouring it directly into the Sacco river, which runs through the territory. The contamination of the river has in fact led to the contamination of the entire valley. In 2005, also following some floods that invaded the fields surrounding the river bed, high quantities of a substance that is

Fig. 111
The cement factory dominates Colleferro urban landscape

Fig. 112
The new Amazon wharehouse

Fig. 113
Logistic wharehouse

*Fig. 114
Modern
wharehouse*

*Fig. 115
The closed
landfill*

toxic to humans and banned in Italy since 2001, beta-hexachlorocyclohexane, were found on its banks, in the hay, corn and milk of cattle. From that moment the national government blocked the activity of numerous local companies, the use of fodder, the production of milk and meat and declared a state of emergency for the municipalities crossed by the river. In 2016, a SIN (Site of National Interest) was established for the Sacco river basin, recognizing the entire course of the river as heavily polluted and promoting an urgent reclamation program. Despite the very difficult situation affecting the Sacco Valley, work has been underway on its recovery for several years. In fact, work is underway on the creation of a plant for the production of electricity from biomass, in particular agricultural residues, waste and manure, since their use in the livestock sector has been blocked. At the same time, numerous solar parks have been built over some of the fields that are no longer cultivable, not without resistance from the local population.

Fig. 116
The SIN "Valle del Sacco"

Fig. 117
Residential building in Colleferro

The chemical district of Anagni

The Anagni production plant is a set of structures from different periods. We can find abandoned warehouses, many of which still need to be reclaimed, but also new and innovative production plants, in the leading sector of chemical-pharmaceutical.

Fig. 118 Anagni industrial nucleus

Fig. 119 Abandoned production plants waiting for reclamation

Fig. 120
Modern wharehouse

Around the nucleus there is an abundance of raw material quarries, many of which are now abandoned.

Fig. 121
Abandoned quarrie in Morolo, next to Anagni

The area between Frosinone and Ferentino

The industrial agglomeration of Frosinone is the result of the fusion now completed between the very first nucleus of the capital and the industrial area of Ferentino. With the opening in 2009 of the motorway junction to which the highway to Sora connects, the nucleus underwent further development.

Fig. 122
The area between Frosinone and Ferentino

Fig. 123
The central huge street

Fig. 124
Modern wharehouse

The road connecting to the Frosinone area is a long straight two-lane road, along which production and logistics warehouses and a more recent shopping center area are located.

Fig. 125
The shopping center

The incomplete nucleus of Ceprano

The Ceprano site is evidently not complete. The original plan envisaged a vast industrial area between the town and the railway, while to date only the road infrastructure has been built and only a few companies have settled.

Fig. 126
The incomplete nucleus of Ceprano

Fig. 126
The oversized main road

*Fig. 128
Logistic
wharehouse*

It is also worth mentioning the presence of one of the most polluted sites in the entire Sacco Valley, the former "Olivieri", at the southern limit of the planned industrial area.

*Fig. 129
Modern
wharehouse*

Bigness and greenhouses in Fondi

To show the greenhouse landscape is useful to dig in the environment of Fondi, in which also the M.O.F. takes place. The market covers a huge area of more than 20 hectares and it's located next to the train station. Road junctions links it to the main network running along the south corridor.

Fig. 130
Bigness and greenhouses in Fondi

Fig. 131
The greenhouse landscape from the road view

Fig. 132
The footprint of the M.O.F.

On the other side, the greenhouses cover vast areas of the plain, creating a unique landscape, both from above and below.

Fig. 133
The greenhouse landscape from the top view

Fig. 134
Warehouse and greenhouse landscapes


ASI Sora
WHAREHOUSE
ASI Cassino
ASI Ceprano
(uncompleted)
MOF
70 km
80 km
90 km
100 km
110 km
120 km

3.2 Mobility along the corridors

3.2.1 Rome dependency and car dependency

The representation of the aggregate resultants on a local scale leaves little doubt: the two corridors are strongly attracted to Rome.

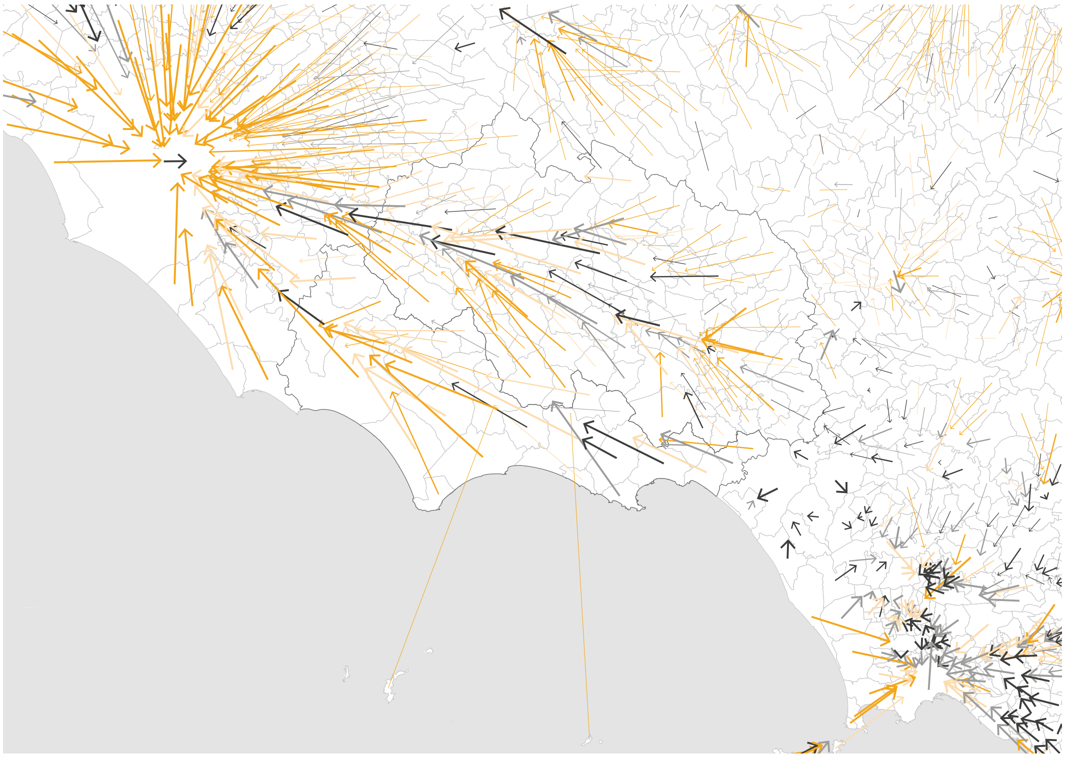


Fig. 135 Aggregate resultants between Rome and Naples

The arrows almost seem to draw a natural border between Lazio, still strongly attracted by Rome and Campania, and the multi-directional territory of Caserta. What is even more surprising is how, despite some municipalities having a low monodirectionality value, in any case the result is strongly oriented towards the capital. The large reference distance certainly contributes to this aspect, but in any case it demonstrates an important attractive force from the Capital, favored by the presence of the two railway corridors and the northern road corridor.

Rome's area of influence is in fact quite extensive. In the southern corridor it attracts more than 10% of outgoing flows from most municipalities, from Latina even more than 35% in total and 60% for study purposes. In the northern corridor Cassino manages to create a local basin around itself, but is itself attracted by Rome, while Anagni and Colleferro, given their greater geographical proximity, exceed the 35% threshold. Interesting how the study purpose polarizes the attraction of Rome towards the major centres. It can be hypothesized that the capital attracts mostly university

Fig. 136
Municipalities by outgoing trips headed to Rome

Fig. 137
Municipalities by outgoing trips with working purpose headed to Rome

students who therefore go to the city by train or long-distance buses along the valley.

If the overall, public transport is still quite competitive. In fact, if we evaluate the modal share of public transport on the larger scale of central Italy, the two corridors are areas with generally high values, especially if outgoing trips are filtered.

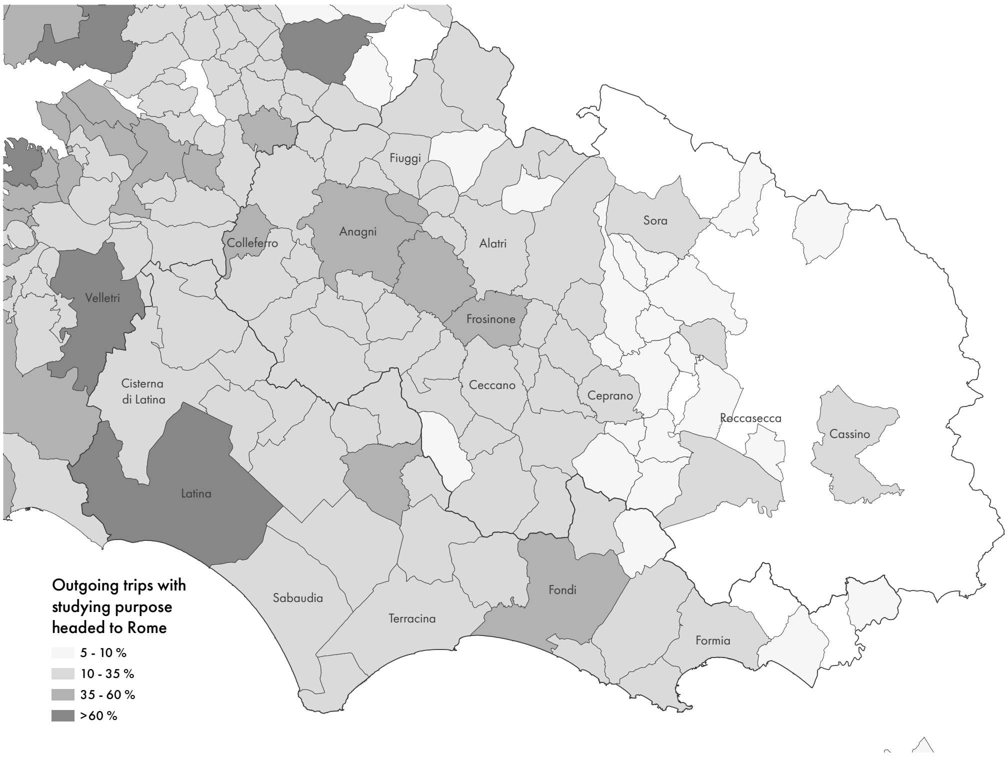


Fig. 138
Municipalities by outgoing trips with studying purpose headed to Rome

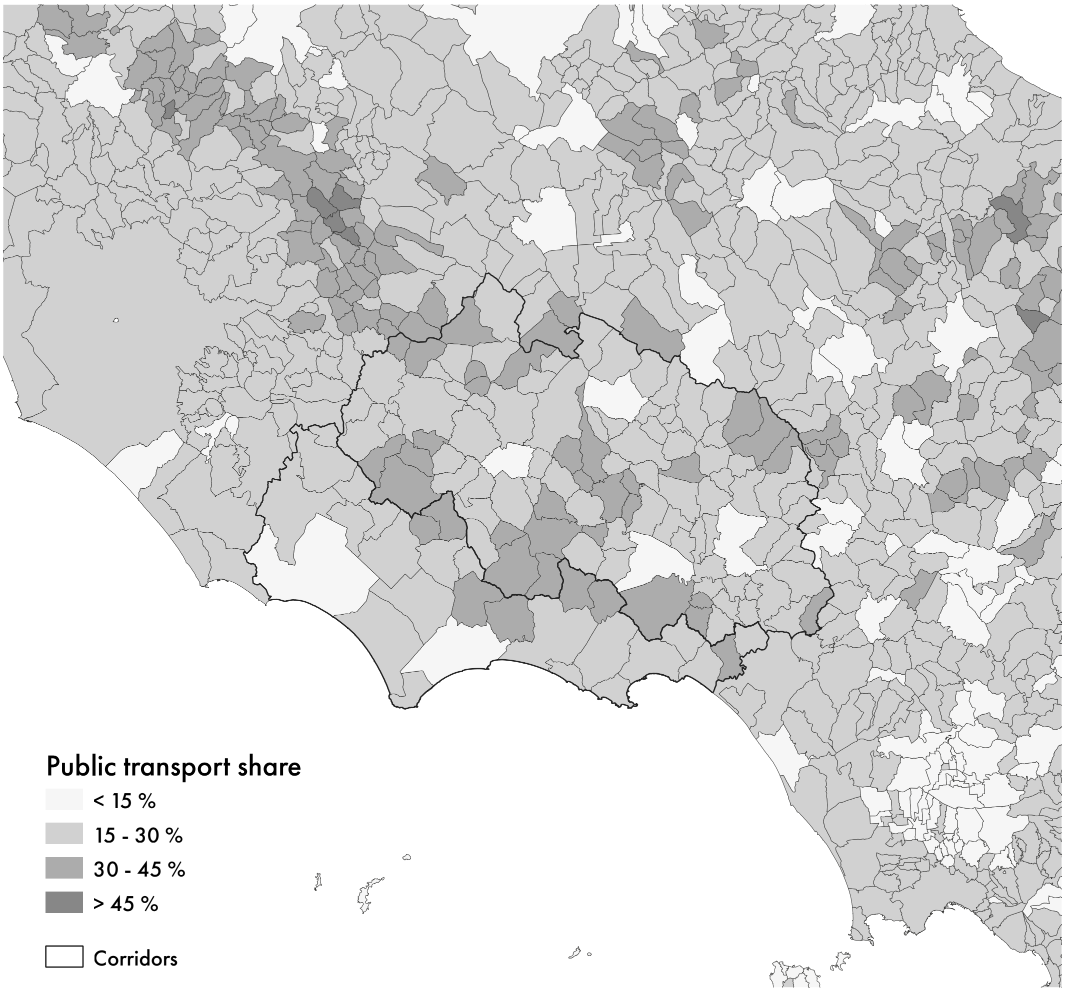


Fig. 139
Public transport share in the central Italy

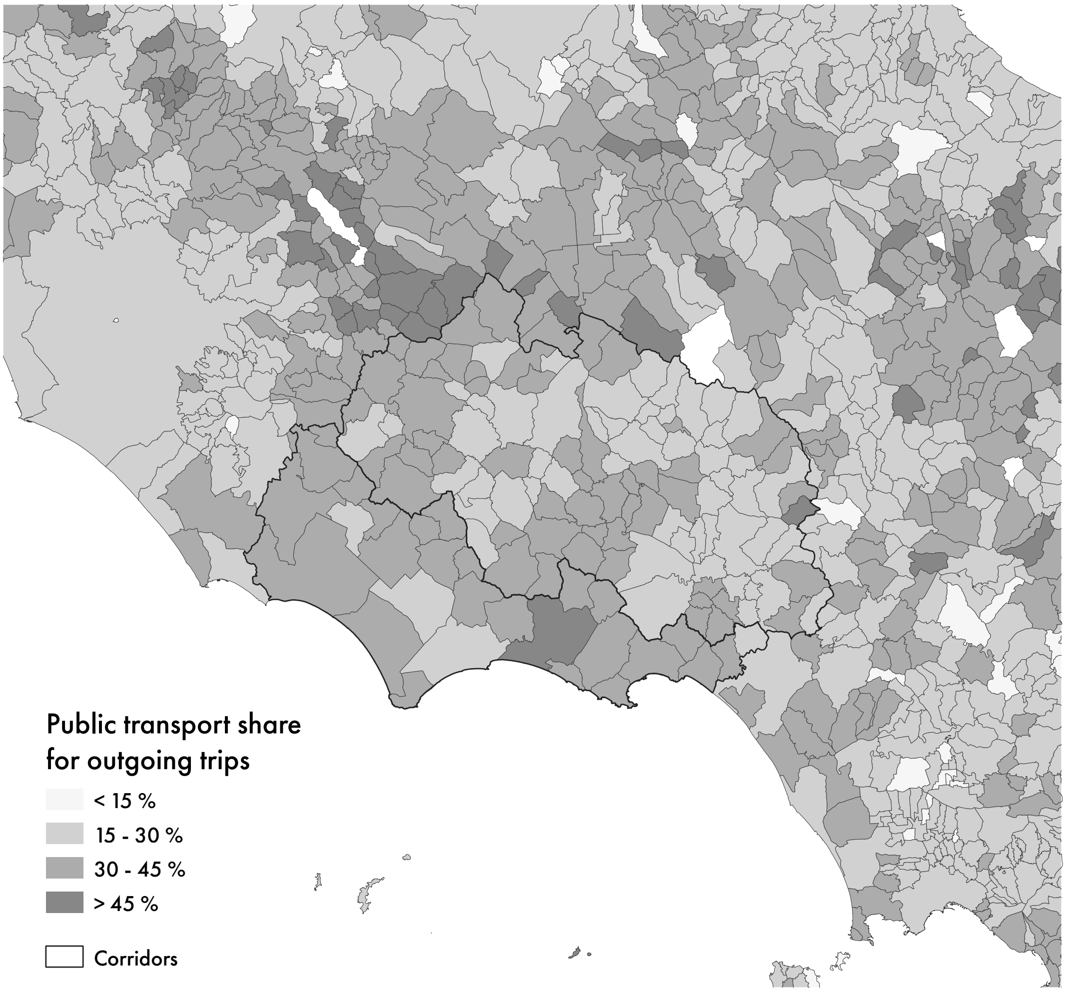


Fig. 140
Public transport share for outgoing trips in the central Italy

If we differentiate the trips between those leaving the corridors and those within them, the share of public transport collapses for the latter. For all trips generated by the corridor municipalities, the modal shares are substantially in line with the value of the region and Central Italy. Only the train has a lower value in the northern corridor in favor of the motorized vehicle. For trips that leave the corridor the distribution undergoes a sharp change. The train acquires up to 20 percentage points away from the value of the car, with a peak of 46% in the southern corridor, a clear symptom of the presence of Rome as the main destination. The latter alone represents the destination of almost 80% of the flows getting out from the corridors by train. The values of the shares become extreme if we filter Rome as the destination, with train reaching almost 50% in the north and 70% in the south. The situation is completely reversed if we consider travel within the corridors, i.e. between different municipalities in the northern or southern corridor. Here public transport seems to be collapsing, especially train transport, which is around 3%, while private transport is around 66% in the north and 73% in the south.

Starting from the corridors					Lazio		Central Italy	
Mode	North		South					
Train	12488	10.93%	14272	18.65%	96281	13.67%	271971	8.83%
Tram	35	0.03%	26	0.03%	463	0.07%	7320	0.24%
Subway	18	0.02%	28	0.04%	3927	0.56%	19303	0.63%
Urban bus	4775	4.18%	3039	3.97%	29338	4.17%	155014	5.03%
Extra-urban bus	13048	11.42%	8430	11.02%	61545	8.74%	229865	7.46%
School or work bus	3001	2.63%	1341	1.75%	12848	1.82%	62243	2.02%
Private car (driver)	67265	58.85%	41460	54.18%	406497	57.72%	1852355	60.13%
Private car (passenger)	12777	11.18%	6489	8.48%	72337	10.27%	351410	11.41%
Motorcycle	271	0.24%	841	1.10%	14580	2.07%	78527	2.55%
Bicycle	58	0.05%	242	0.32%	857	0.12%	12226	0.40%
Others	182	0.16%	184	0.24%	1293	0.18%	10543	0.34%
Walking	379	0.33%	173	0.23%	4248	0.60%	29711	0.96%
Total	114296		76523		704213	100.00%	3080488	100.00%

Tab. 3
Number of trips originated from the corridors by mode of travel

Starting inside and ending outside the corridors					Lazio		Central Italy	
Mode	North		South					
Train	9653	38.61%	12846	46.50%	96281	13.67%	271971	8.83%
Tram	14	0.05%	14	0.05%	463	0.07%	7320	0.24%
Subway	18	0.07%	28	0.10%	3927	0.56%	19303	0.63%
Urban bus	590	2.36%	443	1.60%	29338	4.17%	155014	5.03%
Extra-urban bus	2368	9.47%	1228	4.44%	61545	8.74%	229865	7.46%
School or work bus	1316	5.26%	379	1.37%	12848	1.82%	62243	2.02%
Private car (driver)	8669	34.67%	11120	40.25%	406497	57.72%	1852355	60.13%
Private car (passenger)	2257	9.03%	1303	4.72%	72337	10.27%	351410	11.41%
Motorcycle	44	0.18%	134	0.49%	14580	2.07%	78527	2.55%
Bicycle		0.00%	1	0.00%	857	0.12%	12226	0.40%
Others	73	0.29%	110	0.40%	1293	0.18%	10543	0.34%
Walking		0.00%	22	0.08%	4248	0.60%	29711	0.96%
Total	25003		27627		704213	100.00%	3080488	100.00%

Tab. 4
Number of trips originated from the corridors and ending outside the corridors by mode of travel

Starting from the corridors ending in Rome					Lazio		Central Italy	
Mode	North		South					
Train	8980	48.16%	11341	69.88%	96281	13.67%	271971	8.83%
Tram	14	0.07%	14	0.08%	463	0.07%	7320	0.24%
Subway	18	0.10%	27	0.16%	3927	0.56%	19303	0.63%
Urban bus	483	2.59%	122	0.75%	29338	4.17%	155014	5.03%
Extra-urban bus	1927	10.33%	509	3.14%	61545	8.74%	229865	7.46%
School or work bus	1061	5.69%	224	1.38%	12848	1.82%	62243	2.02%
Private car (driver)	4391	23.55%	3283	20.23%	406497	57.72%	1852355	60.13%
Private car (passenger)	1686	9.04%	573	3.53%	72337	10.27%	351410	11.41%
Motorcycle	32	0.17%	72	0.44%	14580	2.07%	78527	2.55%
Bicycle	0	0.00%	0	0.00%	857	0.12%	12226	0.40%
Others	55	0.30%	63	0.39%	1293	0.18%	10543	0.34%
Walking	0	0.00%	0	0.00%	4248	0.60%	29711	0.96%
Total	18646		16229		704213	100.00%	3080488	100.00%

Tab. 5
Number of trips originated from the corridors and ending in Rome by mode of travel

Tab. 6
Number of trips originated from the corridors and ending inside the corridors by mode of travel

Starting and ending inside the corridors					Lazio		Central Italy	
Mode	North		South					
Train	2836	3.18%	1426	2.92%	96281	13.67%	271971	8.83%
Tram	21	0.02%	12	0.03%	463	0.07%	7320	0.24%
Subway	0	0.00%	0	0.00%	3927	0.56%	19303	0.63%
Urban bus	4185	4.69%	2596	5.31%	29338	4.17%	155014	5.03%
Extra-urban bus	10680	11.96%	7202	14.73%	61545	8.74%	229865	7.46%
School or work bus	1684	1.89%	962	1.97%	12848	1.82%	62243	2.02%
Private car (driver)	58596	65.62%	30340	62.05%	406497	57.72%	1852355	60.13%
Private car (passenger)	10519	11.78%	5186	10.61%	72337	10.27%	351410	11.41%
Motorcycle	227	0.25%	706	1.44%	14580	2.07%	78527	2.55%
Bicycle	58	0.06%	241	0.49%	857	0.12%	12226	0.40%
Others	109	0.12%	74	0.15%	1293	0.18%	10543	0.34%
Walking	379	0.42%	151	0.31%	4248	0.60%	29711	0.96%
Total	89294		48895		704213	100.00%	3080488	100.00%

Tab. 7
Top destinations for trips originated from the corridors by train

Starting from the corridors by train		
Destination	Trips/day	
Roma	20321	78.24%
Cassino	1478	5.69%
Napoli	889	3.42%
Latina	677	2.61%
Frosinone	650	2.50%
Formia	192	0.74%
Sora	187	0.72%
Cisterna di Latina	167	0.64%
Aprilia	165	0.63%
Pomezia	142	0.55%
Colleferro	133	0.51%
Ciampino	131	0.50%
Ceccano	91	0.35%
Fondi	87	0.34%
Fiumicino	86	0.33%
Anagni	74	0.29%
Priverno	72	0.28%
Sezze	70	0.27%
Caserta	67	0.26%
Ferentino	51	0.19%
Sabaudia	47	0.18%
Frascati	38	0.15%
Velletri	35	0.14%
Gaeta	32	0.12%
Terracina	31	0.12%
Avezzano	30	0.12%
Aversa	30	0.12%

The analysis generally describes two clear phenomena:

- the two corridors are rather dependent on Rome and for trips that are headed to the capital an important if not decisive role is played by public transport, in particular train.
- Movements within the corridors are mainly carried out by private motorized vehicle. It is no coincidence that Frosinone is one of the Italian provinces with the highest motorization rate.[6]

These two evident phenomena raise at least two questions:

- is such strong commuting with such long distances and times sustainable?
- Is it possible to change this trend towards a model of sustainable mobility with which to rebalance the weights between the capital and this middle territory?

The classification from chapter 2 effectively returns the presence of minor poles, made such precisely by the cumbersome presence of Rome, but poles nonetheless. If from for working purposes the picture is rather uniform, travels for study purposes offer an interesting point.

Although Rome maintains the record for trips for study purposes attracted by the corridors, especially university students, local education centers emerge with significant

Fig. 141 Incoming study trips from the corridors' municipalities

6 https://ambientenonsolo.com/un-tasso-di-motorizzazione-elevatissimo-ed-un-parco-auto-ancora-molto-inquinante/

Fig. 142 Incoming study trips from the corridors' municipalities by public transport

numbers. These are relevant centers that very often offer secondary education institutions such as technical institutes and high schools or even the university , in Cassino.

Public transport is the relevant mode for study trips even excluding those for Rome. In particular, these are extra-urban buses, which are decidedly more competitive

Tab. 8 Number of trips for study purpose originated from the corridors and ending not in Rome by mode of travel

Study trips from the corridors (not to Rome)				
Mode	North		South	
Train	2181	8.47%	907	6.10%
Tram	19	0.07%	8	0.05%
Subway		0.00%	1	0.01%
Urban bus	3564	13.84%	2388	16.06%
Extra-urban bus	9298	36.12%	6410	43.12%
School or work bus	1145	4.45%	621	4.17%
Private car (driver)	2364	9.18%	1129	7.60%
Private car (passenger)	6974	27.09%	3217	21.64%
Motorcycle	85	0.33%	146	0.98%
Bicycle	7	0.03%	7	0.05%
Others	7	0.03%		0.00%
Walking	102	0.40%	32	0.21%
Total	25746	100%	14865	100%

than the train for this type of travel. The catchment area of high schools outside the municipality in which they are located is in fact mostly represented by students who live in smaller towns up to the smallest villages. For this reason the bus-train interchange is not convenient for one or two stops, when a Cotral bus picks them up from the town and takes them directly to the school, avoiding even the last mile from the train station.

