

How urban fabric fosters knowledge transfer and innovation: the example of Barcelona

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1. From an industrial past to a based-knowledge future

Barcelona has a long and well-established history of embracing new ideas and encouraging innovation. The symbiosis between research capacity and urban development is an important dynamic in the city. Whether it is new technologies, health or digital fabrication, its connections with major global companies, or its position as a leading city in the quality of life of workers, Barcelona is a vibrant place of innovation – and that stimulates job growth and opportunities for businesses and stakeholders alike.

As Mercè Tatjer (2006) highlights, since the late 18th century, Barcelona and its region (Catalonia) became the most important industrial centre in Spain, providing Spanish market with manufactured goods such as textiles or chemicals. From this early manufacturing period and almost in parallel with industrialization during the XIX century, industrial sites moved out from the inner city to outside the city walls.

This trend continued into the first third of the twentieth century, when an important industrial diversification began at the expense of textile sector. If industrial buildings continued to expand throughout the city both in the new Eixample Cerdà and small villages in Barcelona's plain such as Sant Antoni or Poble Nou, the development of a second industrial belt represented a major spatial change which serve as a starting-point of industrial growth at a metropolitan scale in the 1960s.

Indeed, the installation of large production centers in emerging sectors such as railway equipment, automotive (SEAT, Pegaso, Ducati) or business products (Hispano Olivetti) changed the scale and content of Barcelona's industrial landscape. Large and modern industrial factory complexes occupied large areas along the railway lines and the valleys of Besós and Llobregat rivers. At the same time, social welfare policies were implemented to respond to the needs of a growing immigrant population coming from the rest of Spain (housing, services and facilities for workers and their families).

By the end of the 1970s, the delocalization of production to new industrial, storage and distribution sites in the periphery became a reality due to technological changes, the crisis in the textile sector along with the emergence of new productive sectors (electronics, pharmaceuticals), the development of the metropolitan network of highways and the changes in maritime transport systems (the revolution of containers).

In the last forty years, the industrial economy has been replaced by an economy of services to production, people and knowledge¹. Barcelona has become a global tourist destination with almost 8 million visitor a year. At the same time, the city produces almost half the technical innovation and much of the research carried out in Catalonia². As facing a crucial moment when traditional stereotypes are being questioned under economical, sustainable and social agendas, defining the city urban model based on research strength or tourism economic activity is a matter of the utmost importance.

Barcelona possess the conditions to consolidate a global research centre. In fact, one of the drivers of Barcelona's success is the constant influx of new ideas and talent into the city. With 961 registered patents in the period 2005-2012, many relevant companies have located its headquarters in the city and its metropolitan area. Local and regional authorities have also implemented proactive policies aimed at facilitating the development of value-added knowledge based facilities, such as universities, while public and private consortia have fostered the development of new technology parks and business initiative support services.

A well-known paradigm of public-private partnership is the 22@ district, involving the transformation of an obsolete industrial environment into an area which is home to new activities related to knowledge. The concentration of these types of activities has allowed 22@ to become a dynamic environment in which the confluence with universities, support activities and accompanying services has produced positive results.

However, beyond the 22@ district example, Barcelona has more than 700 startups, leading companies and research centres that create a unique innovation ecosystem—a synergistic relationship between people, firms and place (the physical geography of the city). What makes Barcelona stand out? How can the city use the strengths of a compact urban model to attract more talent, companies, and investment?

This paper presents the main conclusions of the study 'Geographies of Innovation', commissioned in 2014 by Barcelona City Council to the design studio 300.000 Km/s. The research examines the necessary urban conditions to promote innovation, the relations established between innovative initiatives, the urban morphology of Barcelona's ecosystem and the transference of knowledge between different areas of the city.

Whereas prior studies have focused on entrepreneurial quality by excluding location-specific measures³ or the impact of research performance⁴ to define a city competitive advantage⁴, this study assesses the impact of research and innovation facilities on an urban scale beyond their individual success. We have worked with a database⁵ of successful initiatives including 562 startups, 78 leading companies and 59 research centres from key areas⁶ such as B2B (115 initiatives), E-Commerce (77 initiatives), Digital (72 initiatives), Biohealth (57 initiatives), Transmedia (53 initiatives), Mobile (51 initiatives) and Fab (43 initiatives).

The data and analysis in this study are intended to help drive evidence-based decisions on which companies and industries should invest in Barcelona and how planning and policy-making can augment this process. It looks at the research landscape underlying the urban landscape, highlighting opportunities for collaboration, innovation, and economic development.

2. Do urban conditions foster innovation?

As Katz and Wagner (2014) state in the report 'The Rise of Innovation Districts: A New Geography of Innovation in America', in recent years a rising number of innovative firms and talented workers are choosing to congregate and co-locate in compact, amenity-rich enclaves in the cores of central cities. Instead of building isolated science parks or reproducing the Silicon Valley Model - suburban corridors of spatially isolated corporate campuses, accessible only by car, with little emphasis on the quality of life or on integrating work, housing, and recreation-, innovation initiatives prefer sites that strength proximity and knowledge spillovers.

