

spatium

urban and spatial planning, architecture, housing building, geodesia, environment

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SCOPE AND AIMS

The review is concerned with a multi-disciplinary approach to spatial, regional and urban planning and architecture, as well as with various aspects of land use, including housing, environment and related themes and topics. It attempts to contribute to better theoretical understanding of a new spatial development processes and to improve the practice in the field.

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EDITORIAL

Dear readers,

a major part of this issue of *Spatium* consists of six selected papers from the 2nd International Conference *Changing Cities II: spatial, design, landscape & socio-economic dimension*, section “In Quest of Sustainable Urban Mobility”, held in Porto Heli, Peloponnese – Greece, 22-26 June, 2015. The selected papers are here published in cooperation with the Department of Planning and Regional Development, University of Thessaly, the organizer of the Conference. In this section, another contribution goes to the issue of urban mobility, written by four authors who did not participate at the mentioned Conference.

Other contributions in this issue of *Spatium* predominantly reflect the findings from some current national and international scientific research projects in which Institute of Architecture and Urban & Regional Planning of Serbia has been participating, on a number of specific themes and issues, viz.: green infrastructure planning, limiting urban sprawl, urban land-use, transformation of residential structure, urban heritage, and implementation of urban and spatial plans.

Also, some minor changes have been introduced with regard to graphical design of *Spatium*, as well as changes in the Editorial team.

Miodrag Vujošević
Editor-in-Chief

AN URBAN STRATEGY IN TIME OF CRISIS: MOBILITY MANAGEMENT AND LOW-COST PUBLIC SPACE DESIGN

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This research underlines the importance of mobility management tools and small-scale targeted interventions of public space upgrades in order to encourage conscious sustainable mobility behaviour. The paper reviews tools and tactics of soft transport policy measures, as well as of small-scale and low-cost public space design approaches and strategies in the USA and Europe to assess their characteristics and results. It will then focus on Thessaloniki (Greece) presenting 1) the main findings of a trip survey concerning the impact of the economic crisis on mobility behaviour and 2) the shift to low-cost street scale urban design projects which have emerged during the crisis. The paper states that quality public space and urban transport constitute conditions necessary to attain long-term change in mobility behaviour. While the importance of hard transport policy measures should not be underestimated, the strategy for achieving sustainable urban mobility and public space design adapted to the economic crisis-specific conditions is discussed.

Key words: mobility management, economic crisis impacts, soft transport policy measures, small-scale and low-cost public space design, Thessaloniki.

INTRODUCTION

Mobility management attempts to change travel behaviour (how, when and where people travel) in order to reduce car use and to promote sustainable urban transport modes. It endorses actions and “soft” transport policy measures such as information and communication, organizing services, coordinating stakeholders and promoting initiatives. In some countries, the definition of mobility management is equivalent to transport demand management (MAX, 2007). In contrast, “hard” measures include the development and the physical improvement of public transport networks and infrastructures (tram lines, bus and bike lanes, transit priority, traffic calming), as well as the introduction of taxes and regulations to control the road space and car use (road pricing, traffic and parking management) (Gärling *et al.*, 2009). The main advantage of “soft” measures is that their implementation requires fewer financial resources than the “hard” ones; they are cost effective methods and can also contribute to enhancing accessibility and decrease social exclusion associated with transport (Clarke, 2012). “Soft” measures are demand-oriented while “hard” measures are

supply-oriented. As stated by Bamberg *et al.* (2011) soft transport measures are designed to voluntarily change people’s travel attitudes (Loukopoulos, 2007) and they are also mentioned as psychological and behavioural strategies (Fujii and Taniguchi, 2006) or mobility management tools (Cairns *et al.*, 2008).

According to Cairns *et al.* (2008) soft policy measures give emphasis to management and marketing activities rather than operation and investments and they include personalized travel planning, public transport information and marketing, travel awareness campaigns, workplace and school travel plans, and teleworking. As reported by Friman *et al.* (2012) soft measures are considered bottom-up approaches that aim to encourage and support people to decide themselves if they wish to change their existing travel choice according to their personal characteristics, needs and goals. They are opposed to top-down process which is oriented to impose new habits and attitudes (Taylor and Ampt, 2003).

In the framework of an integrated approach soft measures can be combined and create synergies with supply-oriented measures or supportive actions concerning planning, constructing and operating infrastructures.

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These could include spatial and land use planning, public transport improvements, bicycle and pedestrian facilities, transport information systems, car parking management, and congestion pricing (MAX, 2009; MIDAS, 2008). The soft policies could be more effective in motivating car users to switch to other travel options with the implementation of hard and supportive transport policies that change the relative attractiveness of these options (Bamberg, 2011).

In this context, of particular interest are a number of local development and interim design strategies adopted recently in various cities worldwide. They focus on short-term, street-scale and community-led interventions, promoting sustainable mobility and immediate regaining and improvement of public space, and they are part of a more generalized tendency to look for alternative urban design strategies in the time of crisis. Among them we can cite:

- “Urban acupuncture” that promotes community-led, targeted but catalytic, small scale interventions as part of a larger strategy, in order to achieve the maximum effect through minimum investment (Parsons, 2007; De Sola Morales, 2008; Unt and Bell, 2014).
- The more recent and radical concepts and movements of “adaptive planning” or “tactical”, “temporary”, “guerrilla”, “pop-up”, “informal”, “emergent”, and “DIY” urbanism that encourage low-cost and often self-funded, short-term actions and initiatives, of well-intentioned but illegal character, causing long-term changes in the city (Rasmussen, 2012; Fernández, 2012; Lydon and Garcia, 2015).

All these strategies draw on basic principles and concepts of planning approaches and theories which resulted from criticism of rational planning (such as incrementalism, participatory, advocacy, progressive, transactive, collaborative planning), as well as on tools and techniques proposed by transport engineers to reconfigure roadways to meet safety and people’s needs. Furthermore, most of them derive from a critical and often resisting attitude against mainstream market-led policies and large-scale, long-term, top-down urban regeneration projects realised during the 1990s and 2000s, under the influence of neoliberal ideology in urban space production. In fact, crisis has only accelerated and multiplied these urban design approaches to planning.

These approaches clearly indicate a shift of interest to more localised, low-cost, low-impact, low-risk, low-tech, temporary or transitional, bottom-up, flexible, soft, alternative, experimental, creative and pragmatic strategies of city making and public space design and use. Together with special events and intervention projects, often situated at the cutting edge of architecture, engineering, urban design, art and social action, and based on citizens’ participation, they aim to increase public awareness of urban sustainability (Bishop, 2012; Chapel, 2012; Athanassiou *et al.*, 2012). In a period of scarce resources and political and economic uncertainty, these approaches seem to fit perfectly with the limited financial capabilities of local authorities, but also with the changing mobility needs and environmental conditions. They also respond better to the demand and pressure of the community for quick results which in most cases are inconsistent with the usually complex and lengthy

typical planning and implementation processes. Fernández (2012) believes that there is a need to adopt new forms of intervention in the city from three perspectives: as dynamic performance against the crisis which is most apparent at the local level; as preparation strategy against climate change with resilient and transitional models as alternatives for the adaptation of the physical environment, the infrastructures and local communities; and as tactical intervention in the city (tactical urbanism) against the exhausted model of hierarchical, centralized and institutional city planning.

SOFT TRANSPORT POLICY MEASURES AND LOW-COST DESIGN TACTICS

Soft measures

Best practices of the soft transport policy techniques come from Austria, Germany, Japan, Netherlands, Sweden, UK, and USA while in other countries their implementation and evaluation are uncommon. Mobility management initiatives in Australia are known as “voluntary travel behaviour change” (VTBC) and in Japan as “travel feedback programs” (TFP). According to Möser and Bamberg (2008) the first five measures presented in Table 1 are the most often implemented during the last decade (Richter, 2010).

Richter (2010) reviewed that in general soft transport approaches seems to be effective in many countries but more research is needed to understand the reasons. According to Richter *et al.* (2009) and Friman *et al.* (2012) the combination of soft and hard measures creates positive interactions and reduces car use further. Richter *et al.* (2009) states that studies from Netherlands and USA report that work travel plans combined with parking management measures or bus subsidy can create a decrease of car use by 20-25%. Without hard measures, the decrease is only 5-15% (Cairns *et al.*, 2008). The quality of public transport (reliability, frequency, travel time, fare level, comfort and cleanliness) is also an important factor in mode choice. As stated by Taylor (2007) the results from studies conducted in Auckland, New Zealand demonstrated that the good quality of public transport system is a significant prerequisite for the successful implementation of soft measures. Findings from research carried out in Porto, Portugal show that in order to attract potential users on public transport, the service provided should satisfy the quality expectations of the customers (Beirão and Sarsfield Cabral, 2007). In addition, it seems that public transport marketing campaigns particularly influence people who are at points of change in their life, so they are more susceptible to changes (Richter *et al.*, 2009). Hence, transitional periods like economic crisis could be the right moment for implementing low cost measures that enhance the quality of mass transit and public space in coordination with soft initiatives that promote sustainable mobility.

Interim, low-cost, and community-led public space design strategies

The improvement of the quality of pedestrian environment, which constitutes one of the principal goals of alternative urban design strategies, would directly lead to a more efficient use of public space, a broader choice of contents and space, and thus to the increase of walking as a

Table 1. Classification of soft measures, adapted from Cairns et al. (2008) and (Clarke, 2012)

Travel awareness campaign	Increases awareness and informs public opinion about problems resulting from car use and proposes sustainable mobility solutions
Public transport information and marketing	Mass advertising and branding campaigns to make public transport desirable and to promote new integrated ticketing policy
Personalised travel planning	Advises and supports individuals and households on sustainable travel options depending on their personal characteristics and location
Workplace travel plan	Encourages employees to reduce the use of the car for commuting in favour of walking, cycling, car sharing or public transport
School travel plan	Encourages young people who live within a realistic walking distance of their school to walk or cycle instead of being driven in a car
Carpooling and Car sharing	Web-based matching of travellers for commuting and business purposes, which can be promoted via work place events, road signs and promotional campaigns.
Car club	Membership based schemes enabling people to gain temporary use of a car without the need to own one.
Teleworking and Teleconferencing	Employers allow employees to work at home or at other locations using information and communications technologies
Home shopping	Electronic retailing and goods ordered by mail, telephone or online which are delivered at the customer's home

sustainable travel attitude in medium sized cities (Đukić and Vukmirović, 2012).

Urban Street Design Guide prepared by the National Association of City Transportation Officials (NACTO) constitutes a very detailed guide on the redesign of different types of streets as a catalyst for urban transformation taking into account the multi-faceted role they could play in any city (walking, driving, cycling, taking transit, parking, working, shopping etc.). According to the Guide, "Interim design strategies are a set of tools and tactics that cities can use to improve their roadways and public spaces in the near-term. They include low-cost, interim materials, new public amenities, and creative partnerships with local stakeholders, which together enable faster project delivery, and more flexible and responsive design," (see Table 2).

These tools and tactics are in fact a combination of soft initiatives and low-cost supportive measures enhancing public space and promoting sustainable mobility.

Concerning interim plazas, one of the most interesting and well known examples, especially because of its extent, is the New York City Plaza Program launched in 2008. A similar approach has been adopted by other large US cities such as Los Angeles, San Francisco, and Philadelphia (NACTO). Another tactic that seems to be more and more attractive is the replacement of on-street parking spaces by parklets. It was originally applied within the initiative PARK(ing)DAY which first occurred in 2005 in San Francisco and spread rapidly, becoming an annual open-source global event. In 2011, it temporarily reclaimed 975 parking spaces in 165 cities, 35 countries, and across six continents. This event,

Table 2. Tools and tactics of interim design strategies, adapted from NACTO Urban Street Design Guide

Tools and tactics	Characteristics	Results
Moving the Curb	Curbsides can host a wide variety of uses beyond parking: bus lanes or cycle tracks / parklets, bike corrals or stations and temporary traffic calming devices	More efficient use of valuable street space Reclaiming space devoted to automobiles Activating street life and creating a destination within the street
From Pilot to Permanent	Phased approach to major redesigns Small-scale, interim changes, such as sidewalk widening, public plazas, street seating	Assessing the impacts of the intended project in real time Building support for a project by realising the benefits for the community more immediately Testing the functionality in a case of full-scale capital project and possibility for modifications
Parklets (street seats or curbside seating)	Public seating platforms that replace one or more parking spaces. Usually distinctive design (often standardized) incorporating seating, food tracks, greenery and/or bike racks Installed and managed by the city or product of partnership between the city and local businesses, residents or neighbourhood associations and non-profit organizations which assume design, installation costs and maintenance	Providing gathering place, vibrant community spaces and pedestrian amenities which encourage non-motorized transportation Increasing foot traffic and visitors, in some cases, revenue for adjacent businesses
Temporary Street Closures	Regularly scheduled restricting of a street to pedestrians and bicyclists at specific times of day, specific days of the week or during the year, or for certain seasons (play streets, block parties, pedestrian streets, street fairs, open streets etc.)	Taking better advantage of the roadways, especially at off-peak hours or weekends and raising awareness about the harmful effects of the automobile Increasing foot traffic and visitors, which promote local economic development
Interim Public Plazas	Underutilized roadway spaces, especially intersections, transformed into public spaces for surrounding residents and businesses Use of low-cost, environmentally friendly materials and moveable equipment Product of a partnership between the city and a business or neighbourhood association and non-profit organization which maintains, oversees and programs the space	Slowing traffic speeds and making intersections safer, more compact, and easier to cross for pedestrians Creating foot traffic that can boost business and invigorate street life in a neighbourhood Taking advantage of all the benefits mentioned in the Pilot to Permanent tactic

together with some influence from New York City Plazas and European open-streets movements, is thought to be the precursor to San Francisco Parklet and Pavement to Parks Programs which were initiated in 2010. The example of San Francisco has inspired other US and Canadian cities such as Philadelphia, Los Angeles, Chicago, Oakland, Montreal, Vancouver, and European cities as well (see Dublin Street Parklet Beta Project) (Lydon, 2012; Loukaitou-Sideris, 2012; NACTO).

URBAN STRATEGY AND MOBILITY BEHAVIOUR IN THESSALONIKI DURING THE ECONOMIC CRISIS

The impacts of economic crisis in mobility behaviour

International experience shows that during an economic crisis, income reduction together with the rise of ticket prices harms both private and public transport means by causing staff reductions, cutting routes and reducing maintenance and quality of service. Citizens, and especially low income classes and the unemployed, are forced to dramatically decrease travel expenses, trip frequencies and travel distances with all transport modes, or choose to use more often mass transit and non-motorised modes for short and medium distances. However, conscious preservation of sustainable mobility behaviour in the future is not certain after the end of the economic crisis. In general, car use is the most affected even from the beginning of the crisis. Further changes depend on the local conditions and the quality of the public transportation system. Spatial coverage, accessibility, frequency and prices are some of the factors that make mass transit attractive and define whether the modal shift takes a permanent or temporary character. For example, when ticket prices remained high, illegal behaviour (free riding, ticket fraud) rose and in many cases the volume of transit users decreased (Papagiannakis, 2014).

The global financial crisis of 2008, the indigenous and skewed Greek economic model of the 70's onwards, combined with the adopted austerity measures imposed by the Financial Aid Programme (May 2010), resulted in sweeping and often violent changes in the society and in all strategic national sectors. Negative economic indicators did not only affect the prospects of the country, but they also had significant impact on the everyday life of citizens, their mobility behaviour and the modal split and the trip frequency patterns in the cities.

A trip survey was conducted from April to May 2014 in order to compare the characteristics of commuting trips between the city centre and the Greater Thessaloniki area, before and during the crisis (Papagiannakis, 2014). The study area included 9 different districts located in the historic centre of Thessaloniki, a dense mixed land-use area, which contains trip generation poles for all trip purposes. The sample consisted of 853 randomly selected pedestrians on typical working days, during morning and evening hours. The methodology applied is a random quota sampling following the sex and age distribution of the overall population in the municipality of Thessaloniki (2011 census).

Drawing from the main results of the research we conclude that the residents of Thessaloniki have reduced the frequency of their trips by private car, with greater reductions observed in trips for shopping and entertainment. Also, a modal shift

is observed towards public transport and soft modes. Thirty-eight percent of the respondents stated a differentiation of transport mode choice during the crisis, while the remaining 62% did not modify transport mode preferences. Figure 1 illustrates the main transport mode preferences of the citizens before and during crisis, in the whole sample. We can observe a clear trend of decreasing preference for the private car and taxi with an inverse upward trend in the preferences of the bus, walking, motorcycle and bicycle. More specifically, before the crisis a percentage of 43% of the sample usually preferred private car and taxis, while nowadays this rate is limited to 26%. The reduction of 17 percentage points observed in car use corresponds to an equivalent increase in the use of bus (from 35% to 47%), walking (14% to 17%), bike (from less than 1% to slightly over 1%) and the motorcycle (from 7% to 9%).

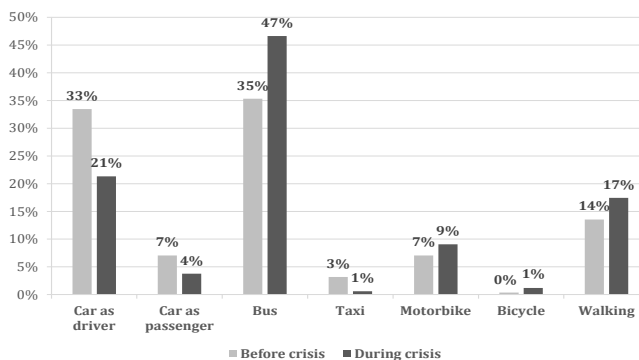


Figure 1. Main modal choice before and during the crisis

In particular (Table 3), almost one in two respondents that used to travel with car before the crisis continues to do so (51%). But the other half has shifted to other transport modes for downtown trips. A figure of 36% of the primarily car users has mostly replaced the car by the bus, 7% by motorbike, 4% by walking and 1% by cycling. None of the people who preferred the taxi before the crisis, continues to do so. Seventy percent of the primarily taxi users replaced it with the bus, 7% with the car and 19% with walking. Concerning the public transport, 80% of the bus riders before the crisis are still traveling by bus, 7% replaced the bus with walking, while 11% shifted towards the car.

Table 3. Changes in transport mode choice during the crisis

Before the crisis, people whose main mode was:	During the crisis, modal split						
	Car	Taxi	Bus	Moto	Walking	Bike	Total
Car	51%	1%	36%	7%	4%	1%	100%
Taxi	7%	0%	70%	4%	19%	0%	100%
Bus	11%	0%	80%	1%	7%	1%	100%
Walking	1%	0%	7%	1%	90%	1%	100%

In order to investigate whether people understand the long term benefits of limiting the use of private car and adopting sustainable travel behaviour, the survey also explored the changes in the use of transport modes as well as the willingness to preserve these changes (Table 4).

Table 4. Willingness to preserve changes in the use of transport modes

	Sample Percent	Willingness to preserve changes			
		Yes	No	Maybe	I don't know
People who reduced car use	29%	40%	36%	14%	10%
People who increased bus use	28%	42%	28%	15%	14%
People who increased walking and biking	10%	76%	6%	14%	5%

According to the results, a clear trend towards the adoption of changes in travel behaviour concerning car, taxi and bus is not observed since the minority of 40% answered clearly "yes," while the remaining 60% stated "No," "Maybe," "I don't know." But 10% of the people that choose to walk and bike more frequently during the crisis, seemed to be more determined to continue this habit in the future. In any case, the future preservation of the new travel habits is not due to awareness of sustainable mobility, but mainly related to cost issues. Forty-five per cent of the respondents declared the high gasoline price as the major cause of the reduction of car use, while 27% stated the expensive cost of parking. For 9% of the sample the high ticket price is the most important reason for decreasing bus use although for 7% it is the overcrowded vehicles. Finally, only 3% of the respondents indicated a modal change due to environmental awareness.

In general, the effects of the economic crisis are proving more effective in limiting the car use compared to any kind of hard or soft policies and measures promoting sustainable mobility that have been implemented in the past. But the answer to the crucial question, whether the financial crisis is an opportunity for sustainable development or not, is neither simple nor easy.

Public space design and sustainable mobility in Thessaloniki during the crisis

Urban and especially metropolitan areas that are particularly affected by the crisis should re-orient planning principles and content, improve democratic participation in the planning process and make the most of the available resources to promote their resilience so as to face new types of emerging problems (Thoidou, 2013). In fact, in Thessaloniki, there has been a shift in the type and character of the public space projects since 2010 towards sustainable urban mobility as confirmed by research concerning the creation of public space in the city since 1980, which was based largely on the consult of the municipal archives (Department of Urban Design and Architecture) (Vitopoulou, 2015).

The period 1995-2010 is characterized by the rhetoric and deficient implementation of a major urban renewal strategy and the key-role of public space in achieving urban restructuring and overall improve of the image of the city. Fragmented funding, often by different sources and financing programs (central government bodies, EU etc.), resulted in the postponement, the partial implementation or the impoverishment of large-scale projects dominating the agendas of local authorities. During the last three decades, the city has also been in constant discussions to promote major public transportation projects and infrastructures

(metro, tram, suburban railway, and suburban sea bus) or awaiting their implementation. The existing public transport system, exclusively based on a bus network, lags behind its European counterparts for cities of similar population and urban characteristics as Thessaloniki. The only significant hard measures that have been implemented are the creation of bus lanes in main arteries, the expansion of the bus network in the suburbs, the bus telematics system, the parking management in the centre, and a cycle paths network of limited length, which proved not enough to reduce car use. In the same period a number of small-scale projects of public space embellishment were realized in a rather ad hoc and piece-meal manner. Some of these, especially during the 2000s, concerned supportive sustainable mobility measures such as sidewalk upgrade in main arteries, curb extensions, ramps and bollards protecting sidewalk space from car parking in the main streets.

As shown in Figure 2, during 1995-1999 a large number of public space design/redesign projects were implemented or elaborated. This can be easily explained as the program of the Organization of Cultural Capital of Europe "Thessaloniki '97" was underway. In fact, it focused not only on the construction of cultural equipment but also on the improvement of public spaces, especially the ones surrounding important monuments. From 2000 to 2009 there is a significant reduction with an almost equal distribution every five years, while during the last five years a significant increase is observed.

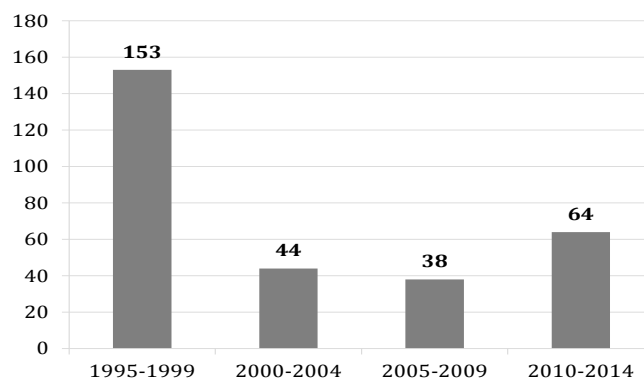


Figure 2. Elaborated/implemented public space projects during 1995-2014

According to the distribution analysis of different types of public space projects every five years, the "street redesign projects" is the second most frequent type after the "open/green space redesign projects". Its maximum value is reached during 1995-1999, followed by a constant decrease during the 2000s, reaching the minimum value during 2005-2009, before increasing again significantly during 2010-2014 almost approaching the levels of the period 1995-1999 (Figure 3).

The noteworthy increase of the small-scale street redesign projects explains the rather peculiar overall increase of public space projects during the period of crisis. Moreover, it points out a shift in the general strategy of the Municipality (we should also bear in mind the political change in the head of the Municipality of Thessaloniki in 2010), from major urban renewal projects that require bold funding and a long

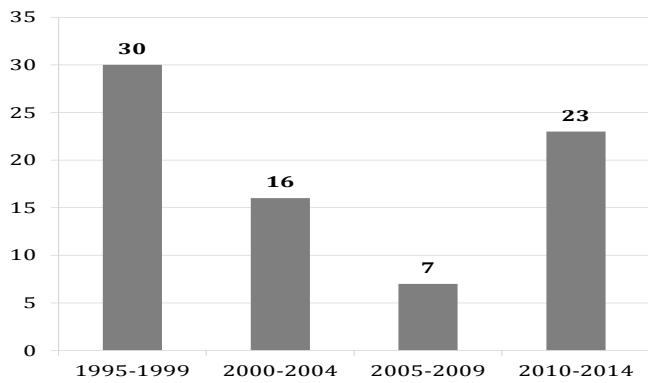


Figure 3. Street redesign projects during 1995-2014

period of implementation, often ever perpetuated, to small-scale targeted and flexible interventions which are part of a larger strategy of reclaiming space devoted to cars. Based on projects elaborated by the municipal technical service, of an immediate implementation and low-cost minimal character, they mostly concern sidewalk widening, traffic-calming streets and pedestrian streets, applied both downtown and in some residential neighbourhoods (Vitopoulou, 2015).

They also concern interim design, such as the temporary closure of the coastal street on certain Saturdays or the transitional phase of pedestrianisation of a part of Aghias Sofias street, an important axis of historical value in the city centre. This was achieved by using temporary materials and moveable equipment, while waiting for the necessary funding and the completion of the complex and lengthy Greek planning and approval procedure of the major redesign project. Many of these interventions are based on the ideas and suggestions made by citizens and communities or local initiatives and partnerships with local stakeholders. Thus, they also indicate a change in the planning and implementation process (Christodoulou, 2013). We could argue that this “strategy of the feasible” (Athanasidou *et al.*, 2012) constitutes in reality the first application of small-scale integrated urban and transport planning in the city.

This change in urban design practice and governance is reinforced by the multiplication of urban interventions and creative actions promoting more efficient or alternative use of public space, which are stimulated mainly by private initiative, that is, volunteer groups, associations or non-profit organizations (such as the “Union for Pedestrian Rights”, the “Thessalonistas”, the “Thessaloniki Cyclists”, the group “BikeRespect” which launched the bicycle sharing system “i-bike” etc.). It should be underlined though that these initiatives had formed long before the crisis a dynamic of various claims and different views on the public space manifested in different opportunities (Christodoulou, 2013).

CONCLUSIONS

In the context of the economic crisis, small-scale, low-cost, interim and community-led integrated urban and transport planning interventions in combination with soft measures (e.g. campaigns, actions, etc.) seem to be gaining ground as an urban strategy in more and more cities worldwide. These approaches face the problems of uncertain and scarce funding while bypassing the complex and lengthy

planning and implementation processes. Thus, they offer direct and quick results to local communities, and attempt to adapt planning to the changes in mobility needs and environmental conditions. These bottom-up approaches involve stakeholders, residents, neighbourhood associations and non-profit organizations in the planning process, as well as in urban management practices.

In the case study of Thessaloniki a tendency towards this type of urban strategy is detected, as well as a slight change in mobility behaviour towards more sustainable transport modes. However, they are not directly related to each other. New travel attitudes are mostly related to cost issues, and thus it is not certain that they will be permanent. The main reasons for this are the lack of an integrated public transport system and the generally degraded public space despite the improvement already achieved. Quality public space and urban transport constitute conditions necessary to attain a long-term change in mobility behaviour. The absence of this in Thessaloniki constitutes the main reason why the aforementioned urban strategy lacks the effectiveness it has abroad.

In order for the city to adjust to and profit from the economic crisis repercussions in favour of sustainable mobility, it is crucial to undertake initiatives that develop and consolidate synergies in the three following directions:

1. Mobility management measures which facilitate citizens’ recognition and understanding of the personal and social benefits of environmentally friendly transport. While not capital spend projects, soft transport measures could be used with a view to enhance and preserve the forced changes observed in the trip choices and travel behaviour.
2. Low-cost hard transport measures and supportive actions preserving an adequate level of quality of public transport service. Since securing funding for the realization of medium and long-term projects for the development of major transport infrastructures is difficult, low-cost and short-term measures for the improvement of the existing urban transport system should be prioritised. A competitive price for public transportation is strong motivation that should be combined with more effective measures enhancing the quality of service (frequency, reliability and comfort) such as: priority of public transportation in the road network (extension and strict bus lane enforcement), parking management and strict parking enforcement in the city centre.
3. Tools and tactics of interim design strategies or tactical urbanism which allocate a part of the road space to promote walking and cycling as conscious mobility behaviour.

Based on the literature review, the proposed urban strategy can make a visible improvement in public space and endorse sustainable urban mobility. However, further quantitative research is needed in order to assess the effectiveness of this crisis strategy, as well as the depth and permanence of the changes that it could bring to the mobility behaviour and the public space appropriation by citizens.

REFERENCES

- Athanassiou E., Vitopoulou A., Karadimou-Yerolymou A., Papagiannakis A., Christodoulou Ch. (2012) From iconic to pragmatic: praxis of urban design for everyday life, in *Proceedings of the 2nd National Conference on Planning and Regional Development*. Volos: Faculty of Engineering, University of Thessaly, pp. 651-656 (in CD-rom) (in Greek).
- Bamberg, S., Fujii, S., Friman, M., Gärling, T. (2011) Behaviour theory and soft transport policy measures. *Transport Policy* 18(1), pp. 228-223.
- Beirão, G., Sarsfield Cabral, J. A. (2007). Understanding attitudes towards public transport and private car: A qualitative study. *Transport Policy*, 14, pp. 478-489.
- Bishop, P., Williams, L. (2012) *The temporary city*. London: Routledge.
- Casagrande, M. Urban Acupuncture, <http://helsinkiacupuncture.blogspot.gr/2008/12/blog-post.html>, accessed 15th Feb 2015.
- Cairns, S., Sloman, L., Newson, C., Anable, J., Kirkbride, A., Goodwin, P. (2008) Smarter choices: assessing the potential to achieve traffic reduction using soft measures. *Transport Reviews*, 28, pp. 593-618.
- Chapel, E. (2012) Urbanités inattendues. Petites fabriques de l'espace public, *INTER, ART ACTUEL*, No. 111, pp. 56-60.
- Christodoulou, Ch. (2013) Urban design practices and local governance policies in crisis conditions - The case of Thessaloniki, paper presented in the conference *Changes and reconceptualization of space in Greece in the time of crisis*. Volos, 1-3 November 2013, http://www.citybranding.gr/-/2014/12/blog-post_48.html, accessed 10th Apr 2015 (in Greek).
- Clarke, K. (2012) *Why is it so hard to be soft? How perceptions of effectiveness and acceptance of measures can be improved to encourage smarter travel*. Research report, Transport Planning Society, http://www.tps.org.uk/files/bursaries/katie_clarke_papers.pdf, accessed 15th Mar 2015.
- De Sola Morales, M. (2008) *A Matter of Things*. Rotterdam: Nai Publishers.
- Đukić, A., Vukmirović, M. (2012) Redesigning the network of pedestrian spaces in the function of reduction of CO₂ emission. *SPATIUM*, 27, pp. 31-39.
- Fernández, M. (2012). *Urbanismo adaptivo*. La ciudad temporal en un mientastanto permanente, <https://es.scribd.com/doc/103325845/Urbanismo-adaptativo-La-ciudad-temporal-en-unmientras-tanto-permanente>, accessed 15th Apr 2015.
- Friman, M., Pedersen, T., Gärling T. (2012) *Feasibility of Voluntary Reduction of Private Car Use*, Research Report, Karlstad University Studies, http://www.kau.se/sites/default/files/-Dokument/subpage/2011/08/friman_et_al_2012_feasibility_pdf_81567.pdf, accessed 15th Jan 2015.
- Fujii, S., Taniguchi, A. (2006) Determinants of the effectiveness of travel feedback programs - a review of communicative mobility management measures for changing travel behaviour in Japan. *Transport Policy*, 13, pp. 339-348.
- Gärling, T., Bamberg, S., Friman, M., Fujii, S., Richter, J. (2009) Implementation of Soft Transport Policy Measures to Reduce Private Car Urban Areas. In: *First European Conference on Energy Efficiency and Behaviour*, Maastricht October 2009, http://www.ecee.org/library/-conference_proceedings/EE_and_Behaviour/-2009/Panel_5/5.501, accessed 10th Mar 2015.
- Loukaitou-Sideris, A., Brozen, M., Callahan, C., Brookover, I., LaMontagne, N., Snehansh, V. (2012) *Reclaiming the right of way. A toolkit for creating and implementing parklets*, UCLA Luskin School of Public Affairs, <http://innovation.luskin.ucla.edu/sites/default/files/parklet-toolkit.pdf>, accessed 15th Feb 2015.
- Loukopoulos, P. (2007) A classification of travel demand management measures. In: Garling, T., Steg, L. (Eds.), *Threats from Car Traffic to the Quality of Urban Life: Problems, Causes, and Solutions*. Elsevier, Amsterdam, pp. 275-292.
- Lydon, M.(ed.) (2012) *Tactical Urbanism: Short-term Action, Long-term Change*, vol. 2, The Street Plans Collaborative, http://issuu.com/streetplanscollaborative/docs/tactical_urbanism-vol_2_final, accessed 15th Feb 2015.
- Lydon, M., Garcia, A. (2015) *Tactical Urbanism: Short Term Action for Long Term Change*. Washington: Island Press.
- MAX-Successful Travel Awareness Campaigns and Mobility Management Strategies (2009) *EU-Project final report-Deliverable D 0.6., FGM-AMOR*, Austria, <http://www.max-success.eu/downloads/>, accessed 2nd Feb 2015.
- MIDAS-Training resource Pack (2008) *EU-Project Deliverable 11*, IEEA, http://www.eltis.org/-sites/eltis/files/D11_MIDAS_Resource_Pack_FINAL_6.pdf, accessed 10th Feb 2015.
- Möser, G., & Bamberg, S. (2008) The effectiveness of soft transport policy measures: A critical assessment and meta-analysis of empirical evidence, *Journal of Environmental Psychology*, 28, pp. 10-26.
- NACTO - Urban Street Design Guide, <http://nacto.org/usdg/>, accessed 15th Feb 2015.
- Rasmussen, C. (2012) *Participative design & planning in contemporary urban projects*. Diploma Thesis, Aalborg University.
- Richter, J., Friman, M., Gärling, T. (2009) *Soft transport policy measures 2 Research needs*, Research report, Karlstad University Studies, <http://www.diva-portal.org/smash/get/-diva2:219056/FULLTEXT02>, accessed 5th Feb 2015.
- Richter, J., Friman, M., Gärling, T. (2010) Review of Evaluations of Soft Transport Policy Measures, *Transportation: Theory and Application*, Vol.2, No.1 (2010), pp. 518.
- Papagiannakis, A. (2014) *The impact of the economic crisis on urban mobility behaviour in the historic center of Thessaloniki*, Research report no 89565, Thessaloniki: Research Committee & Spatial Planning and Development Department AUTH (in Greek).
- Parsons, A. (2007) *small scale, BIG CHANGE: Urban Acupuncture as a strategy for sustainable regeneration*. Diploma Thesis, University of Portsmouth.
- Taylor, M. A. P., Ampt, E. S. (2003) Travelling smarter down under: policies for voluntary travel behaviour change in Australia. *Transport Policy*, 10, pp. 165-177.
- Taylor, M. (2007) Voluntary travel behaviour change programs in Australia: The carrot rather than the stick in travel demand management. *International Journal of Sustainable Transportation*, 1 (3), pp. 173-192.
- Thoidou, E. (2013) Strategic spatial planning in the era of crisis: Current trends and evidence from the metropolitan area of Thessaloniki. *SPATIUM*, 30, pp. 12-17.
- Unt, A.-L., Bell, S. (2014) The impact of small-scale design interventions on the behaviour patterns of the users of an urban wasteland, *Urban Forestry & Urban Greening*, No. 13 (1), pp. 121-135.
- Vitopoulou, A. (2015) *Urban design and public space in Thessaloniki since the 1980s: forms, functions and production processes*. Post-doctoral research, Aristotle University of Thessaloniki (in Greek).

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THE EFFECT OF URBAN DENSITY, GREEN SPACES AND MOBILITY PATTERNS IN CITIES' ENVIRONMENTAL QUALITY: AN EMPIRICAL STUDY OF THE METROPOLITAN AREA OF THESSALONIKI

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It has been proved that urban development patterns affect in various ways cities' environmental quality. To this purpose, one of the factors that have been examined is the role of urban green spaces, in balancing the effects of human activities in dense urban landscapes. One of the major external costs of dense urban environment is smog and greenhouse gas emissions that are heavily related to existing mobility patterns. High levels of concentration of such emissions along with high urban density are considered to be the main reason for cities' environmental degradation. In this context this paper presents the results of a study investigating how urban green spaces can improve air quality, in major transportation axis within the city of Thessaloniki. In order to do so, urban density along the axis, green space per capita, green space spatial distribution, mobility patterns and transport emissions volumes are being considered. Comparison of these indices among the transportation axis under study indicates that there is a positive relation between building density, urban density and volume of emissions observed, while a dispersed rather than a concentrated pattern of green spaces could better help improve cities' environmental quality.

Key words: Urban patterns, urban mobility, green spaces, environmental quality.

THE ISSUE OF URBAN DENSITY AND ENVIRONMENTAL QUALITY

Cities are considered to be as emergent phenomena of interactions among socioeconomic and biophysical forces (Alberti *et al.*, 2003). Thus different urban development patterns reflect the amount and interspersions of built and natural environment within urban fabric. Recently great emphasis has been given on the effect of green spaces in improving cities' air quality through the absorption of various air pollutants, while relevant research has shown that appropriate allocation of urban green spaces, considering air pollution sources and urban density, has significant effect on improving air quality (Bolund and Hunhammar, 1999).

In this context, there have been many studies and empirical research examining the environmental performance of urban patterns at the local, regional and global scale (Alberti, 1999). Furthermore there is an extensive bibliography related to the impact of urban development patterns on landscape, with urban density being one of the major determinants of cities' environmental performance. Specifically to urban density there has been a long lasting and extensive debate about the impacts of dense or sprawl urban patterns on quality of life. Most planning scholars argue that extensive urban sprawl has negative effects on the environmental and social sustainability of our cities (Newman and Kenworthy, 1999; Calthrope, 1993; Cervero and Kockelman, 1997), when several empirical studies have shown that areas with different residential and job density

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or with the same density but with clustered, rather than dispersed, development patterns have different effect on energy consumption, transportation related atmospheric emissions and urban air quality.

On the other hand there have been serious concerns and critics about compact high density development patterns. Opponents to dense urban development approach (Cox, 2003; Crane, 1996) argue that one of the principal reasons that compact city strategies cannot reach its objective of reducing traffic congestion (or its rate of growth) is because of the strong positive relationship between higher population density and higher traffic volumes (Ross and Dunning, 1997). Moreover, as more vehicle miles occur in a confined geographical location, traffic slows down and is subject to more stop-and-go operation, leading to increased time spent in traffic and higher air pollution emissions, since most vehicle created pollutants are emitted at higher rates in lower speeds (Cox, 2003). Also, the presence of high buildings on either side of the road, common in many city centres, creates a 'street canyon', which reduces the dispersion of the emitted pollutants from traffic sources and can lead to significantly higher concentrations locally (EEA, 2012).

The hypothesis that spatial configuration of elements in an urban region, influences ecosystem has been examined in various ways both by environmentalists and urban planners. Alberti (1999) identified four elements that are relevant to the metropolitan scale and can be examined in relation to a broad range of environmental variables. These elements were *form*, *density*, *grain* and *connectivity*. More specifically, *form* refers to the degree of centralization/decentralization of urban structure, *density* is the ratio of population or jobs to the area, *grain* indicates the diversity and heterogeneity of functional land uses and *connectivity* measures the interrelation and mode of circulation of people and goods across the location of fixed activities (Alberti, 2005). Furthermore Alberti (2005) identified four dimensions according to which the interaction between urban landscape and natural ecosystem functions should be considered, one of them being the ability of the environment to act as an absorbing factor of emissions and waste.

Thinking about urban green spaces as absorbing surfaces within urban environment the question that this paper poses is how green spaces can improve air quality through the absorption of transport emissions. Related bibliography indicates that urban green spaces have important ecological effects (Attwell, 2000; DeRidder *et al.*, 2004), and enhancement of green spaces has the potential to mitigate and adverse effects of urbanization in a sustainable way, making cities more attractive to live in reversing urban sprawl and reducing travel demand. A survey on ecological function on green spaces indicates that vegetation cover in urban parks may filter up to 85% of surrounding urban pollutants (Miller, 1997; Bollund and Hunhammar, 1999; Jim and Chen 2008). Allocation of green space is also quite important in mitigating the negative effects of urbanization since more dispersed forms of green space may be preferred when congestion externalities are present (Wu *et al.*, 2003). In addition, other research showed that suitable allocation of urban green spaces, considering the air pollution sources

and urban densities has significant effects on improving air quality and the whole ecosystem balance (Smith, 1990).

In this context this paper investigates how certain factors like urban density, green space per capita, green space spatial distribution and mobility patterns could affect air quality². Different parts of the Metropolitan Area of Thessaloniki (MATH) are being examined in order to evaluate how green space can mitigate the adverse effects of urbanization. Furthermore comparison of indices amongst the transportation axis under study will help on one hand to set planning priorities and formulate recommendations regarding the use of green space as a design tool in urban planning strategies, and on the other hand to consider alterations in existing mobility patterns.

METHODOLOGY

Taking into account the four structural variables (form, density, grain and connectivity) that Alberti identifies as major elements in examining the relation of urban patterns and environmental performance of cities (Alberti, 1999, 2003, 2005), four group of indices were identified:

Building density: The main parameter describing the form of a city is its overall density. Building density refers to the degree of centralization or decentralization of urban structures and to the intensity of development of a city. Many studies have shown that intensity of development in a city has significant effect on the travel distances, modal splits, economic productivity, and lower per capita energy and carbon dioxide emissions (Beatley, 2000).

In order to measure building density *floor area ratio index* (FAR) was used. Floor area ratio is defined as the total square meters of a building divided by the total square meters of the lot the building is located on. Generally, higher FARs tend to indicate more dense urban tissue. On the other hand buildings of varying numbers of stories can have the same FAR, because FAR counts the total floor area of a building, not just the building's footprint. Therefore, in order to avoid any misinterpretations additional data that has to do with the height of the buildings have been used to identify the "intensity" of building structures.

Urban Density: Urban density is referring to *grain*, meaning the diversity and heterogeneity of functional land uses. Mixed land use is considered to be a critical issue in achieving more efficient, equitable and livable cities, since having residential, commercial, recreational and light industry uses in close proximity to one another, creates viable alternatives to driving and increases viability of public transit (http://www.smartgrowth.org/principles/mix_land.php).

Urban density index has been calculated as the sum of square meters that each functional land use occupies to the build surface for each building block, multiplied by a diversity factor. More specifically the function used to calculate urban density index, is as follows:

$$UDIndex = (\Sigma L_i / TL) * (n / n_{max}) * 100$$

² It should be mentioned that this paper presents the results of a research conducted solely by the authors. The crude data used in this paper was acquired from other research programs that authors participated in the past.

where,

ΣL_i = sum of functional land uses in the zone (in square meters);

TL = total build surface of building block;

n = number of land uses recorded in the zone (except residential land use);

n_{max} = maximum number of land uses that could be recorded (according to relevant land use legislation, excluding residential land use).

Functional land uses include all sorts of uses like commerce, administration, education, health, recreation etc. and doesn't include residential use. Values of urban density index close to 100 indicate greater mix and heterogeneity of urban functions.

In addition to urban density, population density was also calculated to depict residential concentrations. The index is calculated as the number of residents per hectare for each building block. This index is extensively used in US and Australian cities to depict the imbalance between job and residential location, where center city population densities are very low. European cities have much healthier and balanced central districts with a mix of jobs, services and housing, which in turn have significant effects in mobility patterns (reduced need to travel). Therefore high population densities indicate a more balanced urban environment, more efficient mobility patterns and less transportation emissions. To this end net population density with values from a 100-400 people/ha are considered to be acceptable and appropriate for residential areas. Contrarily in areas with 400-600 people/ha, serious issues of light, air and congestion occurs. Such high densities could be realized in cases where mix density is high enough to ensure a hygiene urban environment (Aravantinos, 1997).