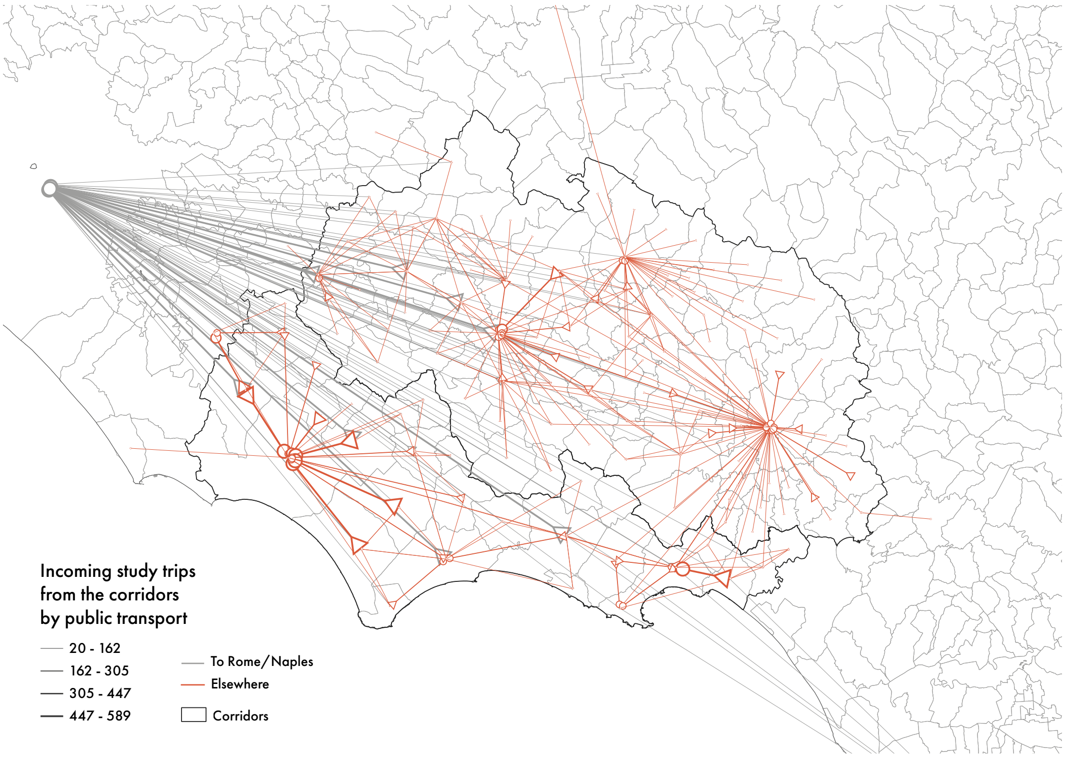


Fig. 143 Incoming study trips from the corridors' municipalities by public transport (matrix visualization)

3.2.2 Public transport supply

From a supply point of view, there are essentially two segments: rail and road transport. The rail segment is entirely operated by Trenitalia and originates from Rome for both corridors. Both corridors are served by the FL (Ferrovie Laziali) network, a suburban railway service which often takes on the characteristics of a regional train, but also by some long-distance connections. The latter mainly travel along the south corridor, while in the north one only some night services pass, as well as deviations from the south in the event of breakdowns or works on the line.

TRAIN CLASS	North	South	TOTAL
LP	5	34	39
RE	110	90	200
TOTAL	115	124	239

The northern corridor is currently served mainly by the FL6 line, which originates from Roma Termini and ends in Cassino while stopping in the main intermediate stations. The main interchange node in the system beyond Termini is Ciampino, where it is possible to change for the various FL4 lines directed to the Castelli Romani, even if the basic goal of the line is to guarantee a direct and fast connection between the territory served and Rome Termini. The service is mainly carried out by double-decker Vivalto trains. From the main line, at Roccasecca, the secondary line for Sora and Avezzano branches off, single track and non-electrified. After a period of closure, the line has

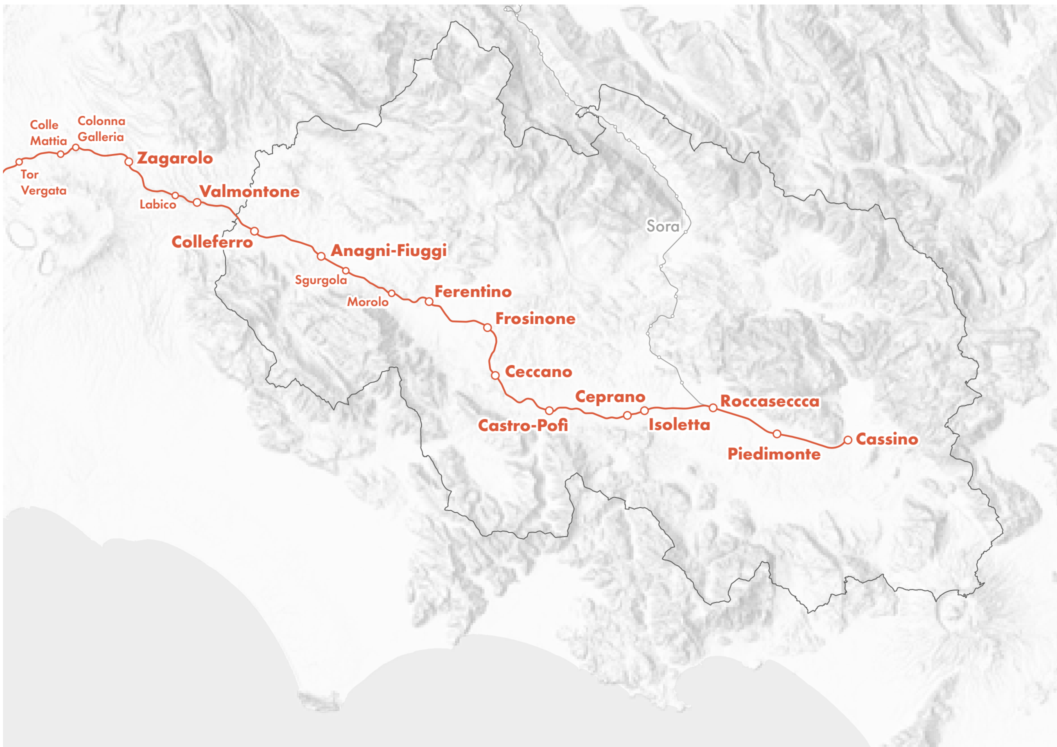


Fig. 144 FL6 line and stations

recently reopened and operates with a frequency of 7 trains per day, supplemented by some bus services.

The stations of the northern corridor, as well as the FL6, are served by 5 long-distance trains and regional trains towards Campania and Molise. Since 2020, a pair of Frecciarossa high-speed services has been introduced which stops in Frosinone and Cassino, early in the morning towards Turin and in the afternoon towards Naples. In general the main destinations are Rome, Cassino, Caserta, Campobasso, Avezzano and Sulmona.

DESTINATION	TRAINS/DAY
ROMA TERMINI	45
CASSINO	25
FROSINONE	12
CASERTA	7
NAPOLI CENTRALE	7
AVEZZANO	6
ISERNIA	4
ROMA TIBURTINA	3
BARI C.LE	1
BENEVENTO	1
VENAFRO	1
ROMA TUSCOLANA	1
TORINO	1
TOTAL	114

Tab. 9 Destinations of trains stopping in the stations of the north corridor

The southern corridor is served by the FL7 line, which originates from Rome Termini and ends in Formia-Gaeta or Minturno and stops at all intermediate stations. At the Campoleone junction it is possible to exchange with the FL8 for Aprilia and Nettuno, while from Priverno the line branches off to Terracina, closed since 2012 due to a landslide. The service is mainly carried out by double-decker Vivalto trains.

The southern corridor is also crossed by 34 long-distance connections between Rome and southern Italy, in particular Naples, Puglia and Sicily. The Rome-Naples Regional trains stop in all the stations of the corridor, while the Intercity and Intercity Night trains only in the Latina and Formia stations. In general the main destinations are Rome, Naples, Formia, Minturno and Latina.

It is clear that the service in the northern corridor is highly dependent on FL6's relations

Fig. 145
FL7 line and stations

with Rome. On the contrary, to the south the suburban line is part of an already dense context of regional and intercity relations between Rome and Naples.

Tab. 10
Destinations of trains stopping in the stations of the south corridor

DESTINATION	TRAINS/DAY
ROMA TERMINI	49
NAPOLI CENTRALE	25
Minturno	10
Latina	9
FORMIA-GAETA	7
REGGIO CAL CLE	4
TORINO P.NUOVA	4
SALERNO	3
SIRACUSA	3
MILANO CENTRALE	2
TARANTO	2
PALERMO C.LE	1
Sestri Levante	1
TOTAL	134

From the point of view of road transport, the main operator is Cotral, an in-house company of the Lazio Region, concessionaire of the extra-urban local public transport service in Lazio. After a long history of participation in the operational management of the capital's public transport lines, today Cotral manages the extra-urban bus lines of the entire Lazio Region and was recently entrusted with the management of the service on the Rome-Lido and Rome-Civita Castellana-Viterbo lines.

The Cotral lines creates a rather dispersed and distributed network serving almost all municipalities of Lazio. If we add the frequency dimension we discover that these lines follow a Rome-centric logic, with some corridors much better served than others:

- to the east for Tivoli and Guidonia;
- to the south for the Castles and the Pontina area;
- to the north for Viterbo, Monterotondo and Mentana.

In the two corridors the service mainly follows some lines of force. In the northern corridor the lines are concentrated along the corridor that from the Anagnina metro terminus in Rome reaches Frosinone and Sora. Some lines branch off from this axis with significant daily frequencies and a dense network of smaller connections, with frequencies of up to 2 trips a day, one early in the morning and one after lunch. The latter are clearly lines for students who must reach the high schools in smaller towns from small towns and then return home. In the southern corridor the lines make fewer total trips (1067) than in the north (1268), but they are on average more frequent, with an average of 2.6 per line compared to 1.7 in the north. In fact, there are almost no lines with low frequencies connecting the smaller towns, a fact due to the geomorphological conformation of the corridor. The lines to the south are concentrated between the main poles of the Pontina Plain, on the coast road and between Fondi and Gaeta. Of all the lines, just over 6% directly connect the two corridors, confirming a marked isolation between the two infrastructural axes. Just over half (51%) stop at the railway stations of the two corridors, ensuring good bus-train integration, at least from a physical point of view.

Compared to a weekday, the service on public holidays is almost completely eliminated. Only a few main lines remain, such as the one for Sora, and some connections to the south between the railway stations and the inhabited centres, often several kilometers away. This is the case of Formia for Gaeta, Monte San Biagio for Terracina and Priverno for Sabaudia.

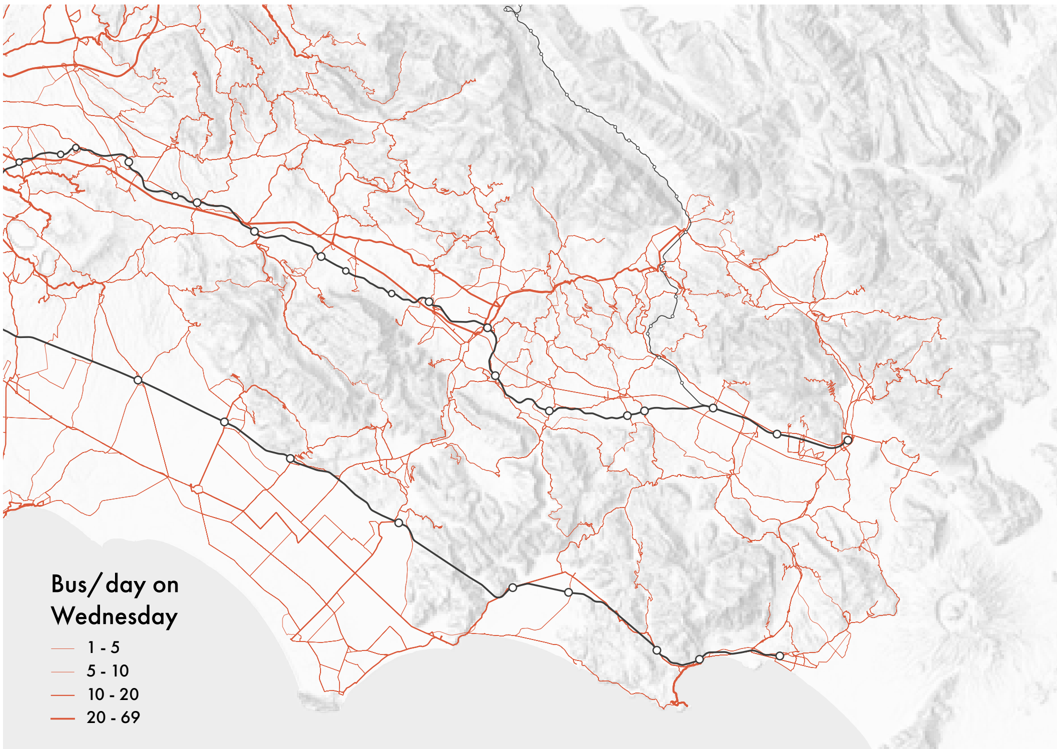


Fig. 146
Cotral network
on Wednesday

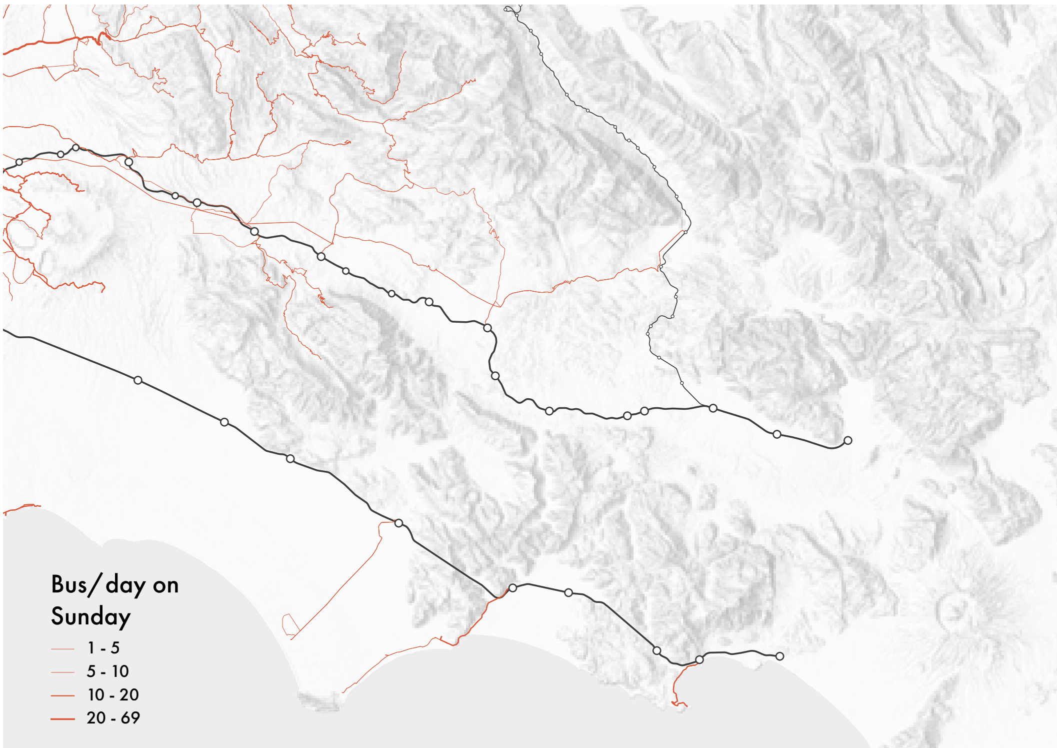


Fig. 147
Cotral network
on Sunday

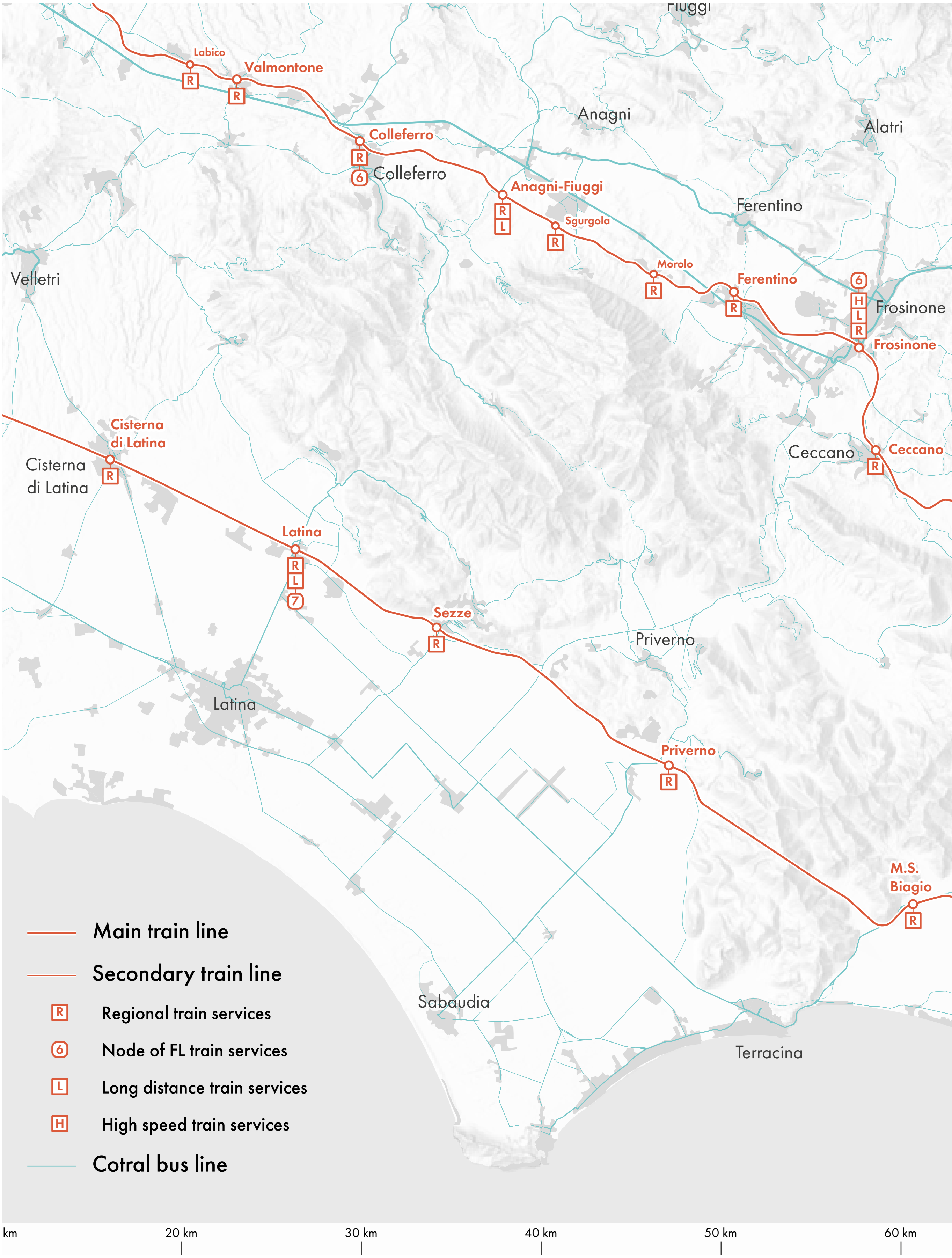

Fiuggi
Labico
Valmontone
Colleferro
Colleferro
Anagni
Alatri
Anagni-Fiuggi
Sgurgola
Ferentino
Morolo
Ferentino
Frosinone
Frosinone
Velletri
Cisterna
di Latina
Cisterna
di Latina
Ceccano
Ceccano
Latina
Sezze
Priverno
Latina
Priverno
M.S.
Biagio
Sabaudia
Terracina
Main train line
Secondary train line
Regional train services
Node of FL train services
Long distance train services
High speed train services
Cotral bus line
km
20 km
30 km
40 km
50 km
60 km

Fig. 148
Public transport supply in the corridors

3.2.3 Future visions, between planning and mega-projects

In this paragraph we want to reconstruct the "reference scenario" for mobility in the two corridors. We want to understand and investigate whether a future vision exists and how this is expressed by local bodies and actors. It is not a direct and trivial operation, since the two corridors correspond to two different provinces, each one with its own future aspirations and points of view for the territory. Often the different levels of planning, starting from the national, regional, vast area (province or basin) up to the municipal level, can find themselves in mutual conflict. These are often documents drawn up in very different periods and which therefore may or may not include how some social, economic but also political conditions have changed in time.

To reconstruct the future vision for the mobility of the two corridors, two points of view will be considered:

- on the one hand, mobility and urban planning at the different scales, in particular regional and provincial.
- On the other hand, the vision that can be deduced from some large infrastructure projects for the corridors which have actively stirred public opinion and collective debate, even in a very critical way.

From the point of view of regional planning we find the Regional Mobility, Transport and Logistics Plan (PRMTL) of the Lazio Region, approved in December 2020. It represents the main document with which the Region intends to direct the regional transport system towards a new balance, which should be:

- more sustainable;
- more inclusive towards vulnerable users;
- more resilient to the impacts of extreme and unexpected events;
- more open to technological innovations.

The document is divided into some fundamental parts, defined based on the covered topic:

- The railway system
- The road system
- Cycling mobility
- The Port Authority system
- Ports of regional interest
- The airport system

- Local public transport
- The logistics system
- Urban systems
- The monitoring plan

The main visions and indications on the topic of public transport and mobility can be deduced from the sections on local public transport and the railway system. The Plan intends to pursue the European objectives defined by the "White paper on transport: roadmap to a single European transport area: towards a competitive and resource-efficient transport system", regarding the containment of climate-changing emissions and regarding the use of alternative and sustainable means of transport and new technologies at the service of mobility. "*The vision for the TPL resumes the European vision for the transport system with a horizon of 2050 of totally accessible and integrated services, of high quality and reliability, highly innovative, totally safe and with low environmental impact.*"

In order to achieve these objectives, the Plan is divided into two main Scenarios, one short-medium term and one long term. For the first scenario, the Plan defines and partly redefines:

- Minimum services, for a rebalancing of the allocated regional resources.
- The Network Units (Unità di Rete), in order to bring together the fragmented dimension of service contracts in some homogeneous basins from the point of view of mobility demand.

From the point of view of rail mobility, the Plan incorporates some indications already present in the reference scenario of the Rome Capital PUMS, such as the pass-through model within the Rome hub, in order to unload the Termini station. For the northern corridor line it would involve continuing to Civitavecchia.

An important role is given to the stations, thought as real modal interchange nodes. To achieve these objectives the plan works on two levels:

- accessibility, with the real physical integration of the bus lines leading to the station and the creation of safe and comfortable cycle-pedestrian paths.
- Timetable coordination, through the integration of bus timetables departing with the train and returning from the train.

Another point is the optimization of extra-urban bus services, especially the segment managed by Cotral. Particular attention is paid to strengthening and optimizing services in areas with weak demand, almost always at an economic loss, but vital for the local population. The optimization then concerns the reorganization of the lines that run overlapping with the railway service and with urban and local bus services.

In the long-term scenario, the Plan only introduces the closure of the Rome railway ring, with consequent alternative routing of railway services, also passing through the northern arc.

With a focus on the railway system, the Plan identifies some priority visions and works for the two northern and southern routes. For the FL6 in the north, technological adjustments are planned between Rome and Colleferro, especially regarding the new central apparatus at Ciampino and the new signaling system. All this in order to guarantee new metropolitan railway services between Rome and Colleferro.

For the FL7 and the southern corridor, new stops are planned for passenger services between Rome and Latina, locatend in the expanding and souther area just outside the GRA motorway of Rome. Also for this line is planned to to confirm and strengthen metropolitan-type services, placing their terminal stop in Latina, already equipped with the platforms and management apparatus suitable for this purpose. A further issue is the reopening of the branch to Terracina, for which RFI has already prepared a project to secure the slope affected by landslides. In addition to it, it's expected a progressive elimination of level crossings which would currently slow down the line considerably.

As regards provincial level planning, reference is made to the Frosinone's General Provincial Territorial Plan (PTPG) of 2007 for the northern corridor and to the Latina's General Provincial Territorial Plan (PTPG) of 2016 and to the Latina's Local Public Transport Basin Plan of 2012 for the southern corridor.

For the northern corridor the Plan recalls the principles already highlighted by the PRMTL, despite the latter being drawn up years later. It hopes for a greater integration between the different modes of transport, especially in conjunction with the main railway stations, both between train and bus and between train and car. An intensification of a metropolitan-type railway service and integration with high-speed services is expected (the high speed line at those times was still to come). It then then mentions some strong connections not served by the railway and on which specific fast and targeted services can be envisaged to satisfy the significant demand. For internal and low-demand areas, the Plan promotes innovative and dedicated approaches.

As regards the southern corridor, the PTPG of Latina constructs a precise geography of rail transport. Beyond the Rome-Naples transversal ridge, the Plan envisages the construction of a railway infrastructure connecting Formia and Cassino, in continuity with the lines planned up to the Adriatic, so as to obtain a cross-shaped scheme for the regional and national scale. This infrastructural scheme would also concern freight traffic, for which the plan envisages exploiting the various freight terminals and interports present and linking them with the wider national network. Another issue concerns the reactivation of the disused railway lines, including the Priverno-Terracina.

The Basin Plan instead proposes the creation of a dense network of railway infrastructures with which to create metropolitan services integrated with the main railway. Although even the routes of the lines are indicated, the type of specific infrastructure envisioned is not specified.

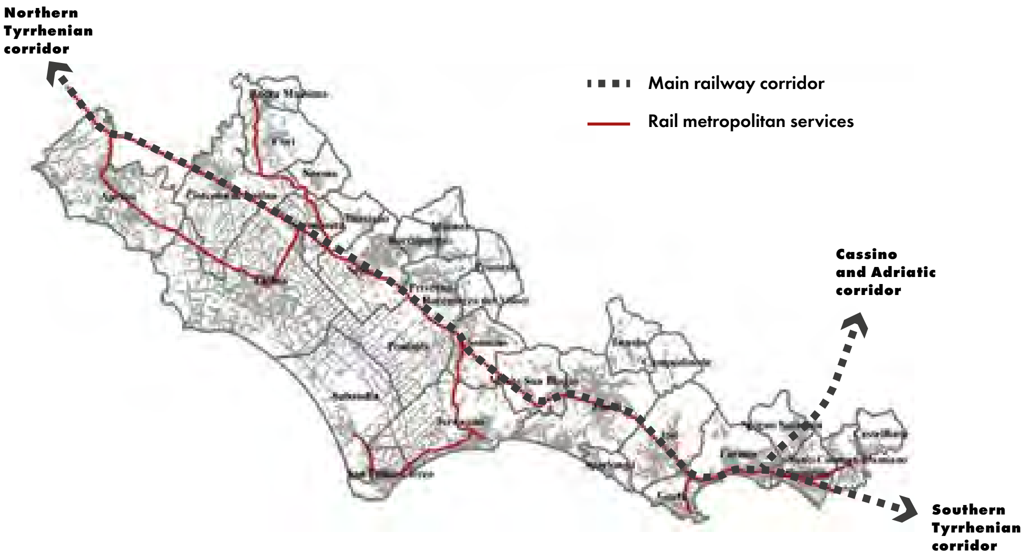


Fig. 149 The south corridor vision from the planning tools

The overall planning framework, although partly quite dated (the only recent plan is the PRMTL of 2020 at a regional scale) establishes the general premises for the creation of a sustainable mobility model for both corridors. The main characteristics and principles can be summarized here:

- *technological innovation*. This group includes all those strategies that are linked to aspects of renewal of the infrastructure (control equipment, train running regulation) or materials (new buses and trains), but also to innovations in the management of the transport and in their ticketing.
- *Integration*. For everything concerning the choice of the most suitable means of transport for the reference scale and for the networking of the different transport scales with each other.
- *Care for nodes*. These are not only thought of as an interchange point between the different modes of transport, but also as opportunities for real connections with the rest of the city, as real urban places.
- *Evaluation of the demand*. Much attention is paid to areas with weak demand and geographically more remote areas. However, the solutions are not given clearly, also because a certain design flexibility is required to evaluate the specific case.

