'Imma summis mutare': landscape of light and shadow in the heart of the city –'Porta Susa' Railway Station, Turin

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Abstract

The construction of the 'New Passengers Building of *Porta Susa'* in Turin, is the last act of a complex infrastructural, territorial, and urban plan that started in Turin in the second half of the 20th century. The succession of urban plans – technological, scientific implementation, and reorganization – is the scenery over which the will and innovative capacity of the city are projected. The dialogue between urban needs and functional reasons for the infrastructure are the basis and the objective of a many-decades-long project. The construction of an extraordinary 'technological *velarium*' is a simple and efficient idea: inundating the depth of a technological underground with light to make the route surface and the enclosed space an integral part of the public space. In its relational complexity, the station reestablishes and restores the break caused by the railway tracks and reconciles parts of the city divided by insurmountable barriers. Natural light, energy, collective, sustainable, and smart mobility are the keywords of a new urbanity that births and regenerates in the arriving and departing places.

Keywords: railway station/link, urban regeneration, intermodal transport systems, economic and social impact, sustainable mobility, energy and transport, bicycle, and pedestrian issues.

1 Introduction

This study is part of a broader research on the dynamics and elements that determine regenerative planning of urban fabrics across Europe. In the late 1990s when projects were banned, the big building projects to create mobility – traditionally attractors of flows but also of potential social conflicts – were

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proposed as solutions for the recovery of entire urban areas. The case study in question – the 'New Passengers Building' of *Porta Susa* in Turin – which is almost functionally complete, is an opportunity to understand how new urban polarities get established and flourish.

2 Study scope

The scope of this paper, which is part of a broader research, is to highlight the modalities with which an architectonic work for functional and size reasons (definable at a territorial scale) can determine the success or decline of entire urban sectors. We also intend to verify what role the 'New Railway Station of *Porta Susa*' can take as a social, economic activator in the current scenario, characterized by a strong recession and widespread impoverishment of the business fabric. A political 'node' for railway transport, in the crucial moment when high-speed rail is a technological option, is one of the strategic factors in the construction of developmental processes of cities with an old industrial layout. The urban and technological events that accompanied the construction of the 'New Passengers Building' of '*Torino – Porta Susa'* can be defined in hindsight as an interesting case of planning resilience. Indeed, all the phases and models of the adaptive development of the urban structure of Turin cross in the evolutionary context of the Italian and European transport network.

The evaluation of the regenerative effects produced, or that are being produced, in the metropolitan area of Turin can be compared to the complex events involving the high capacity *New Line Turin-Lyon* (NLTL), a section of the trans-European railway, *Priority Project 6* (Lyon-Trieste-Budapest-Ukraine border), which is part of the *Trans-European Networks – Transport* (Luxembourg Publ. Office of EU, 2010). The case in question is one of the infrequent opportunities we have to monitor a highly innovative infrastructural intervention in a recessive economic context. Such observations are even more interesting when considered in the context of a process that has been highly criticised since its preliminary planning, due to intense and growing social conflict ('*NO TAV'* – No to the High Speed Train – movements) on the Italian Alpine side, because of this intervention. Such a phenomenon was produced despite such a climate of broad-based government and economic interventions, and a convergence of objectives and benefits induced in the context of the national and European transport system [1].

2.1 Railway mobility: solutions and a generation of conflicts

In the Turin case-study, management of the whole work is set in a context of deep cultural opinions at a global level where the use of individual and mass smart mobility have to be both efficient and fully sustainable in both environmental and social economic terms. A revolutionary in the analysis of the limits of development was Turin-born Aurelio Peccei (1908–1984). In 1972, a year before the outbreak of the 'energy crisis' [2], he had circulated in Italy the

considerations and reflections of the so-called Meadows Report [3] anticipating the cultural battle between 'innovators' and 'conservatives'.

Contrary to what happened with the urban infrastructure, which was respectful of the requests of the citizenry, the advancement of the extra-urban railway line (Turin-Lyon) in the internal pocket of the *Susa valley*, can be defined as an example of missed or late planning *resilience*. During the years that preceded and accompanied the work project, a process of growing environmental sensitivity and of civic participation in the territorial layout had been evident.

However, such maturation was not accompanied by the same capability to listen and interpret people's requests by the local government and the technicians involved. The more and more complex political and economic context and the erroneous evaluation of the cost-profit analysis deeply weighed on the fate of the *High Speed (HS)/High Capacity (HC) railway*, highlighting how the actions of oligarchic politics have negative effects both in economic and development terms.

Figure 1: Schematic view of existing (black) and planned (blue) Turin-Lyon rail-way link (Italian ad international tracks) [4].

Therefore, the increase in costs of the project cause the damages of 'cogent conditions', which are difficult to compute and are linked to serious technical and environmental issues of an undertaking that is almost entirely underground and to the inevitable subsequent uneasiness of local citizens.

