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Requirements of Users and Operators on the Design and Operation of Intermodal Interchanges

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Summary

The various projects made in Europe (Research for sustainable mobility), applied to the study and to the improvement of the intermodality in the urban areas, confirm the need to identify a system of transport more sustainable and, at the same time, making public transport interchanges more attractive. This work is turned to focus on those factors that determine the good quality of these intermodal spaces through the study of the different requirements of users and operators, who are involved in the use of the interchanges, and in particular to identify them as useful for the design and the management all the paces of the mobility.

1 Introduction

Such words as “interchangeability” and “intermodality” are today terms which are well implanted in the specialist literature. They are fundamental for the study of themes concerning systems of integrated transport and the places where such interchange occurs. Their use is rather recent and representative of the cultural process, began at the end of the Sixties, that tried to overtake the concept of urban space and transport systems. It is a vestige of the Age of Functionalism, of which marks are well visible in our cities.

The various projects carried out in Europe (Research for sustainable mobility), applied to the study and improvement of intermodality in urban areas, confirm the need to identify a more sustainable system of transport and, at the same time, make public transport interchanges more attractive.

In order to achieve such a goal we need to disengage ourselves from an obsolete approach to the problem of traffic in general, starting from the study of different requirements of users and operators involved in the use of such interchanges.

This work, realised during a stay at Darmstadt University of Technology (Germany), Section Transport Planning and Transport Engineering (Prof. Dr.-Ing Manfred Boltze), focuses upon those factors that determine the quality of intermodal spaces. In particular, these intermodal spaces were identified as useful:

- To demonstrate that ready-made models to adopt for any problem of mobility do not exist.
- To act as a guide to a major design and management of the systems of interchange.
- To improve the quality of mobility in order to rise the quality of the urban landscape.
- To create a conscience of co-ordination and co-operation between all those *key actors,* directly involved and not into the process of planning and management of the systems of transport.

Before entering into details of this draft, we must spend a few words to introduce the path through which the interchanges became the main factors for the sustainability of the system of mobility.

1.1 From the functionalism to a sustainable system of transport

“It needs to classify the different means of transport and to build for each type a lane that was adapted to the nature of the used means of transport...”, (Le Corbusier, 1933).[(1)]

The fact that the theme of integration of different transport systems was probably one of the most studied contemporary fields, both nationally and internationally (see the various projects of the European Commission), proves that the development of European cities, from the post – war period onwards, has been influenced by a common approach to town planning. It has contributed in part to the management and to legislative and infrastuctural aspects of transport systems, to create those ”barriers

to intermodality" (see MIMIC Project)[2] which are responsible for the imperfect operation of the mobility and quality of the interchanges.

This is not so excessive, reading the words mentioned above as a synthesis of that functionalist conceptualisation, that through the "denial of the city", refuses substantially the street as *social entity* and thus the "confusion" produced by it. It has brought to the "silence" and "order" - granted that we do not ignore the traffic - subordinating the needs and feelings of the human being to certain technical-functional categories, which are today insufficient for encompassing the evolution of cities or for managing the social - economic dynamics of modern society. Also, with the theory of the *organic city*, such paradigm is not completely finished. The structure of the city is associated with the organisation of the human organism. The street, considered a blood vessel in a wider system, represents the vital element for the maintenance of life in the urban organism. Inevitably, this has tended to adapt the design of streets and squares to the characteristics of cars (speed, linearity, parking places, signals, traffic lights, zebra crossings, etc.). Until the end of the Sixties, apart from some pedestrian areas, the attention to planning of urban space had been dedicated almost exclusively to private transport. The next decade witnessed a new urban conceptualisation of the city, that marks the beginning of a new cultural phase that, tied to Rationalism, tries to put itself inside this paradigm, to widen the basis, only then to distort the contents. It has started from a revision of the city as a form and result of a scientific-mathematical process, arriving subsequently at its complete "deconstruction" into fragments, more acceptable on both the planning and communicative level. It was exactly during these years - 1977 to be precise - that Alexander, Ishikawa and Silverstein, considering the traditional way to looking at public transport, said: "The traditional way of looking at public transportation assumes that lines are primary and that the interchanges needed to connect the lines to one another are secondary. We propose the opposite - namely that interchanges are primary and the transportation lines are secondary elements, which connect the interchanges", and still, critically: "The system of public transportation-the entire web …- can only work if all the parts are well connected. But they usually are not, because the different agencies in charge of various forms of public transportation have no incentives to connect to one another. Here, in brief, is the general public transportation problem." [3] Finally, since this moment, the interchange has been identified as a *strategic place* in the transport system, no longer *passive* but *active* in terms of mobility, whilst the arrangement between the different operators, is seen as essential to the co-ordinated management of traffic planning. Today the metropolitan areas of our cities are nodes of a vast system of movement and of social/economical relations at a national and international level, but the accessibility and the potentialities of urban area development are still conditioned, in negative terms, by the delay with which the national Authorities have proceeded to adjust road and transport infrastructures. This is a delay that could be avoided through a more careful approach to management and urban development, a more complete way of integration between all means of transport, identifying all those measures which make the public transport system more sustainable and the intermodal interchanges more attractive.

1.2 Intermodal interchanges: their role and operation

An *intermodal interchange* is an area destined in a permanent way to facilitate the interchange of passengers between different modes of transport. Such term contains both the concept of the mixing of modes (intermodality) for one journey, and the concept of interchangeability of such modes. The entity which links and successfully operates intermodality at the level of interchangeability is the *integration*. The integration has an institutional level (ticketing, administration, information services, etc.) and a technical level (connecting the different modes of the network together with the urban environment).

Within interchangeability are two related concepts:

- *Activity* (transfer) - what passengers do when they change between modes and services, include getting to/from the public transport network, could include park and ride, kiss and ride, taxis, bicycles, walk and ride, etc.;
- *Location* (space) - the place where the interchange occurs. This includes railway stations, ports, airports, tram, coach and bus stations ("formal interchange"), or also "informal locations" such as between simple bus or tram stops.

