TOWARDS A BALANCED AND EQUITABLE DISTRIBUTION OF THE URBAN RIGHT-OF-WAY

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ABSTRACT

Streets account for a significant share of urban public space, a valuable but finite resource. But the distribution of the right-of-way of urban streets has historically been ruled by the traditional level-of-service methodology, which emphasizes the movement function of streets. Paved areas are vast in cities, contributing to climate change and urban heat island. Inserting pervious areas and trees into the built environment will help to mitigate these phenomena and will produce many other benefits. Because of the scarcity of “empty” land, the thoroughfare right-of-way (ROW) arises as a good option to insert green infrastructure, because it is public and well distributed across the city). The objective of this paper is to define, based on a multidisciplinary approach, the functions of the street beyond the function of movement and to develop a framework for distributing street space to achieve a more effective balance between these functions. We concluded that so far no method is approaching the allocation problem in an equitable way, and that more research would be necessary.

Keywords: Right-of-way, street, level-of-service, place, environment, equity, surface transportation, liveability.

INTRODUCTION

Frequently, in many new street developments or rebuilding projects, other considerations seem to be absent or to have to give way to new or altered traffic or movement requirements (Lillebye, 1996). The principles behind the allocation of the right-of-way (ROW) are heavy influenced by traffic demands i.e level-of-Service. But the destructive effects of automobiles are "much less a cause than a symptom of our incompetence at city building" (Jacobs, 1961 in Lilleby, 1996). Unlike private plots, the ROW is the only place where we can decide as a society to make changes.

Streets account for a significant share of urban public space, a valuable but finite resource. But the distribution of the right-of-way of urban streets has historically been ruled by the traditional level-of-service methodology, which emphasizes the movement function of streets. Traffic-oriented design, however, does not address either the function of streets as urban "places," where people rather than vehicles move or gather, nor does it address other possible functions of the street, particularly their potential environmental functions. On the street, there are the two primary functions competing for this valuable scarce space: The link and the place functions (Jefferson, 2001; Jones & Boujenko, 2009; Schoon, 2010; Schumacher, 1978), As defined by Jones et al. (2009) the first deals with enabling users to pass through the street quickly and conveniently as possible, and the second is related with encouraging users to stay as long as desirable and enjoy the street's surroundings.

The objective of this paper is to define, based on a multidisciplinary approach, the functions of the street beyond the function of movement and to develop a framework for distributing street space to achieve a more effective balance between these functions. An extensive literature review was conducted in order to: (a) understand the role of the street in history; (b) identify the main events over time that changed views as to the primary function of the street and led to substantial changes in its use, (c) assess shortcomings of contemporary streets with respect to the distribution of right-of-way across functions, and (d) understand features of the current design practice that work towards a more or less balanced and equitable distribution. We developed a conceptual framework that adds place and environmental functions to the traditional movement function of the street. This framework permits the qualitative assessment of the degree of competition among the functions (movement, place, and environment) given the distribution of right-of-way across these functions for urban streets.

THE ROLE OF STREETS IN THE HISTORY

Back in time, streets were public spaces where a multitude of purposes essential to our social, cultural and economic needs occurred, transportation notwithstanding (Hamilton-Baillie, 2008). However the separation of vehicular and pedestrian activity has existed since ancient Rome (Southworth & Ben-Joseph, 1997) and may in fact be necessary

(Schumacher, 1978). Indeed, from the early modern period when the Italian architect Andreas Palladio (1518 – 1580) envisioned an ideal city street, which basically consisted of dividing "the place where men are to walk, from that which serves for the use of carts and of cattle" (Southworth & Ben-Joseph, 1997), this division of utility has been recognized.

The ROW distribution bore witness to important changes in history. The first occurred in Paris during the 19th century when Baron Haussmann led an urban reshape of the city. Prior to these changes a majority of the streets were narrow and dark, and there were clear problems of insanity because of the lack of ways of managing the disposals. Access of carts and carriages became a problem due to the limited streets width. Baron Haussmann changed the history of urbanism by implementing the boulevards – thirty-meter wide streets – in Paris after 1850. According to Vidler (1977), the purpose was to open up to light and air "the horrible sinks" and to public circulation. Haussmann's boulevard "was lit with gas light, planned to separate pedestrian from vehicle traffic, planted with rows of trees to ensure shade in summer, provided with underground piping for rain water, sewage, and gas, … and carefully sited to point toward a monument or vista as the object of civil pride or aesthetic pleasure" (sic.) (Vidler, 1978). The public character of the street made possible the easy provisioning of water supplies and sewage services to private plots, most of them underground. At this point trees were the only aesthetic elements on the urban landscape.

