

Territorial Attraction for New Industrial-Productive Plants. The Case of Pavia Province

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Abstract. Territorial attractiveness to production activities is a determining factor for the revitalization of degraded, abandoned, and impoverished territories and urban areas from an economic, social and environmental point of view. A competitive territory is capable of producing wealth and economic prosperity for its citizens and, at the same time, enhancing the environment, guaranteeing the protection of natural resources and cultural heritage and encourage the joint intervention of different subjects and institutional levels. New experiences in industrial plants planning concretely demonstrate how it is possible to create production plants capable of integrating sustainable principles in planning, design and management phases.

It is well recognized the possibility to pursue (according to principles and sustainability objectives) the competitiveness of the production system through localization choices capable of guaranteeing economic development, environmental protection and the involvement of different public and private subjects. Authors, in accordance to the new Lombardy Region Law (LR 18/2019) on urban regeneration, develop a Planning Support System (PSS) that leads to the study and definition of key elements for the planning of complex production-industrial system. In particular, the logical framework summarizes every steps of the planning process of productive activities on a territory. Moreover, authors present the case study related to the territorial and economic organization of Pavia Province.

Keywords: Planning Support System · Territorial competitiveness · Urban regeneration

1 Introduction

Over the last decades, the theme of territorial development and competitiveness, addressed for a long time exclusively in economic terms [1, 2], has been enriched with new visions and approaches that consider competitiveness as a complex concept, multidimensional and deeply linked to the principles and objectives of sustainable development [3–5]. A competitive territory is capable of producing wealth and economic prosperity for its citizens (economic competitiveness) and, at the same time, enhancing the environment, guaranteeing the protection of natural resources and historical-cultural-anthropological-territorial heritage (environmental competitiveness) and encourage the joint intervention of different subjects and institutional levels (social competitiveness).

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In a territorial context, the presence of an efficient production system can represent a valid possibility to pursue the concept of competitiveness in all its components. Experiences such as the Ecologically Equipped Production Areas [6] concretely demonstrate how it is possible to create production plants capable of integrating sustainable principles in planning, design and management phases. The use of innovative tools aims at promoting economic growth, the reduction of environmental impacts and synergies between institutions, citizens and businesses [7]. The success of these experiences is partly due to the planning process that identifies the complex elements (in socio-economic, infrastructural, environmental systems) that characterize it and that define its predisposition to be the right place of certain productive activities, clarifying its vocation. The analysis of the territory's vocation is a fundamental requirement to guarantee the protection and enhancement of the territory itself and therefore of its competitiveness.

The main scope (location of productive activities) can be analyzed from the general supply and demand law that in territorial meanings may be translated in two points of view: the first as an activity that wants to establish itself in the territory and therefore expresses a demand (What-Where), the latter as a planning process that guides the development of the territory by defining its offer (Where-What). Defined the production activity type and its specific characteristics, the What-Where model allows to identify the most appropriate areas for their location. Otherwise, given a specific area of intervention, the Where-What model allows to highlight the functional vocation to be attributed, taking into account the area peculiarities and the mutual influence with the territorial context [8, 9]. In the planning choices of both models, a plurality of territorial stakeholders contributes (including public administration bureaus, business companies, monitoring agencies, common citizens, labor unions, research centers, etc.). According to a multi-level governance, they work together in order to identify factors, conditions and enhancement actions for the establishment of new production activities.

2 Main Objectives

Nowadays, it is recognized the possibility to pursue (according to sustainable principles) the competitiveness of the production system through localization choices capable of guaranteeing economic development, environmental protection and the involvement of different public and private subjects. In order to guide the planning process and then the design activities of metropolitan area, authors develop a methodology based on a set of tools and techniques, Planning Support System (PSS), which allows focalizing roles and interests of the different involved stakeholders. The presented methodology leads to the study and definition of key elements for the planning of complex production-industrial system. For this purpose, authors develop a partially automatic GIS tool based on the processual method that combines the characteristics and typical elements of a DSS (Decision Support System), a KDDM (Knowledge Discovery Data Mining) and an ES (Expert System) [10, 11].

The logical framework summarizes the planning process of productive activities on a territory in order to pursue the objectives established a priori starting from the reference model (What-Where or Where-What). In particular, the tool supports users

(professionals, administrative staff, and stakeholders) in making decisions, in evaluating the effects (direct and indirect) of actions and in monitoring results.

Authors also present the case study related to the territorial and economic organization of Pavia Province. In particular, it is analyzed: the territorial development with specific reference to some municipal realities; the widespread and specific territorial marketing; the territorial attraction to industrial/productive activities; the definition of new relationships between territorial and economic systems; the urban regeneration of dismissed areas and the definition of optimal scenarios for the regeneration of territorial, economic and social elements.

3 Methodology: Parameters and Analysis Techniques

The PSS, based on an analytical, multidisciplinary and trans-scalar approach of the territory, is divided into logical and coherent steps (punctually described in the next paragraphs):

- Analysis of territory characteristics and GIS tool construction;
- Multicriteria analysis;
- GIS tool query and spatial analysis techniques.

Table 1 summarize the main involved subjects, with specific roles and interests in the different process phases.

Table 1. PSS stakeholder.