Consequently, the mash up of entrepreneurs and educational institutions, start-ups and schools, mixed-use development and medical innovations, bike-sharing and bankable investments -all connected by transit, powered by clean energy, wired for digital technology are important factors that influence the proliferation of innovative initiatives.

In the case of Barcelona, this study found an apparently uniform distribution of innovation facilities throughout the city. Innovative initiatives locate both in central areas with good accessibility to public transport and peripheral zones with low rents and a lack of local services. What are the socio-demographic, economic and urban factors that determine this contrasting situation?

We implemented our approach using demographic data and economic indicators from the Open Data Service of Barcelona City Council, cadastral information from the General Directorate for Cadastre, Google Places and Flickr services and transit data from Barcelona TMB public transport agency.

When we look at the economic and social fabric, innovative initiatives are more likely to success in neighborhoods with a high rate of young people and women (*Figure 2*), and an income per capita that remained stable or declined in the past 5 years. Economic dynamism and real state fluctuations play also an outsized role: innovative initiatives are located in areas where positive synergies between companies result in a high level of economic activity as well as areas with a growing rental cost of premises due to its central position or its limited availability (*Figure 4*). The 22@ district differs from the regular pattern as the quantity of initiatives exceeds the number of traditional companies (*Figure 2*) and rents are still affordable.

Regarding the morphology of urban fabric, innovative initiatives tend to be placed on consolidated urban zones, occupying small plots in the city centre (except co-working spaces) or larger surfaces when situated on the periphery (*Figure 3*). Generally, innovation spreads to mixed-use fabrics achieving a sustainable balance between residence, commerce, office and industry although, in some cases, innovative initiatives prefer mono-functional areas either office or industrial.

Neighbourhood services are an indicator of urban quality that influences the implementation of initiatives: local shops, financial services or restaurants can contribute to a better quality of life of workers even if this relationship is not linear (*Figure 5*). Once again, the 22@ district is an exception as the quarter has experienced major urban transformations and some parts provide almost no services to residents.

Centrality and representativeness play a secondary role. Likewise large industrial estates were traditionally located in proximity to railway network and main roads, innovative initiatives are regularly close to major public transport nodes (*Figure 6*). The location of innovative initiatives is generally at a certain distance of most representative areas of the city.

In short, environmental conditions (compactness, good accessibility to public transportation, cheap rentals, diversity of local services, etc.) influence the location of innovative initiatives. However, urban context is not always a crucial factor -each activity requires a specific background.

3. The role of leading companies and research institutions

From Almirall to Telefónica, from Desigual to Puig Group, Barcelona is already home to companies spanning a diverse range of business sectors such as biotechnology, digital technologies and fashion. Universities are also the cornerstone of the city's research and innovation offerings. Barcelona has recently promoted five Campus of International Excellence involving several institutions such as UPC-Barcelona Tech, the Autonomous University of Barcelona (UAB), Pompeu Fabra University (UPF) and the University of Barcelona (UB).

It has commonly been assumed that big companies and research clusters act as magnets for startups and small companies. In order to understand the role of these leading firms and R+D facilities in attracting innovative initiatives, we analysed the number of startups falling within a range of 50, 100 and 200 metres. In both scenarios, just a few companies and research centres are able to concentrate more than 7 innovative initiatives in its immediate perimeter: the quantity of innovative initiatives increases in inverse proportion to distance (*Figure 7*).

For instance, Desigual, which is a global fashion brand, has no innovative initiatives within a radius of more than one kilometre as it is located in a peripheral site on the shoreline that lacks of transportation and access to services. On the contrary, firms situated in the 22@ show the highest ratio of attractiveness.

The same applies to main universities and R+D facilities. Most campuses have a low concentration of such initiatives, except in certain cases like the Institute for Advanced Architecture or some science parks (Hospital Clínic, Poble Nou, BarcelonaTech North and Sarria-Bonanova campuses) where innovation is maintained beyond the university facilities.

The most likely cause of this absence of attractiveness is the difficulty to generate certain urbanity conditions (centrality, small size of plots, mixed-use activities, etc.) as frequently research campuses are the result of large-scale urban transformations (*Figure 8*).

However, we have identified several examples that bring together a significant number of initiatives like the Barcelona Media Park. Located in a central site along Diagonal Avenue, it congregates the new campus of Communication Sciences, MediaPro tower, MediaTic building, RTVE studios, Barcelona's building incubator and a number of small business related to media sector. In this case, attractiveness depends on the partnership between leading companies and research centres.