Finally, it should be noted that all crude land use and building data used in this paper to calculate the above mentioned indices was acquired from a research program conducted by the Aristotle University of Thessaloniki in 2007³.

Green Space: Having set the indices that would help us identify urban landscape, the next step was to find indices that would consider the interaction between urban landscape and natural ecosystem mainly as a way to absorb transportation produced emissions. Green and open space that is integrated into urban fabric is considered to be the best absorbing surfaces for any air pollutants. Related research shows that creation and improvement of urban green spaces are suggested as main policies for mid and long-term environmental improvement in city scale (De Ridder et al, 2004). For the purposes of this research two types of indices were calculated: one related to the size and number of green spaces and one to their distribution. It should be noted that as green spaces both parks and open spaces (public squares) were considered.

³ The research program was related to the development of a global methodology for the vulnerability assessment and risk management of lifelines, infrastructures and critical facilities, within dense urban areas (SRM-LIFE). An application to the metropolitan area of Thessaloniki was performed where a detail recording of building data and land use was made, in building block level.

As far as the size of green spaces the percentage of green space to the total area of the building block (in square meters) and to the total area of the zone under study was calculated. Furthermore in order to relate green spaces to the population living in the area a second index was calculated, the green space per capita (sqm/person). Despite the fact these two indices enabled us to make inferences about the amount of green space they did not give any information about its spatial distribution. Therefore two more indices showing distribution of green spaces were calculated.

The first spatial distribution index is related to the density of green spaces. Kernel Density method⁴ was used to calculate the density of green spaces in a neighbourhood, therefore when two green spaces are close or in short distance then the intensity of the phenomenon under study is higher. Under this notion a series of maps showing Kernel Density, hence the density of green spaces, were created. Furthermore a Nearest Neighbour Analysis was performed in order to determine if the pattern of green spaces is random, regular or clustered. This type of analyses uses the distance between each green space and its closest neighbouring green space to determine the pattern⁵. If Nearest Neighbour Index (NNI) is smaller than one then pattern exhibits clustering, if index is larger than one then pattern is ordered. In order to calculate spatial distribution indices ArcGIS software program was used.

Finally, it should be noted that there are several other indices that could be used in order to evaluate urban green space quality i.e. the Biotope Area Factor (BAF), Greenspace Factor etc. More specifically BAF expresses the area portion of a plot of land that serves as a location for plants or assumes other functions for the ecosystem. Despite the fact that this index could add valuable information in regard to green space quality, data availability was the main factor that defined which indices could be used in the analysis described in this paper.

Mobility patterns, transportation emissions and air quality: Mobility patterns are considered as a major factor in assessing environmental performance of a city. They are strongly related to the use of car and transit, the journey-to-work distances and urban density. Furthermore, it has been proved that different urban forms produce different mobility patterns (Banister 1997; Cervero and Kockelman, 1997). In this paper mobility patterns are considered to be the major determinant of produced air pollutants volumes (Đukić and Vukmirović, 2012). The major automotive emissions of concern to health are presented in terms CO, NO_x, VOC, PM, NH₃, SO₂ and heavy metals produced by different vehicle categories as well as greenhouse gas emissions (CO₂, N₂O,

⁴ Kernel method is used in statistics as a measure of similarity. In particular, the kernel function $k(x,.)$ defines the distribution of similarities of points around a given point x . In this paper Kernel Density was used to calculate the density of features in a neighbourhood around those features (feature being green space).

⁵ The Nearest Neighbour index measures the distance between each feature centroid and its nearest neighbour's centroid location. It then averages all these nearest neighbour distances. If the average distance is less than the average for a hypothetical random distribution, the distribution of the features being analyzed is considered clustered. If the average distance is greater than a hypothetical random distribution, the features are considered dispersed.

CH₄). Besides, pollutants are influenced by the composition of traffic (HGVs, buses etc.) since different modes of transport use different types of energy, and therefore emit different pollutants. Vehicle composition in urban areas is generally different to the national composition. For example, buses, mopeds and motorcycles make up a higher proportion of vehicle composition in urban areas than they do nationally (EEA, 2012).

More specifically, the calculation of emissions was conducted using COPERT 4 model, a Computer Programme that calculates Emissions from Road Transport.⁶ COPERT 4 estimates emissions of all major air pollutants (CO, NO_x, VOC, PM, NH₃, SO₂, heavy metals) produced by different vehicle categories (passenger cars, light commercial vehicles, heavy duty trucks, busses, motorcycles, and mopeds) as well as greenhouse gas emissions (CO₂, N₂O, CH₄). It also provides speciation for NO/NO₂, elemental carbon and organic matter of PM and non-methane VOCs, including PAHs and POPs. The general equation used to calculate emissions and fuel consumption is the following:

$$\text{Emissions [g]} = \text{Emission_Factor [g/km]} \times \text{Distance_Travelled [km]}$$

were «Emissions» denote the emission factors for each vehicle category and «Distance_Travelled» is considered equal to the length of each road segment which is deducted from the GIS information system (<http://emisia.com.copert>).

In order to examine the connection between build environment and environmental quality a descriptive analysis of the above mentioned indices amongst the different study areas was performed. Furthermore, a series of maps were generated depicting their spatial distribution. The distribution and quantity of each index was measured, evaluated and compared for each one of the areas revealing the connection (if any) between urban green spaces and environmental quality.

APPLICATION TO THE METROPOLITAN AREA OF THESSALONIKI

The Metropolitan Area of Thessaloniki

Thessaloniki is the second largest city in Greece (after Athens), the administrative centre of the region of Central Macedonia and a significant industrial and commercial gateway for the Balkans and the wider Eastern Mediterranean region. Metropolitan area of Thessaloniki (MATH) consists of 11 municipalities, extends over an area of 1,455 km² and, according to the most recent census (2011), its population reaches approximately a total of 1,000,000 inhabitants. Since the early '80s MATH experienced tremendous changes in terms of its morphological and functional organization. Significant elements of these changes were the continuous urban expansion and the formation of a "new city" that lacked defined boundaries and dominant center(s) (Pozoukidou, 2014).

Key feature in Thessaloniki's urban structure is its high building and population density. Comparing to other European cities, Thessaloniki is considered to have high urban density that in many areas far surpasses the threshold limits set in several European cities⁷. This quite dense urban environment, combined with the non-existence green spaces and the inadequate road network leads to great degradation of city's environment. It is quite important to highlight that Thessaloniki's central business district (CBD) is characterized by a diversity and mix of urban functions with emphasis in businesses, service and commerce. In the areas adjacent to CBD there are smaller sub centers that function supplementary to center city and with the exception of certain transport axis these areas are predominantly residential (AUTH Research Committee, 2007).

Apart from commerce and services, CBD accommodates significant residential activity and a considerable number of archaeological sites and historical monuments. Due to the geomorphological constraints, CBD extends as a strip between the coastal zone and a mountainous area, with a width of approximately 1 kilometer at its most narrow section. Figure 1 shows the general configuration of the city and CBD.

The road network of the city is often congested and delays are presented during peak periods mainly due to commuters' traffic. The findings of the General Transportation study of the Metropolitan Area of Thessaloniki indicates that 25% of approximately 1,600,000 daily trips in the city have as origin and/or destination the CBD, resulting to the degradation of the environment and the quality of life in this area (ORTHE, 2000). Nowadays this figure is more than 1,750,000 trips/day.

Despite the large population of the metropolitan area and the mobility problems city centre experiences due to the private car dependence, Thessaloniki is one of the few European cities of similar urban characteristics that have no fixed route rail transport system (http://library.tee.gr/digital/kma/kma_m1498/kma_m1498_galouis.pdf). The present public transport system of Thessaloniki comprises the public bus system and the number of passengers annually served by the bus fleet is approximately 180,000,000, with an average occupancy of 42% (<http://www.oasth.gr>). Surveys show that the urban transport problem of the city centre is expected to be alleviated in a considerable degree when the currently under construction metro system will be in operation (Roukouni *et al.*, 2012). As far as the environmental benefits, it is estimated that the operation of Line 1 will decrease the CO₂ and CO emissions approximately by 1.25 Mt and 25 kt respectively up to 2041, mainly due to the diminishment of road volumes and congestion (Gavanas *et al.*, 2012).

As far as the environmental performance of the city it should be pointed out that Thessaloniki, in terms of its air quality, is considered as one of the most polluted cities in the European Union (www.who.int/ceh/publications/11airpollution.pdf). This is mainly due to the fact that existing mobility patterns,

⁶COPERT 4 is a software tool used world-wide to calculate air pollutant and greenhouse gas emissions from road transport that has been developed by EMISIA S.A., a spin-off company of Aristotle University of Thessaloniki.

⁷For instance there are areas in the city center where the FAR reaches 8.2, where gross (bruto) and net (netto) density can reach up to 800 persons/ha and 1600 persons/ha respectively.

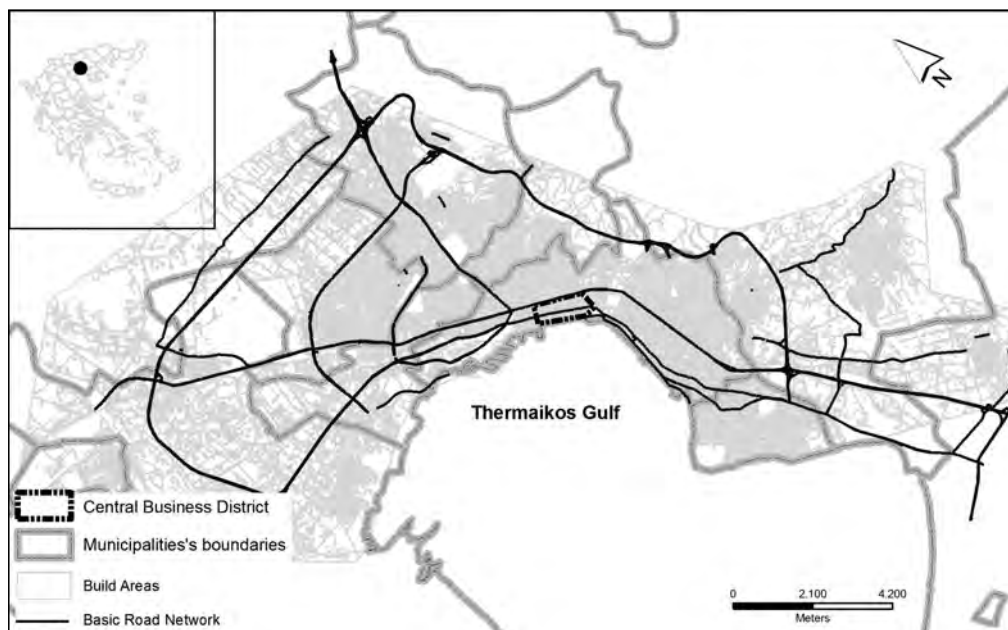


Figure 1. The city of Thessaloniki
(Source: processed by authors)

mediterranean climate, geographic location and topography of the city create favorable conditions for the production and reciprocation movement of air masses and transport of air pollutants (SO_2 , particulates, CO, NO, NO_2 and O_3) in the city (Tsitsoni and Zagas, 2001).

Description of the study area

The study area consists of 6 zones extending approximately one block (depending on the geometry and size of city blocks) along six transport axis. The criteria used for choosing these areas were: location within MATH, land use functional characteristics, as well as functional and geometric characteristics of each transport route (Figure 2),

(Table 1, 2). Following is a short description of the major characteristics of each study zone.

Zone 1, is located in the Municipality of Thessaloniki, extends along Tsimiski Street and comprises the CBD of Thessaloniki. It is the most central and busiest area of Thessaloniki and an origin-destination for the majority of trips taking place in the metropolitan area of Thessaloniki. Tsimiski Street is a main one-way-artery, with particularly high traffic volumes, serving through traffic in the east-west direction of the city. During peak hours there are serious congestion issues, with extremely low traffic speeds, a problem that is exacerbated by road side illegal parking. Zone 1 is a densely populated area with high FAR and high buildings heights (6-9 floors).

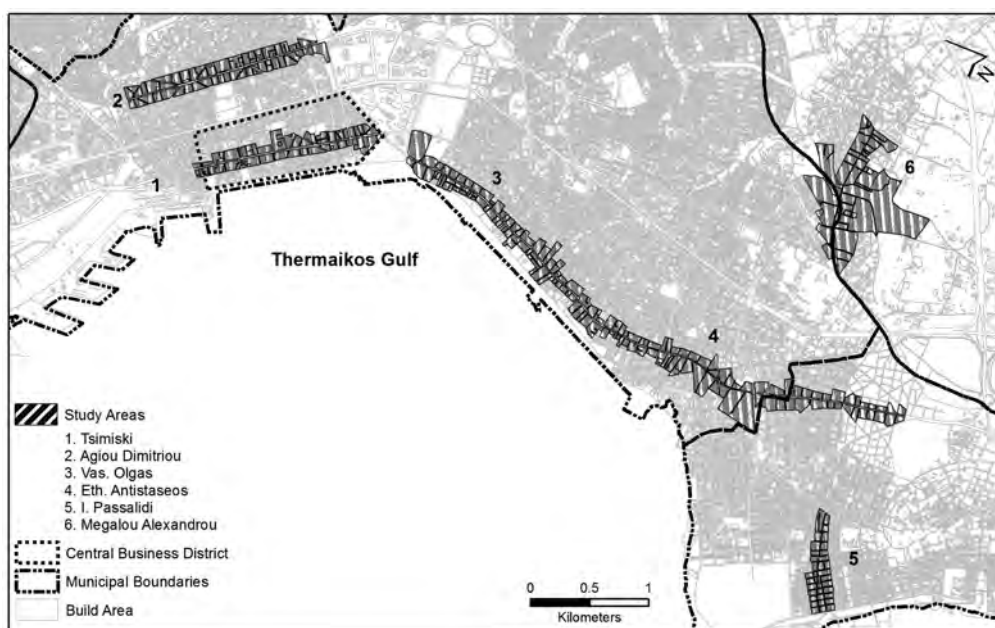


Figure 2. Study Areas
(Source: processed by authors)

The predominant functional use is retail that coexists with uses like service, education, administration, health, culture etc. Despite the dominance of the tertiary sector, residential use is also present, which is concentrated mainly in the east part of the zone. As for green spaces, they are quite limited, while there are some major pedestrian areas that function as open spaces.

Zone 2 is located near CBD and extends along Agiou Dimitriou Street. In terms of its functionally Agiou Dimitriou is a secondary-one way-artery, with relatively low traffic volumes that serves the west-east direction. The zone has a FAR of 3.3, which is predominantly residential and with especially high population density (454 res/ha). Apart for residential use there are other type of uses related to the tertiary sector, culture, education and health, while in the west part of the area there is concentration of light industry and crafts. As far as green and open spaces, there are two significant open spaces, while there are some smaller urban green islets.

Zone 3, belongs to the municipality of Thessaloniki and extends along Vas. Olgas street. This street is a main -one way-artery, with high traffic volumes that serves through traffic in the direction east - west. The zone is located close to CBD with an average FAR of 3.8. It is a densely populated area with a total population of 16,167 inhabitants. It is a residential area with a mix of other uses such as services, administration and culture. Green spaces are mostly concentrated in the western part of the zone where the Horticultural Park and two other smaller urban parks are located.

Zone 4 is located in southeastern part of the city. It belongs to the municipality of Thessaloniki and Kalamaria and extends

along a portion of Eth. Antistaseos Street. In essence this zone is a continuation of Zone 3 to the east, and is also a main -one way-artery with sufficient functional width that serves through traffic in the direction of east-west. Nonetheless it has smaller traffic volumes comparing to zone 3. Zone 4 is primarily a residential zone, with the exception of some uses that are related to services, culture and administration. The area has an average FAR of 2.4, much lower compared to the adjacent Zone 3 due to the fact that a large part of the area belongs to a different municipality where the statutory FAR is lower than those in the Municipality of Thessaloniki. With a population of 7,337 inhabitants and a population density of 210 res/ha this area is characterized by low population density compared to other zones. As for green and open spaces there are two small green spaces along the axis.

Zone 5, belongs entirely to the municipality of Kalamaria located in the east side of the city, and extends along a portion of I. Passalidi. Functionally I. Passalidi Street is a main -one way-collector artery with relatively small traffic volumes, connecting main arteries to the local network in the direction of south - north. It is primarily a residential zone, with the exception of some services and recreation uses. There are no green and open spaces located in the area. FAR is 2.9, while the population of the area is 4,008 inhabitants. It should be noted that Zone 5 is the smallest in terms of area size.

Zone 6 belongs both to municipality of Thessaloniki and municipality of Pilea-Hortiatis. It extends along Megalou Alexandrou Street in the northeast side of the city. Functionally Megalou Alexandrou Street is characterized as a secondary collector street, is bidirectional and serves as a connection between several arteries and local roads. It is a street with relatively low speed and low traffic volumes. This

Table 1. Urban features of study areas

Zones	Building Density (Mean)*	Population Density (Mean) (res/ha)	Building Height (Mean) (m)**	Number of floors (Mean)	Population	Area (m ²)	Area of green space (m ²)
1. Tsimiski	5.3	174.48	16.52	5.90	5,857	363,633	8,844
2. Agiou Dimitriou	3.3	454.21	12.30	4.39	15,592	339,099	41,748
3. Vas. Olgas	3.8	482.78	14.20	5.07	16,167	409,242	26,056
4. Eth. Antistaseos	2.4	210.03	9.56	3.41	7,337	429,232	26,041
5. I. Passalidi	2.9	343.03	11.81	4.22	4,008	113,865	0
6. Megalou Alexandrou	0.8	76.92	5.74	2.05	1,913	577,579	24,058

Source: processed by authors

* mean Floor Area Ratio (FRA) per Zone

** number of floors x 2,80 m

Table 2. Functional classification/Functional and geometrical attributes of road segments

Road Segments	Functional Classification	Length (km)	Hourly Average Daily Traffic Volume (PCU*)	Average Speed (km/h)	Effective width (m)
1. Tsimiski	Main Artery	1.6	3283	28	14
2. Agiou Dimitriou	Secondary Artery	1.7	555	28	12
3. Vas. Olgas	Main Artery	2.8	1995	34	16
4. Eth. Antistaseos	Main Artery	2.2	1470	35	16
5. I. Passalidi	Main Collector	0.9	322	37	7
6. Megalou Alexandrou	Secondary Collector	1.2	269	26	10

Source: processed by authors

* Passenger car unit

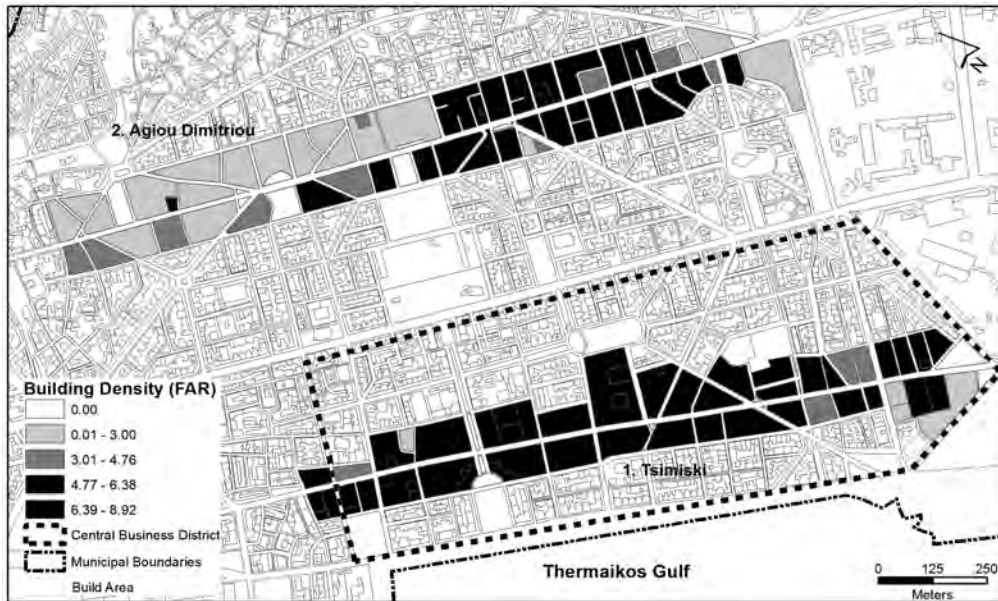


Figure 3. Building density in Zones 1 and 2
(Source: processed by authors)

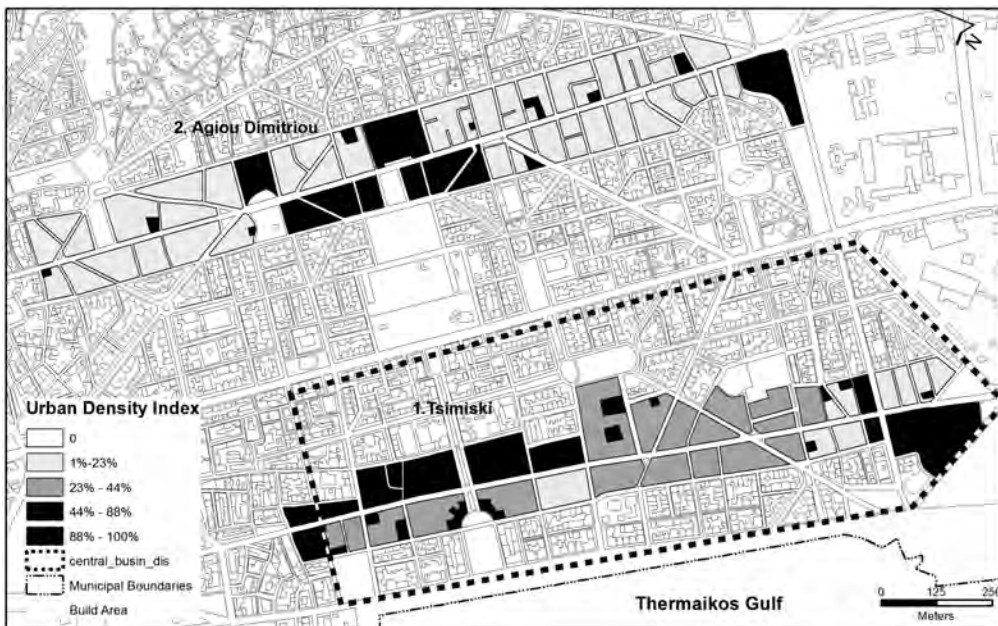


Figure 4. Urban density in Zones 1 and 2
(Source: processed by authors)

zone is characterized by an average FAR of 0.8 and therefore has low building heights. A total 1,913 inhabitants resides in this area. Large and unformed building blocks are particular to this zone due to the fact that in this area there is still a lot of undergoing construction. The prevalent use is residential but other uses like recreation, education and services are recorded. The green and open spaces are confined to small urban green islets.

Results and Discussion

Following is a presentation of the indices calculated for each zone and a comparison amongst the different zones. In the end a synthetic approach is attempted to reveal any relations between urban/build environment and air quality for the city of Thessaloniki.

Building Density

In order to measure urban density FAR index was used. FAR for each building bock and a mean value for each zone was calculated. It should be noted that FAR presented here is the “realized” one, meaning that it is the result of the calculations performed in the context of this paper and represents existing situation. Therefore the realized FAR may vary from the statutory one due to illegal construction.

Building density indicator shows that CBD area (Zone 1 and 2) has very high building densities that in some cases reach the value of 8.5. Specifically, Zone 1 has the highest building density values and Zone 6 the lowest, where only one block has FAR greater than 3. In general building densities tend to become lower towards the east side of the city. As far

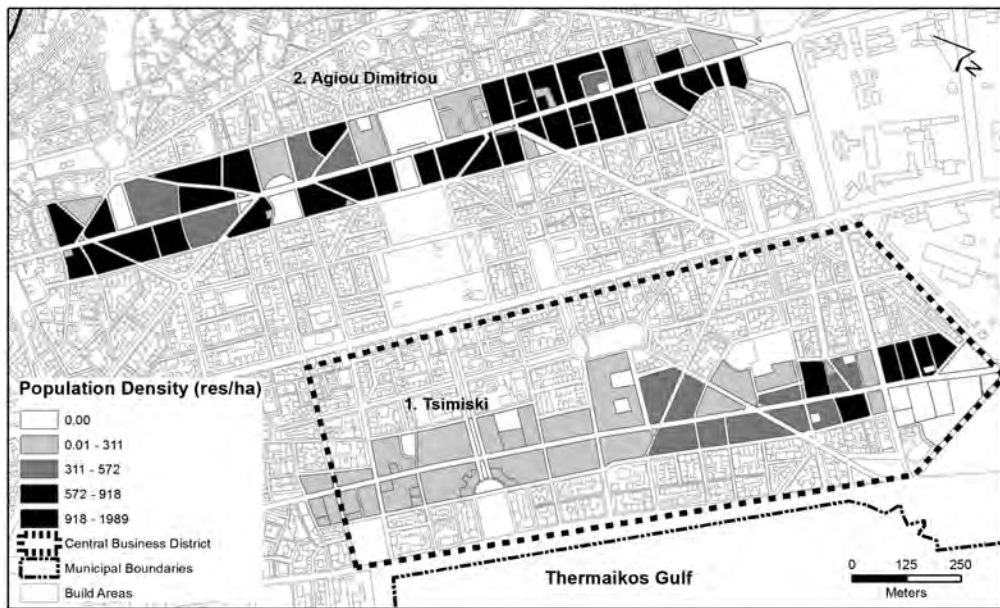


Figure 5. Population density in Zones 1 and 2
(Source: processed by authors)

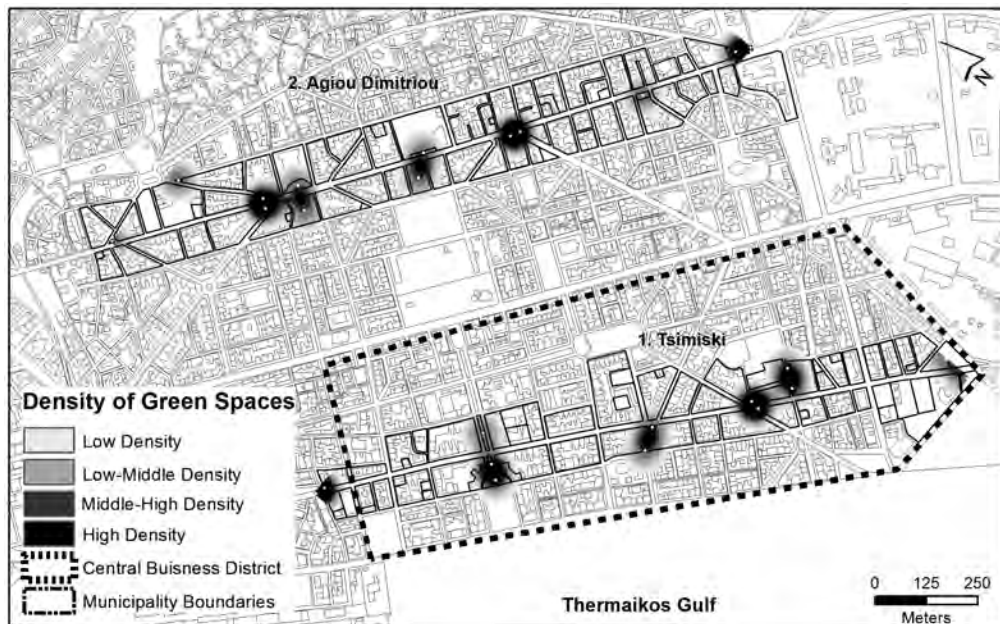


Figure 6. Green Space density in Zones 1 and 2
(Source: processed by authors)

as number of floors and height of the buildings, these are directly related to FAR. Therefore the highest buildings are located in Zone 1 (8-9 floors) and the lowest buildings in Zone 6 (2-3 floors). Figure 3 shows the values for building density in Zone 1 and 2.

Urban Density

Calculation of urban density index indicates that Zone 1 and 2 have high values (Figure 4). Zone 3 and 4 present quite high values in certain parts, since these areas accommodate a variety of uses that mostly serve the east part of the city. Zone 5 and 6 seem to have less variety of land uses and are mostly residential areas with a handful of other uses to accommodate local needs.

Population Density

Zone 2 and 3 have the highest values of population density that surpasses 918 res/ha. It is worth noting that in Zone 3 there are building blocks that have population density from 1417 to 1989 res/ha, an extremely high number according to international standards. Zone 1 (Figure 5) has relatively low population density which is increasing towards the east part of the zone. The relatively low values in this zone are due to the fact that this area is primarily occupied by uses such as commercial and services. The lowest population density occurs in Zone 6, which as mentioned earlier is a new area, with low building density and still in construction phase, while Zone 5, which is primarily a residential zone, has a population density that ranges between 311-572 res/ha.

Percentage of green space to the total land area & Green space per capita

According to Table 3 that presents "Percentage of green space per zone" index, the highest values occur in Zones 2, 3 and 4 with very similar percentages, while Zone 5 has no green spaces therefore the value of index is 0. On the other hand the results of "green space per capita" index shows that Zone 2 has the lowest value (2.68 m²/person) due high population numbers in this area.

Table 3. Green Space Indices

Zones	Percentage of green space pre zone (%)	Green space (m ² /capita)	NNIndex
1. Tsimiski	2.43	1.51	0.894
2. Agiou Dimitriou	12.31	2.68	1.28
3. Vas. Olgas	6.37	1.61	0.970
4. Eth. Antistaseos	6.07	3.55	2,578
5. I. Passalidi	0.00	0.00	-
6. Meg. Alexandrou	4.17	12.58	3,627

Source: processed by authors

Table 4. Emissions per zone

Road Segments	CH ₄ (gr)/km	PM ₁₀ (gr)/km	NO _x (gr)/km	CO ₂ (gr)/km	FC (gr)/km
1. Tsimiski	171.8	149.1	2014.0	686235.2	217007.7
2. Agi. Dimitriou	24.0	18.0	224.9	118078.3	37347.9
3. Vas. Olgas	100.0	75.9	906.2	369680.4	116923.1
4. Eth. Antistaseos	65.1	53.3	730.1	290563.0	91887.4
5. I. Passalidi	13.9	14.4	245.9	70227.3	22202.5
6. Meg. Alexandrou	11.3	10.1	146.3	61884.4	19566.9

Source: processed by authors

According to an OECD (2014) report that sets the standards in terms of urban green spaces, the rate of 9 m²/person is recommended as the low end threshold.⁷ Furthermore according to a research conducted by the Aristotle University of Thessaloniki in 2002, the green space per capita in Municipality of Thessaloniki was 2,19 m²/capita, while in the municipality of Kalamaria, where two of our study areas are located, this index is 7,28 m²/capita (Ganatsas *et al.*, 2002). Table 3 indicates that only Zone 6 meets the international standards, mainly due to the fact that few people resides in this area and certainly not because of the presence of large green and open spaces. Zone 2 is the only area within the municipality of Thessaloniki that has a rate of green space/capita greater than the average of the municipality. Zone 1 has just 1.51 m²/capita of green space when Zone 5 has a value of zero for this index.

In terms of its spatial distribution, Figure 6 shows the density of green spaces in zones 1 and 2. The input distance used to calculate density of green spaces, using the Kernel Density method was 75m. The distance was determined by

⁷ The same study reports that North American cities such as Edmonton, Des Moines and Madison have the largest share of green area per person which is higher than 5000 m²/person when in Juarez, Bari, Anjo and Athens, recorded the lowest values of this index which was below 9 m²/person.

the size of the block therefore for Zone 6 a larger distance was used due the peculiarity of building blocks in this area. Furthermore calculating NNI for each zone (Table 3), revealed that center city areas are of high density and concentration of green and open spaces, while the pattern is definitely clustered (NNI<1 or close to 1). For zones 3, 4 and 6 distribution of green spaces is somehow ordered and there are no green space concentrations.

Emissions

Table 4 indicates that higher pollutants are observed in Zone 1 and lower in Zone 6. Furthermore it seems that pollutants are proportionate to traffic volumes and inversely proportional to speed.

CONCLUSIVE REMARKS

The initial purpose of this paper was to assess the effect of urban green spaces on air quality accounting for traffic emissions and build environment. Results show that there is a positive relation between building density, urban density and volume of emissions observed in the six zones. This means that the higher urban density is, the higher the emissions/pollutants are and vice versa. The same rationality applies for building density. It should be noted that the positive relation was something that was expected since dense urban development patterns in conjunction with mobility patterns that heavily rely in private vehicles and bus public transit, creates high rates of emissions.

In regard to green spaces the first remark has to do with their quantity, since according to international standards, all six areas have low rate of green space per zone and low green per capita index. At the same time both Green Density Index and NNIndex indicate that the relative dispersion of green spaces is minimal. For instance in Zone 2 where the highest percentage of green space per zone occurs, there is one large open space and several smaller ones. Nevertheless their effectiveness as absorbing surfaces is reduced due to the fact that most of green spaces are concentrated in certain parts of the zone, when according to Wu *et al.* (2003) more dispersed forms of green space are preferred when congestion externalities are present. The same rational applies also for Zone 1, where concentration of green spaces occurs in certain parts of the axis. As far as the rest of zones where NNI indicates a more regular distribution, the size and number of green spaces per se, makes them inadequate to mitigate the negative effects of traffic.

All the above findings have certain planning implications. Ensuring green and open space in Greek cities is performed through General Urban Plans. In these plans there are regulations related to the amount of green space that has to be reserved and is proportional to the population of the area planned. The planning standard is 2.5 m²/resident, which obviously is not enough so that to play a significant role in improving environmental quality of cities. Therefore it is imperative to increase the rate of green space per capita but also to integrate guidelines in regard to allocation of green spaces. Towards this direction it is also imperative to alter existing mobility patterns in a way that alternative forms of transport is promoted. This includes a turn towards public transit and non-motorized traffic i.e. walking biking etc. as

well as use of eco-vehicles. In this way it can be ensured that green and open spaces can mitigate the adverse effects of urbanization in a sustainable way, making cities desirable places to live in.

REFERENCES

- Alberti, M. (2005) The effects of urban patterns on ecosystem function. *International regional science review*, 28(2), pp. 168-192.
- Alberti, M., Marzluff, J. M., Shulenberger, E., Bradley, G., Ryan, C., Zumbrunnen, C. (2003) Integrating humans into ecology: opportunities and challenges for studying urban ecosystems. *BioScience*, 53(12), pp. 1169-1179.
- Alberti, M. (1999) Urban patterns and environmental performance: what do we know? *Journal of planning education and research*, 19(2), pp. 151-163.
- Aravantinos, A. (1997) *Urban planning for a sustainable development of the urban space*. Athens: Simmetria.
- Attwell, K. (2000). Urban land resources and urban planting—case studies from Denmark. *Landscape and Urban Planning*, 52(2), pp. 145-163.
- AUTH Research Committee (2007) Research Programme: "Development of a global methodology for the vulnerability assessment and risk management of lifelines, infrastructures and critical facilities, within dense urban areas (SRM-LIFE). An application to the metropolitan area of Thessaloniki", Deliverable 31.
- Banister, D., Watson, S., Wood, C. (1997) Sustainable cities: transport, energy, and urban form. *Environment and Planning B*, 24, pp. 125-144.
- Beatley, T. (2000) *Green urbanism: Learning from European cities*. Island Press.
- Bolund, P., Hunhammar, S. (1999) Ecosystem services in urban areas. *Ecological economics*, 29(2), pp. 293-301.
- Calthorpe, P. (1993) *The next American metropolis: Ecology, community, and the American dream*. Princeton Architectural Press.
- Cervero, R., Kockelman, K. (1997) Travel demand and the 3Ds: density, diversity, and design. *Transportation Research Part D: Transport and Environment*, 2(3), pp. 199-219.
- Cox, W. (2003) How higher density makes traffic worse. *The Public Purpose*, 57.
- Crane, R. (1996) On form versus function: Will the new urbanism reduce traffic, or increase it?. *Journal of Planning Education and Research*, 15(2), pp. 117-126.
- De Ridder, K., Adamec, V., Bañuelos, A., Bruse, M., Bürger, M., Damsgaard, O., Weber, C. (2004) An integrated methodology to assess the benefits of urban green space. *Science of the Total Environment*, 334, pp. 489-497.
- Developmet of Thessaloniki Metro (2009) - http://library.tee.gr/digital/kma/kma_m1498/kma_m1498_galouis.pdf, accessed 22nd Mar 2015.
- Đukić, A., Vukmirović, M. (2012) Redesigning the network of pedestrian spaces in the function of reduction of CO₂ emission. Case Study: Pančevo and Vršac, *SPATIUM*, No. 27, pp. 31-39.
- EEA. (2012) *The contribution of transport to air quality*. TERM 2012: transport indicators tracking progress towards environmental targets in Europe. Report No. 10.
- EMISIA S.A. - <http://emisia.com/copert>, accessed 22nd Mar 2015.
- Ganatsas, P., Tsitsoni, Th., Zagas, Th., Tsakalimi, M. (2002) *Assessment of urban green space in urban area of Thessaloniki*. Proceedings 10th National Conference. "Research, Protection and Management of Land Ecosystems Peri-urban forests and urban green areas." Greek Forestry Society. Tripoli, 26-29 May.
- Gavanas N., Politis I., Dovas K., Lianakis E. (2012) Is a new Metro line a mean for sustainable mobility among commuters? The case of Thessaloniki city. *International Journal for Traffic and Transport Engineering*, 2 (2), pp. 98 – 106.
- Jim, C. Y., Chen, W. Y. (2008) Assessing the ecosystem service of air pollutant removal by urban trees in Guangzhou (China). *Journal of Environmental Management*, 88(4), pp. 665-676.
- Miller, R. W. (1997) *Urban forestry: planning and managing urban greenspaces*. Prentice Hall.
- Newman, P., Kenworthy, J. (1999) *Sustainability and cities: overcoming automobile dependence*. Island Press.
- OECD (2014) "Environmental sustainability in metropolitan areas", in *OECD Factbook 2014: Economic, Environmental and Social Statistics*, OECD Publishing.
- ORTHE - Organization for the Master Plan and Environmental Protection of Thessaloniki (2000) General Transport Study (G.T.S) of Thessaloniki Metropolitan Area. Denco, Trademco, Infodim, Aggelidis, Truth, SDG, WS-Atkins.
- Pozoukidou, G. (2014) Land Use Transport Interaction Models: Application perspectives for the city of Thessaloniki, *SPATIUM*, No. 32, pp. 7-14.
- Ross, C. L., Dunning, A. E. (1997) *Land use transportation interaction: An examination of the 1995 NPTS data*. Georgia Institute of Technology.
- Roukouni A., Basbas S., Kokkalis A. (2012) Impacts of a Metro station to the land use and transport system: The Thessaloniki Metro case. *Procedia - Social and Behavioral Sciences*, 48, pp. 1155-1163.
- Smart Growth Principles - http://www.smartgrowth.org/principles/mix_land.php, accessed 22nd Mar 2015.
- Smith, W. H. (1990) *Air pollution and forests*. New York: Springer
- Tsitsoni, Th., Zagas, Th. (2001) Silvicultural measures for improved adaptability of tree species in the urban environment. Proc. Res. Symp. (eds) *Ecological Protection of the Planet Earth*, V. Tsihrizis and Ph.Tsalides, Xanthi, Greece, June 5-8, 2001. Vol. 2, pp. 415-422.
- Wu, J., Plantinga, A. J. (2003) The influence of public open space on urban spatial structure. *Journal of Environmental Economics and Management*, 46(2), pp. 288-309.
- World Health Organization - www.who.int/ceh/publications/11airpollution.pdf, accessed 22nd Mar 2015.

STRASBOURG EUROMÉTROPOLE, A CROSS-BORDER CONURBATION TOWARDS NEW SUSTAINABLE MOBILITY PATTERNS

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In the French context, Strasbourg is an exemplary case study for the development pattern of the “city of short distances”: its local and regional components were developed in the long term after the polycentric “Rhineland model” of German, Swiss, and Dutch cities. According to the French law on cities of 27 January 2014, Strasbourg has become a local authority with special status – the Eurométropole – replacing the former local authority status (CUS). The new Eurométropole is supposed to “enhance metropolitan economic functions, transport networks and academic resources, research and innovation, in a spirit of regional and interregional cooperation and with a desire for balanced development of its territory” (LOW 2014-58). The concept of metropolitan development territory in Strasbourg includes thus the metropolitan system of the Upper Rhine, the idea of innovative governance of the projects shared between several institutional actors referring to multiple scales and diversified skills. Taking into consideration its particular geographical, cultural, social and economical context, ‘bottom up’ approaches and exploratory scenarios mark a joint effort to invent Strasbourg’s metropolitan development.

Key words: Strasbourg, Eurométropole, cross-border, slow-mobility, rails.

INTRODUCTION - STRASBOURG, A SINGULAR AND COMPLEX CONTEXT

Advocated by the European Commission’s Green Paper *Towards a new culture for urban mobility*, the “city of short distances” is a development pattern which aims to introduce the essential daily services within 800 meters of homes, transport hubs and park-and-ride, favouring service accessibility by promoting public transport and soft mobility (cycling, walking) at the expense of private car trips (CEC, 2007). This pattern – extended to the metropolitan scale and intended as a “city of easy access” – derives from the polycentric model of German, Swiss and Dutch cities: in the 1990’s in Germany and the Netherlands, the concept of the compact city in a polycentric metropolitan area emerged as part of the sustainable development philosophy. It incorporates environmental concepts: the fight against urban sprawl, the promotion of functional and social diversity, and the project of sustainable mobility reducing the environmental footprint. The concept was

also included in the European Union’s texts,² emphasizing the difficulties of its translation from theory to territorial realities: “Thereafter, the Swiss urban culture added the dimension of short distances and urban proximity. Actually, the problem is how to translate this theoretical model in the lives of residents and business practices” (CERTU, 2012).

In the French context, Strasbourg is an exemplary case study for its sustainable metropolitan development and its tension between the local and global: it represents a “balanced metropolis” with a strong symbolic border dimension to its regional claims. These local and regional components were developed in the long term after the polycentric “Rhineland model” of German and Swiss cities. Furthermore, geographical and cultural proximity to Germany - and its *Energiewende* - also makes the Strasbourg area an interesting case study when it comes to energy transition and its impact on the territorial development.

In addition, Strasbourg has recently become a local authority with special status – the Eurométropole³ – replacing the former local authority, the Communauté Urbaine de Strasbourg - CUS. Supposed to “enhance

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² first in the *European Spatial Development Perspective* (EC, 1999), and later in the *Leipzig Charter on Sustainable European Cities* (Ministers of the EU Member States, 2007).

³ According to the French law on cities of 27 January 2014.

metropolitan economic functions, transport networks and academic resources, research and innovation, in a spirit of regional and interregional cooperation and with a desire for balanced development of its territory” (LOW 2014-58), the newly created Eurométropole is thus a key actor for the future metropolitan development. This is a major challenge, especially in the particular context of Strasbourg, where the concept of metropolitan development territory includes the metropolitan system of the Upper Rhine along with the idea of innovative governance of the projects, shared between several institutional actors referring to multiple scales and diversified skills. In this perspective, one of the best ways for Strasbourg to prepare itself for the creation of the Eurométropole is to combine city and university into forming a cluster of excellence actors working on the new meaning of sustainable metropolitan development and governance.

SHARING AND SEARCHING FOR NEW IDEAS IN SUSTAINABLE METROPOLITAN DEVELOPMENT: STATE OF THE ART, FRAMEWORKS AND METHODS

The concept of Metropolitan development territory refers to the complex interdependencies between regional dynamics and worldwide challenges, in particular climate change and energy provision, which were considered as prominent issues with potential effects on spatial structures and dynamics (ESPON, 2013). Even if there is a growing agreement that the challenges of the metropolitan and transnational territories are important, it is not always clear for the local stakeholders in what ways they can build and represent these structures and dynamics (Mazzoni, d’Emilio, 2014). The competences necessary to act directly – and coherently – through an integrated metropolitan and transnational perspective on spatial dynamics are to be known and reinforced.