Phase	Role	Stakeholder
Analysis of territory characteristics	Collecting data	Administrative bureau (Region, Province, Municipality) Business enterprises Business organization (Confindustria) Labor union Citizen committee Monitoring agencies (ARPA, ASST) Environmental groups Research institutes (University, Technological centers)
	GIS tool development	Professionals

(*continued*)

Table 1. (*continued*)

Phase	Role	Stakeholder
Multicriteria analysis	Qualitative and quantitative criteria definition	Administrative bureau (Region, Province, Municipality) Business enterprises Business organization (Confindustria) Professionals
	Qualitative and quantitative criteria evaluation	Administrative bureau (Region, Province, Municipality) Business enterprises Business organization (Confindustria) Labor union Citizen committee Monitoring agencies (ARPA, ASST) Environmental groups Research institutes (University, Technological centers) Professionals
GIS tool query	Spatial analysis	Professionals

3.1 Analysis of Territory Characteristics and GIS Tool Construction

The territorial analysis aims to provide a general overview of landscape, environmental, anthropogenic and socio-economic assets in the area in order to identify potentialities, fragilities, environmental sensibilities, anthropic pressure and local community needs. Authors start the analysis from the collection of the huge amount of available territorial data [12]. Furthermore, different thematic maps are drawn up (by overlapping shapefiles). They represent synthetic graphic tools showing the current state of affairs of the territory at the different planning scales:

- Infrastructure charter: it is analyzed the existing structure and the potential of territory infrastructures (at national, regional and provincial level) related to railway, main road and intermodal centers;
- Charter of natural and heritage assets and environmental restrictions: the databases of environmental heritage, the plains environmental bases, the Regional Ecological Network (REN), database of municipality plans and protected areas give all the information relating to environmental and landscape elements and sensitivities;
- Charter of the settlement system: it is analyzed the presence of strategic structures as driving force for the economic, cultural and social growth of the territory. These structures often perform as polarization function towards the surrounding areas for

trade, work, leisure, education and health, becoming attracting poles (main production areas, technological centers, research institutes, universities, hospitals, colleges);
- Charter of industrial districts and meta-districts: the system of industrial districts and meta-districts defines the state of manufacturing activities present in a territory, in particular the cluster of companies specialized in a complex production process and the supply chains with high technological potential (Lombardy Region recognizes 16 districts and 6 meta-districts).

3.2 Multicriteria Analysis

In order to evaluate and establish a priority of importance among the different aspects highlighted in the analysis phase, and in order to define the optimal localization of the productive activities' establishment, it is necessary to define qualitative and quantitative indicators.

In particular, the indicators belonging to the infrastructural system assess the efficiency of the local road system, measured in terms of accessibility, travel time, proximity to the main infrastructures (highway, pan-European freight transit corridors). The indicators that belong to the demographic field consider the local population as a source of customers and potential workforce. The economic sector refers to factors capable of attracting industrial settlements such as capital, the price of land and the presence of investments. Lastly, those relating to the environmental system evaluate the ability of the interventions to reduce the impact on the environment by limiting the soil consumption and protecting the areas with the greatest environmental value through adequate physical distance.

For the indicators' assessment, authors use the pairwise comparison matrix (attribution of weight from 1 – equivalence of criteria – to 6 – strong prevalence of one over the other); the weights are added together and normalized, in order to identify the most relevant and to facilitate the ranking. Expert evaluators supported by a group of public-private subjects (Table 1) assign the weights considering their knowledge and the specific needs of the type of industrial activity selected.

3.3 GIS Tool Query and Spatial Analysis Techniques

The final phase of the PSS foresees the graphic representation of the indicators and the spatial analysis allowing the processing of the obtained results, their visualization and the creation of future development scenarios [8, 9]. In particular:

- Querying: it allows making a selection from a group of items;
- Proximity analysis: it allows analyzing the vector objects and their context, identifying areas of spatial influence. It is based on two functions: spatial property selection and buffering. The selection by spatial properties sets a choice based on the spatial relationship with other objects belonging or not to the same layer. Buffering operations create polygons whose perimeter has a constant and determined distance from existing objects;
- Overlay analysis: it allows intersection, union, difference, fade and cut operations between overlapping themes.

4 Case Study: Territorial Attraction for Industrial Activities in Pavia Province

In 2014, the regional law LR 31/2014 [13] introduced new provisions aimed at limiting the consumption of soil and promoting the regeneration of urbanized areas. Since that the soil is a non-renewable resource, the priority objective of reducing soil consumption takes the form of re-directing urban-building transformation activities not on virgin areas but on already urbanized, degraded or dismissed areas, in order to activate an urban renewal and regeneration process. It establishes also that it is a task of Territorial Government Plan – PGT [14] to identify the areas where urban and territorial regeneration processes start. To gain a better urban and territorial regeneration in the regional area, the Regional Territorial Plan intends to systematize transversal policies (territorial planning, economic, social and environmental policies) and activate direct collaboration and co-planning with local administrations (to avoid the fragmentation of interventions). The Regional Territorial Plan intends also to systematize all the policies creating a systemic vision, capable of attracting and directing investment and innovation (respecting the functional vocation and the peculiarities of each contexts).

