MOBILITY AND URBAN AREAS INTERCHANGE

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Abstract

Urban transportation today is matching more and more new needs for mobility due to the continuous change of urban functions. Nowadays, the concept of the city transcends the vision of a constructed and circumscribed space to reach the valence of a service system, linked by an infrastructure network which allows the same functionality. In this sense, mobility has suffered substantial modification in adapting to the changing needs of the local populations. Thus, the interpretation of urban mobility must change in satisfying three instances: the routes, means of transport, and mode change. Above all, the mode change needs to be adequately exploited to support new mobility. It is necessary to improve integration between different transfer modality, and to affect the propensity (favored by major guarantees of quality of travel) of the users to the use of public transport. This work is aimed to identify those parameters which are useful in planning an area where two or more transport networks can be employed. Thus, even if they are hierarchically different, they must be connected and their functions and equipment must be concentrated to facilitate the transition from one system of transport to another.

Keywords: Mobility, Interchange areas, Urban transport

Introduction

Few decades ago, the trend of a rigid schedule of public transport and related infrastructure for urban mobility, has failed to meet the increased demand for transport services. Also, it has failed to meet the radical transformation that has suffered its qualitative structure and spatial organization. This is because the actions have been often addressed in a sectoral way and without a suitable functional reorganization of the entire urban system.

Administrations in the absence of careful planning and appropriate investment, have only partially satisfied the need for mobility. It is compensating the request for public transport with rail transport systems for both medium and long distances[24]. However, it is entrusting the capillary service to the road transport. Therefore, all applied solutions have been related only to road transportation. This was accomplised very often by disposing the demobilization of the trolleybus or tram lines even if this system is presently considered obsolete.

Moreover, the priority to road transport, according to similar guidelines adopted at national level[25], has required the construction of expressway arteries within metropolitan areas, or transurban highway distribution rings for the outer areas. This dense network of infrastructure (super sized for facing the high pressure of the traffic during rush hour[26]), uncritically penetrates the inside of urban areas[27], that are not supported by appropriate marshalling and parking. Therefore, the expected results were disregarded.

The Evolution of Urban Mobility

Consequently, the policy of transport management shows the incongruity that you can observe through any analysis of urban systems. The deterministic logic used in evaluating and analyzing, has generally provided solutions which are excessively standardized, and can hardly adapt to the conditions in areas of high complexity like our urban centers, where the countless constraints, the variety of pre-existing, and the rapidly changing needs requires the use of flexible scheduling.

In fact, our cities are not simply a collection of homes. They have risen with a slow and gradual agglomerate, such as shopping centers or

[24] Against the total disregard of the revitalization of rail transport on a national scale, following which there was the closure of many dead branches, we have made underground lines (remember those in Rome and Naples), which do not offer those benefits that a transportation system requires today. These benefits can be seen in terms of costs, lead times, and operational flexibility,

25 Transport policy in Italy during the last forty years is characterized by a constant and onerous financial commitment of investments directed towards the construction of a road network that was supposed to solve all the problems related to mobility both at the extra regional and regional levels in urban areas. Therefore, neglecting to encourage rail transport by focusing on a single solution, have highlighted with time, the error of an insufficient diversity and an integration of different means of transportation.

26 The actual conurbation has become a system where in a specific time periods (coincident with the working time), the implosion of all technical, administrative, and trading activities towards the poles of attraction occur (mostly still located in the downtown). This results in an unsustainable pressure along the arteries that connect the suburbs with the central areas. Thus, these are then emptied by expelling in a centrifuged way, the consumer to the periphery at the end of the working day.

27 The inclusion of a highway network with a functional autonomy in the urban area, create a greater distance between contiguous areas due to the failure to build a system of relationships with the areas crossed.

traffic junction. This takes specific identity and skills in relation to the territory. Therefore, they are becoming the equipped place of services, which centralizes or condenses the opportunities for trade in goods and information.

Through this way, the concept of the city transcends the vision of a constructed and circumscribed space to reach the valence of a service system. Thus, this service system is often linked by an infrastructure network, which allows the same functionality. Subsequently, the mobility of people, information, and things takes priority not just by a physical entity or a settlement system, but above all, through an organized system of functions.

In this sense, mobility due to its very diversified field, has emerged as a large and complex set of phenomena. This has over time, suffered substantial modification in adapting to the changing needs of the local populations. Thus, at the same time, it conditions the relations and the development of the same urban structure.