The second important change for streets involved the introduction of automobiles to the urban scene. The speed of motor vehicles and the demand for additional road capacity were the two main factors that affected the ROW distribution and ultimately the character of the street. Rapoport (1990) suggests that the conflict between pedestrians and motorists was not understood in terms of people versus cars, but rather in terms of slow movement versus fast movement (Rapoport, 1990). The demand for additional road capacity for motor vehicles started early in the 20th century. As early as 1920, the New York City Police Commissioner pushed the need for more street room (Weinberg & Gershen, 1952). Haslett (1927) as well as Weinberg and Gershen (1952) stated that the best way to achieve higher road capacity would be by simply recessing sidewalks within the property line, and under the upper stories (in the form or arcades) while widening the carriageway by the width of the previous sidewalk. In some busy streets in American cities, the high competition for the space resulted in skinny sidewalks and sometimes in elevated (overhead) freeways. As overhead structures for cars were very expensive and intrusive to the city environment, a more straightforward and pragmatic solution was adopted, which was to reduce the width of the space utilized for non-vehicular traffic to the minimum necessary in order to free up more space for cars, i.e. sidewalk narrowing and road widening. This occurred gradually over the ensuing years to make way for an ever-increasing volume of traffic (Richards, 1966; Southworth & Ben-Joseph, 1997).

In many cities worldwide, urban public space started to be allocated based on the motorized traffic demand. Documents like the Athens Charter during the 1930's and the Buchanan's report in the 1960's put forth an enhanced hierarchical road network and zoning scheme, which later were found to be triggers of costly and inconvenient urban development. Since cities were founded prior to the advent of the automobile, the manner in which the buildings and streets were structured was generally unsuitable for motor traffic (Buchanan, 1963). Many projects envisioned by planners and architects showed highways passing under or through buildings. Soon these utopian ideas were adapted to reality and ended up as elevated (overhead) freeways by the 1930's. In many cities, underpasses or bridges, concrete kerbs, barriers, and traffic islands were the result in busy roads, isolating pedestrians from both each other as well as from the traffic, in small residual areas (Hamilton-Baillie, 2008). The complete segregation of other modes was made under the guise of accident reduction when in reality it was to permit higher speeds for cars.

The public space was thus "carelessly donated to the vehicle" (Wolf, 1978). Pedestrians and cyclists became strangers in the space that they had dominated for centuries while other activities were simply moved out of the street. Nowadays, the automobile, a 'quasi-private' mobility, has subordinated other 'public' mobility (Urry, 2006). "Street" ultimately became synonymous with "road." The street, in its original broad sense of 'a place where all people in equality of conditions could use and enjoy a public benefit' rather became a noisy, dirty, and dangerous place due to the extensive use of automobiles. The link function subordinated the place function.

REALIZING THAT SOMETHING WAS WRONG

Changes in paradigms

From the early 1960's when the automobile was at its peak, cities such as London started to become concerned about their future under the burgeoning increase in motorists. Although the Buchanan report was not able to spark a new paradigm for automobile use as well as transport infrastructure, introduced important concepts such as "environmental zones" by acknowledging that traffic has a major negative impact on the environment. "A convenient term is required to convey the idea of a place or area or even a street, which is free from the dangers, and nuisances of motor traffic. The expression that immediately comes to mind is to say that the area has good environment" (Buchanan, 1963).

There is increasingly a consensus that the automobile has had a significant impact on urban issues, be it environmentally or on humans (Badoe & Miller, 2000; Greene & Wegener, 1997; Nilsson & Küller, 2000). The quantity and length of trips in an automobile (Vehicle trips-VT and vehicle miles traveled-VMT) are critically linked to traffic safety, air quality, energy consumption, climate change, and other social costs due to extensive automobile use (Ewing & Cervero, 2010). Automobiles have strongly led land development patterns, which are overwhelmingly prone to scattered settlements and urban sprawl (Badoe & Miller, 2000). Similarly, it has been realized that providing roads in response to the increasing demand would be an endless problem, exacerbating congestion rather than acting as a real solution. In any case, after several months, during which some improvement was recorded, previous traffic volumes were again reached, even increasing during peak weekend periods (Joumard, Lamure, Lambert, & Tripiana, 1996).

