

New Theoretical Models and Governance for Territorial Complexity

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Abstract: Today's cities, metropolitan areas, are "complex urban regions" where varied episodes and dissonant experiences reach a very high intensity; an intensity that clearly shows us that the traditional identification and planning criteria are today strongly under discussion.

The new settlement models assume the appearance of "nebulas". The new way of "functioning" of the city, the new form that urban armor is taking, produces deep changes in the social and spatial configuration of the material and immaterial relations of the community.

The aim of the research lies in investigating the potentialities inherent in the transport infrastructure system and in the settlement-functional system both in representing paradigms for the reading and interpretation of metropolitan areas, and at the same time in becoming tools through which to direct their development.

The research has the task of verifying the possibilities and methods through which the infrastructures and mobility services and the qualitative and quantitative consistency of activities and innovative functions can be assumed as indicators of the degree of "metropolitanity". of a territory and, consequently, be identified as "strategic levers" by which to guide the government and the urban transformations.

1. Introduction

This article starts from a research done at the University of Rome "La Sapienza"¹, from the preparatory studies for the PTCP of the Province of Rome² and relates the updated results obtained inside the interdepartmental agreement between the Marconi University of Rome and the Neapolis University of Pafos³.

The morphogenetic elements (land orography, river engravings and infrastructure), with their strength and their stability in time, are the support frames to an intuitive interpretation of the urban configurations, of the settlement systems, identifying the realities in which we live.

1. The research has been published in: Bellone, C (2012) 'I nuovi paradigmi interpretativi per la definizione della dimensione morfologica del territorio metropolitano. Le infrastrutture di trasporto come criteri di identificazione e come strumenti strategici ed innovativi nella pianificazione urbanistica di un'area metropolitana' (Orienta Edizioni, Roma) ISBN: 978-88-96467-22.

2. Bellone C. "Il Piano territoriale di coordinamento della Provincia di Roma", in *Urbanistica Dossier* N. 13/1998

3. The agreement was signed in April 2019.

The metropolitan areas, instead, are “complex urban regions” where variegated diverse episodes and dissonant experiences reach a very significant intensity; an intensity clearly showing us how the identification criteria are now heavily under discussion.

Looking at a “bird’s eye” a metropolitan area (applications like Google Heart help us a lot, but it can be done also with the traditional cartography), and in particular the one of Rome, we realize how “many of the boundaries and partitions continuing to mark our mind maps” have crumbled; territories and cities are no longer so distinct in the physicality of space.

The starting point should be, of course, to identify / define the actual physical “signs” of transformations affecting the metropolitan territories, to interpret and bringing them back, as much as possible, within general identification criteria (aggregates).

The two hypotheses from which the research was inspired are the following:

The first is that the functionality of the network road, as a tool to create new territorial opportunities, becomes a privileged tool to contribute to the identification of settlement patterns and consequently assumes a fundamental role for the interpretation and the territorial planning;

the second hypothesis is that the understanding of the phenomena (including social ones), linked to the construction of the urban-settlement system, represents a strategic resource for grasping the logic guiding the spontaneous settlement choices.

The knowledge about the configuration of urban spaces (of settlement features, territorial morphology, functional structure of the urban conurbations and infrastructures) and about the process produced by this configuration, allows to reach actions able to implement the New Urban Agenda objectives (NUA)⁴.

2. Methodology

The research on “New theoretical models and governance for territorial complexity” deals with the fundamental questions of the interaction between the territorial system and the mobility network. It try to understand the influence that the offer of infrastructures can have for the location of economic activities and how the accessibility factor influences the demand for location of functions in the various zones of the metropolitan area.

It is important to take in mind as the demand for transport derives from the exchanges established among various economic activities, concerning people and goods; transports and land use are strongly correlated to the balanced interaction between the offer of transport networks and building land and the demand for traffic flows and location of activities and families⁵.

The research has a dual scope:

- the first, experimental, aimed to the “definition of qualitative / quantitative parameters” able to determine the “accessibility classes” and the configuration of “territorial zones” (for the mobility system) and “families of dynamic functions”, including the types of functions and their accessibility (for the settlement-functional system) .
- the second, experimental and cognitive, aimed to interpreting the spatial model of the Roman metropolitan area (which here coincides with the administrative boundaries of the Rome Province).

