

Annex 2: Data issues for the Visual Platform and Regional Portrait construction

2.1. Description of the four recent research projects which constitute the base for advanced research on the Milan-Bologna corridor

a) **The PRIN POSTMETROPOLI research project** (Research Project of National Interest "Post-Metropolitan Territories as Emerging Urban Forms: The Challenges Of Sustainability, Habitability and Governability" funded by the Italian Ministry of University), was coordinated by Politecnico di Milano (2013 and 2015). It produced a municipal-scale dataset composed of hundreds of indicators, also available in historical series, available at the freely accessible Web Atlas of Post-metropolitan territories (www.postmetropoli.it/atlante), the tool which allows to interrogate such data geographically and statistically and verify emerging urban patterns in relation to different administrative, functional and infrastructural geographies. This instrument has been designed to investigate the conditions of "the urban" in Italy and in particular its regional dimensions and dynamics thanks to two "lenses": the "quadrants" (100 x 100 km) and the "corridors". Milan and Bologna quadrants are already available and elaborated, within the wider urban region; we also have already elaborated a general analysis of main socio-spatial-economic trends along the main infrastructural corridors in Italy, here included the Milan-Bologna one and experimented the elaboration of the Index of Corridoriety (which maps correlation between certain indicators and the fact of being or not included in the area serving the corridor). In many cases the data (simple indicators as well as complex/synthetic indexes) are available even for those municipalities external or included between the two mentioned quadrants. The Atlas is directly managed by the RUFLAB team at Politecnico di Milano, with the support of MAUD, Mapping and Urban Data Lab. It also includes a methodology and preliminary data for the analysis of form of voluntary multiscalar cooperation among institutional actors, included the Index of Cooperation, elaborated and tested for some of the quadrants, and that can be easily extended to the Milan-Bologna urban region. The Web Atlas has been thought from the original project as a tool of visualisation able to generate new spatial imaginaries, and with this project it will be used as such, testing its potential with stakeholders.

b) **The URBAN INDEX project**, run by POLIMI in collaboration with the Department for Programming and Coordination of Economic Policy (DiPE) of the Italian Presidency of the Council of the Ministers. This governmental office was interested in identifying potential target areas for present and future national urban policies, policies no longer destined exclusively to the main provincial capitals but to the far more complex Italian polycentric and regionalized urban system that, in the past decades, has been often under-represented because of partial or faulty definitions and boundaries of the urban and metropolitan areas. The project has

implemented an original municipal dataset (based upon 98 indicators) which has generated an activity of clustering of contemporary "urban questions", through the selection and statistical grouping of different thematic indicators. This work, published on the Urban Index government platform (<https://www.urbanindex.it/>), is the main output of the research activity conducted of the DASTU group, which is able therefore to exploit all its geostatistical potential in order to explore urban region comprised between Milan and Bologna.

c) A third research project will provide key inputs is **the QUIANT project**, funded by the Italian Ministry of University and led by prof. Paolo Beria, which was the basis for the development of the Italian transport model i-TraM, a partnership between TRASPOL/Polimi laboratory and META s.r.l. (www.quaint.polimi.it). I-TraM is the only independent national-scale transport model existing and working in Italy, excluding those owned by larger transport companies. I-TraM is a full 4-steps model, capable to simulate the entire Italian transport system from demand generation to path choice. It is based on sub-provincial zoning (or sub-municipal zoning in large cities) for a total of 1764 zones. This level of detail allows not only to properly simulate long-distance demand, but is suitable also for regional-scale simulations and to correctly estimate the congestion of the road network around urban areas. All demand components are simulated (not only commuting, but also occasional and tourism) and the supply of all modes is present in the database. The tool is mostly dedicated to the study of long-distance demand, but of course also local demand is present (for example to correctly forecast congestion conditions), in all modes. The availability of such tool will make possible a sound analysis of the current mobility patterns, as well as the possibility to produce comparison in time series (in particular between T0, before High-speed network opened, T1, during its first years when only Trenitalia was operating; and T2, the current situation with multiple operators and the introduction of regional policies to integrate the High speed system). More precisely, the model allows to produce accessibility analyses, estimate the Origin-Destination matrix of a specific link, estimate the costs of all transport components, and of course simulate the effect on demand of changes to the supply. All of this will feed the analysis of correlation between the introduction of high-speed trains new economic trends and the emergence of new functional relations (see dedicated ANNEX 6).

d) A fourth research project can highly contribute to the design of the analytical framework. The **Cost Action – CA 18214 “The geography of new working spaces and the impact on the periphery”**, led by prof. Ilaria Mariotti at DASTU-Politecnico di Milano – recently started, and involving 25 European countries and Israel – aims at exploring the emergence of the creative and innovative economy in the urban context and the peripheral areas worldwide. Specifically, POLIMI has conducted several research projects on the Italian context about the changing nature of urban economy, with particular attention to new manufacturing activities (i.e. fab labs and makerspaces) and coworking spaces (Mariotti, Akhavan, 2019). Besides, the location

patterns of (manufacturing and transport-logistics) multinational enterprises (MNE) and their effects on the local context has been investigated (Mariotti, 2018; Mariotti, 2015).