1.3 The role of the interchanges in the complex system of the contemporary mobility

While the ease with which a person uses public transport is of obvious importance for emerging transport policies dealing with congestion and pollution, it has only limited bearing on the number and quality of interchange opportunities. The places, where such activities take place, are closely related to the quality of the service in general and how such service is able to satisfy the requirements of users and operators. These are requirements for which the main characteristics are expressed inside the major stations, which are, on the one hand, the centre of a complex network between mobility and urban service and, on the other hand, provide new symbols (both technical and aesthetic) for the collective imagination.

The major infrastructures allow the shunting of traffic (at all its levels) and the connection of two means of transport which are very "different" and "distant" from each other, namely trains and planes. The catalyst of such change is certainly the advent of the *high-speed train*, putting the two in competition on the middle-range stretches of domestic transport. Their architecture, organisation, management and economics, in general, are coming near to those adopted in airport systems. Besides the concept of an "easier" typology of the station on a line-crossing necessary for the new *high velocity technologies*, it creates new poles of urban development for areas around the new stations. The increased value of such areas, attracting the interest of new operators in the financial and transport sectors, renders these infrastructures as *marketplaces*, where users can choose their operator, or other means of transport, and the one or the other operator, while these work in a state of free competition. Our big cities are changing and with them the identity of the places of mobility. These are defined by the French anthropologist Marc Augé: non-places, in which the users, transformed from *travellers* to *passengers*, "move in silence from one point to another,

from one screen to another, from one booth to another"[(4)]. In the present-day city the use of *social architectures* has changed fundamentally, as has the relationship between them and the people who move and work inside. The large places of mobility belong to this age, but they do not represent at all, as the literature (specialised magazines of the architectural and engineering sector) should show. Before becoming important junctions of international and domestic networks, they are often terminals of shunting between lines, that have their origins at *points,* belonging to a vast transport network, rooted in the territory, from which the mobility derives. We start from the concept that inside the mobility system, there are no hubs more important than others, as there are no means of transport subordinated to others. For such reason, in this work we will try to consider with *intermodal interchanges* all those places which serve to link local, regional, national and international passenger services and act as a junction between the transport system and society more widely. Their role has thus not be seen only as an element of entrance into the system or organisation of it, but also as an entity strongly linked with the local urban environment. Interchange can be an element of regional urban development strategies, acting as "city gates", giving access to the central hub of a city or representing simply an "informal" stop, but with precise relationships between the territory and the users. The improvement of the popularity of interchanges brings together ideas from urban design, transportation and market economics. Besides mixed usage of houses, jobs, shops and other activities around the interchange, it creates occasions to bind parts of the urban space, often scarified by bad development policies. This means that interchanges have an important part in the planning of the contemporary city, that must be organically planned as a unitary event and never viewed as definite fact.

1.4 Operation of the intermodal interchanges

The operation of interchanges depends upon technical and organising aspects, extremely important inside the planning and managerial process. Of course it means that it needs an tight collaboration between all the *key actors*, who are present in the process of planning, designing, operating interchanges, or have a significant interest in being consulted during the planning and design phases, such as:

- Policy makers.
- National, regional and local authority planners.
- Designers: architects, engineers and other planning figures
- Service operators.
- Passenger pressure groups.

Their dialog is fundamental in taking part in the design and management of the intermodal interchange, identifying differences between the stated intentions of planners, operators, regulators, inside the experience and preferences of end users. Such an approach enables the assessment of the role of different actors and organisations in creating new interchanges or changing existing ones.

The combination between the programmatic level and the technical-functional characteristics of the junctions, inside their system of transport, creates precise relationships (requirements) between users and operators, that simultaneously contribute to modifying the "nature" of these places of interconnection. Inside this system of *cause and effect*, we will see how such *protagonists* have the same needs.

Here are the main functions and characteristics of the intermodal interchanges.

Functions: [5]

- Interchanges (between transport modes) that perform only those functions required for the physical transfer of passengers from one vehicle to another.
- Interchanges involving elementary functions regarding passengers and their movements requiring a ticket office, a waiting room and a control room.
- Interchanges providing user services that facilitate the use of the interchange, such as catering, newspapers and magazines, toilets, and similar services.
- Interchanges involving complex functions for numerous users and which become a more or less large business centre.

Characteristics:

- Nature of the traffic: local, regional, national or international.
- Level of infrastructures and services.
- Urban location: central, tangential, exterior.
- Level of operation.
- Hierarchy in relation to other modes: terminal or not, linear or central.
- Characteristics of the user: frequent, occasional, new passengers, social state, etc.
- Type of trip: work, shopping, school, leisure, etc.
- Characteristics of the operator: public or private.

2 Users and their characteristics

The characteristics of people who interchange cannot reflect the population as a whole. Knowing these characteristics is fundamental to identifying the requirements of the users, thereby maintaining the quality of the public service and its competition with the car. The factors for which the users travel through the interchanges depend on:

- Structure of the integrated public transport system.
- Location and integration of the interchanges with the urban environment.
- Quality and accessibility of the interchanges.
- Quality of the operational and management of the interchanges.
- Complementary services.
- Type of trips.
- Ticket rates.
- Level of information.
- Security.

All of these characteristics contribute to influencing the number and the nature of the users, who, according to the public transport literature, can be divided into three main categories:

- *Users*: people using a selected interchange when making a trip.

  Inside this category we find different target groups of public transport users:

  - Local residents, including elderly people
  - Local and external business people
  - Public transport commuters
  - School age users and youth groups
  - People who use cars (park-and-ride, kiss-and-ride) and bicycles regularly
  - People with special mobility requirements and people with physical and visual/perceptual difficulties
  - Interchange staff and bus drivers

- *Potential users:* people not using the interchange at the moment but potentially using it if the values of transport supply factors (i.e. characteristics of interchange, transport modes or trip) change. This category is for us of particular importance because it represents the majority of people for whom, by improving the quality of the interchange or re-organising the transport network, it is possible to raise their number and reduce the gap with the other users. If we consider that nearly almost all elderly and people with mobility difficulties (about 8% of the population in United Kingdom;)[(6)] would use public transport

more often if there were assistants during the journey, it means that such passengers could become common users.