4. <http://habitat3.org/the-new-urban-agenda/> ultimo accesso 2019-04-09.

5. E. Cascetta, P. Ferrari, B. Montella, A. Nuzzolo, P. Rostirolla, *Obiettivi, strategie e metodologie per il piano comunale trasporti di Napoli*, *Giornata di lavoro: Pensare e agire metropolitano*, Roma, 23 aprile 1998.

2.1. Accessibility classes and territorial areas

We reach a definition of accessibility classes for territorial areas, with the construction of a metropolitan quality matrix divided into two parts, one concerning the settlement system – functional and the other the mobility system (fig.1). In this way it is possible, providing a territorial status to information, to trace the profile of each territorial area.

The definition of “accessibility classes” arises from the need to make a choice expressing the degrees of accessibility characterizing the various territorial areas. These classes are intended as assessment categories of the services offered by the mobility system within each of the areas. In this phase, the evaluation of the territorial distribution of accessibility degrees has a theoretical value, since it does not derive from the comparison with the different relationship needs expressed by the activities and functions families.

The next operation was to define the process of assigning the accessibility class to each territorial area. The belonging of a territorial area to a specific class of accessibility is defined as the product of successive comparisons within the “types of area” to which it the territorial area belongs.

The types of area are intended as evaluative summaries relating to the “thematic areas” and the “key issues” and therefore represent the tools for expressing the summary judgment on the endowment and on the quality of the infrastructures and the service that concern a specific territorial area.

The “types” were divided into four levels, expressing different judgments : high (A), good (B), medium (C), low (D) looking to the presence, consistency and quality of existing infrastructures and services.

Specifically, it is considered that a territorial area is endowed with a “high accessibility” when the levels of qualitative / quantitative consistency and modal co-presence are between the high and good values; consequently the criterion of distinction between “high accessibility” and “good accessibility” is identified in the presence, indifferently referred to the qualitative /

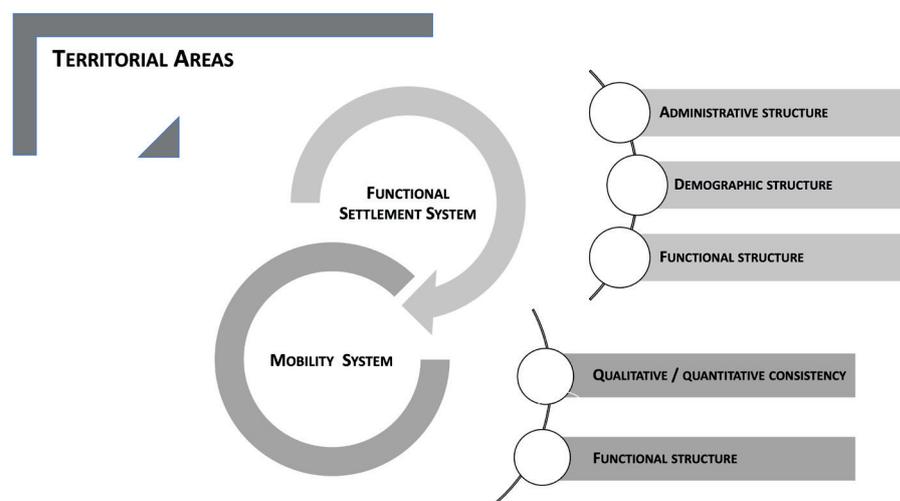


Figure 1. the structure of the Metropolitan Quality Matrix.

quantitative consistency or to the modal coexistence, of an average value level. With regards to the definition of the characteristics constituting the “average accessibility”, the existence of a level of qualitative / quantitative consistency of average value and of modal presence of medium or low level is taken as the criterion; in this case it is believed that, in relation to the provincial dynamic of values, a lower degree of multi-modality and inter-modality does not constitute a threshold of relevance to configure the characteristics of a lower-level accessibility class. This element of discrimination is instead identified in the lower level of qualitative / quantitative consistency; in particular the “low accessibility” is exclusively defined as a function of this last parameter, since it is considered that, in the presence of a low qualitative / quantity, the presence of several mobility subsystems as well as a greater degree of inter-modality are not, however, decisive.