What seems to be missing is a well-defined "geographical" vision of the projects for the territory. A vision that is not expected so much from the regional plan, due to the scale and scope of reference, but rather from the provincial plans. These should bring the more general indications of the regional plan to bear on their territories, indicating and localizing priority actions, building spatial strategies, providing indications to local authorities. In fact, there seems to be a lack of a "medium" strategic scale, between that of a large area, which however remains generic and not very place-based, and that of the municipalities.

Into this "void" some specific visions are inserted from below. They move in a diametrically opposite manner, envisaging large works and infrastructures that are geographically defined and often directly placed at the center of the local public debate. These are works that are often not even foreseen by the higher-level planning and they are the result of consultations between local authorities, infrastructure managers, and public and private stakeholders. These projects, even if in the embryonic planning stage or without even a precise vision, have strongly polarized local public opinion, between those who find themselves supporting them and those opposing. Reference will be made to two specific projects that are animating the debate in this period, even if they are ideas conceived several years ago.

The first "mega-project" concerns the construction of a new high-speed rail station near the Ferentino toll booth. The project is currently being assessed for technical-economic feasibility by RFI, but it is already causing discussion among ardent supporters and those who view the work with skepticism. This would be the second high-speed passing station not serving a large city, after that of Reggio Emilia. But if in the case of Reggio Emilia -despite all the critical issues that have emerged and the issues still unresolved- we are still talking about a station inserted in a highly urbanized corridor and cities of more than 100 thousand inhabitants, the territory of the northern corridor is decidedly more unloading from the point of view of demand, not to mention that it would be a node only reachable by car, as it is very far from the traditional railway line.

Adding to the skepticism is the fact that, as already mentioned, a pair of high-speed connections stopping in Frosinone and Cassino has recently been introduced on an experimental basis, thus serving the two main hubs of the corridor. In this sense it seems like a rather redundant work, also considering the relative reduction in travel times to Rome. To date, in fact, from Frosinone it takes around 40 minutes with the Frecciarossa and from the future AV station it would take 25 to 35 minutes to which to add the access time to the system[7]. Competitiveness is marginal for those who have to travel to Rome every day for work or study and this has further exacerbated the voices

7 The official data has not been released. The estimate was made considering the maximum speeds allowed along the HS line between Rome and the Ferentino site.

of commuters, who instead do not yet see a substantial investment for faster regional services between the capital and Rome.

The project is part of a broader strategic italian framework that has recently taken hold in the italian context, that is to build passing rail stations along the high-speed line in areas with dispersed and intermediate demand between two large cities. Beyond Reggio Emilia, some other relevant cases can be included, such as that of Orte, which has recently seen two pairs of Frecciarossa trains a day but which is aiming for a dedicated AV station and that of "Medioetruria", clearly referring to the Mediopadana already built, a station strongly requested by the Regions of Umbria and Tuscany and which should be built in a location that is not yet well defined between Arezzo and Orvieto. This recent "race to the high speed station" is indicative of an inability of the intermediate and middle territories to easily reach the main national rail network, precisely because those interventions to integrate the local railway services into the high-speed network are systematically not carried out.

Fig. 150
Rendering of the new HS station of Ferentino

The second mega-project on which an effective debate has recently opened is that of the new civil airport of Frosinone, to be built by redeveloping the existing small airport, currently with a military function. An ad hoc company was set up for the project, "Aeroporto di Frosinone S.p.A",.and the land had begun to be frozen for future expropriation. To date, the project is at a standstill and the company is in liquidation, while the new "Associazione Progetto Aeroporto di Roma Frosinone" has been created, which has as its aim the promotion of the territory and the airport project, with the ultimate aim of creating the third airport civil of Rome. In fact, the current project is based on the idea of connecting the capital with this new airport by hooking up to the HS line near Frosinone. It is not explicitly clarified how this vision would coexist with the new Ferentino HS station.

In the meantime, a front opposing the project has been created, especially with demonstrations from below. These are mainly those citizens who suffered the first preparatory actions for the expropriations and who then loudly requested compensation, receiving a recent negative response from the Court of Appeal of Rome.

Fig. 151
The new airport project, top view and rendering

3.3 The railway transept

The scale of analysis moves along the corridor, precisely along the railway transect that goes from the Colleferro station to Cassino. In this section each station will be analyzed according to some main criteria.

Initially, a territorial framework will be presented, in order to highlight the morphology of the territory in which each station of the transept is located. We will therefore estimate the size of the population that currently orbits in a buffer of 300 meters and 1 km from the station. The resident population and employees are reworked from ISTAT dataset, while the number of students in secondary schools is obtained from the dataset of the Ministry of Education.

An RFI dataset will allow us to reconstruct for some stations the modal split of people arriving and leaving each station.

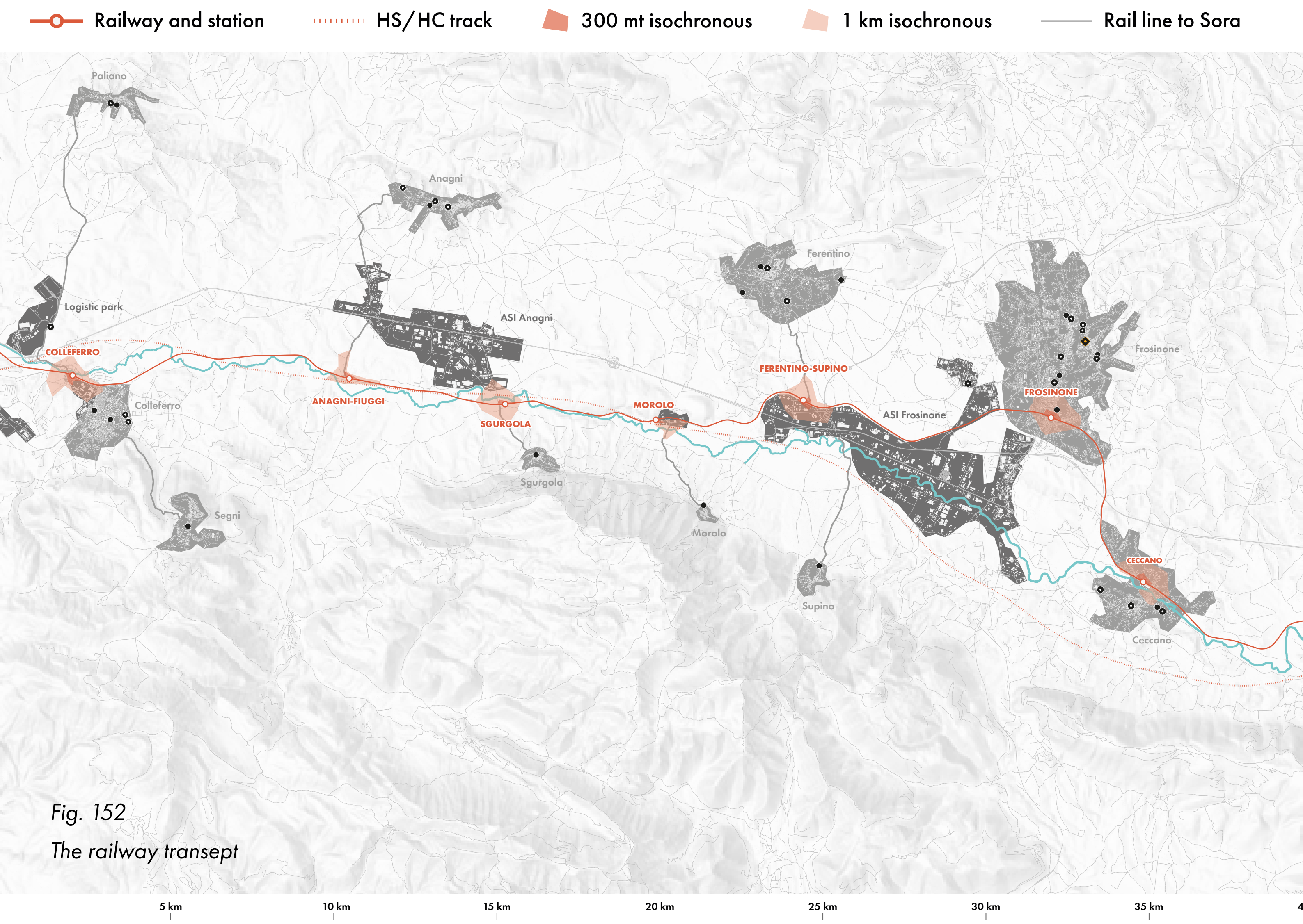


Fig. 152
The railway transept

A more morphological analysis will instead present the context in which the station is located, its typology regarding the number of accesses and the presence or absence of passenger buildings, the type of public space in front of the passenger building and finally the presence or absence of services for passengers, both inside and outside the railway spaces.

From a Lazio Region dataset, the values relating to the number of people got on and off the trains are then presented to describe the overall use of each station.

Finally, the structure of the railway services that stop at each station will be schematically reconstructed, dividing them by type of service and time of day.

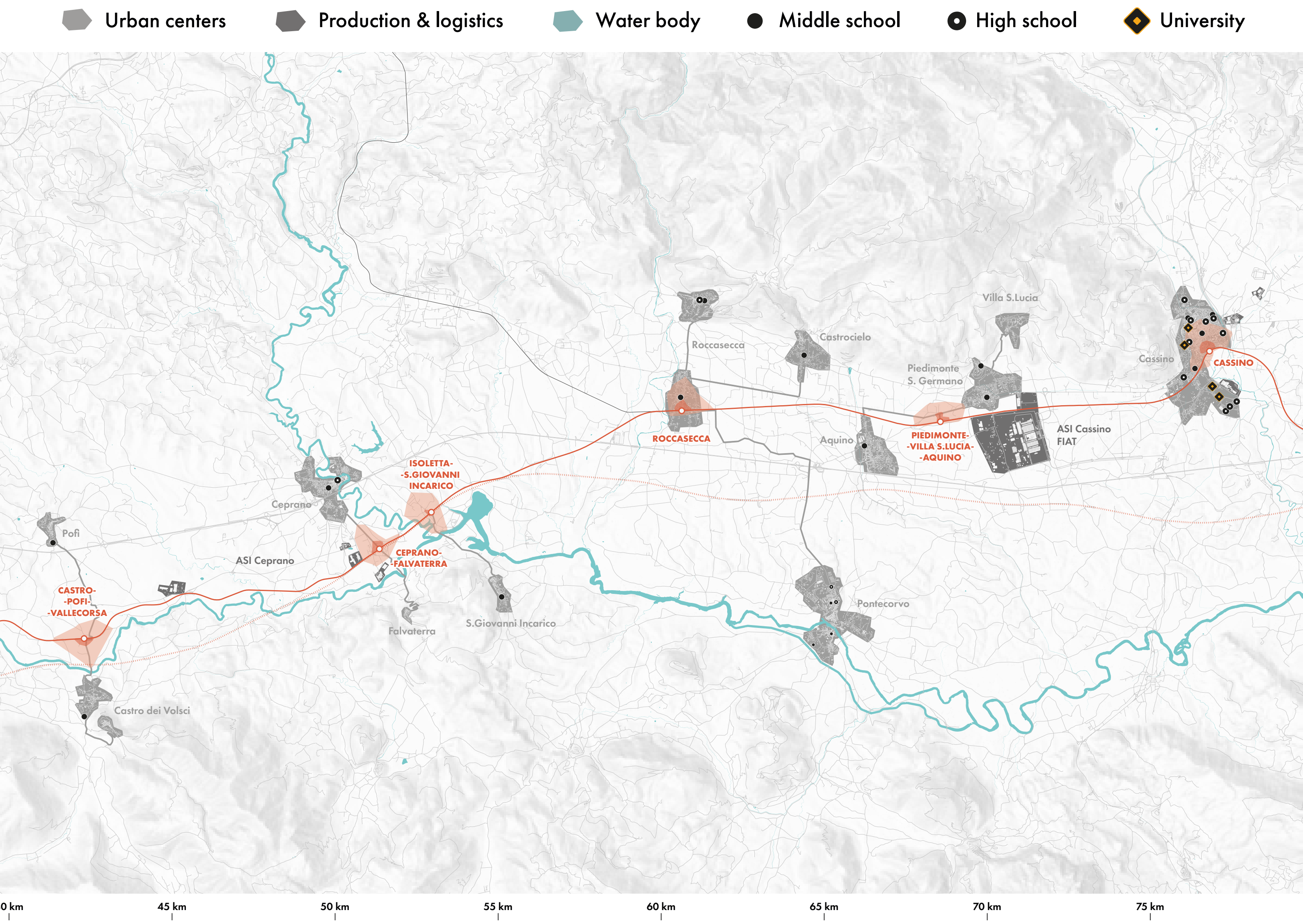


Fig. 153
The bus terminal outside the station of Colleferro

Colleferro-Segni-Paliano

Colleferro station is the first in the transept from Rome. It is located in a marginal position in respect to the city center, next to the Sacco river and the cement factory.

It represents an important intermobility hub, due to the presence of the terminus of the urban and interurban bus lines and the parking area. It is also the interchange hub between metropolitan railway services to and from Rome and the line to Cassino.

The station is equipped with the main services and has recently been redeveloped and equipped with a new pedestrian overpass between the different platforms.

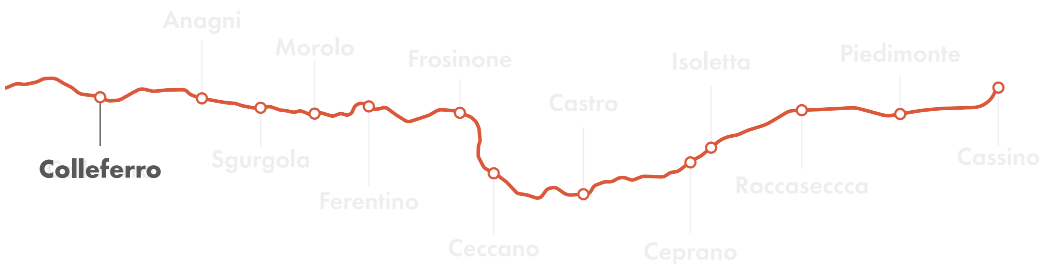


Fig. 154
Satellite view of the Colleferro station

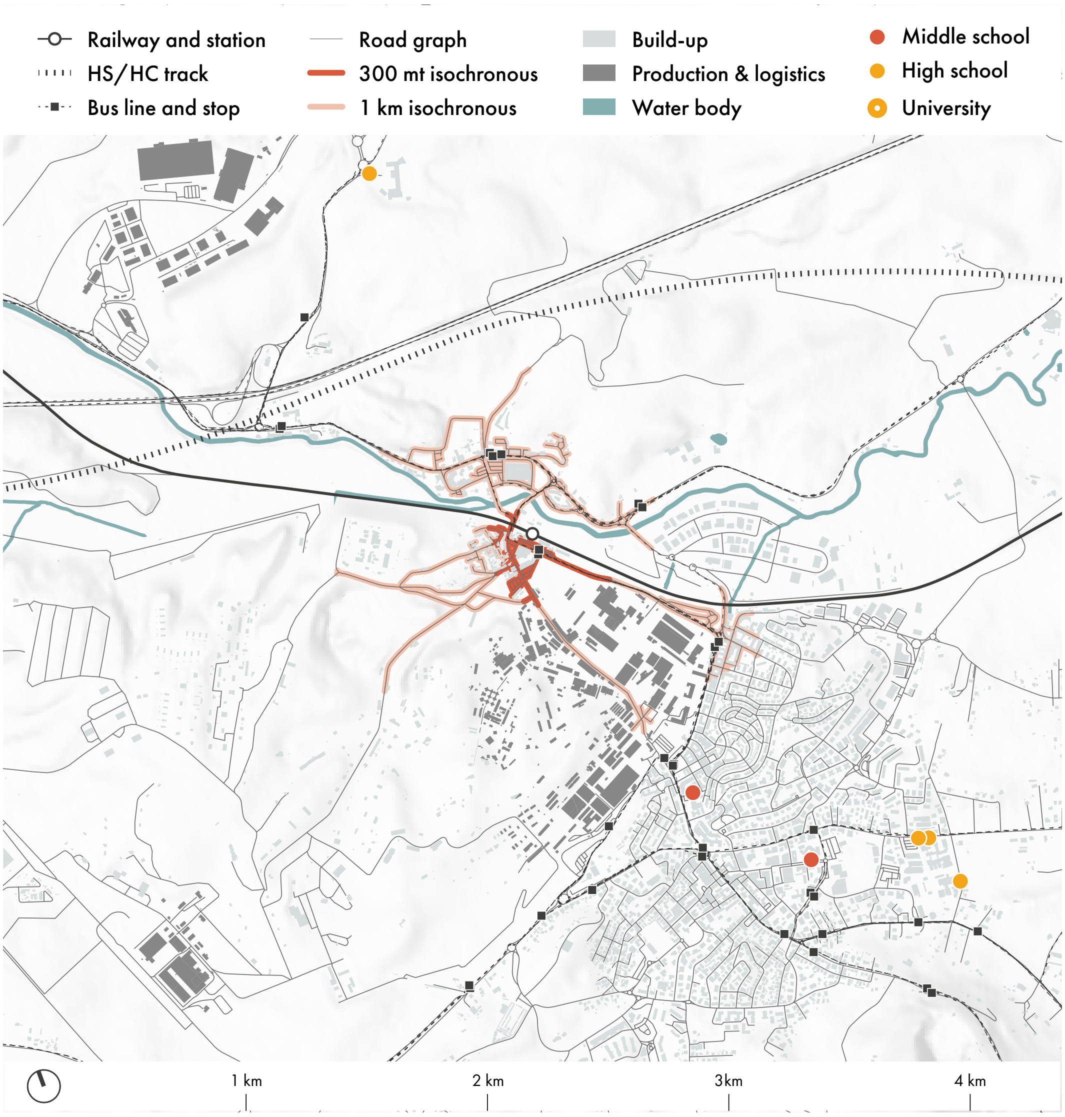


Fig. 155 Colleferro framework

298 Population within 300mt
178 Employees within 300mt
0 Students within 300mt

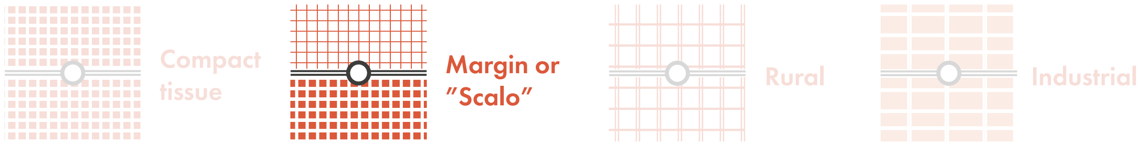
1603 Population within 1km
1176 Employees within 1km
0 Students within 1km

Modal split arriving at the station

Modal split leaving the station

OMISSIS

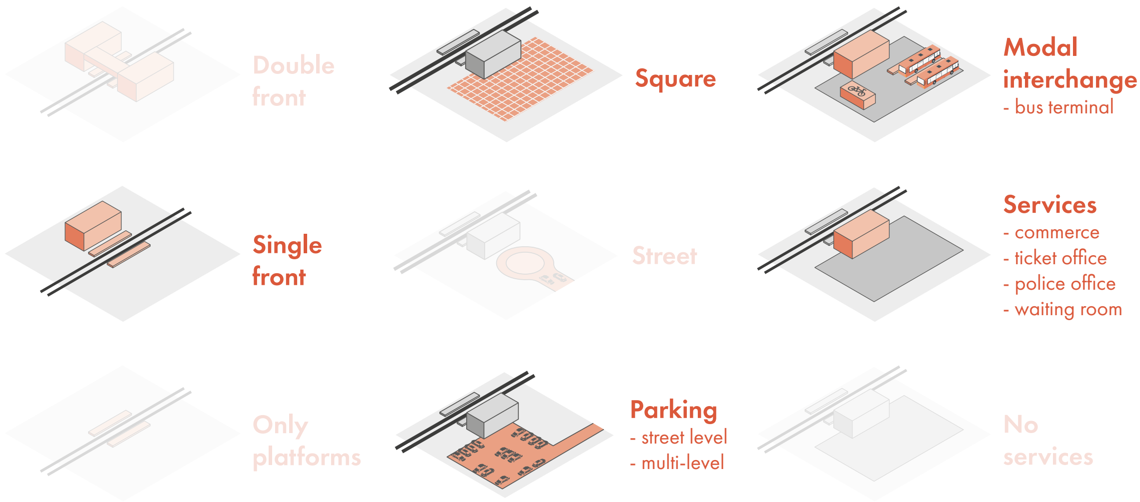
Context



Typology

Public space

Services



Station usage by passengers/day

OMISSIS

Rail services by destination and time of departure

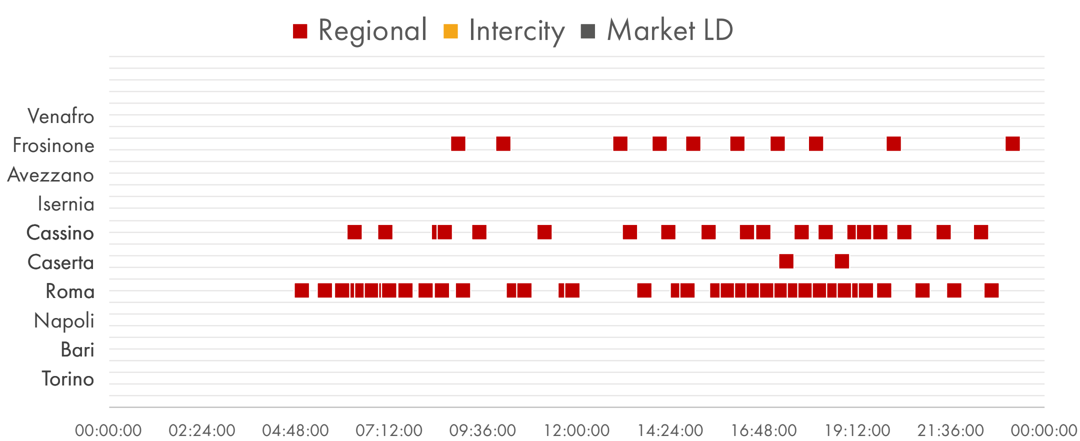


Fig. 156
The front of the station

Fig. 157
The new configuration of the station

Fig. 158
The new overpass

Fig. 159
The multilevel car parking and the auditorium

Fig. 160
The platform of the Anagni station

Anagni-Fiuggi

The Anagni station mainly serves the municipalities of Anagni and Fiuggi, but is 8 and 20 km away respectively by car. It is in fact located in the middle of the Sacco valley, along a stretch parallel to the HS/HC line.

The station has a large interchange multilevel car park, which guarantees its good performance in terms of passengers. Even if the car remains the main means of arrival and exit, there is also a bus terminus of the Cotral lines with more than hourly frequencies to the center of the town.

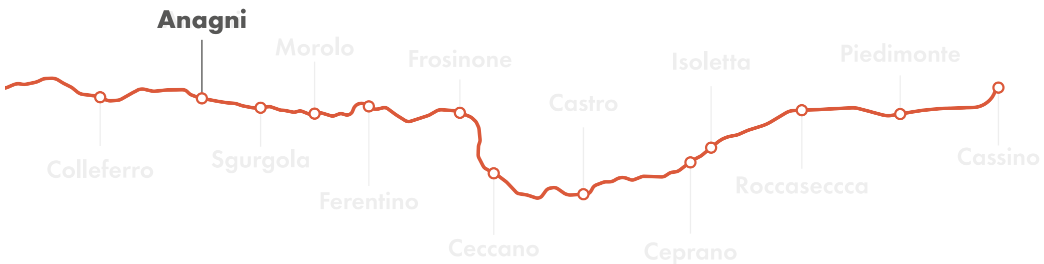


Fig. 161
Satellite view of the Anagni station

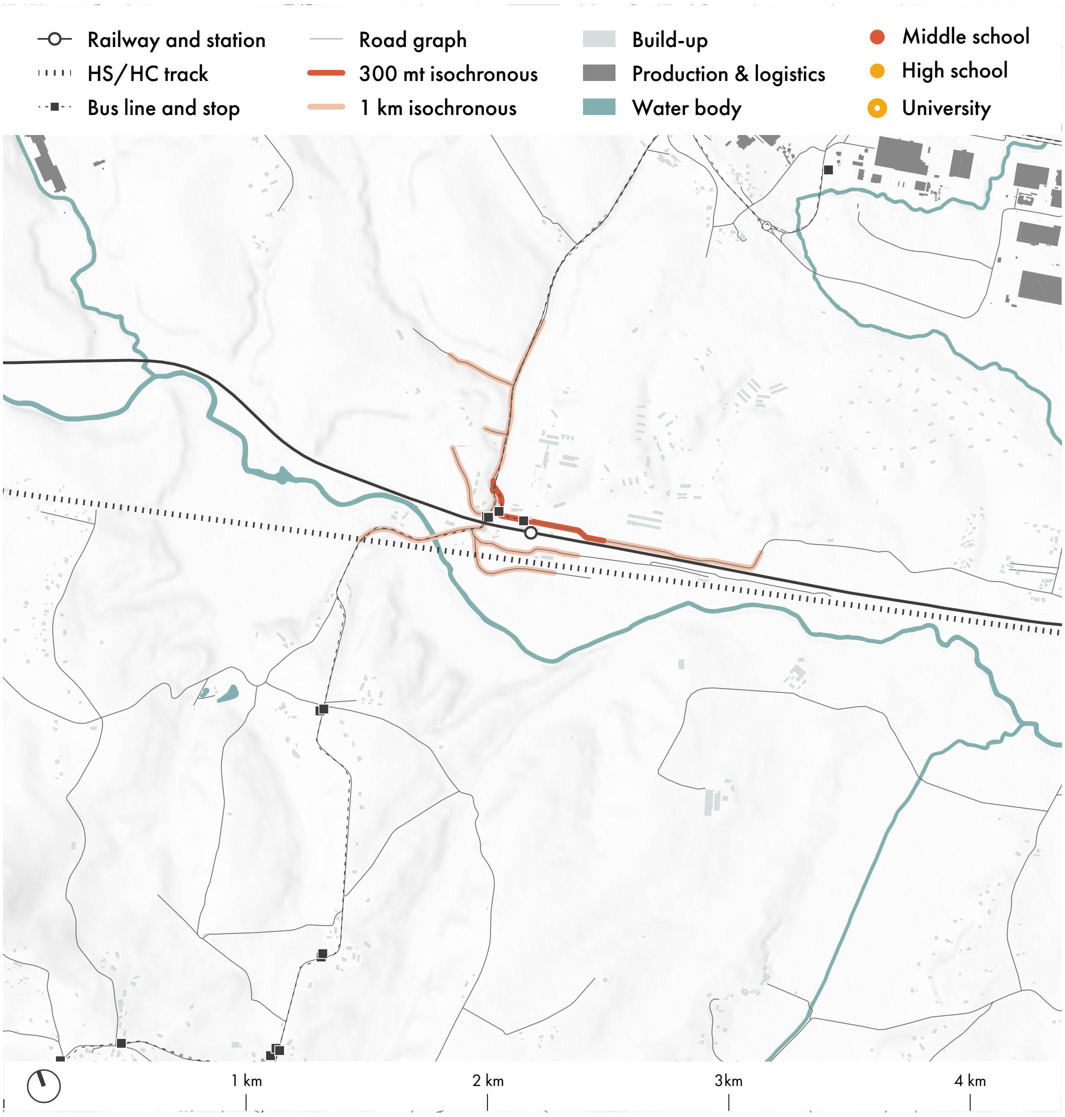


Fig. 162 Anagni framework

36 Population within 300mt
6 Employees within 300mt
0 Students within 300mt

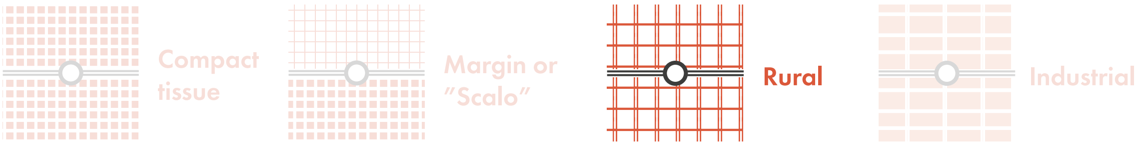
228 Population within 1km
57 Employees within 1km
0 Students within 1km