Social tensions generated are such that they affect the local/national cohesion. They also confront the need to discuss arrangements with the European Union and transnational agreements with France. Similar Italian and European projects recently completed (new Lötschberg Base Tunnel, Switzerland, 2007) highlight how an adequate accompaniment and information process are fundamental to avoid the rise of the '"Not In My Backyard" (NIMBY) effect', even by overcoming and rethinking the rigidities imposed by the decision-making process [5].

In the case-study in question, the high-speed station of *Porta Susa*, we intend to carry out a first *'ex-post'* evaluation on the effects that the work imprinted on the urban fabric and verify what objectives it achieved, as well as the unresolved dimensions as of today. In particular, we intend to verify whether, in the context of environmental sustainability, the project layouts are focused and corrected according to smart perspectives, i.e. flexible and modifiable in all the phases of the project without missing or reducing the objectives and, most of all, without substantial cost increases.

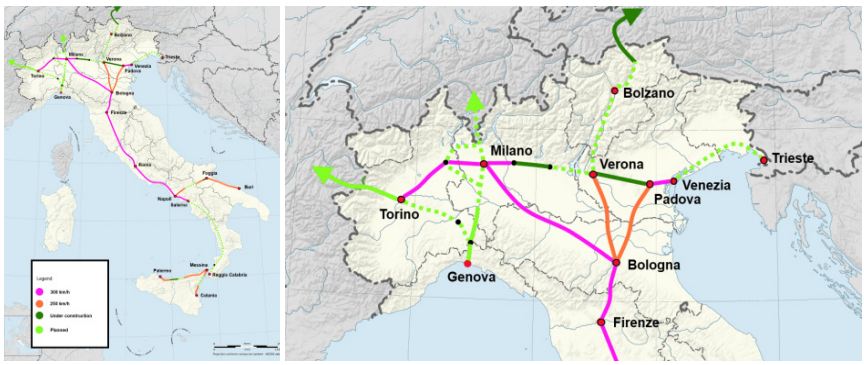


Figure 2: HS-HC railway lines in Italy (2012) [6].

3 Historic-urban evolution

3.1 (1844–1900): Turin in the evolution of the Italian railway line

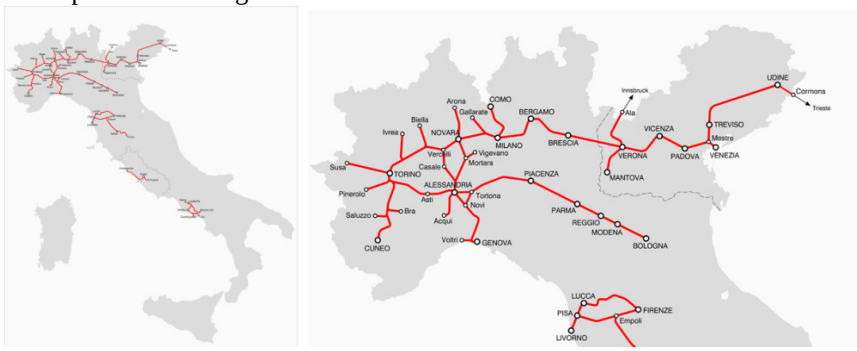
Turin, the historic capital city of the Kingdom of Sardinia (1720–1861) and then of the unified Italy (1861–1870), boasts and shares together with Naples, Genoa, and Milan, the oldest and most consolidated tradition in industrial production as well as technological and scientific elaboration [7]. The entrepreneurial, private, and public long view saw an extraordinary development in the Piedmontese railway lines during the years 1844 to 1853 (Turin-Genoa), linking Turin to the Swiss, French, and Austrian-German railways in 1859. The decade 1861 to 1871 – the year the national capital city transferred to Rome – showed an impressive increase in railway lines across the Peninsula.

3.2 (1905–1928): railway lines in the urban and logistic layout of Turin

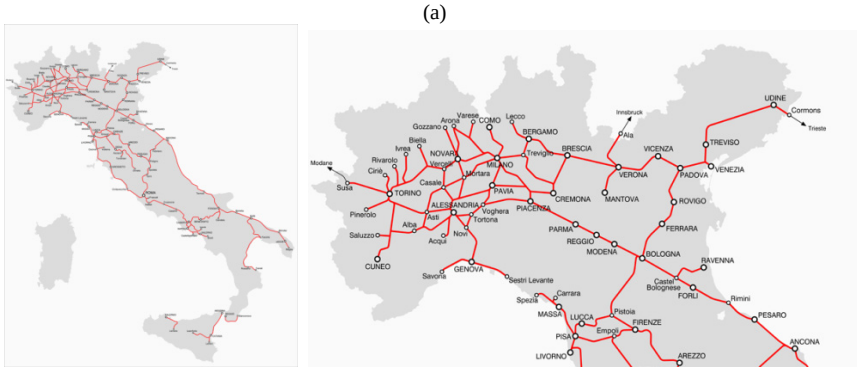
The achievement of railway links was pivotal in the development of the area around Turin from the second half of 1800. The two strategic lines, one north terminating at *'Porta Susa'* corresponding with the historic part of the city, and one south terminating at *'Porta Nuova'*, were connected only at the end of 1800.