2.2. The “Families” of dynamic functions, the accessibility, the characteristic requirements of each function, the relationships between functions and the metropolitan context

The research has attempted to provide, through interpretative hypotheses of the processes of redistribution of activities and the levels of relationships and interconnections between the activities themselves, some possible categories of dynamic functions, which are listed below:

- A) Productive Activities
 - A1) Industry
 - A2) Trade
 - A3) Private services
 - A4) Institutions (public services)

In this case, an analysis of the quantitative consistency of the Productive Activities present in each individual municipality and, therefore, in each Area was performed.

The number of Local Present Units was assessed according to the following structure: a) number of Local Present Units close to 3,000; b) number of Local Present Units close to 2,000; c) number of Local Present Units close to 1000.

- B) Research and Development
 - B1) Specialized hospitals
 - B2) Research Centers (Public Bodies)
 - B3) Research Institutes
 - B4) Public and private universities
- C) High level services
 - C1) Airport areas
 - C2) Airports
 - C3) Logistic platforms
 - C4) Courts
 - C5) Courtesy
 - C6) Hospital centers
- D) Activities for culture and leisure
 - D1) Large Parks and Protected Green Areas
 - D2) Archaeological areas

- D3) Multifunctional infrastructures (convention centers and multifunctional centers)
- D4) Uncommon sports facilities (Baseball fields, Skating rinks, Velodromes, Motocross tracks, Autodrome etc.)
- D*) Theme Parks
 - D * 1) Aquatic Parks
 - D * 2) Amusement parks
- E) Large commercial services
 - E1) Department stores
 - E2) Shopping centers
- F) Advanced technologies production
 - F1) Electronics, telecommunications and aerospace systems industry

2.3. Compatibility and incompatibility analysis of function requirements and accessibility types

It is important to highlight the relationships between the requirements of the various functions (production activities, research and development, high level services, culture and leisure activities, theme parks, large commercial services) and the types of accessibility, to arrive to have a picture of the macro-functions, grouping functions with similar characteristics, based on the location advantages of each of them, relative to transport modes and the environmental, technological, social aggregation and dimensional requirements.

The combination of the specific requirements of each function results in a macro-function, which has relative degrees of accessibility. For example, functions such as, high level services, research and development, production of advanced technologies, can have a global and direct accessibility, while activities for culture and leisure, theme parks, large commercial services, can have a local direct accessibility.

Urban systems are very complex, because they are characterized by several exchanges with the environment and with other urban systems, in terms of resources, information, energy: for example, production sub-system is only one of the structural components of the urban⁶ systems and it is of considerable interest to understand changes taking place in metropolitan context.

To make an analysis of the requirements of compatibility and incompatibility between the localization of the functions and types of accessibility it should be carried out an analysis of the competitive positioning of each zone of the metropolitan area, and an evaluation of the attractiveness of each activity, expressed by the number of occupied and the prevailing specific area of interest (national, metropolitan, local ...) ⁷.

By examining each of the dynamic functions, we can proceed with the study of the compatibility of a function with respect to its location and its requirements.

If we observe as in a given place there are some characteristics of localization, which are linked with the requirements of a function to be allocated and related to the level of potential accessibility to it (global, local, direct, indirect accessibility), we can plan the functional layout of the territory in an integrated view of the various elements constituting it.

All the functions, generally, must have the requisites of environmental quality, technological, social aggregation and dimensional ones, however, based on the found or possible accessibili-