Lombardy Region, through RL 18/2019 – art.1, pursuing the objective of sustainable development, recognizes the interventions aimed to urban and territorial regeneration, concerning areas (with different dimensions) or buildings, as priority actions to reduce soil consumption, improve functional, environmental and landscape quality of territories and settlements, as well as the socio-economic conditions of the population [15].

The RL 18/2019 brings significant changes to RL 12/2005 and RL 31/2014 by increasing the importance of interventions aimed at urban and territorial regeneration. In particular, in the new art. 4 of LR 12/2005, it defines criteria for the reduction of urbanization costs and the contribution on the construction cost up to 50%. Moreover, it defines also an increasing (up to 50%) of the contribution on the construction cost for interventions that consume agricultural land included or not in the consolidated urban fabric and for logistics or road haulage operations that do not incident on the regeneration areas. It is evident how the law plays an important role as driver of the sustainable development of the territory and pushes private stakeholder to develop targeted urban regeneration actions.

The Province of Pavia has over 4 sq. km of dismissed area (former industrial/productive/storage areas) spread on its territory. The city of Pavia, alone, has over 800.000 sq. m of former disused industrial areas to which must be added the areas that need effective regeneration: for decades, they have represented not only disqualifying urban voids but also areas of strong environmental and social pressure. They represent a reality that is dimensionally and temporally strategic in relation to urban and territorial development: they are actual opportunity for economic and entrepreneurial development.

The basic need is to identify the best location for a mechanical industry with a regional reference market (What-Where model), within the context of Pavia Province.

The main analyzed requirements are:

- Efficient infrastructure system, in particular regional level transport lines (fast-link road network - highways and main roads, railway network);
- Dismissed (industrial) areas, in order to start a regeneration process and to obtain the regional bonus;
- Highly skilled workforce (number of persons – 14–65 years of age – with a specific educational and technical college degree);
- Differentiated and specialized industrial cluster;
- Capital for scientific research in order to struggle competition and bring innovations;
- Availability of raw materials.

Based on these considerations, the specific stakeholders define the qualitative and quantitative parameters (Table 2) and, then, evaluate them.

Table 2. Qualitative and quantitative indicators related to the different fields of interest.

		Medium-long term indicator
Infrastructural system	a	Proximity to the fast link road system Proximity to the nearest motorway exit (5 km sphere of influence)
	b	Proximity to the main road system Proximity to main roads (500 m sphere of influence)
	c	Proximity to railway areas for loading-unloading goods Proximity to the nearest freight yard (1 km sphere of influence)
	d	Proximity to freight sorting and distribution site Proximity to the nearest intermodal pole (5 km sphere of influence)
	e	Proximity to the railway network Proximity (on foot) to the nearest train station (1 km sphere of influence)
Demographic field	f	Potentially customer base Average real-estate price (€/sq. m)
	g	Potential workforce Proximity to technological centers, universities, research institutes (10 km sphere of influence)
Economic sector	h	Real-estate values in the context Average real-estate price (€/sq. m)
	i	Proximity to strategic infrastructures Proximity to technological centers, universities, research institutes (10 km sphere of influence)
	j	Specialized industrial cluster Existence of other similar enterprises within a 15-min isochronous (15 km sphere of influence)
	k	Availability of economic investments and capital Ability to take advantage of capital-financing aimed at localization in certain areas
	l	Availability of resources Proximity to raw materials resources (water, energy, wood, etc.)

(*continued*)

Table 2. (*continued*)

		Medium-long term indicator
Environmental system	m	Distance from protected natural areas Distance from protected natural areas (more than 1 km)
	n	Distance from protected cultural heritage Distance from protected cultural heritage (more than 1 km)
	o	Distance from sensitive structures Distance from health and social care structures (500 m), and school (300 m)
	p	Distance from sensitive urban functions Distance from city center and residential areas (3 km)

Subsequently, authors assess the parameters using the pairwise comparison matrix and then define the classification of the parameters relating to the defined production activity. Due to this type of activity needs, the most relevant parameters concern the proximity to the main roads and fast link road system (a, b); while those who obtained a lower score are related to potential customers and environmental issues (f, m, n, o, p). The remaining parameters (g, i, j, k) and (c, d, e, h, l) obtained an average and sufficient evaluation respectively.

At the same time, experts build the GIS tool through the union of different thematic maps, representative of the territory (Table 3).

Table 3. Main data used to create the territory representation and to make the spatial analysis.

Thematic maps	Data type
Infrastructure charter	Railway network, road network (main and secondary), motorway exit, railway station, railway freight yard, intermodal, bridges
Protected cultural heritage and natural sites	General beauties, individual beauties, areas of particular environmental interest, rivers, streams, public waterways and their banks, Po river embankment area, natural monuments, local parks, natural parks, regional-national parks, SCI (Sites of Community Importance), Special Protection Areas (SPAs), active springs, relevance items protected by law 1089/39 (now Legislative Decree 22 January 2004, n° 42), primary ecological corridors REN, first level REN areas, second level REN areas
Settlement system charter	Dismissed areas, industrial-production area
Industrial districts and meta-districts charter	Industrial districts and meta-districts

The GIS assessment phase involves the use of different spatial analysis techniques: the buffering technique for displaying the parameters defined by creating specific sphere of influence (buffer) and the intersection between dismissed areas and industrial-

production areas (existing and planned) and different systems buffers. Specifically, for the infrastructure and economic system, the intersection has a positive value; for the environmental system, negative. For the demographic system, there are problems in the visualization of data as these are obtained only from statistical processing (Istat) with no available shapefile. In particular, Table 4 shows the information related to the data availability and the possibility of displaying it in GIS environment.