4. Spatial models, borders and opportunities

As discussed above, innovation creates a closely linked network, which is polarized around nodes concentrating a larger number of initiatives. If leading companies and research centres are important players in the innovation ecosystem, small companies and startups can also generate links and attractiveness for themselves.

We have explored from a spatial point of view how these different types of initiatives cluster in urban space using a gravity model and Delaunay triangulation.⁷ Morphological and environmental factors configure three different spatial models: line, network and centres. In the lineal model, innovative initiatives align geometrically along main civic axes as Diagonal and Passeig de Gracia, taking advantage of a well-connected area with high economic activity, small plots, local facilities and representative character. In contrast, the network model results from the concentration of a diversity of initiatives (startups, research centres and leading companies) in a short distance as is the case of the 22@ area near Diagonal.

In these first two cases, despite reflecting opposite situations (an area that concentrates representativeness and economic power with respect to a district with low rentals and large premises), innovative initiatives benefit from centrality and mixed-use. As explained earlier, the centre model is based on major anchor institutions mainly research hubs and university campuses.

Beyond these main archetypes, we have detected other sub-centres and neighbourhoods with a high potential to develop innovation, located in the east and north areas. Certain residential quarters and zones gathering large urban facilities could represent a barrier to connect existing innovation districts, even if the tendency is the spreading of innovation all over the city thanks to the diversity and compactness of urban fabric that enables a positive transference of innovation and knowledge. In addition, the location of large innovation facilities demands increased investment of public administration. Frequently, research centres and university campuses have been placed in apparently central sites (mountain, coastline) regardless of urban conditions. These operations didn't achieve maximum impact in contrast to other situations that profit from an existing vibrant urban fabric to implement successful development.

It is important to recall that in today's hyper-competitive, global knowledge economy, innovation initiatives will play a key role in generating economic growth and social prosperity, particularly when they work in the context of city-wide strategies for smart specialization. In this sense, the innovation ecosystem of Barcelona could become a reference for other urban areas. This model embraces those very attributes of urbanism—what Saskia Sassen (2008) calls “cityness”—that were denigrated and often destroyed in the 20th century: complexity, density, diversity of people and cultures, and a layering of the old and the new.

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¹ The GDP of the province of Barcelona is divided as following: 0.5% in Agriculture; 6.9% Construction; 18.7% Industry, 65.6% Services. Regarding the percentage of workers, 0.1% of the population is employed in Agriculture, 6.9% in the Construction Sector, 10% in industrial activities and 85% in Services. Data source: Ministry of Employment, Labour and Social Security.

² At present, Barcelona metropolitan area contains 60% of workers in knowledge-intensive activities and 68% in creative activities in Catalonia. Data source: Ministry of Employment, Labour and Social Security.

³ Guzman and Stern (2014) introduce a new method for studying the founding and growth of entrepreneurial ventures. The study that uses for profit business registrations in California from 2001-2011, estimate outcomes on the basis of start-up characteristics regardless of location restraints.

⁴ Elsevier and Urban innovation network (2015) report analyses Amsterdam's research strengths and benchmarks its performance against ten other European cities of comparable size and standing.

⁵ Infonomia is an innovation consulting firm based in Barcelona tapping into global ecosystem of experts and partners, which combines a wide variety of backgrounds.

⁶ The initiatives have been classified in 21 categories: Food and agriculture, Self-sufficiency, B2B, Big Data, Biomed, Coworking, Digital, E-commerce, Edu-play, Fab, Fashion, Green, Inno-social, Mobile, Nano, Smart, Trans, Transmedia, Tourism, University and Videogames.

⁷ Delaunay triangulation and gravity model are commonly used in spatial analysis to define areas and distance relationships according to proximity and density of data.