The pre-industrial city expanded with a global dynamic which provided the harmonious development of all its parts. Growth, similar to a biological system, occurred along the arteries that penetrated the territory. This is accompanied with a road structure that is consistent with local natural morphologies. However, the towns retained their size which is commensurate with the movement of residents between the different areas of the same urban center. The path of the road tissue was rich and articulated and the transverse dimensions of the roadways were adequate to the small volume of traffic (mostly pedestrian). Also, this was constructed so as to allow the passage of the various means of transport available at that time. The subsequent industrialization leads to the phenomenon of massive urbanization of the rural population. Hence, this is drained from rural labor force which involved the centralization of settlements in the city, around which production centers were developed[28]. The relative increase in the size of the town, the commuting between towns and the industrial areas, and the increase in interiors commercial traffic, gave rise to a greater demand for mobility. Thus, this overlapped with the previous requirements compared to the system which collapsed.

The solutions prepared to support mobility in this period, showed the first researches aimed at identifying and orienting the tensions within the urban structures, according to rigid patterns[29]. However, the same were

28 The factories were located within the same urban areas or neighboring areas (primary condition because the city was both a source of labor, than a first commercial outlet).

29 The prefect Haussman with the opening of boulvard in Paris is ... ... il primo a scorgere e a descrivere l'ordine urbano di questa società come lo spazio per circolare, il primo a trattare la città come uno strumento. Choay F. (1973), La città. Utopie e realtà. Giulio Einaudi, Torino (Tit. orig. The urbanisme. Utopies et réalités. Editions du Seuil, Paris, 1965).

mirrors of an age ruled by reason only, where the multiplicity of solutions was resolved by rational and rigid scientific speculation.

Moreover, the radical actions were made in the city at the end of the nineteenth century. Thus, this was made by the opening of the axes of penetration in historic areas, or through the construction of urban railways. Consequently, this overwhelmingly affected a space that was until then in equilibrium, only partially satisfying the need of travel. Above all, they aim to facilitate the socio-political management of the city.

In fact, in particular, these solutions were concerned with broad mobility. They did not resolve one of the levels of the individual areas that remained, but was excluded from trade flows under strong pressure.

In the advanced stage of industrialization, the city is characterized by the destination of the central areas which is predominantly outsourcing. Consequently, it spread like a metastasis in the territory, generating the phenomenon of deconcentration of the settlement system (a phenomenon that even today affect the urban system in terms of loss of liability, loss of identity, and marginalization of residents).

Urban sprawl and the greater extension of the urbanized area has spatial relationships which makes it difficult to detect boundaries between the town and the countryside (for the alternation of areas where an intensive type of residence were developed with random and point interventions, and areas with low population density). Therefore, this displays the limits of the policy of settlements, especially when it made municipalities unable to support the demand for mobility, extremely fragmented[30], and to be only satisfiable from the use of private transport[31]. In addition, this is because of the absence or inadequacy of alternative services.

The Dynamics and the Development of the Transport System and Urban Connections

In recent years, we are witnessing a change in this phenomenon. The life patterns, behaviors and alternatives that the great city offers (services, job opportunities, cultural activities, etc.) have also been extended to smaller towns. This relative uniformity or homogenization was largely induced by

30 In these areas where the demand for transportation is split, it is impractical to think of a support network which connects sufficiently. Mobility in small scale will necessarily be orientated towards the use of private or privatized transport (which moves with an undifferentiated logistics). On a regional scale, the network of fast roads will have to be further enhanced. In addition, the regional railways whose uses should be encouraged by a pricing policy in providing better service will also need to be further enhanced.

31 The private transport, on the contrary of public transport, has various characteristics of elasticity and capillary penetration into a spatial structure of this type. However, the increase in private motorization to guarantee a mobility which is consistent with the individual needs is usually considered to be the first cause of the slowdown and the increase in travel time.

the means of mass communication; by the decentralization of trade and administrative centers; and finally, by the inability of the metropolis to provide essential services such as mobility. Consequently, this triggered the phenomenon of the removal of residents from major cities to power a new devolution settlement in the neighboring villages to metropolitan areas. Thus these metropolitan areas have started becoming satellites.

The city, losing the notion of specific place, gains the new connotation of urban sprawl. This is a space with no real limits. Also, it is an abstraction whereby it becomes increasingly difficult to distinguish between the cornerstones of the system.

