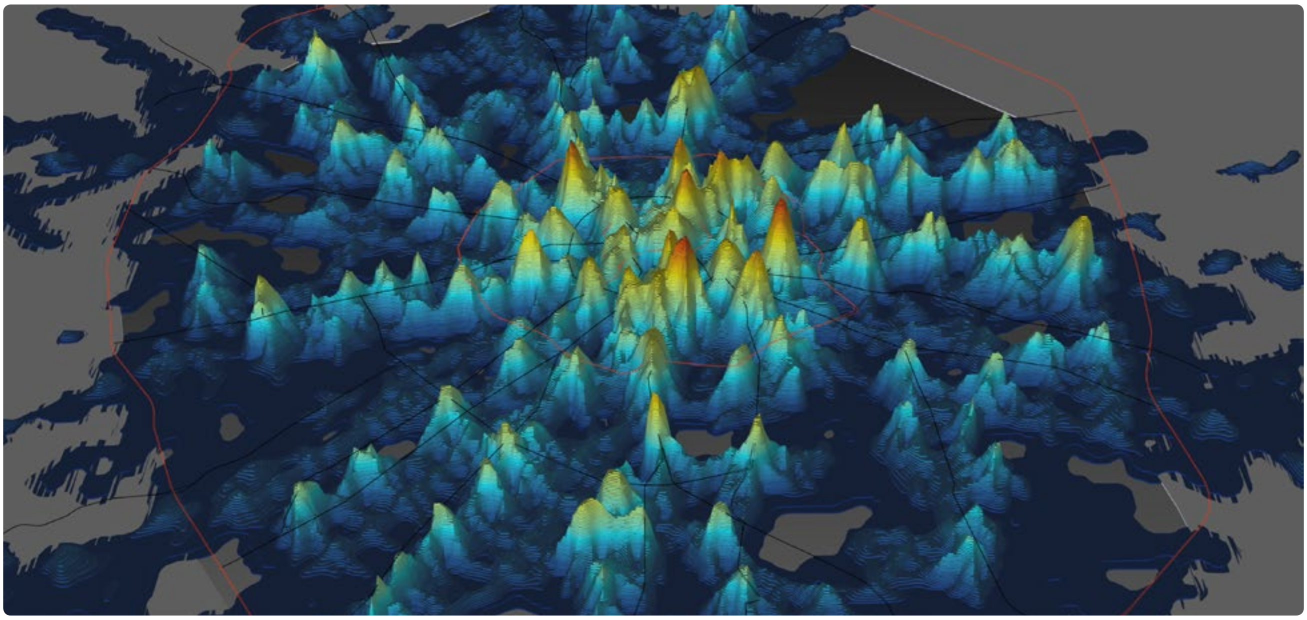
Moscow Archaeology of the periphery

Location	Moscow
Main Expertise	Public Transport Accessibility; Urban Research
PROJECT HIGHLIGHTS	• Research for the Moscow Urban Forum 2013 - Topic Megacities: success beyond the centre • Archaeology of the periphery is the first major interdisciplinary urban research in the post-Soviet practice • Research Team: MIC-HUB, Project Meganom, Strelka