Table 4. Data availability and data visualization on GIS tool.

		Medium-long term indicator	Data availability	Visualization on GIS tool
Infrastructural system	a	Proximity to the fast link road system	X	X
	b	Proximity to the main road system	X	X
	c	Proximity to railway areas for loading-unloading goods	X	X
	d	Proximity to freight sorting and distribution site	X	X
	e	Proximity to the railway network	X	X
Demographic field	f	Potentially customer base	X	–
	g	Potential workforce	X	–
Economic sector	h	Real-estate values in the context	X	–
	i	Proximity to strategic infrastructures	X	X
	j	Specialized industrial cluster	–	–
	k	Availability of economic investments and capital	–	–
	l	Availability of resources	–	–
Environmental system	m	Distance from protected natural areas	X	X
	n	Distance from protected cultural heritage	X	X
	o	Distance from sensitive structures	X	X
	p	Distance from sensitive urban functions	X	X

5 Results

The 2 selected territorial contexts in Pavia Province (Pavia, Broni-Stradella) are analyzed below, considering:

- Infrastructural system;
- Environmental system: green landscape and cultural heritage [16];
- Settlement system: sensitive facilities to noise, car traffic, and air-water pollution;
- Economic system.

5.1 Infrastructural System

The intersection between the brownfield/production areas and the buffers of the infrastructural system identifies the best location of the production activity (Figs. 1 and 2).

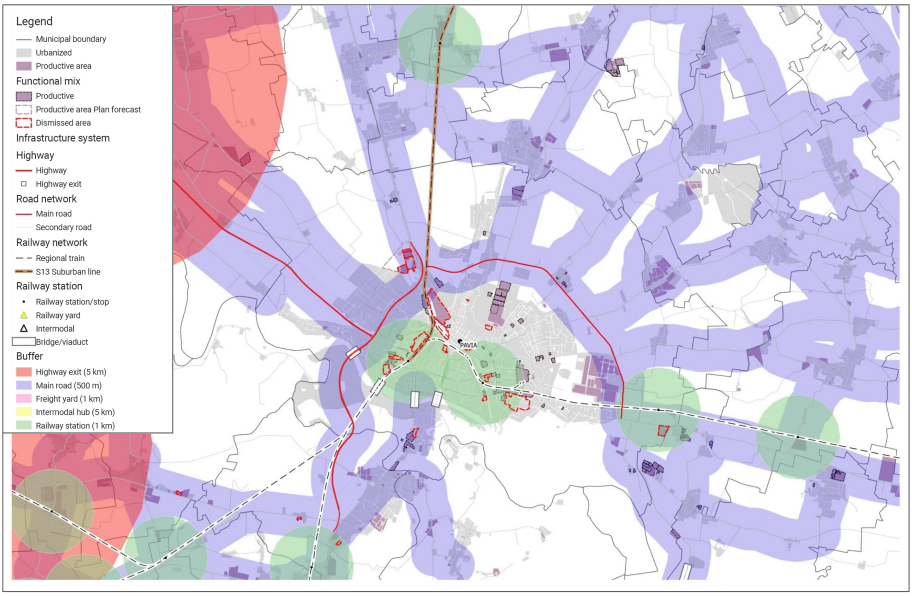

Fig. 1. Pavia infrastructural system analysis, scale 1:50.000.

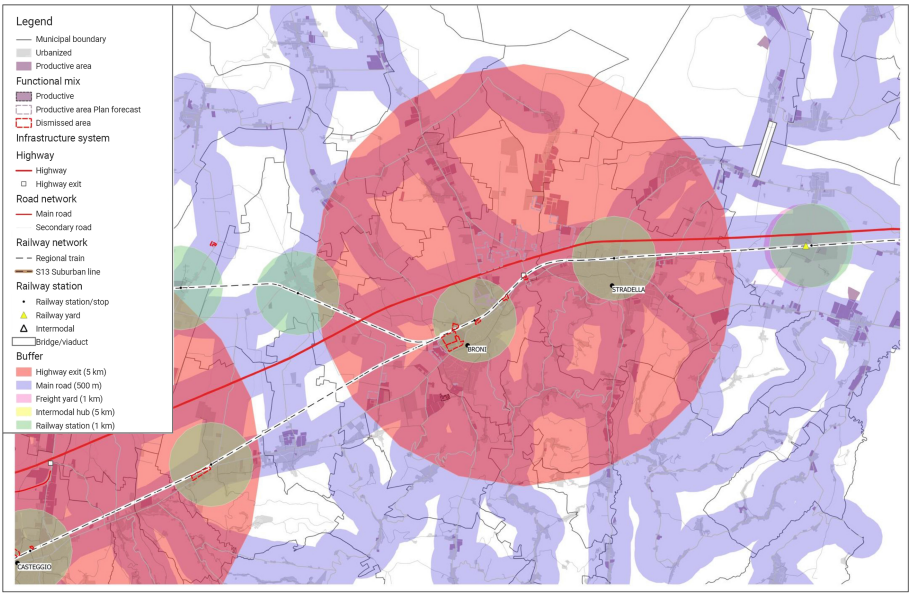

Fig. 2. Broni-Stradella infrastructural system analysis, scale 1:50.000.