The sign system which was present in the past cities, allowed the semiotic recognizability of space organizations. However, this proves unreliable when applied to urban product of advanced industrial societies. This new urban reality which is much more complex than the previous models, have less understanding ability.

The different areas by which it was possible to distinguish the roles and functions in the city, as traditionally understood, overlapped and merged to create a polycentric system[32]. In this system, each element has its own autonomy. As such, it is impossible to establish an order of values or hierarchies, which is related to the dynamic of the residents.

Furthermore, the need for mobility in the past has increased in parallel to the increase of trade. Today, it tends to detach from these to follow the exponential increase in information circuit. This will probably result in a decline of interest in the physical movement, favoring virtual mobility which is implemented via telecommunications networks[33]. In other words, the mobility that currently has the maximum flow in users who concentrate their need to travel in some areas and in specific times in the future may decrease or change up to render any kind of planning to be unnecessary.

Consequently, in waiting for new tendency in the definition of a city to emerge, one needs to meet today's mobility needs of users,and its diversification of the request.

You need to change the interpretation of urban mobility as a strict and regular sequence of requests, which so far, has led the government to

32 This new way of performing city also deviates from the models assumed by some science fiction (it is neither the rigid and planned metropolis described in *Brave New World* by Aldous Huxley, even nor the anarchic megalopolises imagined in *Blade Runner* by Ridley Scott). Thus, this led to further difficulty in hazarding credible projections for a city that better reflects the possible future society of the universe.

33 The technique of optics fiber, laser and broadband, will make available in the coming years, a huge number of new telephone channels which will allow many people to work at a location. Thus, this will bring about a reduction in travel home-office.

simplify the choices regarding the type of transport to be used in an urban center (the idea is to match the number and frequency of the means of transport, mostly belonging to the same system, only with the standard requests of users). Therefore, the system still remains identifiable through three instances which are characterized by unique specificity: the routes, means of transport, and mode change.

The paths, otherwise defined as transfer routes, can be by the surface, overpass, underground, or trenches. It should not necessarily be tied or contiguous to the road network, but should also be detached from it to look different or have a higher level of integration. The choice, relative to the type of path to be used, is determined by the environmental factors of the area to be served. However, this is usually from the used transport system and from the requests dictated by specific opportunities.

Basically, the conventional means of transport for the movement of people and goods, are usually classified[34] into: iron transport (trams, cable cars, subways, people mover), road transport (private cars, taxis, bus, etc.), and finally a third category through which you can include all the various transport system such as the cable cars, the river boats, aircraft, etc. Each has a specific attributes, which plays a subsidiary role in the urban transport.

There are several possible objective assessments of the services offered by the means of transport. Thus, these objective assesement include: the index efficiency of transport[35], the operating speed[36], the flow rate, the crowd index[37], and the net efficiency propulsion[38]. Therefore, these parameters which are complemented by factors of a different order[39] such as facility of driving and maneuvering, have reduced maintenance, operating costs, flexibility of use, and technical-administrative interest. Furthermore, they do not intervene in the choice of users, who primarily requires continuity and regularity of services.

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34 Additional parameters to be used in the classification can be in relation to the type of engine used (electricity, fuel, etc.); the type of used energy source conditions; the drive system; and the path and the autonomy of the vehicle.

35 Number of passengers transported per unit time for the traveled distances.

36 The operating speed is usually measured in km/h and is divided into maximum speed (maximum speed allowed for a system of transport on reserved path) and commercial speed (indicates the average speed including downtime).

37 Index that measures the seating capacity suits the vejicle (in square meters).

38 Net Propulsion efficiency is the value that is expressed in the passenger kilometers traveled/ kg fuel used (for example, the values for the most common means of transportation are: buses 48.4, 442 tram, metro 40.0, 14.0 automobile) from : Vallauri M., Evoluzione e integrazione dei trasporti urbani. In: Scienza & Tecnica 76, Mondadori Editore, Milan 1976.

39 The parameters of an environmental nature (reduced emission of exhaust gases, low noise, etc.) which in recent years have become of particular importance should not be forgotten.

When as frequent, the impossibility of using a single means of transport occurs on a path, it is necessary to ensure their integration with others. In this case, the user must make a transfer i.e., a change in the mode of traveling itinerary. However, the mode change regards all the relations of randomness and interdependence for the required operations to switch between a vehicle and another of equal or different type.

The individual user can be free to choose his own transaction or a proper system. For example, interchange points can be provided.