Transport planning is experiencing shifts in paradigms. The automobile-based transportation planning approach based on predicting future traffic demand and providing sufficient roads to attain reasonable Level-of-Service (LOS) (so-called the "predict and provide") has been acknowledged as unsustainable (Downs, 1992; Joumard et al., 1996). Indefinitely providing roads to relieve the congestion is a 'tail-wagging-the-dog' situation. On the contrary, under a new transportation planning paradigm based on "predict and prevent", the street is no longer considered just a *road*, but rather a *space* for people (Banister, 2008).

The planning approach based on the LOS has heavily influenced the ROW distribution and allocation in urban areas. However the recognition and acceptance of other functions in the contemporary street took some time. Several decades ago, some academics insisted on the need to recognize a second function for streets whereby they are considered as "places" where people (rather than vehicles) move or gather (Hamilton-Baillie, 2008; Jefferson, 2001; Jones & Boujenko, 2009; Schoon, 2010; Schumacher, 1978). There is further evidence of a change in urban transportation planning, which is shifting from a car-oriented to a more people-oriented approach. Projects like the Big Dig in Boston, the road diet on Broadway Boulevard in New York City, and the Klyde Warren Park in Dallas demonstrate the interest of planners and governments in providing livable places for people as well as intrinsically demonstrate and acknowledge the unbalanced distribution of the ROW.

Critiques of the current transport planning methods

The problem has not been the LOS method itself, rather its adoption as a valid method for allocating the urban ROW by urban planners. Hebbert (2005) recalls the close 'fit' between engineering and urban design during 20th-century urbanism. In fact, since World War II, more emphasis has been placed on functional (movement) aspects of the street (Lillebye, 1996). Urban design and planning guidelines and standards have been heavily influenced by the movement function of the street, specifically by LOS of roads. Parking requirements have also contributed to street design manuals.

According to Franck (2004), "LOS measures are employed within cost–benefit analyses to assess transportation facility performance, identify system deficiencies and to program where investments should be made" (Frank, 2004). In a simplistic way, decisions between transport projects are based on the relative dollars required for land, infrastructure, services, and for various forms of mitigation relative to the resulting time savings, or in other words, the resulting increase in facility performance or level of service.

The traditional 4-step algorithm for transport demand forecasting has many limitations, especially when considering non-motorized trips (Hebbert, 2005; Rodríguez & Joo, 2004) and has direct influence in the distribution of the ROW. Mode choice models are mostly concentrated on explaining travelers' decisions based on time, costs, and socio-demographic or attitudinal characteristics of the traveler. All other possible factors that might affect travelers' decisions, such as the quality of sidewalks, the presence of trees, or the quality of crosswalks are included in the random part of the utility function of each of the modes, i.e. it is not quantified. Therefore, for decades, the recommendations from travel demand forecasts were mostly focused on road infrastructure and transit supply rather than other important aspects of infrastructure such as trees.

Although the most recent version of the LOS guidelines (multimodal LOS) that consider pedestrian and cyclists in its calculation is a starting point to find an alternative and more equitable way of distributing the ROW, it is nonetheless still a one-sided a method. The new methodology has included important relationships for measuring the LOS of pedestrian and cyclists – for instance, the greater the speeds or volumes of motorized traffic, the lower the LOS for non-motorized traffic. However the method (a) is still considering that the less pedestrian on the street is worst, and (b) is not capable of considering other factors on the street related to the street vocation (commercial, recreational, residential etc.) that are independent of the movement performance of all modes.

New approaches

Recently, a new approach considering redistribution of the ROW has arisen. The Complete Streets movement aim to enable safe, attractive, and comfortable access and travel for all users, be they pedestrians, cyclists, transit riders, or drivers (LaPlante & McCann, 2008). Complete Streets imply a redistribution of the ROW to allow space for all users. Complete Streets focuses more on road users and is about making multimodal accommodation routine (LaPlante & McCann, 2008). This means that this is still, similar to LOS, a movement approach, but less quantitative and more design-focused.

NECESSITY FOR CONSIDERATION OF THE THIRD FUNCTION

Bogotá, The concentration of populations in major urban centers results in an increase in overall imperviousness and deterioration of ecosystems. Cities have displaced natural environments. As a result changes in ecological processes including the water cycle, atmospheric balance, soil structure, and ecosystem equilibrium occurred. Worldwide, at least one-third of all developed urban land is paved (i.e. devoted to motor vehicle infrastructure in the form of roads, parking lots etc.) while in the United States this amount is close to one half of the land area of cities (Southworth & Ben-Joseph, 1997). For instance in the Sacramento area, paved areas cover around 40% of the surface while residential areas are 35% paved on average (Akbari, Shea Rose, & Taha, 2003). The urbanization process has many implications such as increased storm water runoff, larger peak flows, higher ambient air temperature, and less aquifer recharge[1] than those generated by natural or permeable

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[1] Recharge of ground water sources

surfaces, which leads to a more active water cycle (Waters, Watt, Marsalek, & Anderson, 2003) (i.e. increasing the probability of more extreme climate events).