5.2 Environmental System

The difference between the brownfield/production areas and the buffers of the environmental system identifies the best location of the production activity (Figs. 3, 4, 5 and 6).

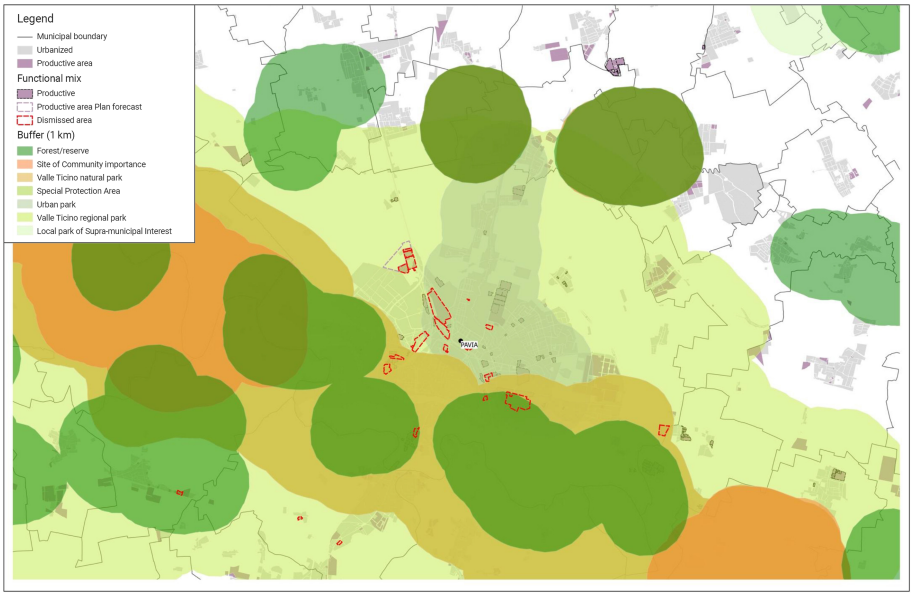

Fig. 3. Pavia environmental system analysis, scale 1:50.000.

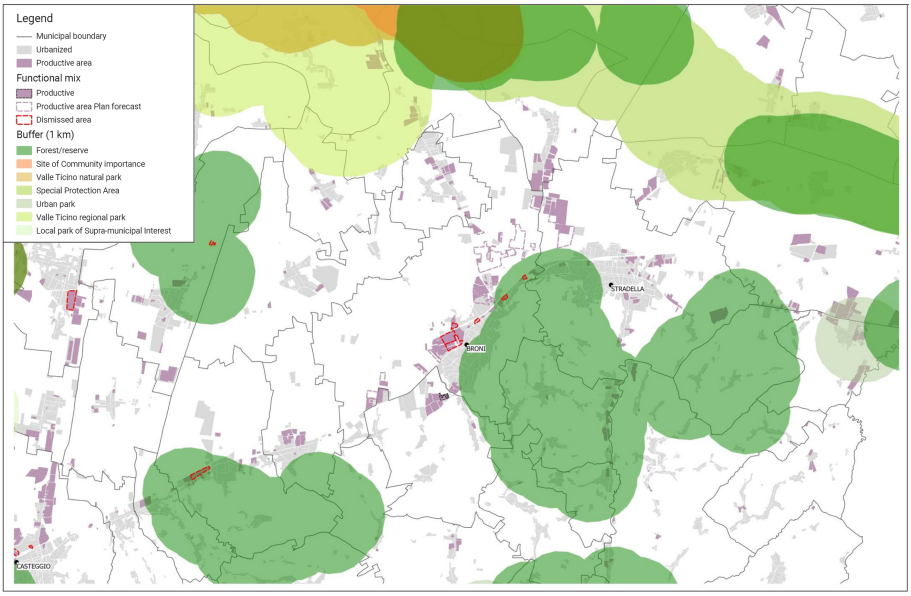

Fig. 4. Broni-Stradella environmental system analysis, scale 1:50.000.