It is obvious that the change mode increase the overall journey time of a user. Hence, it must be particularly easy and functional in order not to discourage the use of public transport. Facilitating the mode change is the task of the systems of services. Consequently, the equipment must guarantee the functions of collection or grouping, translation or conveyance, and the distribution of user flows in the centers of interchange.

The functions of grouping and breakdown have an additional role of input-output from the interchange center. Above all, the number and the localization are above all related to the connected urban system (population density, road network, the quantity of user flows, etc.).

For a center of interchange, in an urban area with high concentrations of population, the pedestrian accessibility from different directions is important. Thus, in an urban system of low population density, the pedestrian access can be unique as it facilitates predominant vehicle access[40].

The pedestrian grouping and distribution may also be carried out with mechanized systems, projecting its tentacles from central interchange to the city in order to facilitate and increase the affected area range.

The translation within the interchange and between different transport systems is the function which plays the most important role, since it is entrusted with the efficiency of the system itself. Therefore, this can be evaluated depending on the transfer time[41] between two transport systems and on the comfort of the transfer[42].

Often, it is attempted to combine all aspects which was previously described to be relative to a system of global transport through mechanical processes. However, the only simple identification and interrelation of the

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40 The vehicular access to the interchange system can be of two types: park and ride, when the user arrives to the system by private car, parked it, and continued with public transport, kisses and ride; this was when the user arrives at the system accompanied by private car or public (taxi) and continues with other means of public transport.

41 The time factor is the sum of the partial times needed for a user to perform all transactions: ticket purchase, request information, movement (according to the internal distances), waiting for the means of transport and get on it.

42 The comfort offered at users during transfer is guaranteed by the slightest physical work transhipment, the climate of waiting areas or passage, and the offer of additional services.

analytical type of the elements of this system were not able to represent the entirety of the problem and the complexity of the system.

The current framework of mobility requires a search of dynamic equilibrium which is adjustable to the changing of boundary situations. Thus, it is proportionate to all available resources, means, and specialized structures. These can be optimized qualitatively and quantitatively, due to requests from service users and the specific constraints of the urban system.

In addition, there are new hypotheses of coordination between the different ways of moving. This is aimed at getting the maximum benefit from the specific peculiarities of different transport means of selecting and integrating the respective attitudes. Above all, it involves the process of organizing a system of versatile elements according to the principle of substitutability.

All this is not possible without a new study of the dynamics of the city and the search for kinematic models which responds adequately to the specific needs of the user. Therefore, this is aimed at avoiding a standardized model so as to arrive at a flexible model based on total planning. This planning considers progressive articulation and differentiation of the means of transport, their high technological level, and above all, the ability to interconnect a framework of global mobility.

Then, more than the strengthening of transport systems, it is necessary to improve their integration, and to affect the propensity (favored by major guarantees of quality of travel) of the users to the use of public transport.

In this sense, innovations become complementary to the computerized management[43]. Also, it became the most requested parameter by users.

Subsequently, this imposes a correct identification of user requirements during the transfer between different transport systems, which becomes the main factors in the programming of an interchange area. Thus, this enables the choices of instrumental character to adhere to the parameters of the relationship needs-functions.

Specific and univocal solutions for the centers of interchange (often more monumental than efficient), is aimed to convey and centralize the functions which is sometimes very different, or is logistically distant. It

43 The dial-a-ride system combines the powers of both the private and public means of transport. It provides the service request from the user processed by a central control in continuous contact with the various means of transport that can give their willingness to meet the demand in times that are satisfactory. The computerized system has high operating costs but which can be reduced by increased demand and an optimization of the supply-demand.

ended up not responding to those expectations and the different variables that characterizes the current model of urban mobility.

In this sense, to an apparatus closed on itself with its rigidly preordained, the idea of system or interchange area is prefered. However, it is more relevant to the organic conception of the city. Consequently, an open structure with margins labile and rarefied, are able to penetrate the urban pattern. The interchange system exceeds both the concept of the historic station (place mostly separated from the city) and the technical joint between different transport networks. Therefore, this is aimed at reaching the function of the reference area and the organization of the dynamic way to move.

In an exchange system, the technical parameters are joined with diverse aspects that concerns all possible levels of aggregation and integration of the elements and the equipment necessary to facilitate the change of mode. This is accompanied with a program of very sophisticated functions, which is able to adapt to the changing needs through operational flexibility and changeability.