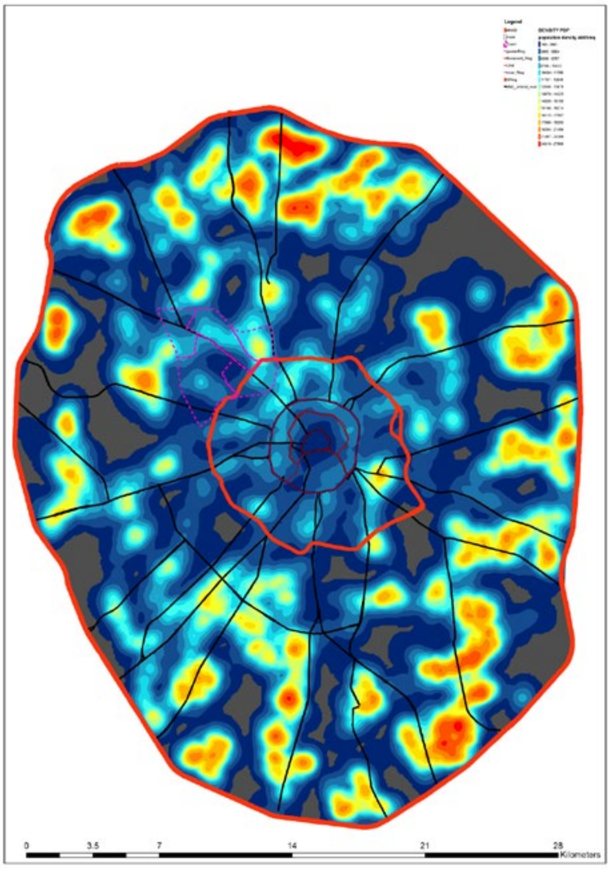
Gridlock, the Donut and the Intelligent Solutions.

In recent years, the Moscow conurbation has experienced a rapid expansion and transformation. Due to the rate of growth of the urban landscape, the city is facing a loss of identity today; it is becoming more and more difficult to control the territorial expansion of the built environment. This ongoing process, affects the quality of life that the city itself can offer to its users. Among the several factors that determine the liveability of a great modern city, the availability of high-quality transport infrastructure certainly play a huge role; this must be conceived in terms of accessibility to the entire population and the rapid connection between places, maximizing opportunities for citizens and businesses that "live" - every day - the wider and wider territory.
Moscow is a clear example of a monocentric urban morphology, according to both its transport infrastructure network and public/private land use distribution.
The radial axis system and orbital paths are reflected in the road fabric as well as in public transport. The current transport scheme was planned and developed over time, based on the assumption that demand for mobility all gathered towards the city center. Following these principles, the urbanized territory of Moscow has been shaped in "super-functional blocks", accessible by few roads (characterized by large section) which serve as connection to big areas, which remain otherwise inaccessible. Such a configuration clearly affects traffic flow; the limited availability of roads cannot allow for proper vehicular circulation.
As a result, the few large connections and rigid patterns of circulation are often congested by immense traffic jams, causing longer trip times, slower speeds and increasing vehicular queuing. Gridlock!



↑ PTALS current scenario

Today, it can be argued that the unbalanced allocation of population and work place is an increasing alarming phenomenon in Moscow. The average population density is 10,500 inhabitants per square kilometer. Within the limits identified by the MKAD about 90% live in the strip of land located between the MKAD and the third road ring (figure 1). This vast area is strongly residential and industrially oriented, with poor social infrastructure and services. On the other hand, considering the spatial distribution of jobs, approximately 70% fall in the area located within the third ring. About half of this is concentrated within the Garden Ring. This type of spatial structure and distribution of functions is no longer sustainable and represents one of the main causes of the transport congestion which Moscow experiences daily. This problem can and must be tackled from different perspectives, with an interdisciplinary approach. Through the strengthening of the current public transport system, it is possible to improve the capacity of existing infrastructures and create a working network system.



↑ Fig. 1 Density population distribution

Accordingly, Moscow has already planned a series of important projects regarding railway, underground and surface lines, all focused to maximize the network over the entire urban area. But equally important is a new distribution of land use, aimed at the creation of new multi-functional cluster located outside the third ring. In this context, the future strategy of the city would be to organize the regeneration of industrial zones for high quality multifunctional developments, located along existing or a planned public transport axis. This would be able to reduce traffic pressure from consolidated transport axes and redistribute flow and mobility demand according to new main traffic axis.