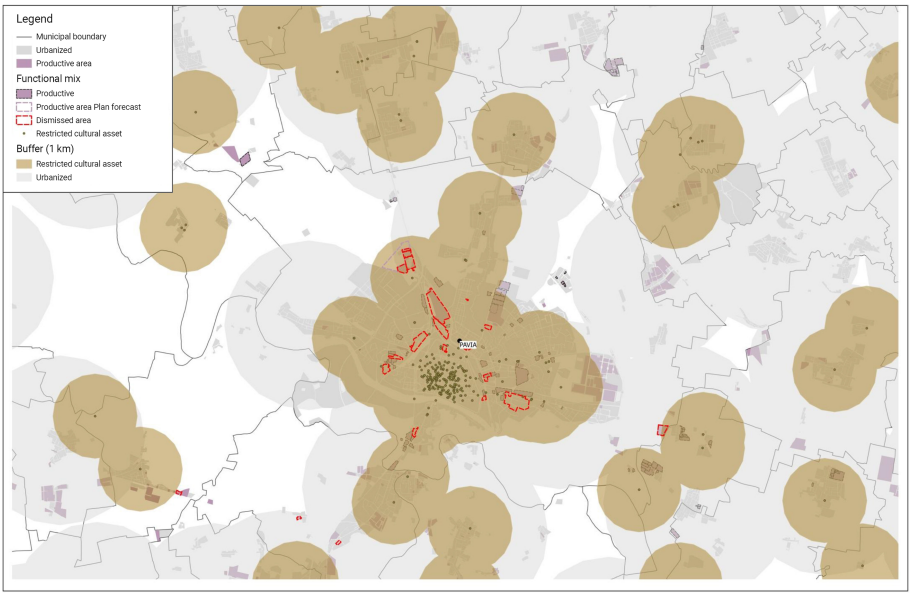

Fig. 5. Pavia cultural heritage analysis, scale 1:50.000.

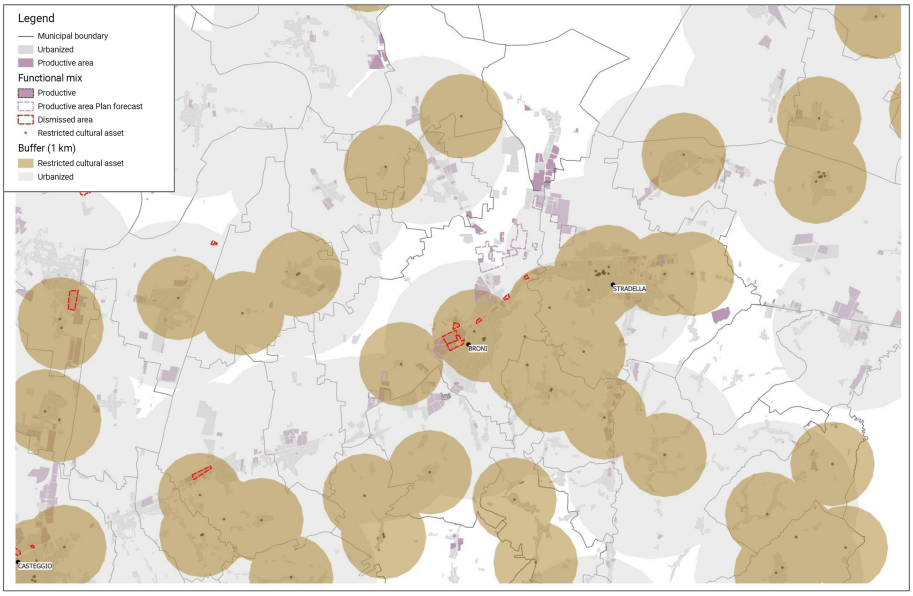

Fig. 6. Broni-Stradella cultural heritage analysis, scale 1:50.000.

5.3 Settlement System

The difference between the brownfield/production areas and the buffers of the sensitive facilities identifies the best location of the production activity (Figs. 7 and 8).



Fig. 7. Pavia settlement system analysis, scale 1:50.000.

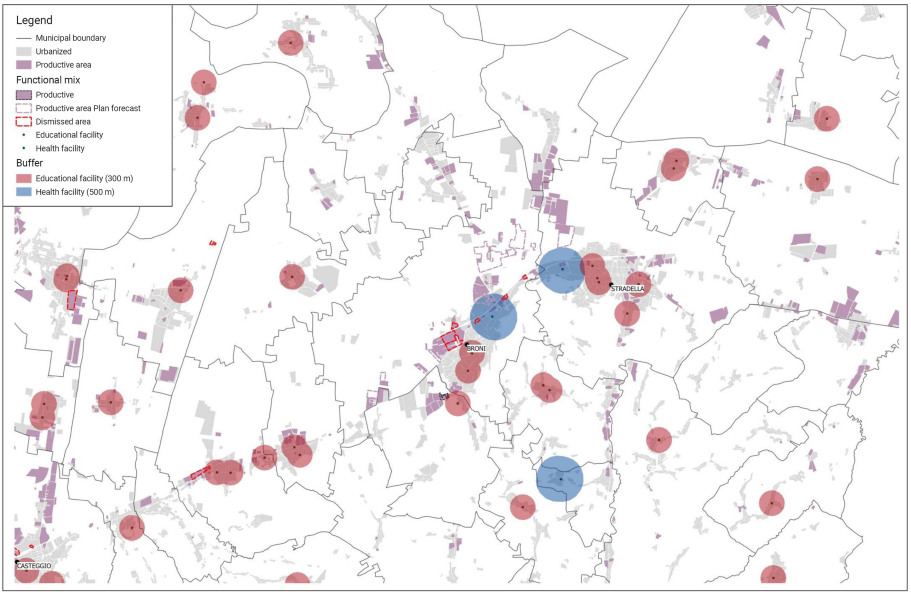

Fig. 8. Broni-Stradella settlement system analysis, scale 1:50.000.

5.4 Economic System

The intersection between the brownfield/production areas and the buffers of the economic system identifies the best location of the production activity (Fig. 9).