6. D. Katz e R.L. Kahn, *Psicologia delle organizzazioni*, Etas Kompass, 1968.

7. Area di prevalente interesse specifico internazionale, nazionale, metropolitano, locale.

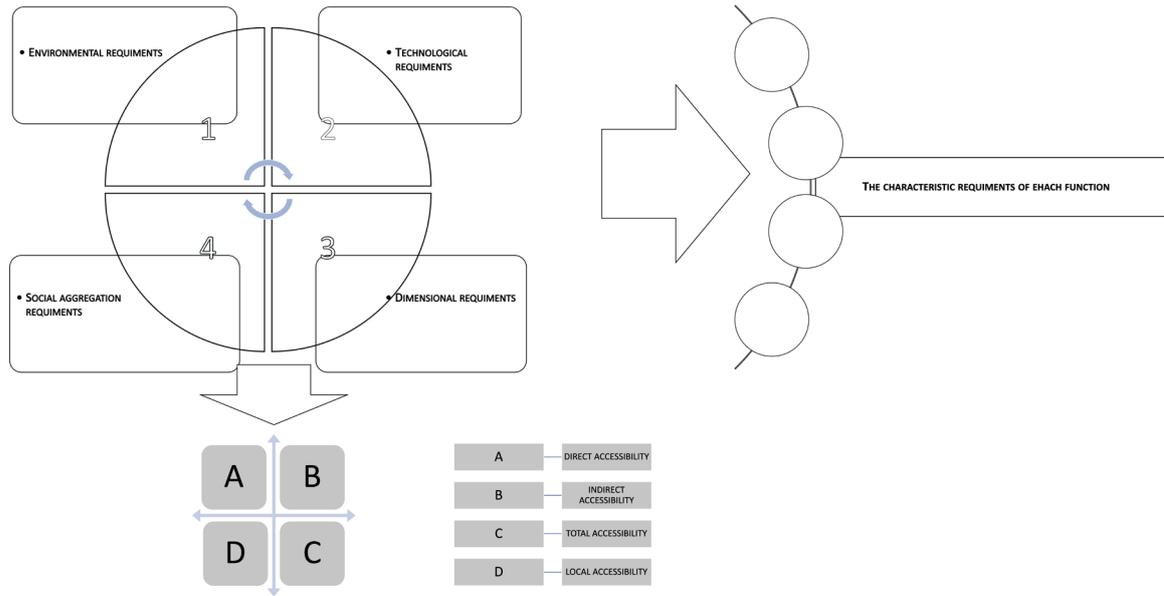


Figure 2. The basic concepts for defining the compatibility and incompatibility profile between function requirements function and accessibility types.

ties, with the support of other interventions, they can be located in appropriate sites for their needs and constitute macro functions, in which similar functions are recompressed.

The productive activities, including Industry, Commerce, Private Services, Public Institutions and Research and Development (Specialized Hospitals, Research Centers, Public Bodies, Research Institutes, Public and Private Universities), for example have, surely, all four categories of requirements and need global, local and direct accessibility: they are included in the macro-function A.

Top level services (airport areas, airports, logistics platforms, Law Courts, District Law Courts, hospital centers), activities for culture and leisure (large parks and protected green areas, archaeological sites), multi-functional infrastructures (congress centers and multifunctional centers), Rare sports facilities (Baseball fields, Skating rinks, Velodromes, Motocross tracks, Autodrome etc.) and theme parks (Aquatic Park and amusement parks), have all the requirements listed above, and need all the accessibility levels: they are included in macro-function B.

The function category Large commercial services (department stores, shopping centers) has the aforementioned requirements, but could have local and direct accessibility so they are included in macro-function C and the production of advanced technologies (electronics, telecommunications and aerospace systems), must have all the requirements and global and direct accessibility so referring to macro-function D.

2.4. The characteristic requirements of each function

The requirements examined for each function refer, as already explained in the diagram, to four categories:

1. environmental requirements
2. technological requirements

3. dimensional requirements
4. social aggregation requirements.

Environmental requirements include:

- the quality of the surrounding space: it defines the optimal value of the level of territorial quality required by the functions for the turning of the relative activities,
- the good position of the function: it expresses the location of a function within an infra-structural and spatial fabric and how much is it favourable to the function.

The technological requirements have been divided into the following elements:

- connection with the mobility network,
- accessibility levels,
- offer of services.

The dimensional and social aggregation requirements are very specific, precisely because the functions are not standardized, but they dependent on the specificity of different bonds and characteristics, on the extremely variable number of opportunities that each type of function requires, changing from area to area. In the category of social aggregation the relationships between the areas and activities can be attributed by identifying the levels of strict interrelationship that the various functions must have between them.

The requirements listed above were connected to the specific features of individual functions in order to search for macro-functions.