Yet the opportunity to transfer the central station to *'Porta Susa'* was missed, despite intense debate involving the city.

The indecisiveness remained for almost half a century that a central station at *'Porta Nuova'*, a link from north to south, and to the west a route towards France, would cost too much in urban terms, limiting and constraining its development for a long time.



(a)



(b)

Figure 3: (a) The railway network of the Piedmont State and of the Italian States when the Kingdom of Italy was proclaimed (17 March 1861) and (b) in 1871 [8].

3.3 Engineering work to lower the railway track grade (*'Abbassamento del piano del ferro'*)

This project was designed in 1905 and partially carried out between 1911 and 1928. Its aim was to eliminate at-grade intersections since the railway line at grade with the road level had caused serious problems with circulation. The engineering work lowered the tracks of the main lines (towards Genoa, France, and Milan) into a trench by 7 metres over 4 kilometres in their urban tracts [respectively: a) the 'Turin-Genoa' railway line; b) the Modane railway line (alpine pass with France); c) 'Torino Smistamento'; d) 'La Grangia' fork; e) 'Porta Nuova'; f) 'Quadrivio Zappata'; g) the Milan-Turin railway line]. The work was completed with the construction of three road flyovers (above Corso Dante, Bramante, and Sommeiller).

The intervention requalified new areas (*Borgo San Paolo* and *Borgo Dora*) for a subsequent land revaluation for speculative aims and improved road connections with the new city centre. The operation increased the load and rank of the urban system flows constituted by the historic *Piazza Castello* and connected to *Porta Nuova* station through the monumental axis of *Via Roma* (previously *'Contrada Nuova'*), according to the 'innovative' acceptance of the fascist planning [9]. The ambitious plan was discontinued in 1928 due to different orientations in national politics regarding transportation. Despite its importance, the lowering of the railway line grade at *'Porta Susa'* station and in the connection stretch with Dora station was finally set aside.

3.4 (1928–1944): the decline of urban infrastructures

At the end of the 1920s, investments allocated to improvement interventions in the urban fabric were drastically reduced due to the regimen's hostility towards the ex-dynastic capital city, which had become a theatre of violent political antagonism [10]. However, the progressive policy of interweaving political and economic interests by the founder of FIAT, *senator* Giovanni Agnelli (1866–1945), and Benito Mussolini, the new arbiter of Italian national politics, fostered a private inclination towards the construction of railway tracks for industrial use to directly connect the '*FIAT Mirafiori'* plant and the *'Lingotto* station'. The new lines totally disregarded Turin's urban layout and were built at road grade.

3.5 (1944–1956): first generation urban plans

Crossing the city via the north-south axis has always been easy, thanks to the railway lines, unlike the roads [11]. For this reason, after the stagnation of the 1930s and 1940s, a new season of reforms started. In 1956 the new city plan (*'Plan G. Rigotti'*) was put into effect based on the never-realised *'Astengo Project'* (1944–1946), which foresaw the doubling of the population, the expulsion of industrial estates from built-up areas, the construction of the hill and of an office district next to the historic city centre. The new infrastructure doubled the urban railway track complete with flyovers with a 3.5-meter clearance.

3.6 (1986–1995): a new urban concept: the 'Central Spine' project

The hypothesis of an integral underground railway and the utilization of the excavated soil for road layouts would be improved and would become operative with the General City Plan (1995) drafted by the Gregotti-Cagnardi-Cerri firm from Milan. Yet, it would be only at the end of the 1990s that the *'Central Spine'* [*'Spina Centrale'*] (1988) started – new tree-lined backbones able to improve road conditions and revitalize conterminous areas. The ambitious project is still in progress, despite it slowing down for financial reasons in the segments *'Spine Three'* [*'Spina Tre'*] and *'Spine Four'* [*'Spina Quattro'*] [12].

The plan allowed for reorganisation of the urban and extra-urban railway line layout. In countertrend to last century, the role of the central public transport

station in Turin was taken by *'Porta Susa'*, which is 500 metres farther south than the original building. In this perspective, the monumental station of *'Porta Nuova'* was significantly resized and formally debased through outsourcing interventions. The two stations are now connected both by the railway line and by Line 1 of the underground.

3.7 The strategic plan of Turin

The strategic plan for the promotion of the city was the first one in Italy, begun in 1998 and published in February 2000. It was the outcome of a complex analysis to anticipate the vision for the future of Turin.

The proposal, drafted by an interdisciplinary group and coordinated by the economist Bagnasco [13], comprised of six strategic lines, twenty objectives, and eighty-four actions, supplied with precise determination, which defined its usefulness and practicality.