The thoroughfare ROW is, besides parks and plazas, the only place where governments have the power to effectively act, through physical intervention to insert green infrastructure. However the ROW is fully occupied already and, in many cases, insufficient to cope with the mere movement necessities of people. This implies that there is an allocation problem, where the scarce resource is the ROW.

Studies on ecosystem services have proven that urban forests both directly and indirectly influence ecological processes, environmental quality, and human well-being in cities (Nowak, Crane, Stevens, & Ibarra, 2002). The importance of urban green infrastructure, or the sum of all urban trees, shrubs, lawns, and permeable soils (frequently labeled as urban forest, urban green space, urban trees, and urban green system), has been underestimated (Jim & Chen, 2009). In the last decades, many studies have attempted to show the importance of such ecosystem services within the built environment to address climate change, to make cities more livable, to enhance active modes (biking and walking), and to improve the environmental quality of urban ecosystems (including catchment protection for urban water supplies, biodiversity conservation).

Brown et al. (2007) define ecosystem services as “the specific results of ecosystem functions that either directly sustain or enhance human life.” Urban green space provides many environmental and social services that contribute to the quality of life in cities (Gregory McPherson, 1992). Besides leisure opportunities, urban ecosystems provide other services and benefits; provisioning services (water or shadow), regulating services (infiltration or storm mitigation), supporting services (soil formation, pollinization), and cultural services (recreation and aesthetics) (Escobedo & Nowak, 2009; Pincetl, 2010) highlight, among many other ecological services, storm water runoff reduction, aquifer and surface water availability, drinking water quality, air quality improvements, erosion control, soil nutrient retention, sediment removal, tree shade and wind reduction, production of grains, fruits, nuts, seeds, wood and biomass, provision of aesthetics, and provision of natural areas for human use. Urban forests simultaneously produce other ecosystem outputs besides ecosystem services (benefits) that can be described as disservices (costs) (Escobedo & Nowak, 2009), such as damage to urban infrastructure (cables, roads, sidewalks, properties etc.), blocked sunlight, green waste, allergenic pollen, fear of crime, fertilizer and pesticide runoff, and increased energy consumption from poor management (water, leaf blowing, etc.).

The insertion of green areas and trees in the built environment provide benefits both at the local as well as global scale. Among the more relevant impacts of this strategy are: reducing impermeable surfaces, raising evapotranspiration rates, mitigating storm water peaks, and improving soil infiltration, green infrastructure ensures these improvements by trapping carbon and producing more oxygen, ameliorating pollution in the city, increase in urban biodiversity and a reduction in the temperature differential between the city and its surroundings (Beatley, 2000; Brack, 2002; Kaule, 1989; Pincetl, 2010).

Redistribution of the ROW in a more balanced way implies a reduction of paved areas, which may result in an additional benefit. It has recently been discovered that the dark urban surfaces of buildings and pavements are one of the major heat sources causing urban heat islands due to a differential albedo effect (Kinouchi, Yoshinaka, Fukae, & Kanda, 2004). The increased area of roads that have a high thermal storage and lower albedo (absorbing more heat from the sun) causes an energy uptake during summer days. This heat that is stored during the day is then reradiated at night (Whitford, Ennos, & Handley, 2001) which consequently results in higher energy consumption for home cooling. A reduction of the pavement surface area would have an equivalent effect of a replacement of dark pavements, but with the extra benefit of the cleared zones within the ROW.

The concept of livability appears to be related to the environmental function of the street. By adding trees to the ROW, the value of properties, communities, and neighborhoods can be increased by having walkable, safe, and healthy environments (H. J. Miller, Witlox, & Tribby, 2013). On the contrary, as streets become less attractive, people are less inclined to spend time in them for social activities. Walking and cycling become less attractive, public perceptions of safety decline and activities such as play relocate away from the public realm to private space (Hamilton-Baillie, 2008).