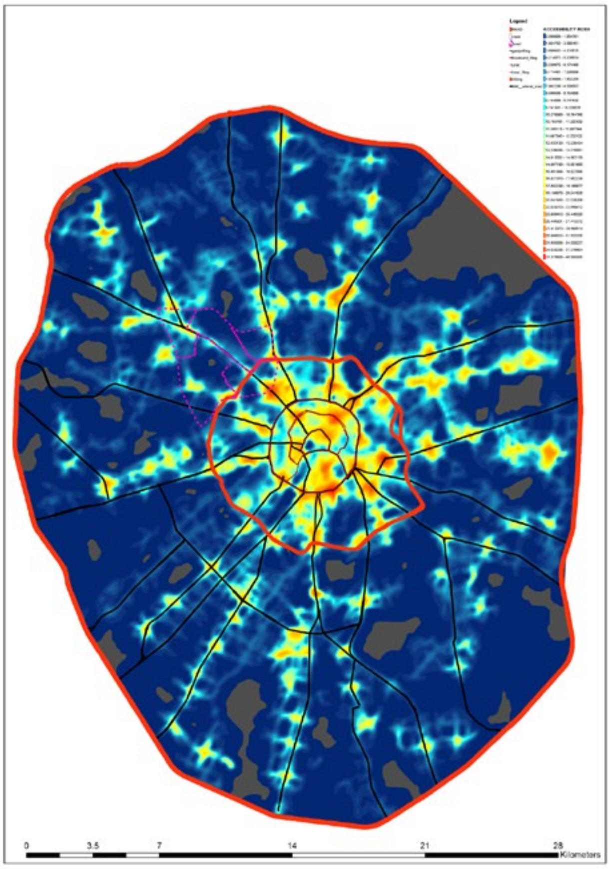
Public Transport Accessibility Levels

A spatial analysis highlighting the levels of accessibility to existing public transport systems and/or planned for any location can influence and shape the planning process, both in terms of configuring public transport networks, and in determining the norms that direct and regulate the distribution of land use. This method has been adopted by the London Department for Transport as a standard method for calculating the levels of accessibility to public transport in the city. It is based on the calculation of pedestrian distance from any point of the territory to the nearest public transport stop and the frequency of services to relative service. The result is an indicator, where the maximum values indicate an excellent access to the public transport system. The first step is to calculate the walking distance from the point of interest (POI) to the nearest stops of the different systems of transport (bus, trolleybus, tram, subway and railway stations). These stops and stations are clearly considered as points of access to the service. Only the stops and stations within a certain distance from the POI are included in the calculation (640 m to bus stops and 960 m to railway stations).

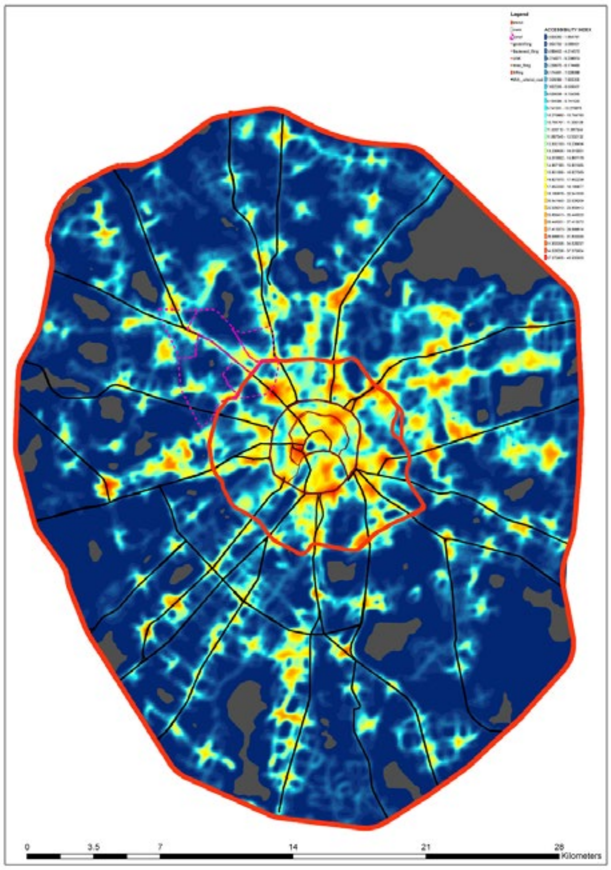
The next step is to determine service levels during the rush hours (morning peak hour) for each route that serves a station or stop.
A total access time for each route is then calculated by adding the walk time needed to reach a stop or station starting point of interest, and the average waiting time for services on routes transiting that specific stop or station (i.e. half the headway). This value is converted to an equivalent doorstep frequency (EDF), divided by 30 (minutes), total access time with the aim to transform the total access time to an "average waiting time", as if the route was immediately available in the proximity of the point of interest.
A weighting is applied to each line to simulate the reliability and attractiveness of a service with a higher frequency than the other services. For each available mode, the path with the highest frequency is given a coefficient of 1.0, while a value of 0.5 is attributed to all other services.