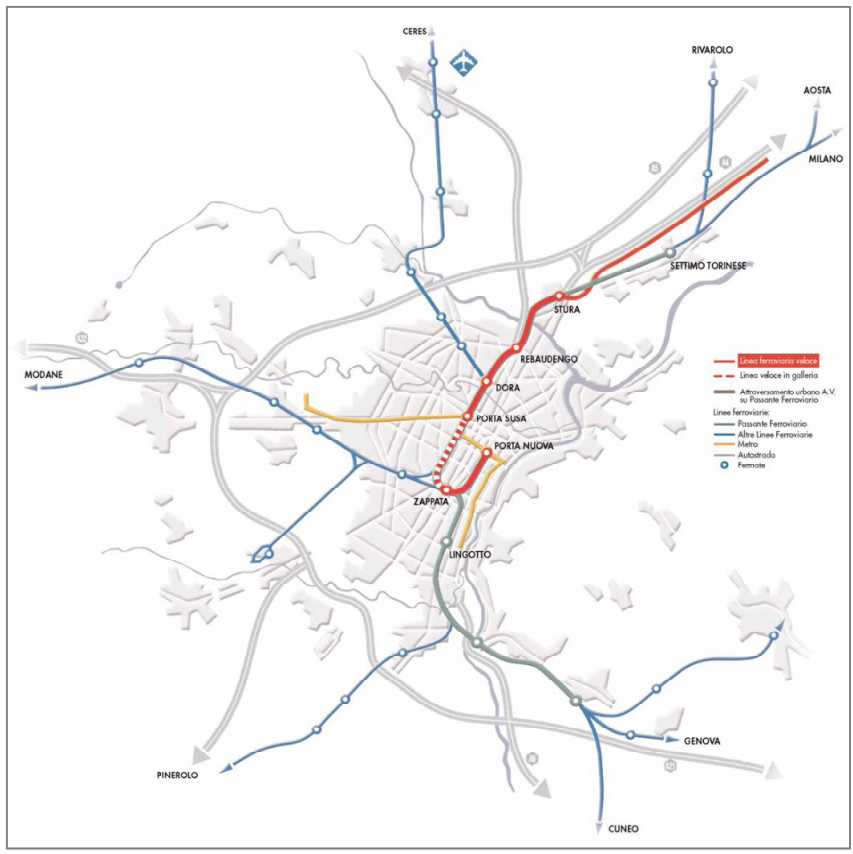


Figure 4: Map of the railway link and Turin's railway hub.

The result defined the city layout in context of urban renewal in occasion of the designation of Turin as host city of the *20th Olympic Games* [14]. In the transformations that affected the city, the plan acted as a tool to promote the growth of the metropolitan area in the new international context. The proposals of strategic renewal, articulated on several intervention scales (global, regional, local), outlined the image of a European metropolis where diversification is the cornerstone of development, an 'ingenious city of the making and the knowing how to make it'.

3.8 2006: the Olympic City, stage of the industrial post-modernism

The 20th Winter Olympic Games (2006) put the city's long renewal process under the evaluation of international criticism. It was on this occasion that the municipal administration achieved important infrastructural improvement interventions, the opening of the underground among them, after decades of waiting, which was certainly one of the most meaningful events. Turin didn't arrive unprepared to this important event: in the past two decades, the city had faced an important rethinking of the urban culture and economic models, which followed the energy crisis of 1974.

The 1980s and 1990s marked the recovery of the historic city centre and of the majority of the monumental heritage, thanks to the beginning of a general regeneration process of the environmental and urban heritage. At the end of the 1990s, the refurbishment of the road and infrastructural axis continued with the completion of 'Spine Two'.

During the same years, the building site of 'Spine Three and Four' had started, rightfully admitting Turin into the European plan for the development and modernization of the High Speed/High Capacity railway line.

3.9 The railway link

The railway link was completed in November 2012 and includes the railway lines that cross the city from *'Stura'* station to *'Lingotto'* station and that refer to the reorganisation and development programme of Turin's railway hub.

The objective of the interventions was aimed at: *a)* including Turin in the European High Speed programme; *b)* increasing the quality of regional and national railway connections; *c)* carrying out a new integrated system of regional, metropolitan public transport; *d)* reconnecting the parts of the city separated by the railway by entrenching the tracks according to the General City Plan; *e)* enhancing the railway lines by doubling the tracks.

The railway link remarkably increased the traffic of Turin's hub and relieved the flow of the national network. It allowed the convergence on this axis of different railway modalities: the Italian and international high speed trains with regional and metropolitan traffic.

The length of the railway line (from Lingotto to Stura) is 112 km long. The maximum entrenchment at street level reaches -18 metres in the area of Zappata and Doria stations. The cover of railway trenches sums up to 260,000 square metres with open digging area of 2,000,000 square metres s.

The system is composed of seven stations in the urban area (Lingotto, Zappata, Susa, Porta Nuova, Dora, Rebaudengo, Stura.

The engineering work made it necessary to redefine the different depth levels of the railway lines in transit, and sometimes to build *ex novo* the junctions between levels, thus completing the City Plan of 1995.

Covering the trenches and carrying out construction of the first of the big boulevards (*'Central Spine'*), reconnecting industrial estates in disuse along the railway line, was one of the most ambitious interventions of urban regeneration achieved in Italy after WW2.