- *Non users:* people not using the facility neither at the moment nor in the future. The reason for this could be the short length of their trip, or a destination not served by any of the line-haul modes present at the facility.

To this classification we must add another group, called:

Non-experienced users: (domestic or international tourists, business people, etc.), who are present daily in our main stations, ports and airports. Their presence is a reality destined to increase in this age, in which the new technologies contribute to reducing the long distances, realising thus a new culture of transport and communication. The Jubilee in Rome, Expo in Hanover or the Olympic Games in Sydney were all events that triggered a huge "machine of mobility", in which the users, with their "diversities", became the main protagonists of these places of "interchangeability" (**figure1**)

Having provided this *identikit* of users, some important considerations are now called for. Although we could consider the user needs of those who regularly travel by public transport, belonging to which are a unique group of requirements, it is necessary to specify that inside of each there exist some *priorities* for certain individuals as opposed to others, not only between categories, mentioned above, but also inside themselves. For example non-users more than users want to have an info-point and a higher quality of inside guidance and a short walking distance between various services at the interchange. Correspondingly, users more often want to have seats, ticket selling points, real-time information, cycle parks, staff and improved walking connections to the city centre. While the availability of staff and increasing ticket selling points were slightly more important for people with physical restrictions; real-time information, timetables and delays were very important in particular for people with perception restrictions. Also the disabled, elderly and women with push-chairs emphasised the need to install ramps, lifts, escalators and lights more than

Figure 1: Welcome Jubilee service at Termini Station, Rome, Italy.

other passengers. Fear of crime, cleanliness, availability of staff and poor light are the most serious factors ranked higher by female travellers and night users than by peak users. So more attention needs to be paid to the *priorities* of each user, which can also change during the same journey from a stop to another, and with the awareness that such requirements depend upon all those different factors (typology of the interchange, where it is sited, the relationship with the residents and the business activities, etc.), which make each interconnection different to others as well as upon belonging to the same system. There are places of the mobility that often are so deeply connected with the habitats, the symbolic baggage and the various codes, of those who use the services offered by a place for travelling, to give them a feeling of "ownership". It needs to save and improve such condition because this is the best way to manage the interchanges.

These final remarks are also addressed to operators in order to establish direct co-operation, on one hand with the authorities in charge of urban and transport planning, and on the other hand with passenger pressure groups, in order to foster the re-qualification of those places of interconnection, thus guaranteeing a high quality of service.

2.1 Operators and their characteristics

Inside the market of mobility we can schematically distinguish between operators in accordance with the various modes of transport, the territorial level at which they work and their status. In this scheme we must remember that those operators which manage the transport at the national level (domestic railways companies), are also present at different levels of the transport field, for instance trains, coaches, buses and boats.

The nature and position of the economy inside this sector has an impact on the operation and marketing of interchanges, but less on the relationship with the customer. The user is the one who is judging what good quality is, so the *product* of the operators has to be up to the requirements of the user. To achieve a high quality service and increase the level of this service, the operators ask to work in condition of competition and “co-operation” (co-ordination).

- *Competition.* As a rule competition is a very important factor because it creates the conditions under which operators do not omit some services in order to be able to offer lower prices. Inside this system privatisation and deregulation have contributed to interchange development through opening up the opportunities for owners and operators to seek co-sponsors and finance from a wide range of sources. But at the same time privatisation could make the planning process more complex, protracted and costly due to the increased number of key players and variations in business objectives held by partners. Some operators see more financial advantage in competition than co-ordination between other companies; but a *market*, based only on competition, can create a system which is incomplete and hence insufficient for guaranteeing a sustainable and attractive integrated public transport system. An evident example comes from those operators who do not mention the existence of the other operators’ service, even when the network effect could work in their favour. At the same time we can have buses that run under a deregulated system, and railways

under a competitive privatised system. Under both systems there are problems caused by a lack of co-ordination between services both in term of timing, ticketing, information and a sense of responsibility towards passengers.

- *Co-operation.* Co-ordination between operators, planners and state/municipal authorities are seen as desirable conditions to create a modal shift. Interchanges are the basis for public transport. They must be seamless, otherwise the public transport will be out of business. An integrated transport system is the basis of the concept of co-operation. It has to be based on these levels:

- Administrative integration: creation of single transport authorities, which co-ordinate the planning and management of the different transport systems;

- Ticketing integration: Establishing unified ticketing systems and multi-modal ticketing.

- Physical integration: Design of an integrated public transport network, which maximises the connections and minimises penalties of intermodal trips.

At an institutional level the operators require that authorities take the responsibility to decide on public transport services using several approaches:

- Raising the profile of intermodal transport, thereby increasing the policies for integration of the public transport system.

- Being responsible for ensuring information.

Encouraging co-operation between operators, issuing a statement about the extent of co-operation permitted, and a review of the co-ordination of services.

- Amending planning guidance, undertaking an audit of significant interchanges, and setting out proposals for improvement.

- Improving the alternatives (to car transport) and intensifying research and planning in the transportation field. New technology and strategies for reaching the targets regarding energy consumption, climate, air pollution, traffic accidents and traffic-induced noise.

- Integration of interchange management.

- Safer and more efficient and comfortable public transport.

- Creation of new transport consortia.

- Reorientation of the investments for a sustainable growth. Usually a single management minimises both the operation and maintenance costs.

2.2 Requirements on intermodal interchanges

Although intermodal interchanges are places where the waiting time (synchronisation) has to be reduced as much as possible to permit faster transit of people between the different means of transport, we have to consider such places as a more complex organism, used by users and operators with precise requirements. For the strict relationship, that links them to the interchange systems, we can identify their main needs in these six common groups:

1. Accessibility and External Circulation.
2. Physical Design.
3. Shops and Amenities.
4. Security and Psychological Factors.
5. Information.
6. Ticketing.