Modal split arriving at the station

Modal split leaving the station

OMISSIS

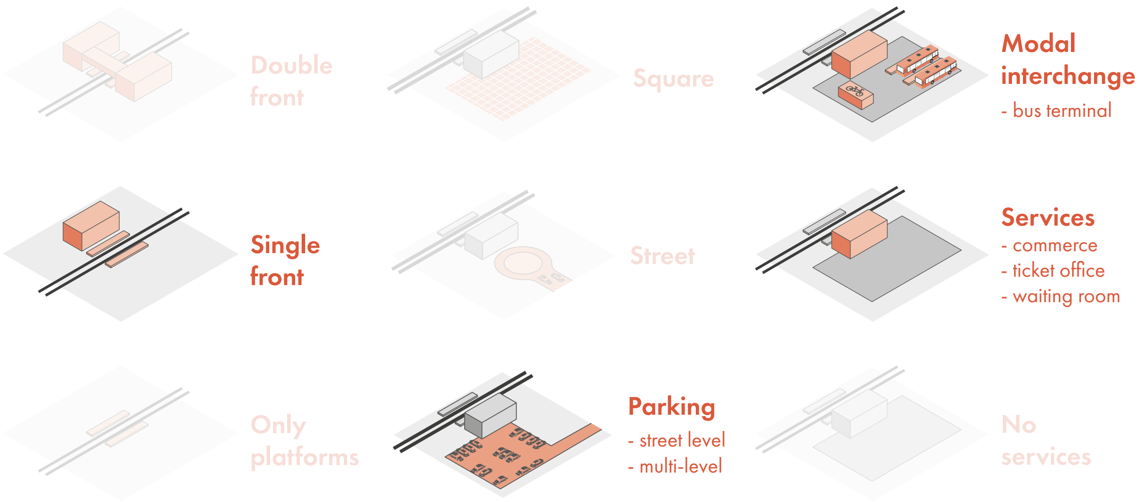
Context



Typology

Public space

Services



Station usage by passengers/day

OMISSIS

Rail services by destination and time of departure

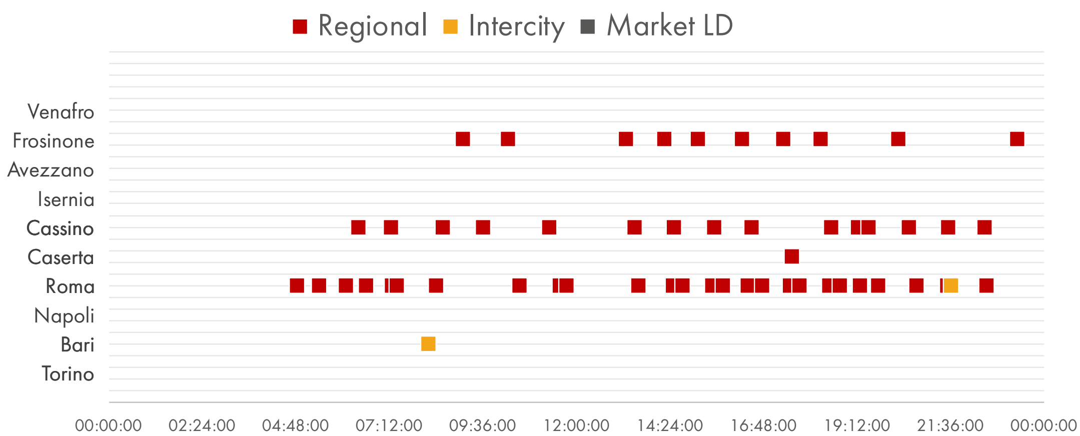


Fig. 163
A train that has just arrived at the station

Fig. 164
Departing bus from the front square

Fig. 165
A disused
charging station

Fig. 166
The multilevel
car parking

Fig. 167
The platform of the Sgurgola station

Sgurgola

The Sgurgola station is located 5 km after that of Anagni in the same valley context. The town center is located 3 km from the station, on the slopes of the Lepini mountains.

The station is equipped with a street level car park and a small passenger building. It has one of the lowest attendances on the entire line and is served by some FL6 connections to Cassino and all those to Frosinone.

It is located strategically close to the industrial area of Anagni, for which however there are no safe connections except by car.

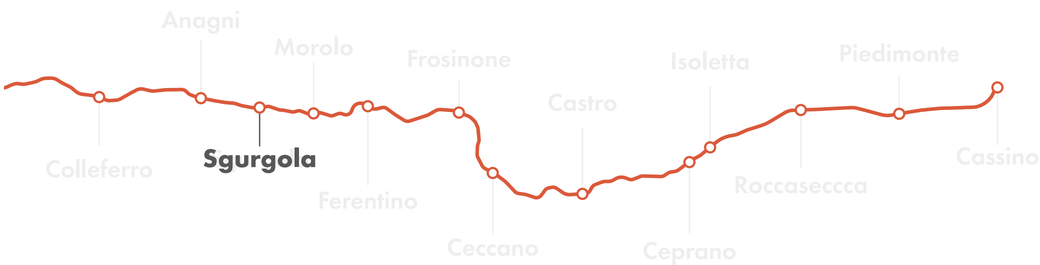


Fig. 168
Satellite view ot the Sgurgola station

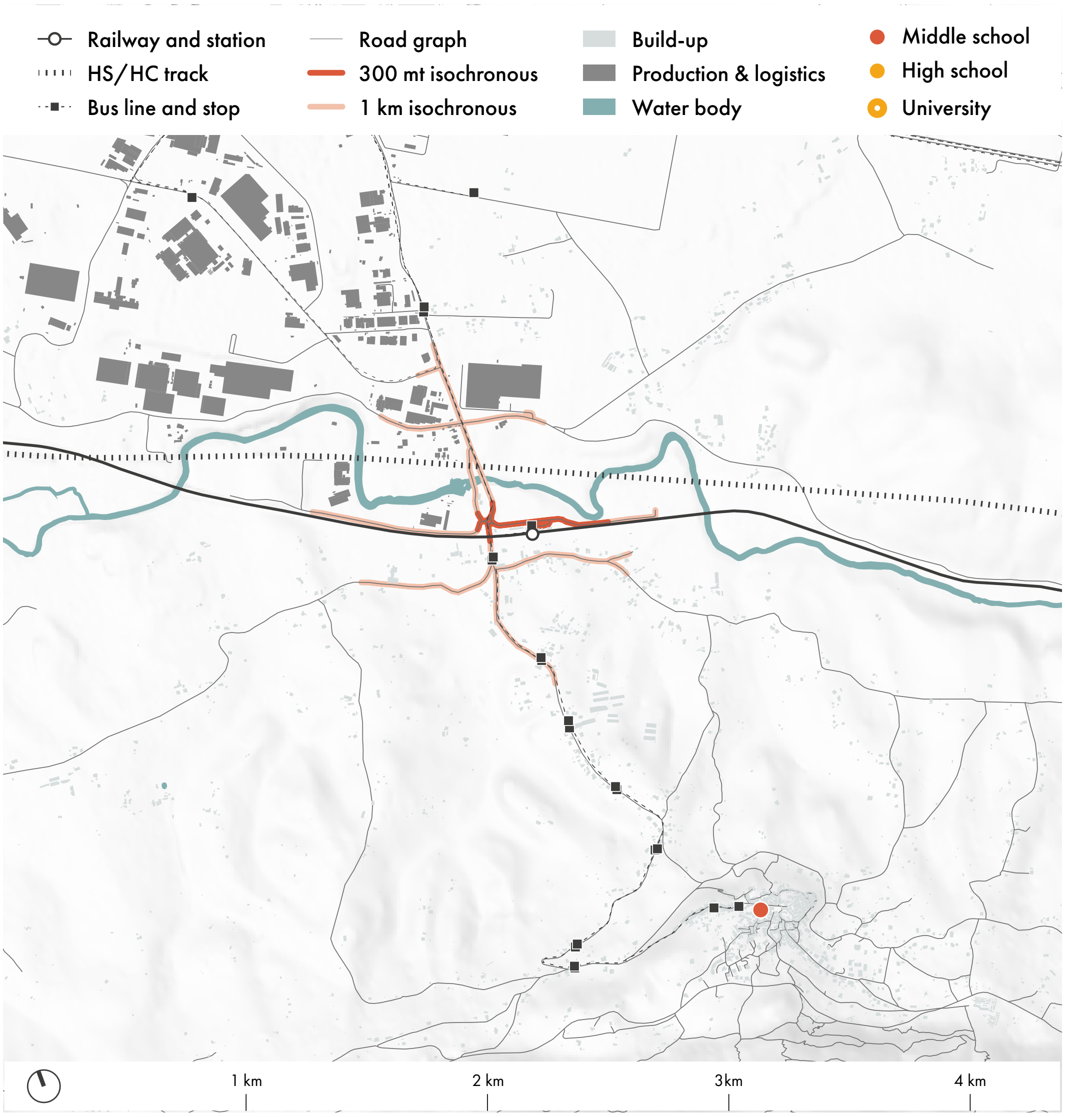


Fig. 169 Sgurgola framework

6 **Population within 300mt**

24 **Employees within 300mt**

0 **Students within 300mt**

16 **Population within 1km**

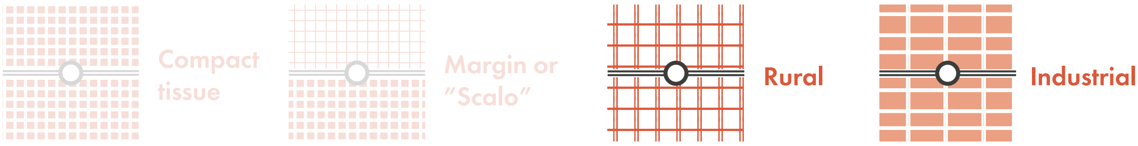
167 **Employees within 1km**

0 **Students within 1km**

Modal split arriving at the station **Modal split leaving the station**

NO DATA

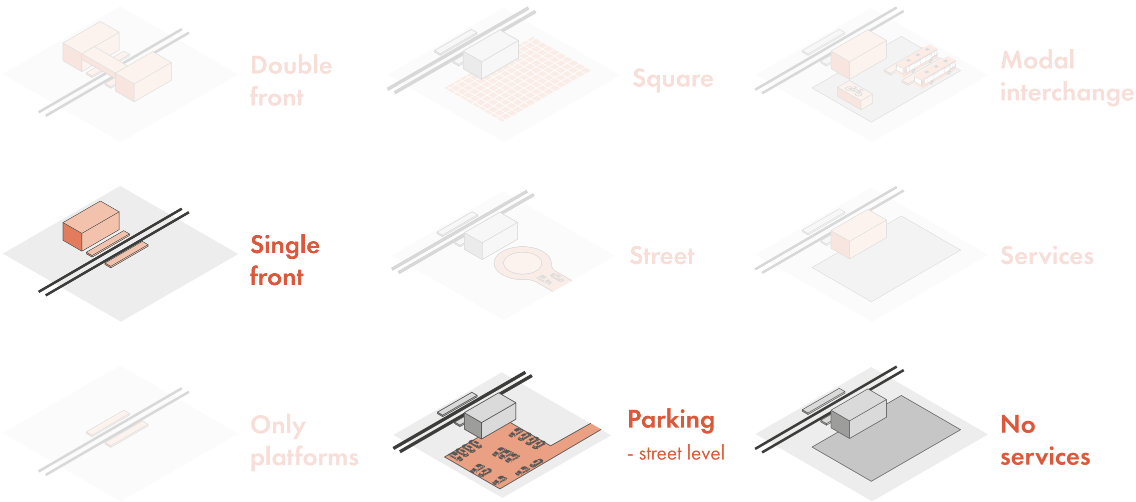
Context



Typology

Public space

Services



Station usage by passengers/day

OMISSIS

Rail services by destination and time of departure

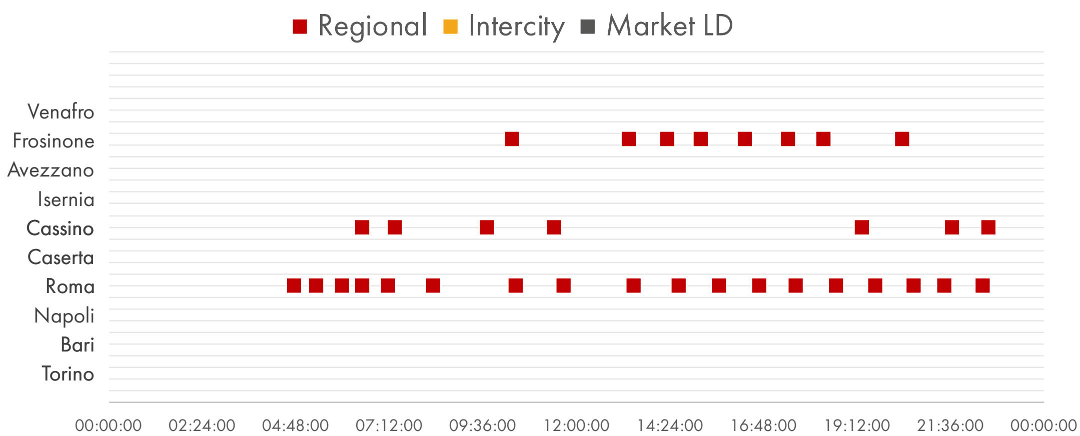


Fig. 170
Top view of the Morolo station

Morolo

The station is located in an area heavily eroded by a series of now abandoned quarries, 4km from the village of Morolo. It is surrounded by some industrial warehouses and is poorly connected to the main road network.

It does not have a real interchange car park but only a few parking spaces and relies on a passenger traffic and a level of service similar to those of Sgurgola.

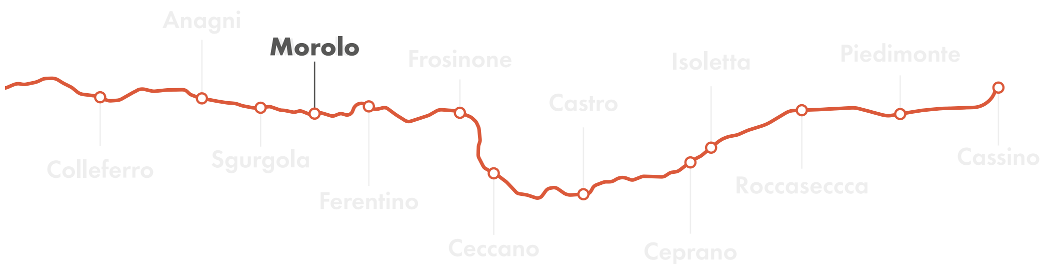


Fig. 171
Satellite view of the Morolo station

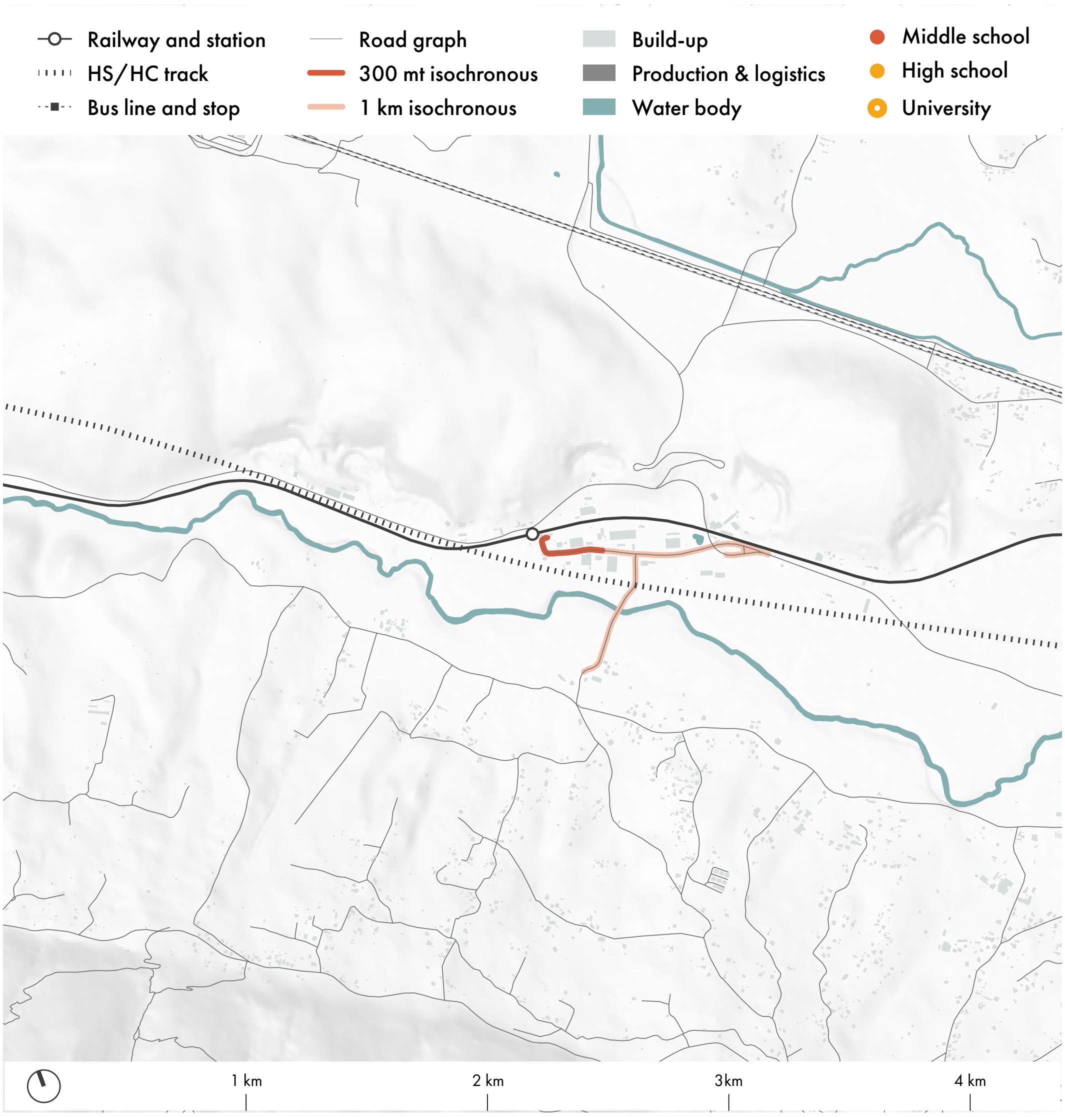


Fig. 172
Morolo framework

7 Population within 300mt

31 Employees within 300mt

0 Students within 300mt

21 Population within 1km

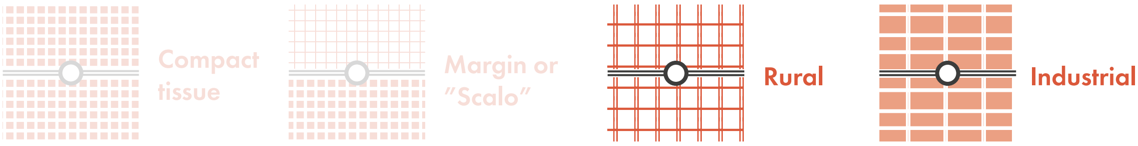
46 Employees within 1km

0 Students within 1km

Modal split arriving at the station **Modal split leaving the station**

NO DATA

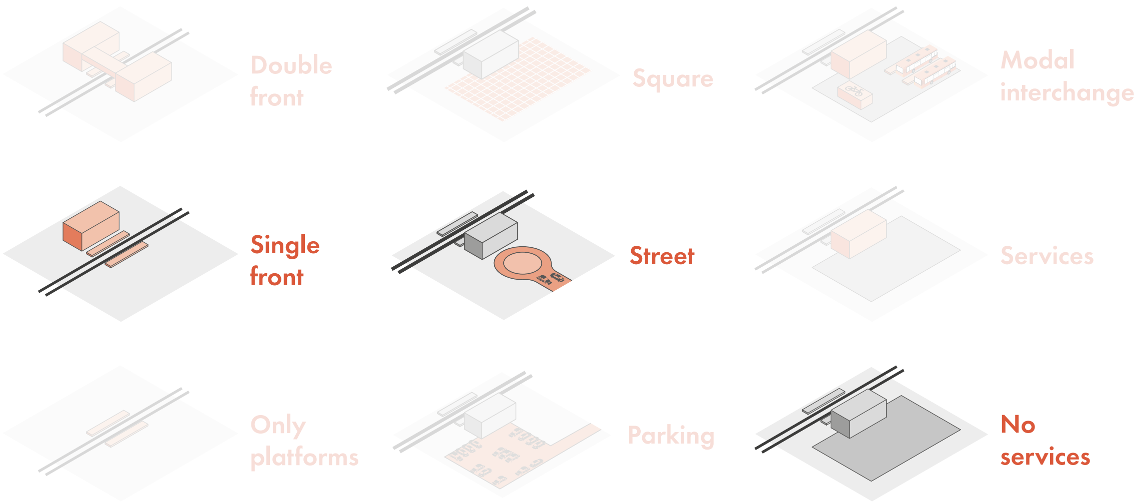
Context



Typology

Public space

Services



Station usage by passengers/day

OMISSIS

Rail services by destination and time of departure

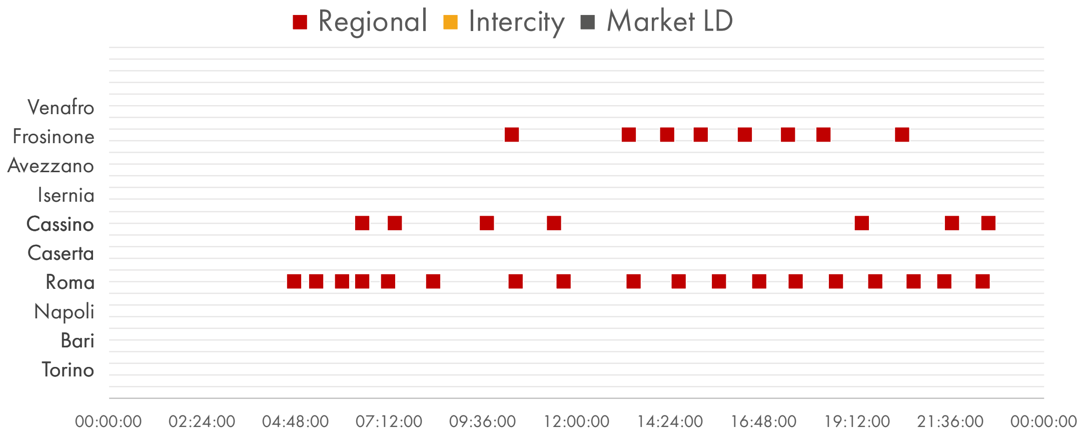


Fig. 173
The platform of the Ferentino station during the renovation works

Ferentino-Supino

The station is located about 5km south of the center of Ferentino, not far from the new motorway junction, the industrial area and the beginning of the highway to Sora.

It was renovated in 2017. New platforms and new interchange car parks were built on both sides of the tracks. These have allowed a further increase of the catchment area of the station, which in fact sees passengers arriving almost exclusively by car.