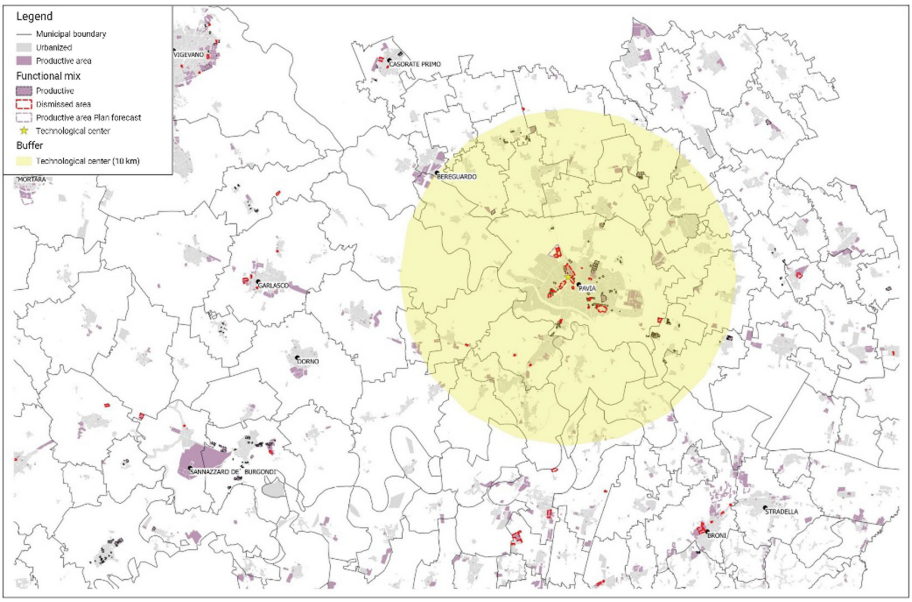

Fig. 9. Economic system analysis, scale 1:125.000.

5.5 Final Localization Ranking

The final step is the attribution of a different color to the intersections created: considering the relevance of each parameter, authors define a chromatic scale (from the darkest blue to the lightest blue) at the various localization levels (Fig. 12–14). In particular, the optimal, good, discrete and insufficient localization is obtained as an intersection between abandoned areas and industrial-productive areas (existing and planned) and the buffers relating respectively to parameters (a, b), (g, i, j, k), (c, d, e, h, l) and (f, m, n, o, p) (Figs. 10 and 11).

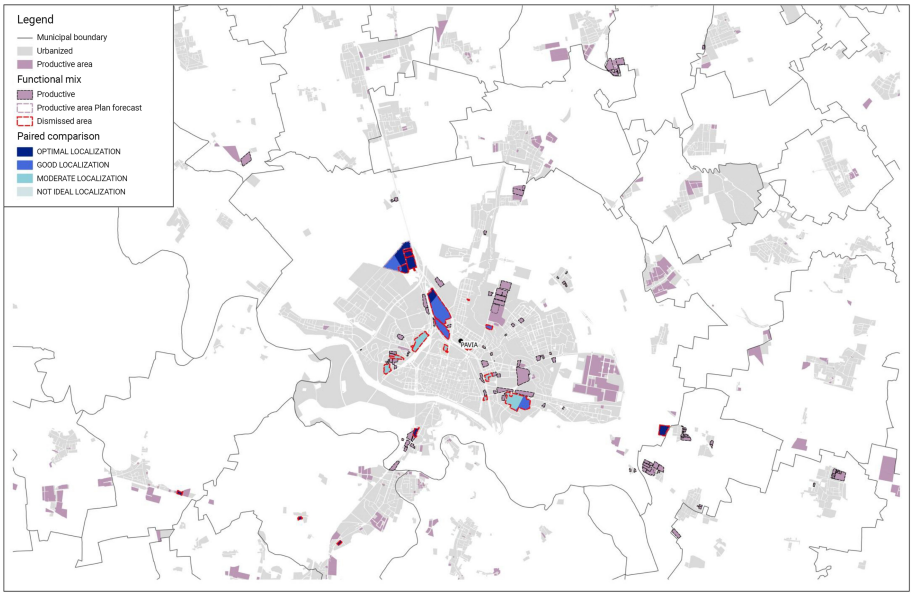

Fig. 10. Pavia area localization ranking, scale 1:50.000.