The scholarly approach to sustainable planning was profoundly renewed during the last two decades (Bocquet, 2013). Not only was the content of the concept of sustainable planning stabilized (Naess, 2001), but also a series of reflections on the relationship between sustainable planning and urban morphology was explored in a several pioneering research works (Breheny, 1992) that themselves opened the way to more systematic explorations. During the 1990s and 2000s, the regional dimension of sustainable planning was progressively emphasized (Roberts, 1994; Haughton and Counsell, 2004): it became clear that reflecting at the scale of single cities considered as functional islands was impossible and that the biggest reservoir of sustainability was at the metropolitan level as well as at the level of urban regions. This introduced a new series of reflections on the dimension of multilevel governance in sustainable planning (Bulkeley and Betsill, 2005). After a decade of debates on the question, the concept of urban and regional politics of climate change was introduced, insisting on the necessity for local democracy to tackle the question of sustainable planning (Bulkeley and Betsill, 2013). In this situation, infrastructures and mobility have long been left apart, or at least treated by scholars coming from different research traditions (Rietveld *et al.*, 2011). But it is now clear that, in the context of the necessity of “tipping the balance”

(Riddell, 2008) between a variety of factors, the issue of present reflections on sustainable planning is to create the conditions for the emergence of decision making processes that take into account various dimensions pertaining to various spheres.

The creation of the “Atelier des mobilités métropolitaines”

In the field of sustainable urban planning and urban design, AMUP laboratory (Architecture, Morphology/Morphogenesis and Project) in Strasbourg explores this kind of articulation between various spheres, including that of multi-modal infrastructure planning and that of governance at the scale of the metropolis. Within this structure, the goal of the research-actions is to create collaboration with the local authorities on metropolitan mobility planning. Such partnerships have been initiated through national researches between 2000 and 2015 (supported by the French Ministry of the Culture-MCC and the French Ministry of Environment and Energy-MEDDE). In 2014, the cooperation between ENSAS and Eurométropole of Strasbourg (former CUS) resulted in the creation of a new framework, the “Atelier des mobilités métropolitaines” (AMUP-Eurométropole Strasbourg, 2014). Since the beginning, the Atelier focuses mainly on experiencing new methods for the construction of common objectives and knowledge, shared between researchers and stakeholders. This framework was enlarged further in 2014 through the “Atelier Franco-Chinois des mobilités métropolitaines” (ENSAS and Tongji University in Shanghai). The aim is to study the realities of the metropolitan governance in these agglomerations, in particular regarding aspects of integrated mobility and slow-mobility systems⁴.

The model of the Italian Urban Centers

In Europe, similar exchange platforms between academic world and political actors already exist. In Italy, the framework for the cooperation between university and the local authority aiming to stimulate an information exchange and to strengthen the knowledge and capacities of the local authorities is the concept of the Italian Urban Centers (Borghi, 2014). The success of this framework has already been proved by the Italian cities of Turin and Bologna.

Within these Urban Centers, databases on innovative mobility solutions can be developed and published in interactive metropolitan maps to promote advanced urban

⁴ The team already researches these topics within several national and international projects (selection): *Tram-train, ou l’énergie des courtes distances dans Strasbourg Métropole. Acteurs, logiques et processus du projet métropolitain durable, research programme* «Ignis Mutat Res. Penser l’architecture, la ville, le paysage au prisme de l’énergie», MCC/MEDDE, 2013-2015; *Strasbourg: la démocratie locale pour construire un récit sur la métropole durable, research programme* «Plateforme d’observation des projets et stratégies urbaines» (POPSU), MEDDE, 2011-2013. Also, recent international seminars and round tables were further discussing these issues: *Urban Public transport*, round table coordination (C. Mazzoni, ZHUO Jian), 7th Forum of Sino-French Sustainable Urban Transport Systems (THNS), CAUP-Tongji, Shanghai, November 1st, 2014. *FabLab on Urban mobilities France-China: Nanjing and Strasbourg, new tramway projects*, seminar-workshop coordination (C. Mazzoni, ZHUO Jian), Urban Institute of Shanghai, November 30th, 2014.

mobility, ICT and digital development as well as socially inclusive mobility approaches. Workshops and conferences further enhance the exchange between the universities and the city. These centers present both a digital platform to share information and research results, and a real place within each participating city to inform and interact with the local community.

Referring to this Italian model, the methodological and practical approach in the “Atelier des mobilités métropolitaines” is turned towards building expertise at a local level. This framework acts both as observatory for local projects of innovative solutions for mobility, as well as theatre dedicated to the creation of exploratory scenarios. Last but not least, the main goal is to make this Atelier a place of shared experiences between scholars, decision-makers, technical experts and the civil society.

Assessing innovative metropolitan mobility solutions. Karlsruhe experience.

Within AMUP laboratory, ongoing researches refer to one specific form of urban mobility: the tram and tram-train. However, the idea is not to limit the research to the discussion of the pertinence and feasibility of a light-rail/rail infrastructure in Strasbourg, but rather to explore a whole set of solutions that innovatively articulate different scales (inner city/metropolitan area/urban region) and different transportation modes in order to facilitate the development of sustainable transportation and urban planning configurations.

The light-rail/rail infrastructure for which Karlsruhe has become a model is used as a starting point in order to study the relationship between transport infrastructure, decision-making processes, and the nexus between urban and transport planning. This innovative transport solution is analysed in the context of challenges (e.g. economic, social, environmental) that the metropolitan area of Strasbourg is confronted with.

According to German experience, developing a “slow mobility” strategy is a process with substantial involvement of citizens and stakeholders who often have strongly divergent interests. Local authorities have to be able to moderate diverging interests and bring them to a productive end, i.e. produce decisions that will be beneficial to the community as a whole and its long-term development. Once the mobility strategy has been formulated there will again be very controversial discussions to establish the necessary projects. And again, after the projects have been decided upon, more controversial discussions will ensue as to the projects’ exact designs and refinements including the permission and building processes. In order to be able to carry out these tasks and decisions, local authorities have to be strengthened with respect to both their general expertise on the relevant issues and their capabilities to moderate the decision processes. They need help to find new strategies and processes along the whole decision-making chain.

From the territorial development viewpoint, the Karlsruhe experience in the matter became a reference. The public transport system in Karlsruhe and its surroundings is managed by the Karlsruher Verkehrsbund GmbH (KVV),

which is the third largest public transport system in the Federal State of Baden-Württemberg. The KVV provides services on 931 km rails and its coach lines have a cumulated length of 2,300 km. In 2013, 177 million passengers used the transport system, and the overall revenues of the service providers were 133 million Euro. In order to provide more attractive routes from the city to the surrounding regions without changing trains, the city of Karlsruhe has implemented a tram-train system – the so-called Karlsruhe Model. In 1992, the first two-system-tram was introduced. Nowadays the tram-train traffic uses the railway network of the city of Karlsruhe as well as the railway network of Deutsche Bahn in the surrounding areas. The system also features flexibility in the choice of electrical concepts. The wide range of the tram-train system is remarkable and this is partly due to the fact that cities and villages of the surrounding region wished to be integrated into it and also contributed to the required investments.

REVEALING POSSIBLE FUTURES FOR STRASBOURG’S METROPOLITAN DEVELOPMENT: THE EXPLORATIVE SCENARIO APPROACH

In the transition from *urban project* towards *metropolitan project* as a new way of thinking and projecting urban development, the explorative scenario approach is a key feature, among other conceptual and methodological trends and weak signals (Grigorovschi, 2015). In this regard, for our Atelier, explorative scenarios became one of the main tools for inventing and questioning the future Strasbourg metropolis. The approach favours an inductive mode of thinking in search of possible futures for the “city of short distances”. Unlike other ways of scenario development (predictive or normative), the explorative scenarios support the idea that it is impossible to predict what will really happen as well as to try to define and then reach an ideal configuration. In other words, this scenario approach, aims the exploration of “what can happen?”, by unfolding a range of possible consequences (risks, strengths, gaps, etc.) without trying to predict probable futures, nor to find the most preferable one⁵.

Initiated by AMUP laboratory’s researchers, PhD students and interns, scenarios developed within the Atelier are conceived as a way to stimulate and enrich the collective reflexion and debates on the metropolitan development territory in Strasbourg. In this sense, they are not to be confused with action-oriented proposals as in a range of choices for decision-making. This gives scenarios a chance

⁵ Even though in literature there is a rich variety of scenario approaches and methods, several authors (Amara, 1981; Dreborg, 2004; Börjeson *et al.*, 2006) seem to agree on the fact that there are three types of future: the probable, preferable and possible. Referring to these categories, Martin Borjeson, (Swedish strategist, scenario developer and futurist) and his colleagues within the field of Future Studies, published in 2006 a scenario typology pointing out these three ways of thinking about the future, resulting in three scenario types: the predictive, normative and explorative scenarios.

Within our disciplinary field, regarding the question of scenarios as a tool for envisioning possible territorial futures, we refer mainly to Paola Viganò. Viganò, P. (2012) *Les territoires de l’urbanisme. Le projet comme producteur de connaissance*, MetisPresses, Genève; Viganò, P. (2010) “Explorer l’avenir”, in Masbouni, A. (eds.), *La ville est une figure libre*. Laurent Théry. Grand prix de l’urbanisme 2010, Parenthèses.

(at least during their initial development) to fly free of any ongoing political trends and directives, escape the institutional constraints and administrative perimeters and set aside the question of governance. However, this should not be confused with utopian or romantic approaches, since the scenarios' baselines are always attached to territorial realities, as in geographical and landscape features, local landmarks, cultural representations, and ways of living and sharing this metropolitan space. Thus, scenario developments as experienced within the Atelier rely on quantitative and qualitative data in order to cover and explore not only explicit features, as physical layouts and ways in which the territory functions, but also implicit ones, such as mental constructions related to the former. This implies both a spatial and a conceptual exploration of possible futures during scenarios' development.

The *Integrated mobility scenario* is one of the first created within the Atelier. Its starting point is the idea that the essence of Strasbourg, as a metropolis of short distances, could be a light-rail/rail infrastructure associated – on a very local scale (e.g. the neighbourhood scale) – with a soft mobility network.

For this scenario, the upstream preparation requested a proactive scientific watch on the current mobility issues and debates within the metropolitan context of Strasbourg, a microdata mining regarding railway network's use, as well as a "stocktaking" cross-border cartographic work.

The hypothesis is questioned and articulated on three different scales: the Upper Rhine metropolitan region, Strasbourg's metropolitan area and the metropolis' urban cores. Each of these frameworks was determined by geographical and urban configurations as well as human practices within the territory, and they all focus on the cross-border dimension. Also, two different timeframes are

considered: the middle-run, settled in 2030, and the long-term horizon of 2100. This is mainly due to the fact that some developments require restoring several abandoned rail corridors and the construction of new railway sections, for which the investments would be impossible to obtain within a short period of time.

The integrated mobility scenario: spatial exploration

The scenario envisions a denser network of regional express train lines (RER/S-BAHN), which, on one hand, consolidates the North-South urban development of the Upper Rhine territory and introduces transversal East-West, cross-border connections, on the other (Figures 1 & 1a).

On the scale of Strasbourg's metropolitan area (Figures 2 & 2a), several express lines (RER) highlight the "30 minutes cross-border metropolis" since they are almost all diametrical (passing through the city center) and their maximum travel time between the termini is about 1 hour long. Moreover, certain lines crossing the Rhine are connecting Strasbourg's hinterland to their German neighbours, without breaking bulk or change in the mode of transportation. In the same way, most of the sites of high economic, cultural and touristic value of the metropolitan area, such as airports, airfields, leisure parks, as well as typical villages and resort towns, are connected to this express network which makes them easily accessible from both sides of the Rhine.

Even though most of the lines rely on the existing railway infrastructure, there are also a few new sections to be built (as a second step) in order to increase the network coverage and improve accessibility. This would also enhance the attractiveness and thus the urban development of some areas, which for the moment are only covered by the regional bus services or only accessible by car.

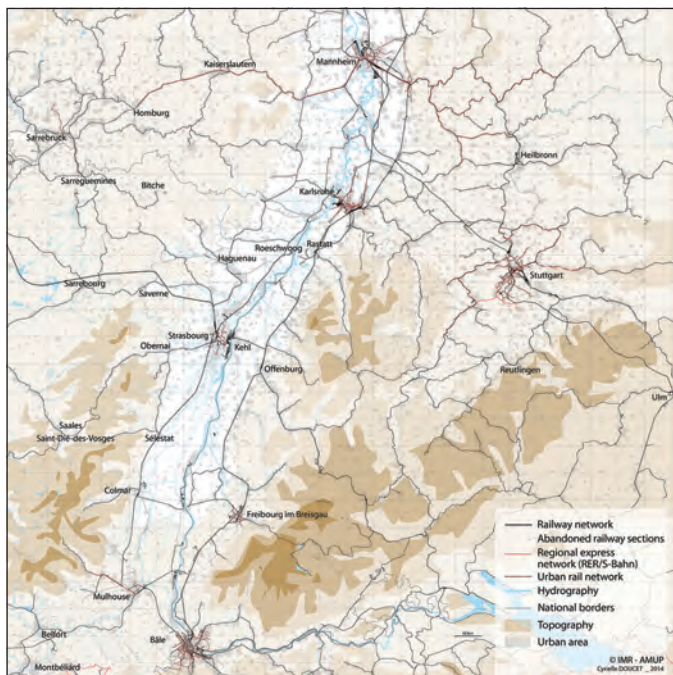


Figure 1. Rail/light-rail network of the Upper Rhine metropolitan region. Current state.
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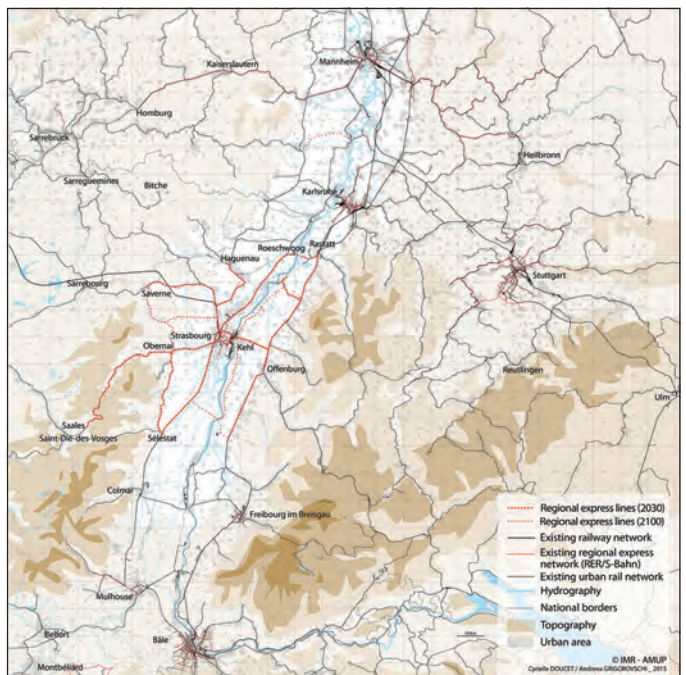


Figure 1a. Possible development of the Upper Rhine metropolitan rail/light-rail network. Scenario of Integrated Mobility.
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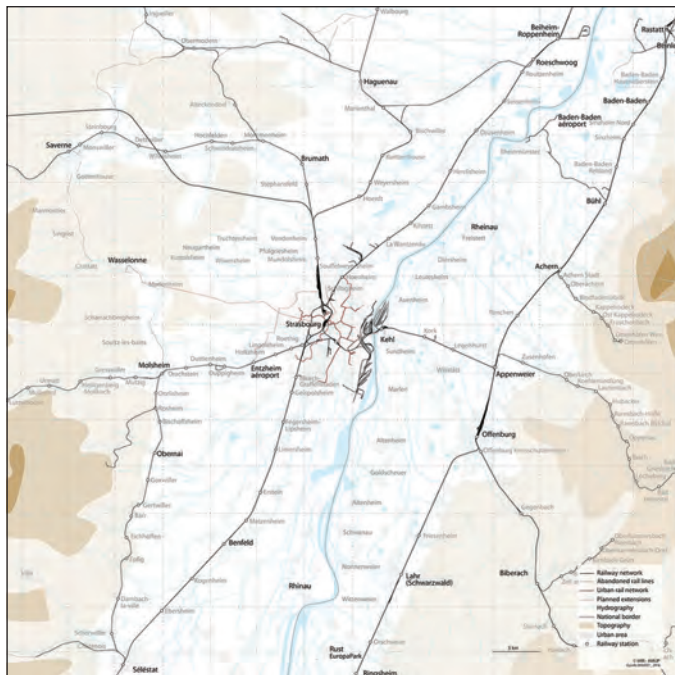


Figure 2. Rail/light-rail network of Strasbourg's metropolitan area. Current state. (© IMR-AMUP. Cyrielle Doucet, 2014)



Figure 2a. Possible development of the rail/light-rail network of Strasbourg's metropolitan area. Scenario of Integrated Mobility. (© IMR-AMUP. Cyrielle Doucet, Andreea Grigorovschi, 2015)

Finally, regarding the metropolis' urban cores (Figures 3 & 3a), it is interesting to outline that although the railway connection between the main cities of Strasbourg and Offenbourg already exists, the fact that they stop being termini stations (the RER lines disserving further destinations within the scenario) gives a new status to the territories situated in-between. An accelerated urban development is thus to be expected for this area.

At the inner city level, a cross-border tram-train draws a city-ring-line defining a bigger center district in-between the main railway stations of Strasbourg (France) and Kehl (Germany), which offers a direct connection to the European Quarter. Passing through the harbour area (on the French side), the city ring could also be used for urban logistics, covering the "last mile" delivery, particularly during night-time. This line would use both rail and light-rail (tramway) infrastructure, therefore, two interconnection platforms would be needed.

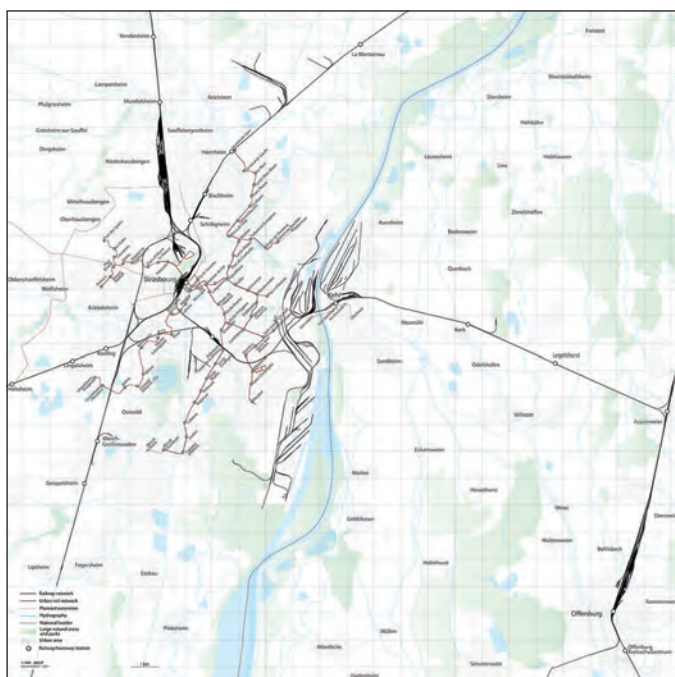


Figure 3. Rail/light-rail network within and in-between the metropolis' urban cores. Current state. (© IMR-AMUP. Cyrielle Doucet, 2014)



Figure 3a. Possible development of the rail/light-rail network within and in-between the metropolis' urban cores. Scenario of Integrated Mobility. (© IMR-AMUP. Cyrielle Doucet, Andreea Grigorovschi, 2015)

All these express and tram-train connections create the conditions for increasing the urban density in the districts surrounding the stations. On this local scale, it is also interesting to imagine “soft”/ “slow mobility” solutions, such as an extended cycling and pedestrian network, which would finely further irrigate the territory around stations.

The integrated mobility scenario: conceptual exploration

From a conceptual viewpoint, the scenario questions the mental constructions of the territory. On a large scale, the Upper Rhine metropolitan region, currently set out as two North-South parallel axes along the river, acquires a new East-West dimension by reinforcing and increasing the cross-border connections. A new structuring image appears, that of a territorial skeleton supported by the Rhine as a backbone. Symbolically, this image tells the story of two parallel urban systems (which used to function independently one from another) coming together and turning towards the Rhine in the process. Previously seen as their dividing line, the river emerges as a shared valuable element, keeping them together (Figure 4).



Figure 4. The territorial skeleton of the Upper Rhine. Scenario of Integrated Mobility _ Conceptual development. (© IMR-AMUP. Andreea Grigorovschi, 2015)

Furthermore, Strasbourg’s metropolitan area becomes coherent and recognizable throughout another territorial figure – the *diametrical beams*. In fact, by analogy, the concept of *beams* recalls the human energy flow drained by the new express lines envisioned within the scenario. Their *diametrical* nature is really the key point for understanding this image, highlighting the fact that metropolitan cores become truly central for the entire metropolis, French and German sides jointly. The metropolis’ territory comes together as a whole since the beams pass through the cores and continue their journey towards the opposite metropolitan fringe. However, the diametrical aspect is not to be confused with a circular configuration per se. It

is rather the symbolic interpretation behind the circle that gives more meaning to this image as it implies the idea of unity. Indeed, put together, these *diametrical beams* reveal and structure the wide surface of the new “30 minutes cross-border metropolis” (Figure 5).

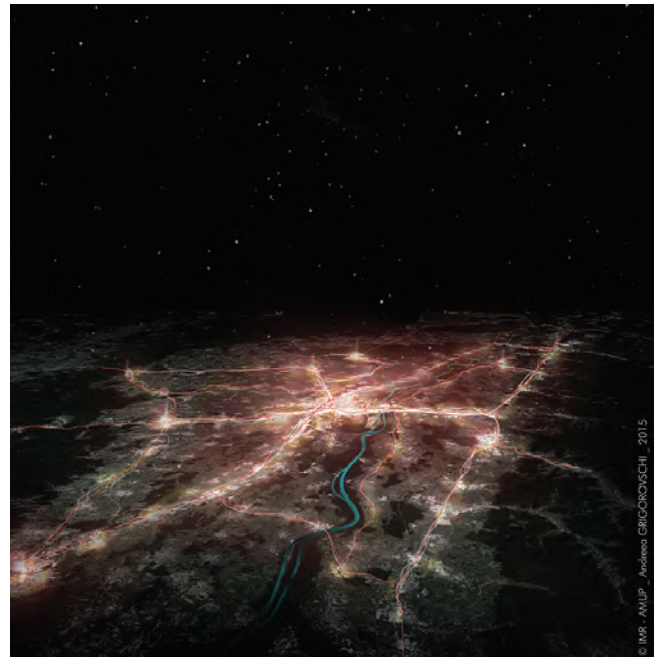


Figure 5. The diametrical beams structuring Strasbourg’s metropolitan area. Scenario of Integrated Mobility _ Conceptual development. (© IMR-AMUP. Andreea Grigorovschi, 2015)

Last but not least, on a smaller scale, another conceptual image synthesizes the architecture of the metropolis. The *Dual-Core braiding* offers an alternative mental construction for the whole metropolis and especially for the territories in-between the cores. The metaphor of the *Dual-Core* stands for the two main central cities of Strasbourg and Offenbourg connected to each other and working together. Without really merging into one single metropolitan center, the two cores continue to co-exist, each with its own autonomy, but together they mark a central part of the new metropolis throughout this single integrated mobility network. The *braiding* suggests precisely the intertwining between the rail, light-rail, cycling and pedestrian networks irrigating the territory and structuring it on different levels, scales, speeds. Although the image of *braiding* applies within the whole metropolitan area, the *Dual-Core braiding* narrates the development of this new metropolitan cross-border centrality (Figure 6).

Besides the above-presented version of the integrated mobility scenario, other possible futures are envisioned through this exploratory approach: alternative developments regarding later timeframes or even completely different visions are thus explored. From a methodological point of view, we also question the ability of the common graphic representations (especially maps and plans) to synthesize and communicate the multiple messages and meanings developed within the think tanks. In this sense, our research team also explores different ways of optimizing graphical and visual communication tools, like aerial oblique viewpoints and moving maps.



Figure 6. The Dual Core braiding.
Scenario of Integrated Mobility_ Conceptual development.
(© IMR-AMUP. Andreea Grigorovschi, 2015)

In sum, this kind of explorative scenario is meant as a basis for discussion during the Atelier's meetings. Even though it can be considered naïve, it is its "immature", unfinished and sometimes even incredible nature that seems to be able to provoke actors and open up the debate. Raising awareness to possibilities, rising technical or political question marks in terms of governance, cross-border cooperation, legal frameworks, practical implementation, the scenarios become a tool for sharing knowledge and moving forward in seeking innovative ideas for metropolitan development. In other words, explorative scenarios (as the one presented above) inquire possible futures on the "what" and "why" levels – *What can happen?* and *Why would it be interesting/risky/damaging for it to happen?* – whereas the revealed possibilities are meant to evolve and further trigger the "how" level – *How could this be possible?*

CONCLUSION

The sustainable urban mobility topic is going to be central both in local and metropolitan scale. In the context of the current process of energy transition, the stakeholders of the newly created 'Eurometropole' of Strasbourg are looking for new integrated strategies and planning approaches for urban mobility. These strategies are intended to be developed on multiple scales (local, regional), especially that of the Upper Rhine territory. Therefore, new cross-border institutional frameworks such as the Upper Rhine Conference are supporting the integration of both science and civil society pillars as new important actors in the local and inter-regional projects. In the main cities of the Upper Rhine territory - Strasbourg, Basel, and Karlsruhe - new visions are emerging, linked to an interesting "bottom up" approach (cf. project "IBA Basel", "Tramway in Strasbourg" and "Tram-train in Karlsruhe"). This way of thinking and acting takes into consideration geographical, cultural,

political, social and economical features and allows better coordination between technical and sensitive data, according to the idea of a "creative" territory (Héraud, 2011). Moreover, bottom-up approach reintroduces in those three cities old forms of slow movement, closely and increasingly related to contemporary lifestyle changes. Articulated to the contemporary hi-speed mobility, the concept of "to slow down" is not a synonym of "out of date" or obsolete world vision. Locally as well as regionally, the sustainable project of public mobility has to integrate the idea of this new slowness, of new break times which appear to be essential for a creative economy and a new quality of live.

REFERENCES

- Bishop, P., Hines, A., Collins, T. (2007) The current state of scenario development: an overview of techniques, *Foresight*, Vol. 9, No. 1, pp. 5-25.
- Bocquet, D. (2013) Challenges to Urbanity in Contemporary Mediterranean Metropolises, New Urban Forms, Dynamics, Boundaries and Tensions, in *New Geographies 5: The Mediterranean* (Antonio Petrov ed.), Harvard University Graduate School of Design, pp. 235-244.
- Borghgi, R. (2014) Repenser la ville en sept figures. Une ouverture sur l'expérience de Bologne, in Mazzoni, C. and d'Emilio, L. (eds.) *Strasbourg métropole. Images et récits pour la ville-archipel*, La Commune, Paris, pp. 211-219.
- Börjeson, L., Höjer, M., Dreborg, K., Ekvall, T., Finnveden, G. (2006) Scenario types and techniques: Towards a user's guide", *Futures*, No. 38, pp. 723-739.
- Breheny, M.J. (ed.) (1992): *Sustainable Development and Urban Form*, European Research in Regional Sciences.
- Bulkeley, H., Betsill, M. (2005) Rethinking Sustainable Cities: Multilevel Governance and the 'Urban' Politics of Climate Change, *Environmental Politics*, 14-1, pp. 42-63.
- Bulkeley, H., Betsill, M. (2013): Revisiting the urban politics of climate change, *Environmental Politics*, 22-1, pp. 136-154.
- CERTU (2012) *Dix réflexions sur la mobilité en périurbain*, collection Essentiel, No. 6, pp. 23.
- Commission of the European Communities (2007) *Towards a new culture for urban mobility*, Green Paper presented by the Commission, COM (2007) 551 final, Brussels.
- CUS (2009) Communauté urbaine de Strasbourg, *Démarche ÉcoCités Strasbourg, métropole des Deux-Rives*, map of the Upper Rhine metropolis, pp. 12.
- ESPON (2013) *Science in support of European Territorial Development and Cohesion*, Scientific Report.
- European Commission (1999) *ESDP - European Spatial Development Perspective, Towards Balanced and Sustainable Development of the Territory of the European Union*, Office for Official Publications of the European Communities, Luxembourg.
- Grigorovschi, A. (JP 2015) *Architecture Urbaine en débats: cultures de projet en interaction. Strasbourg métropole rhénane et son récit urbanistique (Debates on Urban Architecture: evolving project cultures. Strasbourg, the Rhine metropolis and its urbanistic narrative)*. PhD thesis (C. Mazzoni coordinator), University of Strasbourg.
- Héraud, J.-A. (2011) Reinventing creativity in old Europe: A development scenario for cities within the Upper Rhine Valley cross-border area, *City, Culture and Society*, No. 2, pp. 65-73.

- International Energy Agency, International Union of Railways (2014) *Railway Handbook 2014*, Energy consumption and CO2 emissions, OECD/IEA. http://www.uic.org/IMG/pdf/iea-uic_railway_handbook_2014_web.pdf
- Jabareen, Y.R. (2006) Sustainable Urban Forms: Their Typologies, Models, and Concepts, *Journal of Planning Education and Research*, Vol.28, No.1, pp. 38-52.
- LOW Mapam (2014) LOI No. 2014-58 du 27 janvier 2014 de modernisation de l'action publique territoriale et d'affirmation des métropoles.
- Mazzoni, C., d'Emilio, L. (eds.) (2014) *Strasbourg métropole. Images et récits pour la ville-archipel*, La Commune, Paris.
- Mazzoni, C., Grigorovschi, A. (eds.) (2014) *Strasbourg métropole. Ourlets urbains dans la ville-mosaïque*, La Commune, Paris.
- Ministers of the EU Member States (2007) *Leipzig Charter on Sustainable European Cities*, Informal Ministerial Meeting on Urban Development and Territorial Cohesion, at the invitation of the German EU Council Presidency, Leipzig, 24th and 25th May 2007.
- Naess, P. (2001): "Urban Planning and Sustainable Development", *European Planning Studies*, 9-1, pp. 503-524.
- Riddell, R. (2008): *Sustainable Urban Planning: Tipping the Balance*, London, Wiley, pp. 356.
- Rietveld, P. et al. (eds.) (2011): *Transitions Towards Sustainable Mobility: New Solutions and Approaches for Sustainable Transport Systems*, Springer, pp. 333.
- Roberts, P. (1994): "Sustainable Regional Planning", *Regional Studies*, 28-8, pp. 781-787.

INTELLIGENT TRANSPORT SYSTEMS DEPLOYMENT IN THESSALONIKI: ASSESSMENT OF COSTS AND BENEFITS

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Transportation projects often require large initial investments and are expected to generate benefits extending far into the future. Thus, there is a need to compare benefits and costs that occur at different periods over time. Since money has a time value, the same amount of money at different time periods does not have the same value. Therefore, it is important to convert costs and benefits into equivalent values when conducting a Cost-Benefit Analysis (CBA). A special category of transportation projects is that of Intelligent Transport Systems (ITS). ITS comprise innovative solutions for travel demand and traffic management, and it is expected to play a key role in future sustainable urban development plans. Compared to other transportation projects, ITS have a lower initial investment. In this paper a framework based on a CBA is presented, assessing costs and benefits of three ITS projects implemented in Thessaloniki, Greece. The paper refers to future developments of ITS in the city of Thessaloniki. The examined systems have already been developed as demonstration systems in various regions throughout Europe. The benefits of the systems have been transferred and scaled up, so as to be in line with the specific characteristics of the Greek environment.

Key words: Intelligent Transport Systems, Cost-Benefit Analysis.

INTRODUCTION

The term “Intelligent Transport Systems” or “ITS” is used to define the use of Information and Communication Technologies (ICT) in the field of transport, to create real time flow of information and data in order to enable more “intelligent” use of infrastructures and vehicles and to enhance the management of traffic and mobility (Giannopoulos *et al.*, 2013). The goal of ITS is to minimize accidents, traffic congestion, and reduce the environmental impacts of traffic, while services are affordable, privacy is respected and security is provided. In Greece, a national ITS strategy has been developed that prioritized for the first time the objectives of ITS in the country (Ministry of Economy, Infrastructure, Shipping & Tourism, 2015). These objectives pertain to the utilization of real time traffic data for the provision of relevant information to the drivers, the development of traffic control centers for the management of public transport, freight transport and monitoring of the road network, as well as the promotion of electronic transactions in transport and connectivity among vehicles

and between infrastructure and vehicles. These priorities are in compliance with the role of ITS in Thessaloniki, as this has been described in the city’s Sustainable Urban Mobility Plan (Thessaloniki Public Transport Authority, 2014). The significance of integrating innovative solutions (i.e. ITS) in the development of sustainable urban plans has been stressed by Thoidou (2013).

Previous research indicates that investments on ITS can generate quickly significant returns (Stevens, 2004). However, field data regarding actual ITS implementations that are necessary for the conduct of CBAs of ITS are normally not available. Thus, it is frequently required to estimate this information from available evidence using expert intuition (Stevens, 2004). Although there is comprehensive research literature on the estimation and monetization of environmental impacts (i.e. noise levels, climate change, etc.) of ITS systems, there is little consensus regarding the proposed valuation methods among the research community. Regarding the positive and negative effects of ITS projects, it has to be mentioned that the distribution of these effects among the various stakeholders plays a key role in the way the projects are perceived (Stevens, 2004).

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Several studies have been conducted for the economic appraisal of ITS systems utilizing different valuation methodologies. Ozbay and Bartin (2004) proposed a new evaluation methodology that integrates a full marginal cost (FMC) approach with microscopic simulation to compare the effectiveness of Advanced Traveller Information Systems (ATIS) that operate via Variable Message Sign (VMS) guidance. Their proposed methodology employed microscopic simulation as a tool for accurately estimating the impact of VMS route guidance on congestion levels that are in turn used as the input to the FMC functions. Brand *et al.* (2004) conducted a comprehensive CBA that was performed based on the results of model deployments of CVISN (Commercial Vehicle Information Systems and Networks) systems that provide electronic credentialing and electronic screening of heavy trucks to improve their safe and efficient operation.

Haynes and Li (2004) developed analytical alternatives in ITS economic evaluation that internalize positive externalities of ITS and incorporate system consideration into CBA. De Brucker *et al.* (2004) described the theoretical foundations of multicriteria analysis (i.e. analytic hierarchy process and PROMETHEE) and critically examined the strengths and weaknesses of multi-criteria analysis (MCA) as compared to cost benefit analysis (CBA), especially in the context of ITS applications. Filipovic (2007) indicated the usefulness of analytic hierarchy process (AHP) as a tool for decision making. Nakanishi and Falcochio (2004) assessed the performance of ITS using data envelopment analysis (DEA). In their work they discussed the potential of DEA to make significant contributions to the evaluation of public sector investments in ITS technologies.

In this present study a comprehensive CBA regarding the implementation of three traffic management and traveler information systems has been conducted. These ITS have been developed within the framework of the SEE-ITS project in Austria, Greece and Hungary. The cost and benefits of the implemented ATIS in Thessaloniki, Greece are estimated and compared. The prospective transfer of the ITS systems that have been developed in Austria and Hungary to Thessaloniki, Greece is also assessed in economic terms.

COST-BENEFIT ANALYSIS FRAMEWORK

The primary goal of an economic assessment of a transport project is to quantify the magnitude of the economic impact resulting from an investment in the transportation sector. The cumulative economic impact is a function of the change in transport user benefits (i.e. consumer's surplus), the change in system operating costs and revenues (i.e. producer surplus), the change in cost of externalities (i.e. environmental costs, accidents, etc.), and finally the investments costs. Monetizing the abovementioned changes is a rather demanding task, since it is necessary to consider:

- The scope of the analysis in terms of mode, study area and range of impacts;
- The definition of the alternatives – particularly the “Do minimum” alternative;
- The estimation of transport user benefits (consumer surplus);

- The estimation of impacts on transport providers and the government (includes producer surplus and investment costs);
- Monetization of time and safety;
- Consideration of environmental impacts and other externalities;
- The mechanics of the process including inputs, project life, discounting, aggregation of benefits and costs, unit of account.

Estimation of consumer's surplus and travel time savings

Monetization of transport user benefits requires the quantification of consumer's surplus. Consumer's surplus has been defined as the excess of consumer willingness to pay over the cost of a trip. Normally, what is of interest is the change in consumer surplus occurring from some change in the cost of travel incurred by an improvement in transport conditions. However, in the transportation field, money costs are only a part of the composite travel cost. In reality the cost of travel also encompasses the time spent by the users, access time to public transport, discomfort, perceived safety risk and other elements. Thus, price alone is not an accurate estimate of the cost of travel of the consumer's willingness to pay, instead generalized cost is used.

Generalized cost is an amount of money representing the overall cost and inconvenience to the transport user of travelling between a particular origin and destination by a particular mode. In practice, generalized cost is usually limited to a number of impacts which when added constitute the components of user benefit:

- Time costs (Time in minutes * Value of Time in €/minute);
- User charges (e.g. fares/tolls); and
- Operating costs for private vehicles.

It is critical though to mention that the components of generalized cost differ among the different transportation modes. Thus, there is a substantial difference in the reported user's benefits for users of different modes. Moreover, it should be noted that Value of Time varies between individuals and even for the same individual, depending for example on the trip purpose. Thus, there is no unique willingness-to-pay for travel time savings.

Given the significance of the Value of Time in the estimation of the generalized cost of travel and in consequence the consumer's surplus, it is recommended that local values should be used whenever possible, provided that they have been produced according to a coherent and well justified methodology. In the case that no such values exist, then default values obtained from international analyses of value of time studies should be used (Developing Harmonized European Approaches for Transport Costing and Project Assessment, 2002). In the abovementioned study different valuation methods of Value of Time have been used for different trip purposes.

Safety related benefits

Safety is not treated like the other components of user benefit. Instead of being considered as a component of generalized cost per trip, accidents and casualties are typically treated as random, occasional costs arising from the transport system (CE Delft, 2007). These costs are estimated by applying unit values per accident and per casualty. The calculation is a simple multiplication of forecasted accident numbers (by severity) with the costs of accidents (by severity). This approach is similar to that of other externalities (e.g. the environment).

Environmental Impacts of a Transport Project

Air pollution, greenhouse gases and noise costs are primary external cost categories (CE Delft, 2007). These costs comprise of health costs, building/material damages, crop losses and costs for further damages for the ecosystem (biosphere, soil, water). Previous research has evaluated the impacts of incident management on air pollution and fuel consumption along Athens Ring Tollway (Kopelias *et al.*, 2013). Investments on ITS technologies and infrastructure can possibly generate significant benefits regarding the surrounding environment (i.e. natural and man-made). The quantification of changes in pollutant emissions, greenhouse gases emissions and noise levels after an ITS project implementation is necessary for the valuation of these environmental impacts. Values regarding emission and noise cost factors for EU member countries can be obtained from the following project report "Developing Harmonized European Approaches for Transport Costing and Project Assessment" (2002).

Evaluation criteria

Costs and benefits have to be converted into equivalent present values prior to the estimation of the evaluation criteria on which the project assessment will be based. Thus, the base year of the evaluation has to be initially determined. All past investment costs have to be converted into present values (with respect to the base year of the valuation) according to the inflation rate of the corresponding country where the investment is taking place. All future costs (i.e. operation and maintenance) and benefits have to be converted into equivalent present values according to the present value formula:

$$P = F \cdot (1+r)^{-N}$$

where P is the present value, F is the future amount, r is the social discount rate, and N is the project lifetime.

The abovementioned conversions require the knowledge of the project lifetime (i.e. typically ranges between 5 - 10 years for ITS projects), the inflation rate as well as the social discount rate. The social discount rate represents the way money now is worth more than money later. It determines by how much any future amount is discounted or reduced, to make it correspond to an equivalent amount today. It is generally specified as a constant rate over time. There are three evaluation criteria that can be used for the economic assessment of a transport project:

- Net Present Value (NPV);

- Benefit-Cost Ratio; and
- Internal Rate of Return (IRR)

The NPV is defined as the difference between benefits and costs. NPV focuses attention on quantity of money, which is what the evaluation is ultimately concerned with. However, it only provides a good comparison between projects when they are strictly comparable in terms of level of investment or total budgets. Benefit-cost ratio is a non-dimensional index of economic evaluation. It allows the comparison of projects on a common scale and provides an easy mean to rank objects in order of relative merit. However, since values change depending on how costs and benefits are counted, there has been frequently observed a tendency to manipulate the data. Finally, the internal rate of return is the discount rate for which the net present value of a project is zero. The internal rate of return introduces the notion of "return on investment" and the project with the highest IRR is ranked as top. The advantages of the IRR is that it eliminates the need to argue about the appropriate discount rate and that rankings cannot be manipulated by the choice of the discount rate. On the other side, such an evaluation could possibly lead to two or more solutions.

RESULTS AND DISCUSSION

Mobility characteristics of the city of Thessaloniki

Thessaloniki is the second largest city in Greece, currently accommodating 1,006,730 citizens in its greater area. It is situated in Northern Greece, and covers a total of 1,455.68 km² with an average density of 665.2 inhabitants per km². Travel demand information has been obtained through 5,000 household phone surveys and Road Side Surveys (RSS) at 40 locations including 33,000 participants, executed between October and November 2010 (Mitsakis *et al.*, 2013). According to these surveys, the average number of persons in a household is estimated at 3.03 and the respective average of driving license holders per household at 1.75. Additionally, 71% of the population owns at least one private car. The average number of trips per person is 2.08. 89.4% of the survey participants stated that they usually execute up to two trips per day. Among various trip purposes, 47.6% of the trips are conducted for work and 26.8% for leisure. The modal split analysis shows that the majority of trips is conducted with private vehicles (67% private cars, 4% motorcycles and 4% taxis), while 23% is conducted with public transport (PT) and 2% with non-motorized modes of transport.

Cost-benefit analysis of ATIS in Thessaloniki

Regarding the Greek system, the investment cost is related to the purchase of the equipment and its installation. In Thessaloniki 25 Bluetooth (BT) devices have been installed. The total installation cost regarding the roadside equipment is 57,500 €. Moreover, the system has been integrated into the local mobility centre of Thessaloniki and therefore the information provision also takes place through the roadside VMS. Each VMS has a value of 48,000 €. The development of the software, which is necessary for the data fusion and the data provision, costs 60,000 €. The total development cost is estimated to be 309,500 €.

Apart from the development cost, which is all paid before the final demonstration of the system, for every year of operation an extra amount is accounted for the system's operation and maintenance. These costs are mainly comprised of the telecommunication and the power supply costs, while no personnel costs are included since the system is integrated into the mobility centre of the area. Considering a monthly operational cost of 95.00 € per unit, its annual value is estimated to be approximately 2.755 €. An extra maintenance cost is also added to this cost which is expected to occur after the first three years of implementation and it includes the possible replacement of various parts or unforeseen events. The total amount of this cost is also expected to be 2.755 € per year.

The investment cost has been paid out entirely in the base year of the evaluation (i.e. 2013), while the operational costs begin in 2014 (the first year of operation) and remain constant for the following years. On the other hand the maintenance costs begin after the first three years of the implementation and remain constant for the following years. The system's costs are extended for the following 7 years into the future. In these values the opportunity cost and the risk of the investment should be taken into account. This is achieved by discounting the future cash flows to present values. Therefore, using a social discount rate of 5.00%, the present value for each year having as a reference the year of 2013, is calculated using Equation 1. The total

NPV of the infrastructure, operation and maintenance costs is estimated to be 341,176 €. The calculated values for the system's costs are presented in Table 1.