For the draft of this part of the report we have taken into consideration the study carried out by the international working group of MIMIC Project[7]. It deals with a complete work that, using unitary and scientific methods, analyses the characteristics of a series of interchanges sited in different European countries. It has been useful to classify the main requirements of users and operators.

3 Accessibility and external circulation

A junction must give all the services that make the spaces of interconnection attractive and productive. Such a condition exists only if there is a sustainable network of infrastructures, a more strategic integration of transport, a better location of interchanges and a more flexible design of these and their surrounding areas. Before entering into major detail in this paragraph, we develop these concepts.

Better integrated accessibility strategy between land-use and the different modes of transport.

There are new junctions which are technically good, but they are not connected with the territory and in particular the urban texture around them. It creates problems with the approach to the junctions, that causes congestion, conflict between the means of transport and finally incidents and surliness. It is in precisely this condition that rude and arrogant behaviour is created in citizens (usually drivers), and is unfortunately very common everywhere. What is needed is a better integrated accessibility strategy between land-use and the different modes of transport, compatible wherever possible with the interior organisation of the interchanges.

Appropriate use of areas close to entrances and exits, and good relations between external and internal design.

An inappropriate use of areas close to the entrance and the lack of relationship between external and internal design, are often the cause of disorientation for users, who approach to the main entrance of the interchange systems. The fact that it is often easier to drop off and pick up passengers than for the pedestrians to reach the entrance, means that the car still has supremacy over the pedestrians. Especially at busy hubs, the approach can be confusing with the combination of car park access, taxi ranks and bus stops and even a commercial centre. Also, once inside, the user can find similar insecurity over not knowing where to go. The same problem re-occurs leaving. Often the old interchanges, that have a close relationship with the local services and the residential inhabitants, need restructuring around their road system and the surrounding areas. The new ones, whilst becoming a provider of urban

Figure 2: ***"The signals will bring towards the bankruptcy of the architecture".***

development, should already have a system of roads and squares, more compatible with functions of the buildings. New infrastructures together with restored ones can create opportunities for reviewing present-day urban space, in the light of new traffic requirements. Only under this condition is it possible to overtake technical barriers and attract new economic figures interested in investing in such areas of development.

Easy language of architecture.

An architecture able to be recognised for its functions is an architecture which can communicate to the user how to gain access and move about inside. An easy *language of architecture* is an important component that allows increased accessibility to public transport. The places in which such an activity is carried out belong to the same urban landscape of our main cities which today are incapable of communicating with its users. It is more obvious for those public buildings, that are identified just by signals (**figure 2**).

The modern architecture (town-planning, engineering, architecture) appears to have forgotten its daily duty to hold a *dialogue* with the people. Interchanges have a very important part inside the urban space. They are capable of creating new hierarchies within the city and the territory. In the last decade the construction of a significant number of new airports and stations, not only in Europe, seems to have rediscovered the monumental role of architecture. After almost fifty years, during which it was believed to reduce the violent impact that such infrastructures have made on our landscape, a *new monumentalism* tries today to embody the imagination of the new age, shared by everyone. It deals with an over-dimensioned language, that often translates into *hybrid environments*, were people get lost and the operators obstruct each other. It needs to open a dialogue between the *key actors*, as we have already seen, and sociologists, anthropologists, psychologists and artists, who can contribute to giving the sense and justification required for the planning work. Conversely, on a lesser scale (regional, provincial, local), we find a more humble *construction language*, through an

Figure 3: Station of Garbagnate, Ferrovie Nord Milano S.p.a., Italy.

external design standardisation of the interchanges and a careful *study of the materials* (**figure 3**).

This mode of design gives both a sense of orientation, and order and cleanliness - all factors which users should note. The external standardisation, required by operators, gives a common look to a series of stops, immediately recognisable and recognised by passengers as part of the same network. Usually, they are composed by simple architectural elements, and by a design approach that takes into consideration the relationship with the environment, the rapport with cities, the functionality from commuters' viewpoint, the client's image and the symbolic representation of the architecture. In this case the technique becomes functionality, while the aesthetic becomes language, of which words are the form and the materials used to represent it. Steel, granite and glass are today materials that, often being used in transport architecture for their intrinsic characteristics inside industrial production, represent for the collective imagination the place of intermodality.

Aesthetics of traffic.

So far we have seen how many different factors are important to making the systems of interchange efficient and attractive. Accessibility and external circulation are the first components of *impact* for all those users that live in the *world of mobility*. It means that the traffic is not only a functional or economic problem but also a larger question connected with the *perception* for the users of the public space. Thus, it is not too hazardous to introduce in this section the concept of *aesthetics* as an important factor able to imply all the problems of traffic, and in addition putting itself in the position to fix them from a point of view definitely in contrast with the official one: bureaucratic, political and technical-functional. In "*Aesthetics of the traffic*"[8] its author, Angiolo Cetica, uses this term, sure that only a new planning approach to traffic focused upon binding the relationship between *mobility* and the *urban scene*, *traffic* and the *environment*, is able to re-establish that *urban continuity* lost with the *wild development* of transport. A *disunited* territory can only have a *sick mobility*.

The geometry of traffic is dividing the urban space in areas, fragments, islands or better saying: in *public avoids* used as parking places, flower-beds, traffic islands, or other. Parts of the city destined to be *urban remnants* often became real *barriers* both physical and visual. It means that we must definitely convince ourselves that the traffic must be seen globally and compared with the requirements of the users who live and move inside the urban space. Postponing a discussion of such a subject until another occasion, we can see now the main needs connected with the approach to interchanges.

User Needs

As the main needs of users concerning access and external circulation, the following requirements have to be considered:

- *External area*. The place of intermodality must be comfortable (plants, seats, etc.) clean, safe and, where the pedestrians can make all transfers, without crossing motorised traffic.

- *Design of functional spaces of interconnection.* Wherever possible it is better to site bus, tram or train stops, shopping centre, petrol stations and car parks in the same building on adjacent floors. In this way it reduces the distance between the means of transport, the connections between floors and increases the possibility of using common routes and services.