3.10 The railway hub in Turin

The envisaged model of the link project was achieved with construction of the so-called *'Stura-Lingotto'* cross-platform interchange stations' (*'attestamento incrociato 'Stura-Lingotto'*), i.e. express trains coming from the south (Genoa) terminating at Stura station, and likewise, express trains coming from Milan terminating at Lingotto station; local trains connecting *'Stura'* and *'Lingotto'*, offering a service similar to underground trains.

The doubling of tracks was completed between the '*Porta Susa'* and *Stura* stations, the most critical part of the line.

Thus, Stura and Lingotto stations now have a particular role because they have become gateways between railway/suburban lines and the system of internal stations (*'Rebaudengo', 'Dora', 'Zappata'*), and between private and public transport.

The result of the engineering work is that *Porta Susa* is now Turin's central station and a transport hub with Line 1 of Turin's underground.

3.11 (1999–2012): urban and infrastructural layout interventions

The realisation of the railway link was subdivided into three lots: the first one (from *Lingotto* station to Corso Vittorio Emanuele II) was completed between 1999 and 2005 with the covering of the railway trenches and the superficial interventions of the boulevard.

The '*Spine 1'* area focussed on the superficial intervention of the so-called *'Quadrivio Zappata'* [*'Quadrivium Zappata'*] (designer A. Cagnardi – City of Turin, 2005) with the creation of a large public park, covered car parks, and a service/community centre with leisure/sports and cultural facilities.

The construction site for the superficial interventions of the boulevard was in the area where the enlargement of the technological campus of Polytechnics (*'Cittadella Politecnica'*) would be carried out, near Corso Castelfidardo.

The second lot (2000–2012) concerned the area of the railway link between Corso Vittorio Emanuele II and Corso Grosseto (south of the river Stura).

3.12 The completion of 'Spine 2' and the reconstruction of 'Porta Susa'

The project for the new *'Porta Susa'* Station is part of the transformation of the Spine 2 area. The reconnection of the two parts of the city that were divided by

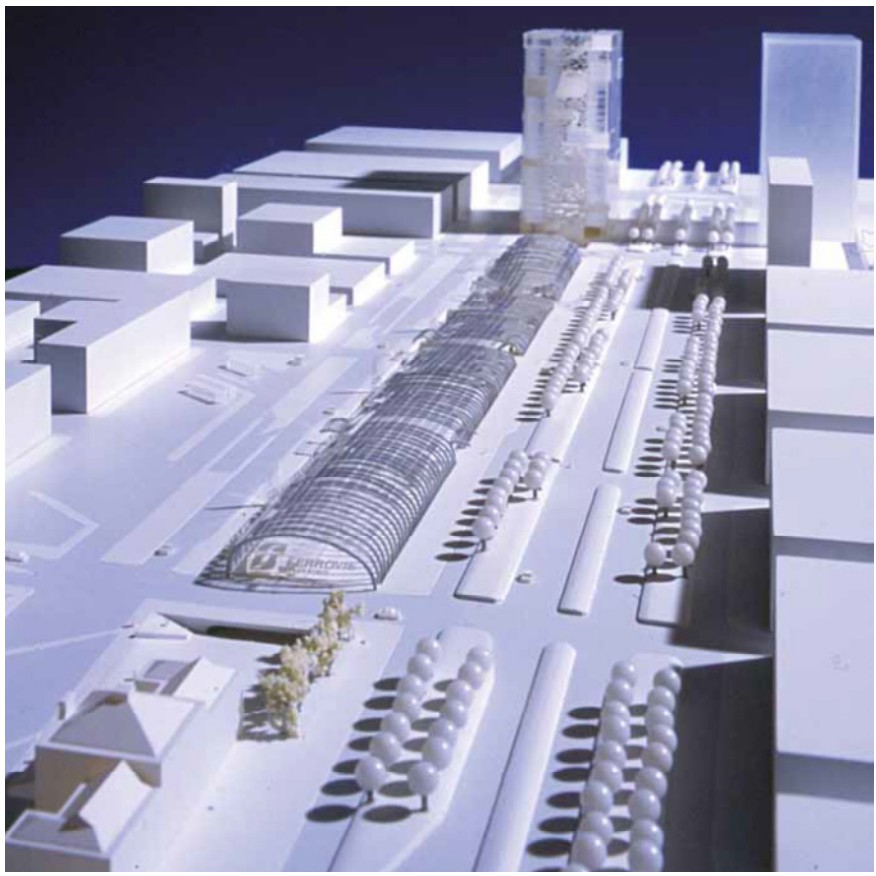


Figure 5: Scale model of the winning project [Motto: *"Ima summis mutare"*] by AREP-Paris, S. D'Ascia, A. Magnaghi (2006).

the railway started with the demolition of the steel railway gangway that connected Piazza XVIII Dicembre to Corso Inghilterra (2003) and with the entrenching and covering of tracks. In the same year, the variation under the Dora river *('Variante Sotto-Dora'*) between Corso Principe Oddone and the *'Dora'* Station was also begun. This modification was necessary to improve the urban and environmental integration of the railway entrenchment with the overlooking buildings. The third lot construction between Corso Grosseto and *Stura Station* was completed in 1989. The railway line has offered a regular service since then. The six stations along the railway link (*Lingotto, Zappata, Porta Susa, Dora, Rebaudengo,* and *Stura*) are now the main accesses to the railway services in the metropolitan area.