In a cost-benefit analysis the benefits should be quantified and converted to monetized values. For example, although it is easy to comprehend the economic benefits arising from travel-time savings, it is difficult to quantify this benefit. The task of estimating the incorporated costs in accidents, travel time, fuel consumption and CO₂ emissions, is facilitated by using the relevant cost factors provided in the HEATCO report. The cost factors found in HEATCO have to be updated since the project was finalized in 2006 and the estimated values of the cost factors represent 2002 socio-economic conditions. It is thus necessary to convert these values to present values (i.e. 2014 values), in order to monetize the projected benefits. The adjustment of the cost factors is done based on the annual growth rate of GDP per capita of the corresponding country that the ITS project has been implemented.

Regarding the Greek system the benefits that have been identified are travel-time, fuel consumption and CO₂ emissions savings. The values of travel time provided by HEATCO represent 2002 values. Therefore these are converted to 2014 present values using the annual growth rate of the GDP. For CO₂ emissions costs factors, relevant values are provided for the year 2014 in HEATCO,

Table 1. Detailed cost description of the implementation of an ATIS system in Thessaloniki

Costs	2013	2014	2015	2016	2017	2018	2019	2020
Development (€)	309,500	0	0	0	0	0	0	0
Operation & Maintenance (€)	0	2,755	2,755	5,550	5,550	5,550	5,550	5,550
Total (€)	309,500	2,755	2,755	5,550	5,550	5,550	5,550	5,550
Discounted Total (€)	309,500	2,624	2,624	5,286	5,286	5,286	5,286	5,286
Total Cost (€) (Present Value)								341,176

Table 2. Benefits from the implementation of an ATIS in Thessaloniki

Year	2014	2015	2016	2017	2018	2019	2020
Reduction of Vehicle-hours	27,041	27,041	27,041	27,041	27,041	27,041	27,041
Value of Travel Time (€/hour)	18.23	18.23	18.23	18.23	18.23	18.23	18.23
Travel time savings (€)	492,912	492,912	492,912	492,912	492,912	492,912	492,912
Discounted Values (€)	469,440	447,086	425,796	405,520	386,209	367,818	350,303
Reduction of CO2 emissions (tons)	254	254	254	254	254	254	254
Cost factor (€/ton)	26	26	26	26	26	26	26
Savings (€)	6,607	6,607	6,607	6,607	6,607	6,607	6,607
Discounted Values (€)	6,292	5,992	5,707	5,435	5,176	4,930	4,695
Reduction of consumed Petrol (litters)	67,872	67,872	67,872	67,872	67,872	67,872	67,872
Price of petrol (€/litter)	1.55	1.55	1.55	1.55	1.55	1.55	1.55
Savings (€)	105,202	105,202	105,202	105,202	105,202	105,202	105,202
Reduction of consumed Diesel (litters)	16,968	16,968	16,968	16,968	16,968	16,968	16,968
Price of diesel (€/litter)	1.23	1.23	1.23	1.23	1.23	1.23	1.23
Savings (€)	20,871	20,871	20,871	20,871	20,871	20,871	20,871
Total Savings from Reduction of Fuel Consumption (€)	126,072	126,072	126,072	126,072	126,072	126,072	126,072
Discounted Values (€)	120,069	114,351	108,906	103,720	98,781	94,077	89,597
Total Cost (€)(Present Value)							3,619,902

and therefore no adjustment is needed. Regarding fuel consumption, current market values are used. At this point it has to be mentioned that 2014 cost factors will be used for the estimation of future year benefits, to avoid overestimation of benefits. The benefits that arise from the implementation of the project are provided in Table 2.

Cost-benefit analysis of a cooperative traffic management system in Thessaloniki

The development cost corresponds to the building of the software and the end-user application, the server, as well as for the planning and set up of the system. This cost was 100,000 € for Vienna's pilot site. For the implementation of the same system in Thessaloniki the development cost has to be adjusted in order to be representative of the current Greek economic conditions. This adjustment is based on the GDP per capita (PPP) of Austria and Greece during the base year of the project's evaluation lifecycle. The ratio of the Greek GDP per capita (PPP) to Austria's GDP per capita (PPP) is estimated and this index is multiplied by the development cost in Austria. The development cost is a one-off cost that is paid in the beginning of the project (i.e. base year). The development cost for the city of Thessaloniki is 60,000 €.

Operations and maintenance costs correspond to costs for hosting the server application. These costs mainly depend on the amount of data generated from the distributed traffic messages and the logging activities carried out for the evaluation purposes. For Vienna's pilot site these costs have been estimated to be 40 € per month, which corresponds to an annual cost of 480 €. Adjusted for current Greek economic conditions according to the aforementioned methodology utilizing the GDP per capita (PPP) of each country the annual operation and maintenance costs for the implementation of the system in Thessaloniki are 288 €. The annual operation and maintenance costs of the system remain constant throughout the project's lifetime. However, future costs have to be discounted to present values, so that the benefit-cost ratio can be estimated. Having assumed a social discount rate of 5.00% and using the present value formula the discounted values per year are obtained. These values along with the initial development cost are shown in Table 3.

A prospective implementation of Vienna's C-ITS system in Thessaloniki is going to yield reduction in CO₂ emissions produced by the transport sector and in the number of accidents occurring in the city's road network. Apart from these direct benefits, the reduction of the number of accidents will also result in the mitigation of non-recurring congestion. Thus, travel time and fuel consumption savings occur as well. The total present value of the benefits amount to 118,533 € and the benefit-cost ratio is 1.92. The benefits

that arise from the implementation of the system are provided in Table 4.

Cost-benefit analysis of ITS deployment for road networks in Thessaloniki

The development cost corresponds to the building of an intermodal route planning application. This cost was 33,200 € for Budapest's pilot site. For the implementation of the same system in Thessaloniki the development cost has to be adjusted in order to be representative of current Greek economic conditions. This adjustment is based on the GDP per capita (PPP) of Hungary and Greece during the base year of the project evaluation lifecycle. The ratio of the Greek GDP per capita (PPP) to Hungary's GDP per capita (PPP) is estimated and this index is multiplied by the development cost in Hungary. The development cost is a one-off cost that is paid in the beginning of the project. The development cost for the city of Thessaloniki is 37,848 €.

Operation and maintenance costs correspond to costs for editing and testing the application's database, answering forum questions and operating a helpdesk. For Budapest's pilot site these costs have been estimated to be 110 € per month, which corresponds to an annual cost of 1,320 €. Adjusted for current Greek economic conditions according to the aforementioned methodology utilizing the GDP per capita (PPP) of each country the annual operation and maintenance costs for the implementation of the system in Thessaloniki are 1505 €. The annual operation and maintenance costs of the system remain constant throughout the project's lifetime. However, future costs have to be discounted to present values, so that the benefit-cost ratio can be finally estimated. Having assumed a social discount rate of 5.00 % and using the present value formula (i.e. Equation 1) the discounted values per year are obtained. These values along with the initial development cost are shown in Table 5.

A prospective implementation of Budapest's intermodal route planning engine in Thessaloniki is going to yield reduction in the total number of vehicle-kilometres travelled in the city. Apart from this direct benefit of the application deployment, the reduction of the vehicle-kilometres travelled will also result in travel time savings, CO₂ emissions and fuel consumption savings. The total present value of the benefits amount to 171,999 € and the benefit-cost ratio is 3.69. The benefits that arise from the implementation of the system are provided in Table 6.

CONCLUSIONS

In this present study the activities that were undertaken for the economic appraisal of three systems that were

Table 3. Detailed cost description of the implementation of a C-ITS system in Thessaloniki

Costs	2013	2014	2015	2016	2017	2018	2019	2020
Development (€)	60,000	0	0	0	0	0	0	0
Operation & Maintenance (€)	0	288	288	288	288	288	288	288
Total (€)	60,000	288	288	288	288	288	288	288
Discounted Total (€)	60,000	274	261	249	237	226	215	205
Total Cost (€) (Present Value)								61,666

Table 4. Benefits from the implementation of a C-ITS in Thessaloniki

Year	2014	2015	2016	2017	2018	2019	2020
Reduction of Vehicle-hours	676	0	676	0	0	676	676
Value of Travel Time (€/hour)	18.23	18.23	18.23	18.23	18.23	18.23	18.23
Travel time savings (€)	12,323	0	12,323	0	0	12,323	12,323
Discounted Values (€)	11,736	0	10,645	0	0	9,195	8,758
Reduction of slight injuries	1	0	1	0	0	1	1
Cost factor (€/slight injury)	7,885	7,885	7,885	7,885	7,885	7,885	7,885
Correction factor	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Savings (€)	15,769	0	15,769	0	0	15,769	15,769
Discounted Values (€)	15,018	0	13,622	0	0	11,767	11,207
Reduction of CO2 emissions (tons)	15.88	0	15.88	0	0	15.88	15.88
Cost factor (€/ton)	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Savings (€)	413	0	413	0	0	413	413
Discounted Values (€)	393	0	357	0	0	308	293
Reduction of consumed Petrol (litters)	3,712	0	3,712	0	0	3,712	3,712
Price of petrol (€/litter)	1.55	1.55	1.55	1.55	1.55	1.55	1.55
Savings (€)	5,754	0	5,754	0	0	5,754	5,754
Reduction of consumed Diesel (litters)	1,590	0	1,590	0	0	1,590	1,590
Price of diesel (€/litter)	1.23	1.23	1.23	1.23	1.23	1.23	1.23
Savings (€)	1,956	0	1,956	0	0	1,956	1,956
Total Savings from Reduction of Fuel Consumption (€)	7,709	0	7,709	0	0	7,709	7,709
Discounted Values (€)	7,342	0	6,660	0	0	5,753	5,479
Total Cost (€) (Present Value)							118,533

Table 5. Detailed cost description of the implementation of a route planning system in Thessaloniki

Costs	2013	2014	2015	2016	2017	2018	2019	2020
Development (€)	37,848	0	0	0	0	0	0	0
Operation & Maintenance (€)	0	1,505	1,505	1,505	1,505	1,505	1,505	1,505
Total (€)	37,848	1,505	1,505	1,505	1,505	1,505	1,505	1,505
Discounted Total (€)	37,848	1,433	1,365	1,300	1,238	1,179	1,123	1,069
Total Cost (€) (Present Value)								46,555

piloted within the SEE-ITS project have been described. A cost-benefit analysis regarding the ATIS demo system that has been implemented in Thessaloniki, Greece is initially presented. Subsequently, the transferability of the applications/services implemented in Austria and Hungary to the Greek road transport network is evaluated in economic terms too. The conduct of the presented CBA's heavily relies on the findings of the research activities of the SEE-ITS project.

An Advanced Traveller Information System has been deployed in Thessaloniki's urban road network. The system is comprised of 25 Bluetooth devices and 4 Variable Message Signs (VMS), which are operated through the city's traffic management centre. The assessment of this system's impacts showed significant travel time, fuel consumption and CO² emissions savings. Despite its high implementation cost, the BCA of this transport project was estimated 10.76, which demonstrates the prospective benefits of this service.

The transfer of Vienna's C-ITS to Thessaloniki could possibly yield reduction in the number of occurring accidents, along

with travel time, CO² emissions and fuel consumption savings. The respective BCA is 1.92, which implies that system's implementation is desirable with respect to economic terms. Although Thessaloniki's bicycle network is currently underdeveloped and the number of cyclists is low, a prospective implementation of Budapest's travel planning service for cyclists in Thessaloniki could also generate significant benefits regarding the city's traffic operations. In this case benefits are higher than costs as well, since BCA is 3.69.

Overall, it is demonstrated that ITS can provide cost efficient solutions to increase road safety, mitigate traffic congestion and ameliorate its negative environmental impacts. A future coordination of the operation of the three individual services is proposed, that could potentially bolster their current positive traffic and environmental effects. A CBA of the prospective coordinated system would be valuable for the assessment of the enhanced effects of the new system in monetary terms, and for the conduct of a comparison with the results presented in this study.

Table 6. Benefits from the implementation of a route planning system in Thessaloniki

Year	2014	2015	2016	2017	2018	2019	2020
Reduction of Vehicle-hours	994	994	994	994	994	994	994
Value of Travel Time (€/hour)	18.23	18.23	18.23	18.23	18.23	18.23	18.23
Travel time savings (€)	18,119	18,119	18,119	18,119	18,119	18,119	18,119
Discounted Values (€)	17,257	16,435	15,652	14,907	14,197	13,521	12,877
Reduction of CO2 emissions (tons)	22.68	22.68	22.68	22.68	22.68	22.68	22.68
Cost factor (€/ton)	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Savings (€)	590	590	590	590	590	590	590
Discounted Values (€)	562	535	510	485	462	440	419
Reduction of consumed Petrol (liters)	5,303	5,303	5,303	5,303	5,303	5,303	5,303
Price of petrol (€/liter)	1.55	1.55	1.55	1.55	1.55	1.55	1.55
Savings (€)	8,220	8,220	8,220	8,220	8,220	8,220	8,220
Reduction of consumed Diesel (liters)	2,273	2,273	2,273	2,273	2,273	2,273	2,273
Price of diesel (€/liter)	1.23	1.23	1.23	1.23	1.23	1.23	1.23
Savings (€)	2,796	2,796	2,796	2,796	2,796	2,796	2,796
Total Savings from Reduction of Fuel Consumption (€)	11,016	11,016	11,016	11,016	11,016	11,016	11,016
Discounted Values (€)	10,491	9,991	9,516	9,062	8,631	8,220	7,829
Total Cost (€) (Present Value)							171,999

REFERENCES

- Brand, D., Parody, T.E., Orban, J.E., Brown, V.J. (2004) A benefit/cost analysis of the commercial vehicle information systems and networks (CVISN) program. *Research in Transportation Economics*, 8, pp. 379-401.
- De Brucker, K., Verbeke, A., Macharis, C. (2004) The applicability of multicriteria-analysis to the evaluation of Intelligent Transport Systems (ITS). *Research in Transportation Economics*, 8, pp. 151-179.
- Filipovic, M. (2007) The analytic hierarchy process as a support for decision making. *Spatium*, 15-16, pp. 44-59.
- Giannopoulos, G., Mitsakis, E., Salanova, J.M., (2012) *Overview of Intelligent Transport Systems (ITS) developments in and across transport modes*. JRC Scientific and Policy Reports.
- CE Delft (2007) *Handbook on estimation of external cost in the transport sector, Internalisation Measures and Policies for All external Cost of Transport (IMPACT)*.
- Haynes, K.E., Li, M. (2004) Analytical alternatives in Intelligent Transportation System (ITS) evaluation. *Research in Transportation Economics*, 8, pp. 127-149.
- HEATCO (2006) *Developing Harmonised European Approaches for Transport Costing and Project Assessment*. Deliverable 5, Proposal for Harmonised Guidelines, Contract No. FP6-2002-SSP-1/502481.
- Kopelias, P., Vogiatzis, K. E., Skabardonis, A. (2013) The impact of congestion management on air pollution emissions in urban freeways, *Int. Journal of Sustainable Development & Planning*, 8 (3), pp. 400-412.
- Ministry of Economy, Infrastructure, Shipping & Tourism (2015) *Hellenic National Strategy for ITS: 2015-2025*.
- Mitsakis, E., Stamos, I., Salanova Grau, J.M., Chrysohoou, E., Iordanopoulos, P., Aifadopoulou, G. (2013) Urban mobility indicators for Thessaloniki. *Journal of Traffic and Logistics Engineering*, 1(2), pp. 148-152
- Nakanishi, Y.J., Falcocchio, J.C. (2004) Performance assessment of Intelligent Transportation Systems using data envelopment analysis. *Research in Transportation Economics*, 8, pp. 181-197.
- Ozbay, K., Bartin, B. (2004) Estimation of economic impact of VMS route guidance using microsimulation. *Research in Transportation Economics*, 8, pp. 215-241.
- Stevens, A. (2004) The application and limitations of cost-benefit assessment (CBA) for Intelligent Transport Systems. *Research in Transportation Economics*, 8, pp. 91-111.
- Thessaloniki Public Transport Authority (2014) *Sustainable urban Mobility Plan for Metropolitan Area of Thessaloniki*.
- Thoidou, E. (2013) Strategic spatial planning in the era of crisis: Current trends and evidence from the Metropolitan area of Thessaloniki. *Spatium*, 30, pp. 12-17.

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EXTERNAL COSTS DUE TO CONGESTION, ACCIDENTS, ENERGY CONSUMPTION AND EMISSIONS BEFORE AND INTO THE ECONOMIC CRISIS: PILOT STUDY ALONG SELECTED ROADWAYS OF THESSALONIKI, GREECE

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Prior to the economic crisis, forecasts indicated a continuous increase of traffic in European cities, highlighting the need of a policy to alleviate the external impacts of transport. The crisis, however, generated pressures on all sectors of activity, with transport being an indicative example. The reduction of income and employment, the increased vehicle maintenance and renewal costs and the transport related taxation seem to affect the transport system and its external impacts. Thus, taking for granted that Europe will eventually achieve “sustainable recovery” from the crisis, the current period presents an opportunity for promoting sustainable mobility policies and interventions in the most affected by the crisis European cities. Towards this goal, it is essential to capitalise on contemporary techniques for the monitoring of changes in transport external costs. The purpose of the paper is the development of a methodology for the estimation of external costs due to congestion, air pollution, climate change and accidents, based on road traffic data. The methodology is applied along road arteries in Thessaloniki for the period “before and after” the emergence of the crisis. As a result, an overall decrease in external costs is observed, creating an unforeseen “surplus” for the society during the crisis.

Key words: Economic crisis, external costs, urban road transport, methodology, sustainable mobility.

INTRODUCTION

During the industrialisation era, the major cities of the “Western World” attracted the main socio-economic activities and played a major role in the development of national economies. This role is further enhanced in the globalisation era, as the contemporary metropolitan areas turn into international landmarks (Maki, 2002). The urban transport system is a crucial component towards this direction due to the provision of connectivity among activity poles and accessibility to the national and international transport networks which link the city to its surroundings (Pozoukidou, 2014). Taking into account that the private car is the prevailing urban transport mode over the last six decades, it can be concluded that the ongoing intensification of socio-economic activity is related to the increase of urban transport demand, which leads to the uncontrolled

development of road transport (Newman and Kenworthy, 1999). As a result, the efficiency of the transport system is compromised by negative impacts on congestion, road safety and unbalanced competitiveness in the transport market. Moreover, pressures are imposed on the built and natural environment, such as urban sprawl, segregation, social exclusion, noise, visual disturbance and pollutant emissions, with their significance being proportional to the development rate of the city. For example, according to data of 2008 for the European Union (EU), the exposure of the urban population to particulate matter (PM), mainly deriving from diesel-engined road vehicles, diverged from the corresponding target value by 5.5%. On the other hand, a significant decrease was observed in NO_x emissions from transport in the period 2000 – 2008, without however eliminating the air quality problems which affect the public health, especially in densely populated urban areas (Eurostat, 2011). During the same period, a large increase of the motorisation rate regarding passenger cars, i.e. number

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of passenger cars per 1,000 inhabitants, was observed in the 18 out of the 22 EU member states with available data, with the highest rates referring to Luxembourg in Western Europe as well as to the new member states in South East and Eastern Europe (Eurostat, 2012). In the 2001 White Paper on transport and in several policy documents afterwards, such as the 2007 Green Paper on urban mobility, the 2008 Communication on greening transport and the 2011 White Paper on transport, the European Commission sets a comprehensive framework of strategies and measures in order to alleviate the situation and promote the concept of sustainable urban mobility (European Commission, 2001; 2007; 2008; 2011).

The globalisation of the economic crisis, which was initiated in 2008 and continues to affect the European economies, emerged as a major obstacle in the implementation of the aforementioned strategies and measures. Taking into account that the urban transport system affects the development of the national and global economy, it can be concluded that the impact of the crisis on the global and national economy affect the conditions of urban development with major consequences on urban mobility. More specifically, the crisis diminishes the available resources for the operation and upgrade of transport infrastructure and services, while it increases the transport operating costs due to the high fuel prices and taxes and the degraded income level, which leads to the reduction of transport demand.

On the other hand, the reduction of demand due to the decrease in the conduction of activities which act as major trip purposes, such as commerce, work, recreation etc., and the avoidance of private car use due to the relatively high personal cost, lead to lower pressures on the urban and natural environment. In the European Union, for example, the crisis led to a drop of energy consumption, fatal road accidents, greenhouse gas emissions, NO_x emissions and Particulate Matter at faster rates than in the pre-crisis period (Eurostat, 2011). Thus, the reduction in energy consumption, accidents and pollutant emissions does not derive solely from the successful implementation of sustainable mobility policies and the overall shifting of societies towards sustainability, but also from the effort of the households to reduce their daily transport costs. It is worth mentioning that the number of passenger trips by public transport, i.e. bus, tram and metro, economic crisis, in Europe was increased by approximately 7.6% in the decade 2002-2012, accompanied by a relative decrease in the use of private cars. However, an overall drop in the overall number of passenger trips was observed in the year 2009, i.e. immediately after the emergence of the economic crisis, which was followed by a steady increase in the following years (UITP, 2014).

Nowadays, it is considered crucial by transport stakeholders at the international level to continue the pursuit for sustainable mobility by taking advantage of the aforementioned effects of the global economic crisis as an opportunity to prepare for the post-crisis period (OECD/ITF, 2009). Furthermore, the efforts for the analysis of the environmental and socio-economic impacts, i.e. the external impacts, of the transport system are enhanced. In this context,

research activities are directed towards the assessment of the external cost of urban transportation, which is the cost on society from the external impacts that are generated but not borne by the user of the transport system. According to this approach, the scope of the research presented in the current paper is the formulation of a methodology for the estimation of the main elements of external cost related to urban transport and the comparative analysis "before and after" the emergence of the global economic crisis. The proposed methodology is based on the combination of the methodologies for external cost assessment suggested by the IMPACT Handbook (Maibach *et al.*, 2008; Korzhenevych *et al.*, 2014), the analysis of the speed-flow function according to empirical and theoretical relations (Transportation Research Board, 2010), the application of COPERT 4 model for the estimation of pollutant and climate change emissions (EMISIA S.A. *et al.*, 2006) and the calculation of congestion cost according to Goodwin's function (Goodwin, 2004).

More specifically, the following section of the paper involves a brief discussion of the impacts of the economic crisis on Greece's road transport system in order to allocate the parameters which lead to the changes in urban mobility conditions from the period before the crisis to the period into the crisis. Next, there is a description of the proposed methodology in a way that allows its adaptation to the characteristics of any city and its implementation by planners and/or local authorities for the analysis of the external costs generated by their city's road transport system. The next section refers to the application of the methodology for selected road segments of Thessaloniki, Greece for the period before and after the emergence of the crisis and the discussion of the results. The final section includes the conclusive remarks as well as a series of suggestions and directions for future research.

IMPACTS OF THE ECONOMIC CRISIS ON GREECE'S ROAD TRANSPORT SYSTEM

In Greece, which is one of the European countries most affected by the economic crisis, a series of negative impacts were imposed on all sectors of the transport system. Regarding the regional transport system, a decrease of approximately 30% in the freight volume transported by the trucks registered in the country was observed in the period 2011-2012 (EL.STAT, 2014). Regarding the urban transport system, reductions were made by the government in the investment and subsidies for public transport as one of the measures for the repayment of loans provided by the International Monetary Fund, the European Central Bank and the Eurozone governments, which resulted in the reduction and merging of existing bus lines and in the raising of Public Transport fares (Christoforou and Karlaftis, 2011). Furthermore, a fuel price increase of 50% in combination to a raise of the transport related taxation, as opposed to a 25 – 40% reduction of gross income, is estimated for Thessaloniki due to the crisis (Papaioannou and Konstadinidou, 2011). As a result, it is estimated that the duration of peak-traffic periods in the Greek cities was reduced by approximately 60% (Hellenic Institute of Transportation Engineers, 2014).

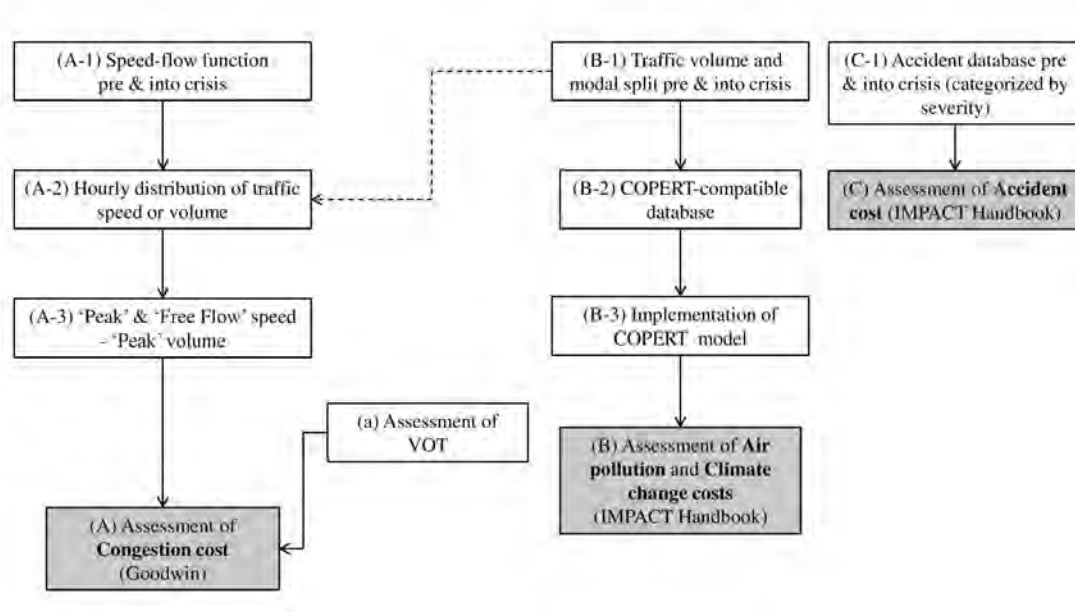


Figure 1. Proposed methodology for the assessment of external cost [own elaboration]

PROPOSED METHODOLOGY FOR THE ASSESSMENT OF EXTERNAL COST

The proposed methodology comprises a series of interrelated steps in order to assess the cost of the following external impacts: A) Congestion (in terms of delay), B) Air pollution and greenhouse gas (GHG) and C) Accidents. The step-by-step methodology is illustrated in Figure 1.

According to the figure, the main features of the methodology are described below:

- Concerning Step "A-1", a speed-flow function is developed for each examined road by conducting a regression analysis based on the available speed and volume data. The speed-flow function enables the estimation of the traffic speed from traffic volume counts or the estimation of the traffic volume from Floating Car Data (FCD), i.e. real-time vehicle speed and location collected by locating the vehicle via mobile phones or GPS over the entire road network (Leduc, 2008). The values of traffic volume and speed are necessary for the assessment of the external costs, as described in the following steps.
- Concerning Step "A-2", the external cost is assessed for the "free flow" and "peak" traffic conditions, so it is possible to compare the external costs resulting from the transition from free flow to congestion. The selection of the "free flow" and "peak" periods is based on empirical data and, more specifically, on the hourly distribution of traffic speed or volume during a typical workday.
- The calculation of "Congestion cost" is based on Goodwin's function (Goodwin, 2004):

$$EC_i = D_i \cdot VOT$$

$$D_i = (t_i - t_0) \cdot V_i$$

Where,

EC_i = Additional congestion cost during the "peak traffic hour" (i) compared to the "free flow hour" (0) (€).

VOT = Weighted average value of time (€).

D_i = Overall delay in the "peak traffic hour" (hours).

V_i = Hourly traffic volume in the "peak traffic hour" (vehicles or PCU/hour).

t_i = Travel time in the "peak traffic hour" (hours).

t_0 = Travel time in the "free flow hour" (hours).

It should be highlighted that, taking into account the length of the examined segment, the traffic speed can be used for the estimation of travel time.

- Concerning Steps "B-2" and "B-3", the COPERT model is used for the estimation of emissions, i.e. $PM_{2.5}$, NO_x and NMVOC for "Air pollution cost" and CO_2 for "Climate change cost" (EMISIA S.A. et al., 2006). In specific, the COPERT-compatible database requires the following data: a) Average hourly traffic volume and speed, b) Distribution of vehicle fleet by engine technology and c) Length of roadway segment.
- Concerning Step "C-1", a categorisation according accident severity is proposed, such as: Slight injury, severe injury and fatality.
- The Air pollution, Climate change and Accident costs, i.e. the external cost due to the air pollutants, the main GHG and the road accidents respectively, is based on the corresponding methods and the average unit values provided by the IMPACT Handbook (Maibach et al., 2008; Korzhenevych et al., 2014).

THE CASE STUDY OF THESSALONIKI

Description of the study area

Thessaloniki is the second largest city in Greece, after Athens - the capital, and one of the largest urban centres in the wider Balkan region (Thoidou, 2013). According to

the Hellenic Statistical Service (<http://www.statistics.gr/portal/page/portal/ESYE>), the regional unit of Thessaloniki has a population of approximately $880 \cdot 10^3$ inhabitants. The main commercial and administrative activities take place in the city centre, sharing the same space with dense residential uses and many historical monuments scattered between the mountainous terrain at the north and the gulf of Thermaikos at the south. New residential and commercial areas are nowadays being developed at the urban areas and suburbs at the east, as well as at the northwest, a part of the city which was underdeveloped until recently. At the western edge of the city an industrial zone and agricultural land uses are located in the wider region of the rivers Axios, Aliakmon, Loudias and Gallikos.

Regarding the transport infrastructure and the mobility conditions, it should be highlighted that the only available public transport network in the city is the public bus network, while the private car and the motorcycle are the dominant modes of daily travel. According to the latest General Transport Study (Organization for the Master Plan and Environmental Protection of Thessaloniki, 2000), half of the personal trips in Thessaloniki was conducted by car or motorcycle, i.e. 44% by car and 6% by motorcycle, while the 27% of personal trips was conducted by the public bus, the 12% by walking and the 10% by taxis and coaches. The aforementioned study also highlights that the Thessaloniki's city centre was the origin or destination of approximately 25% of the total daily trips within the metropolitan area. Despite the fact that these data refer to the year 1999 and should be treated as historical, they are indicative of the role of the road transport network and the attractiveness of the city centre, which often result to the congestion of the central road network as well as the main road axes that lead towards or pass through the city centre.

In order to cope with the problem, a series of measures and interventions are in the stage of implementation, planning or debate. Recently, a bicycle network and a public bicycle sharing system were developed, while a metro system and a seaborne transport system are under development. At the meantime, there are several urban regeneration schemes gradually implemented mainly within the city centre, including traffic calming measures and the pedestrianisation of roadway segments. Moreover, other alternatives are being examined such as the expansion of the orbital road network and the development of a tramway system. Nonetheless, the lack of resources due to the economic crisis affects the progress of the aforementioned interventions.

Implementation of the methodology

The methodology proposed in Section 3 of the current paper was adjusted to the available data sources and the specific requirements of the case study. More specifically, according to data availability and taking into account that the economic crisis emerged in 2008, the years 2004 (before crisis) and 2013 (in crisis) are used as milestones of the study. A set of representative segments of the following roadways were examined (Figure 2):

- Egnatia St. from Aggelaki St. to Agia Sofia St.
- Tsimiski St. from Agia Sofia St. to Aristotelous Sq.
- Aggelaki St. from Tsimiski St. to Svolou St.

- Botsari St. from Olgas St. to Delphon St.
- Plastira St. from Papanastasiou St. to Anaximandrou St.

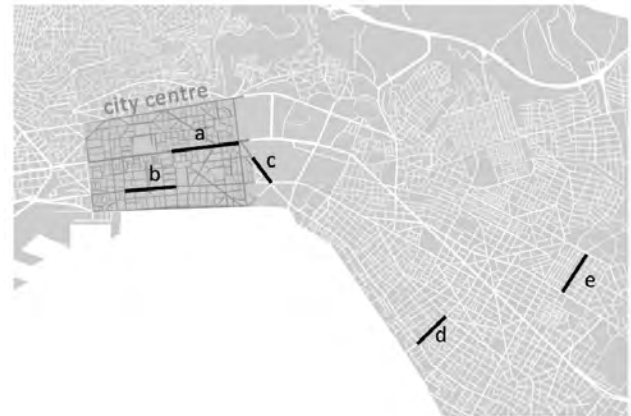


Figure 2. Examined roadway segments in the study area [own elaboration]

Moreover, the following assumptions were made:

- The hourly traffic volumes for 2004 derive from the Traffic Flow Factsheets of the Regional Administration of Central Macedonia while the corresponding volumes as well as the traffic speeds for 2013 derive from the Research Project: "Development of a system of traffic, environmental and energy consumption data for the road network of Thessaloniki's wider urban area", funded by the Programme: "Synergasia" of the Hellenic Ministry of Education, Lifelong Learning and Religious Affairs (Gavanas *et al.*, 2014) (Table 1). The road accident data derive from the Traffic Police, Division of Thessaloniki (Table 2).
- The available speed-flow functions of 2013, developed in the context of the aforementioned Research Project, refer to a set of selected road segments of different functional and geometrical characteristics (Table 3). Taking into account that these characteristics remain unchanged since 2004, it is assumed that the speed-flow functions of 2013 may represent the traffic conditions of 2004.
- According to the hourly distribution of traffic speed, cross-checked by the corresponding traffic volume, the "peak" period corresponds to the hour: 15.00 - 16.00 and the "free flow" period corresponds to the hour: 04.00 - 05.00.

Table 1. Cumulative traffic volume data

Street	Traffic volume (Private Car Units, PCU/hour)	
	2004	2013
Egnatia	59860	54345
Tsimiski	54855	51709
Aggelaki	22384	28935
Botsari	15880	11352
Plastira	20744	12321

Source: Traffic Flow Factsheets of the Regional Administration of Central Macedonia; Research Project: "Development of a system of traffic, environmental and energy consumption data for the road network of Thessaloniki's wider urban area"

Table 2. Accident data

Street	Number of persons involved in road accidents per year					
	2004			2013		
	Fatality	Severe injury	Slight injury	Fatality	Severe injury	Slight injury
Egnatia	1	12	98	0	2	78
Tsimiski	1	4	22	0	0	33
Aggelaki	0	0	0	0	0	9
Botsari	0	1	18	0	0	6
Plastira	1	2	12	0	0	24
Total	3	19	150	0	2	150

Source: Road Accident Factsheets of the Traffic Police, Division of Thessaloniki

Table 3. Speed-flow functions

Street	Length (m)	Classification	Direction	Location	Speed-flow function (2004, 2013)
Egnatia	650	main artery	2-way	city centre	$y=189,747 \cdot x^{-0,256}$
Tsimiski	280	main artery	1-way		$y=\exp[3,204+(395,791/x)]$
Aggelaki	300	main collector	1-way		$y=132,955 \cdot x^{-0,200}$
Botsari	350	main collector	2-way	outside the city centre	$y=42,088 \cdot x^{-0,080}$
Plastira	450	secondary collector	2-way		$y=38,479 \cdot x^{-0,069}$

Source: Pitsiava-Latinopoulou et al., 2013

- The data collected along the Streets: Egnatia, Botsari and Plastira show that the hourly average speed during the day does not exceed the speed limit (40 km/h). This is due to the fact that during the off-peak hours of the day, the traffic flow is controlled by the signing system. Thus, in order to select a value for the free-flow speed, the lowest value of free-flow speed for the road category: "Urban IV", i.e. 40km/h (according to the "2010 Highway Capacity Manual"), was selected (Transportation Research Board, 2010).
- According to Barrett (2010), the VOT was estimated approximately as 1/3 of the country's average hourly wage.
- The external costs of both 2013 and 2004 are given in euros in 2013 euros.

Discussion of results

The implementation of the initial steps of the methodology leads to the results presented in Table 4. More specifically, the average hourly traffic volumes for the hours: 15.00 - 16.00 (peak) and 04.00 - 05.00 (free flow) were inserted in the speed-flow functions of Table 3 for the estimation of the corresponding values of average hourly speed, with the exception of the "free flow" speed for the Streets: Egnatia, Botsari and Plastira, which was estimated as described in the previous section.

Table 4. Average hourly traffic speed along the examined segments

Street	Average hourly speed (km/h)			
	2004		2013	
	peak	free flow	peak	free flow
Egnatia	24.5	40.0	25.4	40.0
Tsimiski	28.4	48.9	27.0	59.0
Aggelaki	32.2	41.8	30.6	45.6
Botsari	24.2	40.0	25.2	40.0
Plastira	23.7	40.0	24.5	40.0

Source: own elaboration

The average hourly speed was used for the calculation of travel time, according to Goodwin's function. Furthermore, the required traffic volumes were estimated using the speed-flow functions. Thus, the "Congestion cost" was calculated for the years 2004 and 2013 respectively and the results, which refer to the "peak" traffic conditions, are presented in Table 5. According to the Table, the cost for 2004 is higher than the cost for 2013, due to the reduction by 1.9 € in the VOT of 2013 compared to 2004 due to the drop in the average hourly wage. It should be noticed here that the average value of "Congestion cost", as well as of "Air pollution cost" and "Climate change cost", weighted by the length of each segment was calculated, in order to formulate a comprehensive indicator that integrates the results from each one of the examined segments.

Table 5. External cost due to congestion along each roadway segment

Street	Congestion cost (€2013)	
	2004	2013
Egnatia	197.0	109.0
Tsimiski	72.7	109.3
Aggelaki	16.4	22.5
Botsari	36.7	14.2
Plastira	55.7	22.4
Weighted average	94.2	60.7

Source: own elaboration

The data used for the assessment of "Congestion cost", i.e. travel speed and volume, combined with the distribution of the traffic volume per transport mode and per engine technology were also used for the application of the COPERT 4 model in order to estimate the air pollutant emissions. The distribution of the vehicles per engine technology derives from the COPERT 4 database for Greece's vehicle fleet after the necessary adjustments for the specific study area, such as the exclusion of non-diesel engine busses etc. The estimations of pollutant emissions are presented in Table 6. Due to the overall decrease in traffic flows and the improvement in engine technologies, the emissions during the crisis period are lower than the corresponding estimations before the crisis.

In order to calculate the external cost for each pollutant emission, the IMPACT Handbook was used, which provides a list of indicative values of cost per unit for each category of air pollutant. The results are presented in Table 7. In accordance to the pollutant emissions, the "Air pollution" cost decreases from the period "before" to the period "after" the emergence of the economic crisis.

Table 6. Estimations of air pollutant emissions in free-flow and peak-hour traffic conditions along each roadway segment

Year	Air pollutant emissions (g per hour)					
	Street	Condition	Air pollutant			
			PM _{2,5}	NO _x	NMVOG	
2004	Egnatia	free flow	0.0110	0.1980	671.4640	
		peak hour	0.0860	1.5430	4441.6030	
	Tsimiski	free flow	0.0050	0.0980	921.9720	
		peak hour	0.0280	0.4940	4290.9700	
	Aggelaki	free flow	0.0040	0.0610	509.5200	
		peak hour	0.0160	0.2480	1785.7970	
	Botsari	free flow	0.0030	0.0480	385.2100	
		peak hour	0.0130	0.2180	1618.9540	
	Plastira	free flow	0.0040	0.0700	433.3010	
		peak hour	0.0180	0.3120	1817.2120	
	2013	Egnatia	free flow	0.0070	0.0950	543.3630
			peak hour	0.0600	1.1330	3294.9570
Tsimiski		free flow	0.0030	0.0390	650.6620	
		peak hour	0.0480	0.5650	5938.3410	
Aggelaki		free flow	0.0020	0.0180	307.9370	
		peak hour	0.0140	0.2320	2068.4920	
Botsari		free flow	0.0005	0.0070	103.3380	
		peak hour	0.0050	0.0620	883.5550	
Plastira		free flow	0.0008	0.0090	120.1590	
		peak hour	0.0060	0.0920	1000.0400	

Source: own elaboration

Similar conclusions can be extracted from the results of GHG emissions and the related “Climate change” cost. More specifically, the results from the assessment of the aforementioned features are presented in Table 8.

According to the accident data presented in Table 2, while the number of slightly injured is the same for the years 2004 and 2013, heavy casualties and fatalities were reduced. Consequently, the total cost of accidents in 2013 is lower by 75% compared to the cost in 2004. In specific, according to the unit values provided by the IMPACT Handbook, the “Accident cost” is equal to 11,001,760€ in 2004 and

Table 7. External cost due to air pollution in free-flow and peak-hour traffic conditions along each roadway segment

Year	Air pollution cost (€2013 per hour)						
	Street	Condition	Cost PM _{2,5}	Cost NO _x	Cost NMVOG	Total	
2004	Egnatia	free flow	0.0023	0.0008	0.5956	0.5986	
		peak hour	0.0177	0.0062	3.9397	3.9636	
	Tsimiski	free flow	0.0010	0.0004	0.8178	0.8192	
		peak hour	0.0058	0.0020	3.8061	3.8138	
	Aggelaki	free flow	0.0008	0.0002	0.4519	0.4530	
		peak hour	0.0033	0.0010	1.5840	1.5883	
	Botsari	free flow	0.0006	0.0002	0.3417	0.3425	
		peak hour	0.0027	0.0009	1.4360	1.4396	
	Plastira	free flow	0.0008	0.0003	0.3843	0.3854	
		peak hour	0.0037	0.0012	1.6119	1.6168	
	Weighed average		free flow	0.5161			
			peak hour	2.6365			
2013	Egnatia	free flow	0.0014	0.0004	0.4820	0.4838	
		peak hour	0.0123	0.0045	2.9226	2.9395	
	Tsimiski	free flow	0.0006	0.0002	0.5771	0.5779	
		peak hour	0.0099	0.0023	5.2673	5.2794	
	Aggelaki	free flow	0.0004	0.0001	0.2731	0.2736	
		peak hour	0.0029	0.0009	1.8348	1.8386	
	Botsari	free flow	0.0001	0.0000	0.0917	0.0918	
		peak hour	0.0010	0.0002	0.7837	0.7850	
	Plastira	free flow	0.0002	0.0000	0.1066	0.1068	
		peak hour	0.0012	0.0004	0.8870	0.8886	
	Weighed average		free flow	0.3146			
			peak hour	2.2734			

Source: own elaboration

2,765,780€ in 2013. The decrease in the “Accident cost” derives only partially from the relative decrease in the observed traffic volumes, since it depends mainly on the presence of a significant number of accidents with severe injuries which occurred along Egnatia St. in 2004.