- *Design of walking routes.* A high-quality walking environment, as a result of improving the pedestrian crossing facilities both in station forecourts and on main roads, makes pedestrian access safer and more pleasant (i.e. road tables, traffic light sequencing, covered walkways, texture and colour to emphasise crossing points, etc.). Links between modes should be as short as possible, and with sheltered walking connections and moving aids such as escalators, ramps, underpasses and bridges both for pedestrians and bikes.

- *Design of vertical connection.* Ramps, lifts and special access routes as facilities for wheelchair users should be available and properly maintained within the interchange and in its surrounding area.

- *Design of bike-and-ride.* Improving bike-and-ride facilities with covered and secure parking, signing for cyclists, bike maintenance and sales facilities and separated cycle lanes on feeder routes.

- *Design of park/kiss-and-ride.* Improving and good location of park-and-ride and kiss-and-ride facilities (of course including handicapped places), that guarantee a sufficient number of car places to satisfy the demand of users.

Operator needs

The use of means of transport that drive on track is not something that considers only the traveller but also everybody that moves from suburban areas to the city daily and vice versa. In the past, these networks have always been lines of crossing of inhabited areas or really barriers for their development. In a modern integrated system these considerations are not sustainable anymore. Each mode of transport has to be able to use, move and work inside the same infrastructures and road system. For good operation the operators ask for flexible places in which, over the years, the widening of the network will not be limited by a system devoid of co-ordination and connection with the different services. Accessibility and external circulation thus become a basic factor for the good operation of the operators' activity. We see now the main measures to follow, for realising the best working environment for operators:

- *High planning strategy.* Co-ordination and integration between urban and transport planning.

- *Integration between interchanges and urban environment.* The planning has to foresee the future development in relation to the transport infrastructures and the surrounding areas.

- *Location of interchanges.* Exact design and location of public transport interchanges within the territorial system and transport system, in order to develop a relationship between land-use and the development of traffic networks.

- *Design of routes.* Short, clear routes and no points of congestion outside and inside the interchanges. Clear signing should show the shortest way. Texture

and colour should be used to emphasise crossing points, directions and services.

- *Better traffic around hub.* Functionality of traffic in the street network near the interchanges can increase pedestrian and bicycle connections.
- *Parking policy.* This needs a complete and co-ordinated planning and management of parking system, able to cover the entire network. Only in this case is it possible to keep driver-users.

4 Physical design

Taking for granted that people tend to undervalue collective places, the designers have set out to build or re-qualify not only the hubs, but also their symbolical bearing at a perceptive level, leaving aside what the users consider as complicated spaces not readily grasped by the people who travel daily on the public transport. A good design steers passengers away from the consolidated assumption that everything that is publicly owned is inevitably in a state of utter neglect and disrepair. A high integration between technique and aesthetics is fundamental for achieving this aim.

Integrated approach in designing transport use and architecture.

An integrated approach to design in terms of both transport use design *(functionality)* and architectural design *(beauty*) is highly recommended in order to guarantee the main needs of users, and to create a more comfortable working environment. Good quality of the infrastructures and their management are fundamental conditions to improve intermodal transport. Although functionality is the prime target, it is the aesthetic design of interchanges that is able to maintain the users and to attract non-travellers as well. The design of stops and stations must be consistent for each mode of transport, with regard to both the *technical language* of transport design and a friendly visual image of interchanges. High quality of services and of low maintenance materials contributes to giving a sense of organisation, trust and cleanliness. Regarding operation, a better organisation and distribution of interior spaces is in general necessary. This is fundamental to facilitate the movements of flows, at the same time reducing congestion, especially for those junctions that during the rush-hour are crossed by hundreds and thousands of people. When a public place is well designed it becomes friendly, familiar and comfortable for users, who do not need signals and points of information for moving inside it.

Such considerations must be applied both to the new interchanges and the old ones.

User Needs

Here are the main requirements of the users of the interchanges in detail concerning their physical design:

- *Level changes.* Moving from one floor to another must be avoided or made as easy as possible. The stairs, escalators, ramps, lifts and luggage conveyor belts must be available, spacious and placed in such a position so as to enable the users to reach their destination and the different floors as quickly as possible. For people with reduced mobility - the elderly, those users with luggage and mothers with push-chairs or shopping bags - the problem of changing floors is even more important at peak hours, when stations are crowded and people in a hurry might trip and fall. The design of the vertical connection system is the most important to be considered by the designers when interchanges are built. Constructing entrances without stairs can often make the movement of passengers easier and it may reduce the costs of construction.

- *Waiting rooms.* The places where travellers pause must be functional and similar to both the shape and the layout of the overall structure. They must also be clean, comfortable, warm, safe, controlled and have catering services and

toilets. Good access to real-time travel information, telephones, toilets, shops and cafes is crucial. Use of plants, music, newspapers and seats gives a more friendly area for waiting.

- *Long waiting spaces.* People appreciate areas inside the space of interconnection to spend the waiting time shopping, meeting people, seeing cultural events or other amenities. We will consider this in detail with the next paragraph.

- *Walkways*. They must link the arrivals and departures of different means of transport and the main relevant services. In no case must they be narrow, unmanageable, unsheltered, slippery (during rainy days the station can become a dangerous place) or have a gravel base. Ceramic steel can produce a corrosion proof surface. Flowerpots, barriers or signs must be placed in positions that do not limit accessibility for the different passenger flows.

- *Interior design.* The design of furniture for interchanges has by now acquired an importance comparable to that of design for homes and offices. Arrival and waiting involve a process of identification. Thus it is fundamental to create a welcoming and homely environment, through a careful use of materials and colours. In general users want a living space, where fluidity, flexibility and dialogue between function and decoration are mixed.

- *Facade materials.* Materials resistant to atmospheric agents and wear are needed. In addition, the use of *cold materials* tends psychologically to keep vandals at bay.

- *Sliding doors.* Doors should open and close automatically, in order to help transit and contribute to maintaining air conditioning in the waiting space.