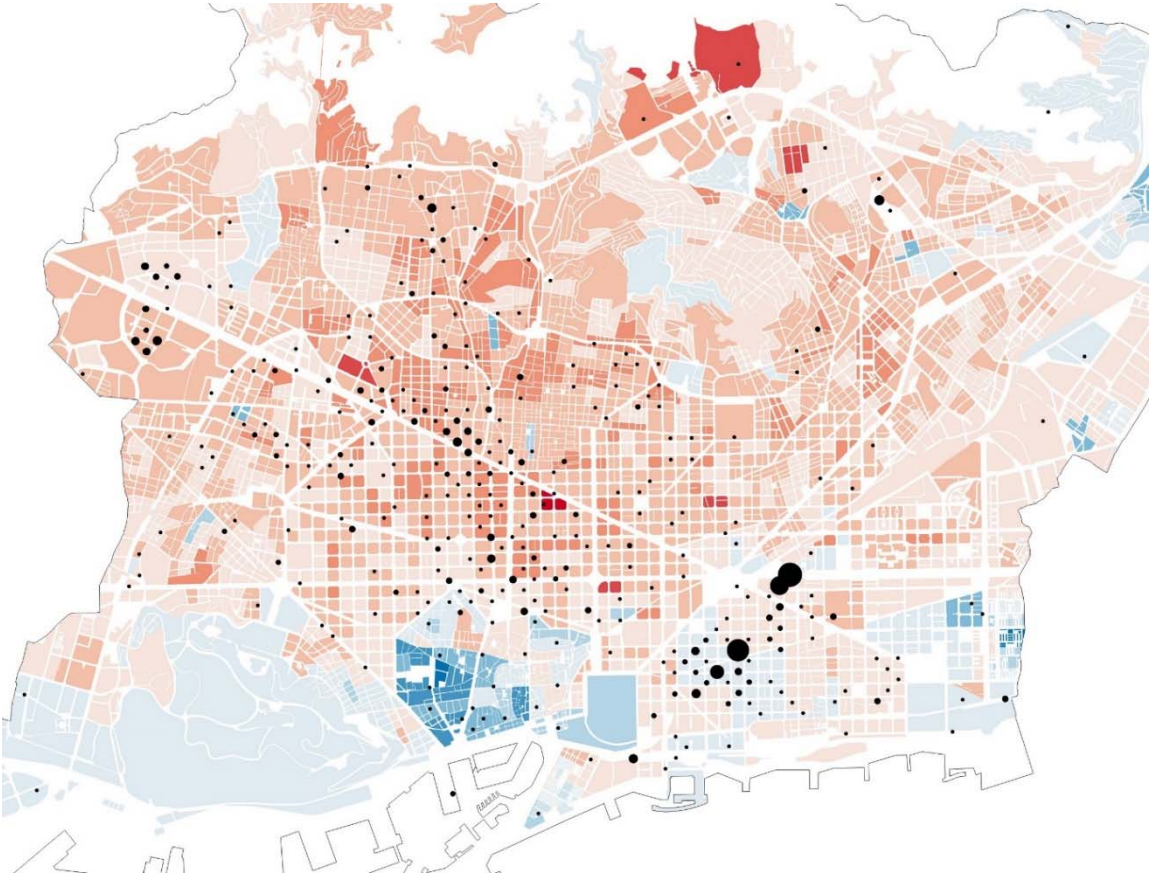
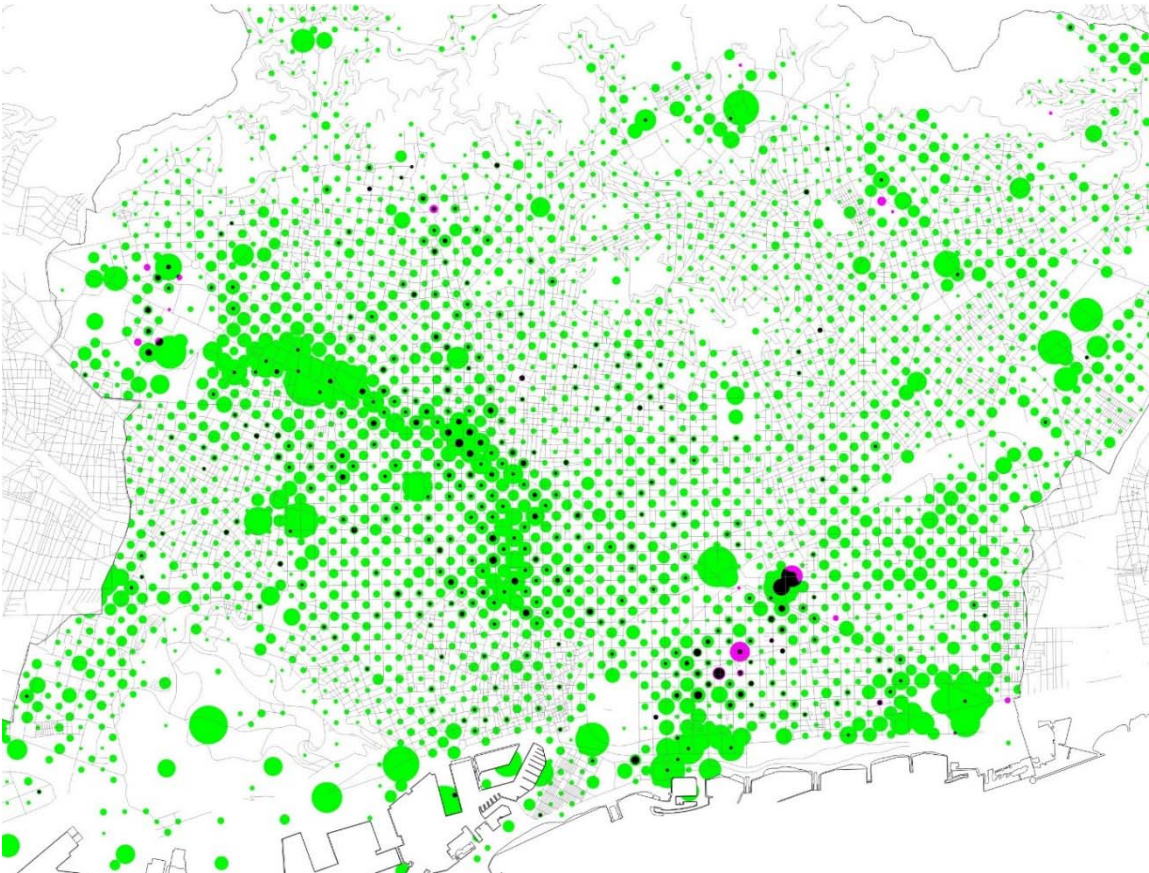