The requalified *'Lingotto'* area became the terminus of the underground during the *XX Winter Olympic Games*. The underground Dora station is part of the urban regenerations and transformations of '*Spine 3*'.

3.13 Intermodal transport systems

The construction of intermodal exchange car parks is anticipated at the stations of 'Lingotto' and '*Stura'*. The connection between '*Caselle'* airport at *'Rebaudengo'* station allows one to reach the air terminal from the city centre without changing trains. '*Stura'* station is the most important intermodal exchange hub, connected to the car park near the Turin-Milan motorway junction and to Line 4 of the underground.

3.14 2001–2012: the new station of Porta Susa

In December 2012 the new station of Porta Susa replaced the modest preexisting building from the 1800s. An international contest was funded by the Italian State Railways together with the City of Turin and 'Satti', Turin's Public Transport Company (now called GTT).

The competition occurred in two phases. In the first one (4th October 2001) the international panel selected seven joint winner projects among 54 participants [Respectively: IAW Int. Arch. Werkstatt Gbr, (D); Tecnosistem spa, (I); Arch. M. Zanon (I); Atelier d'Architecture Paczowski and Fritsch; Turner and Townsend Group Ltd (UK); AREP Paris (F)] and Prof A Magnaghi (I); Ing L Gambogi (I)].

The second phase (March 2002) concluded with the announcement of the winning project Motto: "Torino-Ima Summis" presented by AREP Paris [Jean Marie Duthilleul and Etienne Tricaud with Silvio d'Ascia] and Prof Agostino Magnaghi (Turin). The preliminary design was presented in November 2003 and the statement of work in the spring of 2004.

The construction process, activated in 2006, was fraught with difficulties and interruptions. After an initial stage of construction, work was interrupted in 2008 due to the withdrawal of the executive firm. Work resumed in the late summer of 2009 despite the worldwide financial crisis. Work was completed at the end of December 2012, and the station was inaugurated on 15th January 2013 in the presence of the Italian Prime Minister, Prof Mario Monti.

3.15 2008–2013: the years of the crisis

Since the beginning of the world financial crisis in 2008, the automotive industry's output has drastically reduced in Turin's automotive cluster.

It is in this post-industrial transition scenario that sector policies and mobility investments were reviewed, first with the rearrangement of the Railway Link then of '*Servizio Ferroviario Metropolitano di Torino'* (SFM) [Turin's Railway/Underground Service, Programme of reorganisation of public transport and tariff integration, 2008]. As of today (January 2013) the regeneration process of Turin's hub is nearing completion.

(a)

(b)

Figure 6: (a), (b) Urban regeneration interventions in the metropolitan area of Turin. View of *'Porta Susa's* glass canopy (2006, 2012) [15].

(a)

(b)

(c)

(d)

Figure 7: (a) [16], (b), (c) The photovoltaic canopy – construction details. (d) The station's headshot overlooking "*Piazza della Stazione*".

3.16 Turin in the perspective of 'European Smart Cities'

Turin has become the leader of cities with smart innovation potential since the 1990s when the project *'Officina Torino'* ['Turin's Workshop'] was launched and when the city's post-industrial future was already clear. The urban and social dynamism was expressed not only in the field of technological innovation but, in particular, in the wake of integrated projects in the sector of ICT and the environment [especially with the *'Environment Park'*]. The launch of innovative start ups in public/private co-partnership and spin-offs, coordinated by Turin's *Polytechnics*, certainly stimulated similar initiatives in Italy. Turin's metropolitan area is currently involved in one of the most ambitious projects for *'European Smart Cities and Smart Communities'*, promoted by the Italian Ministry of Education, University and Research. From an infrastructural point of view, the initiatives are based on *'Sustainable Plans of Mobility' ('Piani di mobilità sostenibile' – PUMS – PMI Città di Torino*.)

The strategic objective is to rebalance the transport demand between the collective and the individual. The other programme of activities is based on a long-term scheme to rationalise and to make energy savings more efficient. Resources have been identified in productive processes, construction, transport of energy (teleheating), and in production from renewable sources. Therefore, the project of the new station is still consistent with those premises conceived in a fertile cultural season and is still maintained, despite the drastic reduction of funding.

Recently, the project of *'Porta Susa'* was awarded the prestigious *'Eurosolar 2012 Prize'* – (Berlin) with the following praise: "*The Porta Susa train station is an interchange hub for high-speed rail service between Paris and Rome, links to regional transport and the Turin underground railway. It shows the promise of a completely renewable urban environment. The canopy is a fine example of how public architecture and photovoltaic technology can be combined. The central location strongly reinforces public awareness of the solar potential of cities*."