- *Hygienic services.* Travellers ask for better access and design of toilets incorporating features that ease cleaning and maintenance. Users often complained about general the level of cleanliness of the interchange site. Provision of toilets also for informal interchanges is a major issue as those provided are generally considered to be of a minimal standard with poor maintenance and lack of supervision being cited as negative factors.

- *Illumination.* Lighting should preferably be natural. This is a factor that users consider very important. Use of glass and transparent walls is highly recommended (**figure 4**).

Figure 4: Glass roof, Waterloo International Station, London, GB

It should be used where possible not only to bring light inside, which can create a less stressful atmosphere, but also to enable passengers to identify their bearings, to see which way they are going and provides perceptual reference points outside the building but at the same time giving a sense of security. Users can require lighting within a graded passage, from light to dark. Dark spaces and corners have also been eliminated for more distribution of space.

- *Control rooms.* Control rooms with staff should be visible for the interchange users to promote the awareness of service and control.
- *Vehicle design.* Particular attention has been given to the overall aesthetics and accessibility of the vehicles (low-floor, comfortable seats, high interior distribution).

Operator Needs

We have already seen, how the design of the major interchanges has undergone significant change, that has "obliged" design to tackle once more the theme of *urban monuments.* It looks like suffering sometimes from the choices made in political and economic fields. Whatever, all the operators must try to establish a direct co-operation with all the authorities in order to foster a more rational design and re-qualification of areas, where the activities impose their most evident presence. The operators' need (*client's demand*) an architecture to build up a look, clear, modern and immediately recognised by users.

- *Design*. Renovation, rebuilding and better maintenance of interchanges.
- *Level changes*. Design of ramps, lifts, escalators, inside and outside interchanges.
- *Parking areas*. Provision of car parks and bicycle storage facilities, with a separated location, closer to the entrance, save and sheltered.
- *Reserved parking spaces.* It must be considered in planning phase a considerable number of areas destined to handicapped people, transport and commercial staffs.
- *Taxi ranks.* A sufficient number of parking places sited in relevant areas, close to the entrance, easy to reach by people, sheltered and separated by other functions.
- *Reserved areas for staff.* Drivers and staff, in particular to rest (waiting rooms, dressing rooms, toilettes) eat and drink during layovers.
- *Transport furniture.* High quality design (comfortable, resistant to climatic conditions, use and blows) for internal and external furniture as platforms, panels, benches, seats, garbage-cans, etc.
- Vehicle design. The needs are the same as for users. In addition the operators ask to personalise their vehicles, in order to give a common *message* of professionality and efficiency.

5 Shops and amenities

Shops and amenities are considered important factors for making the interchanges more agreeable as the users are entertained while waiting for their transport. Travellers and operators ask for the opening of retail shops inside the terminal. The presence of open shops increases the feeling of security and therefore reduces fear of crime. Moreover people returning from work can do their shopping. Busy interchanges are safe places and can be as important as social meeting places and sources of information on the local area. Culture and service should be considered because, for many people arriving in the interchanges, it is the first impression created of a neighbourhood. Unfortunately such conditions do not always exist, or are present only during the day time. This is especially common in small places of interconnection. In fact, although users demand shops and facilities inside interchanges with short waiting times, it is often harder to attract shops and business because traders feel people will not be shopping while they are waiting, or only be there for a short period. In this case the people as k for more security and alternative services inside or outside the interchanges. Users very much appreciate ideas that bring life to the environment, through providing local information on arts and entertainment, big screen, displays of news, school work, movies, etc. (**figures 5 and 6**).

Figure 5: Frankfurt-Hauptbahnhof, Germany

Figure 6: Big screen, Danzig Central Station, Poland.

Art and design in the interchanges have the clear function of creating a pleasant and stimulating environment and to give a sense of orientation, especially the underground stops (**figure 7**), to make the traveller pause for thought and take a break from everyday stress and prevent vandalism of big city environments. A stronger physical and psychological link is seen to be favourable between the interchange and town centre to reinforce and extend recent measures, taken to raise cultural attractions (i.e. cinema, arts centre, restaurants, etc.). Publicity campaigns and marketing strategy should be applied to help citizens know the functions and facilities of their local interchanges and to establish a sense of *ownership.*

Figure 7 Stadion Metro Station, Stockholm, Sweden.

6 Security and Psychological Factors.

Concerns for personal safety and security on the interchange site and in its immediate local environments are a major priority to all users and operators. The feeling of insecurity, when using the public transport system depends on both real security and psychological factors. Such feeling shows itself in each category of users, including the transport staff inside the interchanges and the drivers of public vehicles. A sense of insecurity can appear during the transfer from one means of transport to another, during one section of a journey instead of another one, or simply during a short stop in a non-busy period of the daytime. Unfortunately this state of mind is already upon the user before starting to travel. The long waiting time especially at nightfall is one of the main factors that conditions users. Women, the young and elderly people are the most interested. Insecurity turns users away from public services: those who do not feel sure about travelling with public transport prefer to use private means of transport.

Next we look at how to deal with such problems.

User Needs

For most people, there is a significant difference between using the system in busy hours and in hours when users are scarce, especially after dark. The security factor is of primary importance for any interchange, as well as in the urban vicinity. Without security no interchange will be a place able to attract users and new users during all day service in general. The psychological factors referring to personal security (e.g. presence of security guards, police or poor lighting) are deeply influencing the choice of private car usage, instead of public transport especially during the night. The feelings of being unsafe are increased when the interchange is located in *dangerous areas*, especially for women, elderly and physically impaired people. Of course the constant presence of vagrants, beggars and drug addicts in the surrounding area makes the interchange appear dangerous. In fact an interchange can be safe inside but not outside, especially in the car parks. Added to this feeling of insecurity is the effect of *vandalism* and *graffiti.* The design of the interchange has many physical features to improve personal safety (i.e. good natural lighting, good visibility, location of shops, no dark corners and good quality materials, etc.). Designers have included measures for creating an open, well-lit environment within the interchange. Design and reconstruction of the station with more durable materials is important, while dark

Figure 8: Stadion Metro Station, Stockholm, Sweden.

spots, pillars, recesses, low ceilings and overuse of concrete should be avoided. In addition, the users prefer an individual design inside the interchange rather than standard design. The use of *personalised interior design*, between the different stops of the same line, can gives a sense of friendliness and, especially for the underground a sense of orientation (**figure 8**). A strategy to minimise insecurity, in all its different forms, should include:

- *Security inside and outside.* Passengers want, both inside and outside the interchange site, to be safe when boarding vehicles or walking between modes. A station can be secure inside, but not in the parking areas. Another one may be secure during the daytime, but not at night.