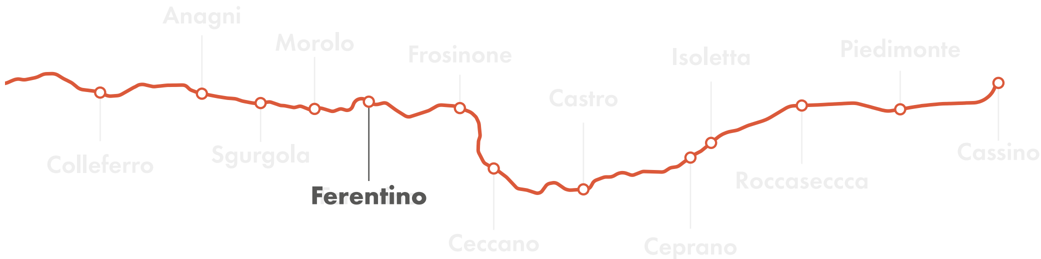


Fig. 174
Satellite view of the Ferentino station

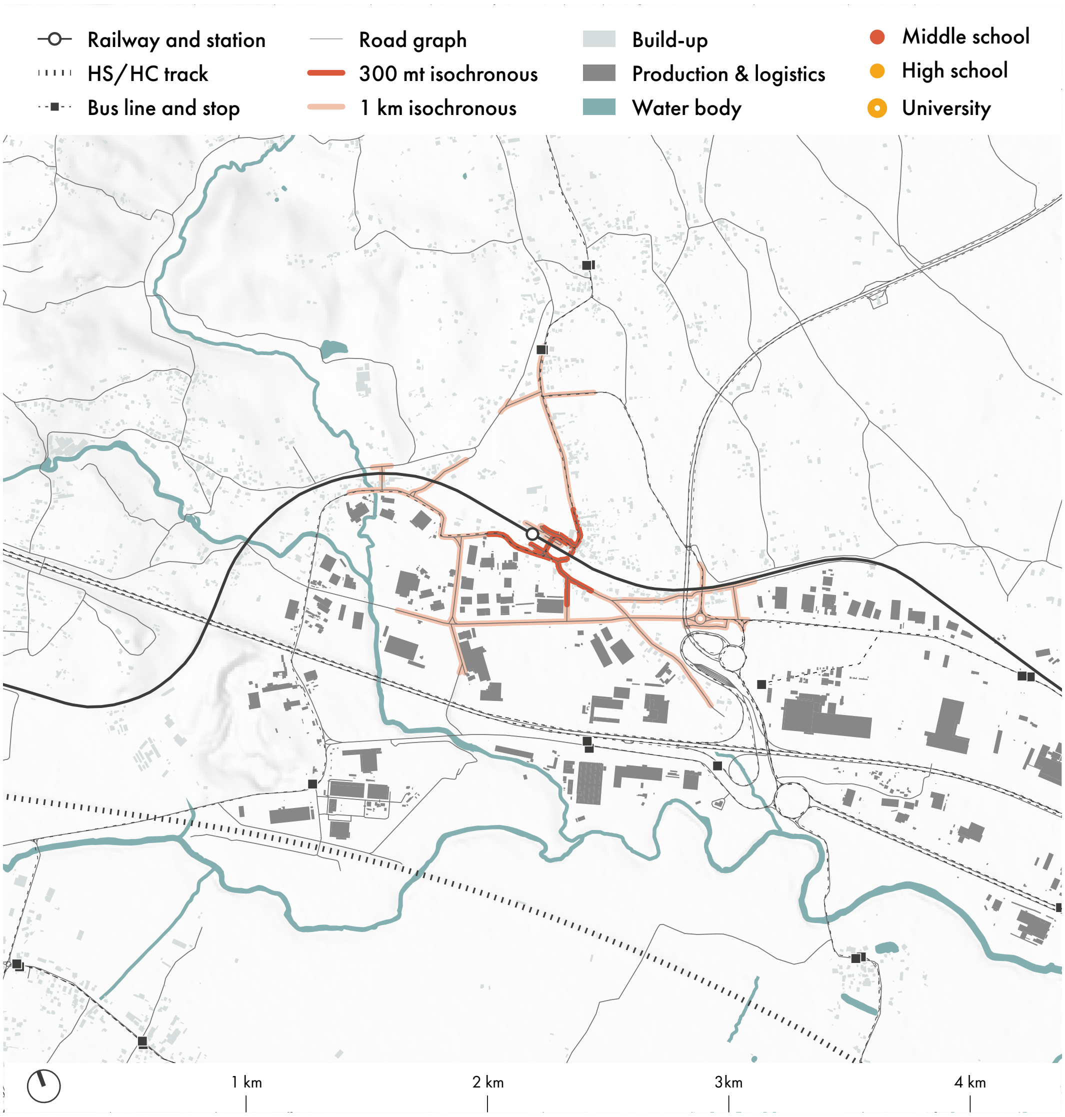
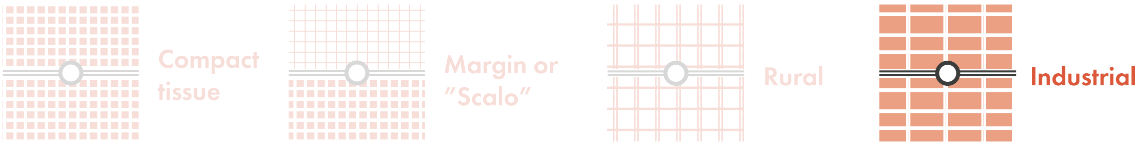


Fig. 175
Ferentino framework

Modal split arriving at the station **Modal split leaving the station**

OMISSIS

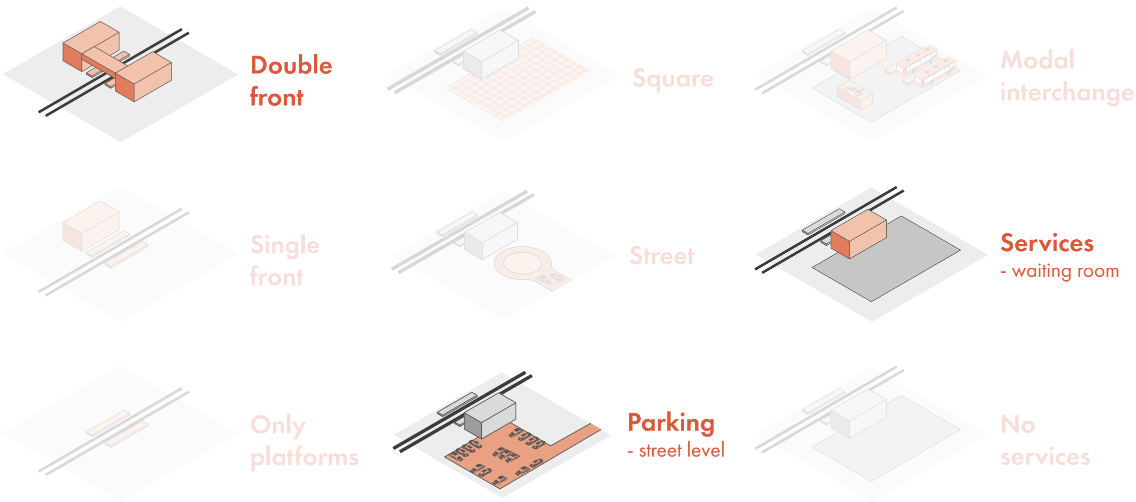
Context



Typology

Public space

Services



Station usage by passengers/day

OMISSIS

Rail services by destination and time of departure

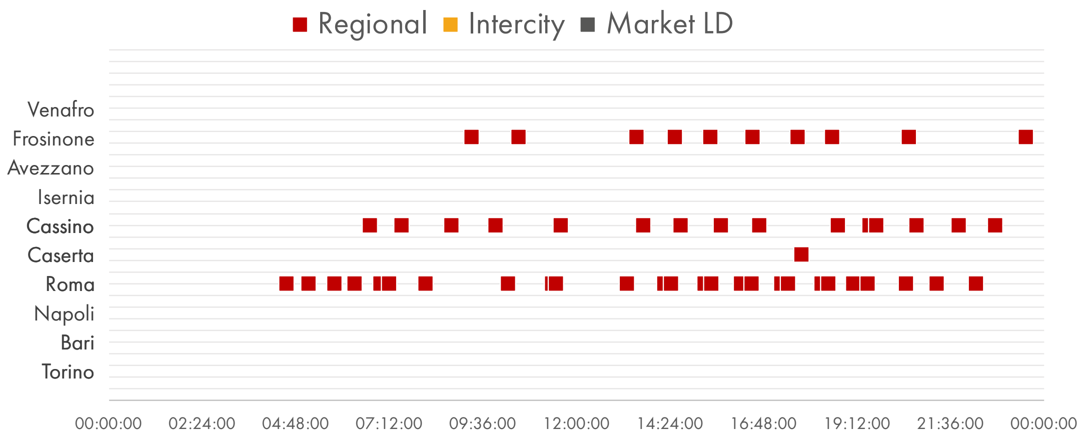


Fig. 176
The platform of the Frosinone station

Frosinone

The station represents the southern limit of the main axis of the lower city and acts as a hinge between the modern city and the first southern suburbs, towards the motorway.

It is served by a bus terminus for urban and extra-urban lines and is also the station with the highest passenger traffic in the corridor. In addition to the regional services of the FL6, some long-distance services and the pair of Frecciarossa trains also stop.

The square in front of the station, until now a simple car park, is now being redeveloped. A new car park has been therefore built on the south side.

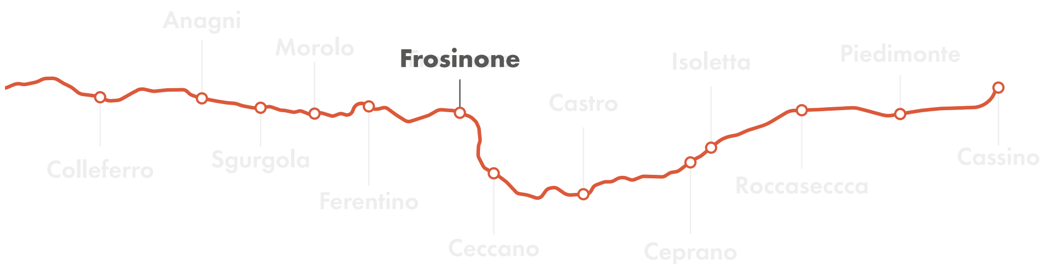


Fig. 177
Satellite view of the Frosinone station

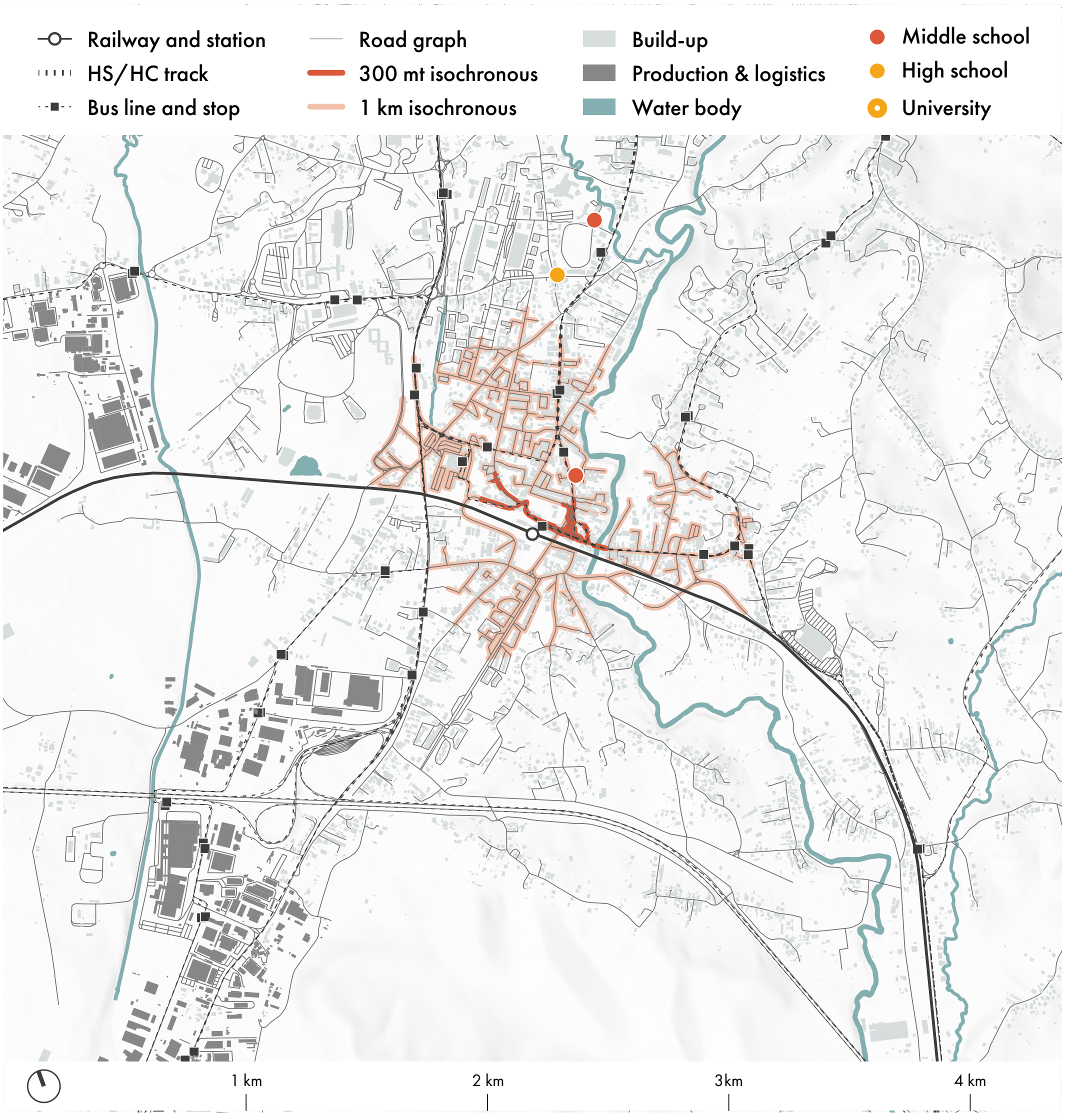


*Fig. 178
Frosinone
framework*

566 Population within 300mt

569 Employees within 300mt

0 Students within 300mt

6186 Population within 1km

2159 Employees within 1km

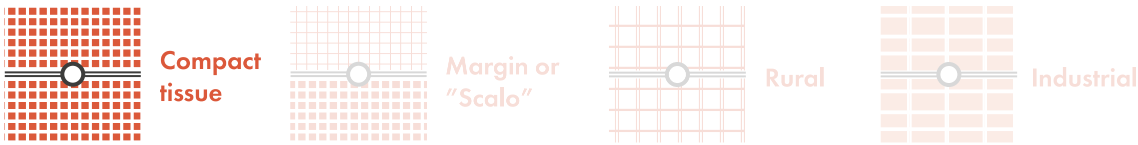
754 Students within 1km

Modal split arriving at the station

Modal split leaving the station

OMISSIS

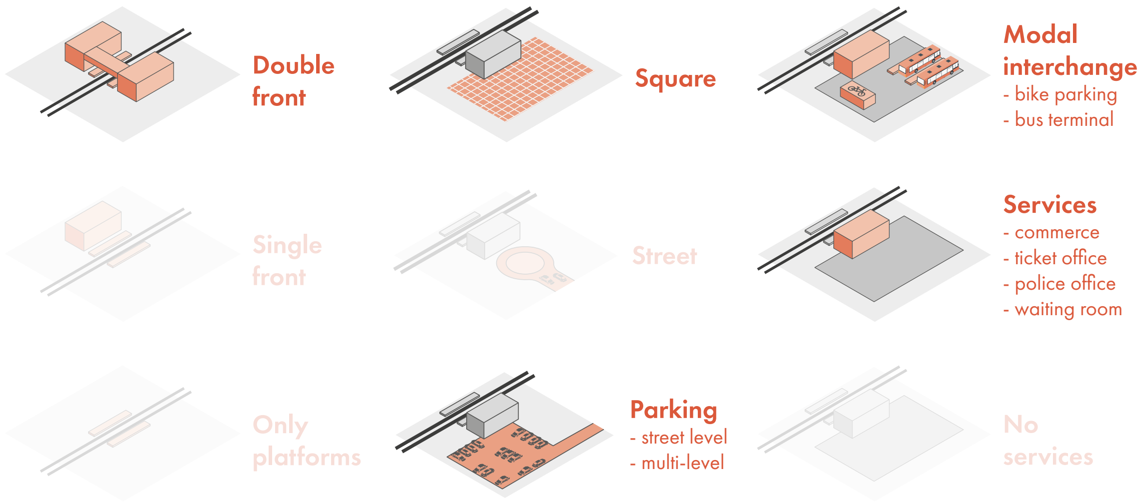
Context



Typology

Public space

Services



Station usage by passengers/day

OMISSIS

Rail services by destination and time of departure

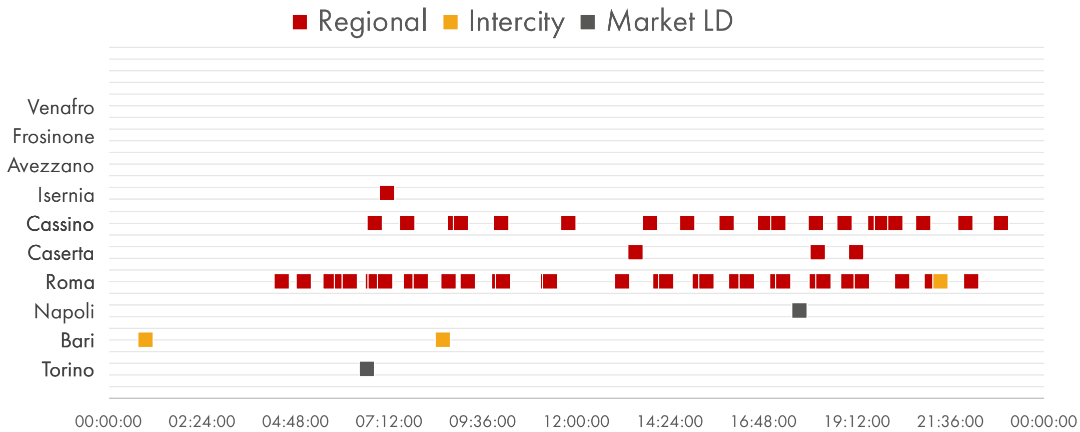


Fig. 179
A train on the platform

Fig. 180
The front square and the renovation works in progress

Fig. 181
Bike sharing racks

Fig. 182
Works in progress for the new square

Fig. 183
The platform of the Ceccano station

Ceccano

Ceccano station is located on the opposite bank of the Sacco from the historic center of the town, next to the former soap factory.

In 2011 RFI carried out modernization works, inserting new platforms and renovating the passenger building. Even before the works, a local association had committed itself to the refunctionalization of some rooms in the station, which were opened to the public through an agreement with RFI. They host activities such as a small library, a reading room, a multimedia and teaching room.

Fig. 184
Satellite view of the Colleferro station

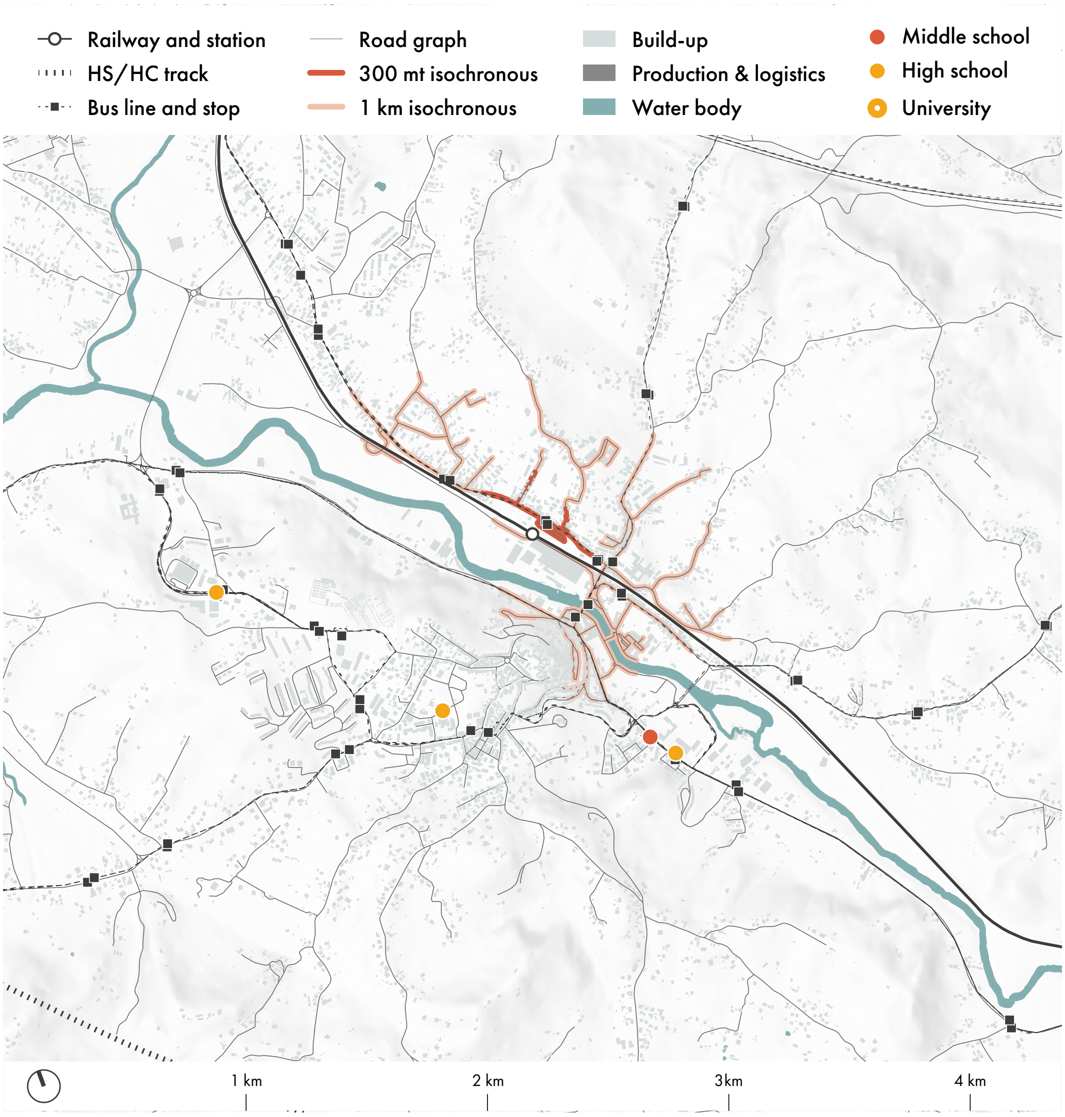


Fig. 185 Ceccano framework

422 **Population within 300mt**

367 **Employees within 300mt**

0 **Students within 300mt**

3013 **Population within 1km**

639 **Employees within 1km**

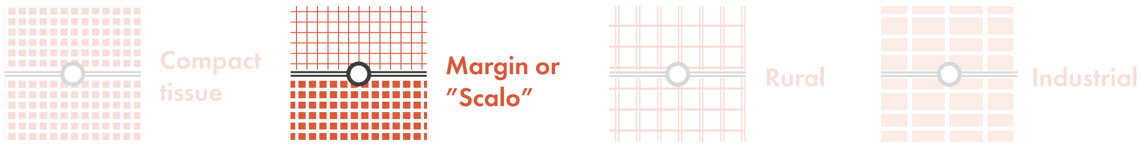
0 **Students within 1km**

Modal split arriving at the station

Modal split leaving the station

OMISSIS

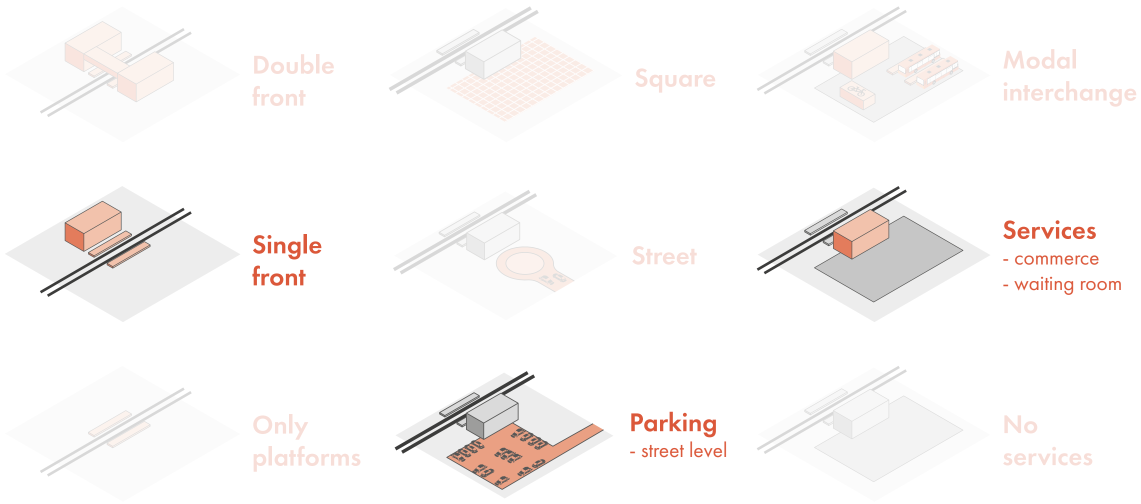
Context



Typology

Public space

Services



Station usage by passengers/day

OMISSIS

Rail services by destination and time of departure

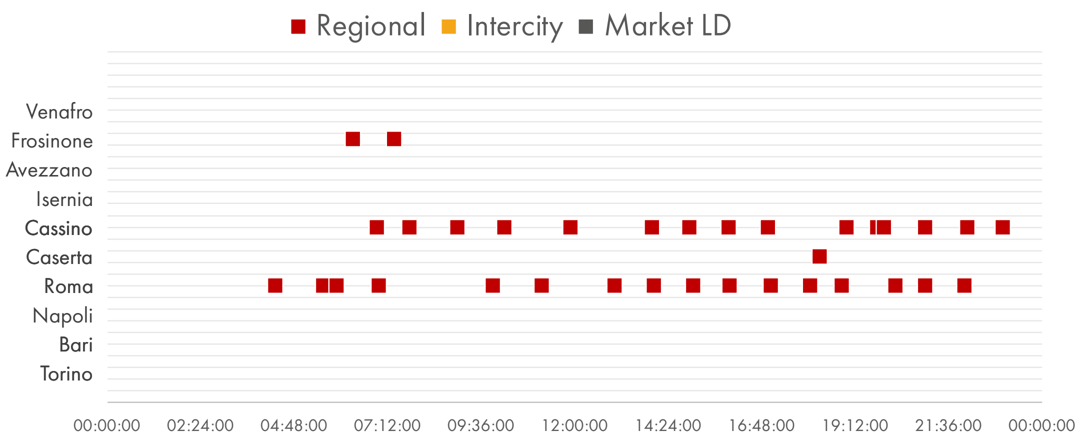


Fig. 186
The new facade of the station

Fig. 187
The platforms

Fig. 188
Bike sharing stalls and the small playground

Fig. 189
Car parking

Fig. 190
The facade of the Castro station

Castro-Pofi-Vallecorsa

The station is 2 km from the town of Castro dei Volsci to the south and 4 km from that of Pofi to the north. Over the years, a small inhabited hamlet with bars and minimarkets has developed around it.

In front of the station, now downgraded to a stop, there is a large car park, recently integrated by a further area along the provincial road.

The passenger building is unguarded and with just a small waiting room.