ROW DISTRIBUTION FRAMEWORK

As previously explained, public spaces in the built environment must consider the provision of an important service for society – an environmental service. We developed a conceptual framework in order to facilitate the understanding of the allocation problem. To approach the problem we complemented by the straightforward bi-dimensional schematic system to explain the ROW distribution between the movement function and the space function presented by (Jones & Boujenko, 2009; Schoon, 2010). This framework is a simplified representation of reality, thus it cannot reproduce all details, but let the reader understand the concepts underneath.

The ROW is in most cases already a fully occupied space. In some cases the ROW is insufficient to accommodate all functions, but in many others there may be space remaining despite the fact that the whole ROW is already in use. Inserting green infrastructure into the ROW creates a resource allocation problem. Although the entire ROW is allocated, it does not mean that there are no spaces remaining (over supply of roads, guidelines, and minimums). In fact, many NCS streets may have ample space for insertion.

Figure 1 shows how the total ROW width (15m in the example) can be distributed in several ways. The envelope line represents all possible combinations between the place and the link functions. It is simple to quantify the requirements for the link function, but more difficult for the place function. This means that mostly the distribution of the ROW is made based on subjective judgments and tradeoffs by designers and engineers. Conversely, minimum requirements permit the determination of whether there is ROW-remaining or not. Depending upon the circumstances, there are three possibilities: the requirements are less than the ROW (zone A in Figure 1), the requirements exceed the ROW (zone B), or the ROW fits exactly for the demands. In case A, the remaining ROW is typically devoted to having wider carriageways for parking, but it may depend on the case (Figure 2). When the ROW is not sufficient to accommodate the minimum requirements of both functions, conflicts arise and tradeoffs have to be considered (Figure 3).

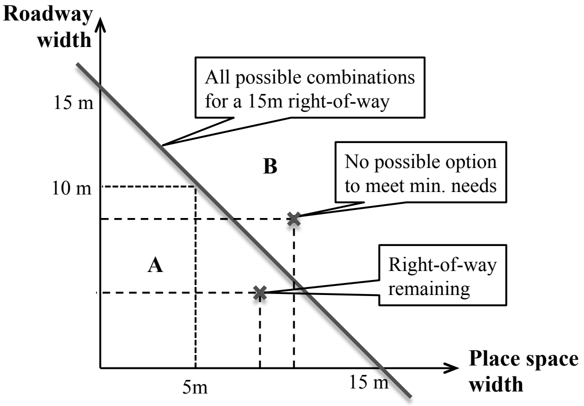

Figure 1. Example of total right of way capacity (based on Jones, 2007).

Figure 2. Situation of non-conflict between function requirements. (Photo: Rodriguez-Valencia)

Figure 3. Situation of conflict because of the necessity for further space of each of the functions (Photo: Radio Santafe).

To include the third function of the street – the environmental function – in the conceptual framework, we add a new dimension to Figure 1. The envelope line that formerly divided the situation with or without competition becomes a three dimensional plane. Any point in this plane is the combination of the sum of three widths that sum up the total ROW (Figure 4 as an example ROW is 15m wide).

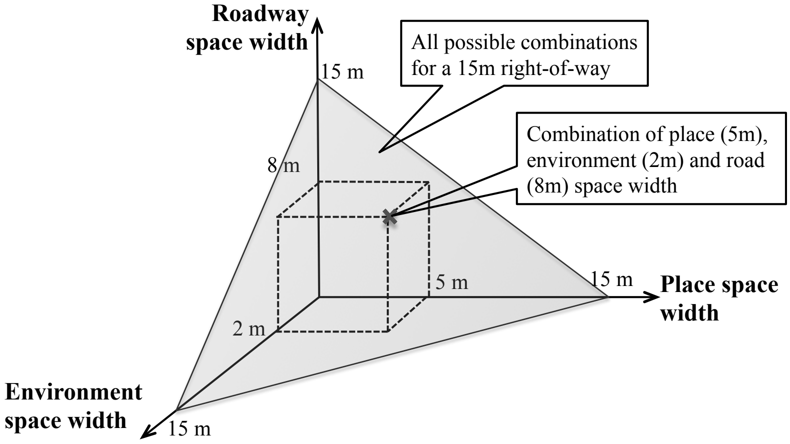

Figure 4. Example of total right of way capacity including environmental function.

For the ROW with no competition, the insertion of green infrastructure would be easier. For the competition cases, new criteria in addition to Level-of-Service must be applied to distribute the ROW. The overlapping (multiuse surfaces) of uses has to be considered when developing the distribution methodology (e.g. permeable-stable parking surfaces). Greenbelts and pervious corridors can be considered as well. We define in the following terms streets that may be under the competition situation (CS), those in equilibrium (ES), and those in non-competition situation (NCS). As the NCS streets might constitute a substantial area within cities, this would then be indicative of a substantial remaining area, depending on the mean remaining space in the ROW.