Finally, these elements are multiplied to produce an accessibility index for each route; accessibility for all routes is then summed to produce an overall index of accessibility for the starting point. Using data about the current public transport, this methodology was applied to the entire urban area that is bounded by MKAD (figure 2).
The long-term future scenario was derived from several sources (http://stroi.mos.ru; http://mkzd.ru and http://dt.mos.ru) and fixed for the year 2025 (figure 3).
The future network is an extension of many subway lines, the introduction of the new Circle line, reusing rail ring for passenger transport and the strengthening for the tramway system.

The results show how major increases in terms of accessibility fall exactly into the urban territory located between the third and the MKAD ring.



↑ Fig. 2 PTALS current scenario



↑ Fig. 3 PTALS future scenario

In particular, keeping constant population values both in terms of absolute values and spatial distribution, the following results are observed:

• The population living in areas with very low levels of accessibility to public transport (indicator values less than 5) increases from the current 5.2 million to 4.4 million in future scenario.

• The population living in areas with low levels of accessibility to public transport (indicator values ranging between 6 and 11) goes from the current 1.0 million to 1.2 million in the future scenario.

• The population living in areas with high levels of accessibility to public transport (indicator values ranging between 11 and 20) runs from the current 0.6 million to 1.0 million in future scenario.

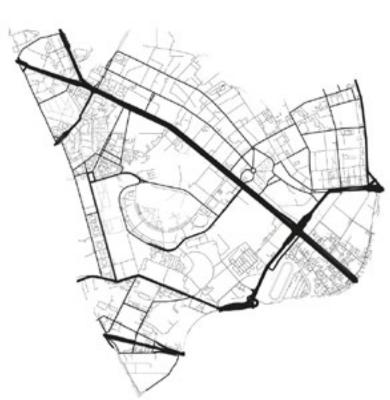
• The population living in areas with high levels of accessibility to public transport (indicator values greater than 20) goes from the current 0.2 million to 0.4 million inhabitants in the future scenario.

There is no doubt that public transport system will be the foundation of sustainable city development, but future planning cannot be based solely on improvements of transport networks, it must also consider new mixed-use developments with particular attention to the design of open spaces and collective services.

Connectivity case study analysis
This is a connectivity case study analysis related to pedestrian and public transport network. The case study area chosen to conduct the analysis is a unique urban cluster, surrounded by a huge railway infrastructure, emerging from the "fusion" of five different rayons of Moscow municipality.

These settlements are as follow: Sokol, Khoroshevskiy, Aeroport, Savelovskiy and Begovoy. These five neighborhoods demonstrate different territorial characteristics and land use, but undoubtedly share the same major road infrastructures, in particular the Leningradskoye highway and Volokolamskoye highway - Leningradskiy prospekt, which crosses the study area along from NW-SE. This infrastructure axis is highlighted in the image of the road hierarchy of the case study area (figure 4). Using typical algorithms of complex networks analysis (Link Betweenness Centrality – BWC), a connectivity indicator was generated for each section of the network in the study area. This indicator gives the number of shortest paths between every two nodes of the network related to the study area and is calculated for all the arcs of the network, generating an outcome that can be identified as a hierarchical pattern of pedestrian connections within the intervention area (figure 5).