2.5. The relationships between functions and the metropolitan context

Therefore, within the Research we consider useful to identify a set of fundamental relationships, understood as strategic reading criteria, to obtain the identification of the relational logics, linking the functions and the “reference areas”.

In relation to the areas of reference and in line with the considerations made in the previous paragraph, within each of them, the following basic concepts have been identified working based on the following relations:

Relations with the urban context

- Relations with urban settlement fabric,
- Relations with the building assets by specific function,
- Relations with the residential building stock,
- Relations with the infrastructural mobility network.

Relations with the production context

- Services Distribution,
- Goods Demand,
- Goods Supply,
- Locations selection,

- Integrated and dynamic functions.

Relations with the infrastructural context

- Consistency of infrastructure offer,
- Infrastructural demand,
- Infrastructural efficiency.

Relations with the mobility system

- Accessibility
- Transport inter-modality,
- People and goods movement,
- Traffic flows.

In the following Figure 2 the relations between the functions and the metropolitan context are grouped into two categories : the localization and the functional one.

3. The case of Rome Metropolitan Area

After analyzing functions and sites compatibility, and in which to allocate the functions, taking into account the different levels of accessibility and relationships established by the functions with the metropolitan context, it is useful to observe the specific case of Rome Metropolitan Area⁸, in order to have a confirmation of the above described methodological theory, starting from the analysis of Rome province and the municipality of Rome.

Based on the obtained data, it is possible to envisage scenarios for the planning of functions, closely linked to the supply of infrastructures in the area and which could lead to the transformation of the same, in a less spontaneous and more reasoned process, taking into account, of course, every function accessibility or need.

First of all, it is necessary to underline the Families of “dynamic” functions characterizing the Province that have been identified and located in the following categories:

- AA- Archaeological areas
- A- Airports
- AP- Port areas
- CC- Shopping centers
- C- Department stores
- D- Amusement parks
- H- Hospitals
- L – Logistic platforms
- PP- Large Parks and Protected Green Areas
- P- Local law Courts
- R- Research Centers
- S- Multifunctional infrastructures

8. It refers to the PTCP of the Province of Rome and to the preparatory studies.

TT- Law Courts
 T- Rare sports facilities
 HT- Industries for the production of advanced technologies

With regard to “Production Activities”, the evaluation was expressed as follows:

- a) high concentration, in the Reference area, of productive activities (number of local Units close to 3000);
- b) average concentration, in the Reference area, of productive activities (number of local Units close to 2000);
- c) low concentration, in the Reference area, of productive activities (number of local Units close to 1000);
- d) very low concentration or absence, in the Reference Area, of productive activities (number of local Units close too).

The result of the survey allowed us to express summary evaluation considering both the *quality* and the *quantity* of the functions present in each individual Area.

The overall evaluation was therefore expressed:

- a) high presence of specific functions;
- b) medium presence of specific functions;
- c) low presence of specific functions;
- d) very low presence or absence of specific functions;
- e) areas of maximum concentration of production and research activities, for which the requalification and upgrading is envisaged through the realization of scientific and technological parks (Provincial General Territorial Plan for the Rome Province).

Numerous matrix have been created reporting and analysis in depth the various data connected to the dynamic functions families, the types of functions, the activities.

Accessibility compared to Function categories

From the data analysis of data, relating to the types of functions present in the Roman provincial metropolitan area, the percentages of total and partial direct accessibility and indirect accessibility have been defined with respect to each function, with the relative levels of accessibility (high, good, medium low). Two areas of analysis have been distinguished : the Province and Rome Municipality. We found that, in the provincial area, function D (cultural activities and leisure) has a greater value than the others, with reference to the total direct accessibility, followed by the category of function C (higher level services), also with a high percentage of total direct accessibility. Instead, the data relating to the other functions A (productive activities), B (development and research), D * (theme parks), E (large commercial services) and F (hi tech production) reveal a low total direct accessibility.

Total direct accessibility of the Province with respect to the categories of functions

With regards to total direct accessibility within the territory, it can be seen that the function, which presents a higher percentage is F (hi tech production), followed by E (large commercial

services) and B (development and research), while functions A (productive activities) and C (high-level services) have intermediate values of total direct accessibility and function D (cultural activities and leisure) low values.