Fig. 191
Satellite view of the Castro station

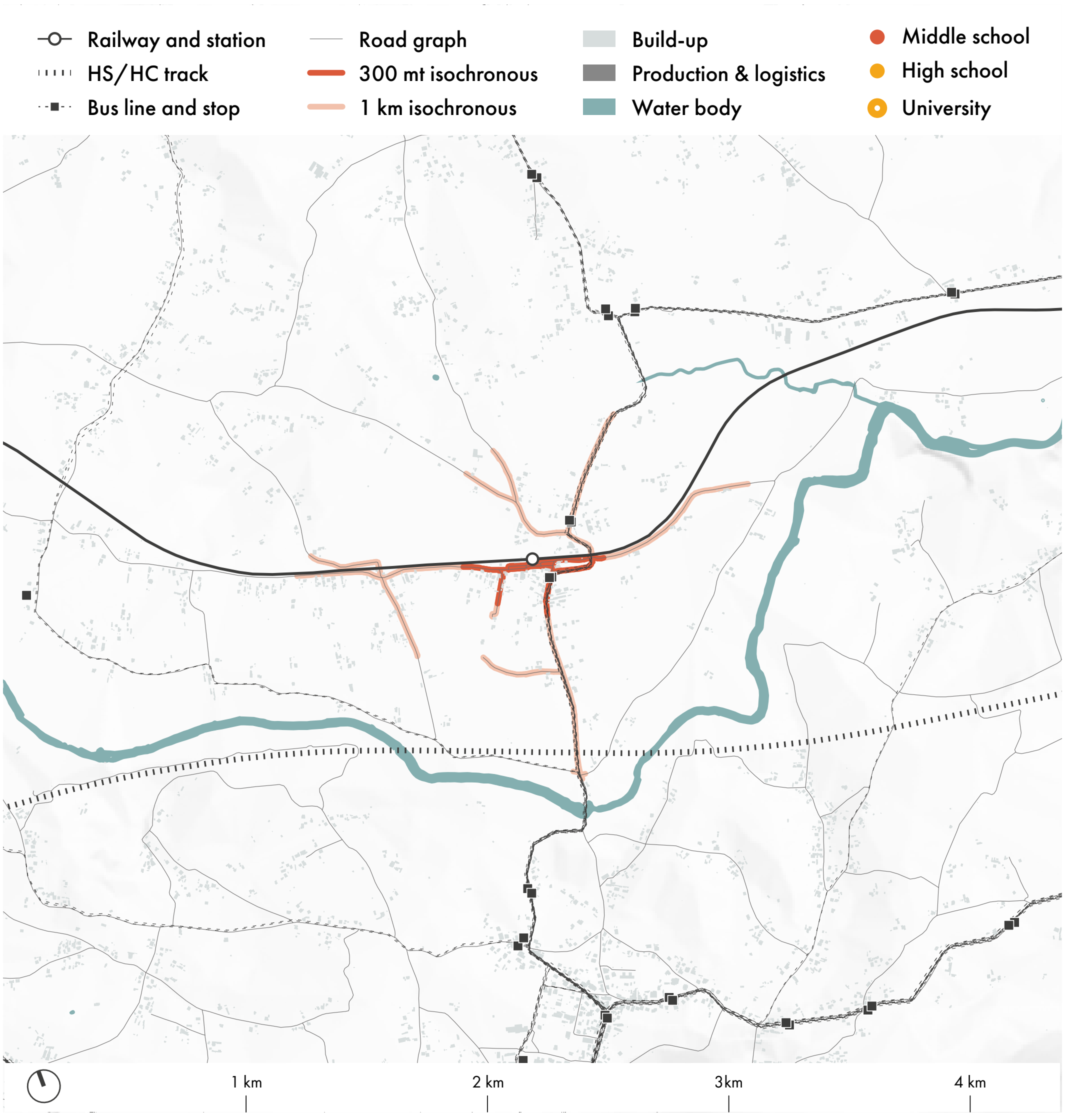


Fig. 192 Castro framework

185 Population within 300mt

25 Employees within 300mt

0 Students within 300mt

339 Population within 1km

39 Employees within 1km

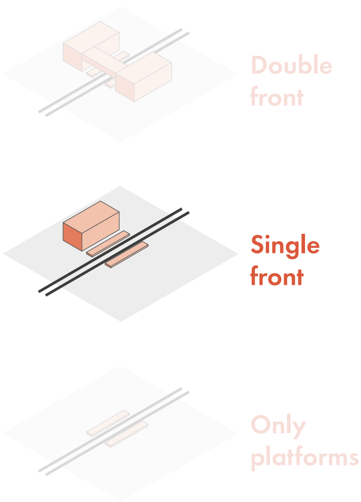
0 Students within 1km

Modal split arriving at the station **Modal split leaving the station**

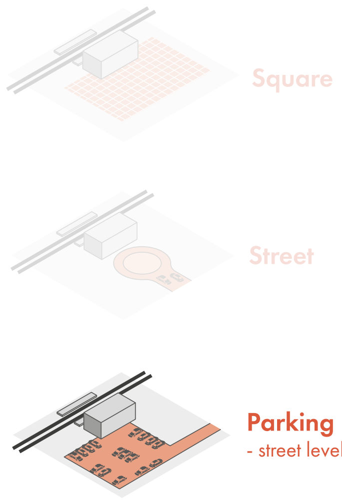
NO DATA

Context

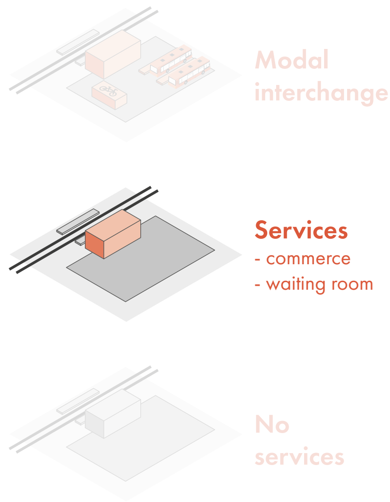
Typology



Public space



Services



Station usage by passengers/day

OMISSIS

Rail services by destination and time of departure

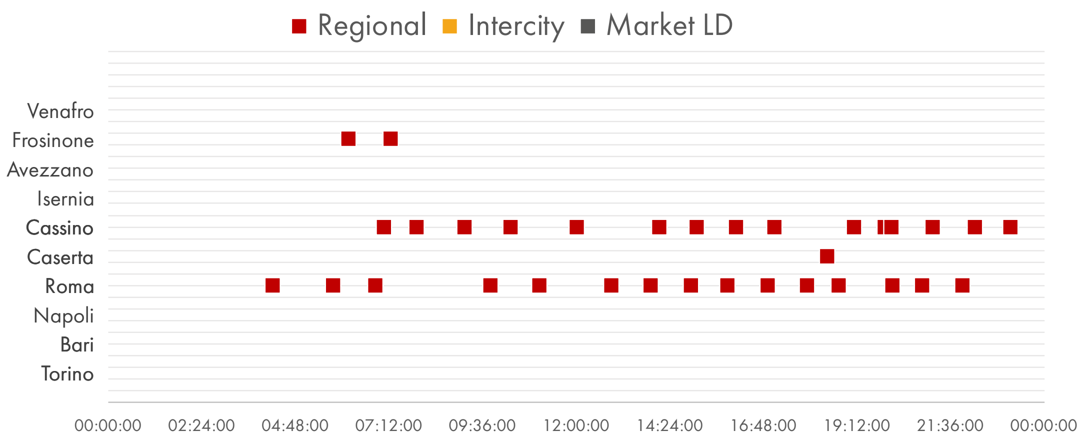


Fig. 193
Platforms in direction of Rome

Fig. 194
Car parking in front of the station

Fig. 195
Bus stop

Fig. 196
Car parking
just outside the
station area

Fig. 197
The facade of the Ceprano station

Ceprano-Falvaterra

The station is located about 3 km from the center of the town of Ceprano. On both sides of the tracks there are clusters of single-family houses and the southern side can be reached with pedestrian overpass. About 1km to the south there is a small industrial area.

The station is equipped with a bar, a parking lot and a small waiting room.

In this section the HS/HC line runs parallel to the railway again.

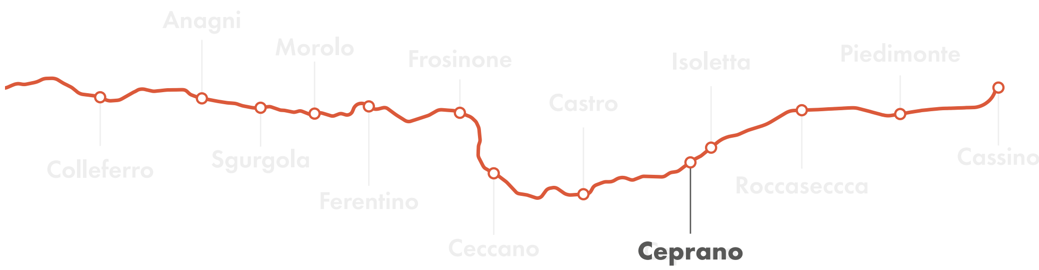


Fig. 198
Satellite view of the Ceprano station

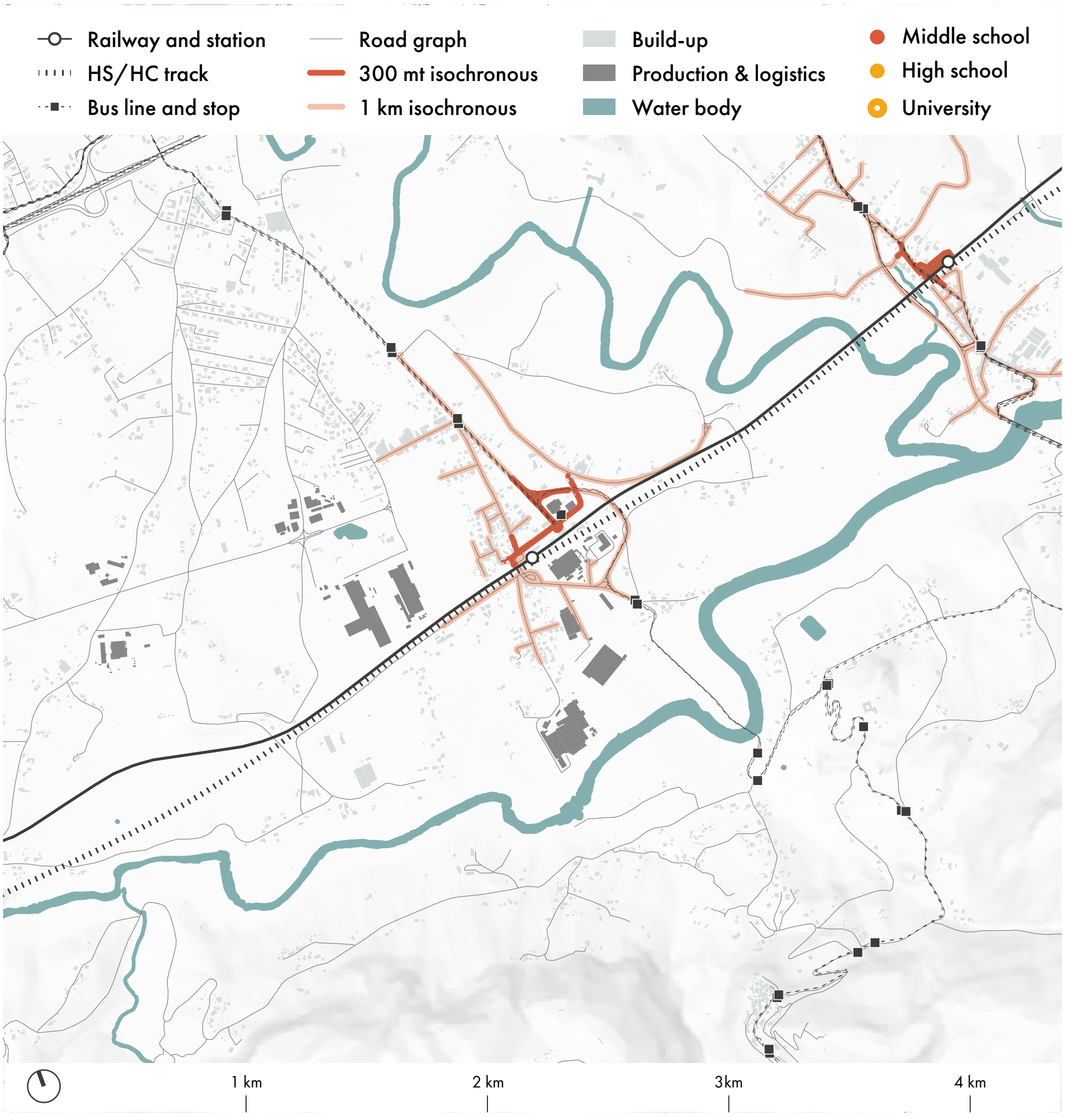


Fig. 199 Ceprano framework

86 Population within 300mt

22 Employees within 300mt

0 Students within 300mt

395 Population within 1km

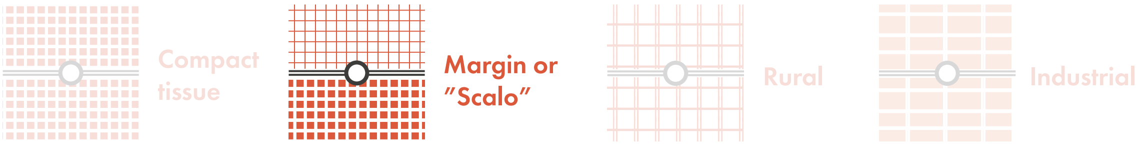
129 Employees within 1km

0 Students within 1km

Modal split arriving at the station **Modal split leaving the station**

OMISSIS

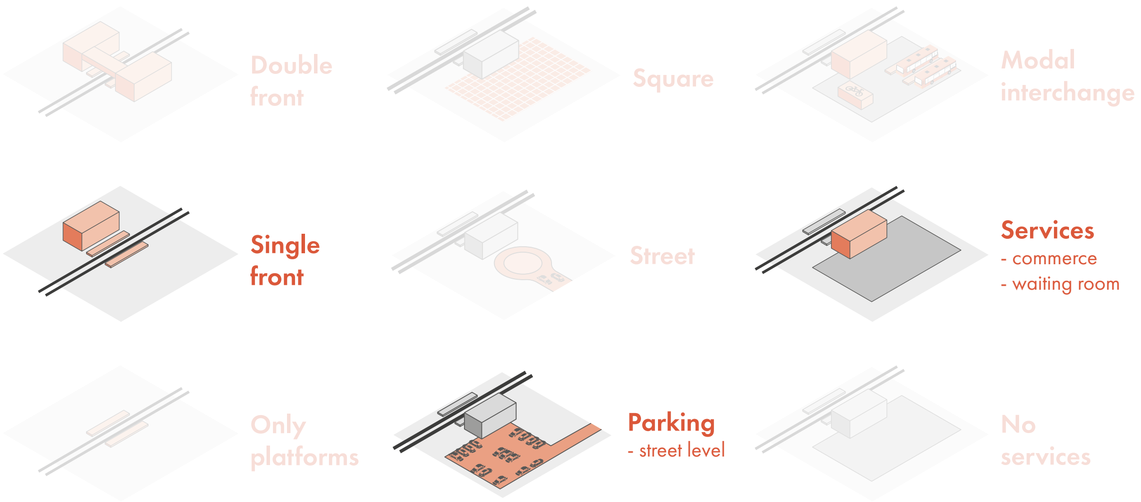
Context



Typology

Public space

Services



Station usage by passengers/day

OMISSIS

Rail services by destination and time of departure

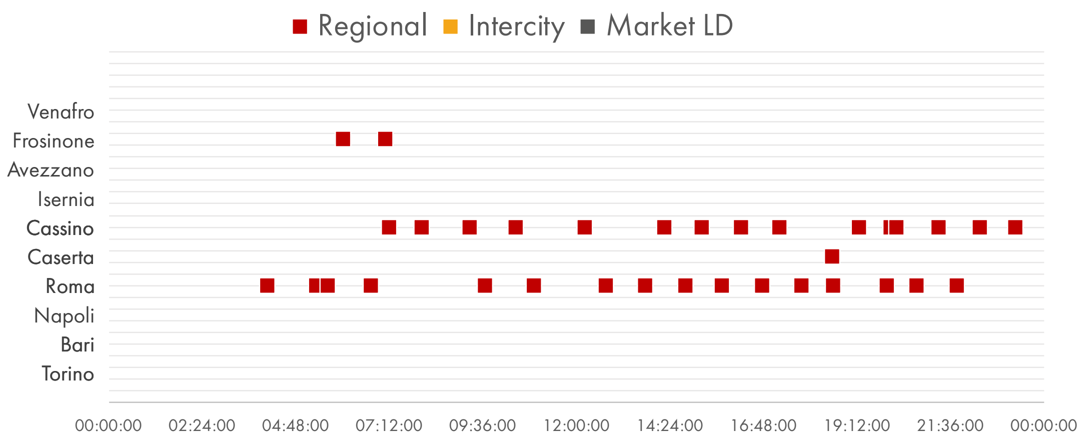


Fig. 200
Platforms in direction of Cassino

Fig. 201
Bus stop and bike rack

Fig. 202
Car parking

Fig. 203
Build-up in front
of the station

Fig. 204
The platform of the Isoletta station

Isoletta-San Giovanni Incarico

The Isoletta station is located at the crossroads between the railway and the road that connects the town of San Giovanni Incarico to Ceprano, 2 km from the Ceprano station.

With the works for the high-speed line, the old passenger building was demolished and replaced with a small volume used as waiting room, unattended and without services.

There is a large car park in front of the station.

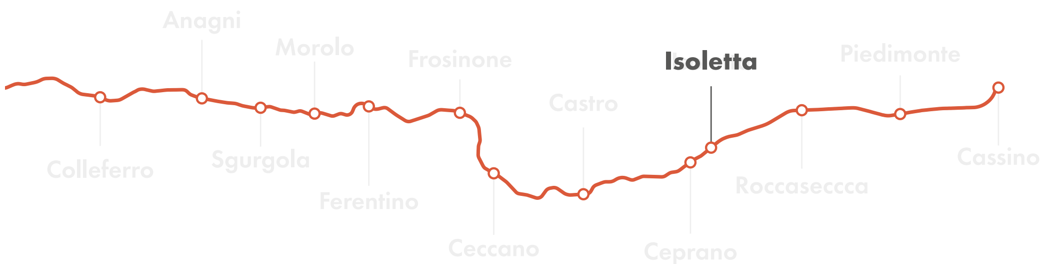


Fig. 205
Satellite view of the Isoletta station

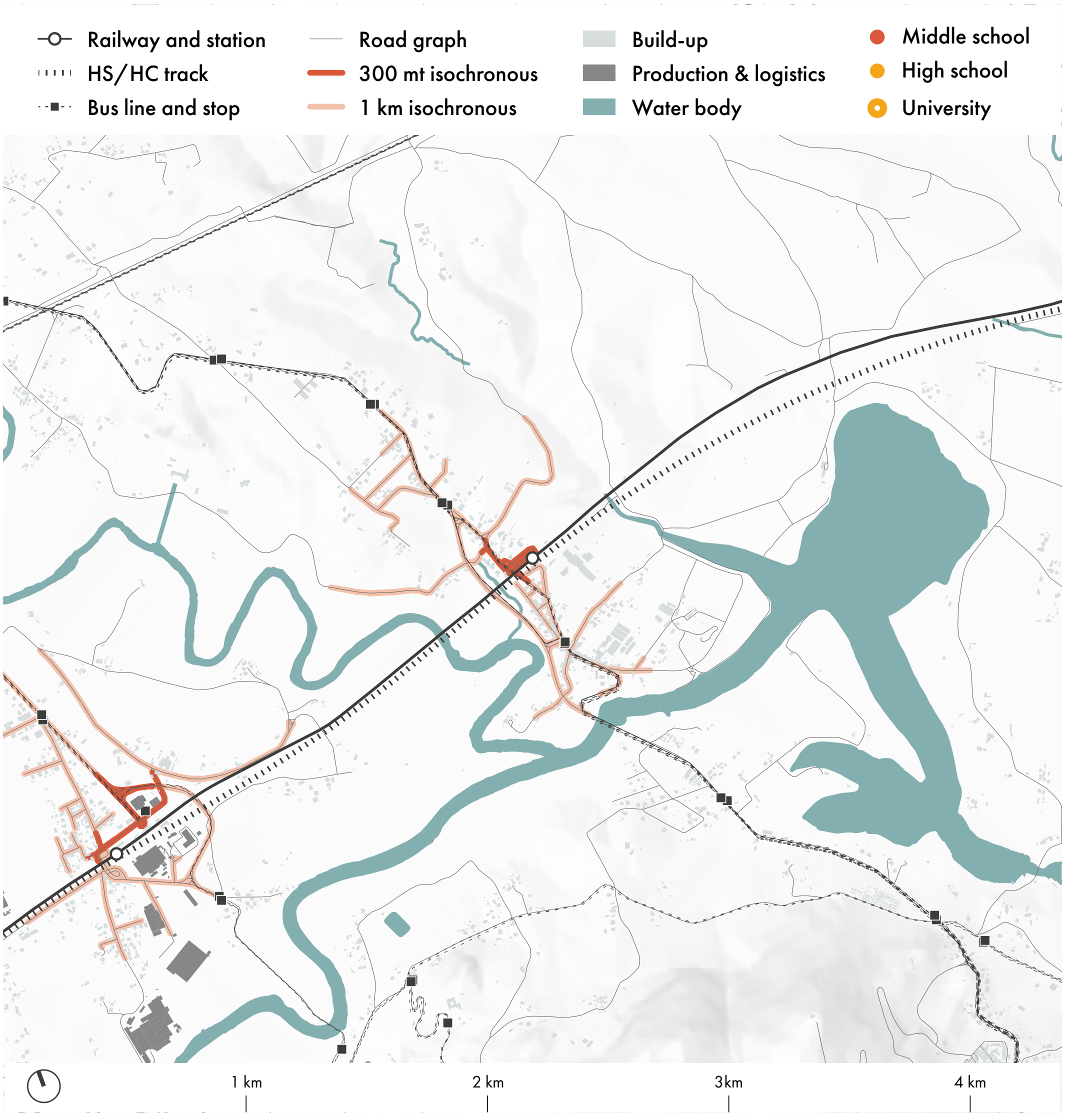


Fig. 206
Isoletta framework

83 Population within 300mt

6 Employees within 300mt

0 Students within 300mt

408 Population within 1km

34 Employees within 1km

0 Students within 1km

Modal split arriving at the station

Modal split leaving the station

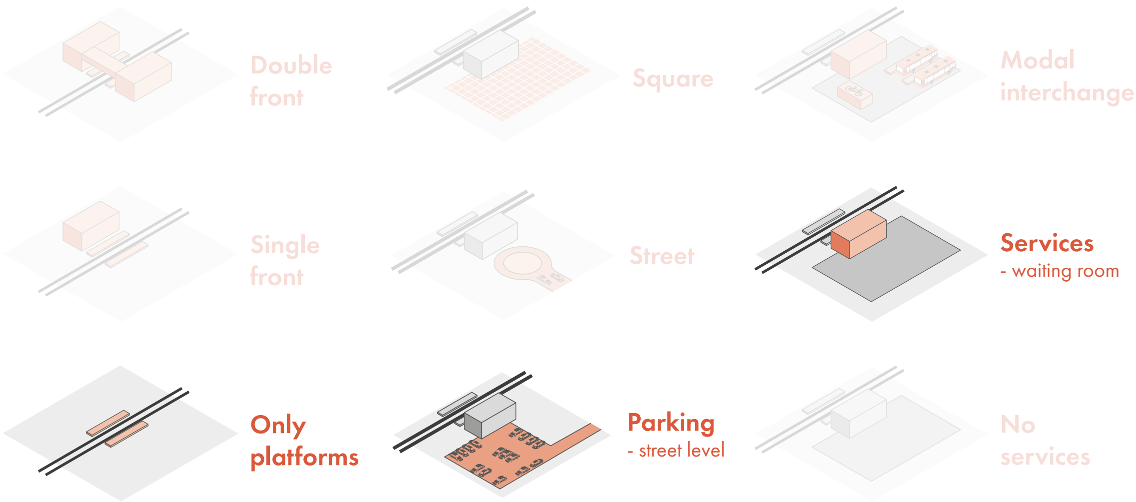
NO DATA

Context

Typology

Public space

Services



Station usage by passengers/day

OMISSIS

Rail services by destination and time of departure

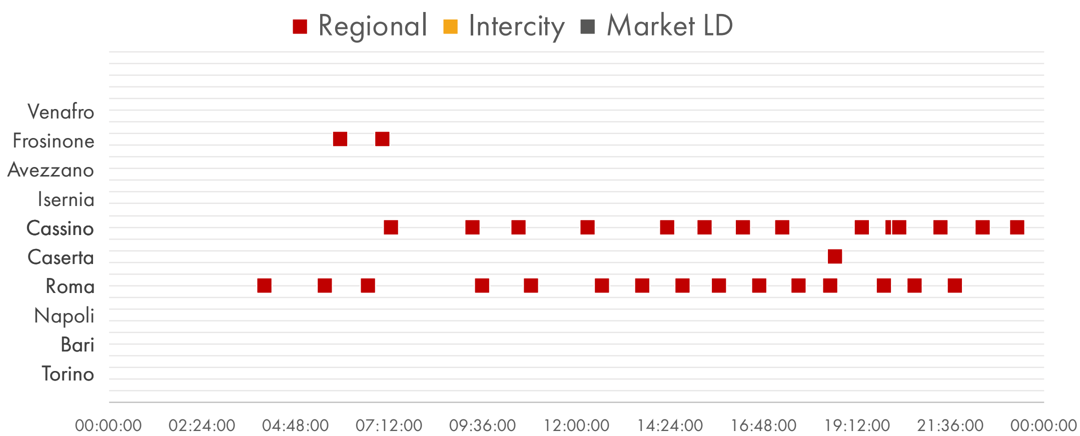


Fig. 207
The waiting room

Fig. 208
Platforms in direction of Cassino

Fig. 209
The underpass

Fig. 210
Car parking
in front of the
station

Fig. 211
The platform of the Roccasecca station

Roccasecca

The station is the junction with the line to Sora and Avezzano. It is located about 3 km from the historic center of Roccasecca and serves the part of the municipality on the plain, which over time has grown north of the station.

There is a car park to the north of the platforms and one to the south, connected with an underpass.

There is good passenger traffic, especially due to the extension of the town and the possibility of exchanging with the line to Sora.