The above observation is the reason for excluding the component of “Accident cost” in the synthetic presentation

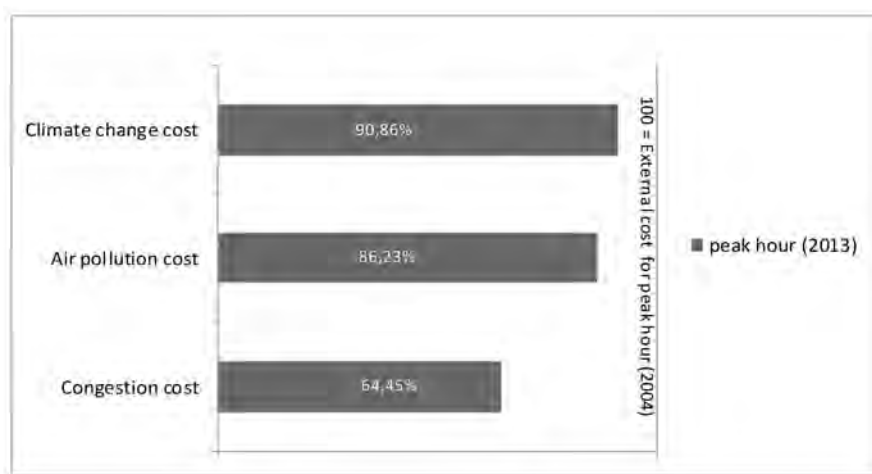


Figure 3. External cost in the year 2013 as percentile of the external cost in the year 2004 [own elaboration]

Table 8. Estimations of CO₂ emissions and related external cost in free-flow and peak-hour traffic conditions along each roadway segment

Year	CO ₂ emissions (g/hour)				
	Street	Condition	CO ₂	Cost CO ₂ (€2013/hour)	
2004	Egnatia	free flow	50.5080	0.0047	
		peak hour	452.1720	0.0423	
	Tsimiski	free flow	24.6700	0.0023	
		peak hour	144.5980	0.0135	
	Aggelaki	free flow	15.6420	0.0015	
		peak hour	66.9620	0.0063	
	Botsari	free flow	13.5580	0.0013	
		peak hour	72.7660	0.0068	
	Plastira	free flow	19.5840	0.0018	
		peak hour	105.5810	0.0099	
	Weighted average		free flow		0.0027
			peak hour		0.0197
2013	Egnatia	free flow	45.7900	0.0043	
		peak hour	392.1910	0.0365	
	Tsimiski	free flow	19.9240	0.0019	
		peak hour	231.9920	0.0216	
	Aggelaki	free flow	10.3740	0.0010	
		peak hour	90.2760	0.0084	
	Botsari	free flow	4.2050	0.0004	
		peak hour	43.5960	0.0041	
	Plastira	free flow	6.2500	0.0006	
		peak hour	65.1700	0.0061	
	Weighted average		free flow		0.0020
			peak hour		0.0179

Source: own elaboration

of the case study's main results (Figure 3). More specifically, the weighted average values of the estimated external costs from each component, i.e. congestion, air pollution and climate change, during a peak hour of a typical workday of the year 2013 are represented in the Figure as percentiles of the corresponding weighted average values of the external costs from each component during the same peak hour of the year 2004. The overall conclusion is that the decrease in the traffic volume leads to a higher diminishment of the external cost due to less congestion than the external cost due to fewer emissions. This fact may be explained by the effect of the crisis on the level of hourly wages and, consequently, on the VOT, as well as to the fact that during the crisis the vehicles are not renewed or maintained at the same rate as before the crisis, with negative impacts on the transmitted emissions.

CONCLUSIVE REMARKS AND FUTURE PROSPECTS

The case study is indicative of the fact that the proposed methodology can be adjusted to the local features of all cities and, especially, in the case of a city with limited availability in time-series of traffic data, such as Thessaloniki, due to the use of speed-flow functions for the estimation of the required traffic speed and volume. Furthermore, the methodology provides useful information about the variation of external

costs due to the impact of the economic crisis on the mobility conditions along the road network, based on the combined implementation of valid methodologies and models.

Regarding the case study, the main conclusion is that the economic crisis leads to an unexpected economic surplus for the society due to the decrease of external costs from the operation of the road transport system. This surplus could be invested towards the enhancement of sustainable mobility for the city of Thessaloniki. Towards this purpose, the stakeholders should produce a comprehensive framework of short-term policies, such as the formulation of an inclusive fare policy for public transport and the provision of incentives for car-sharing in commuting trips, as well as of long-term interventions regarding transport and urban infrastructure, such as the use of the "spare" (due to the decrease of travel demand) roadway's width along selected roads for the strategic development or expansion of public and active transport infrastructure. In this way, the attractiveness of public and active transport is expected to be increased and, thus, further reductions in the external costs are anticipated, which would lead to a higher economic surplus for the society.

However, despite the use of the weighted average as a common indicator, the methodology lacks the ability to integrate the costs from the different components of external impact, i.e. congestion, air pollution, climate change and road safety, into a total or average expression of external cost. This conclusion is the main motivation for future research in the specific topic. Moreover, further research should be conducted towards the implementation of the appropriate techniques and technologies, such as Floating Car Data (FCD), in order to collect primary data and generate estimations of external cost along the whole of the road network as well as to formulate a mechanism which, based on the proposed methodology, will be able to monitor on a regular basis the economic impact of traffic changes along the road network.

REFERENCES

- Barrett, J. (2010) *The impact of transportation infrastructure on the Value of Time*, California: University of California.
- Christoforou, Z., Karlaftis, M. (2011) *Urban restructuring and transportation in the financial crisis era: A study of the Athens CBD*. European Transport Conference 2011, 10-12 October 2011, Glasgow.
- EL.STAT (2014) *Newsletter. Freight transportation study 2012*. (in Greek), Piraeus: EL.STAT.
- EMISIA S.A., Joint Research Centre and European Environment Agency (2006) COPERT 4. *Estimating emissions from road transport*, Copenhagen: European Environment Agency.
- European Commission (2001) *White Paper. European transport policy for 2010: time to decide*. COM (2001) 370 final.
- European Commission (2007) *Green Paper. Towards a new culture for urban mobility*. COM (2007) 551 final.
- European Commission (2008) *Greening transport*. COM (2008) 433 final.
- European Commission (2011) *White Paper. Roadmap to a Single European Transport Area. Towards a competitive and resource efficient transport system*. COM (2011) 144 final.

- Eurostat (2011) *Sustainable development in the European Union. 2011 monitoring report of the EU sustainable development strategy*. Eurostat Statistical Books. Luxembourg: Publications Office of the European Union.
- Eurostat (2012) *Energy, transport and environment indicators*. Eurostat Pocketbooks. Luxembourg: Publications Office of the European Union.
- Gavanas, N., Tsakalidis, A., Verani, E., Sdoukopoulos, A., Pitsiava-Latinopoulou, M., Kouridis, C., Papageorgiou, T., Blatsis, E., Melios, G. (2014) *Real-time information and guidance based on road traffic and environmental criteria*, ITS and Smart Cities Conference, 19-21 November 2014, Patras.
- Goodwin, P. (2004) *The economic costs of road traffic congestion*, London: ESRC Transport Studies Unit, University College London.
- Hellenic Institute of Transportation Engineers (2014) *Positions of the Hellenic Institute of Transportation Engineers on the impact of the crisis on the transport sector*. (in Greek), <http://www.ses.gr/o-sylogos/theseisses.html>, accessed 15th Apr 2015.
- Korzhenevych, A., Dehnen, N., Bröcker, J., Holtkamp, M., Meier, H., Gibson, G., Varma, A., Cox, V. (2014) *Update of the handbook on external costs of transport*, Final report, London: Ricardo-AEA.
- Leduc, G. (2008) *JRC Technical Notes. Road traffic data: Collection methods and applications*. Luxembourg: Office for Official Publications of the European Communities.
- Maibach, M., Schreyer, C., Sutter, D., van Essen, H. P., Boon, B. H., Smokers, R., Schrotten, A., Doll, C., Pawlowska, B., Bak M. (2008) *Handbook on estimation of external costs in the transport sector. Internalisation measures and policies for all external cost of transport (IMPACT)*, Version 1.1, Delft: CE Delft.
- Maki, W. R. (2002) *Positioning a metropolitan area for global competition*. *The Journal of Regional Analysis and Policy*, 32(2), pp. 79-94.
- Newman, P., Kenworthy, J. (1999) *Sustainability and cities. Overcoming automobile dependence*. Washington D.C.: Island Press.
- OECD/ITF (2009) *Transport for a global economy. Challenges and opportunities in the downturn*. 2009 International Transport Forum Highlights. <http://www.internationaltransportforum.org/2009/forum2009.html>, accessed 8th Apr 2015.
- Organization for the Master Plan and Environmental Protection of Thessaloniki (2000) *General transport study (G.T.S) of Thessaloniki metropolitan area*, Thessaloniki: Organization for the Master Plan and Environmental Protection of Thessaloniki.
- Papaioannou, P., Konstadinidou, C. (2011) *Restructuring the public transport network in times of financial crisis: Solutions from Thessaloniki*. http://www.thita.gov.gr/sites/default/files/Publication/Presentation/uitp_restructuringpublictransport.pdf, accessed 24th Jan 2014.
- Pitsiava-Latinopoulou, M., Gavanas, N., Tsakalidis, A., Aggelakakis A., Verani E., Sdoukopoulos, A. (2013) *Investigation of the speed-flow relation in urban networks. Application along the classified road network of the municipality of Thessaloniki*, (in Greek), 6th International Congress on Transport Research – ICTR, 17-18 October 2013, Thessaloniki.
- Pozoukidou, G. (2014) *Land use transport interaction models: Application perspectives for the city of Thessaloniki*. *SPATIUM*, 32, pp. 7-14.
- Thoidou, E. (2013) *Strategic spatial planning in the era of crisis: Current trends and evidence from the metropolitan area of Thessaloniki*. *SPATIUM*, 30, pp. 12-17.
- Transportation Research Board (2010) *HCM 2010: Highway Capacity Manual*. Washington D.C.: Transportation Research Board.
- UITP (2014) *Local public transport trends in the European Union*, Statistics Brief. Brussels: UITP.

THE IMPACTS OF ILLEGAL PARKING ON THE URBAN AREAS' TRAFFIC AND ENVIRONMENTAL CONDITIONS: THE CASE OF THE CITY OF THESSALONIKI

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A combination of factors including an unattractive public transport offering a low level of service, the lack of parking facilities, an inadequate drivers' education and poor policing have led to illegal parking phenomena in many Greek cities, contributing in their aesthetic and cultural degradation, making them inaccessible for both vehicles and pedestrians. In the present study the phenomenon of illegal parking is investigated along selected road axes in the city of Thessaloniki, Greece. After the appropriate processing of the data collected, the impact of illegal parking on the reduction of road capacity was calculated. Moreover, it was attempted to relate illegal parking activity with the type of adjacent land uses. Conclusions regarding the degree of parking violations and the road capacity reduction in relation to road and adjacent land uses' characteristics are given and possible measures and policies towards the alleviation of the problem are proposed.

Key words: Illegal parking, road capacity, traffic impact, urban traffic, urban degradation.

INTRODUCTION

The economic development that occurred in western societies during the last decades of the previous century led to a rapid increase in private car ownership, which resulted to high traffic congestion in most city centers. A combination of factors including an unattractive public transport offering a low level of service, the lack of parking facilities for off-road parking, an inadequate drivers' education and poor policing may lead to illegal parking phenomena in central urban areas. Illegal parking has major impacts on everyday quality of life, such as increased travel times and slower movement of goods, due to the critical reduction in road capacity and may cause an increase in car emissions. In the framework of a research in the city of Athens by Frantzeskakis (1989) it was found that illegal parking at certain spaces, such as bus stops, can potentially increase emissions within the adjacent areas at up to five times as a result of the derived delays and increased fuel consumption. All these effects contribute in the aesthetic and environmental degradation of urban centers, making them inaccessible for both vehicles and pedestrians (Taxiltaris *et al.*, 2001). This fact, combined with the overall decentralization that is now observed in most cities through the appearance of new commercial

activities in the suburbs, where a sufficient number of parking spaces is offered, can lead to the decline of urban centers. Furthermore, illegal parking can have negative effects on tourism since visitors are obliged to confront the daily traffic congestion in all affected city centers, which usually constitute the cultural generators of most tourist attractions. Land use and transport systems allocation and integration have played a major role in the context of urban planning. An optimal spatial organization of urban functions correlated in harmony with the transport systems is a prerequisite for a sustainable transportation planning urban development (Pozoukidou, 2014). Parking policies are considered to be one of the key links between transport and land use policy (Marsden, 2006) having an impact on transport mode choices and travel routes thus affecting the urban mobility, the environment and therefore the economic development (Feeney, 1989; Sisiopiku, 2001).

In the present study the phenomenon of illegal parking is investigated along selected road axes in the city of Thessaloniki, Greece since it is a more critical problem for the Greek city centers than other European cities where, apart from adequate and proper policing, the appropriate drivers' education exists. In addition, the non-integrated urban and transportation planning in Greece resulted to the current development of cities' form that is unable to

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support the soaring ownership of private cars and applies more pressure to the existing parking problems. Within this framework, parking measurements were conducted along selected road segments and a database including legal and illegal parking data was developed. After the appropriate statistical processing of the data collected, the impacts on the reduction of road capacity were calculated. In addition, the connection of existing land uses and illegal parking activity was investigated. Finally, some interesting conclusions regarding both the degree of parking violations and the road capacity reduction in relation to road and adjacent land uses' characteristics are given and possible measures and solutions to the problem are proposed.

METHODOLOGY

The proposed methodology used for this study comprises five stages: a) the selection of the road segments to be investigated, b) the collection of local urban data, including type of land use, road geometric and operational characteristics, c) the collection of local parking data concerning both legal and illegal parking, d) the analysis of the data collected and e) finally, the extraction of conclusions and the proposal of possible solutions. The stages of the methodology are presented in Figure 1.

Initially, the road segments to be investigated are selected within the study area. The primary data collection includes the recording of the adjacent land use data type and the characteristics of the selected roads (number of lanes, existence of bus lanes, traffic direction, existence of center island etc.). On-site measurements are conducted at the selected road segments; with those measurements the exact number of illegal parking, the parking supply (i.e. the number of offered legal parking spaces) and the percentage of each kind of deviant behavior was evaluated (i.e. parking on the sidewalk, not adequate distance from the junction, etc.). Then, a statistical analysis of the measurements is made followed by comments and descriptions of the current situation occurring in each street. In addition, with the help of spreadsheets, the calculation of the reduction of road capacity is made for each road at specific points at the midblock between traffic lights (Frantzeskakis *et al.*, 2008). The green times and the total cycle length of each traffic light are measured and then, with the use of the methodology for the calculation of traffic saturation flows deriving from the early studies of Webster and Cobbe (1966) and later of Kimber *et al.* (1986), the road capacity of each section is

calculated. Aiming to estimate the impact of illegal parking on the reduction of road capacity the calculation of road capacity is made for two traffic situations, i.e. the existing one where illegal parking has been recorded and an 'ideal' one where there is complete compliance with the existing parking regulations. The comparison of the two situations results in the estimation of the road capacity reduction due to the illegal parking. Then, an attempt is made to establish a connection between the adjacent land uses and the main type of deviant behavior concerning parking that occurs at each road. Finally, based on the above results possible measures to tackle the problem of illegal parking are proposed.

CASE STUDY

Study Area

The study area includes selected road segments in the city of Thessaloniki. Thessaloniki is the second largest city in Greece and plays a major role as the administrative, financial and cultural center of the country's north but also contributing in the strategy of promoting spatial competitiveness and in the country's development in general, with a population of 1110312 and a density of 301.49 inhabitants per km² (Thoidou, 2013; Hellenic Statistical Authority, 2011). The use of private car is the citizens' first travel choice as 1800000 out of 2300000 or 78.26% of the trips made daily within the city are conducted using the private car, while the private car ownership index reaches a 45% (Organization of Urban Transportation of Thessaloniki, 2014). Public transport, currently including only buses, is run by the Thessaloniki Urban Transport Organization serving 167000000 passengers annually with a fleet of 618 vehicles serving 79 lines in the city center and its premises. Moreover, the city operates as a transportation node for southeastern Europe, by having an international seaport and airport as well as a railway terminal, supporting thus the transportation of people and goods at the urban, regional, national and international level. Nine major road axes of the city were included in this study in order to have a representative picture of the impacts of illegal parking in areas with different characteristics. The study area and its selected road segments are presented in Figure 2. Along these streets parking policy varies according to its type. Along main arteries parking is prohibited and only a few parking spaces exist. Along secondary arteries parking is allowed except for bus lanes and spaces reserved for special



Figure 1. Methodology of the study



Figure 2. Study area and selected road segments

use (e.g. disabled people, loading/unloading of goods etc., while along collector roads parking is generally allowed with minor exceptions in cases of spaces reserved for special use. Along local roads parking is generally allowed on both sides of the road.

Application of the Methodology

The nine major road axes that were selected for the investigation include three main arteries, three secondary arteries and three main collector roads.

Field recordings were conducted separately for each of the nine road segments where the legal parking spaces, the total number of illegally parked vehicles and the type of delinquency were registered. Two recordings were made per route, one in the morning and one in the afternoon during 8:30-11:30 and 19:00-21:00 respectively, in order to capture a representative view of the parking conditions throughout the day. The days the recordings took place had to be typical working days when the commercial shops remain open during the afternoon (i.e. Tuesday, Thursday and Friday). With the assistance of spreadsheets, the reduction of road capacity for each route was calculated at points in the midblock between two successive signalized intersections. The calculation of road capacity was based on the geometric characteristics of the road (road width, number of lanes, lane width etc.), traffic characteristics (traffic volumes and traffic composition) and on the existing traffic regulations (existence of signalized intersections, one-way system). In addition, data concerning the green phase as well as the whole cycle of the signalization along

the examined road segments were taken into consideration. Then, as it was mentioned above, the road capacity was estimated for the conditions that should normally exist if there was no illegal parking at all and also the capacity for the existing situation based on the type of delinquency recorded by the field measurements. Finally, the percentage of the capacity reduction caused by illegal parking on each road segment was calculated. The Transport Engineering Laboratory of the Aristotle University of Thessaloniki provided land use data for the study area; the nine areas of the study do not have common elements concerning the adjacent land uses (SRM-LIFE, 2006). More specifically, they include road segments with purely residential areas adjacent to them, such as Olympiados and Plastira Str. and road segments that are characterized by intense commercial activity and nightlife activities (recreation, restaurants etc.), such as Tsimiski and Mitropoleos Str. The various road segments also differ as far as the geometric characteristics are concerned, ranging from roads with four lanes and adequate width (i.e. Egnatia Str. with 16.00m) to roads with fairly limited width, such as Mpotsari Str. (6.00m). Thus, the analysis of data resulted to some interesting conclusions about the degree of delinquency and the reduction of road capacity in relation to the particular road characteristics.

RESULTS

For the analysis of illegal parking the following cases of violations are considered: parking on private spaces or spaces for special use (e.g. reserved for loading/unloading, reserved for disabled people), double-parking (illegal parking besides parked vehicles), parking on bus-lanes or bus stops, parking on pedestrian crossings, parking in close proximity to signalized intersections and parking on corners. The analysis of the data concerning parking behavior showed that the majority of drivers did not keep the minimum parking distances from intersections, pedestrian crossings, bus stops etc. (Frantzeskakis *et al.*, 2002). More specifically, in Plastira Str. there were very high percentages recorded near or inside an intersection (15.7%), near a bus-stop (7.5%) or near pedestrian crossings (9.0%), while in Olympiados Str. there was a high number of vehicles parked at a corner (29.7%). Nevertheless, the most significant illegal parking rates observed were those that referred to the violation of bus-lanes and of special parking places as well as those that referred to double-parking. Those types are

Table 1. Selected road segments and their characteristics

Road	Road Class	Directions	Lanes per Direction	Lane Width (m)	Bus-Lane	Center Island	Signalized Intersection
Egnatia Str.	Main Artery	Two	Three	2.75	Yes	No	Yes
Tsimiski Str.	Main Artery	One	Four	3.50	Yes	No	Yes
Olgas Ave.	Main Artery	One	Four	3.00	Yes	No	Yes
Mitropoleos Str.	Secondary Artery	One	Two	3.20	Yes	No	Yes
Papanastasiou Str.	Secondary Artery	Two	Two	3.00	Yes	Yes	Yes
N. Plastira Str.	Secondary Artery	Two	One	4.00	No	No	Yes
Aggelaki Str.	Main Collector Road	One	Three	4.00	Yes	No	Yes
M. Mpotsari Str.	Main Collector Road	Two	One	3.00	No	No	Yes
Olympiados	Main Collector Road	Two	One	3.00	No	Yes	No

the ones causing the most important problems contributing to the highest reductions in road capacity. The road segment with the highest percentage of illegal parking at special parking spaces (26%) and double-parking (65.4%) was that of Aggelaki Str. Concerning illegal parking along bus-lanes Egnatia Str. holds the highest percentage (37.4%), a type of illegal parking activity that affects the its road capacity with a reduction at least of 5%. Table 2 presents the examined nine road segments according to their adjacent land uses while the total number of illegal parked vehicles per 100m, as well as the percentages of illegal recordings per type are presented in Table 3 and 4 respectively.

Table 2. Road segments and distribution of adjacent land uses (SRM-LIFE, 2006)

Road	Residential	Commercial
Egnatia Str.	30%	70%
Olgas Ave.	30%	70%
Tsimiski Str.	30%	70%
Mitropoleos Str.	30%	70%
Papanastasiou Str.	30%	70%
Aggelaki Str.	50%	50%
M. Mpotsari Str.	50%	50%
Olympiados Str.	70%	30%
N. Plastira Str.	90%	10%

Table 3. Illegal recordings per 100m per hour

Road	Road Segment Length	Illegal Recordings per 100m per hour
Egnatia Str.	708	44
Olgas Ave.	537	61
Tsimiski Str.	562	50
Mitropoleos Str.	526	31
Papanastasiou Str.	726	43
Aggelaki Str.	490	47
M. Mpotsari Str.	644	44
Olympiados Str.	571	15
N. Plastira Str.	681	26

Table 4. Distribution of illegal recordings per type

Road	Minimum Distance from Signalized Intersection	Parking on Corner	Minimum Distance from Bus Stop	Minimum Distance from Pedestrian Crossing	Parking on Bus-lane	Parking on Special Parking Space	Double-parking
Egnatia Str.	3.9%	1.5%	0.2%	3.8%	37.4%	6.3%	0.4%
Olgas Ave.	0.9%	1.7%	0.0%	0.7%	18.4%	17.6%	21.5%
Tsimiski Str.	1.6%	0.8%	0.0%	2.4%	5.5%	3.5%	7.2%
Mitropoleos Str.	0.2%	5.4%	0.0%	4.5%	2.5%	25.8%	56.7%
Papanastasiou Str.	8.4%	1.7%	2.0%	4.5%	0.0%	2.5%	2.4%
Aggelaki Str.	0.0	7.0%	0.0%	1.5%	0.1%	26.0%	65.4%
M. Mpotsari Str.	6.3%	1.1%	0.0%	5.9%	0.0%	2.9%	32.5%
Olympiados Str.	6.2%	27.9%	0.0%	0.7%	0.0%	24.0%	1.4%
N. Plastira Str.	15.7%	3.9%	7.5%	9.0%	0.0%	3.3%	0.3%

The estimation of the illegal parking impact on road capacity showed that there is a great variation in the capacity reduction rate according to the road geometric characteristics. Thus, along Egnatia Str. a small decrease in road capacity was observed (5 - 10.4%), due to the large width of the road, while in Olgas Ave. the capacity reduction remained constant (22.0%) throughout the study section, due to the same geometric and operational characteristics along the road.

The width of the road is critical concerning the effect of double-parking. Double-parking strongly affects roads with limited width in various ways i.e. reduction of the number of available lanes, restriction of existing turns at intersections and occupation of bus lanes. Moreover, the existence of center islands creates space, which in some cases can be used for illegal parking in the middle of the road having a negative impact on the road capacity. Therefore, a limited width of the road combined with double-parking and illegal parking on the center island can create severe problems in the effective operation of the traffic along the roads.

Special mention should be also made for special parking spaces, whose illegal occupation creates multiple problems to the proper functioning of the road. Particularly important is the seizure of cargo positions, leading trucks to double park or park farther away from the shops where the loading and unloading of goods should take place. It should be pointed out that throughout the duration of the in-situ survey no trucks were parked in special cargo spaces, a fact that requires more effective policing in order to keep the specific places free for the hours when loading and unloading is allowed by law. Regarding the taxi parking spaces the situation is different because the taxi drivers remain in their vehicles while they are on-duty and therefore they apply enforcement by themselves. Finally, the recorded spaces reserved for special vehicles were primarily places for school buses in front of schools and parking spaces for disabled people. Although most of these spaces were occupied, this did not lead to further problems in traffic; this phenomenon, however, should be evaluated by its social side.

The reduction of road capacity per road segment and the possible correlation between the size and type of illegal activity and adjacent land uses by processing the collected data is presented in Table 5.

Table 5. Reduction of road capacity per road segment

Road	Residential Use	Commercial Use	Capacity Reduction Percentage	Main Type of Illegal Parking
Egnatia Str.	30%	70%	5.0-10.4%	Parking on Bus-lane
Olgas Ave.	30%	70%	22.0%	Double-parking
Tsimiski Str.	30%	70%	36.7-54.8%	Violation of parking prohibition
Mitropoleos Str.	30%	70%	47.2-64.8%	Double-parking
Papanastasiou Str.	30%	70%	26.6-85.1%	Violation of parking prohibition
Aggelaki Str.	50%	50%	26.5-47.2%	Double-parking
M. Mpotsari Str.	50%	50%	28.0-74.3%	Double-parking
Olympiados Str.	70%	30%	55.9-56.2%	Violation of parking prohibition
N. Plastira Str.	90%	10%	26.5-39.0%	Violation of parking prohibition

From the data of Table 5 it can be concluded that double-parking is observed when there is an intense adjacent land use i.e. commercial or multi-purpose, with the exception of Egnatia Str. where the existence of bus lanes limits illegal parking. Moreover, these results are confirmed by Table 3 where it can be seen that the roads with an intense land use present more illegal recordings.

Regarding the rate of road capacity reduction, this is mainly a function of the geometric characteristics of the road, as it has been mentioned previously, while the roads with mixed land uses adjacent to them, i.e. regions with 50% residential and 50% commercial uses (Mpotsari Str.), show the highest reduction rates of over 70%, as they attract or produce multi-purpose trips. It should be pointed out that the highest capacity reduction rates were observed along Papanastasiou Str. (85.1%) and Mpotsari Str. (74.3%), reflecting the bad actual traffic conditions at those road segments.

CONCLUSIONS

In recent decades an exponential increase in car sales took place leading to a large number of households with two or more private cars; this results in poor parking supply, unable to meet the actual parking requirements. In the framework of the present study it was found that capacity reductions due to illegal parking vary from 10% to 75% according to the road geometric characteristics. This means that there is a necessity to switch users from the use of private car to public transport by implementing bus priority measures i.e. extension of bus-lanes and bus priority in signalization.

Suitable parking policies should be also implemented in order to limit both car ownership and car use. Policies for the control of the growth of private car ownership usually include the control of car owners for households that already possess one or more vehicles i.e. higher taxes or higher traffic charges. Of course the prerequisite of such measures is the existence of a dense and well-organized urban transport network that will cover the population's needs for travel to all parts of a city, making the private car unnecessary for the majority of trips which is not valid for the case of most Greek cities, including the city of Thessaloniki. Concerning car use, the common parking policies applied are: the coordination of on and off-street parking management and charging, the charging for on-street parking in order to achieve the preferred occupancy rates and have the ideal performance rates, the design of parking facilities that are well-integrated

with the surrounding urban environment and transport infrastructure and that increase the turnover in the existing parking spaces in order to serve more cars through the appropriate parking charging.

Of course, regarding the illegal parking, a very effective and direct way to address it, is the correct and adequate enforcement and the imposition of an appropriate penalty system. Regarding the city of Thessaloniki, enforcement could be limited to parts of the city with a significant problem of illegal parking if the resources available are not currently sufficient for traffic or municipal police to adequately cover all areas of the city. In addition, contemporary technology could be used in order to achieve a more effective policing. Traffic cameras can be installed for the real-time monitoring and recording of offenders' vehicles. This measure, however, is highly unpopular in many countries and installed cameras are often at risk by phenomena of vandalism.

Finally, other ways to deal with illegal parking beyond policing are the appropriate street-design interventions. These include the widening of the pavements at corners, leading to the limitation of the lane width, the placement of appropriate obstacles on sidewalks that will prevent the access of vehicles, the better marking of areas where parking is prohibited, warning the driver not to park at that point.

Above all these measures, a key condition for the elimination or reduction of illegal parking is an adequate traffic education of drivers, as its lack is the main cause of the problem in general. Concluding, it can be said that the improvement of parking conditions results to a better urban environment and to a higher quality of everyday life.

REFERENCES

- Feeney, B. (1989) A review of the impact of parking policy measures on travel demand, *Transportation Planning and Technology*, No. 13(4), pp. 229-244.
- Frantzeskakis, I. (1989) Traffic and environmental impacts of illegal on-street parking, *Two-Day Conference of the Hellenic Institute of Transport Engineers*, Athens.
- Frantzeskakis, I., Pitsiava-Latinopoulou, M., Tsamboulas, D. (2002) *Parking Planning, 2nd Edition*. Athens: Papatotiriou Publications.
- Frantzeskakis, I., Golias, I., Pitsiava-Latinopoulou, M. (2008) *Traffic Engineering*. Athens: Papatotiriou Publications.

- Hellenic Statistical Authority (2011) <http://www.statistics.gr/portal/page/portal/ESYE>, accessed 20th Nov 2014.
- Kimber, R. M., McDonald, M., Hounsell, N. B. (1986) *The prediction of saturation flows for road junctions controlled by traffic signals*, Research report No. 67, Transport and Road research Laboratory, Crowthorne, England.
- Marsden, G. (2006) The evidence base for parking policies – a review, *Transport Policy*, No. 13(6), pp. 447-457.
- Organization of Urban Transportation of Thessaloniki (2014) <http://www.oasth.gr>, accessed 20th Nov 2014.
- Pozoukidou, G. (2014) Land use transport interaction models: Application perspectives for the city of Thessaloniki, *SPATIUM*, No. 32, pp. 7–14.
- Sisiopiku, V. (2001) On-street parking on state roads, *Proceedings of 2001 ITE International Conference*, Chicago, Illinois.
- SRM-LIFE (2006) *Development of a global methodology for the vulnerability assessment and risk management of lifelines, infrastructures and critical facilities, Application to the metropolitan area of Thessaloniki – SRM-LIFE*, Research Program assigned from the General Secretariat for Research and Technology to AUTH, Greece, 2002-2006.
- Taxiltaris, C., Pitsiava-Latinopoulou, M., Basbas, S. (2001) Design of an environment friendly parking policy for historical areas in city centers. The experience from Greek cities, *World Parking Symposium III*, St. Andrews, Scotland.
- Thoidou, E. (2013) Strategic spatial planning in the era of crisis: Current trends and evidence from the metropolitan area of Thessaloniki, *SPATIUM*, No. 30, pp. 12–17.
- Webster, F. V., Cobbe, B. M. (1966) *Traffic Signals*, Road Research Technical Paper No. 56, London: Road Research Laboratory.

DESIGNING A STRATEGIC MOBILITY PLAN FOR A SMALL AND MEDIUM SIZED CITIES USING A MULTI-STAGE METHODOLOGY: CASE OF CELJE

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Urban mobility is one of the crucial factors of quality of life in cities. Therefore, an effective mobility system and its holistic planning are of utmost importance for sustainable and quality development of urban centres. This paper focuses on holistic and integrated strategic planning of a mobility system. The used multi – step methodology was tested on a case of a city of Celje, Slovenia. With the first round of focus groups, information about the specific urban mobility system was gathered which was used to develop a SWOT matrix. This was the foundation for the execution of a second round of focus groups, where the output was a proposition for a strategic plan for mobility development in small and medium sized cities.

Key words: urban mobility, strategy, planning, multi-stage methodology, small and medium sized cities (SMSC).

INTRODUCTION

A key element of any city is a well-functioning transport network, which is a prerequisite for economic and social activities that develop within urban centres. The development of transport is accompanied by negative effects that show through congestion, accidents, pollution, social exclusion and high consumption of energy (UN-Habitat: Urban transport, 2014b). The residents themselves are also aware of this, because nine out of ten EU citizens believe that it is necessary to improve the state of the transport in their area (The Gallup Organization, 2007).

All these negative impacts and the upward trend of population in urban centres require action on the development of the transport system in cities (UN-Habitat: Urban transport, 2014a). Ensuring mobility is therefore a priority of transport policies.

Mobility as considered in this research is treated as a physical or mental ability of secure and independent movement, regardless of whether the system is observed inside or outside the home (Alsnih and Hensher, 2003).

Mobility is therefore the ability to alter one's position in the social, economic and spatial systems (Keller, 2000). This paper will focus on spatial mobility.

Mobility management in its core, transport related way, can be described as a mechanism to control and manage the demand for transport, whose goal is to satisfy the needs for people and freight transport (Luca and Sercaianu, 2011). It is basically a policy plan for managing transport, mostly aimed at the reduction of car use and promotion of sustainable transport alternatives (Taniguchi and Fujii, 2007). Mobility management is most often concretised in sustainable (integrated) urban mobility plans.

As Lindholm and Behrends (2010) point out, a sustainable urban transport plan (SUTP) is an integrated approach to the management of urban transport by adopting long-term and strategic action plans in order to overcome deficits in coordination and cooperation across administrative boundaries, as well as between the authorities in a national hierarchy regarding their plans and policies.

Policies and measures laid down in sustainable urban transport plans must comprehensively address all the ways and means of transport in the city and its hinterland: public and private, passenger and freight, motorized and non-

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motorized, moving and passive transport (parking). It is important to emphasize that sustainable urban transport plans build on and complement existing planning documents (Bührmann *et al.*, 2011).

As Lindholm (2013) notes, there must be a willingness to change in order to achieve sustainability, and the active involvement of all stakeholders is the most effective way to achieve change. Also, efficient cooperation between different actors is important in the design of an efficient transport system.

There has been a high degree of fragmentation and lack of plans in the field of solving urban mobility. If strategic plans are developed, many of them neglect the importance of including different stakeholders and interested public in the process (Hristić and Stefanović, 2013). This fragmentation and lack of strategic plans can also be seen (or is especially important) in small and medium sized cities (SMSC). Hecimovic (2014) explains the underlying factors as to why this is so:

- National and regional roads disturb the social networks of small towns,
- Residential areas are disconnected from major functions and services,
- Poor choice of mobility options,
- Ageing population disconnected from services,
- Mobility is rarely perceived as a major issue,
- Lack of administrative capacity and knowledge,
- Lack of funding,
- Lack of support of regional and national decision makers.

Mercatelli (2014) states that the typology and size of a city is of great importance when planning for sustainable mobility, from different aspects, such as the overall evaluation of size-related parameters, the difference in scope and reach of needed measures and competence of local authorities.

In literature there is no unified definition of small and medium sized cities (ESPON, 2014; ESPON, 2013; Austrian Institute for Regional Studies and Spatial Planning, 2005; European Commission, Directorate General for Regional Policy, 2011; Dijkstra and Poelman, 2012)². The meaning of 'medium-sized' depends on the scale one looks at. What appears medium-sized at the European scale may be considered large at the national scale or small on the global scale (Giffinger *et al.*, 2007). As ESPON (2014) explains whatever the country considered, there is no official definition of small and/or medium sized town (except Northern Ireland).

Because of a lack of unified definitions and many different criteria (see for example: Zavodnik Lamovšek *et al.*, 2008), we will define small and medium sized cities according to their number of inhabitants (ESPON, 2014), namely 5.000 to 50.000 (ESPON, 2013). The city of Celje is also within this

range (around 38.000 inhabitants).

The research scope on strategic planning of urban mobility in SMSC is limited. The literature does however present some cases where the used methodologies were akin to the segments of the methodology used in this research, e.g. the inclusion of stakeholders and analysis of the traffic situation (Hecimovic, 2014) or travel surveys (D'Otero and Abril, 2013).

According to the literature review and the importance of strategic planning of urban mobility, the main research question for this paper was set:

How to develop an integrated participatory urban mobility strategic plan in SMCS?

Consequently, the first aim of this study was to develop and test a methodology for a participatory and integrated strategic urban mobility plan and then test this on the case of Celje, Slovenia. With this, we will complete one of the main prerequisites for sustainable urban mobility planning in small cities as was set by Mercatelli (2014), which is "guidance – user friendly, simplifies, ready to use models and frameworks". As Čolić (2014) explains, a participatory planning process is a process where planners, politicians, administration and public mutually learn. In order to include all crucial stakeholders in the decision making process, focus groups were introduced and surveys were used prior to that to gain insight into as wide a range of interest groups as possible. Involving communities in planning is a fundamental duty of local authorities to improve decision-making and is also a requirement stipulated by EU directives and international conventions (Bührmann *et al.*, 2011).

To sum up, the main purpose of this paper is twofold: to present a multi stage methodology for planning urban mobility in SMCS and to present an example of an integrated approach in solving the problems of urban mobility in a selected small city, with the case city being Celje, Slovenia with around 38.000 inhabitants.

METHODOLOGY

For the purpose of our research, the following stages of the conceptual framework have been applied to the city of Celje (Figure 1):

1st stage: To create an integrated approach to solving the problems of urban mobility, it was necessary to collect data on key characteristics influencing the development of a mobility system in Celje. Collecting the data was done in three steps: surveys, an inventory of the status quo and traffic counting.

2nd stage: In the second stage we developed research questions that were the basis for the first round of focus group meetings and analysis. Based on the results of the focus groups we created a SWOT matrix for the mobility system in Celje.

3rd stage: The data gathered and formed in the SWOT matrix was the basis for developing research questions for the second round of newly formed focus group. As a result of the second round of focus groups, the final proposal was a strategic mobility plan for Celje.

² The meaning of 'medium-sized' depends on the scale one looks at. What appears medium-sized at the European scale, may be considered large at the national scale or small on the global scale (Giffinger *et al.*, 2007).

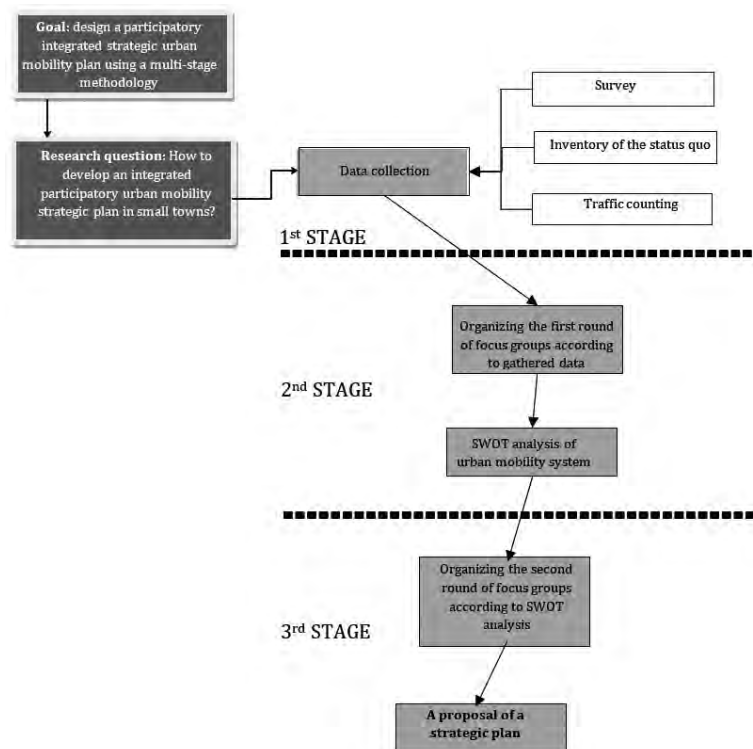


Figure 1. Conceptual research framework

Collecting the initial data (1st stage)

As can be seen from the figure (Figure 1), this stage was carried out in three steps, dependent on the method of data collection. The first parts were surveys, which consisted of:

- Two separate surveys carried out to determine travel habits of the old town on a narrower and broader scale. The first consisted of 16 questions and was performed in December 2010. There were 446 surveys returned and statistically processed. The second consisted of 17 questions and was performed in April 2011 in the wider area of the city; 377 surveys were returned and statistically processed.
- Survey on the current state of freight delivery in the city: The purpose was to determine the status of the delivery traffic in the city centre (the number of different suppliers, frequency of deliveries, location and time of delivery, mode of delivery, handling and packaging and the need for distributive centre). The survey included 110 firms in the inner city centre of Celje. It was conducted between August and November 2010.
- Analysis of the use of public transport among local communities and urban neighbourhoods: We surveyed primarily the population who lives in the Municipality of Celje, but we also wanted to determine whether urban transport service is used by residents of other municipalities that are migrating to Celje. The survey was conducted in March 2010. Answers from 306 respondents who live in Celje and 314 respondents from elsewhere were obtained. The first part of the survey was an exploration of use of public passenger transport, and the second part focused on the everyday use of urban public passenger transport in the Municipality of Celje.

- A survey of travel habits of cyclists, which was directed to the understanding of travel behaviour of cyclists within the city and included the purpose of the journey, timing of trips and perceived disadvantages from the point of view of cyclists. The survey comprised of 17 questions and was conducted in April 2011. It included 130 cyclists who were located in the area of the old town at the time of the interview.
- Survey among users of major parking spaces. The objective of this survey, which was carried out on larger car parks of the city, was to learn about the travel habits of people who park in the large parking lots on the outskirts of the old town area. Surveys were carried out in April 2011 and gained 142 responses.

The second part of data collection was an inventory of the status quo. This consisted of the following areas:

- Examination of the overall state of transport infrastructure (apart from cycling infrastructure) with an emphasis on "black" points. The examination took place in January 2011.
- Status quo of freight traffic. A review of existing delivery points in the city centre in Celje (their number, arrangement and frequency) and analysis of regulations for delivery traffic. The review was conducted in November, 2010.
- The definition of the status quo of public transport lines (in April 2010) in the city and closest suburbs.
- The status quo inventory of cycling infrastructure, which was carried out in December 2010. In the review of cycling infrastructure we analysed the actual state of Celje bike routes, paths and lanes, their structure, accessibility, markings and biggest problems.

- Parking lots. We conducted a census of parking spaces in the area of the old town of Celje and parking lots on the outskirts of the city in April 2011. It was necessary to determine the occupancy of parking spaces, and determine how many of those were improperly used or occupied. It was also necessary to determine what the traffic signs were on the surveyed area, because only this brings visitors and residents to the appropriate location for parking. Also, the accessibility of parking lots was assessed.

The third part of the data collection consisted of counting vehicles and traffic monitoring. This part of the data collection was based on two methods: manual traffic counting to count the cyclists in the pedestrian part of the city, and automatic counting of vehicles using the system Viacount:

- Counting cyclists took place at 17 locations in Celje, its main purpose was to determine the frequency of bicycle use as a means of transport in the area of Celje's old town. Counting of cyclists was conducted on 25th March 2011 from 7:00 h to 19:00 h.
- Traffic counting on a broader area of Celje city centre was done with Viacount, which is a traffic counting device consisting of a Doppler radar set, data collector with serial interface RS232 and a battery pack. The device detects the movement of vehicles in the direction of travel and for each of them records speed, length and the interval since the previous vehicle. Subsequent data processing allows for specification of the number of vehicles by size groups depending on the pre-set orders of magnitude, and their speed. Subsequent data processing also allows for acquisition of other data specific to the description of a traffic flow. Counting traffic in the Celje area was conducted in November and December 2010 on 15 pre-defined critical locations.

Focus groups (2nd and 3rd stage)

In the second and third stage, a well-established method of focus groups was used. With its use in designing the process of integrated planning of a mobility system, quality information from the interaction between participants and a quick insight into the mobility system was gained, which enabled collaboration among different stakeholders of the mobility system.

Krueger and Casey (2009) identified a focus group as a carefully set series of discussions with stakeholders, designed to obtain perceptions on a particular area of interest in a permissive and non-endangering environment. Morgan (1996) explains that the focus group research technique collects data through the interaction in a group on a topic determined by the investigator. An identifying feature of focus groups is the interaction between participants according to a general structured outline from a moderator; it is not a group structured interview, participant observation or a debate (Kahan, 2001). The term "focus" has significant meaning - it points out that the group will discuss an exact topic of interest and not just general points (Masadeh, 2012)

The participant interactions are as important as the actual content of the conversation (Kress and Shoffner, 2007).

The importance of including crucial stakeholders and their socialization and communication is also pointed out by Čolić (2014). Moreover, this allows for the inclusion of all stakeholders and their interaction on the selected topic, most importantly also the interested public, whose participation in the processes of urban planning is often wrongly neglected (Hristić and Stefanović, 2013).

Purposes to perform focus groups may be manifold (Dürrenberger, 1999). They present a decision support for complex urban mobility problems which requires integration of different experts and knowledge from a wide range of disciplines. Developing an integrated strategic plan for urban mobility is impossible without a whole array of subjective judgments which are combined with quantitative research.