Figure 1, 2: proportion of innovative initiatives and gender analysis.

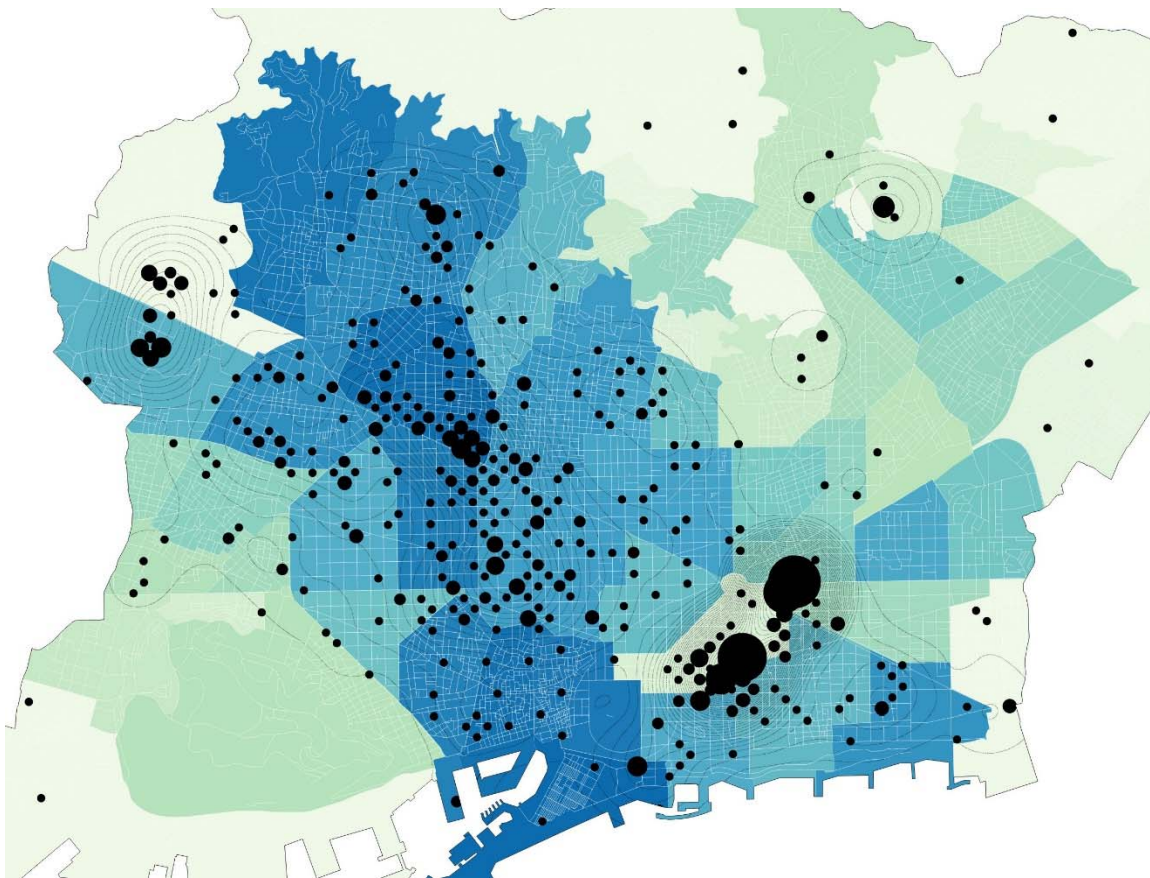
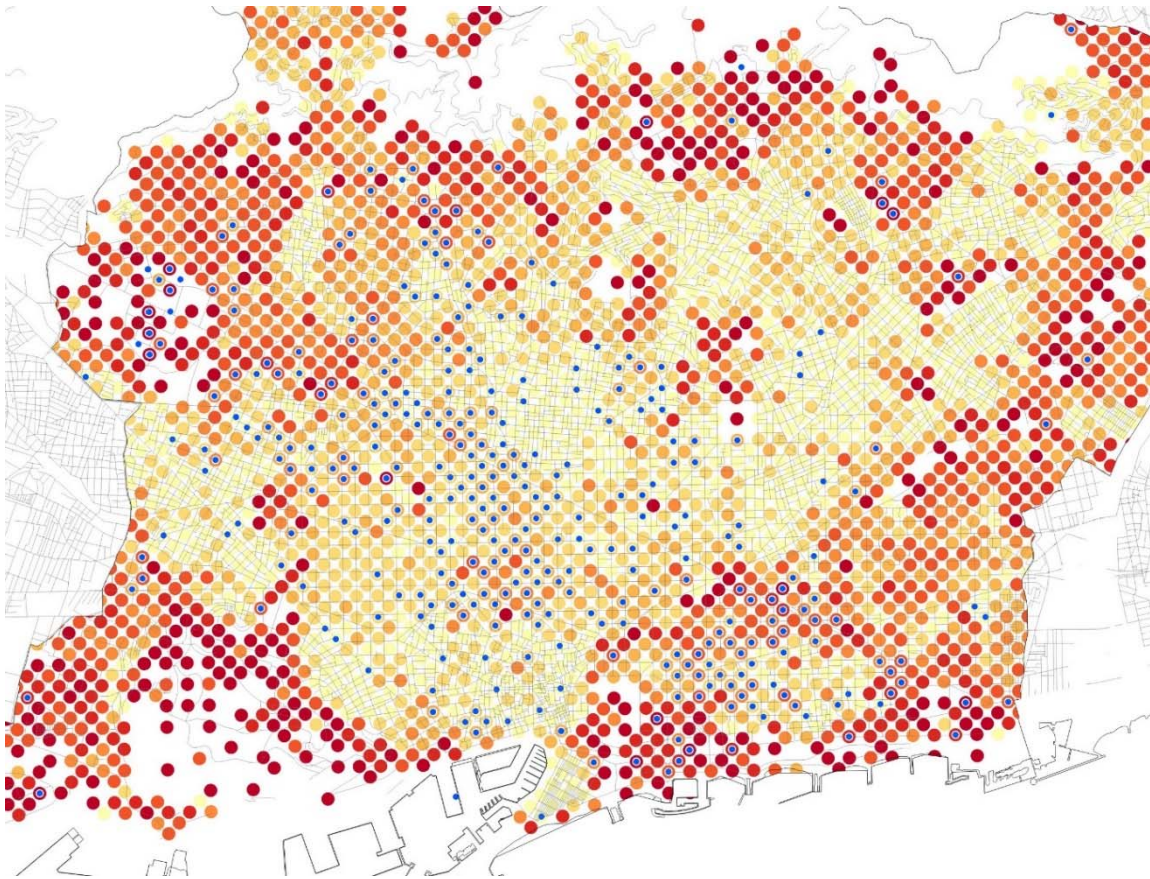