DISCUSSION

The social meaning of the car and its use affected the perception of the street, resulting in the public space (ROW) becoming uncontested and taken for granted by the majority associated with this activity. The increase of private, individualized motorized transport enhanced this social construct, associated with freedom, independence, adventure, and open-mindedness, and as a result, the goods under competition are distributed according to that dominant social meaning (Martens, Golub, & Robinson, 2012). The primacy of motorized transportation (and the underestimation of the built environment, active modes, and other relevant factors) in current transport planning methods, discussed earlier, stress even more this unbalanced distribution of ROW among street users.

To that end, Waltzer (1993) stated that goods to which a particular society ascribes a distinct social meaning are to be taken out of the sphere of free exchange and distributions must be autonomous (Walzer, 1993). Conversely, existing initiatives intended to achieve a more balanced distribution (of the ROW) come from other competitor, e.g. bike users, road safety advocates, environmentalists, etc. For instance, Complete Streets advocates are approaching the problem based on the self-construction of the social meaning of the street and are trying to overcome the dominance of the social construct regarding the car. This would imply that so far, no method or proposal have taken aside a specific social construct before approaching the distribution problem, probably leading to inequitable outcomes.

Transport facilities are a necessary social asset and a precondition for the progress and the existence of modem society (Lillebye, 1996). The accommodation of new transport facilities, required for a vibrant economic development, would be even more difficult if considering insertion of a new competing function to the ROW. The challenge is thus establishing an urban transport system, which can provide accessibility for the various parcels of the city at environmentally and aesthetically acceptable levels.

As possible implication of the formal consideration of a new methodology for distributing the ROW based on the framework presented in this paper, we consider that it would result in the stimulation for the underground exploitation for transportation projects. There are two arguments justifying our statement. Firstly, since both place and environmental functions are dependent on open spaces (and movement function do not), the expected result after inserting the environmental function (considering the place function as well) would be that new transport infrastructure would be built below the surface, if competition occurs. Clearly, for people to gather and enjoyment of the public spaces, light, greenery, and fresh air are important. Furthermore, it is seemingly important for cities to have beautiful green spaces for people. The place function has been becoming important and as evidences are the mentioned projects (Big Dig, Broadway Bvrd., Klyde Warren Park) and intrinsically demonstrate and acknowledge the unbalanced distribution of the ROW.

The second argument is that, since a new function has to be considered among the ROW, any new road or any road enlargement would require considering the cost of displacing the other two functions. The surface space that before was given as granted now has to be accounted in the cost-benefit analysis (or any other assessment method) for the road project. Depending on the city and the case, it would be possible that the relative value of the place function (livability, aesthetics, etc.) and the environmental function overcome the benefits of the movement function, thus justifying the construction of the underground structure.

Another important implication of the presented framework is answering the question: what happend if urban planning is evolving towards denser and more mixed cities? This problem of ROW allocation becomes more relevant for two reasons: more demand of alternative modes of transport (intensification of the use of the ROW) and less pervious areas in private plots. The dense city is suitable direction for future city planning, the idea being that such cities promote sustainable development (Hardy, 2004). Dense urban developments are expected to produce shorter trips and increasing attractiveness for transit. In fact, the underground metro-system was introduced in major cities to relieve the pressure on the surface (Durmisevic & Sariyildiz, 2001).

Our final concern is regarding to how to evaluate the environmental function in a comprehensible, simple, and valid manner. There are no widely accepted methods for the quantification and assessment of the ecosystem services offered by urban green infrastructures (Jim & Chen, 2009). The qualities of urban green areas are often not appropriately accounted (Grahn & Stigsdotter, 2010). A standard method would be very useful (a) for assessment of the economic benefits and (b) for comparison between different scenarios, and (c) for communities and decision makers to become aware.

CONCLUSIONS

Thus far the distribution has been in the moral-normative scope, which is always arguably biased towards some social meaning of a particular group among the various members of society. The LOS methodologies, including the most recent version, and complete streets approach are still one-sided methods, neglecting the core of the other two street´s functions: the place function and the environmental function. The necessity of an independent, autonomous method for ROW distribution is quite evident and this paper attempts to provide the framework whereby to approach the allocation problem in a more holistic way. We are aware of its limitations. More research is needed to strengthen the arguments presented herein.

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