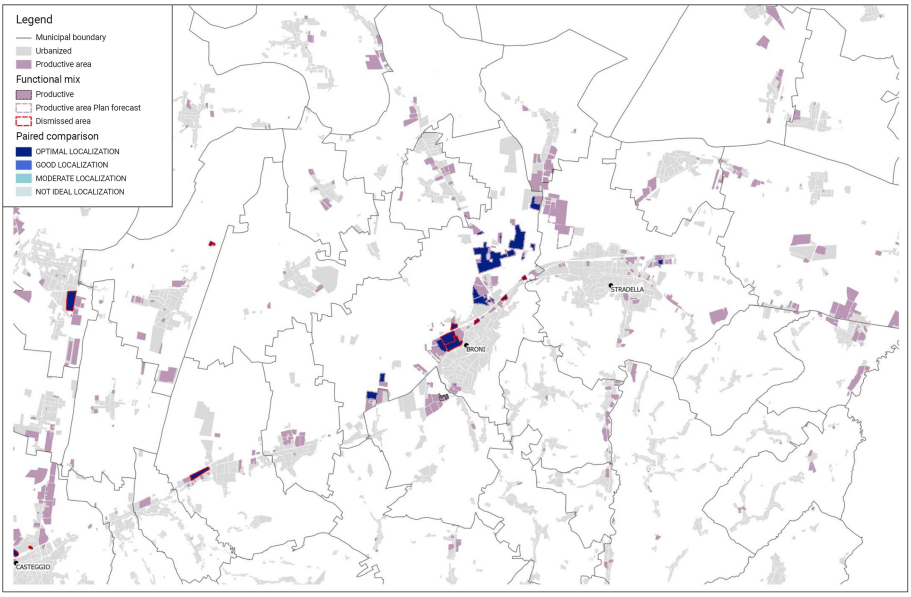

Fig. 11. Broni-Stradella area localization ranking, scale 1:50.000.

6 Conclusions

Each planning activity can be seen as an interactive and iterative process applied to the complex system in which it is not always easy to define the relationships that exist among the different elements and therefore the correct set of procedures to develop at a single decision-making process. In particular, in the territorial planning of industrial settlements it becomes fundamental to consider a set of factors that define the main peculiarities of these areas, the organization of which must facilitate, economically and technically, the individual business companies established.

The presented PSS represents contains tools and techniques suitable to help all the subjects involved in the production sites planning process. In particular, the stakeholders coordinated intervention to define the correct localization strategies allows determining the needs (socio-economic and environmental) of a specific territory by sharing knowledge and interests and by guaranteeing the protection and enhancement of the territory itself hence its competitiveness.

The critical issues found in the presented application case (above all the lack of updated spatial shape-form data availability) make necessary to strengthen these relationships among the subjects (public and private) in order to improve the efficiency of the tool and therefore of the entire planning process.

References

1. Porter, M.E.: The Competitive Advantage of Nations. Macmillan, Londra (1990)
2. Storper, M.: Competitiveness policy options: the tecnologicy-regions connection. Growth Change **26**, 285–308 (1995)
3. Kitson, M., Martin, R., Tyler, P.: Regional Competitiveness: an Elusive yet Key Concept? Reg. Stud. **38**(9), 991–999 (2004)
4. Ciciotti, E., Dallara, A., Rizzi, P.: Una geografia della sostenibilità dei sistemi locali italiani. In: XXVII Conferenza di Scienze Regionali (2006)
5. Gemmiti, R: Competitività territoriale in sostenibilità. L'interpretazione alla base della ricerca. In: Prezioso, M., Bencardino, F. (eds.) Competitività in sostenibilità: la dimensione territoriale nell'attuazione dei processi di Lisbona/Gothenburg nelle regioni e nelle province italiane. Geotema, Special Issue, pp. 31–32 (2007)
6. Borsari, L., Stacchini, V. (eds.): Linee guida per la realizzazione delle Aree produttive Ecologicamente Attrezzate della provincia di Bologna (2006)
7. Conticelli, E., Tondelli, S.: La pianificazione delle aree produttive per lo sviluppo sostenibile del territorio. Alinea, Firenze (2009)
8. Cattaneo, T., De Lotto, R., Venco, E.M.: Functional reuse and intensification of rural-urban context: rural architectural urbanism. Int. J. Agric. Environ. Inf. Syst. **7**(1), 1–27 (2016)
9. Cattaneo, T., De Lotto, R., Venco, E.M.: Methodology and applications for rurban sustainable development. In: Mastorakis, N.E., Corbi, O., Corbi, I. (eds.) Environmental and Agricultural Science, Atti della IV Conferenza Internazionale Energia, Ambiente, Imprese e Innovazione (ICESEEI15), pp. 111–120. WSEAS Press, Dubai (2015)
10. Densham, P.: Spatial Decision Support Systems. In: Maguire, D.J., Goodchild, M.F., Rhind, D.W. (eds.) Geographical Information Systems: Principles and Applications, pp. 403–412. John Wiley and Sons, New York (1991)

11. Brail, R.K.: Planning Support Systems for Cities and Regions. Lincoln Institute of Land Policy, Cambridge (2008)
12. Regione Lombardia, Geoportale della Lombardia. http://www.geoportale.regione.lombardia.it. Accessed 11 Feb 2020
13. Legge Regionale 28 novembre 2014, n. 31 Disposizioni per la riduzione del consumo di suolo e la riqualificazione del suolo degradato
14. Legge Regionale 11 marzo 2005, n. 12 Legge per il Governo del Territorio
15. Legge Regionale 26 novembre 2019, n. 18 Misure di semplificazione e incentivazione per la rigenerazione urbana e territoriale, nonché per il recupero del patrimonio edilizio esistente. Modifiche e integrazioni alla legge regionale 11 marzo 2005, n. 12 (Legge per il governo del territorio) e ad altre leggi regionali (BURL n. 48, suppl. del 29 Novembre 2019)
16. Decreto Legislativo 22 gennaio 2004, n. 42 Codice dei beni culturali e del paesaggio