Figure 3, 4: surface of plots and rental cost of premises.

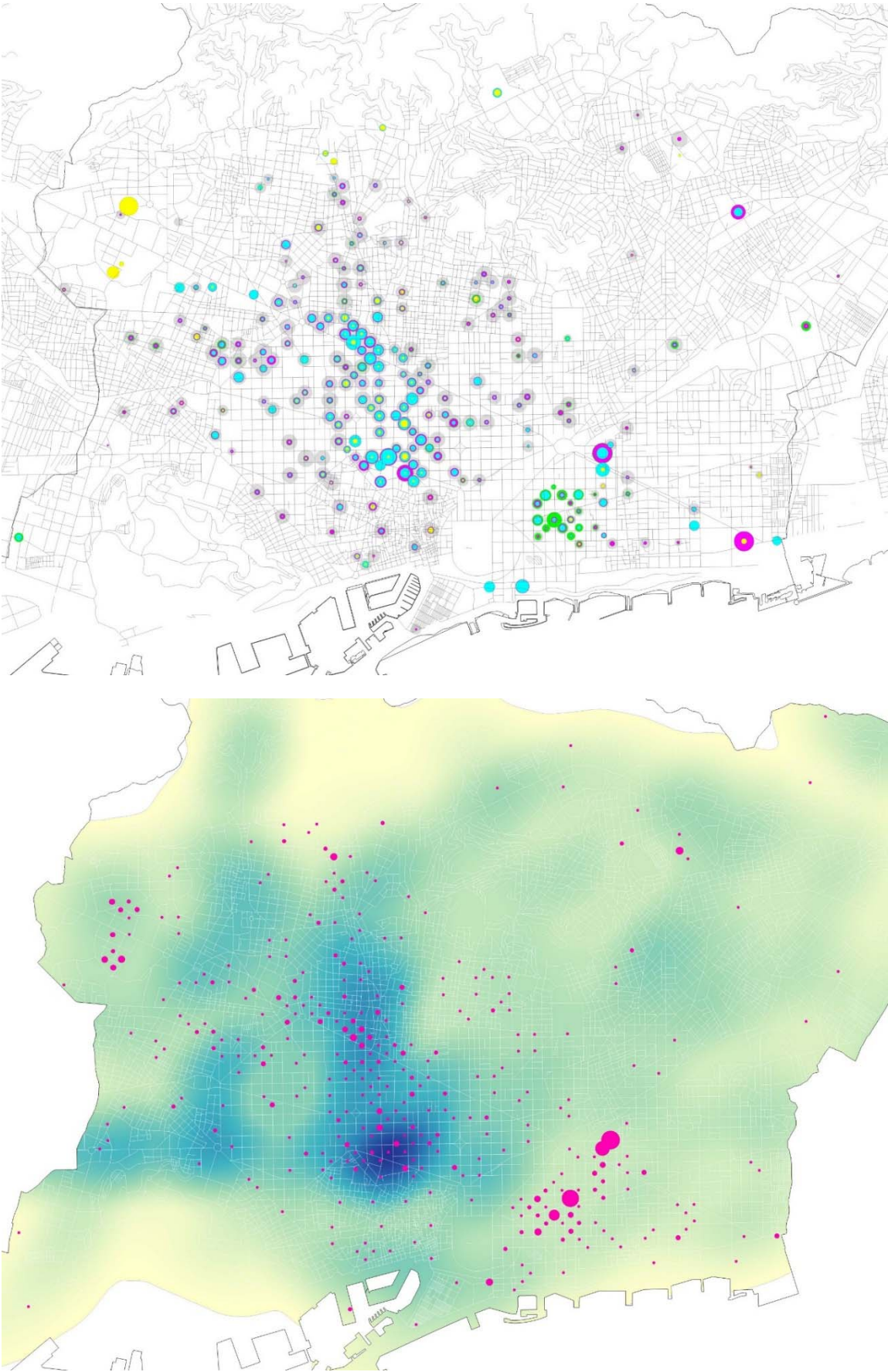


Figure 5, 6: analysis of land use and accessibility to public transportation.



Figure 7, 8: attractiveness of leading companies and research centres according to distance and surface of plots.