2.2 List of pre-selected indicators

This sub-annex contains a preliminary selection of indicators from the Atlas of post-metropolitan territories (*), Urban Index project (**), QUIANT Project (^) and COST Action Project (^^) datasets that can be temporally updated or integrated with other available data and indicators (underlined).

Urban density and morphology (concentration/dispersion; compactness/fragmentation)

- Population density (ISTAT, 2011)*
- Net human density (ISTAT, 2011)*
- Percentage of the resident population in the nuclei and scattered houses (ISTAT, 2011)*
- Housing dispersion index (ISTAT, 2011)*
- Concentration index of the building types (ISTAT, 2011)**
- Private mobility index (private vehicle use) (ISTAT, 2011)**
- Index of fragmentation of the urban landscape (ISPRA, 2011)*
- Housing under-utilization index (ISTAT, 2011)
- Density of retail trade at a fixed location (ISTAT, 2011)*
- Index of building expansion in centres and residential areas (ISTAT, 2011)**

Socio-demographic trends (growth/decline)

- Rate of change of the resident population (ISTAT 2001-2011)*
- Variation in the rate of building vacancy (ISTAT 2001-2011)*
- Change in the index of housing under-utilization (ISTAT 2001-2011)*
- Variation in the vacancy rate of residential buildings 2001-2011 (ISTAT 2001-2011)*
- Change in the unemployment rate (ISTAT 2001-2011)*
- Change in the economic dynamism index (ISTAT 2001-2011)*
- Rate of change of the resident population (ISTAT 2011-2019)

Housing condition and residential attractiveness (high/low)

- Index of residential attractiveness (ISTAT, 2002-2011)*
- Ageing index (ISTAT, 2011)*
- Old-age dependency ratio (ISTAT, 2011)*
- Percentage of young single-parent families (ISTAT, 2011)*
- Per capita urban green land (non-agricultural) (ISTAT, 2012)**
- Percentage of young couples with children (ISTAT, 2011)**
- Schools (kindergartens and primary schools) per 10,000 inhabitants (ISTAT, 2011)
- Housing crowding index (ISTAT, 2011)*
- Rate of unused buildings (Potential use of buildings) (ISTAT, 2011)*
- Rate of inactivity of residential buildings (Potential residential use) (ISTAT, 2011)
- Housing exclusion index (Share of improper housing) (ISTAT, 2011)*
- Share of residential buildings in deprived maintenance conditions (ISTAT, 2011)*
- Average age of recent housing stock (ISTAT, 2011)**
- House price developments across and within OECD countries (OECD, 2020)

Workers and students presence/mobility (high/low)

- Occupational turnover index (ISTAT, 2011)*

- Employment quality (high vs. low skilled labour force), only at NUTS3 level (ISTAT, 2011)
- Daily mobility for study or work (ISTAT, 2011)**
- Index of university presence (athenaeums and poles) (MIUR, 2012)*
- Mobility index (commuting for work) (ISTAT, 2011)*
- Self-containment index (commuting for work) (ISTAT, 2011)*
- Residential mobility index (ISTAT, 2011)*
- Index of economic dynamism (ISTAT, 2011; elab. PRIN Postmetropoli, 2013)*
- Map of influence areas of selected zones, per travel purpose (QUAINT)^
- Map of total long-distance trips to selected zones, per travel purpose (QUAINT)^
- Road network flows (QUAINT)^
- Tourism, leisure, services supply (high/low)
- Rate of composed receptive (hotel) function (ISTAT, 2010; elab. PRIN Postmetropoli, 2013)*
- Number of annual visitors to state cultural sites (MiBAC, 2013)* // temporal update: 2014-2018
- Number of state cultural places (MiBAC, 2013)* // temporal update: 2014-2018
- Number of exhibition centers (elab. PRIN Postmetropoli, 2013)*
- Number of stadiums (elab. PRIN Postmetropoli, 2013)*
- Number of entertainment hubs (elab. PRIN Postmetropoli, 2013)*
- Number of commercial hubs (elab. PRIN Postmetropoli, 2013)*
- Number of firms, establishments and employees of the transport and logistics sector, and number of logistics poles at municipality level (ISTAT, 2011, web site of the logistics poles).
- Public service and infrastructure supply (high/low)
- Digital divide from fixed and mobile telephone network (MISE, 2013; SNAI, 2014)* // possible temporal update
- Road accessibility index to shopping centers (ISTAT, 2013; PRIN Postmetropoli, 2015)* // possible temporal update
- Railway stock index (Trenitalia, 2012; SNAI, 2014)* // possible temporal update
- Train services per city, per category (QUAINT 2008, 2018)^
- Accessibility index to railway stations (Grandi Stazioni and Centostazioni; PRIN Postmetropoli, 2013)* // possible temporal update
- Ordinary hospital beds per 1,000 inhabitants (Ministero delle Salute, 2011)* // temporal update: 2014-2018
- Index of public institutions dynamism (ISTAT, 2011; elab. PRIN Postmetropoli, 2013)*
- Ordinary pharmacies for every 1,000 inhabitants (Ministero delle Salute, 2011)* // possible temporal update
- Public mobility index (ISTAT, 2011)**
- Libraries per 1,000 inhabitants (elab. PRIN Postmetropoli, 2013)* // possible temporal update
- Overall index road accessibility to urban centers and structures (road) (PRIN Postmetropoli, 2014)*
- Isochrone and Isocost maps (QUAINT 2008, 2018)^