- *Good surveillance.* The presence of policemen, guards and staff both inside and outside the interchange site, especially in parking areas (if any) or along outdoor walkways. In particular the *availability* of interchange staff, possibly in special trained uniformed staff, is an important factor for common users. This is the most important for physically-impaired people. Such availability is ranked higher by night users than by *peak-users* and *non-peak-users.* Generally the night users pay more attention to psychological factors.

- *Waiting areas.* These spaces, including a choice of seating for different categories of users and information on service delays and alternative route options, are seen as very essential to make the station more *user friendly.*

- *Shops and activities*. The disposal of commercial activities or others inside interchanges is considered as an important factor in making the station more agreeable, as the users are entertained while waiting for their transport. These amenities also give life to the junctions, thus making the users feel more secure.

- *Cleanliness.* Such a characteristic is also considered an important factor to make people comfortable and the station more pleasant. Equipped toilets, telephones, lifts and comfortable waiting rooms are factors that highly influence the user to travel serenely by public transport. Surroundings must be kept clean and graffiti removed quickly.

- *CCTV.* Use of the closed-circuit TV system to be extended in lifts, waiting areas, cycle storage areas in vehicles and at bus stops to generally raise the level of security.

Operator Needs

On the traffic level operators emphasise the need for security, proposing to amend the road system and not simply around the interchanges, in order to avoid accidents to vehicles and people. On the level of criminality, the operators consider necessary these security measures:

- *Institutional measures.* Linking transport policy to authorities, for providing anti-crime guidance on how to reduce fears and to improve feelings of personal security, when travelling by public transport.

- *Better surveillance.* Presence of patrolling staff and police all day long inside and outside the places of interconnection. Transport staff (drivers, ticket collectors, etc.) also want such a presence inside the vehicles.

- *Against vandalism.* Prevention of vandalism inside the vehicles and inside the interchanges through observation and new anti-vandalism material.

Figure 9 Kröpcke Metro Station (Arch. M. Iosa Ghini), Hannover, Germany

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7 Information

Travel information and ticketing are factors that have to be encouraged both to increase the usage of the public transport, and to create a real integrated system of mobility. The purpose of information is to assist the users in deciding on the appropriate transport modes and to confirm their findings. In the present-day, the concept of information is more significant than in the past, as much as the ways to travel and the reasons for which a person travels. The needs of the travellers are focused not only on the easy and economical way to move but also on all of this information connected with the type of the journey. It means that where the user needs information on the transport system, it should be possible for him to obtain details in places (streets, squares, monuments, etc.) and for services such as: renting a car or bike, changing money, finding left-luggage, and so on. Inside the transport system we have two types of information. **(9)**

- *information before the journey* - or even information about where to go for information,
- *information during the journey* - need for feeling of control with reassurance that journey is going as expected.

Both typologies must take into consideration the different characteristics of users. For example elderly people have difficulties getting information on timetables, routes, bus stops, stations, connections, transport of luggage, prices or special services. Besides these, for other users (young, visually impaired people, foreigners, etc.) the automatic machine can be a barrier to intermodality. There is a need to provide a higher quality of information on the street about the available services, inside and outside interchanges. Information has been successfully conveyed to users when: it tells them what they want to know; it reassures them and eliminates travel-related anxiety; the information is positive, simple, has visual clarity and design consistency. Uncoordinated information can be a barrier to some categories of users and acts detrimentally on the interconnection in general and thus upon the effective operation of the public transport. The type of information provided must be *custom made*, not excessive, well packaged, accessible and comprehensible.

User Needs

For users a high quality of information depends on:

- *General information.* A user could need information on advantages of public transport, lines, services, times and tariffs, how to approach a stop or a vehicle; but at the same time, he might need to reach a place, a building, a square, outside the junction.
- *Signing.* Adequate methods for good transmission of information through a wide-scale use of signs, visual guidance, symbols, pictograms, and guiding line environment and special design solutions for visually impaired passengers, such as brochures in Braille.
- *Real-time information.* Information on arrivals, departures, delays and advice on alternative routes must be updated in real-time. Timetables and microphones

must cover all the travel spaces (halls, waiting rooms, ticket office, etc.), and, when necessary, make announcements also inside shops, bars, toilets, etc. It is extremely important that a system of displays should be installed in the most strategic points, inside and outside each. In addition, the usage of modern technologies such as satellite-boards at the main stops makes the transfer from one means of transport to another easier, thus guaranteeing the *synchronisation.*

- *Service point*. They must be located directly in the entrance hall, with the advantage that this information desk is situated directly among the users (**figure 10**).

Figure 10: Service point, Frankfurt-Hauptbahnhof, Germany.

- The information is located where the questions are. The service staff provides information concerning timetables, locations of certain facilities, tourist information, but they do not sell tickets. This facility is part of a very customer-oriented strategy to increase the number of public transport users.
- *Trained staff.* They need to be patient with and helpful to customers, able to give the main information to each one and at each moment. The knowledge of foreign languages is appreciated.

Operator Needs

In order to realise a real integration between the means of transport, a complete system of information (*collaboration*) between the various operators that work inside the same network is needed. The operators ask for a more completed and integrated information system, starting from the local level, and arriving at the international one. They must work on the condition that the user should be able to know in general the advantages and services of the public transport and, in detail, how to move about inside it.