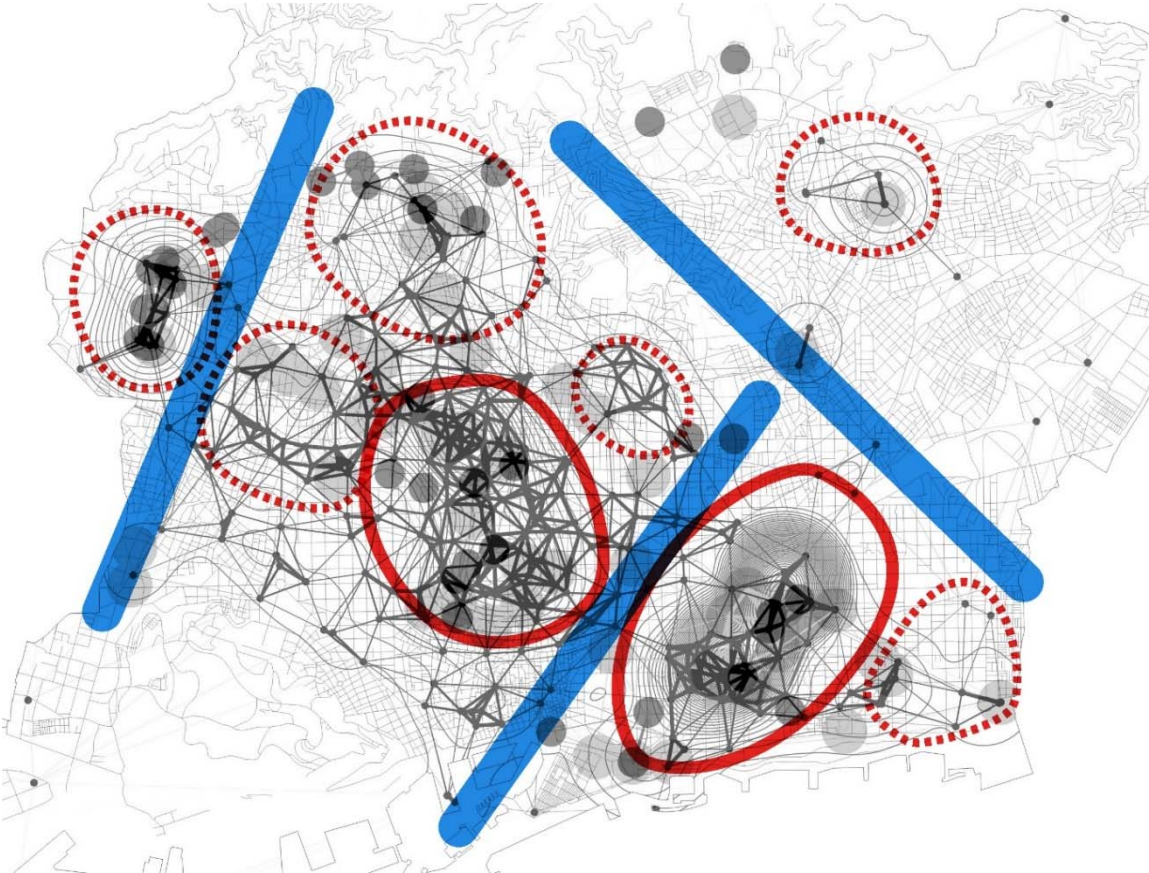
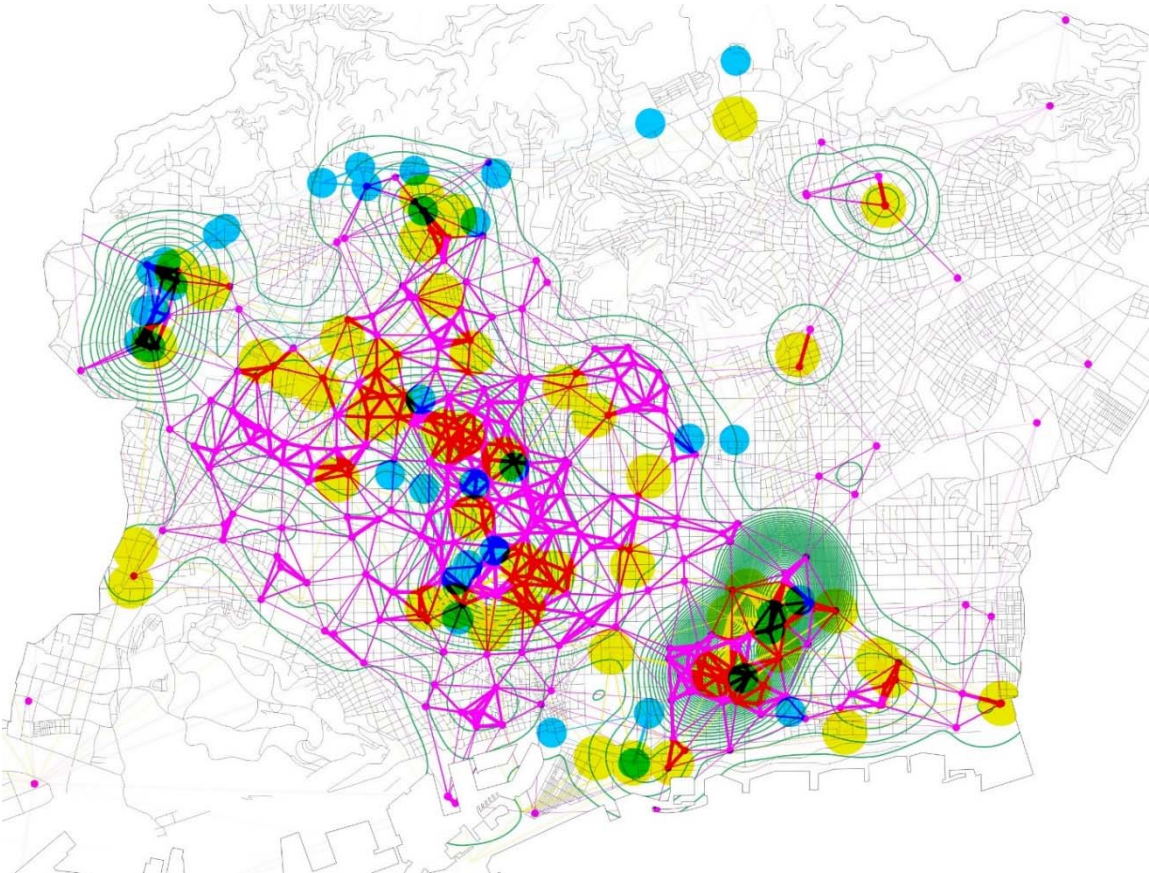







Figure 9, 10: spatial models (line, network and centres) and opportunities for transference.

-  innovative initiative
-  economic fabric according to the number of companies (radius)
-  innovative initiatives exceed the average of traditional companies
-  the number of innovative initiatives is lower than the rate of traditional companies

-  innovative initiative
-  < proportion of women
-  < proporció of men

-  innovative initiative
-  < plot surface

-  innovative initiative
-  < rental cost of premises

-  innovative initiative
-  culture
-  office
-  commerce
-  industry
-  housing

-  innovative initiative
-  < accessibility to public transportation

-  leading company
- number of innovative initiatives within a radius
- 50m 100m 200m 400m
- 

-  plot surface leading companies and research centres
-  plot surface of small companies and startups

-  startup
-  research centre
-  leading company
-  coincidence of different type of initiatives
-  level of connectivity
-  density of innovative initiatives