The road designed for pedestrian access were excluded from this analysis. This diagram suggests the following:



↑ Fig. 4 Car connectivity

↑ Fig. 5 Pedestrian connectivity

↑ Fig. 6 Public Transport connectivity

• The powerful radial road infrastructure NW-SE, the highway, represents a physical barrier between the northern and southern portions of the study area; the pedestrian connection between the North and South area intervenes strongly on the side road of Schosse (Leningradskiy Prospekt), until reaching a crossing walkway or underpass.

• The irregular distribution of crossing connections determines a general extension of pedestrian paths, given that the steps may be as much as 1-2 miles between them.

• The structure of the pedestrian network requires the use of the side-road of the highway to move from one node to another, despite the fact that it is unsuitable for increased pedestrian use.

• In the South, where large industrial areas are found, there is a lack of permeability between the highway and private developments. This configuration of the urban fabric further pushes pedestrians to use an infrastructure in order to circumnavigate industrial areas, channeling their movements to mainly dedicated connections.

• The North portion is definitely more permeable; the absence of large industrial areas enables the activation of pedestrian paths parallel to the position of internal highway, opposite to what is observed in the South.

This analysis highlights two types of barriers to pedestrian permeability: major road infrastructures (and railway), and at some point the presence of extensive private/industrial areas; both strongly affect the pedestrian permeability of territories, affecting the connectivity of large pedestrian areas and the shape of pedestrian paths.

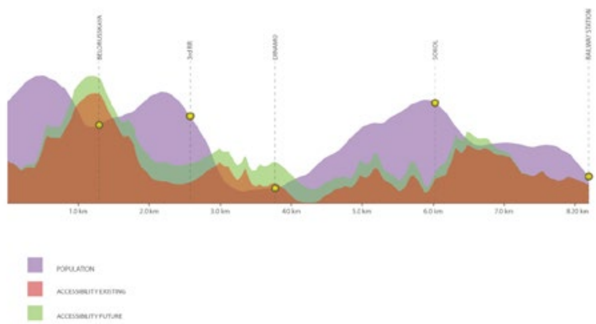
As a result, in the third image (figure 6), the connectivity analysis is observed in a more complex network, formed by the merger of two levels: the level of the pedestrian network and the level of public transportation network.

The communication nodes between the two networks are located at bus, trolley, tram and metro stops.

The analysis of pedestrian intermodal network connectivity and public transport shows a public transport network with an effective surface navigation mode within the borders of the Southern portion of the area. Conversely, the lack of dissemination of public transport lines on the surface in the North leads to a dispersal of walking trails towards the great highway node in Dynamo Metro, underlining again the centrality of highway, its infrastructure and its more important nodes in the internal connectivity to the study area.

Firstly the careful planning of pedestrian routes, and then the dissemination of surface public transport are solutions that must aim for improved connectivity at both local and neighborhood scale, ensuring fast connections and car-free areas within the surrounding environment.

The planning of these mobility networks at a reduced scale, combined with a careful distribution of the functions and land use can act synergistically to guide sustainable urban space redevelopment at the local level. Finally, it is possible to show the indicators (population density, and levels of accessibility to public transport) previously evaluated for the entire city along the section shown in the following image (figure 7). This well represents the effect induced by planned public transport improvements.