Total direct accessibility of Rome Municipality with respect to the categories of function

The data relating to partial direct accessibility, relative to function D (cultural activities and free time), show high level of this type of accessibility, while functions A (productive activities) and C (higher level services) have an average percentage value and the functions E (large commercial services) D * (theme parks) present a low one.

Partial direct accessibility of the Province with respect to the function categories

In the territory the function F (hi tech production) has a high percentage of direct partial accessibility, while the rest of the functions, except the D * (theme parks) with a low value, presents a media percentage of partial direct accessibility.

Partial direct partial accessibility of Rome Municipality with respect to the categories of functions

Indirect accessibility, referring to the Province, reveals that C (high level services) and D (cultural and leisure activities) have a high percentage of accessibility of this type, the E function (large commercial services), a medium value and other functions, a low value of indirect accessibility.

Indirect accessibility of the Province with respect to the categories of functions

In the territory, functions E (large commercial services) have a high percentage value of indirect accessibility, while functions F (hi-tech production) and D (cultural and leisure activities) have an average percentage and functions A (productive activities) and B (development and research) low percentage.

Indirect Accessibility of Rome Municipality with respect to the categories functions

Total, partial, indirect, direct accessibility percentages for each function can be grouped into high, medium and low values, both for the Province and for Rome Municipality.

Rome Categorie Functons	Accessibility Percentages		
	High	Medium	Low
Total Direct Accessibility	B (71%), E (76%), F (100%)	A (47%), C (24%)	D (18%)
Partial Direct Accessibility	F (100%)	A (46%), B (38%), C (23%), D (38%), E (31%)	D* (8%)
Indirect Accessibility	E (100%), F (69%)	D (31%)	A (15%), B (8%)

The compatibility of localization policies for residential and productive settlements with sustainable mobility

Since the offer of infrastructures and transport services and the structure of the territory greatly influence mobility, it can be said that, in the province of Rome, the dichotomy between the role of the capital and the rest of the territory has caused an unbalanced territorial distribution of productive and residential settlements and problems in the mobility sector.

The Roman provincial basin is of great importance for the national, interregional, regional and local level exchanges and requires an efficient mobility network, which today, from the analysis, seems poorly suited to the demand for public transport by rail and by road.

Often, the public transportation lines are underutilized or overused, the railway infrastructures are not technologically advanced and they overlap each other, furthermore they have a radial and concentric structure respect the city; moreover the public transport by bus too presents overlapping lines in the south and east of the province and a single-central organization with respect to Rome.

To overcome these mobility problems, we need:

- improve transport performance, through plant and network innovation;
- develop an integration of the different transport systems;
- manage and reduce the congestion due to traffic.

From this all, a more rational reorganization of the territory and a more immediate socio-economic development can result, but it will be necessary to proceed to the existing railway lines improving, an increasing in investments for the transport sector and the stipulation of new agreements between the various actors of transport planning, to achieve better quality and efficiency objectives.

The location of particular production initiatives in a given territorial context, can be favored by the existence of particular economic and human resources, and it can encourage the development of infrastructures and services for businesses, contributing to further strengthening the development of the industrial sector and at the same time enrich the local economy.

The factors encouraging the localization of functions in Roman provincial territory are the external economies, represented by the service offer, by the efficient connection transport and infrastructure systems. From a research carried out by the Industrialists' Union of Rome and the Province and by the Chamber of Commerce, Industry, Handicraft and Agriculture of Rome, among the advantages and disadvantages, which can influence the localization of companies, figure, with the high scores: as advantages, the relations with the internal market (66.3%) and the distribution and sales networks (55.4%); as disadvantages, the connections and infrastructure (59.8%), and this analysis is true for the economic operators, for the exchange and distribution of goods, for the information and movement of workers and for the recruitment of personnel.

4. Conclusion

An efficient and functional communications network enables a metropolitan area to initiate and support technological and productive innovation processes, and the same is true considering the people and goods transport systems. The political objective, therefore, should address

the territory rebirth, creating new infrastructures, redeveloping some areas and creating new opportunities for localization of metropolitan functions, because the competition between different productive realities is no longer played on the territorial level, but on the network resources and opportunities one, and it is a political necessity to develop means which can give the territory a remarkable level of attraction, supported by the inclusion of functions promoting the territory in a marketing perspective.