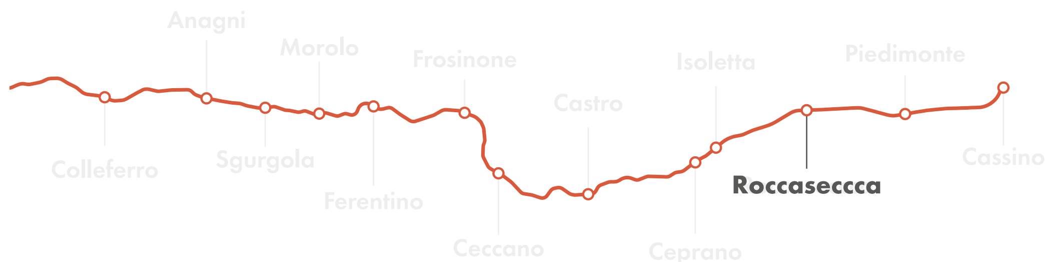


Fig. 212
Satellite view of the Roccasecca station

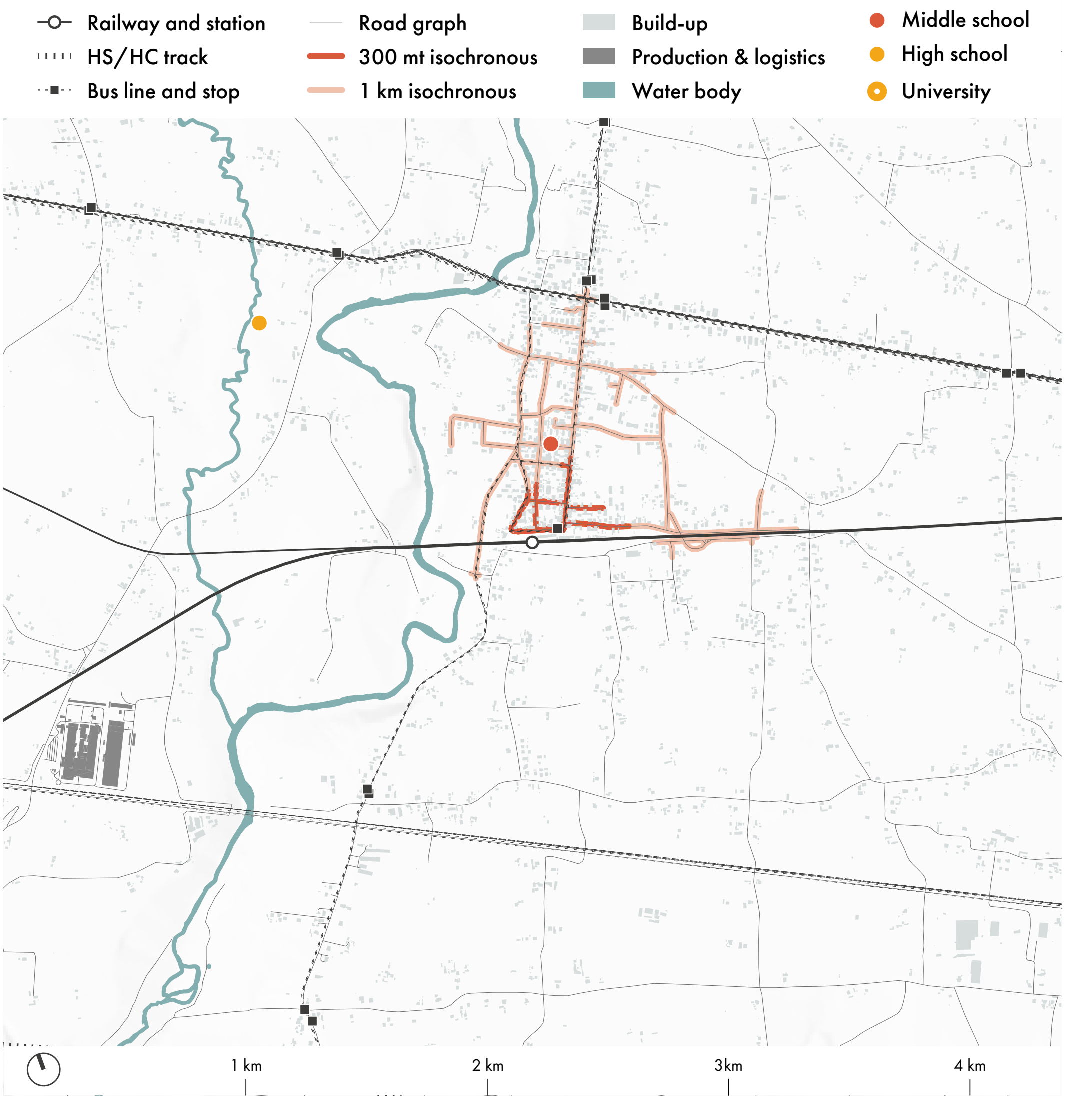


Fig. 213 Roccasecca framework

663 Population within 300mt

96 Employees within 300mt

178 Students within 300mt

1847 Population within 1km

380 Employees within 1km

361 Students within 1km

Modal split arriving at the station

Modal split leaving the station

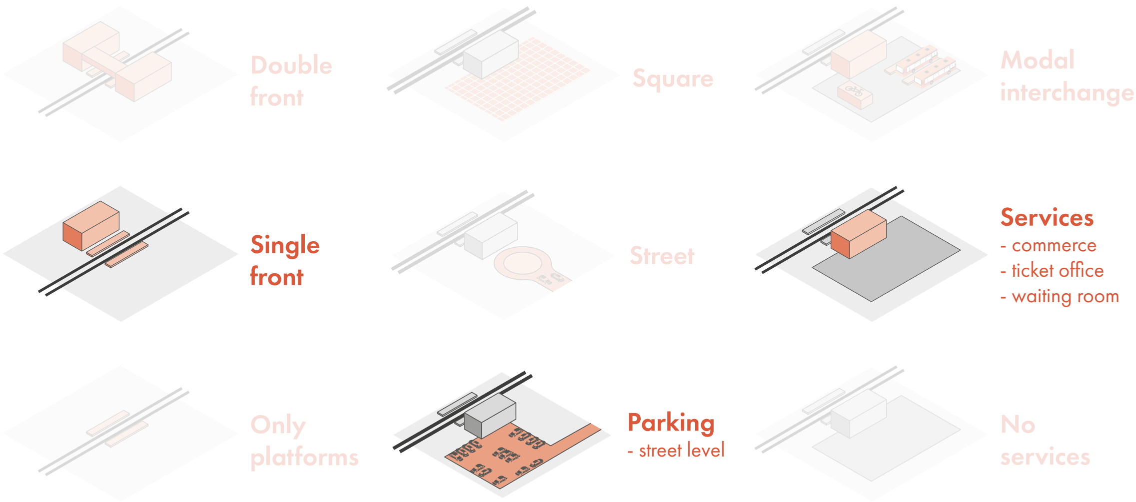
OMISSIS

Context

Typology

Public space

Services



Station usage by passengers/day

OMISSIS

Rail services by destination and time of departure

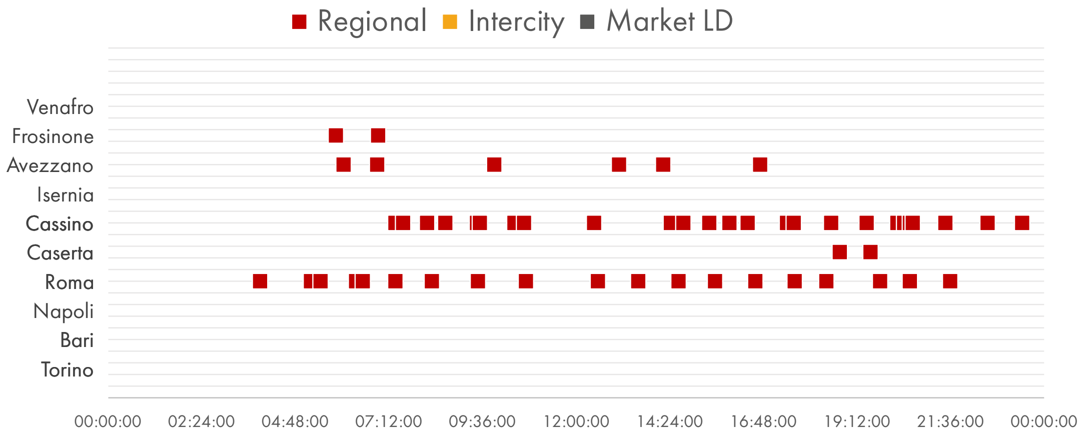


Fig. 214
Top view of the Piedimonte station

Piedimonte-Villa Santa Lucia-Aquino

Opened in 2000, the station was designed for a passenger service between the old and today closed Aquino and Piedimonte stations and to enhance freight transport from the nearby FIAT factory, with the construction of a new yard and a dedicated set of tracks, which still exists today. .

The new station building has a large car park but is unguarded and lacks essential services.

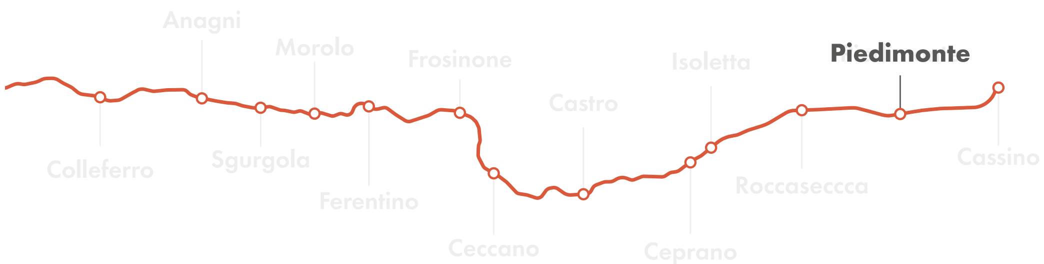


Fig. 215
Satellite view of the Piedimonte station

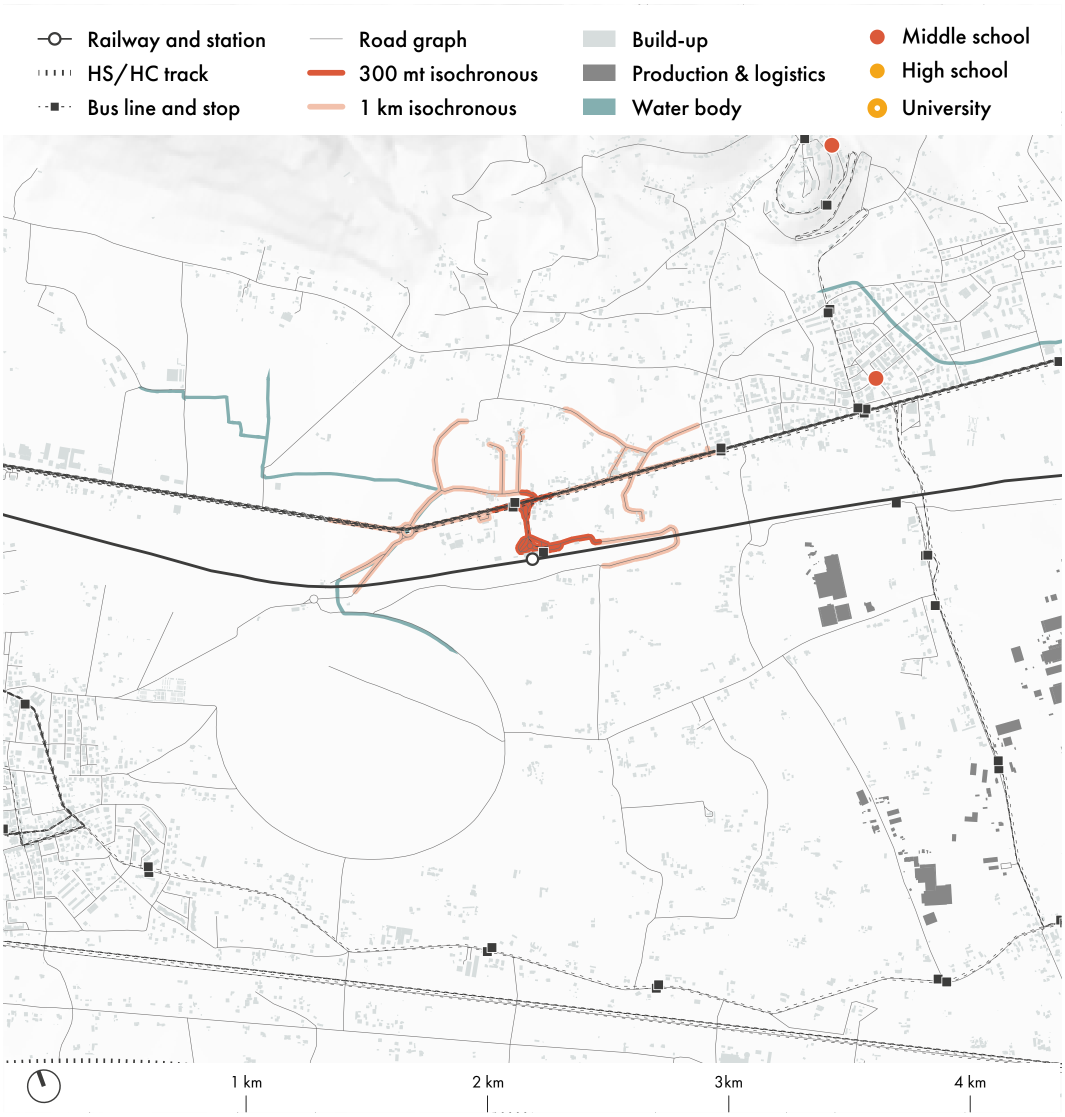


Fig. 216 Piedimonte framework

232 Population within 300mt

5 Employees within 300mt

178 Students within 300mt

534 Population within 1km

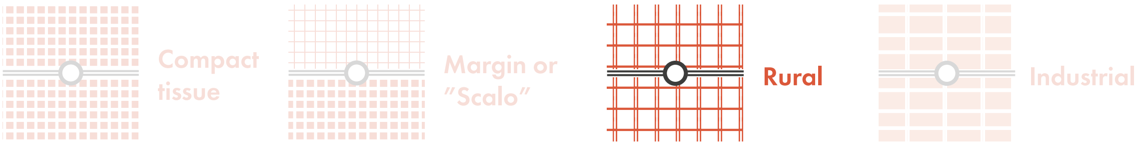
43 Employees within 1km

361 Students within 1km

Modal split arriving at the station **Modal split leaving the station**

NO DATA

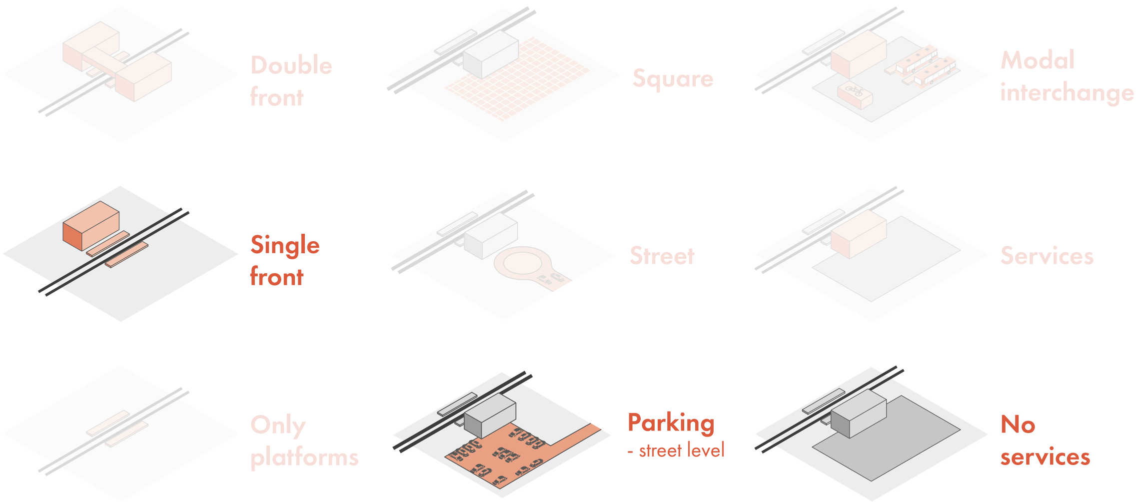
Context



Typology

Public space

Services



Station usage by passengers/day

OMISSIS

Rail services by destination and time of departure

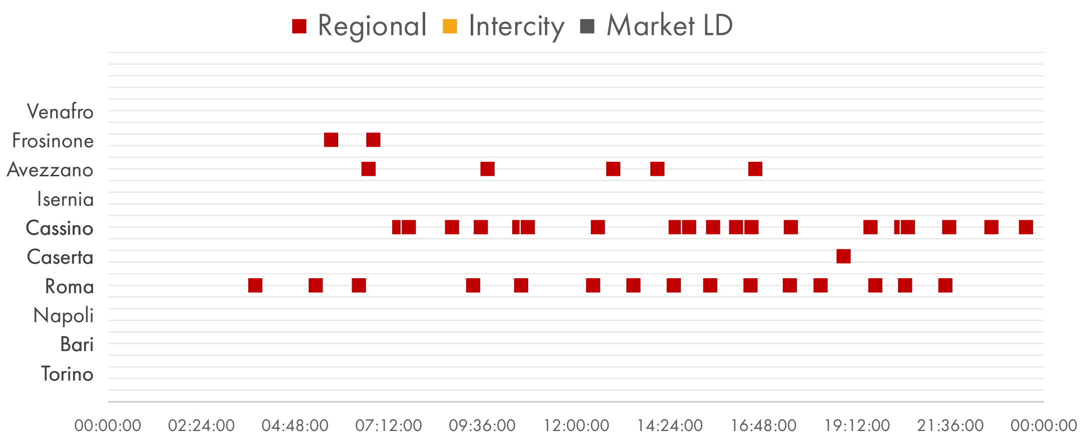


Fig. 217
The platform of the Cassino station

Cassino

The station is the last on the northern corridor. It serves the city of Cassino, defining its southern edge. The location is the result of a move that occurred after 1860. Previously it was in a more central position.

The station's main catchment area is the city of Cassino itself and the neighboring towns, connected by a frequent bus network starting and ending at the terminus in front of the station. There is the availability of an underground car park, currently being redeveloped together with the square and the station building.

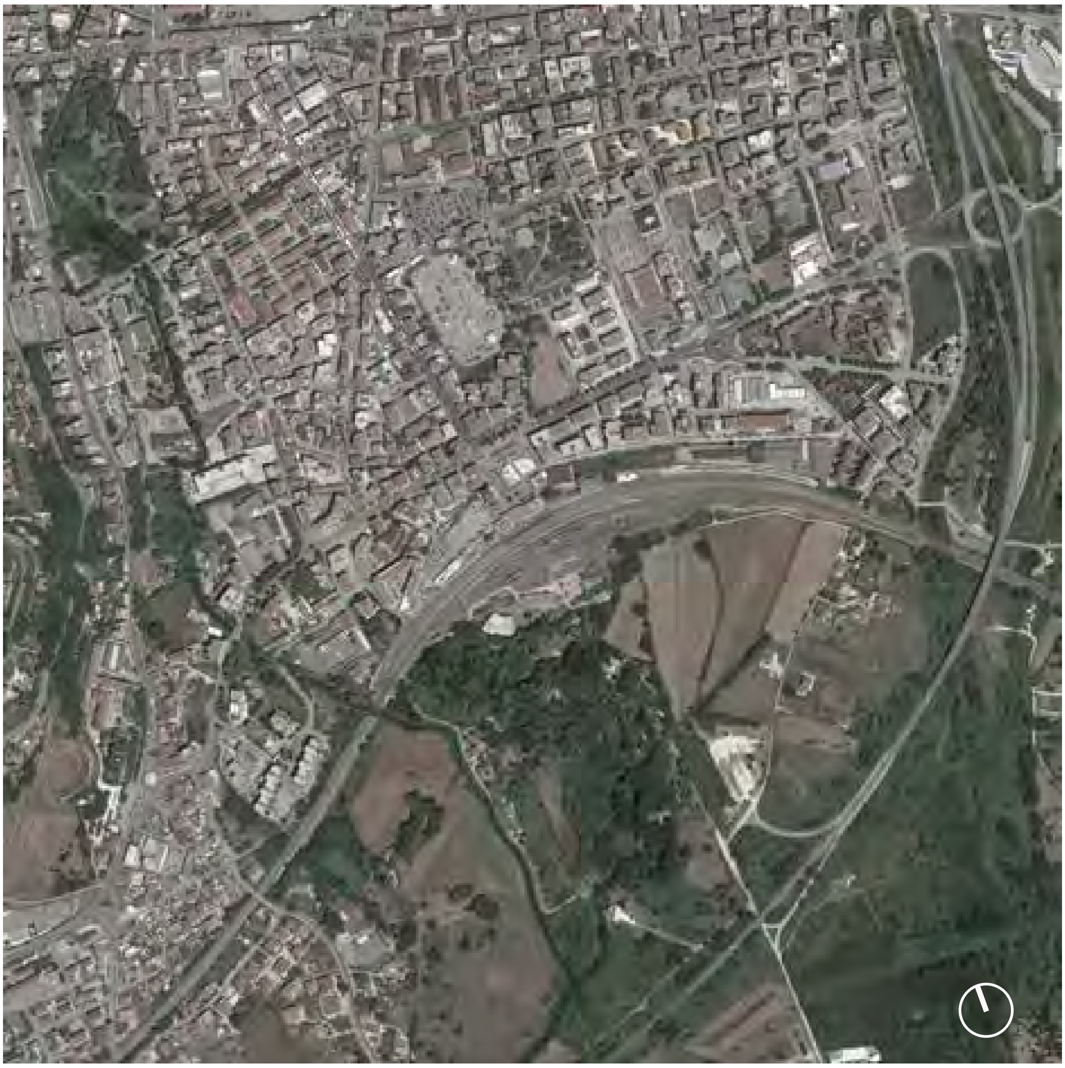


Fig. 218
Satellite view of the Cassino station

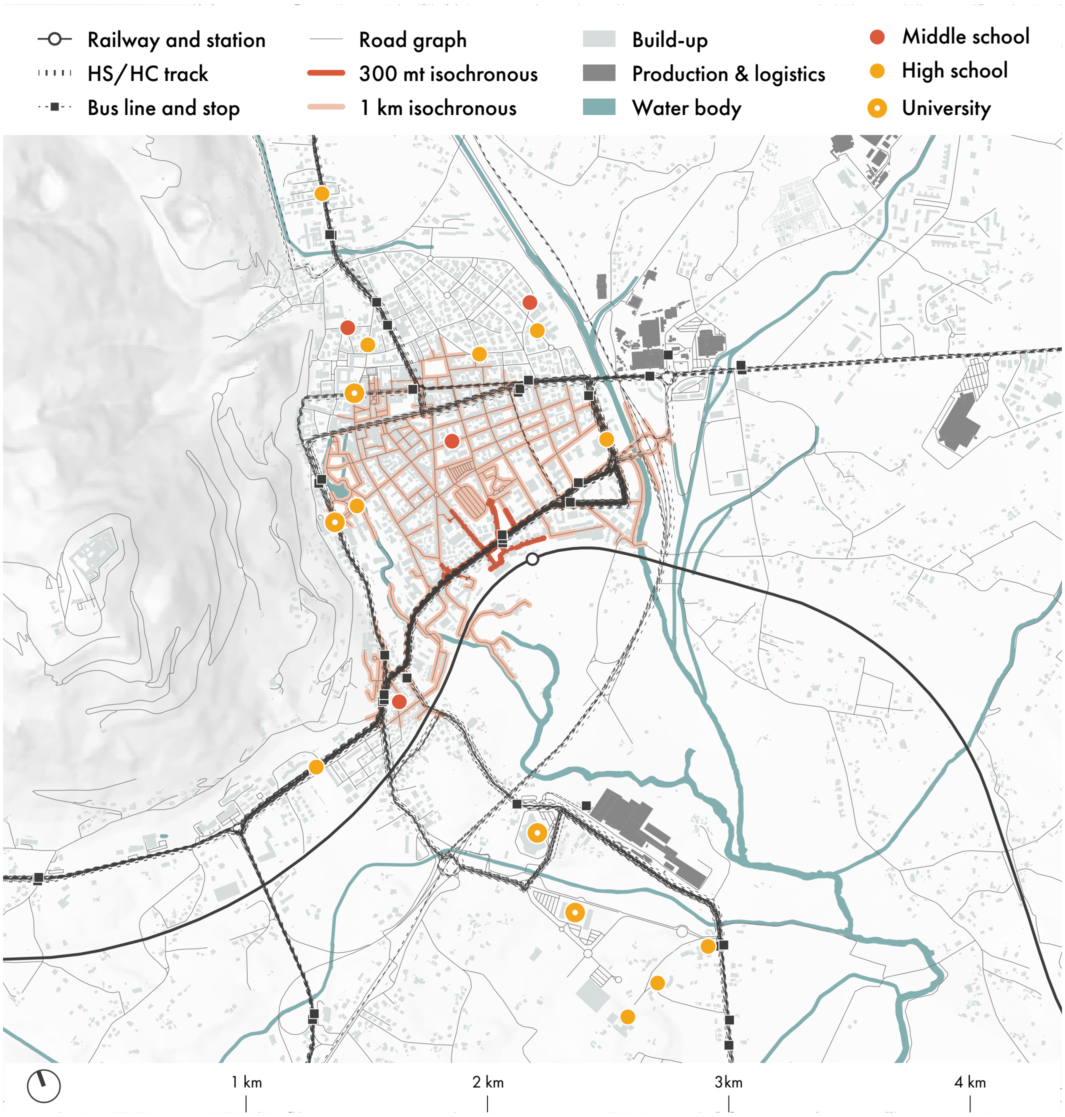


Fig. 219 Cassino framework

2038 Population within 300mt

1107 Employees within 300mt

0 Students within 300mt

10629 Population within 1km

5613 Employees within 1km

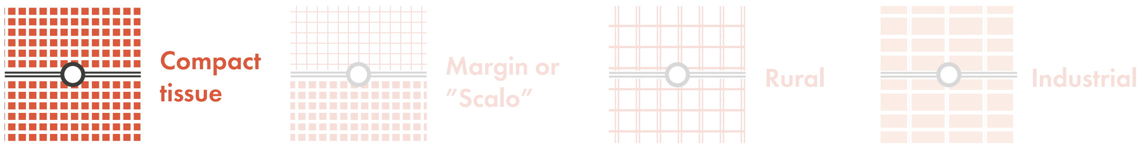
3296 Students within 1km

Modal split arriving at the station

Modal split leaving the station

OMISSIS

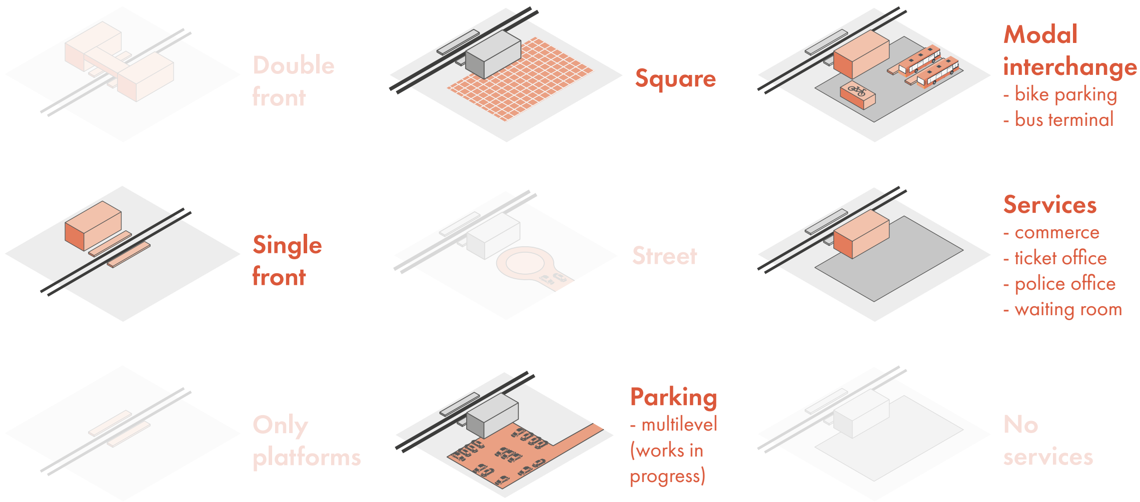
Context



Typology

Public space

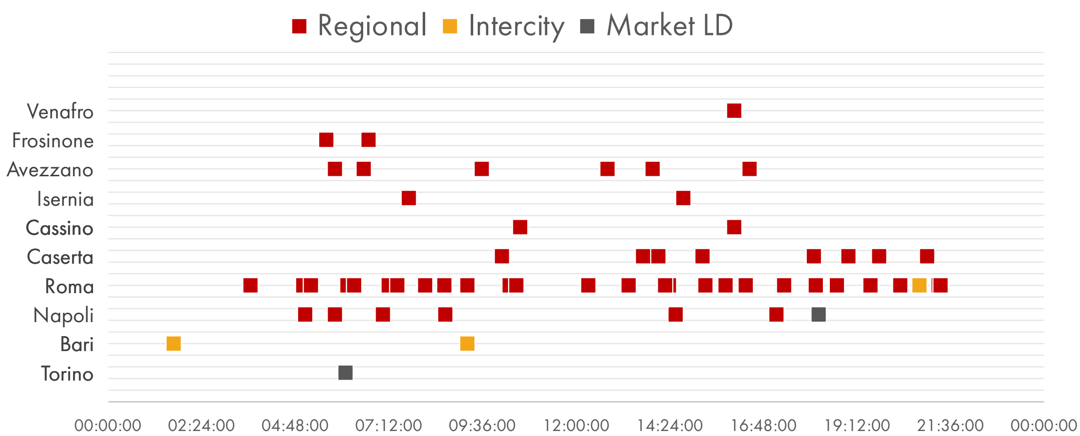
Services



Station usage by passengers/day

OMISSIS

Rail services by destination and time of departure



3.4 Working guidelines for the construction of a sustainable mobility scenario

The analysis work of the northern Colleferro-Cassino corridor returns a complex interpretative image which represents the basis for a more proactive and planning dimension. This would explore the possibilities of development of the northern corridor through a hypothetical Mobility Plan on an intermediate scale, both by formulating a overall strategy, both by focusing on the local dimension, with specific actions.

Although this thesis work does not intend to delve into the design phase in depth, we nevertheless want to propose some possible working guidelines around the strategic themes useful for the future development of a Mobility Plan for the Colleferro-Cassino railway axis.

First of all, it is necessary to reiterate some premises, summarizing the main territorial images obtained from the conducted analyses.