↑ Fig. 7 Case study indicators

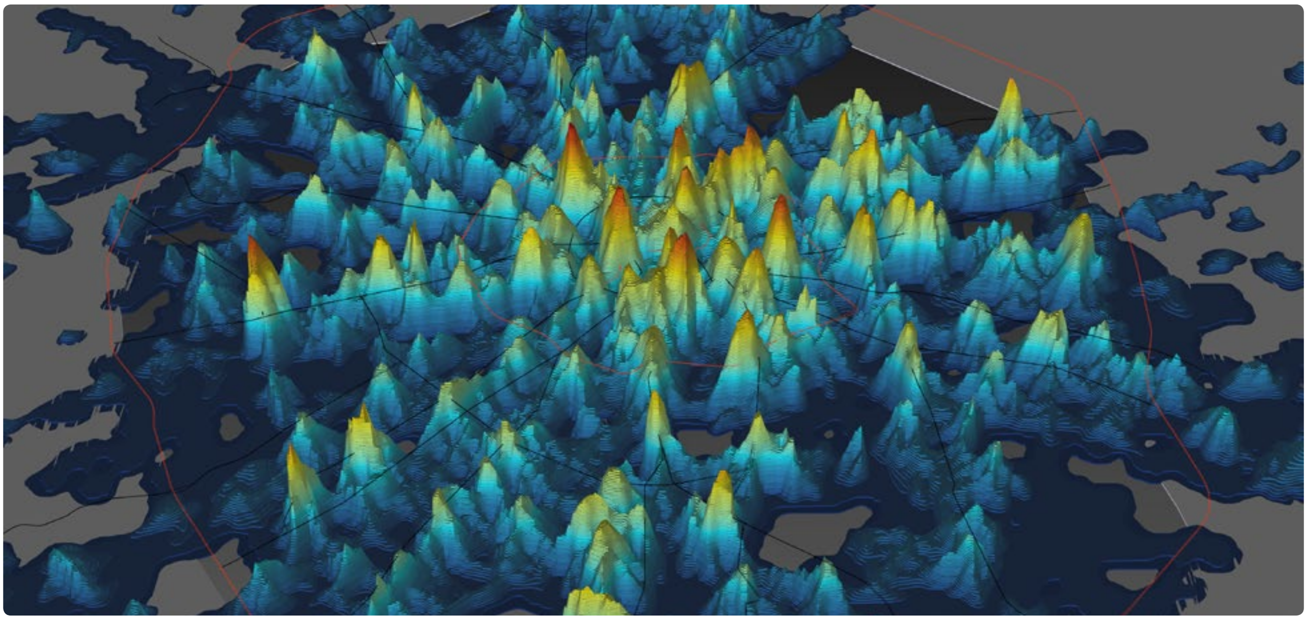
Intelligent Solutions?

Transport planning is changing radically; there is an urgent need to produce sustainable and resilient cites which require new operational methodologies. The traditional way of addressing capacity in cities, that has led for instance to the once powerful one way traffic system typical of central Moscow, needs to be revised in favour of sustainable transport modes.
A strong focus used to be given to motorists, but it is now clear that the metropolis of western world are progressively going through a process of space and time redistribution, a process aimed to give a more balanced weight to various mode of transport. The city of the future will need to reduce car densities in city centres, by reducing space given to car or by introducing other appropriate policies for cars that need to access the city centre, changes have to be made.

Such policies can be seen for instance in Paris with the progressive space redistribution, recently the Les Berger project has been implemented and part of the express way alongside the Seine has been closed to cars in favour of a public space, whereas in London and more recently in Stockholm and Milan, the introduction of a congestion charge has dramatically reduced the amount of vehicles that access the city Centre. It is clear that Moscow is endowed with a low number of inhabitants in the central part of the city, whereas the "donut", as it is called, contains the vast majority of the city dwellers. This generates a strong commuter pattern that has to be balanced by introducing services and tertiary functions in the "donut", together with the increase of residents in the central part of the city. Such land use redistribution will need to be centered on public transport hubs; the map of the Public Transport Accessibility Level (PTAL) bringing to the surface the hidden shape of public transport in cities (figure 8).

It is the topology of public transport that will be the driver of land use densification and redistribution; the contours of the PTAL maps will define planning policies that will not generically locate land use in proximity of public transport but rather will respond to the specific "shape" of public transport densities.

The future of Moscow will need to address the way transport operates today by reducing the usage of the car, enhancing public transport connectivity together with more intelligent land use redistribution.



↑ Fig. 8 PTALS future scenario