8 Ticketing

An efficient fare system in general and the number and type of tickets (multi – modal ticketing products) in particular are counted as the main factors which motivate users to use public transport. For such reason we can say that a good ticketing policy is essential for encouraging intermodality. Integration and diversification of tickets are certainly the main measures for increasing economic attractiveness of public transport, creating, at the same time, an efficient operation of interconnections in an interchange. If the user finds the price of the ticket cheap and compatible with both the travel distance and the travel time, he will gladly using the public transport.

A modern and integrated policy of ticketing needs an efficient system of distribution both manual and mechanised. Now we will look at what this implies.

Automatic systems of ticket-distribution.

Although in general the users prefer to buy the ticket directly from authorised personnel, because it is possible to get information not only concerning the ticket, the trend will be in the future to adopt an automatic system of sales. Leaving aside questions concerning the validity of tickets, we focus just on the mechanised sale. If we consider the automatic systems of ticket-distribution (single-mode, trip related, trips of all modes), by now adopted in most cities, the user should be able to have the main information on transport and buy his ticket without having to wait in offices. Looking in particular at the tariff system, to which the price corresponds to the numbers of zones covered during the journey, it means that the user would be able to know by himself where he is, what is the shortest and most comfortable way to reach his destination, the different options of travel, the real price of the ticket, its validity and in general to understand how the transport system is organised. So the adoption of such ticketing machines entails an easy and fast use of the functions and a high quality of *communication* such as: graphic language, tactile commands, options, etc. (**figure 11**).

Figure 6: Ticket machines in Bratislava, Slovakia

The lack of a simple approach to them may be a real problem to

some users (foreigners, the young, the elderly and non users), creating feelings of insecurity, which make people ask for information from unqualified persons such as police, security or transport staff.

Our major stations and airports are full of people with such requirements.

User Needs

Here are the main aspects, which need to be considered by the users when they decide to travel with the public transport:

- *Selling and automatic distributors.* Accessibility and availability to reach the ticket shops or machines in places close to the main points inside or outside the interchanges. Higher level of both simplicity and comprehension of maps and functions of the machines, the fare (convenience) of the ticket, its validity (time), and the distance to travel.
- *Joint ticketing.* The different companies must unify the journey ticket, for reducing tariffs and travel time.
- *Park and ride ticket.* Drivers ask for facilities for park-and-ride users' park, as well as parking refund tickets or ones integrated in the journey ticket.

Operator Needs

The convention of special tariffs is a particularly convenient incentive to renounce the car. To reach it, operators must work in an integrated system of transport and collaborate. The development of public transport implies the co-operation of all the enterprises belonging to the same network. We have already seen, speaking about operators, how the co-operation works. On a tariff level, it means an equal division of the receipts (the measured income to the real use of the service, given by each operator, to the user). Such a measure is possible only through the electronic ticketing system. Thus all operators joined in partnerships have to use this technique. Finally, the operators do not believe that the price of the ticket or the difficulty in finding selling points or using automatic distributors, is a factor which puts off people using the public transport. The real reason is the efficiency and quality of the service - and this is exactly what they are focused upon improving.

9 Conclusions

We opened this work mentioning the conceptualisation of transport by the well-known architect of the Modern Movement, viewing in his words the "death of the road" and so the cause of the beginning of the crisis of mobility and the development of territory. In the ideal city of Le Corbusier, the *Ville Radieuse,* the functions - residence, commerce, culture, industry - are deeply separated from each other. The *Ville Radieuse* has not been realised but its model - *the zoning*, with the town planning for separate functions - has had an enormous impact in the past century, leaving its mark in many countries in the form and life of our cities and creating at the same time a bigger distance between people and their environment, that is at the base of deep transformations of the society.

Let us say that we must re-start from the *road*, the real *theatre of traffic* and the basic element of mobility and thus of public space and of social life, in order to re-form those links between places and functions, which already existed in our historical European cities. In the past, space was often central and centralised: it was easy to distinguish what was placed at the centre from what was on the periphery. This centrality was a visual affirmation and confirmation of the One, of unity. Although today such a condition is difficult to find and save, especially in our metropolis and cities, in the way of development it is possible to reach and to guarantee the *continuity* of public space.

The interchanges can be the real protagonists of a new era, in which the organisation of mobility demands a *culture of services,* capable of realising global solutions to the movements of users and their activities.

Starting from a measured approach to planning, re-design, conservation and re-usage, managing and improving the quality of the interchange, and taking care of the real requirements of who uses and works inside the systems of interchange, it is possible to achieve goals more ambitious than the simple operation of such systems.

As a result, the terms *interchange* and *intermodality*, defined at the beginning of this piece, and today strongly connected with the modern concept of transport, take on now a larger meaning, to be extended to all those functions and entities that are parts of our society.

The place of interconnection can be the occasion to bring infrastructures into force again, re-establishing "those elements considered fundamental for a future reconstitution of the sustainability: the links between people (community) and the link between people and the urban space (places).[(10)] Becoming real *catalysts* of flows and functions, the interchanges become, at the same time, *points of departure* for a global re-designing of parts of the city. Leaving from the district, and arriving at the new urban areas, they can offer an interesting stimulus for the evolution and transformation of the transport systems and create, at the same time, analogous relations between other strictly urban places typical of the public spaces, such as roads, squares, markets, public buildings, residences, parks, etc., that constitute the urban texture and territory in general.

It means that where there was *separation* between function and place, now there is *interconnection* between them.

This is definitely the major potential of the systems of interchange in the contemporary environment and we must use this opportunity. But in order to render such potentiality active and lasting it is necessary to:

- re-find that polyfunctionality inside the urban continuity (lost due to the mono-functionality of the modern cities) fighting against the plurality of the single-interest providers of dispersion, division and fragmentation of the territory.
- think about the public sphere and the imagined public space, once again discussing the aspect concerning the " urban scene" and the "places of visibility and perception".
- resolve (or try to resolve) the problem of modern traffic, proposing more sustainable solutions, and not just through a technical and marketing approach.
- adopt innovative and integrated systems of collaboration between various partners, that are focused upon increasing the usage of means of transport, their operation and in general the accessibility to networks, infrastructures and services connected with the social life in our cities.

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