For the needs of this research, focus groups were performed on two levels, firstly as input into the SWOT analysis and secondly in designing a strategic mobility plan and activities proposals. In the first round there were 3 focus groups, and in the second round 4 focus groups. In the first round, mainly experts from academia and representatives of local authorities participated. In the second round, there were additions of residents, representatives of local communities, police, parking lot managers, representatives of bus operators and interested public, all of who participated in order to get quality integrated and participatory answers.

SWOT analysis (2nd stage)

Based on an analysis of focus groups we created a SWOT matrix, which is the basis for strategic mobility planning. SWOT analysis represents a general tool designed for use in the early stages of decision-making and strategic planning as a precursor to the different types of applications (Balamuralikrishna and Dugger, 1995).

Strategies can then be developed that can build on the strengths, overcome weaknesses, exploit opportunities or prevent threats (Dyson, 2004). It is a systematic analysis to identify those factors that develop strategies that create the best accommodation between the internal and external factors (Zohrabi and Manteghi, 2011; Glaister and Falshaw, 1999). In itself, SWOT does not perform in depth analysis, but is used as a tool that can help in effectively carrying out a comprehensive analysis (Duarte *et al.*, 2006; Celik *et al.*, 2012).

ANALYSIS AND RESULTS

The research methodology was based on three modes of data collection, which are the basis of this study.

In the next section, the most important data gathered from the surveys, inventory of the status quo and counting vehicles and traffic monitoring is shown (Table 1). These information present the basic for moderation of both the first and the second round of focus groups. Qualitative and quantitative data were combined in developing the SWOT analysis (after the first stage) and strategic plan (after the second stage).

The next stage was developing a SWOT analysis to serve as input into the making of a strategic mobility plan. For this,

Table 1. Main results from the first stage of the research methodology: data collection

MAIN FINDINGS OF THE FIRST STAGE	
Travel habits	Modal split shows that people coming to the centre of Celje mostly travel by car (47 %), 22 % by foot, 13 % by bus and 11 % by train, which is expected in regard to the city size. Frequency of visits show that most visitors come to Celje on a daily basis. This is expected, since most of them come to the centre for work, school, living or shopping.
Travel habits of cyclists	The share of cycling is around 4,5% and growing. Most cyclists stay in the city centre between two and three hours. 55 % of cyclist come to the city every day. Cyclists use their bike in the city centre to come to work (23 %), come to their home (40 %) and for recreation (15 %).
Survey among users of major parking spaces	The biggest problem is traffic leading up to parking lots, unclean surfaces and vehicles in pedestrian zones. Biggest usage of parking lots was recorded between 7 and 11 am on weekdays. The average duration of parking is 2 to 3 hours. Most users park in the city 2 to 3 times weekly, followed by those who use the city's parking lots every day. Most surveyed people believe that Celje's parking lots are not problematic. Some wish for free parking for at least 30 minutes, better tidiness and arranged supervision of the lots.
Analysis of the use of public transport among local communities and urban neighbourhoods	Among those that do not live in Celje, 5,2 % come to Celje daily, 39,2 % weekly, 1,2 % monthly and 5,4 % yearly. An analysis of daily use of transport showed that 85,8 % of visitors choose cars. Among only 99 surveyed people who use urban or suburban bus transport, 16 use it daily, 23 weekly and 60 monthly. It is most used by younger people of up to 30 years of age and older than 50 years. When asked how far they are willing to walk to a bus stop, most (74,8 %) respondents said up to 500 metres and 17,4 % up to 1000 metres. The Municipality of Celje does not maintain regulated public transport; all public transport is based on the individual supply of bus services. The respondents of the survey and first focus group participants see the implementation of two round bus services as optimal for Celje's situation.
Examination of the overall state of transport infrastructure	Black spots on the infrastructure within the old town of Celje were divided into four categories: the inadequacy of transport routes, improperly marked delivery points, improperly installed lights, bollards and other barriers, infrastructure damage.
Survey on the current state of freight delivery in the city	Most stores (79 %) receive their deliveries on the street in front of their shops. 86 % of deliveries is done between 8 and 12 am. 68 % of deliveries are made using vans. Packaging which is most used in deliveries are boxes of up to 5 kilograms and boxes from 6 to 25 kilograms. Deliverers mostly deliver between one and five products or product types. Among the surveyed companies, almost half have weekly deliveries, 17 % have daily deliveries and 28 % have monthly deliveries. 75 % would not voluntarily use an urban distribution centre.

we carried out focus groups and used collected data from the first stage of the research. The data was used for an introduction with facts about the urban mobility situation in Celje and to moderate focus groups in order to get quality answers. For the purpose of the focus group, research questions that were the basis for the focus groups were set. The research questions were as follows:

1. What advantages does the city of Celje have, which can be taken into account in the design of a mobility plan?
2. What are the disadvantages encountered in the design of a mobility system in the city of Celje?
3. What opportunities are emerging in the design of a mobility system in the city of Celje?
4. What dangers in the area of a mobility system may the city of Celje face in the future?

For the purposes of our research and to create a SWOT matrix, we developed three focus groups which sought answers to questions presented earlier. Within each focus group, six experts from academia and representatives of local authorities (experts from the municipal, environmental, financial, transport, urban and international divisions) participated. All participants had more than five years of experience in the field of transport and mobility. Individuals were invited to participate in focus groups because they were seen as an important source of knowledge about specific

experiences, needs and perspectives, which we hoped to learn more about as a result of these assessment (Hřýland *et al.*, 2014). The discussion lasted for one hour for each focus group. Each focus group was led by two moderators. One was responsible for leading the discussion and the other for writing and recording the answers given.

The result of the data collected and the analysis of focus groups is a SWOT matrix that highlights key benefits and opportunities offered by the city of Celje and at the same time draw attention to the weaknesses and threats that must be taken into account in the design of urban development – shown in the future (Table 2).

The formed SWOT matrix represents the input data for the design of research questions for the implementation of the second set of focus groups. We developed five research questions that have been linked to the strengths, weaknesses, opportunities and threats of the town of Celje and to shaping the proposal of a strategic mobility plan:

1. How to comprehensively solve the problems of urban mobility in the city of Celje? The question was focused on integration of different policies, subsystems and stakeholders.
2. How to increase the use of alternatives to the private car? With this topic, we sought answers on how to increase the share of public transport users, cyclists and pedestrians.

Table 2. SWOT matrix of city mobility for the town of Celje

STRENGTHS	WEAKNESSES
<p>S1. Small size of the area that enables holistic treatment</p> <p>S2. Favourable geographical location and favourable climate</p> <p>S3. Attractive connection to the Slovenian road network and proximity to high way network</p> <p>S4. Favourable location of parking lots around the old town centre</p> <p>S5. A sufficient number of parking spaces</p> <p>S6. The proximity of railway and central bus station</p> <p>S7. Pedestrian zone</p> <p>S8. Attractive city centre</p> <p>S9. Renovation of the old town centre project</p> <p>S10. Security</p> <p>S11. Revitalization of the old town centre project</p> <p>S12. Developed system of parking zones</p> <p>S13. Short time of day trips and short-distance commutes</p>	<p>W1. Partial solutions to urban mobility and fragmentation of decision-making</p> <p>W2. Limited spatial potential for spread of transport infrastructure</p> <p>W3. Spatial planning in the past</p> <p>W4. Lack of control</p> <p>W5. High proportion of car owners</p> <p>W6. Poor incentives to use alternative modes of travel to the private car</p> <p>W7. Poorly developed infrastructure for cyclists (bicycle lanes, trails, paths)</p> <p>W8. Transit transport from north to south runs through the city centre</p> <p>W9. Transport streams from east to west partially pass through the old town centre</p> <p>W10. Low share of cyclists</p> <p>W11. Inappropriately developed system of public transport</p> <p>W12. Low occupancy of vehicles</p> <p>W13. Fall in the number of passengers using public transport</p>
OPPORTUNITIES	THREATS
<p>O1. Strong support for EU measures to improve urban mobility</p> <p>O2. Development of a system of bicycle rental</p> <p>O3. Faster development of cycling transport</p> <p>O4. Introduction of technology solutions for the implementation of control</p> <p>O5. Promoting the use and creation of infrastructure for use of green technologies</p> <p>O6. Improve communication and the involvement of user groups</p> <p>O7. Targeted data collection for decision-making</p> <p>O8. Options to optimize city logistics</p> <p>O9. Wide consensus on the design of urban transport</p> <p>O10. Optimizing the use of parking spaces for all user groups</p> <p>O11. Organization of business operations of public institutions to reduce the pressure of transport</p> <p>O12. Examples of successful practices in comparable cities</p>	<p>T1. Less activity in the old town</p> <p>T2. Negative impact in achieving economies of scale because of smaller city</p> <p>T3. Poor efficiency of delivery</p> <p>T4. Limited financial resources</p> <p>T5. Exclusion of individual user groups</p> <p>T6. Pressure of transport</p> <p>T7. Negative trend of population growth in Celje</p> <p>T8. Lack of strategy and policy at national and regional level</p> <p>T9. Negative environmental impacts</p> <p>T10. A large number of commuters from neighbouring municipalities</p> <p>T11. Reluctance for measures of encouraging alternative modes of transport to the private car</p>

Table 3. Strategic goals and action plan

STRATEGIC GOALS	ACTIONS TO IMPLEMENT THESE GOALS
SG 1: Creation of an integrated systemic approach	<p>1. Creation of a unified strategy for development of the city</p> <p>2. Collection of quality "real time" information for mobility needs</p> <p>3. Promotion of sustainable modes of transport and changing travel habits - promoting alternatives to car</p> <p>4. Regular meetings to coordinate development plans (over the entire planning period of the plan for sustainable urban mobility)</p> <p>5. Integration of the Savinja region and design of a common strategy for the development of mobility</p>
SG 2: Increasing the percentage of public transport users by 10 % by 2017	<p>6. Introduction of high-quality urban bus transport</p> <p>7. Creation of intermodal points</p> <p>8. Creation of high-quality information system to support public transport</p> <p>9. Integration of school transport and urban public transport</p> <p>10. Determination of the tariff system and the ticket price</p>
SG 3: Increasing the percentage of bicycle users and pedestrians by 5 % by 2017	<p>11. Improving cycling infrastructure</p> <p>12. Introduction of renting bicycles - urban bikes (mobiCELJ)</p> <p>13. More people on the streets</p> <p>14. Mobility management in the field of cycling and walking</p>
SG 4: Efficient city logistics	<p>15. Implementation of the plan and monitoring</p> <p>16. Effective use of infrastructure</p> <p>17. An effective information system for the needs of city logistics</p> <p>18. Reduction of negative impacts on the environment</p>
SG 5: Mobility management	<p>19. Mobility plans</p> <p>20. Mobility centre</p> <p>21. Feasibility study for a car sharing system</p> <p>22. Feasibility study for a car pooling system</p> <p>23. Feasibility study for a Park & Ride system (link with neighbouring municipalities)</p> <p>24. Development of a strategy for taxi transport</p>
SG 6: Introducing green technologies	<p>25. Integration of environmentally friendly vehicles in the public service</p> <p>26. Environmentally friendly vehicles for public transport and delivery</p> <p>27. Design of charging stations for electric vehicles</p> <p>28. Promoting the use of electric vehicles in the general population (eg. free parking)</p>
SG 7: Management of passive transport and transport flows	<p>29. Management of passive transport and parking</p> <p>30. Planning transport flows</p>

3. How to effectively solve the problems of city logistics?
4. How to increase the role of mobility management?
5. How to integrate the mobility challenges of the future into plans for the city of Celje? In this context, the questions sought answers on how to integrate concern for the environment in the design of a mobility system and how to effectively manage traffic flows in the city of Celje and its surroundings.

Based on the research questions, we carried out a second set of focus groups with the participation of actors from different sectors (academic, representatives of local authorities, residents, representatives of local communities, police, parking lot managers, representatives of bus operators and interested public). We formed four groups of six people whom we asked the same questions. Focus groups lasted for one hour while the process of implementation was the same as in the first part of the focus groups.

From the data collected, we then implemented the final stage within which a strategic plan for comprehensive problem solving of mobility in the city of Celje was designed. The result of the implementation of the focus groups are therefore developed proposals for a strategic mobility plan for the city of Celje (Table 3). Such plans can and must be a prerequisite for further sustainable planning of all aspects of urban sustainability, starting with feasibility studies (e.g. see O'Doherty *et al.*, 2013).

CONCLUSION

Integrated strategic planning of a mobility system, despite its strong impact on the quality of life in cities, is still not sufficiently introduced in practice, although awareness of the importance of sustainable urban planning is increasingly present. This deficiency is manifested primarily in small and medium sized cities, where an integrated approach to mobility is often missing, due to many factors such as lack of motivation and organizational factors.

In this paper we presented the use of a methodology that consists of three stages: initial data collection, a round of focus groups and consequent SWOT analysis, and lastly a second round of focus groups with a broader stakeholder inclusion followed by a final proposal for a strategic mobility plan. With the constructed multi stage methodology, we gave an example of creating an integrated strategic mobility plan in SMCS. In doing so, both passenger and freight transport in all its forms were covered. Therefore, a methodology for integrated and participatory strategic planning was designed and tested in order to combine qualitative and quantitative data, which included all stakeholders of an urban mobility system. The main advantage of this methodology is its clear structure with inputs into next stages coming from different interactions with stakeholders.

The use of this approach resulted in a strategic mobility plan that can be seen as one of the most important steps in designing and ensuring sustainable mobility in cities. Even though smaller cities may have somewhat lesser mobility issues in comparison to megalopolises (mostly due to lesser traffic scope and smaller traffic generators), the results of our research clearly show that there is room for improvements

on the field of both personal and freight mobility in the observed case city. As the literature review showed, Celje is most certainly not the only small/medium sized dealing with mobility issues, therefore the research results can be transferred to a wide array of SMSC over the world. The best course of action is to take the final strategic plan proposition from this paper as a starting point and input into the whole process of designing a sustainable strategic mobility plan for any SMSC, and use the proposed methodology as the guidance that is often needed for the whole process to be as effective and holistic as possible. It is however important to be aware that there is no possible "one size fits all" solution and each city has its specifics which need to be addressed in further practical and theoretical works and research.

REFERENCES

- Alsnihi, R., Hensher, D. A. (2003) The mobility and accessibility expectations of seniors in an aging population, *Transportation Research Part A*, Vol. 37, pp. 903-916.
- Austrian Institute for Regional Studies and Spatial Planning (2005). ESPON 2006 Programme. *ESPON 1.4.1 „Small and Medium-sized Towns (SMESTO)“*. Vienna.
- Balamuralikrishna, R., Dugger, C. J. (1995) SWOT analysis: a management tool for initiating new programs in vocational schools, *Journal of Vocational and Technical Education*, Vol. 12, pp. 36-41.
- Bührmann, S., Wefering, F., Rupprecht, S. (2011) *Guidelines on the development and implementation of a Sustainable Urban Mobility Plan*. Cologne: Rupprecht Consult.
- Celik, A. Metin, I., Celik, M. (2012) Taking a Photo of Turkish Fishery Sector: A Swot Analysis, *Procedia - Social and Behavioral Sciences*, No. 58, pp. 1515-1524.
- Čolić, R. (2014) Evaluation of the capacity development of actors within participatory planning process, *SPATIUM*, No. 31, pp. 45-50.
- Dijkstra, L. and Poelman, H. (2012). *Cities in Europe the new OECD-EC Definition. Regional Focus*. A series of short papers on regional research and indicators produced by the Directorate-General for Regional and Urban Policy.
- D'Otero, J. C. P., Abril, H. M. S. (2013). Methodological proposal for the characterization of mobility in small cities tourism, *13th World Conference on Transport Research*, 15. - 18. July 2013, Rio de Janeiro, Brazil.
- Duarte C., Ettkin, L. P., Helms, M. M., Anderson, M. S. (2006) The challenge of Venezuela: a SWOT analysis, *Competitiveness Review: An International Business Journal incorporating Journal of Global Competitiveness*, Vol. 16, No. 3, pp. 233-247.
- Dürrenberger, G. (1999) *Focus Groups in Integrated Assessment*. ULYSSES Working Paper.
- Dyson, R. G. (2004) Strategic development and SWOT analysis at the University of Warwick, *European Journal of Operational Research*, No. 152, pp. 631-640.
- ESPON. (2013). TOWN. *Small and medium sized towns in their functional territorial context*. Case Study Report Slovenia.
- ESPON. (2014). TOWN. *Small and medium sized towns in their functional territorial context*. Scientific Report.
- European Commission, Directorate General for Regional Policy. (2011). *Cities of tomorrow Challenges, visions, ways forward*.

- Glaister, K. W., Falshaw, J. R. (1999) Strategic planning still going strong, *Long Range Planning*, Vol. 32, No. 1, pp. 107-116.
- Giffinger, R., Fertner, C., Kramar, H., Meijers, E. (2007). *City-ranking of European Medium-Sized Cities. Paper presented at IFHP World Congress - Futures of Cities, IFHP, Denmark*.
- Hecimovic, H. (2014) *Koprivnica – Planning sustainable mobility in a small town*, CIVITAS forum 2014, 23. – 26. September 2014, Casablanca, Marocco.
- Hristić, D. N., Stefanović, N. (2013) The role of public insight in urban planning process: Increasing efficiency and effectiveness, *SPATIUM*, No. 30, pp. 33-39.
- Hřýland, S., Haugen, A. S., Thomassen, Ř. (2014) Perceptions of time spent on safety tasks in surgical operations: A focus group study, *Safety Science*, No. 70, pp. 70-79.
- Kahan, J. P. (2001) Focus Groups as a Tool for Policy Analysis, *Analyses of Social Issues and Public Policy*, No. 2001, pp. 129-146.
- Keller, P. (2000) *A Challenge in Future Transportation Research and Planning. Energy Technologies for a Sustainable Future*. Villigen: Paul Scherrer Institute.
- Kress, V. E., Shoffner, M. F. (2007) Focus Groups: A Practical and Applied Research Approach for Counselors, *Journal of Counseling & Development*, Vol. 85.
- Krueger, R.A., Casey, M.A. (2009) *Focus Groups: A Practical Guide for Applied Research*, 4th ed. Thousand Oaks, CA: Sage Publications.
- Lindholm, M. (2013) Urban freight transport from a local authority perspective – a literature review, *European Transport*, No. 54, paper no 3.
- Lindholm, M., Behrends, S. (2010) *A holistic approach to challenges in urban freight transport planning*. 12th WCTR. Lisbon: Portugal
- Luca, O., Sercaianu, M. (2011) Mobility management in European projects. Lessons learned for Romania, *Theoretical and Empirical Researches in Urban Management*, 6 (2), 54-66.
- Masadeh, A. M. (2012) Focus Group: Reviews and Practices, *International Journal of Applied Science and Technology*, Vol. 2, No. 10, pp. 63-68.
- Mercatelli, L. (2014) Urban mobility planning in cities and town with less than 100.000 inhabitants: Planning challenges and opportunities, *1st European Conference on Sustainable Urban Mobility Plans*, 12. – 13. June 2014, Sopot, Poland.
- Morgan, D. L. (1996) Focus Groups, *Annual Review of Sociology*, Vol. 22, pp. 129-152.
- O'Doherty, T., Fitzgerald, B. G., Moles, R., O'Regan, B. (2013) A novel method for feasibility testing urban sustainable development policies, *SPATIUM*, No. 30, pp. 1-6.
- Taniguchi, A., Fujii, S. (2007) Promoting Public Transport Using Marketing Techniques in Mobility Management and Verifying their Quantitative Effects, *Transportation*, 34 (1), pp. 37-49.
- The Gallup Organization (2007) *Attitudes on issues related to EU Transport Policy*. Hungary: Flash EB No206b.
- UN-Habitat: Urban transport (2014a) *Objectives and Strategy*. Online: <http://mirror.unhabitat.org/content.asp?typeid=19&catid=639&cid=7984>, accessed 20th Sep 2014.
- UN-Habitat: Urban transport (2014b) *Urban Transport Programme*. Online: <http://mirror.unhabitat.org/content.asp?cid=849&catid=639&typeid=24&subMenuId=0>, accessed 20th Sep 2014.
- Zavodnik Lamovšek, A., Drobne, S., Žaucer, T. (2008). Small and medium-size towns as the basis of polycentric urban development. *Geodetski vestnik*, 52 (2), pp. 290-312.
- Zohrabi, A., Manteghi, N. (2011) A Proposed model for strategic planning in educational organizations, *Procedia - Social and Behavioral Sciences*, Vol. 28, pp. 205-210.

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GREEN INFRASTRUCTURE PLANNING FOR COOLING URBAN COMMUNITIES: OVERVIEW OF THE CONTEMPORARY APPROACHES WITH SPECIAL REFERENCE TO SERBIAN EXPERIENCES

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This paper investigates contemporary approaches defined by the policies, programs or standards that favor green infrastructure in urban planning for cooling urban environments with special reference to Serbian experiences.

The research results reveal an increasing emphasis on the multifunctionality of green infrastructure as well the determination to the development of policies, guidelines and standards with the support of the overall community. Further, special importance is given to policies that promote 'cool communities' strategies resulting in the increase of vegetation-covered areas, what has contributed in adapting urban environments to the impacts of climate change.

In addition, this research indicates the important role of local authorities and planners in Serbia in promoting planning policies and programs that take into consideration the role of green infrastructure in terms of improving climatic conditions, quality of life and reducing energy needed for cooling and heating.

Key words: green infrastructure, cooling urban communities, urban planning, vegetation.

INTRODUCTION

The planning and realization of urban green infrastructure is one of the passive measures to help reduce the energy needed to provide cooling and heating. On the one hand, urban green infrastructure has special importance in the adaptation of urban environments to climate change, while, on the other hand, it is also a certain, limited contributor to climate change mitigation (Cvejić *et al.*, 2011). Over recent years, in the context of climate change, the multifunctionality of green infrastructure has been growingly taken into account, thus leading to definitions which include "the concept of multifunctionality related to natural resources, adopt a holistic approach to thinking putting the focus on physical interactions between different types of green spaces" (Ibid: 32). The green infrastructure enables preservation, restoration or creation of facilities that utilize natural processes to recycle storm water, conserve energy and purify air in a way that encourages

connectivity, supports development and is environmentally and economically sustainable (Hamin and Gurran, 2009).

The European Union (EU) policies documents, such as The Sixth Community Environment Action Programme, the Thematic Strategy on the Urban Environment, the European Landscape Convention, the Leipzig Charter, as well as the Aalborg Charter of European Cities and Towns towards Sustainability (Hudekova, 2011), highlight the importance of open spaces for improving environmental quality. However, the above policies, supported by international, national and regional regulations, are not enough to ensure the establishment of adaptation measures at the local level (Hersperger and Burgi, 2009). Results of the analysis of contemporary practice within green infrastructure planning emphasize that the cooperation of all participants is crucial as the importance of local authorities not only as a driving force for the development of local policies and regulations, but also as an important factor that influences the success of actions and activities aimed at climate change adaptation (Hersperger and Burgi, 2009; Kazmierczak and Carter, 2010).

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Over recent years, the activities for harmonization of the legal framework of the Republic of Serbia with the EU *acquis* have intensified, resulting in the adoption of a set of new environmental laws, as well as the adaptation of the existing planning legislation. In this context, the aim of this paper is to present an overview of the existing legislation, policies and practice worldwide and Serbia related to the planning of green infrastructure in urban environments, aimed at implementing the concept of green infrastructure to mitigate and adapt to climate change and improve not only outdoor but also indoor environmental quality. The research is based on descriptive and analytical methods applied to contemporary theoretical and empirical frameworks that promote green infrastructure in urban environments, as well as on a comparison and synthesis of research results.

GREEN INFRASTRUCTURE PLANNING FOR COOLING URBAN ENVIRONMENTS: OVERVIEW OF POLICIES, PROGRAMS AND STANDARDS

Along with the positive impact of open spaces and vegetation on environmental conditions, that have always been known and recognized, the fundamental, mystic or religious values associated with the nature have existed in the folklore culture. Traditionally, nature has been considered through its use-value, and the relationship with nature was functional, mystic or religious. In Serbia, there were votive inscriptions carved in trees marked a spiritual space instead of a church, while "folk planners were looking for suitable sites near agricultural land and water for organizing their holdings ..." (Marić, 2006:48). Traditional respect for the nature and its spiritual meaning have an increasing importance in planning of green infrastructures. Contemporary urban planning and design also aim to protect the existing values of the natural environment by adapting to local environmental conditions and climate. The use of vegetation in urban planning as a passive measure is based on main principles and established criteria for bioclimatic urban planning and design for the distribution of vegetation which are, amongst other things, aimed to reduce heat transfer losses and improve natural ventilation. With climate change, the multifunctionality of urban green spaces is becoming increasingly important (Gill *et al.*, 2007), i.e. its significance in terms of energy efficiency and microclimate is emphasized. In addition to the functions and effects of urban green spaces such as air purification, protection against dust, smoke and soot, increase in relative humidity, and the positive effects on human health, etc., the research conducted in recent years has been directed towards the quantification of the effects of green spaces in terms of energy savings and the improvement of microclimatic conditions. Research by Ca *et al.* (1998) shows the impact of green spaces on energy saving in hot climates by establishing that the cooling effects of a park can extend up to 0.5km², and during one hour, from 1 to 2 pm, 4000kWh of electricity can be saved and, at the same time, air quality improved, while the anthropogenic heat released to the air can be reduced: this results in savings of 650 U.S. dollars in only one hour in the summer period. Further, it has been projected that, to plant an urban tree to shade a building and cool a community, is equivalent to three forest trees in terms of CO₂ emissions (Rosenfeld *et al.*, 1998). As planted roofs are used as a passive cooling technique it was

estimated that installation of a rooftop garden on a five-story commercial building results in savings of 1-15% in annual energy consumption, 17-19% in the space cooling load and 17-79% in the peak space load (Wong *et al.*, 2003).

Standards for planning of green infrastructure in the Republic of Serbia to date were based on the minimum size of green space expressed as a square meter per city dweller. However, deterioration of environmental quality, the impacts of climate change and the results of research on the effects of green spaces on temperature have led to the development of new standards, similar to the related international standards, for planning and design of local green spaces. The Biotope Area Factor (BAF) (Kazmierczak and Carter, 2010), used in Berlin to establish the proportion of green space required in a development area has influenced planning policies in several countries. The BAF expresses the ratio of the ecologically effective surface to the total area (or plot) covered by the development. All potential green spaces, such as courtyards, roofs and walls are included in the BAF. However, different types of green space are weighted differently in relation to evapotranspiring qualities, permeability, possibility to store rain water, relationship to soil functioning and provision of habitat for plants and animals. Thus, surfaces covered by vegetation have the highest weighting factor - 1.0, while partially sealed surfaces have the lowest weighting factor - 0.3. The BAF covers all forms of urban land use, and it sets out minimum ecological standards for structural changes and new development. One of the important advantages of the BAF regulation is that it provides flexibility in the process of planning as developers can decide on the type of green space to be created. Today, the BAF is recognized as having certain international importance, and it also helped other countries in developing their standards. Thus, in Slovakia, a set of standards has been developed (Ibid.) that are categorized by municipality (population) size. They comprise quantitative standards in relation to the provision and accessibility of open space, as well as standards focusing on the quality of green space. Standards also comprise guidelines for planning open green space, impacts of climate change including flooding in urban areas, high temperatures and inadequate air quality. This set of standards is intended for spatial planners, as well as others who make decisions on spatial development planning, but they are not legally binding.

A review of available professional and scientific literature revealed that in the Republic of Serbia there are no registered activities in the domain of investigation of the effects of green infrastructure in the context of climate change and its quantification. However, the research conducted for the territory of the city of Belgrade, Municipality of Vračar, in which ecological standards and BAF were used has proved that there is the "possibility of improving the functionality of the system by forming new biotopes, and at the same time maintaining urban morphology and purposes of areas ..."; thereby indicating that these standards "are becoming increasingly important due to topicality of climate change issues" (Cvejić *et al.*, 2012: 108).

In recent years, the development of policies, guidelines and standards worldwide indicates both international and local determination to address problems with the support of the

Table 1. Overview of contemporary urban policies and programs (according to Kazmierczak and Carter, 2010; Jansma and Visser, 2013).

<p>Urban policies</p> <ul style="list-style-type: none"> • Stuttgart (Germany) – By creating a database on climate, land use and topography (“Climate Booklet for Urban Development Online-Stadtebauliche Klimafibel Online”), requirements for precise planning of different urban spaces have been established, where the “German Building Code”, which provides a legal basis for proposed solutions in the Climate Booklet, is a main mechanism for implementation; result – numerous planning and zoning regulations aimed to preserve open spaces and increase the presence of vegetation in densely populated parts; • North West England (Great Britain) – The regional <i>Climate Change Action Plan</i> (2007-2009 and then refreshed for the years 2010-2012) in which green infrastructure has an important role in climate change adaptation and mitigation; • Almere (Holland) – Urban plan for the city of <i>Almere</i> which envisages integrated housing and urban agriculture is an important innovation in the planning system in Holland. <p>Urban programs</p> <ul style="list-style-type: none"> • Faenza (Italy) – The “Bio-neighborhood” incentive program, for which the city of Faenza has received national and international recognitions such as the European Prize for Urban and Regional Planning (Challenges 2009), is an integral part of town planning regulations offering a larger area for the development in return for green space - green roofs, walls and water retention systems, as well as for the creation of continuous public green space; • Basel (Switzerland) – As a result of the implementation of building regulations which require the use of vegetation on roofs, from 2002, when these regulations came into force, until now, a great number of green roofs have been installed, so that today Basel has the highest area of green roofs per capita in the world; • Chicago (USA) – The <i>Green Permit Program</i> is a support to strategic commitment to installing green roofs. At the initiative of Chicago’s Department of Buildings, an incentive program has been developed which encourages developers to incorporate elements of environmentally conscious design, including green roofs on new buildings.

overall community. There is an increasing emphasis on the multifunctionality of green infrastructure, but also on its social and ecological, as well as economic importance. Special emphasis is given to policies that promote the adoption of ‘cool communities’ strategies for reroofing and repaving in lighter colors and planting trees which can produce substantial energy savings, both directly and indirectly. An overview of several contemporary international urban policies and programs, presented in Table 1, shows that there are many examples of good practice resulting in the increase of vegetation-covered areas, which has contributed to better environmental quality, as well as to reducing the need for cooling and heating, i.e. to adapting urban environments to the impacts of climate change.

As emphasized by Kazmierczak and Carter, 2010:3, the summarized results of previous studies indicate that “collaboration with external stakeholders and internal, cross-departmental collaboration” have crucially influenced the success “of putting adaptation onto policy agenda”, and that the “autonomy of the local authority in developing local policies and regulations was other important factor influencing the potential success of actions aimed at adaptation to climate change”. Definitely, the awareness of the adaptation issue is seen as important among the general public and within organizations, as this will influence whether adaptation, as well as the presence of guidance, is perceived as a priority issue at both the national and regional/local levels. Further, the result of *The Green and Blue Space Adaptation for Urban Areas and Eco Towns Projects* (GRaBs) funded under INTERREG IV C Program shows that the existing international and national regulations are seen as additional potential support for the development and use of adaptation responses at the local level. The character of the current regulations at the local level and the possibility for local organizations to revise and innovate them is a major factor which influences development and adaptation strategies while the importance of access to knowledge, data and information, as well as the importance of collaboration and public involvement, have also been pointed out (Ibid.).

REPUBLIC OF SERBIA – GREEN INFRASTRUCTURE AND CLIMATE CHANGE

Legislative and town planning background

The concept of green infrastructure is relatively new in Serbia and this is one of the reasons why green infrastructure is not incorporated in the current legislation (Law on Environmental Protection, Law on Nature Protection, etc.). However, in recent years, it has mainly been mentioned in scientific and professional papers in terms of its role in climate change adaptation and mitigation (Crnčević, 2013; Cvejić *et al.*, 2012; Crnčević and Sekulić, 2012; Cvejić *et al.*, 2011; Manić *et al.*, 2011, etc.).

Planning the multifunctional green infrastructure does not have an explicit legal basis at any level of planning. The section of the Law on Planning and Construction (2014) which refers to urban plans implies the obligation to take into account “general directions and corridors for transportation, energy, water supply, utility and other infrastructures” (Art. 24, paragraph 3), while the section “Rules on Urban Planning and Design” sets out the obligation to create “requirements for urban planning and other requirements for planning and construction of structures in public use and network of transport and other infrastructures.” (Art. 30, paragraph 2). The green infrastructure can also be subsumed into “other infrastructures”. The Law also encompasses the issue of energy efficiency specifying that a “structure...must be designed, built, used and maintained in a way that ensures prescribed energy efficiency features” (Art. 4), which also supports the multifunctional green infrastructure planning. Therefore, it can be concluded that, although green infrastructure planning is not explicitly prescribed by law, the Law provides a minimal framework for its planning, which is, on the other hand, also related to the adequate interpretation of these articles in the Law.

However, the concept of public green areas is also incorporated in Serbian legislation. The Law on Environmental Protection (2004), in its Art.20 sets out the obligation according to which “public green areas in

settlements and places covered by spatial and urban plans shall be made and maintained in a way which shall enable preservation and development of natural and man-made values". This Law further stipulates that "general conditions of protection, the way of making, maintaining and renewing the destroyed public green areas, as well as data about the public green areas, shall be regulated by special law". An attempt to adopt a special law which would derive from this provision of the Law on Environmental Protection was not successful². Currently local authorities prescribe requirements and ways of compensation for destroying green space. This provides the possibility for local authorities to take initiatives such as the Decision of the City of Belgrade for green roofs from 2011. This Decision is certainly a step forward in terms of the initiative of local authorities, but the question of its influence still remains because, according to the current legal framework, these types of green space, as well as green walls and green parking lots, are not included in the total amount of greenery. On the other hand, it should be mentioned that this Decision has not been implemented yet.

Important elements of green infrastructure, such as forests, are regulated by a special law –the Law on Forests (2010), while nature protection is regulated by the Law on Nature Protection (2010). Unfortunately, neither of these laws have special provisions which would ensure their use in the context of multifunctional green infrastructure planning and the reduction of energy needs, while the importance of vegetation is not emphasized either in this context or in relation to climate change. However, it should be mentioned that the Law on Nature Protection, Art. 38, prescribes the obligation to establish ecological networks which are an essential element of green infrastructure at the wider regional and national levels.

On the other hand, the basis for planning at the national level provides a certain level of support to urban green infrastructure planning and development. Thus, the adopted Spatial Plan of the Republic of Serbia (SPRS) promotes the improvement/preservation of image and structure of urban landscape, amongst other things, also through the "preservation, improvement and sustainable use of open green spaces and elements of nature in cities, as well as creation of green and public open space networks which connect natural and cultural values of settlements, peri-urban areas and rural landscape" (Law on the Spatial Plan of the Republic of Serbia, 2010:139).

The study entitled "Belgrade Afforestation Strategy" (2011) encompasses the administrative area of the City of Belgrade and deals with climate change impacts and effects of afforestation on energy saving. This document indicates that saving only 10% of energy would save 7,100,000 Euros per year, taking into consideration annual electricity consumption of 7,555kWh per household and the projected price of 5.5 Euro cents per kWh. Taking into account the importance of greenery in saving energy, the Strategy

² One of the results of the "Belgrade Green Regulation" project (Urbanistički zavod Beograda, 2014) was a draft law. Although the final draft was later prepared by the Serbian Association of Landscape Architects, it did not strike a responsive chord among lawmakers and has not been adopted thus far.

promotes a set of principles outlining:

- The creation of windbreaks which prevent penetration of cold winds (southeastern wind), but allow the penetration of fresh summer breeze;
- Increase in the total vegetated area; and
- Planting trees on the eastern and western sides of solid structures and avoiding planting trees on their northern sides.

It should be stressed that it is particularly suitable to plant deciduous trees on the south side of buildings as during the summer this practice protects buildings from overheating, and in winter when the sun is low it can more easily enter buildings (Pucar *et al.*, 1994).

Public participation in urban planning is not sufficiently supported by the Law on Planning and Construction which, except the obligation of presenting the planning document for public insight (articles 50 and 51), „does not oblige the developer of the Plan to cooperate with the local community and population living in its vicinity“ (Petovar, Jokić, 2011:10). The decision on cooperation is left to the discretion of planners, or it is carried out if required by the promoter. Furthermore, there is also the "lack of experience and knowledge about techniques and methods, as well as insufficiently developed mechanisms and procedures for public participation in the decision-making process" (Orlović *et al.*, 2013:51).

Previous analysis of the legal framework, as well as of the studies and research conducted, indicate that there is a lack of adequate support and legal framework for the planning and realization of multifunctional green infrastructure. On the other hand, current practice in planning indicates that a certain amount of attention has been dedicated to this issue. The Detailed regulation plan for block 23 in the town of Bela Crkva (IAUS, 2011) represents good practice regarding the inclusion of areas under agricultural use into the green infrastructure, while the Master plan of Vrnjačka Banja (IAUS, 2005) provides an example of good practice regarding the protection of forests and their function within the green infrastructure system. Further, published results of the analysis of the current practice in planning also imply that a certain attention has been dedicated to this issue (Manić *et al.*, 2011; Crnčević, Bakić, 2008; Crnčević, Bakić, 2010; Crnčević, Bakić, 2011; Crnčević, 2013), which can be documented by the following good practice example.

City of Belgrade case study

The Master Plan of Belgrade up to 2021

The spatial distribution of vegetation coverage for Master Plan of Belgrade up to 2021 (2003) is green infrastructure and the coverage of planned intervention are concepts and requirements. Quality of life, biological-sanitary-hygienic function in terms of improving climatic conditions, reducing energy needed for cooling and heating are recognized as the core drivers.

The Master Plan of Belgrade (Figure 1) introduced the concept of the *urban green space system*, a system that includes different forms of property ownership, from suburban forests, private forests and shrubs, urban forests, urban gardens, to urban parks and tree avenues.

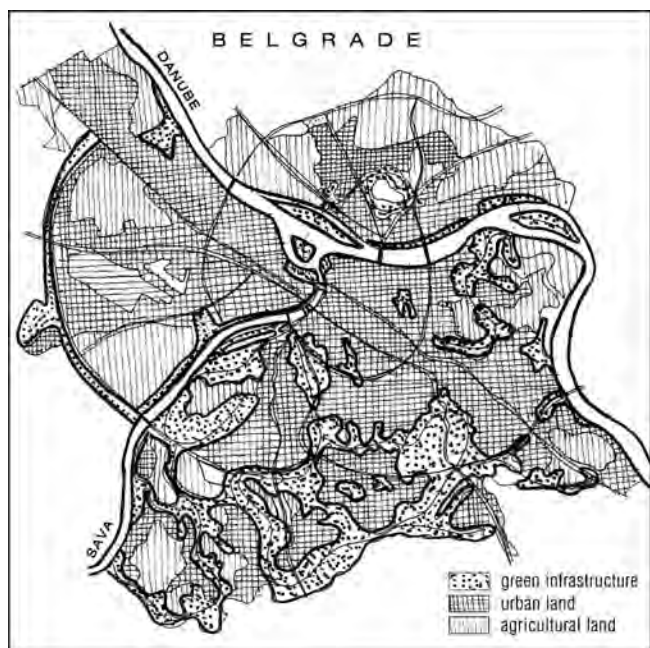


Figure 1. Design of the urban green space system according to the Master Plan of Belgrade up to 2021

The purpose of each space is defined primarily from the standpoint of land cover - greenery, and not in terms of the activities that are carried out in these green spaces (Master Plan of Belgrade up to 2021: 110). The system is defined as *green infrastructure for urban climate adaptation*. The goals for developing the system of urban green space have been set, such as: the preservation of green space inside the city and the forests outside the city within their existing borders; protection of foreland forests and river islands; protection of remnant marshes, ponds and wetlands; connectivity of the existing forests to the greenbelt; realization of a networked green space system using linear connections between the existing and planned green areas; remediation of a wider riparian area of the Sava and Danube rivers and formation of continuous linear greenery along river banks where possible, etc. This system and the concept of urban green infrastructure share many similarities.

The Master Plan of Belgrade sets forth minimal norms for planning various urban green spaces adapted to different uses of space, zones, position in the territory of the city and to existing and planned uses. Thus, for example, the percentage of site coverage of greenery according to the site area of 10-20% is envisaged in spaces around residential buildings for existing compact urban blocks in the central zone of the city; 20-30% for existing compact blocks outside the central zone of the city, and 30% in new compact blocks.

Belgrade Green Regulation

The Action Plan for the Protection of the Environment in the Territory of the City of Belgrade and the Master Plan of Belgrade up to 2021 were starting points for creating a project for the preservation and development of green space in the city of Belgrade, the "Belgrade Green Regulation" project. The spatial distribution of vegetation coverage for *Belgrade Green Regulation* (Urbanistički zavod Beograda, 2014) is green infrastructure and the coverage of planned interventions are regulations.

This project defines the concept of Belgrade's green space system taking into account the following principles: connectivity, multifunctionality, accessibility, protection of the character of the landscape, preservation of biodiversity, and improvement of the state of the environment. The spatial realization of conceptual commitments is planned by establishing a system of interconnected green areas. The generative elements of the system are dominants, spots and lines. Dominants include large green areas which are of importance for the city and region and are the main elements of the greenery system. Spots include green areas of local importance, while lines are connecting green spaces (Cvejić and Teofilović, 2010). Planning solutions include the following types of green area:

- a) Maintenance of urban green spaces
 - *Freestanding*: parks, squares, botanic gardens, cemeteries, park forests, community gardens, river islands, forests;
 - *Connecting*: in street regulation, in wetlands;
 - *Around buildings*: different types of residential tissue, industrial and commercial buildings, infrastructure facilities, sports facilities, facilities for public use;
- b) Naturally regulated green areas
 - *Freestanding*: plantations, forest-like habitats, fallows, wetlands;
 - *Connecting*: brushwood and forest remnants in wetlands – foreland, brushwood and forest remnants in agricultural land.

The proposed concept of Belgrade's green space system, compared to previous solutions, has placed an emphasis on the importance of green areas near the confluence of two large rivers, the Sava and the Danube, by singling out the "core" of the system and by strong "green connections" along the riparian area. Another important component of the system includes green corridors along the transportation network. Two rings, inner and outer, are a continuation of the main "skeleton" of the system. The rings are connected to numerous green corridors along small urban watercourses, roads and the network of land reclamation canals in the alluvial plains of the Belgrade area.

CONCLUDING REMARKS

The multifunctional nature of green infrastructure that creates positive impacts on human health mitigates climate change and saves energy should be a basis for initiating related policies and setting adequate standards for its inclusion in planning at national, regional and local levels.

In developing green infrastructure planning policies, the initiatives of local authorities particularly stand out, as shown in the examples of Belgrade. The new concept of Belgrade's green space system, which is based on ecological approach to landscape design, as well as on the use of European standards and contemporary theory of planning, has come closer to the practices of planning in other European towns and cities. The planning method used, although modified and adapted to available data and level of detail, is not a novelty in European practice, but its use in the example of Belgrade is definitely a verification and

new experience. The contribution of the used method can be seen at the national level. It is definitely a new approach and demonstrates understanding of the importance of the urban green space system. The preparation of detailed argumentation through conducted studies and analyses, which can have an important role in achieving a consensus in the future town planning, can be singled out as a unique contribution. The change in the philosophy of and approach to urban planning which is based on the ecological approach to landscape design is another important contribution. The new concept is an example of taking into account the multifunctional role of urban green space. The reservation of space which is to be excluded from future in Belgrade is also an important contribution considering the specific role of green space and the provision of an integrated urban green space system. Additionally, the improved typology of open green spaces, including completely maintained, but also naturally regulated green spaces, is an important novelty in relation to previous planning practices. Besides the protection of the still-remaining valuable biotopes, the Study on Mapping and Assessment of the Belgrade Biotopes, which was conducted for an urban territory in Serbia for the first time, has also provided very detailed information on the resources available for the creation of new urban green spaces. New knowledge which was derived from this Study is primarily related to the great diversity of habitats and species that survive in an urban landscape such as Belgrade. This represents an important information base for further development of green infrastructure planning with a shift towards green blue infrastructure planning³ that aims to reintroduce natural water cycles within urban environments.