It is essential to identify the strategic elements to set up the development, starting from the dynamic aspect of exchanges and relationships, from the technological characteristics, from the infrastructural potentialities and creating “networks of networks”.

A place identification is given, not only by its administrative boundaries but, above all, by factors concerning the social, economic and cultural behaviours. It is interesting to understand “to what extent” the territory is able to influence the economic development of each individual area and not only why the economic development is more intense in certain areas than others. It is in this way that the concept of space becomes an essential factor in the processes of local development and it influences the entrepreneurial processes, the company organizational models, their innovative performances and, more generally, the entire growth capacity of the individual territorial local⁹ systems.

The relations between metropolitan functions / activities, “are identified in the traditional relations: daily and stable (commuting), residence / work and residence / vast service areas, which still constitute the prevailing basis of dependence between central area and hinterland and the articulation of these second parts in the local functional sub-systems”.

The high level activities and the functional relationships between these activities and the production structure have increasingly acquired a propulsive role in stimulating technological, informational and decision-making impulses for the development of companies and production, constituting one of the main innovation factor of the metropolitan layout transformation.

Most of the “service” activities, developed due to the greater metropolitan dimension, connect with the area’s central activities, looking for central positions for their development. The rapid transformations, which have taken place in recent years, have caused changes, especially in metropolitan areas, these changes impacted also the relations which the areas themselves had with the outside and with their internal territory. This emphasizes the theme of urban centrality, which contains levels of physical-functional concentration, given the presence of activities in the central areas and the decentralization in more external zones of productive activities, wholesale trade, and goods traffic.

The aforementioned decentralization, however, is not far from the central zones; the dispersion of service activities in the metropolitan area keeps strong ties with the decision-making centers and we see the creation of settlements along the arteries and nodes based on the main routes and the transport system hubs.

It seems important differentiate the various economic, social and cultural functions of the service sector, to better understand the influences they have on the dynamics of the metropolitan area development, given that we have moved from a service sector aimed at consumption or at the choices of industries for locations, instead today, we have a “always changing” service sector, able to influence economic relations and localization phenomena.

If a concentration of service industry realities takes place around production core centers, located in central zones, it is advisable to delocalize them in peripheral areas, so to decongest

9. Unione degli Industriali di Roma, *I sistemi produttivi metropolitani. Da satelliti a pianeti. Lo sviluppo industriale del nord-est e del sud-est di Roma*, Roma, giugno 1994.

the central areas and revitalize the periphery and the metropolitan structure creating a new polarity system, that will become the base of new developments.

On one side, positioning, almost exclusively, in peripheral areas the productive activities of the service sector has functionally pauperized them, creating in some cases degradation situations, causing a negative impact on the service industry offer at local level and on the demand for these services by local business operators.

On the other side, there are benefits deriving from the agglomeration process, related to its ability to promote innovations, so that we can be induced to encourage or, at least, not to prevent, this process of concentration of advanced services, taking also into consideration the needs of innovative processes, driven by both quantitative and qualitative economies of scale.

In summary, it looks like the characteristics of human capital and the technological level – both incorporated in the products and in the production processes (i.e. the functional mix expressed in terms of technical-productive structures, and, above all, the entrepreneurial and organizational capacity in the most broad sense) – can determine the potential innovative, of individual areas and / or regions.

The relationships between functions and localization features highlight the need to define “invariants” in urban system transformation processes, “it is the preference different service activities have to locate in certain urban sectors, where it exists an optimal combination of accessibility levels, availability and cost of areas, general settlement quality and, finally, potential for vertical and horizontal integration with other service activities”.

It is necessary to create the physical-spatial conditions for the conquest of modern urban functions, relevant for the structural underway transformations; to reduce agglomeration diseconomies for these functions; to control the dichotomizing effects of these processes; to pursue, through new tools and strategies, urban integration; to rediscover, based on new structural and economic contents, the road to a new quality of the metropolis.

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