Due to the impossibility of a systematic and rigorously analytical organization of an interchange system, we identified those parameters useful to plan an area where two or more transport networks, even if hierarchically different, must be connected and where functions and equipment must be concentrated ("concentration" means the process of polarization of mobility) to facilitate the transition from a system transport to another.

Therefore, the identification and quantization of the parameters may be accomplished by an inferential logic, typically used in all research areas. However, in specific cases, it specializes in three successive stages:

1. analysis of the kinematic settlement system of the intervention and identification of its range of influence;
2. determination and scaling of technical and functional invariant and its support structures appropriate for the needs; and
3. construction of a functional model to analyse the relationship from the needs and performance.

The different operational phases should never be considered in isolation, as each of them represent a step of control, verification, and permit.

The critical reconstruction of the complex phenomena that produce the configuration of an interchange area needs to be supported by a careful observation and evaluation of the dynamics of settlement in the area to identify the elements that have favored the development. Consequently, it also identifies how many of these elements remain as a condition or limit for further development or planning of the area.

The analysis of the settlement system should aim in the identification of all those factors, which represent the main features of the urban landscape (building types, population density[44], sanitation structure, etc.). Also, the vocational spirit of the area should be defined at the same time (socio-cultural aspects of the residents, the poles of attraction of the settlement, the prevailing type of use of the area, the main commercial activities, etc.). These parameters when compared with the diagrams of use of transport systems in the area, can serve the interpretation of the flow dynamics of the gravitational ordinary mobility (periodicity, rhythm, the flow of users). Then, it can also outline the nature and size of the kinematic system, and the relationship with the road structure. This is both main and support, with the different transport networks. Furthermore, this first level of analysis aimed at defining the scale of the catchment area and the size. Also, the kind of demand for mobility must follow the reorganization of the spatial relationships between the carriers (transportation) and equipment. In other words, you need to define the field of relevance of the interchange system by establishing the size and the level of intervention[45]; identifying the services and equipment (functional elements for the employees[46] and for the user[47]) in the present and future; and depending on the framework of the needs.

Conclusion

From the above considerations, it arises that the possibility to decompose the operating system into small elements, particularly when they

44 We can classify the population density into three levels:
a) Low-populated (30-150 inhabitants / ha)
b) Average population concentrations (150-300 inhabitants / ha)
c) High concentration of inhabitants (over 300 inhabitants / ha).

45 The system interchange can be characterized, and classified for the size and the number of functions that it can provide. However, we distinguished between four orders of levels:
- Simple - no function if not relevant to the simple transfer,
- Secondary - annexed technical and management functions related to the transfer,
- Primary - presence of functions also not relevant to the simple transfer, and
- Higher - are activated complex functions that go beyond the scope of the system and also provide services at the urban level.

46 The services and equipment managed by staff, for the efficiency and monitoring of the system are identified in: personnel services (management, dressing rooms, storage rooms, toilets, etc.), technical services or facilities (internal phone, closed circuit television, lighting, ventilation, air conditioning, fire, etc.).

47 The functional elements intended for the user of the system are:
- Services for internal mobility (docks, escalators, treadmill, ramps for the disabled, elevators, etc.);
- Information services (fixed and mobile signage, interactive information, sound information, time, billboards for advertising posters, etc.); and
- Related services, public functions and travel (ticket, ticket machines, waiting rooms, baggage rooms, mobile, retail, library, cinema, business center, tourist offices, dining places, toilets, etc.).

are little is dependent on each other. However, this facilitates the adoption of the analytical approach that still lends itself to partial solutions.

By filling in a matrix of functional elements coming from the level of the interchange system, we can derive the relationship (direct or indirect) of the equipment and services. Thus, this is made possible by bringing out a balance of qualitative factors to be integrated or to be retrained.

The verification of the adequacy of the system can be made with the control, both of compatibility that interaction between the variables, through a process of systematic emulation of existing relations, through the construction of diagrams, or organization charts. In this way, layouts can be processed that highlight the technical gap (absence of privileged paths, the absence of direct connections between the various parts of the system, underpasses or overpasses impassable, no parking, etc.) and the nodes of conflict (between the pedestrian traffic and transportation systems or between flows of pedestrians), which can occur within an interchange system.

However, when the specific peculiarities of the intervention area are recognized, and the feasibility of the exchange system is verified, it is possible to hypothesize design solutions that translate the policy guidelines. These guidelines are consistent with the characters and the constraints of the environmental system. Also, it encourages various choices about the related system of equipments, which could be adjustable and reversible.

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