It should be emphasized that, although the issue of climate change is not always adequately addressed in the legal framework, the importance and role of green infrastructure is clearly recognized worldwide and, as well, in Serbia. It is thus fair to conclude that local authorities and planners have an important role in promoting planning policies and programs that take into account the role of green infrastructure with the aim to improve living conditions and the quality of life, as well as for cooling urban communities and reducing energy needs.

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³ Green and blue infrastructure is defined as "an interconnected network of protected land and water that supports native species, maintains natural ecological processes, prevents flooding, and sustains air and water resources, and contributes to the health and quality of life of local communities" (Plus Integreat Knowledge, 2012:32).

REFERENCES

- Belgrade Afforestation Strategy*. Official Gazette of the Republic of Serbia, No.20/11.
- Ca, V.T., Asaeda, T., Abu, E.M. (1998) Reductions in air conditioning energy caused by a nearby park, *Energy and Buildings* 29, pp. 83-92.
- Cvejić, J., Bobić, A., Teofilović, A., Tutundžić, A., Radulović, S. (2012) Adaptacija kompaktnog grada na klimatske promene: primena ekološkog modela u Beogradu. In: Đokić, V., Lazović, Z. (Eds.), *Uticaj klimatskih promena na planiranje i projektovanje, razvijanje optimalnih modela*, Arhitektonski fakultet, Beograd, pp. 83-109.
- Cvejić, J., Bobić, A., Tutundžić, A., Radulović, S. (2011) Adaptacija gradova na klimatske promene – uloga zelene infrastrukture. In: Zlatanović-Tomašević, V., Gajić, R., Kaić, F. (Eds.), *Budućnost razvoja naselja u svetlu klimatskih promena*, Društvo urbanista Beograda, pp. 27-44.
- Cvejić j., Teofilović A. (2010) Concept of Green Spaces System –Belgrade Case Study, *Proceedings of Fabos Conference on Landscape and Greenway Planning 2010 Budapest*, July 8-11, Hungary, pp. 171-178.
- Crnčević, T., Bakić, O. (2008) The system of green surfaces in spas with special reference to the case studies: Vrnjačka, Kanjiža and Pribojska spa; *SPATIUM*, No. 17/18, pp. 92-97
- Crnčević, T., Bakić, O. (2010) Zelene površine banjskih naselja – prilog uspostavljanju I razvoju informacione osnove u GIS okruženju, in *Održivi razvoj banjskih I turističkih naselja u Srbiji*, Posebna izdanja 64, Beograd: IAUS, pp. 59-74.
- Crnčević, T., Bakić, O. (2011) The system of green spaces in spatial and urban planning in Serbia with special reference to the General Regulation Plan of the city of Knjaževac, 1st *International Conference "Ecology of urban areas 2011"*, *Proceedings*, University of Novi Sad, Technical Faculty "Mihajlo Pupin" Zrenjanin, Republic of Serbia in cooperation with Politehnica University Timisoara, Romania, pp. 456-453.
- Crnčević, T. (2013) Planiranje i zaštita prirode, prirodnih vrednosti i predela u kontekstu klimatskih promena u Republici Srbiji – prilog razvoju metodološkog okvira, *Posebna izdanja*, 72, Beograd: IAUS.
- Crnčević, T., Sekulić, M. (2012) Zeleni krovovi u kontekstu klimatskih promena – pregled novijih iskustava, *Arhitektura i urbanizam*, 36, pp. 57-67.
- Gill, S.E., Handley, J.F., Ennos, A.R., Pauleit, S. (2007) Adapting Cities for Climate Change: The role of the Green infrastructure, *Built Environment*, 33, no.1, pp. 115-133, http://www.fs.fed.us/ccrc/topics/urban-forests/docs/Gill_Adapting_Cities.pdf, accessed: 18th Sep 2013.
- Hamin, E.M., Gurrán, N. (2009) Urban form and climate change: Balancing adaptation and mitigation in the U.S. and Australia, *Habitat International*, 33, pp. 238-245.
- Hersperger, A. M., M. Bürgi (2009) Going beyond landscape change description: quantifying the importance of driving forces of landscape change in a Central Europe case study, *Land Use Policy*, 26, pp. 640-648.
- Hudekova, Z. (2011) Assessing vulnerability to climate change and adapting through green infrastructure, GRABs Expert Paper 7, <http://www.grabs-eu.org/downloads/EP7%20FINAL.pdf>, accessed: 11th Jan 2014.
- Jansma, J.E., Visser, A.J. (2011) Agromere: Integrating urban agriculture in the development of the city Almere; *Urban*

- Agriculture Magazine, 25, <http://www.ruaf.org/sites/default/files/UAM%2025-Agromere%2028-31.pdf>, accessed: 11th Nov 2013.
- Kazmierczak, A., Carter, J. (2010) Adaptation to climate change using green and blue infrastructure, A database of case studies, http://www.grabs-eu.org/membersArea/files/Database_Final_no_hyperlinks.pdf, accessed: 11th Nov 2014.
- Marić, I. (2006) Tradicionalno graditeljstvo Pomoravlja i savremena arhitektura, *Posebna izdanja*, No. 46, Beograd: Institut za arhitekturu i urbanizam Srbije.
- Manić, B., Crnčević, T., Niković, A. (2011) Uloga zelenih površina u prostornoj i funkcionalnoj koncepciji Bloka 23 u Beloj Crkvi, *Arhitektura i urbanizam*, 33, pp. 67-74.
- Orlović, L., V., Crnčević, T., Milijić, S. (2013) Tourism development in Serbia – on the way to sustainability and European integration, *SPATIUM*, No. 30, pp. 47-53.
- Petovar, K., Jokić, V. (2011) The right of servitude between public interest and undisturbed use of private property, *SPATIUM*, No. 26, pp. 7-13.
- Pucar, M., Pajević, M., Jovanović-Popović, M. (1994) *Bioklimatsko planiranje i projektovanje - urbanistički parametri*, Zavet, Beograd.
- Plus Integreat Knowledge (2012) Planning committee members learning and development program Leeds & Bradford Series module 2: Green and Blue infrastructure, <http://www.more.lgyh.gov.uk/wp-content/uploads/2012/03/Green-Blue-Infrastructure-Planning-Series-Handout-.pdf>, accessed: 15th Mar 2014.
- Rosenfeld, A.H., Akbari, H., Romm, J.J., Pomerantz, M. (1998) Cool communities: strategies for heat island mitigation and smog reduction, *Energy and Buildings*, 28, pp. 51-62.
- Urbanistički zavod Beograda, Generalni Plan Beograda 2021 (Master Plan of Belgrade to 2021), http://www.urbel.com/cms_images/gup1.jpg, accessed: 15th Jan 2015.
- Urbanistički zavod Beograda, Zelena regulativa Beograda (Belgrade green regulation), http://www.urbel.com/default.aspx?ID=uzb_ZelenaReg3&LN=S, accessed: 15th Jan 2014.
- Master Plan of Belgrade to 2021* (Generalni plan Beograda 2021), Official Gazette of the town of Belgrade, No. 27/03.
- Law on Environmental Protection*, Official Gazette of the Republic of Serbia, No.135/04.
- Law on Forests*, Official Gazette of the Republic of Serbia, No. 30/2010.
- Law on Nature Protection*, Official Gazette of the Republic of Serbia, No. 36/2009, 88/2010.
- Law on Planning and Construction*, Official Gazette of the Republic of Serbia No. 72/09, 81/09, 64/10, 24/11,121/12, 42/13,50/13,98/13,132/14,145/14.
- Law on the Spatial Plan of the Republic of Serbia*, Official Gazette of the Republic of Serbia, No. 88/2010.
- Wong, N.H., Cheong, D.K.W, Yan, H., Soh, J., Ong, C.L., Sia, A. (2002) The effects of rooftop garden on energy consumption of a commercial building in Singapore, *Energy and Buildings*, 35, pp. 353-364.

THE IMPLEMENTATION MODEL OF PLANNING RULES IN SPATIAL PLANS

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The implementation of spatial plans in past practice in Serbia was the weakest link of planning – theoretically insufficiently studied, methodologically vague and non-positioned, and only formally and partially carried out in practice. There is a general agreement that implementation should be perceived and oriented through spatial plans, in order to maximize the effect on other factors beyond the planning system. For that reason it is necessary to define theoretically the model of implementation for the spatial plan, the elements and contents of which reflect the logical, functional and time coherence of all planning decisions. Since there are several different methods and objects of planning, this paper has singled out four basic models and presents the results of the research (comparative analyses) into the role of application in the planning practice in Serbia using the example of a model of implementation for planning rules. An evaluated and studied model of implementation was applied in spatial plans for areas of special purpose and spatial plans of the local government units. This paper provides recommendations for further application of the model in the planning practice in Serbia.

Key words: implementation, spatial planning, model, element, planning rules.

INTRODUCTION

The implementation of planning documents in past practice in Serbia was the weakest link of planning – theoretically insufficiently studied, methodologically vague and non-positioned, and only formally and partially implemented in practice. Therefore, further research of implementation is necessary, in which spatial planning is perceived as a continuous process and set of implementation measures and activities as part of the plan.

From the moment when planning started to be perceived from the position of the connection between development of the planning decisions and their implementation, a combination of planning implementation and evaluation has become of central importance in respect to other phases of the planning process (Vujošević, 2004). The significance of implementation has been particularly pronounced in the approach to rationalist planning (Sager, 1994). The implementation of past planning decisions into practice was the least developed planning field, that is, the most complex one and the weakest link in planning. More than being just a part of the plan and its finalization, the implementation must be a more rounded process. The logic of planning interaction,

participation of actors and collaboration of different sectors also had to be subordinated to the possibilities and means of the planning implementation.

In order to promote the theory and practice of planning and implementation, it is necessary to define and theoretically elaborate the model of implementation of spatial planning, to specify the basic types of implementation models, and propose the guidelines for their application in future practice (Stefanović, 2011). In past practice there were no clearly defined and developed implementation models for spatial plans, and they were only mentioned in technical terms without being defined.

In lieu of former mechanical models based more on hierarchy and subordination, more significant are interactive models of implementation (Alexander and Faludi, 1989). These models combine collaboration through interaction and corresponding instruments of power in a suitable manner, without which planning decisions cannot be implemented.

The treatment of the implementation model of planning rules in spatial plans in Serbia is the basic aim of this paper.

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A THEORETICAL APPROACH TO RESEARCH INTO THE PROCESS OF IMPLEMENTATION OF PLANNING DOCUMENTS

It is of key significance for successful implementation that planning objectives be suitably structured, starting from the general determinations, via relatively target propositions made concrete, as far as rather concretized statements in view of their contents, time and space (Boisier, 1981). Implementation is in continuous interaction with planning conception and policies, since it emphasizes that plans have to possess internal consistency, meaning that: the individual plan parts must not be mutually contradictory, namely the evaluation of the condition and objectives must be compatible with the structure of that which is planned; the parts have to be mutually compliant; and the objectives have to comply with the measures and instruments (Johansen, 1985). The plan must meet the following requirements: concreteness of the dispositions; avoiding excessive complexity and detailing; avoiding fragmentation and having orientation towards integrity; giving attention to those problems that may be resolved; the structure of objectives within a coherent set of general, special and detailed planning determinations; and linkage with measures and instruments from the other fields (Barras and Broadbent, 1979). That is why there has to be a real resolve in the planning community that objectives and policies be implemented, which excludes “pseudo” and “quasi” plans. The means for implementation have to be actually available, and brought into indirect relationship with defining the necessary strategies and corresponding policies. In other words, the entire system has to be logically, functionally and time coherent.

The foregoing authors clearly point out that implementation is a continuous category, constantly in interaction with planning conception and policies, which change. Implementation comprises and relates to “planning elements” (objectives, planning policies, decisions, priorities) and “post-planning elements” (elaborated measures and instruments of implementation), as well as various aspects relating to monitoring (indicators), evaluation, institutional-organizational aspects and others. Implementation is determined by the integrity of the planning process and is in direct dependence (interaction, correlation) with the methodology and elements of the planning system. Consequently, implementation is a complex process, incorporating both the plan with all its elements and all that follows after it, namely, putting into practice a greater or smaller set of specific solutions. The continuously present factor of uncertainty (in these regions) should also be mentioned, which is conceptually linked to the future, when the outcome of the event is not known with certainty, and which in itself carries a degree of risk, and may result either in loss or in a favorable opportunity. Uncertainty, as a subjective experience, also comprises a dose of fear, non-readiness and hesitation, which to a certain degree may explain the restraint when passing the decisions, with the knowledge that the plausibility of the results is uncertain. Consequently, the uncertainty and insecurity of the system (first of all in the economic, but also in the political, territorial and demographic sense), have become a protracted and

everyday condition and they have an impact on the spatial and urban development of the community (Danilović Hrstić, 2014). When the economy and politics are variable values on a daily basis, without a basic constant and consistency, or any clear and elaborated strategy, then it is difficult to plan the components of a system which may not be sustainable until tomorrow, let alone for the designed time distance. However, no community foregoes development in full, not even in the periods when a reliable perception of the situation is not secured (Nikezić, 1996), but then the process must adapt and fall in line with the existing conditions. It is then mostly concentrated on the activities related to the improvement of certain living conditions, which by their virtue are short-term and fragmentary, without the risk of endangering any superior strategic objectives. The goal of such action is to have maximum effect, and to minimize possible loss, and that is achieved by the restrictive selection of objectives, determining the solution to a lesser degree and by being open to different scenarios and variants in case of a change in the conditions (Danilović Hrstić and Stefanović, 2013).

THE IMPLEMENTATION MODEL OF SPATIAL PLANS

Defining an implementation model of spatial plans starts from the following basic positions:

- That implementation of plans is currently unclear and non-positioned, as well as that in practice it has only been formally and partially implemented;
- That implementation should be perceived as an integral part of a continual planning process which starts with the plan preparation, and which incorporates “planning” and “post-planning” elements, as well as monitoring, evaluation, institutional and organizational aspects;
- That it is necessary to define and theoretically elaborate the implementation model of spatial plans and determine the basic types of implementation models, depending on the types and methods of planning.

In order to approach the preparation of the spatial plan successfully and perceive the framework for its implementation, it is necessary to reply to two basic questions: “*what are we planning?*” and “*who are we planning for?*”. The search for the reply to these two seemingly simple questions opens up numerous dimensions and aspects of planning which have to be perceived rationally, in order to have planning and the plan clearly positioned in the system of passing decisions and coordination of various interests.

The character and purpose of planning are strongly influenced by the fact that in modern society all forms of property have been made equal and also that besides the state ownership over the land being the object of planning there is also private ownership. The approaches are various, or at least they should be various, depending on whether planning is carried out for the requirements of the state, namely the national interest, or for the requirements of larger or smaller groups of separate interests (Vujošević, 2004). This is directly dependent on the level of planning as well, since obviously there must be a corresponding framework of planning and policy of spatial development, which is orientating and binding in regard to the vital national interests.

Having in view the new planning tendencies, as well as the past practice in spatial plan preparation, it is possible to define theoretically and identify in practice the four basic elements of planning, which themselves answer the question of what is being planned. They are as follows:

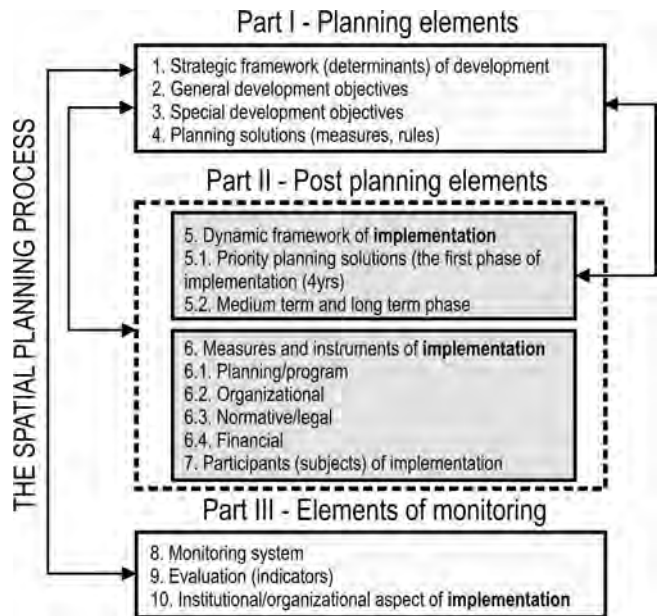
- *Strategic planning and defining the general policy of spatial development* – in which planning is “generally developing”. The results of such planning are strategic commitments associated with the development of certain regions, whereby there is minor planning of concrete activities that are spatially and time determined. Such planning is predominantly linked to the national and regional level of planning (Milić and Stefanović, 2009);
- *Planning the activities of technical nature which are physically realized in space* – in which planning is more concrete and “more spatial” than in the previous one. It can also be termed as physical planning, the results of which are concrete, spatially determined planning solutions, which in practice for the greater part relate to infrastructure networks and facilities, the realization of which is within the competence of the state;
- *Planning the protection of a certain space* – in which major physical interventions in space are not stressed, but by means of planning solutions in the form of protective measures and specified activities (permitted and forbidden), space with all its natural and created values is protected;
- *Planning by means of the set of rules of use, regulation and construction* – in which planning solutions are reduced to a system of rules defining the manner of use of space, regulation and construction. This form of “urban planning” operates with concrete spatial and technical determinants and is the basis for the construction in space.

Having in mind the above, planning and implementation are directly dependent on the type of ownership over the land, on one hand, and the type, namely object of planning, on the other.

A similar conclusion has been presented by the majority of authors engaged in the theory of implementation, stating that the role of implementation basically depends on the applied planning approach (method), namely on the role and conception of what the plan should be. The following are singled out: vision plans; detailed plans (blueprints); plans as a set of guidelines (e.g. for land use, development management, and others); plans as the means for resolving concrete issues; plans as a means of attracting investments; plans as a medium of communication and interaction; plans as policies; and similar (Baer, 1997). With the exception of vision plans, for the majority of other planning approaches, namely models, it is important that the objectives of the very planning undertaking (project) are carried out, thus they most often also contain special instructions and guidelines for implementation.

It is elementary to ask what implementation is like (its role, significance, object and similar) and how it depends on planning types and methods (Vujošević, 2004). There

is an essential discord between two planning types, the one which accentuates the significance of developing other projects (concrete planning solutions in the broadest sense) and the other where greater significance is placed on the general strategic framework (in which developing projects and solutions are positioned). In an ideal situation some balance and flexibility between these approaches is strived for. Such coordination is rather difficult to achieve, even in countries with a developed planning system and planning practice, but without that it is not possible to arrive at any quality and mutually coordinated decisions which can be implemented.



Scheme 1. Roles in the implementation of the planning process

The definition of the implementation model of spatial plans is based on:

- A general definition of the model as 1) the basic specimen according to which something is made, fabricated, or 2) the approximate description of the manifestation or the object in the real world, along with the assistance of mathematical symbolism;
- A definition of planning as the process of preparation of a set of decisions on future actions, directed towards attaining the objectives by the preferred means (Perišić, 1985);
- The position that implementation is a unique continual process beginning with the plan preparation;
- The requirement that the entire planning system must be logically, functionally and time coherent (for successful implementation it is of key significance that planning objectives are conveniently structured, starting from general determinations, via relatively concretized target propositions, as far as concretized statements in view of contents, time and space);
- The fact that implementation is directly dependent on that which is planned, namely on types and methods of planning.

In conformity with the stated positions, *the implementation model of spatial plans is a simplified presentation of a set of related planning decisions on future actions, which reflects the logical, functional and time coherence of the planning actions, depending on the type and method of planning.*

As such the implementation model possesses the elements determined by a set of planning actions in the broadest possible sense, starting from general determinations, via relatively concretized target propositions, as far as concretized statements in view of contents, time and space. The elements of the model surpass the plan itself as a document (the planning phase) and besides the mentioned "planning" elements they also include "post-planning elements" which are only defined by the plan (implemented later on) and all the necessary monitoring elements.

With the proposed definition of the model and by defining its elements, the fundamental theoretical postulate of the model of implementation has been completed. Having in mind the diverse problems and methodology of preparing spatial plans, it is necessary to clearly separate the different types of implementation models which can be identified from past practice, as a part of spatial plans, and which correspond to the types and methods of planning (Stefanović and Milijić, 2009). They are:

- Model of implementation for the strategy and policy of spatial development;
- Model of implementation for the protection of space;
- Model of implementation for planning solutions of a technical nature;
- Model of implementation of the rules regarding the use of space, regulation and construction.

The stated models of implementation can be identified in the past practice of preparing plans in Serbia. They do not mutually exclude each other, but are combined during plan preparation, whereby one of them dominates and determines the character of planning and the plan, and *ipso facto* implementation itself (Stefanović, 2011).

In order for the stated models of implementation to be efficient, it is necessary to develop and promote institutional/organizational and IT support for plans to be implemented in Serbia, which can also be perceived as a separate model.

APPLYING THE IMPLEMENTATION MODEL IN THE SPATIAL PLANS PREPARATION – THE EXAMPLE OF THE MODEL FOR RULES REGARDING THE USE OF SPACE, REGULATION AND CONSTRUCTION

The new planning challenges and styles are progressively requiring pliable and flexible means of planning, unlike the former traditional positions which gave priority to rigid regulatory means. The increasing complexity and interdependence of territorial processes and the increasing uncertainty in respect of spatial tendencies, along with shifting the limits of competences in the national sector, also require the new planning styles oriented towards defining the principles and rules, and not strict and rigid obligations and regulations. It has been defined by numerous European documents that modern plans should become a system of

rules, endeavor to comprehend and anticipate the future territorial tendencies and effects, and be a strategic means directed to activation of the capabilities of the private sector^{2,3}.

With such general tendencies, the spatial planning in Serbia has been developing in light of changes in ownership relationships and the development of private ownership and interests, which require flexible plans as a means of "initiating and facilitating", as opposed to being a means of state intervention and "limitation". At the same time, the limited amount of territory covered by urban plans and the lack of time and means for preparing them condition the requirement that spatial plans be implemented directly, namely that the realization and construction in space can start when the lower order urban plan will not be prepared subsequently.

Such circumstances have conditioned that the model of implementation of the rules regarding the use of space, regulation and construction may be identified in past planning practice. Comparative analysis of the application of this model in spatial plans includes identification of its elements in compliance with the general theoretical postulate of the implementation model.

An exception to this are those plans which do not have such rules and which can be implemented directly, namely the Spatial Plan of the Republic of Serbia and Regional Spatial Plans.

Individual elements of the model of implementation of the rules regarding the use of space, regulation and construction have been identified in all of the analyzed spatial plans for the areas of special purpose and in the spatial plans of the municipalities. However, the analysis has affirmed the position that such rules are a specific element of the plan, and that defining them does not imply coherence of the planning actions. Based on that, it was evaluated that the implementation model of the rules for the use of space, regulation and construction was applied in all analyzed spatial plans for the areas of special purpose and spatial plans of the municipalities.

The stated examples of the rules in the plans of special purpose clearly indicate the dominance and more detailed elaboration of those rules which are related to the construction of infrastructural systems and facilities, which is positive, having in mind that for space regulation the competence lies within the state, which prepares and passes such plans through its institutions.

A particular analysis concludes that the implementation model of the rules for use of space, regulation and construction was applied in the plans of special purpose as a rule in combination with other implementation models (Stefanović, 2011).

² European Spatial Development Perspective ESDP, Towards Balanced and Sustainable Development of the Territory of the European Union), Agreed at the Informal Council of Ministers responsible for Spatial Planning, Potsdam, May 1999 – Published by the European Commission.

³ Guiding Principles for Sustainable Spatial Development of the European Continent, 12th Session of the European Conference of Ministers responsible for Regional Planning (CEMAT), September 2000, Hanover.

Table 1. Presentation of the Model of Implementation for the Rules regarding the Use of Space, Regulation and Construction in Spatial Plans

Spatial Plan	I Planning elements				II Post-planning elements						III Monitoring elements			Representation of the elements in the model (%)	
	Strategic framework	General objectives	Special objectives	Planning solutions (rules of regulation and construction)	Dynamic framework		Measures and instruments				Participants	System of monitoring	Evaluation (indicators)		Institutional organizational aspect
					Priority planning solutions First phase	Middle-term and Long-term phase	Planning-Program	Organizational	Normative - Legal	Financial					
1. Spatial Plan of NP and TR Stara Planina			√	√			√	√			√				36
2. Special purpose Plan of accumulation of the Bovam				√							√				14
3. Spatial plan of the infrastructure of corridor of E-75 highway			√	√	√	√	√	√			√				50
4. Spatial plan of the City Municipality of Lazarevac	√	√	√	√			√	√			√				50
5. Spatial plan of the Municipality of Sremska Mitrovica	√			√			√				√				29
6. Spatial plan of the Municipality of Arilje	√	√	√	√			√	√			√				50
Representation of the elements of model in the plans (%)	33	22	44	67	11	11	55	44	0	0	67	0	0	0	

Unlike the spatial plans for regions of special purpose, in spatial plans of the local government units the rules of construction have been elaborated in more detail, and for the most part relate to the construction of buildings in private ownership, namely to the land for other uses. The rules of regulation are also defined in more detail, however, they are of a more orientating character, having in mind that for the requirements of land regulation and infrastructural facilities construction it is most often necessary to resolve the proprietary/legal relationships by preparing a corresponding urban plan (whereby the spheres of interest between the land of public use and other use are defined).

Such conclusions, supported by numerous examples of the rules of construction for individual dwellings, economic facilities, farms on agricultural land, pile dwellings on floodplains and others, which are fully flexible and open towards a broader spectrum of possible initiatives, have proved that planning practice is slowly meeting the new tendencies and requirements for the new styles of planning, which comprise defining the principles and rules, anticipating future territorial tendencies and effects, as well as activating the capabilities of the private sector.

Numerous examples of the detailed rules for regulation and construction in the analyzed spatial plans of the municipalities confirm that the implementation model of those rules has been applied in them, and that based on the system of rules the possibilities were created for direct implementation (realization) of certain planning solutions.

The spatial plans of the municipalities, therefore, can be evaluated as a successful attempt at responding to the newly created circumstances of planning in Serbia, since they actually define that which was postulated by the legislative regulations by defining the system of rules for regulation and construction on the basis of which the plans can be directly implemented for those areas for which the urban plans will not be prepared.

Although the number and representation of the model elements in the plans mean that it is not directly comparable to the other implementation models, it is evident that it is equally represented with other models, since the analysis conducted has indicated that it was applied in combination with other implementation (Stefanović, 2011).

CONCLUSIONS AND RECOMMENDATIONS

(1) The model of implementation of the rules for the use of space, regulation and construction should be applied as a mandatory model in all spatial plans for the areas of special purpose and spatial plans for municipalities. Such a position is supported by the results of the conducted analysis, which indicates that the model has been applied in the past planning practice in the mentioned plan types.

(2) The basic problem when preparing plans and determining the rules for the use of space, regulation and construction is how and in which way to coordinate the competences in passing the plans with the competences for their implementation and issuing of required permits based

on the set of rules. The same territory has been the object of planning, both on the national and on the local level. That is why it is necessary that the approach to defining the rules of space regulation and construction be established depending on the level of planning (type of plan). In spatial plans for the regions of special purpose it is necessary to define the rules of regulation and construction for the facilities for which further realization and issuing of the necessary permits would be within the competence of the state. For all other facilities, the realization of which is within the competence of the local government, the rules of regulation and construction should be prescribed in spatial plans of the local government units. Thereby one should have in mind that the methodological/theoretical approach in planning should be strived for, since in practice it is not always possible to delimit the competences clearly and anticipate the construction of individual buildings, and it is necessary through plan preparation to perceive the deficiencies and substitute the omissions in defining the rules in the former plans, even independently from the level of planning.

(3) The model of implementation for the rules regarding the use of space, regulation and construction needs to be disburdened of the majority of its elements, which to some extent corrects the theoretical postulate of the elements in the case of this implementation model. Through introductory notes in the plan it is necessary to emphasize that direct implementation is one of the tasks of the plan preparation, which would represent the first planning element of the model. It would condition a further definition of the objectives and conception, as the second element of the model, in a manner to define priority areas and activities which would be supported by the rules and possibility of direct implementation of the plan (for example, economically and demographically affected peripheral regions, the regions in need of urgent rehabilitation and reconstruction, and similar). The planning elements of the model would be rounded by the rules of regulation and construction, and prepared in compliance with the examples and proposals presented. The provisions on the manner of direct implementation of the plan should be singled out as post-planning elements of the model, as well as a separate element, namely a set of rules, which would not be applied directly, but would be of an orientating character and would be elaborated through the preparation of urban plans. Finally, it is necessary to define a special system for monitoring and evaluation within the plans which would incorporate, for example, the guidelines for the operation of the administrative authorities in issuing the required permits, organization of supervision over application of the rules, information system in the field, decided and realized application requests for construction, as well as an evaluation of the direct implementation and preparation of the urban plans.

(4) Having in mind the developed practice of defining the rules of regulation and construction on building land, which is primarily within the field of urban planning and as such theoretically and practically more elaborated, it is necessary to develop and promote the methodology for determining the contents of the rules of regulation and construction on agricultural and timber-land. The practice of preparing

spatial plans in Serbia in recent years has pointed to the significance and need for defining such rules, and thus it is realistic to expect further growth of the initiatives for construction on agricultural, timber-land and construction land, and accordingly, it is necessary to adjust the system of plans and the rules in them, in order for the planners to adequately respond to those initiatives, or limit them.

In Serbia, there are relevant planning experiences which define quality planning solutions and the basic elements of the plan implementation. However, the implementation model/process related to institutional/organizational and IT support of the plan application, following its adoption, is insufficiently developed. This implementation model/process is conditioned by the socio-political system, the possibility of securing funds for its realization, legal prerequisites for the requirements of plan application, and similar. Thus, in the plan implementation in Serbia the present factor of uncertainty has a negative effect on spatial and urban development, namely the reality of the time perspective in planning solutions.

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REFERENCES

- Alexander, E.R., Faludi, A. (1989) Planning and Plan Implementation: Notes on Evaluation Criteria, Environment and Planning B site, *Planning and Design*, No. 16, pp. 127-140.
- Baer, W.C. (1997) General Plan Evaluation Criteria, An Approach to Making Better Plans, *JAPA*, No. 63, pp. 329-344.
- Barras, R., Broadbent, T.A. (1979) The Analysis in the English Structure Plans, *Urban Studies*, Vol. 16, No.1, pp. 1-18.
- Boisier, S. (1981) *Planning a Regional System*, ECE/UN for Latin America, ILPES, Santiago de Chile.
- Danilović Hristić, N., Stefanović, N. (2013) The Role of Public Insight in Urban Planning Process: Increasing Efficiency and Effectiveness, *SPATIUM*, No. 30, pp. 33-39.
- Danilović Hristić, N. (2014) Izazovi urbanizacije prestonice pod uticajem faktora neizvesnosti, u Božić, S. (ed.) *Istorija i geografija – susreti prožimanja*, Beograd: Geografski institut „Jovan Cvijić” SANU, Institut za noviju istoriju Srbije, Institut za slavistiku RAN, pp. 519-533.
- European Spatial Development Perspective ESDP (1999) *Towards Balanced and Sustainable Development of the Territory of the European Union*, Agreed at the Informal Council of Ministers responsible for Spatial Planning, European Commission, Potsdam.
- Guiding Principles for Sustainable Spatial Development of the European Continent* (2000) 12th Session of the European Conference of Ministers responsible for Regional Planning (CEMAT), Hanover.
- Johansen, L. (1985) *Predavanja iz makro ekonomskog planiranja*. Zagreb: Cekade.
- JP „Direkcija za izgradnju” (2010) *Nacrt prostornog plana opštine Arilje*, Arilje.

Law on Planning and Construction, The Official Gazette of the RS, No. 47/03, 34/06, 72/09.

Milić, Đ., Stefanović, N. (2009) Pristup izradi i sprovođenju regionalnih prostornih planova u aktuelnoj praksi planiranja u Srbiji, u Marić, M. i Milijić, S. (ur.) *Regionalni razvoj, prostorno planiranje i strateško upravljanje*, Beograd: Institut za arhitekturu i urbanizam Srbije, pp. 159-176.

Nikezić, Z. (1996) Strategija urbanizacije u uslovima neizvesnosti, neizvesnost kao polazna pretpostavka u određivanju aktivnosti usmeravanja razvoja grada, u Lazarević Bajec, N. i Ralević, M. (ur.) *Strategija urbanizacije u uslovima neizvesnosti*, Beograd: Arhitektonski fakultet, edicija Urbanologija, pp. 30-39.

Perišić, D. (1985) *O prostornom planiranju*. Beograd: Institut za arhitekturu i urbanizam Srbije.

Prostorni plan gradske opštine Lazarevac, The Official Gazette of the City of Belgrade, No. 58/08.

Prostorni plan opštine Sremska Mitrovica, The Official Gazette of the City of Sremska Mitrovica, No. 9/09.

Regionalni prostorni plan administrativnog područja grada Beograda, The Official Gazette of the City of Belgrade, No. 10/04.

Sager, T. (1994) *Communicative Planning Theory*. Avebury: Aldershot.

Stefanović, N. (2011) *Modeli implementacije prostornih planova*. Beograd: Neobjavljena Doktorska teza, Geografski fakultet.

Stefanović, N., Milijić, S. (2009) Potrebe i mogućnosti unapređenja implementacije prostornih planova u Srbiji, u Filipović, D. i dr. (ur.) *Planska i normativna zaštita prostora i životne sredine*, Beograd: Asocijacija prostornih planera Srbije i Geografski fakultet Univerziteta u Beogradu, pp. 373-381.

Uredba o utvrđivanju Prostornog plana područja infrastrukturnog koridora autoputa E-75, deonica Beograd-Niš, The Official Gazette of the RS, No. 69/03.

Uredba o utvrđivanju Prostornog plana područja i Turističke regije Stara planina, The Official Gazette of the RS, No. 115/08.

Uredba o utvrđivanju Prostornog plana područja posebne namene akumulacije Bovan, The Official Gazette of the RS, No. 14/09.

Uredba o utvrđivanju Regionalnog prostornog plana opština Južnog pomoravlja, The Official Gazette of the RS, No. 83/10.

Vujošević, M. (2004) The Search for a New Development Planning/Policy Mode: Problems of Expertise in the Transition Period, *SPATIUM*, No. 10, pp. 12-18.

Vujošević, M. (2004) *Racionalnost, legitimitet implementacija planskih odluka – novije teorijske interpretacije pouke za planiranje u tranziciji*. Beograd: Institut za arhitekturu i urbanizam Srbije.

With Spatial Planning Instruments to More Effective Solutions (2002) Alpine Adriatic Working Community, Working Group for Spatial Planning (first meeting-Castel Brando, Cison Di Valmarino), Ljubljana.

PLANNING AND LAND POLICY TOOLS FOR LIMITING URBAN SPRAWL: THE EXAMPLE OF BELGRADE

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Both the characteristics of Serbia's urban land policy, the delay in reforms and land development management of the Belgrade Metropolitan Area (BMA) illustrate the complexities following the reshaping of institutional framework under the conditions of economic and other uncertainties of societal transition. The negative implications of the prolonged crisis on the new urban development policy and urban land tools can postpone the establishment and application of guidelines for limiting the urban sprawl. This paper presents a brief literature review, as well as the current urban land policy and land-use efficiency in the BMA. Traditional urban land tools will be shortly described, followed by recommendations for limiting sprawl. There is a need for readjusting the current planning and urban policy regarding the urban sprawl, from an urban "command-and-control" approach to a "learn-and-adapt" approach. We suggest the introduction of more innovative and flexible urban land policy tools.

Key words: Urban land policy, urban land tools, urban land bubble, urban sprawl, Belgrade.

INTRODUCTION

A number of factors contributed to a drastic decline in real-estate values, followed by their subsequent erratic, weak and slow recovery, viz.: global economic and financial crisis, growing economic uncertainties and risks, spreading of "the real-estate bubble" (the conversion of the development boom into development doom), conversion of the housing boom, real-estate boom and urban land bubble into urban doom (urban sprawl), etc. The causes of the "real-estate bubble" and "land bubble" growth in cities are numerous, and they have led to several consequences in the global crisis. A lack of equipped urban construction land for green-field investments, housing, business and industry, along with neglecting of brown-fields has also contributed to the crisis. According to the UN-Habitat (2015), the lack of land policies and clear regulations can lead to uncoordinated city growth and the increase of illegal/irregular and informal settlements, while excessive regulations (such as strict zoning) can lead to division of urban land-use into exclusive residential, commercial, or industrial areas, which may result

in urban sprawl and low density urban expansion. In both cases, urban land regulations can inhibit the development of smart cities. The paper opens a few questions, such as: How to prepare planning and development regulations for limiting urban sprawl, while facing a lack of guidance for dealing with uncertainties and disturbances in the post-socialist context? How can urban systems become more adaptable to change and reshaping, and less sensitive to disturbances, uncertainties and external shocks (e.g. natural disasters, economic crises, impacts of public policies, societal impacts, political shifts, etc.)? What are the main tools for planning and protecting public land and enhancing public participation in the suburbs, and/or for the containment of urban sprawl? In that respect, there has been a need for major readjustments of the current planning policy regarding the control of urban sprawl, from an urban "command-and-control" approach to the "learn-and-adapt" approach, including pertinent institutional, procedural and substantive aspects. The institutions play an important role in reducing current uncertainties. This requires the adaptation of the traditional urban policies and urban land policy and tools for limiting urban sprawl, better urban governance, as well as the new tools.

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Literature review with theoretical and contextual background

The literature on urban planning transformations in transitional countries indicates the dominant trend of suburbanization or urban sprawl based on different frameworks – policy research, theories of urban development (Novák and Sýkora, 2007; Tsenkova, 2012; Dovenyi and Kovacs, 2006; Slaev and Nikiforov, 2013; Hirt, 2007), legal theory, theory of polyrational land policy (Davy, 2012 and 2014), property theories (Hann, 2007). Bertaud and Renaud (1997) indicate that the suppressed urban land market started to “bloom” after 1989, as the new housing preferences and consumption developed and the market for urban development land emerged. Limiting urban sprawl (or “urban growth machine”) is not a part of the integrative planning practices, but a part of realistic approach based on national and other strategic policies, market trends, governance, smart regulations, programs, etc. Stumpp (2013) points out that resilience has displaced sustainability, and that planning has adopted this concept with its uncertainty and discontinuity, especially in the urban context. Bosselman (1968) has indicated an alternative to urban sprawl – the legal guidelines for government activities. He suggested that the urban sprawl can be stopped by planning and developing large parts of land, such as the following alternatives: a) planned-development zoning, b) compensative regulations, and c) public land assembly, with a legal analysis of these techniques. Land consumption for housing, economic growth, employment, population growth and transportation create serious pressures in urban areas (Nuisl *et al.*, 2009). Different policies and instruments try to prevent excessive land consumption and impact assessment of land-use changes in urban areas, as well as different types of spatial governance—strong, soft, weak, or multi-level, multi-sectoral, multifunctional “integrated governance for peri-urban territorial cohesion” (Ravetz and Loibl, 2011). Needham and Verhage (2003) argued that different (political/ideological) approaches regarding that who should receive the financial benefits lead to different policies, to different instruments of land policy, and to different distributions of that surplus. Assessment of the effects of possible instruments requires a financial analysis of the urban development. Blair and Wellman (2011) questioned the role of the public policies by Growth Network (a coalition of more than 40 national and local organizations working to minimize low-density, auto-dependent development), for promoting a policy agenda, providing guidelines and tools for cities to better control or limit urban sprawl. The authors put a typology for the overall implementation approaches in terms of managing sprawl: 1) *Traditional approaches to growth management* focus on compulsory, regulatory policy tools, like planning and zoning, by focusing their strategies on top-down approaches. 2) *A government-centered approach* emphasizes traditional compulsory government strategies and tools, and 3) *a market-based approach*, more mixed, voluntary, policy tools like private market and voluntary organizations. If development resources are directed to the periphery, the result can be a disinvestment in core cities. City government policy-makers and administrators need to find ways to manage urban sprawl, especially because the city cannot depend on zoning and coercion to control

urban sprawl. Limiting of urban sprawl depends on policy tools and strategies of implementation from *voluntary* and *mixed* level tools to (*legal*) *compulsory* tools. Knaap (1998) concludes that land markets are imperfect and subject to government interventions. Land values and land-use are determined by the interaction of supply and demand (Harvey and Jowsey, 2004). Needham (2000) stated that land policy can be used to support land-use planning, and that land-use planning can restrict the land supply on some locations and for some uses. Bolay *et al.* (2005) indicated that the contextual resources of an urban environment in a developing country can appeal for incoherent distribution of resources and responsibilities.

METHODOLOGICAL APPROACH

Currently, Serbia's economic and urban development is a reflection of the previous development policy and transition recession, a consequence of the global economic and financial crisis and other factors. We applied a *contextually appropriate approach*, which includes the comprehensive and integrated analysis of the national urban policy, metropolitan governance and the urban land policy, and their importance for limiting urban sprawl. This approach focuses on the syncretic forms of the urban land policies and tools, and combines some components of urban development theories, the theory of polyrational land policy, property theories, the current discourse analysis, comparative (critical) law analysis, the methods for evaluating urban land tools, as well as a brief analysis of the urban land issues on the available data or indicators of land-use changes and the urban sprawl (in the BMA).

Current urban land policy and land-use efficiency in the BMA

The case of Serbia's incomplete reforms illustrates the challenges of land policy development in a post-socialist societal transition, especially in the conversion of the urban land-use rights into land ownership by the Law on Planning and Construction (LPC), which is not *sui generis* for land regulation² (Nedovic-Budic *et al.*, 2012; Živanović Miljković and Popović, 2014a). The urban land policy includes the introduction of regulatory mechanisms, restructured institutions, new ways of financing land development, and market-based instruments of land policy. The review of the Master urban plan of Belgrade 2021 (MUP, 2003), vis-à-vis respective roles regarding the efficiency of urban land policy, indicates that the provisions were more precisely formulated in the latter MUP amendments of 2006 and 2009. Some MUP goals are contradictory, e.g. the urban renewal was strongly stipulated, as well as increase of 50% of planned urban built land. The MUP has not identified suburbanisation and sprawl as important issues and has not explicitly stipulated any respective measures.

In the BMA urban land occupies 40% of the administrative territory, with more than 50% state-owned urban land (Zeković, 2008). Territory covered by the MUP is 77,600 ha, 84% of which is state-owned urban buildable land.

² In previous period LPC also stipulated some important land policy issues, such as land privatization or land restitution (cf. Živanović Miljković and Popović, 2014b).