- The territory in question represents an *Italia di Mezzo* still very linked to a strong commuting hub like Rome. The geographical position of the explored transept, between the Capital and Naples, could suggest some form of autonomy from the point of view of mobility, however it has been highlighted that this is not the case. Even the area of Cassino, the only center capable of creating an effective basin around itself, is generally attracted to the capital. In the "Map of the resulting flows" (fig. 135) the prevailing directions and flows mark the regional border with extreme precision as a border of actual dependence.
- Urban and infrastructural development is profoundly linked to the geomorphology of the corridor. The central bundle of railway and road infrastructures is the backbone of the mobility that crosses the corridor, more than it is for mobility within it. The latter is dispersed in small municipalities on the edges of the valley, often at higher altitudes and with less direct relationships with the central corridor
- The settlement conformation of the corridor over time has meant that the specific relationship between the railway and urbanized areas is now inconsistent. In fact, we move from stations inserted in compact fabrics, which have developed around it, up to stations isolated from the rest of the municipality and not very accessible except by private transport.

It is believed that a plan for this mobility corridor in *Italia di Mezzo* must consider at least these three dimensions:

- The first is linked to the railway operating model that can be applied to the northern corridor. It is a theme that concerns the planning of services, but also the vision that is intended to be given at different scales, from the regional to the local.

- The second must explore the possibility or not of pursuing a "Transit Oriented Development" (TOD) approach along the corridor and define which type of approach. Stations will have to be evaluated as intermodality nodes but also as urban places to be (re)discovered and reconnected to the territory.
- The last dimension is perhaps the most complex and in a certain sense represents a meta-strategy, i.e. the way in which to implement this Plan, through forms of governance that should be different from those implemented today.

3.4.1 Between Rome, Naples and the world. Hypotheses for a redesign of the operating model

The railway services in the northern corridor follow a very precise pattern from a geographical point of view, but rather variable at different times of the day, with an effective schedule only in certain time slots. As we have had the opportunity to analyze in chapter 3.2, but also in the various analytical sheets of the stations, the departure center is always Roma Termini, from which the services perform two main types of functions:

- "Slow" regionals. From these we can isolate a subgroup that are similar to metropolitan services -even if they are not indicated with a different wording as happens for the Milanese S lines or the Campania M lines- since they are limited to the connection between Rome and Colleferro and Frosinone and make all the stops. The first group has 3 trips in the morning before 7 am and then another 6 scheduled every hour from 2 pm. The second group instead has 10 more distributed daily reports, of which 7 scheduled per hour. All the FL6 trains that arrive at Cassino are also "slow" regionals, almost always making all the stops with some rare exceptions. These are also distributed throughout the day and of the 15 trips per day, 9 are scheduled per hour, while the others are concentrated in the morning.
- "Fast" regionals. There are 4 trains a day between Rome Termini and Cassino which stop only in Colleferro, Frosinone and Roccasecca. One in the morning at 8 and then 3 more in the afternoon.

Overall, when leaving Termini, services are less frequent in the morning while they are concentrated in the afternoon starting from 1pm (therefore very early, suggesting a significant school audience). During these hours we also find the most different levels of frequency. The situation is mirrored when considered entering in Rome.

To these trains are added a few others that come from outside the region, such as

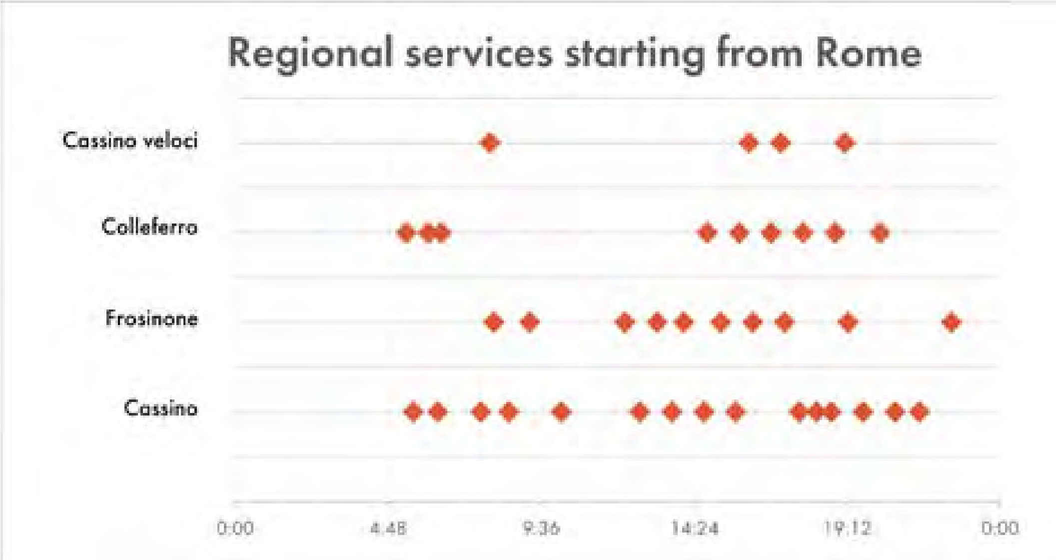


Fig. 220
Regionals services starting from Rome and stopping in the corridor

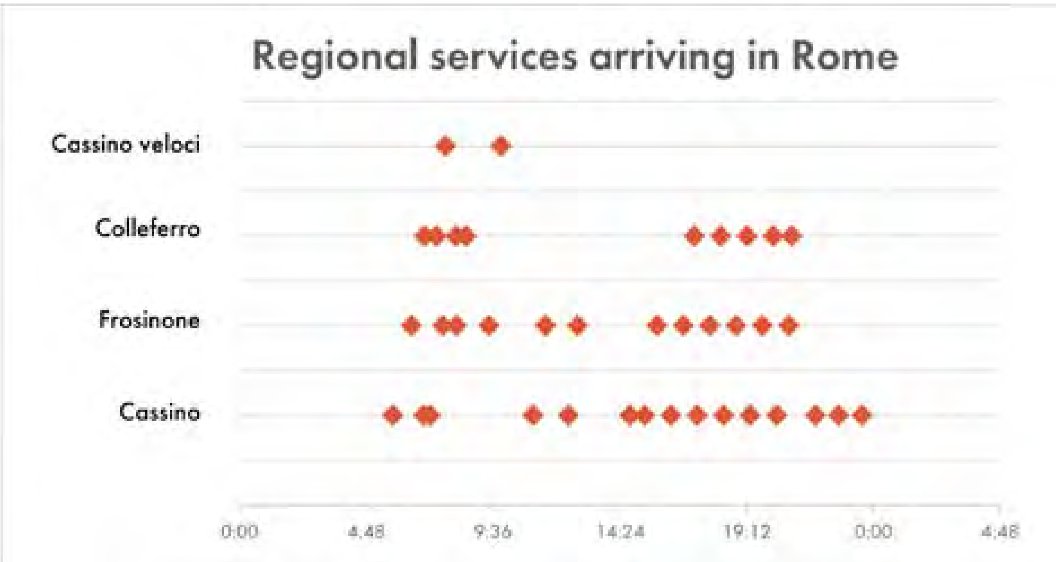


Fig. 221
Regionals services arriving in Rome and stopping in the corridor

the 2/3 daily regional trains from Caserta or from the Molise region, or the recent experimentation of Frecciarossa stopping in Cassino and Frosinone.

This scheme ensures a constant connection with Roma Termini station and more generally with the Capital. The train is therefore a means essentially used to "exit" the corridor.

Once the reference framework has been clarified, a reprogramming of services can consider at least three types of relationships:

- interregional relations between Campania, Lazio, Molise;
- the relations between the Colleferro-Cassino corridor and the city of Rome;
- internal relations in the Colleferro-Cassino corridor.

Interregional relations between Rome and Naples

To date, the corridor poles are connected to each other by some relationships that come from other regions and arrive in Rome. These mainly concern the few relation to and from Molise and some regional ones to and from Caserta. These are trains that simply "cross" the corridor and are always directed to Rome Termini.

For a long-term vision, we can think of different interregional relationships, with solutions that also integrate with the issue of connection to the high-speed network. Without going into the details of the project for the new Ferentino HS stop - about which very little is known in detail - the request for an intermediate station between Rome and Naples raises a relevant question, namely the general inability of the territory to be well connected to the main HS network of the country. Further confirmation of this is the recent renewal of the Frecciarossa pair of trains per day stopping in Cassino and Frosinone for 2024[8] using interconnections between the high-speed and conventional networks.

This gap can be filled by the intensification of services that leave the HS network and collect users from the two main hubs of the corridor, Frosinone and Cassino. In the long term, however, it seems unlikely that these trains will be intensified, both due to the inability of the traditional line to accommodate more than a certain number of them per day, and because these would be relationships with marginal demand that is difficult to sustain for market services.

As regards the new HS station, it would be an investment of several tens of millions of euros and with an impact on the territory and on the entire HS network still to be demonstrated.[9] More promising is the creation of rapid connections between the territory and the existing HS network nodes, in this case in Rome and only marginally in Naples.[10] To guarantee useful connections for this purpose it is necessary to work on the remodulation of existing interregional services, but also to imagine new ones. In fact, one could think of exploiting the long-term actions planned in the Rome hub to create rapid services between Naples and Rome with stops in Roma Tiburtina and connection at Roma Fiumicino using the new northern ring, once it is closed. The reuse of the currently incomplete railway ring would have the dual effect of quickly connecting the territory with the HS network towards the north, bypassing the long stop at Termini and also quickly connecting the corridor, but also Campania, with Fiumicino airport, discharging an airport as saturated and unable to expand as that

8 https://www.ferrovie.info/index.php/it/13-treni-reali/28279-ferrovie-confermati-i-treni-av-a-frosinone-e-orte

9 To date, the project is in the technical and economic feasibility study phase

10 It is not demonstrated here but it is easy to understand how the demand for new high-speed services departing from the corridor is to a greater extent destined for the hubs of northern Italy.

of Capodichino. These relationships could travel both on the traditional line and on sections of the HS line to make travel time competitive.

The relations between the corridor and the city of Rome

It is possible to experiment with a partial redesign of the exercise model. To date, regional metropolitan trains are attested in Colleferro and Frosinone. If in the first case it is an acceptable distance and travel time (approximately 45-50 minutes to cover 53 km), with an average commercial speed of 65 km/h, for the services that ends in Frosinone we arrive at an average of 56 km/h. Just in terms of comparison, the long regional trains for Cassino reach 66 km/h and the (few) fast trains 83 km/h.

Services to Frosinone are trains that almost always stop at all stations, both before and after Colleferro, and for this reason they travel at a very low commercial speed. The stations served, with few exceptions, experience low demand. For those coming from the main hubs the journey is unnecessarily lengthened, but at the same time the demand that benefits from the additional stop is minimal. In a first phase it could be envisaged that the services limited to Frosinone will make all the stops between Frosinone and Colleferro and then from there directly towards Rome, also because the station to reach by incoming demand is almost exclusively Rome Termini, with very few users going to the intermediate stops. This change to the service alone would lead to a leap in commercial speed from 56 to almost 70 km/h, therefore with the margin of being able to stop for example at Zagarolo, one of the few stations with significant traffic, and remain in line with the current average performance of the entire line.

In the long term the scheme could evolve further. The metropolitan services would be located exclusively in Colleferro, with a frequency of half an hour and adequate rolling stock for carrying out a rapid and widespread suburban-type service. Colleferro would therefore become an interchange hub between the more widespread and slow services and the fast connections along the corridor. The latter must have the task of connecting the main hubs with hourly timetables and rolling stock suitable for a fast regional service. In this phase it would be necessary to provide for the partial or total closure of some stations with reduced demand after Colleferro (Sgurgola or Morolo), in order to guarantee fast services from the hubs without intermediate stops. We would be dealing with a "local resistance" scenario, but it would benefit the system as a whole. For these minor stops, one or two targeted pairs of trains per day could be envisaged or an expansion of dedicated bus lines connecting them to the railway hubs.

The relationships within the corridor

If for relations leaving the corridor the railway services are still competitive and indeed need to be strengthened, the situation changes when we consider internal travel. For this scenario we have already seen how the train represents only 3% of mobility and all types of buses almost 20%. Confirming the lack of competitiveness of the train we can see how Rome is the destination of more than 78% of the trips generated by train within the corridor, while the main local nodes represent only 13% with Cassino and 6% with Frosinone.

In particular, the relationships on which the train is always inconvenient compared to the bus are the short ones and those consisting of commuting mobility for study purposes. In the first case we are dealing with relationships between neighboring municipalities in which, even if only for a geographical reason, it is always better to use the bus to reach travel destinations more comfortably. The second case instead represents all those movements generated by the small municipalities on the edge of the valley from which students must reach the high schools of the poles. In that case the choice normally falls on the bus to avoid the load breaking at the train station. Let's take as a specific example a trip to a high school in Frosinone. Let's assume that the Cotral bus line, after having collected school users from some small towns, passes through the Castro railway station. Even if there was a train to Frosinone, no one would be forced to get off and take the train, both because they would have to cover the last mile between the arrival station and the high school, and because at that point the times would be comparable. With an extra 5 minutes by bus the student is accompanied to the entrance of the institute.

Also in this case, the optimization of the service could work on two fronts. On the one hand, it is possible to work on bus-train intermodality, in order to make interchanges at railway stations simpler and more direct, for those routes that would actually benefit from it. On the other hand, it is possible to exploit internal demand within the corridor, especially that between and towards the poles. There is still room to aim for a modal shift from the car to public transport, in particular the train, for a type of travel for which private transport still represents the predominant mode. In the long term, the possibility of introducing railway services between Colleferro, Frosinone and Cassino could be explored, with stops at all stations and characteristics similar to a metropolitan service. These would be some pairs of day trains during school time slots, to serve the highs schools but also the University of Cassino. It would be a journey of approximately 1 hour and twenty minutes between Colleferro and Cassino, of which 50 minutes between Cassino and Frosinone and 30 minutes between Frosinone and Colleferro. To date, a hypothetical Cassino Colleferro bus would take almost 2 hours.

Below is a diagram that introduces the possible implementation of the new operating model, summarizing the main points touched upon above.

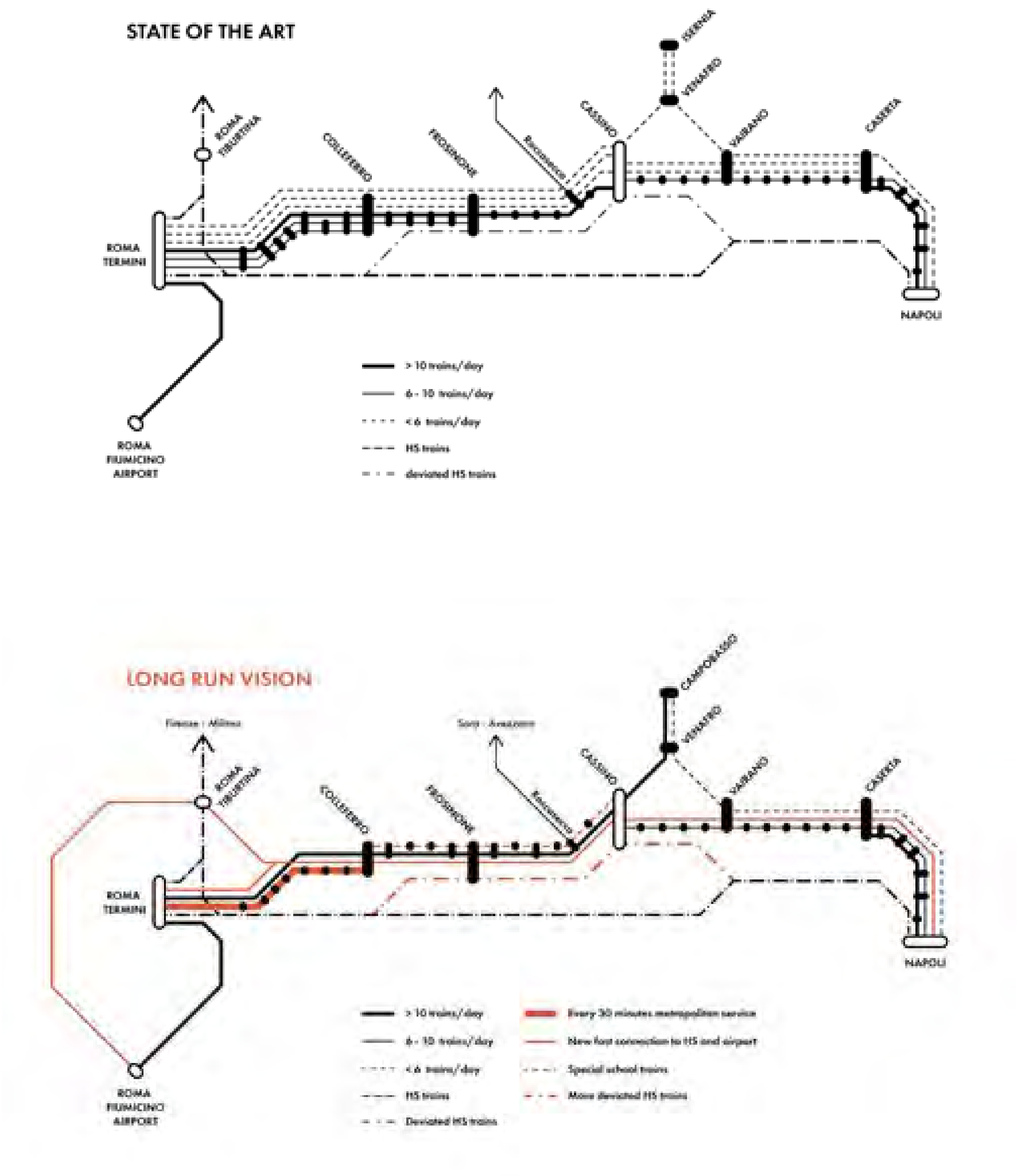


Fig. 222
State of the art and proposed long run vision of the train services operating model

3.4.2 For a Transport Oriented Corridor

The moves of the Plan for the analyzed corridor should go down in scale and reach the local dimension of the stations. It is also about translating the overall strategic vision for the Colleferro-Cassino corridor into concrete actions at the urban scale. It is no longer a question of considering them exclusively as network mobility nodes, but also as real urban places.

Considering the stations as points with a certain "thickness" brings out the idea of a TOD approach on a large scale. It is a truly challenging vision since it has already been highlighted how these types of strategies are successful in highly urbanized contexts and with a large demand for mobility to be satisfied. It is a challenge that to date planning along the Rome-Naples corridor seems not to have yet wanted to face, delegating the scope of action to generic and non-spatialized strategies or to long "shopping lists".

The strategies for a possible Transit Oriented Corridor (TOC) should touch at least two main themes: the station as an intermodal hub and as an "urban place" (Coppola et al., 2021).

For the first theme, a possible guideline is offered to us by a plan outside the corridor, namely the SUMP (Sustainable Urban Mobility Plan) of the Metropolitan City of Rome, which formulates an interesting categorization of railway stations, in particular introducing the concept of Mobility Centres, through "the identification and subsequent organization of the nodes to carry out this role, identifying them at the points of the network positioned on the routes in which high levels of mobility demand are detected and in which the maximum intensity of opportunities of transshipment/intermodality is concentrated, in particular with the public transport network."

It involves evaluating the potential of each station in terms of its ability to attract mobility demand within a variable spatial radius. Some stations, for reasons of location and already present resources, clearly have the potential to be an exchange hub between private vehicles and trains. These are stations already equipped with large and functioning interchange car parks (such as Anagni) or which could instead expand their services or see new ones created with a view to rationalizing the railway service by eliminating minor nodes (such as Ceprano). Other stations, however, are decidedly more suited to welcoming the exchange between the train and other forms of public transport or active mobility. These are stations inserted in a dense urbanized context full of demand that can be easily intercepted within the first kilometer of radius and in which it would also be possible to enhance pedestrian and cycle accessibility (such as Colleferro, Frosinone, Ceccano, Roccasecca and Cassino). Obviously, all those nodes capable of performing both functions (such as Colleferro) should be recognized.

Fig. 223
Mobility Centres from the SUMP of Metropolitan City of Rome

The second aspect would see the integration of mobility planning with urban planning and land use planning (Coppola et al., 2021). Also in this case a strategic evaluation is needed to formulate a design vision for the corridor stations. This vision should be integrated between what can be achieved inside and outside the station, since they are spaces with different competences (RFI, Municipality) and which often risk not talking to each other in the design phase.

Some stations have already been redeveloped along the corridor. In Colleferro in 2015 the overpass was added to reach the new platform 4 and the platforms were raised. In Ceccano in 2012 the docks and passenger buildings were modernized and the canopies were added. In some cases these interventions to upgrade the railway facilities have addressed the station's role as a modal interchange. In the case of Ferentino, the 2017 works renovated platforms and passenger buildings, but also defined the space in front of both sides of the station as a large interchange car park, so that the hub is now exclusively served by private motorized traffic.

Also in this case, a vision of stations as urban places should be preceded by a strategic phase of formulating the possible roles that these places can take on. In fact, if we

Fig. 224
The renewed station of Ferentino

Fig. 225
The renewed station of Colleferro

consider the stations most isolated from the urban centers of reference, the approach will have to be doubly cautious. We cannot run the risk of transforming these spaces into cathedrals in the desert with inadequate and oversized functions. In these stations it will be a question of applying effective maintenance of spaces and functions, in order to make these nodes attractive while maintaining the high quality of public spaces.

The case of stations just at the margins of the center or those inserted in dense urban contexts is different. Here we can really seize some important opportunities for the regeneration of the areas near the mobility hub, also through innovative urban planning and taxation tools, even on a supra-municipal scale, with which it is possible to transfer volumes already foreseen in the urban planning plans near the station. It involves planning actions to strengthen services linked to access to the train and urban services (interchange car parks, bike/car sharing, ticket offices) and urban quality (of the internal and appurtenant spaces of the station, commercial facilities, toilets, shelters and trees, seats) through the reuse and refunctionalization of underused spaces or land already consumed but currently unused - rather than consumption of free land - near the station or within the perimeter of the station itself. A densification strategy can also be formulated in some of these stations, where the context and opportunities allow.

Innovative functions could also be envisaged, which could reflect a new function for stations in these contexts, i.e. as spaces between the place of residence and the place of work. Some of these volumes, often unused, could be differently modulated for co-working and micro-coworking spaces. This would benefit both those who want to use travel time actively and exploit waiting times at the station but also for the inhabitants who could benefit from new activities and experience the station as a space for daily activities (Coppola et al., 2021).

In particular, it should be noted that in many of the stations along the corridor there are large areas free from construction, once the site of railway freight yards. Almost every station, even the smallest ones, was equipped with an area for goods movement and storage buildings. Today some of these areas have already been incorporated into the regeneration processes of the old stations and are therefore unrecognizable, others have been used to expand the parking areas at ground level, while others still lie unused and represent an interesting development opportunity, especially in denser contexts and in which free areas tend to be scarce.

3.4.3 Which scale of governance?

The third line of work for the Strategic Integrated Plan for Sustainable Mobility concerns its governance. This is a cross-cutting issue and deals with the ways in which strategies for a Northern Corridor Plan can be formulated and implemented.

As we have already seen, mobility planning competences in a context such as that of the Colleferro-Cassino corridor are separated at multiple hierarchical levels, both vertical and horizontal:

- the Region, which plans mobility on a regional scale through the development of the Regional Mobility, Transport and Logistics Plan (PRMTL), but which also has the task of planning transport services such as railways, stipulating specific service contracts with the operators. Furthermore, the Lazio Region has formulated the new "Network Units" in order to better distribute financial resources for local public transport. The corridor is divided into four units: Valle del Sacco, Ciociaria, Frosinone municipality and Terra di Lavoro.
- Among large-scale entities, the Metropolitan Cities have obtained the competence regarding "general territorial planning, including communication structures, service and infrastructure networks" and "mobility and viability". For this reason, many Metropolitan Cities have already moved to fulfill their new role and have formulated PUMS at their own reference scale (Coppola et al., 2023). This is the case of the aforementioned PUMS of the Metropolitan City of Rome. The Province of Frosinone has formulated its visions through the PTPG. These are rather generic strategies and indications on road strength axes. Mention is made of some actions to strengthen regional rail transport with the inclusion of metropolitan-type services and the exploitation of new high-speed services diverted to traditional lines.
- The local scale is the responsibility of the municipal administrations. These are the ones that should make the indications of the large area plans land in the contexts of the railway stations and in the immediate surroundings, using the urban planning instruments at their disposal.
- There is a further scale, transversal to the previous ones, relating to the railway manager. On the one hand we have RFI which deals with the management of the infrastructure and Trenitalia which stipulates service contracts with the Lazio Region for the operation of railway services. With their industrial plans these companies clearly direct investments in the territory and the business model to operate there. For this reason, a dialogue between public institutions and the infrastructure manager is essential.

The formation of a Plan for the corridor would face an intricate institutional and planning framework. It cannot be established a priori which should be the best path to follow to frame the vast scale of the corridor, but at least two hypotheses can be formulated:

- in the first case, the provincial body could dedicate a part in the new Plan to clarify the indications contained in the regional PRMTL, building an integrated vision for the railway corridor. It is a partly limiting hypothesis because it is linked to administrative geography: Colleferro would for example be excluded.
- In the second case the Region could specify more precise indications upstream for some strong mobility corridors to be recognized within the regional territory, even between different provinces. It could also hypothesize indications of territorial governance and soil regulation to be implemented in the station areas.

At the moment, as there are no forecasts of this type, on a local scale we are witnessing the stipulation of specific agreements between the municipalities and the railway manager for the implementation of combined redevelopment projects, i.e. of the station buildings and surrounding areas. This is the case of Frosinone, which is going through a restyling phase of both the station (to date not yet started) and the squares on the north and south sides. These works are the result of a Memorandum of Understanding signed in 2019 between the Municipality of Frosinone and RFI. The first has committed to investing around 10 million euros for the transformation of the square in front of the station into a vast pedestrian and intermodal interchange area

Fig. 226 Rendering of the new station and square of Frosinone

and for the construction of an interchange car park south of the station. RFI instead invested around 15 million euros for an overall restyling of the passenger building as well as the construction of a pedestrian overpass connecting with the new car park and the southern outskirts of the city in general.

Beyond these specific examples of integrated planning, the challenge is still open if we want to consider these territories in their entirety and at the appropriate scale. The case of the northern corridor of lower Lazio is an interesting first answer to the main thesis question, since it represents a field of investigation to try to understand and interpret *Italia di Mezzo* from the point of view of mobility. It is a territory strongly dependent on an attracting hub like Rome, but at the same time it poses some "resistances", both geographical and cultural, linked to mobility practices, both current and potential.

But if in a large metropolis like Rome financial and mobility planning resources are more easily obtainable and there is all the interest, as well as the ability, to formulate far-reaching strategies, a territory like that of the northern corridor remains stuck between two scales. On the one hand, it does not see an integrated vision of mobility formulated upstream, being relegated as the terminal stretch of the radial lines from Rome and as an area from which to absorb the workforce and university commuters during the day. On the other hand, local municipalities are generally incapable of intercepting the financial and institutional resources necessary to promote integrated development between forms of mobility and the government of the city and the territory. The few municipalities capable of doing so are the most important poles, which however legitimately tend to centralize these resources within their own administrative borders, generating further inequalities at the local scale, in territories already at a disadvantage compared to other areas of the country.

The challenge for the territories of *Italia di Mezzo* is crucial, not only for the sustainability of the settlement and mobility model of these areas, but also for that of the urban system on a national scale, of which they represent an important part.

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