4 Urban regeneration

4.1 Economic and social impact: a vital infrastructure in Turin's productive system

The history of Turin's railway infrastructure corresponds and mirrors the urban and socioeconomic events of post unitarian Italy, the negative repercussions of which are still observable in the difficult railway link project. The old *Porta Susa* station began operation in 1856 with the Turin – Novara line which terminated at the Genoa landing stage, overlooking the *'Piazza Carlo Felice'* [17].

The building was named *'Porta Susa'* after the connection of the following railway lines: Genoa, Novara, and Susa Alpine pass. Its strategic role, especially in economic rather than ridership terms, became immediately evident as an essential functional hub for the newly settled business area. Therefore, *'Porta Susa'* became the median of a minute and well-rooted artisanal and industrial

fabric at the borders of the historic city with the function of serving existing business hubs and those in the course of allocation. As further proof, the huge industrial development of the *'Officine Grandi Riparazioni'* (OGR) ['Railway Repair Yard'] was built near *'Porta Susa'* in 1885 to 1895 – a hub of mechanic and technologic excellence of over 20,000 square metres and that employed more than 22,000 workers. OGR was also an undeniable social stabilizer and achieved a specialization effect at the European level.

4.2 In the heart of '*mixité*': from peripheral rail yard to new urban centrality

The linear system of Porta Susa is still today an 'urban linkage' in which heterogeneous systems have been connected – an attractor of multiple activities and diverse social classes, in a prevailing *'mixité'* that has persisted over time [20]. From WW2 until the 21st century, migratory flows triggered by the economic boom have impressed deep modifications in the metropolitan demographic fabric. In particular, residential areas crossed by the Genoa-Susa railway line – typically characterised by a concentrated and promiscuous development of artisans – underwent a progressive decline. The outsourcing of jobs and the decrease of artisans in the area [18] fostered the settlement of poor immigrants from abroad.

4.3 The new station: architectural and structural features

The project of the new station utilizes and reelaborates a transparent and lightness language borrowed from the examples of the '*Grandes Gares*' of the 19th century European capitals. The elements of the project were accompanied and integrated with the construction of majestic boulevards, allowing access to the city centre and to industrial areas in disuse (already requalified and utilized).Prerequisites for the recovery of the area were based on the principle of maximum urban integration between different sectors of the historic city and 20th century expansions. The improvement of the intermodal exchange and the enhancement of *Spine 3* and of the new open spaces *('Piazza della Stazione di Porta Susa'*) were among the requests of the buyers, i.e. the managing institution (*'Trenitalia'*), and the Turin Borough Council. The winning project of the competition (2002) prepared by the international Team AREP-D'Ascia (Paris, F) and Prof Agostino Magnaghi (Turin, I) allowed for the construction of a steel tunnel supported by 110 archivolts with a variable contour. It is 385 metres long and 30 metres wide with a variable height of 12 to 13 metres above street level.

The structure, in its laconic and abstract urban expressivity, is internally characterised by a sort of breathtaking technological landscape. It is an airy and bright *'promenade architecturale'* enhanced by a succession of functional flexible and light volumes with steel and glass structures that host waiting rooms and train operator lounges (*Trenitalia*, *Nuovo Trasport Viaggiatori – NTV*). It's a very complex system with car parks, deposits, warehouses, and technical areas.

The whole defines a public space where the station, a covered tunnel, becomes 'Passage', a street, a place of new urbanity. The total surface of the

intervention area is 47,500 square metres. *Porta Susa*'s daily capacity at full operation will be: 549 trains, 80 of which long haul an average of 23,600 travellers a day, with a peak of 7,000 travellers at rush hours.

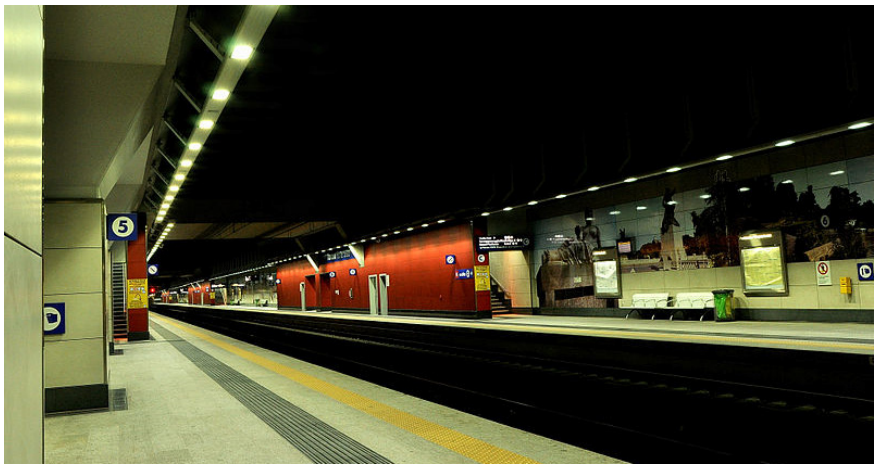


Figure 8: Torino *'Porta Susa'*. Ground level is at -10 metres and is used for the transit of railway convoys.