Socio-economic conditions (good/bad)

- Incidence of population in conditions of overcrowding (ISTAT, 2011)**
- Share of pupils in lower secondary schools at risk of abandonment (SNAI, 2011/2012)*
- Share of secondary school pupils at risk of abandonment (SNAI, 2011/2012)*
- Early exit from the education and training system (ISTAT, 2011)**
- Unemployment rate (ISTAT, 2011)*
- Youth unemployment rate (ISTAT, 2011)**
- Impact of young people outside the labor market and training (ISTAT, 2011)**
- Incidence of families with potential economic hardship (ISTAT, 2011)**
- Incidence of lonely elderly (ISTAT, 2011)**
- Suicide mortality per 100,000 inhabitants (ISTAT, 2011)**
- Socio-economic mix and inequalities (high/low); Percentage of foreign population (ISTAT, 2011)*
- Concentration index of the continents of citizenship of the resident population (ISTAT, 2011; elab. PRIN Postmetropoli, 2013)*
- Share of mixed couples (ISTAT, 2011)**

- Employee concentration index in the economic sectors (ISTAT, 2011; elab. PRIN Postmetropoli, 2013)*
- Gini Index (MEF, 2012; elab. PRIN Postmetropoli, 2013)* // possible temporal update
- Italians/foreigners employment ratio (ISTAT, 2011) // temporal update: 2012-2017
- Italians/foreigners school attendance ratio (ISTAT, 2011)**
- Italians/foreigners self-employment ratio (ISTAT, 2011)**
- Men/women employment ratio for (ISTAT, 2011)**
- Average prices of houses, warehouses, shops and offices (OMI-Osservatorio Mercato Immobiliare, 2012)* // temporal update: 2016
- Environmental performance (efficient/inefficient)
- Per capita land take (ISPRA, 2015) // possible temporal update
- Percentage of utilized agricultural surface (ISTAT, 2010)*
- Per capita production of urban waste (ISPRA, 2013)* // possible temporal update
- Slow mobility index (on foot or by bicycle) (ISTAT, 2011)**
- Per capita drinking water introduced into the municipal network (ISTAT, 2012; elab. PRIN Postmetropoli, 2013)*
- Urban waste recycling share (ISPRA, 2013)* // possible temporal update
- Density of installed photovoltaic systems (GSE, 2013; elab. PRIN Postmetropoli, 2013)* // possible temporal update
- Percentage of Euro 5 and Euro 6 cars (ACI, 2012) // possible temporal update
- Economic innovation (good/bad; high/low)
- Percentage of employees in APS and KIBS firms (ISTAT-ASIA, 2011)* // temporal update: 2012-2017
- Percentage of APS and KIBS companies (ISTAT-ASIA, 2011)* // temporal update: 2012-2017
- Number of CNR institutes (National Research Centers) (CNR, 2012)* // possible temporal update
- Number of non-CNR research institutions (CNR, 2012)* // possible temporal update
- Number of science parks, technological districts and centers of excellence (Associazione Parchi Scientifici e Tecnologici Italiani; Atlante Tecnologico Italia 2012) // possible temporal update
- Number of new working spaces (coworking and maker spaces, including fab-labs) settled in the area (Cost Action project, 2020)^
- Number of innovative small and medium size firms (PMI innovative), start up and incubators, by municipality (Registro Imprese, from 2015 onwards)^
- Data on multinational firms (AIDA by Bureau Van Dijk)
- Number and characteristics (sector, n. of firms and employees, etc.) of the industrial districts located in the interested municipalities and Local Labour Systems – LLS (ISTAT, 2001, 2011);
- Institutional Quality Indicator (IQI), only at NUTS3 level (Nifo and Vecchione, 2004-2012)