4.4 Interconnections for sustainable mobility

One of the biggest criticisms of pedestrian and cycling mobility in Turin is due to the grid road system with many unsafe 'T junctions'. In *Porta Susa*, the construction of the station at a lower urban level could have created new barriers and critical elements for cyclists and pedestrians. The designers' choice, i.e. the construction of ramps – pedestrian bridges in correspondence of perpendicular roads to Corso Inghilterra – not only met citizens' needs but also gave some dynamism to a space of great functionality and elegance.

The pavement, made of a local light grey stone, honed but not burnished, confers a diffused luminosity, visually comfortable in different conditions of solar radiation or diffraction. The full functionality of spaces, especially possible conflicts between pedestrians and cyclists, will tell whether the designers' and buyers' anticipations were correct.

4.5 Urban vitality and real estate values

As two scholars from Bologna, Simona Tondelli and Elisa Conticelli [19], very well explain: '[…] *infrastructural railway hubs, configuring as public spaces' [are] 'representative of a complex society, which is more and more prone to movement and represent therefore an unmissable opportunity, not only to attract development and territorial cohesion policies'. They are a medium capable 'to solve old tensions due to the sharing of a physical space, which is smaller and smaller and more and more precious and local ghettoization phenomena*

between the railway infrastructure and the surrounding urban context. Such tensions are coming back today in the shape of possible threats and involve a plurality of actors much more interested in the fates of railway stations compared to the past'. In fact, areas surrounding the project are characterised by historic or historicized housings of high or medium density.
Prolonged construction with its subsequent discomforts caused a loss in property value, at least in the short term. Actually, these consequences, exacerbated by the financial crisis, caused a further loss of vitality in areas already in decline. The infrastructure functionality should now reverse the negative trend, enhancing the conterminous urban compartments in a recovery and requalification process.
The confirmation that the phenomenon has been triggered (and possibly has generated some gentrification) can only be monitored in the long term by analysing fluctuations of property value and of the allocation of prestigious commercial and outsourcing activities in the urban fabric.

4.6 Building typologies and production of energy

The new station of *'Porta Susa'* is an example of 'resilient design' because during the construction it welcomed and elaborated the modifications of national and European regulations without reducing its innovation coefficient, despite the long process. The structure, a decade after its design, has demonstrated the ability to sustainably *'bear'* technologies and new high-performance materials aimed to improve energy efficiency and to reduce environmental impact, according to the principle of *'zero impact building'*.
Particular care was given to the control and abatement of polluting factors, to the improvement of health conditions in working spaces, and to ensure high standards of health, safety, and comfort to users.
The load-bearing structure was constructed with a series of steel gates to support steel structures and is covered with structural photovoltaic glass sheets. Glass 'scales' are distanced to allow micro-ventilation and to avoid summer's overheating.
The particular shape and irregularity of the tunnel was necessary to produce customised trapezoidal photovoltaic glasses. The canopy's capturing surface is 10,500 square metres of photovoltaic glass at variable transparency to provide more opacity where there is more solar irradiation. The production of electricity, limited by pre-existing urban conditions, was calculated to satisfy about 30% of the station's requirements with a significant saving both in economic and in clean air emissions terms.

5 Conclusion

Such a technological, financial, and urban undertaking is certainly destined to activate a phenomenon of remarkable mobility and socioeconomic impact improvement in the future. The immediate effects of the completion of the high speed railway line have been a substantial reduction in travel times and passenger intermodality at the urban level.

Despite the unfavourable economic trends, railway services, which have recently been opened to independent operators, have shown slightly improved customer satisfaction levels, narrowing the gap for central European customer service standards.

The first visible effect at the urban level since the partial launch of the hub and railway link is a clear improvement in private mobility flows. Fewer vehicles in the metropolitan also have resulted in better traffic conditions around pedestrian areas in the city centre.

This factor, together with the launch of smart mobility projects integrated by users and the Borough Council, is positively affecting air quality parameters, which in Turin have been mediocre for many years. See reports by the Regional Agency for Environmental Protection, dated 21st December 2012 (‘*Agenzia Regionale per la Protezione Ambientale’ – ARPA*). In the High Capacity (HC) sector, huge investments for works still at odds with the local citizenry have not dispelled all doubts about their returns on investment at a local, national, and European level and are destined to have long-term repercussions for their complex and delicate management.

Uncertainties that accompany the definition of the extra-urban and territorial layout dilute the actions that have already been carried out for a smart distribution of goods at the local (metropolitan area and municipalities of Turin’s belt), inter, and macro-regional level (Central Europe and Northern Italy).

In this paper, these and other topics have been regrettably limited (or omitted) due to space and expertise limitations. Further in-depth multidisciplinary and multiscale studies are desired, in a perspective of Life Cycle Assessment (LCA). These would give an initial *‘ex-post evaluation’* of the effects impressed on Turin’s urban fabric by the railway construction, identifying its resilience to big projects of urban reform meant to improve the efficacy of the area.

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