Urban sprawl is not mentioned in Serbian legislation, but a number of national and local legal acts define the utilization of agricultural and forest land and their conversion into urban land. After 1990, three laws have been passed on the legalization of massive illegal construction, but all of them failed to regulate the sprawl. The LPC defines the legal basis for ownership transformation - underlying the principle that privatization of the urban land should be based on its market value. However, no regulatory rules, institutions and instruments for conducting the urban land policies have been defined either for the compensation or for the assessment of the market value of land and related assets. Pertinent legal acts stipulated the forms of conversion of agricultural land to other purposes allowed, followed by appropriate provisions on the market value of arable land. In the BMA from 1993 to 2010 some 53,700 ha of agricultural land was lost, mostly for urban/construction land due to: a) massive illegal construction; b) construction of technical infrastructure; and c) conversion of former agricultural land to other uses, during the privatization of state-owned agricultural estates. The MUP of Belgrade addressed the issue of accelerating suburban development, mostly by occupying land for housing in the periphery. For the period 2001-2021, a further decrease of agricultural land is predicted (from its share of 51% to 28%). All data sources indicate a dramatic decrease of the size of agricultural lands. In 1990s, the key driving force was accommodation a large number of immigrants who came from Croatia, Bosnia & Herzegovina and Kosovo & Metohija. In 2009, in Belgrade City, informal settlements represented the key form of urban sprawl, covering 22% of the construction land, and taking up some 40% of the residential areas. The MUP of Belgrade recorded that the majority of informal residents lived in compact informal housing, scattered in 34 city zones, 18 low-density informal settlements, and in urban slums. In Serbia, the process of “real-estate bubble growth” manifested itself via an additional increase in illegal construction, now totalling some 1.4 million illegal buildings (or 30% of their total number). In the BMA, some 0.2 million of illegal buildings were recorded, causing pressure on the uncontrolled urban sprawl. Urban sprawl/suburbanization is one of the most dominant processes of land-use changes in the BMA, with strong spatial and environmental impacts. Belgrade’s urban land market is undeveloped, because of the inefficient regulatory mechanisms and institutions, the lack of more up-to-date ways of financing urban land development which has not been established yet, and current predominantly administrative approach. The aforementioned have all brought negative consequences regarding zoning regulations and other tools of urban land policy (development fee, land-use fee, utilities taxes, and urban growth boundaries) which have proved to be vulnerable and useless in limiting urban sprawl. The urban land regulation in the BMA, demonstrating a traditional administrative approach, was a key reason for massive illegal building and sprawl. A misbalance in market supply and demand for undeveloped urban land in Belgrade, as well as too high or low values of floor space index, indicate the type of regulatory framework and governance which supports much more an administrative than a market approach. This imposes a question: how to adapt current traditional urban

land tools to managed sprawl and the urban resilience? (To note, in 2014 Belgrade was selected to join 100 Resilient Cities Challenge by the Rockefeller Foundation; see: 100 resilient cities).

Some of the indicators for measuring sustainability in land-use and urban sprawl in the BMA are shown in Table 1. Urban density has rapidly decreased. Urban land consumption of 670 m² per person in the BMA shows an extremely high value as the indication of an excessively intensive urban sprawl – more than in all other European cities (Bertaud, 2012). The BMA is the “leader” in inefficient urban land-use and urban sprawl. The U-Index indicates the level of disturbance of natural land area. The conversion of agricultural land in urban land-use is evident in the BMA. The urban sprawl index in the BMA is 0.378>0. The index shows greater growth of the build-up area than population growth, while the density of the metropolitan area has decreased.

Table 1. Indicators of sustainability of urban land-use and urban sprawl in the BMA

Indicators	1991	2011
1. Urban density (people per ha of urban area)	42.9	14.9
2. Urban land consumption p.c. (m ²)	233.0	670.47
3. U-Index (Human Use Index) ³ as % of human land-use	-	68.78
4. Residential floor space m ² /p.c.	18.9	28.0
5. Agriculture land p.c. (m2)	1.431	821-1.271
6. Urban sprawl (change in urban area vs. change in population index 2011/1990)	-	0.378

Source: Zeković et al., 2015

The stipulation of the LPC of 2009 may have even worsened the situation by introducing the stipulations that provide conversion of leaseholds on urban (construction) land into property right – without applying actual market prices to the urban land (which was kept by the privatized companies). In Serbia, there is a lack of transparency and stability on the real estate market and urban land market, as well as a lack of established approaches, criteria and methods for the evaluation of properties in accordance with reliable market and planning data on property values. These types of evaluation are important for urban and territorial planning, limiting urban sprawl, urban land taxation and land-financed tools, especially for privatization of former state-owned land or conversion of urban land-use rights to urban land ownership. Municipalities use different local databases and secondary data. According to Božić and Mihajlović (2014) real estate appraisal systems are organized in different ways in Europe, viz. the legal framework; appraisal methods, etc.

RESULTS AND DISCUSSION

A comprehensive analysis of the urban policy and urban land policy has shown that it is necessary to introduce:

³The U-Index is a measure of the total area that is covered by urban or agricultural lands, or the % of human land-use in an area, including agriculture, urban and suburban development. The larger values indicate main disturbances of natural land area.

1) a clear national urban policy, 2) an improved metropolitan policy and urban governance and 3) a reformed urban land policy and tools against urban sprawl.

Support to national urban policy

UN-Habitat strongly supports improvement of national urban policy in Serbia, as well as planning and development of adequate policy and institutional framework for its faster integration into the EU. Sietchiping (2014) has analyzed the International Guidelines on Urban and Territorial Planning (IG-UTP), the UN-Habitat Urban Planning and Design Strategy 2014-2019 (which included urban sprawl vs. compactness), and National Urban Policies (in Europe – only in Kosovo and Serbia). UN-Habitat supports and guides the IG-UTP drafting process, together with: national governments, local authorities, development partners (e.g. World Bank, OECD), research, academia, civil society organizations, etc. The key principles (12) of the Draft of IG-UTP (2014) are divided into four groups: A) Urban policy and governance, B) Urban and territorial planning for sustainable development, C) Urban and territorial components, and D) Implementation of urban and territorial planning. The IG-UTP intend to constitute a global framework for improving policies, plans and designs for more compact, socially inclusive, better integrated and connected cities and territories that support sustainable urban development and urban resilience under impacts of climate changes. The IG-UTP would complement two sets of guidelines of UN-Habitat: the *Guidelines on Decentralization* (2007) and the *Guidelines on Access to Basic Services for All* (2009), which had been used in the countries to catalyze policy and institutional reforms.

The UN-HABITAT's activities in Serbia are focused on the following priorities: 1) Promoting shelter for all; 2) Improving urban governance; 3) Reducing urban poverty; 4) Improving the living environment; 5) Managing disaster mitigation and post-conflict rehabilitation. UN-Habitat activities in Serbia have managed to formulate global policy options and guidelines, especially in the *Global Campaigns for Secure Tenure and Good Urban Governance*.

The improvement of metropolitan policy and urban governance in Serbia

The Leipzig Charter on Sustainable European Cities (2007) shows that the European plan to strengthen citizen participation in the urban design should support the integrated urban development strategy as tool for improved city management, based on the principles of competitiveness, social and territorial cohesion. The Strategy for the development of the European cities should be based on strengthening the policy of integrated urban development in line with the Lisbon Strategy (*Europe 2020*), the *EU Sustainable Development Strategy and the European Employment Strategy*, and a greater focus on the deprived city areas and a greater use of the integrated urban development approach. Nonetheless, these set of European strategies lose their substance and vigour when they are spatially translated to these qualitatively different causing them to derive and grow informally through the ill-decoded application of western patterns (Bolay and Pedrazzini, 2004).

During the period 2011-2014, AMBERO-ICON, GIZ, and the Serbian Ministry of Construction, Traffic and Infrastructure realized the German-Serbian cooperation project *Strengthening of Local Land Management in Serbia*. Project activities are distributed in three modules - *Integrated and Sustainable Urban Development*, *Construction Land Management and GIS in Local Land Management*. The project results focused on integrated and sustainable urban development, and development of new instruments for a sustainable, socially balanced, market-oriented and efficient urban management, which are being tested in 13 pilot-municipalities. In these municipalities, new participation approach and methods are being tested in line with in/formal urban planning. Results have been included in the *Guide for Participation in Urban Development Planning* (Čolić et al., 2013). Those experiences on the local level (i.e. the principle of early stakeholder involvement in making plans), are moved into the LPC (2014).

As a part of the module *Sustainable and Integrated Urban Development* three concepts of *Integrated Urban Development Strategy* were realized on the examples of cities- Kragujevac, Užice and Kraljevo. In the module *Construction Land Management*, a part entitled *Construction Land Development and Real Estate Valuation* was realized with the three pilot-projects of real estate evaluation (Zrenjanin, Subotica, Valjevo), as well as the three projects of *Land Reallocation* (Despotovac - new instruments for the Detailed Regulation Plan for a new residential area, in Užice -Development of a new business zone, and in Kraljevo - Integrated Urban Development Strategy for the Inner-city).

Reformed urban land policy and tools against urban sprawl

Traditional planning tools

Traditional planning tools and tools of urban land control (zoning/land regulations, urban growth boundaries, infrastructure investments, green belts, and the urban land policy with price mechanisms - development fees, property taxes, land tenure, expropriation, acquisition) will be shortly described, followed by some recommendations for limiting suburbanization, as follows: 1. *Zoning regulations* - A number of by-laws followed LPC, including a specific *Ordinance on Common Rules for Land Parcelation, Regulation and Construction* (2011), as well as regulation of the maximum construction index and occupancy rate for nine predominant types of land-use. Zoning is an essential act of city planning. It helps to determine the function of a property in specific locations in order to provide the most well-planned city. A property may be zoned for commercial or industrial use, or for residential use. Sometimes properties like "live/work" spaces contain multiple zones, some for residential and some for commercial use. When a city government or a property owner wishes to change the terms of property use, they may need to go through the process of rezoning physical property, which may be simple or complex depending upon the city demands and requirements. Zoning and other land-use regulations, especially when adopted at the local level, tend to result in lower overall urban densities and encourage urban sprawl. Pogodzinski and Sass (1991) indicated that the effects of

zoning depend on several factors, including: a) *what* local governments control through zoning; b) *how* strictly zoning regulations are enforced; c) *who* controls the zoning process, and d) the metropolitan context in which zoning takes place. The elements of zoning ordinances and subdivision regulations can be classified into three types: a) regulations that are regional or spatial in orientation; b) regulations that are process-oriented or transportation-oriented and c) regulations that shape the individual development sites. Regulations strongly prescribe the allowed and forbidden positions, and their rationale is the so-called 'command-and-control' approach. Many countries have different regulations on land-use, and usually the public sector intervenes more in the construction of urban areas. In some countries, the government retains a discretionary power (i.e. in Serbia, recently adopted *lex specialis* for the project 'Belgrade Waterfront'), while in the European countries government power is limited by constitution and laws.

2. *Urban growth boundaries*. 3. *Infrastructure investments* - As cities grow, the pressure to improve services and provide essential infrastructure can be enormous. Because land cannot be moved, it can be a unique foundation for local revenue. Land-based financing should cover land valuation, land and property taxation and other means of creating revenue through land and over land. Very important is the redistribution of the costs of public infrastructure among all stakeholders (within various approaches of planning-cum-market/market-cum-planning, predominantly non-administrative, etc.). 4. *Green belts* - The green belt is a fundamental tool of anti-sprawl growth policy (Pond, 2009). Sometimes, the leapfrogging phenomenon can emerge as development jumps in the green belt boundaries in search for cheap land available for rezoning (Bimbaum, 2004). 5. *Urban land policy with price mechanism* - key tools include development fees, property taxes, etc. Land development fee is local public revenue managed for financing infrastructure development in the BMA, according to the Program on the building land.⁴

There are some important conclusions by UN-Habitat⁵ related to the land-based financing: urban development should be financed through capturing the increases in land value resulting from public investment or broad urban trends, tools and policies which should be implemented on local conditions; land valuation methods should be implemented within the local administrative capacities as well. In addition to property tax, which may include the market price of building land, the most important fiscal tool is a *land value tax* on the increased value of building land/property as an *ad valorem tax*. Taxes/fees on the

increased value of urban land should capture its extra value because the investments of the public sector. The land rent corresponds to an annual discount rate.

More innovative and flexible urban land policy tools

Besides the traditional planning tools, there is a need for alternative, adoptive or complimentary approaches to current 'command-and control' regulation. Common law, public and private agreements, and market-based tools as contemporary regulations provide development of the hybrid 'smart regulation' approach. The advantages of 'smart regulation' reflect on the changing urban sprawl and planning. We suggest the introduction of more innovative and flexible urban land policy tools that would support the new role of planning in creating a more resilient city, viz.: 1) *Urban rezoning* (as adaptation, recruitment or deconstruction of densities and zone rules). Rezoning is the term used for any change zoning by-laws and zoning urban plans. During the 21st century, the concept of mixed urban land-use became quite popular. Many cities embarked on rezoning campaigns, labelling the resulting areas as "mixed use". *Rezoning* is the act of changing the terms of property use for a part of land. When a property owner wants to use land in a way that is not permitted by the zoning of his/her property, the owner must request to rezone the property to a classification which permits the desired use. *Rezoning* is a legislative action which is considered through a complex process. Rezoning may occur in three ways: a) To change the current zoning of a site or to accommodate other uses or forms of development, b) To change the current zoning of a site from one standard zoning area to another, and c) To change the text of the by-law on zoning and development. 2) *Tradable development rights, trading density for benefits - density bonus policy*. Cities have used the density bonus as a policy when rezoning has been applied as a tool to capture the increased land value created by the rezoning (Moore, 2012; Baxamusa, 2008). The liberal policy instrument is Purchase of Development Rights (PDR) or Transfer of Development Rights (TDR) programmes. The former is similar to the conservation easements which are an established regulatory tool, while the latter bears some resemblance to the density bonusing provisions. The PDR and TDR tools are voluntary and require direct funding. 3) *Infrastructure finance* (capital infrastructure, utilities)- what is important is the influence of infrastructure finance on urban form and the influence of urban form on infrastructure costs. 4) *Regulatory arrangements of the Public-Private-Partnerships (PPP) for the capture of the increased urban land values*. PPP includes different types of legal acts/tools - community development agreements (e.g. the program of urban re/development), community benefits agreements, planning agreements, negotiation, covenants, and easements - as types of servitudes. *Covenants* are tools for the management of urban growth, as well as land-use changes which include environmental protection. An *easement* is a non-possessory right to use the real property of another for a specific purpose without possessing it. The use of covenants and transferable/tradable development rights is a part of land-use management. Regulatory mechanisms provide the indirect capture of increased urban land value, usually through synergy of PPP, the urban

⁴ Level of the land development fee in the BMA is: for housing from 8.6 EUR/m² (VIII zone) to 358.48 EUR/m² of floor space (in I extra zone); for commercial assignment: from 13.37 EUR/m² (in VIII zone) to 576.65 EUR/m² of floor space (in I extra zone); for industry: from 11.04 EUR/m² (in VIII zone) to 411.89 EUR/m² of floor space (in I zone). All prices are calculated in accordance with the data from 2014. The fee levels are regulated by ordinance (I-VIII zones) in Belgrade City. Fee is determined in accord with the following criteria - the degree of infrastructural equipment, the programme of construction land, urban zones (there are eight zones in BMA), and kinds of land-use and building surface.

⁵ Research for the Reduction of Land Consumption and for Sustainable Land Management, <http://www.refina-info.de/termine/termin.php?id=2239>, accessed 10th Mar 2015.

propositions and planning arrangements. In recent years, *social impact bonds* have often been applied, which means that an investor who builds on an exclusive location has to finance the construction of social services, social housing at a given location, without the financial participation of the local community. This instrument is different from the so-called “bonus” urban zoning, which implies that the investor may obtain a permit for a higher additional floor space index than allowed, parallel with the requirement to invest in the social services. 5) *Implosive and inclusive zoning* is one of complement tools, especially in the revitalization of brown-fields. In some countries, the protection of human rights and social inclusion in the urban renewal involves inclusive zoning, i.e. rights of the “caught up” land owners/users. The investors on attractive locations have an obligation to build housing for the “domicile” citizens (e.g. the poor). 6) *Land tenure*, as a form of participation of the private land owner in strategic projects (e.g. infrastructure) that provide income to the owner (Mittal, 2014). The introduction of development land in the periphery is tool for the conversion of agricultural land for urban uses.

In accordance with the rule of law, how can new instruments contribute to a more efficient planning? *Global Land Tools Network (GLTN) work programme* offers the land tools as a practical way of solving a problem in land administration and management for the next 10 years. Land tools are also a way of enforcing principles, policies and legislation for limiting urban sprawl. It includes many approaches and methods: legal means, a set of software, the accompanying protocols, guidelines, etc. Land tools may be complementary or may offer alternative ways of work. According to GLTN (UN-Habitat, 2013), the land tools should be affordable, equitable, subsidiarable, sustainable, systematic and large scale. Governance as a process of tool development should provide access to land and the use of land, the implementation of decisions, and reconciliation of conflict interests in urban land affairs. According to UN-Habitat, urban governance provides a lot of ways how institutions can organize the daily management of a city, by realizing the short-term and strategic decisions of urban development. According to GLTN development of 18 land tools is divided into five themes, and cross cutting issues: 1) Access to land and tenure security (i.e. tenure security, the land rights, contracts; socially appropriate legal adjudication, by statutory and customary ways, land management approach); 2) Land administration and information (spatial units, the land agencies budget approach); 3) Land-based financing (land tax for financial and land management); 4) Land management and planning (urban and spatial planning, regional land-use planning, land readjustment); 5) Land policy and legislation (regulatory framework, legal allocation of the assets; expropriation, eviction and compensation); and cross cutting (capacity development, conflict/ disaster, environment, land governance). Urban land governance requires clear legal frameworks, efficient political, managerial and administrative processes, as well as guidelines and tools for limiting urban sprawl. This is a process of decision-making with a lot of stakeholders who have different priorities in land-use or development. Hartmann and Needham (2012) find that planning approaches are rooted in the activities of making,

implementation and enforcing for property rights over land and buildings, i.e. ‘planning by law and property rights’ as unavoidable in a society with the rule of law.

CONCLUSIONS

Urban land policy still does not represent a part of the complex post-socialist mosaic of transition reforms. In Serbia, there has been a prolonged delay in the adoption of effective reforms in land management, which has not radically changed over the post-socialist period (Nedovic-Budic *et al.*, 2012). The current Serbian land management framework does not reflect the requisite political changes, the need for market regulation, and the enormous increase in urban land prices. According to the UN-Habitat, good land management is vital for improving urban planning. In cities where urban sprawl is becoming difficult, local authorities should reconsider building regulations and zoning laws and promote more compact cities. Urban authorities should be empowered to adopt and implement better laws and regulation, as well as more innovative and more flexible planning and urban land tools. According to UN-Habitat (2013) Belgrade is “able to fully integration into the European economies (as MEGA-4) and has good future prospects...and have to modernize governance, openness and transparency in decision-making and improved participation.” Multi-level participation and coordination of institutional governance should include the effective implementation of urban policies and tools.

Based on the results of a contextually appropriate approach, a comprehensive and comparative analysis of the urban land policy and tools for limiting urban sprawl in Serbian cities, we suggest application of the following guidelines: 1) *Guidelines on UTP* by the UN-Habitat; 2) *Guide for the participation in urban development planning* in Serbia; 3) *Guidelines on access to basic services for all*; and 4) planned guidelines for urban governance in Serbia (UN-Habitat), as well as creation of guidelines for urban land tools in accordance with GLTN. We emphasize that some factors have a decisive role in establishing policies and tools for the containment of urban sprawl, mainly: the ‘power-game-and-balance’ among the key stakeholders, as well as the political will of the responsible national authorities in formulating urban policies and tools in the specific constellation of power.

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REFERENCES

- 100 resilient cities, http://www.100resilientcities.org/blog/#/_Yz45NTk1MidpPTEocz5j/, accessed 9th Apr 2015.
- Baxamusa, M. (2008) Empowering Communities Through Deliberation: Community Development Agreement, *Journal of Planning Education and Research*, 27, pp. 261-276.

- Bertaud, A. (2012) Government intervention and urban land markets: the case of China. *Journal of Architectural and Planning Research*, 29(4), pp. 335-346.
- Bertaud, A., Renaud, B. (1997) Socialist cities without land markets. *Journal of Urban Economics*, 41(1), pp. 137-151.
- Birnbaum, L. (2004) *Simcoe County: the new growth frontier*. Toronto: Neptis Foundation.
- Blair, R., Wellman, G. (2011) Smart growth principles and the management of urban sprawl, *Community Development*, 42(4), pp. 494-510.
- Bolay, J.C., Pedrazzini, Y. (2004) *Social practices and spatial changes*, Switzerland: IP5/JACS.ACC.
- Bolay, J.C., Pedrazzini, Y., Rabinovich, A., Catemazzi, A., Garsia Pleyan, C. (2005) Urban Environment, Spatial Fragmentation and Social Segregation in Latin America: Where does Innovation Lie? *Habitat International*, 29(4), pp. 627-645.
- Bosselman, F. (1968) *Alternatives to urban sprawl: legal guidelines for governmental action*. U.S. Government Print Off.
- Božić, B., Mihajlović, R. (2014) *Analysis of existing condition and developmental needs for official real estate appraisal infrastructure in the Serbia*. Belgrade: GIZ, AMBERO-ICON.
- Čolić, R., Mojović, Đ., Petković, M., Čolić, N. (2013) *Guide for participation in urban development planning*, Belgrade: GIZ, GmbH/AMBERO Consulting-ICON Institute.
- Davy, B. (2012) *Land policy, Planning and the Spatial Consequences of Property*. Farnham, Surrey & Burlington, Vermont: Ashgate.
- Davy, B. (2014) Poly-rational property: rules for the many uses of land, *International journal of the commons*, 8(2), pp. 472-492.
- Dovenyi, Z., Kovacs, Z. (2006) Budapest-The Post-socialist Metropolitan Periphery between 'Catching up' and Development Path, *European Spatial Research and Policy*, 13(2), pp. 23-41.
- Global land tools network, <http://www.gltm.net/index.php/land-tools/introduction-to-land-tools>, accessed 10th Jan 2015.
- Hann, C. (2007) A new double movement? Anthropological perspectives on property in the age of neoliberalism, *Socio-Economic Review*, 5(2), pp. 287-318.
- Hartmann, T., Needham, B. (eds.) (2012) *Planning by law and property rights reconsidered*. Farnham: Ashgate.
- Harvey, J., Jowsey, E. (2004) *Urban Land Economics*. 6th ed, Palgrave Macmillan: Basingstoke.
- Hirt, S. (2007) Suburbanizing Sofia: characteristics of post-socialist peri-urban change. *Urban Geography*, 28(8), pp. 755-780.
- Knaap, G. (1998) The Determinants of Residential Property Values: Implications for Metropolitan Planning, *Journal of Planning Literature*, 12(3), pp. 267-282.
- Mittal, J. (2014) Self-financing land and urban development via land readjustment and value capture, *Habitat International*, 44, pp. 314-323.
- Moore, A. (2012) Trading Density for Benefits: Toronto and Vancouver, Institute of Municipal Finance and Governance, Munk Centre, University of Toronto.
- Nedovic-Budic, Z., Zekovic, S., Vujosevic, M. (2012) Land Privatization and Management in Serbia – Policy in Limbo, *Journal of Architecture and Planning Research*, 29(4), pp. 306-317.
- Needham, B. (2000) Land taxation, development charges, and the effects on land-use, *Journal of Property Research*, 17(3), pp. 241-257.
- Needham, B., Verhage, R. (2003) *The politics of land policy: using development gains for public purposes*, University of Nijmegen, The Netherlands.
- Novák, J., Sýkora, L. (2007) A city in motion: time-space activity and mobility patterns of suburban inhabitants and the structuration of the spatial organization of the Prague metropolitan area. *Geografiska Annaler: Series B, Human Geography*, 89(2), pp. 147-168.
- Nuissl, H., Haase, D., Lanzendorf, M., Wittlmer, H. (2009) Environmental impact assessment of urban land-use transitions - A context-sensitive approach, *Land use policy*, 26(2), pp. 414-424.
- Pogodzinski, J.M., Sass, T.R. (1991) Measuring the effects of municipal zoning regulation: A Survey, *Urban Studies*, 28, pp. 597-621.
- Pond, D. (2009) Institutions, political economy and land-use policy: greenbelt politics in Ontario, *Environmental Politics*, 18(2), pp. 238-256.
- Ravetz, J., Loibl, W. (2011) The dynamics of the peri-urban: global change and regional response. In A. Piore, I. Tosics & J. Ravetz (Eds.), *Peri-urbanization in Europe*. Towards European Policies to Sustain Urban-Rural Futures. Syntesis Report. Copenhagen: PLUREL.
- REFINA, Research for the Reduction of Land Consumption and for Sustainable Land Management, <http://www.refina-info.de/termine/termin.php?id=2239>, accessed 10th Mar 2015.
- Sietchiping, R. (2014) Towards development of International Guidelines on Urban and Territorial Planning, First meeting of the UNECE Task Group on Urban Planning, UN-Habitat.
- Slaev, A., Nikiforov, I. (2013) Factors of urban sprawl in Bulgaria. *Spatium*, 29, pp. 22-29.
- Stumpp, E.M. (2013) From system to action: Towards a More Radical Conceptualisation of Urban Resilience for Planning Practise, AESOP, July 15th -19th, UCD Dublin.
- Tsenkova, S. (2012) Urban planning and informal cities in Southeast Europe, *Journal of Architecture and Planning Research*, 9(4), pp. 292-305.
- UN-Habitat, (2013) *The state of European cities in transition 2013. Taking stock after 20 years of reform*. Nairobi/Krakov: UN-Habitat & Institute of Urban Development.
- UN-HABITAT - <http://unhabitat.org/urban-themes/land>, accessed 1st Mar 2015.
- Zeković, S. (2008) Evaluation of the current urban land system in Serbia, *Spatium*, 17-18, pp. 55-60.
- Zeković, S., Vujošević, M., Maričić, T. (2015) Spatial regularization, planning instruments and urban land market in a post-socialist society: the case of Belgrade, *Habitat International*, 48, pp. 65-78.
- Živanović Miljković, J., Popović, V. (2014a) Urban land policy-theoretical and practical perspectives. In R. Efe et al. (eds.) *Cities in the Globalizing World and Turkey: A theoretical and empirical perspective*. Sofia: St. Kliment Ohridski University Press, pp. 432-444.
- Živanović Miljković, J., Popović, V. (2014b) Land use regulation and property rights regime over land in Serbia, *Spatium*, 32, pp. 22-27.

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URBAN MORPHOLOGY AS A TOOL FOR EXPLORING THE LAND USE IN RESIDENTIAL AREAS: EXAMPLE OF NEW BELGRADE

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The paper presents findings of research about the classification of New Belgrade's super-blocks using the typomorphology approach and the morphogenetic analysis of urban morphology in relation to land use. The example of New Belgrade is particularly interesting given the fact that the morphological patterns of land use within its super-blocks were created during the period of non-market economy in Socialism, and now it is possible to review the effect that the socio-political transition into Capitalism, which started in the 1990s, has had on its land use.

As a result, a data base with the typology of residential super-blocks of New Belgrade is created: from the perspective of urban land use there are four main morphological types (with the subtypes) taking into account the morphology of the position of the buildings on the terrain, and traffic (cars-pedestrian) flows. The morphogenetic analysis reveals that after the 1990s there are processes pointing to powerful influence of land policy driven by private interests. Research findings suggest that nowadays there are negative trends of using the land in super-blocks in New Belgrade - e.g. percentage of land occupancy by buildings is getting bigger and almost 100% of the un-built soil in the newly developed super-blocks is covered /paved.

Key words: urban morphology, urban land use, land policy, New Belgrade, Serbia.

INTRODUCTION

The subject matter studied in this paper is the morphological aspect of small-scale urban land use with New Belgrade residential super-blocks being the framework of the study. New Belgrade is the largest municipality of the City of Belgrade, the Capital of Serbia, which dominantly features the residential content of collective housing.

After a brief description of the theoretical debates regarding urban land, the paper will point out the position of urban morphology as an instrument for studying its use from the perspective of an architect/urban planner. This will be followed by a thorough explanation of residential super-block classification methodology as applied small-scale to the above described location of New Belgrade. The synthesis will include the morphogenetic overview of the findings from the perspective of historical development phases.

Residential super-block is defined as a "neighbourhood unit understood as a basic unit for which planning is undertaken" (Bogdanović, 1990), and the concept involved is that of a "city territory bordered with traffic facilities, with minimum

possible traffic within the unit itself, morphologically consisting of detached buildings with a diffuse layout" (Kostof, 1991).

THEORETICAL BASICS

Urban land use: practical and theoretical discourse

The practical discourse of urban land use involves a large number of activities with land parcelling and the management of land resources from the economic, social and environmental perspective, with direct consequences for urban morphology (Chapin, 1970; Vernez - Moudon, 2000; Gajić, 2004). From the perspective of practical discourse of urban land use and its implications for morphology, the contemporary topics also include: 1/underground construction; 2/high-rise buildings; 3/urban farms (urban agriculture) (Lovell, 2010).

The theoretical discourse of land use refers to the economic location theory (Alonso, 1964; Voigt, 2003; Walker, 2004) concluding that the outcome of socio-economic processes reflects, among other things, through structural and functional characteristics of land use. Within the conceptual approaches to urban planning, by understanding the role and criticism of land use, the following issues come up:

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zoning; activity patterns; use of IT systems, participation and impact on local planning; land use and sustainable development; integration of analytical support systems; integration of urban design and urban forms into planning processes with a holistic, integrative approach (Oliveira and Pinho, 2010; Berke *et al.*, 2006).

The recommendations and conclusions of the studies made by European professional teams for sustainable urban land use in the 2000s (Expert Group on the Urban Environment, 2001; Engelke and Vancutsem, 2010) indicate the importance of this topic: through the creation of goals and indicators, introduction of market mechanisms for control and implementation, integration with brownfield and transportation issues to the city networking with a goal to generate the databases of good practice.

The "Thematic Strategy on the Urban Environment" underlines the need for high-density and mixed-use urban patterns with the aim to avoid urban expansion as a way to reduce land exploitation and transport and heating requirements (Commission of the European Communities, 2006). However, Oslo conference about climate change and urban design organised in 2008 by the Council for European Urbanism, found that urban sprawl around the perimeter of the city had become invasive all over Europe. That makes significant studies of the land use in more dense, collective housing area.

Tools of urban morphology in analysing land use - from the perspective of an architect/urban planner

Almost every urban-morphological study addressed the use of land in the studied area to some extent, be it through the method of occupation, travel patterns and/or through ownership status (from the mid-20th century morphogenetic studies conducted by Conzen in the UK (Conzen/revisited, 2009), through typomorphology introduced by Caniggia in Italy (Cataldi *et al.*, 2002), to the Space Syntax group's contemporary studies about the links between physical and social city that are defined through travel patterns (Hillier and Stuty, 2005; Stonor, 2006; Vaughan, 2007). Rofe developed analyses for studying the theory of spatial foundations of urban neighbourhoods in which morphogenesis is used to define the relationship between the form and ownership patterns (Rofe, 1995). Typomorphology method developed by Gil and his team for a residential block in Lisbon primarily deals with the data on land use (Gil *et al.*, 2010) in the same way in which Salat and his team studied Toledo (Salat, 2010).

General opinion is that in urban morphology analysis, land is included as a constitutive element – and became a link between individual elements (parcels and houses) and a wider urban context (Đokić, 2007; Lloyd-Jones and Erickson, 2007; Whitehand and Larkham, 1992).

THE EXAMPLE OF NEW BELGRADE: DESCRIPTION OF LOCATION AND LAND POLICY

Description of the location of New Belgrade, Serbia

New Belgrade is the largest municipality of Belgrade, the Serbian Capital that reflects many aspects of the issue of urban land and land policy planning in the previously

socialist-oriented society, within the process of transition into capitalism.



Figure 1. Position of New Belgrade in the city of Belgrade (http://www.isocarp.net/data/case_studies/748.pdf)

As an urban structure, "planned on the principles of modern urbanism and the paradigm of "functional city" (Blagojević, 2014), New Belgrade was built in the period after the World War II on an area between the historically independent cities of Zemun and Belgrade, of approx. 4074 ha flood-prone and marchland undeveloped land at the confluence of rivers the Sava and the Danube (Figure 1). By the mid-1960s, the construction of New Belgrade was fully fledged and that was the time it acquired its contemporary shape (Blagojević, 2004; 2007).

Today New Belgrade is a well-developed municipality of Belgrade, with the population of about 236 thousand, with a considerable potential for development which is at this time considered only in economic sphere – through increased prices of real estate and land and large investments in the construction of primarily business, residential-business, and commercial facilities (NBG, 2008; Politika, daily news, 2008). Up till now, the plans for this location have largely followed and supported the economic growth. Expert research in other areas relevant for sustainable development of this part of the city (analyses and studies of economic growth implications and relations with the environmental, social, and morphological spheres) is still poorly represented in planning activities.

New Belgrade – morphological characteristics of the urban structure of the total area

According to the size, regularity and compactness of the main network/block structures, three different units may be distinguished in the global context: 1 - "central zone of regular blocks", mostly square-shaped (400x400m and 400x550m), 2 - "the Danube shore with elongated blocks" (210x350m to 350x600m), and 3 - "the Sava shore with mega blocks" (rectangular: 800x800m, 700x800m and elongated ones: 550x700m, 360x800m) (Gajić and Dimitrijević-Marković, 2006), (see Figure 2).

Genesis of the developments in Serbian/Yugoslav land policy (from 1948 onwards)

The attitude towards land policy in ex-Yugoslavia has continuously evolved in the period after the WW II. National experts in this field demonstrate that urban land legislation became autonomous in relation to urban planning legislation: "... they have changed places – higher determinants and instruments arising from the land-laws were used for urban planning..." (Krstić and Pajović, 1987).



Figure 2. New Belgrade, 2013
(Source: Google-Earth)

Land policy in the period of the **1940s and 1950s** in Yugoslavia focused on the issues related to the nationalisation of urban land (1958), and in the **1960s** the focus shifted to the legislation to strategically pave the way to the establishment of common - public ownership of land (1965, 1968.). The land policy of Yugoslavia in the **1970s** saw no major developments with regard to urban land. As for the land policy in the **1980s**: “preparing the land for construction becomes an important activity of the communal economy... whilst the construction of the cities is being increasingly more shaped by the partial interests”. (Krstić and Pajović, 1987).

According to urban sociologist Sreten Vujovic, the change of social-political system, with the aggravating circumstances resulting from the disintegration of the country and the wars in the territory of former Yugoslavia in the **1990s**, introduced the country into a slow transition process (Vujović, 1996). Throughout this period, urban planning legislation attempted to establish the rules of management and control in the newly-created conditions, but its implementation was predictably slowed down. Local experts warned that “...the drive to have power and dominate the space became the essential ambition in the cities of Serbia.” (Stojkov, 1997).

The land policy related legislation established the *Law on Expropriation* (1995) and the *Law on Land Survey and Catastre and Entering of Rights on Real Estate* (1992); the legislator made the development of land parcelling plans become a legal requirement (*Regulation on common rules for zoning and subdivision*, 1998). The ownership of land was the critical issue in this period, and the need to render the return of nationalised property through the restitution, was constantly present. Today (2014) currently applicable *Law on Planning and Construction* (2009), defines the urban land in all forms of ownership and primarily addresses the issues of financing the development, selling and leasing the public land, and the obligation to have the right to use converted right into the ownership right.

It may therefore be concluded that the turning point towards the individual – partial interest emerged in the **1980s** within the idea of non-market economy of socialist self-management was finally implemented in the market economy concept in Serbia in the **2000s**.

MORPHOLOGICAL ANALYSIS OF LAND USE IN RESIDENTIAL SUPER-BLOCKS IN NEW BELGRADE

Methodology

Whitehand identified three important areas within which modern morphogenetic research is conducted: 1) Micromorphology (analyses at the level of a single parcel); 2) The relations between morphological periods and different typologies (synthesis of morphogenetic and typomorphology approaches); and 3) Connections between decision-making and urban forms (perceiving morphological characteristics from the perspective of different needs/interests of those involved) (Whitehand, 2001).

The method applied in this paper leans on the second above mentioned area – a synthesis of morphogenetic and typomorphological approaches (see Table 1) in the following way:

Stage 1 - *Typomorphology: Identification of the morphological types of land use* (follow the classification against **direct - visible** effects of spatial use, concerning relations between land/2D, buildings/3D and flows on the terrain/4D).

Stage 2 - *Morphogenetic analysis* (identification of common characteristics of, in the previous stage identified morphological types of land use, through a prism of genesis of space – through the analysis of the morphological consequences of land policy ‘dictate’ and the ‘dictate’ of, in the time actual, urban trend). Results are the identification of: 1-common characteristics of specific types; 2-development phases (with a chronological differentiation of what type belongs to what phase) and the 3-perspective of how they are connected in the space.

Table 1. Header of the table with data required for urban-morphology analysis

Super block/No.	Surface (ha)	Spatial Picture/global morphology structure 3D	Buildings/No. of storeys	Flows pedestrians cars /4D	Relations buildings pedestrians cars /2D:3D	Uses (primary school + dominant non-residential)	Density of uses (inhabitants per ha)	% occupancy	% water permeability
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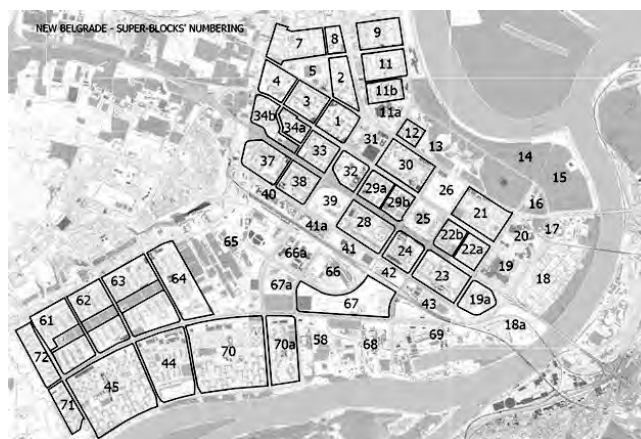


Figure 3. Official numeration of super-blocks in New Belgrade (residential super-blocks are bordered)

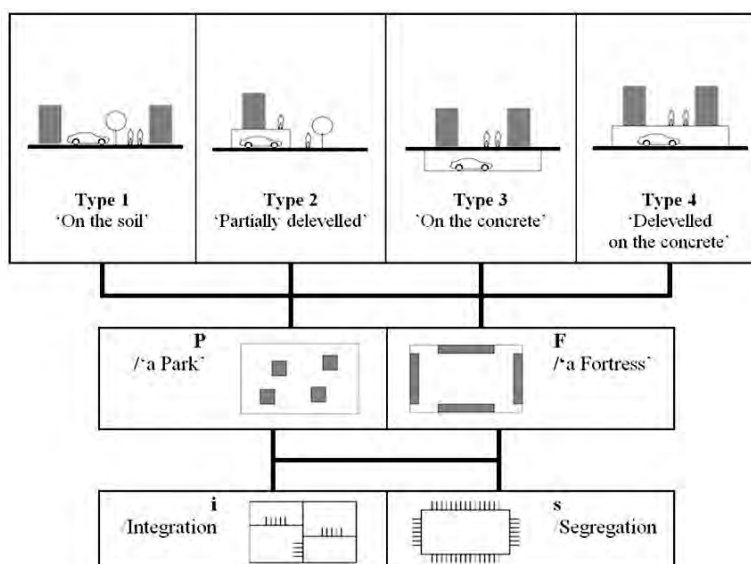


Figure 4 The matrix for identification of the typology of land use in the residential superblocks of New Belgrade

Typomorphology of New Belgrade

For the *typomorphological approach* to land use, the main criteria were adopted for classification against **direct - clearly visible** effects of spatial use (see Figure 3 and Figure 4):

- 1 - the relation between type of pavement/land cover and the buildings (2D:3D),
- 2 - spatial picture defined by the facilities/buildings on the terrain (3D presentation of the super-block),
- 3 - flows – pedestrians: cars – travel across the terrain (4D pedestrian and vehicular flows).

Based on the criteria of pavement type and the space use by levels (2D:3D), it is possible to create a matrix with four main types (see Figure 4): TYPE 1 'on the soil', TYPE 2 'partially delevelled', TYPE 3 'on the concrete', and TYPE 4 'delevelled,

on the concrete'. Each of the four main types may have different varieties taking into account two more criteria: 1/ the criterion of morphological structure made by buildings in super-block (3D/are they freestanding according to the peripheral streets so a view from them gives an impression of 'a park', or are they parallel with the peripheral streets so that a view from them on the super-block gives an impression of 'a fortress'); 2/the criterion of pedestrian/vehicle flows (4D/are they segregation/vehicular traffic is restricted to the peripheral streets/or integration/vehicles travel across the inside of the super-block/) (see Figure 4).

Findings of typomorphological analyses

When typological matrix was used to study the residential super blocks of New Belgrade, the following types were noted:



Figure 5. Overview of Type 1 - "On the soil"; dominant subtype: Park integration/Super-block 1 (Source: Google Earth)

Factography for TYPE 1 - "On the soil":

- Presence: 65% out of the total (24 out of 37).
- The subtypes 'Park' and 'Fortress' - almost equally (13:11); Park_integration is dominant (11), there are: Park_segregation (2); Fortress_integration (5); Fortress_segregation (6).
- Size: 5.5-64ha; mostly present super-blocks are of 11-20ha (75% out of all of this type).
- % occupancy: small (0-33%)
- % water permeability: between 30-50% and 50-80%
- Buildings: mix of storeys (lamellas 4-8 + skyscrapers 11-20)
- Uses: primary school in every + non-residential uses in less than 15% of all of this type
- Density: 280-450 inhab/ha
- Built in: 1940s to 1960s (rarely, 1970s and 1980s).



Figure 6. Overview of Type 2 - "Partial deleveling"; dominant subtype: Park segregation/Super-block 29a (Source: Google Earth)

Factography for TYPE 2 - "Partial deleveling":

- Presence: around 22% out of the total (8 out of 37).
- The dominant subtype - 'Park' (6:2); Park_segregation (6); one of each "Fortress" subtypes (Fs, Fi).
- Size: 10-42ha (central zone: 10-20ha; on the river Sava's side: 24-42ha).
- % occupancy: small (0-33%)
- % water permeability: between 30-50% and 50-80%
- Buildings: mix of storeys (lamellas 4-8 + skyscrapers 16-20)
- Uses: primary school in 38% + non-residential uses in 50% of all of this type
- Density: 350-569 inhab/ha
- Built in: 1970s and 1980s.



Figure 7. Overview of Type 3 - "On the concrete"; subtype: Park segregation/Super-block 67 (Source: Google Earth)

Factography for TYPE 3 - "On the concrete":

- Presence: 2 super-blocks (5% out of the total). One is Park_segregation and the other is Fortress_segregation
- Size: 11ha (super-block 32) and 19ha (Super-block 67)
- % occupancy: big (66-100%)
- % water permeability: around 0%
- Buildings: levelled no. of storeys
- Uses: no primary schools + dominant presence of non-residential uses (trade, business, church)
- Uses: primary school in 38% + non-residential uses in 50% of all of this type
- Density: 400-450 inhab/ha
- Built: after year 2000.



Figure 8. Overview of Type 4 - "Delevelling on the concrete"; subtype: Fortress segregation/Super-block 12 (Source: <http://ilicd.tripod.com>)

Factography for TYPE 4 - "Delevelling on the concrete":

- Presence: 3 super-blocks (8% out of the total). All of them are Fortress_segregation.
- Size: 6-9 ha
- % occupancy: big (66-100%)
- % water permeability: around 0%
- Buildings: levelled no. of storeys
- Uses: no primary schools + dominant presence of non-residential uses (trade, business)
- Density: around 530 inhab/ha
- Built in: the 1990s.

Morphogenetic synthesis in the context of the genesis of New Belgrade

Taking into account the indirect (not clearly visible) effects of using the urban land (density of use, occupancy percentage, water permeability of the site surface, uses) and findings of typomorphological analyses (types of super-blocks), a synthesis made through the *morphogenetic approach* revealed some characteristics shared by all of the above identified morphological types of land use when they are looked at from the prism of the genesis of the area (see: Figure 9 - Synthesis map).

The 1950s and 1960s

Almost 50% of the territory of New Belgrade was built in this period. Super-blocks TYPE 1_"On the Soil" are most present, with overall characteristics: small (0-33%) percentage of building occupancy, medium to high percentage of water permeability (30-50% to 50-80%), buildings with mix of storeys (lamellas 4-8 + skyscrapers 11-20), medium density (280-450 inhab/ha) and presence of primary school in every + non-residential uses in less than 15% of all of this type.



Figure 9. Synthesis map with the built period (number in the super-block represents a decade of the 20th century; "00" is for the first decade of the 21st century)

The 1970s and 1980s

In the 1970s, the development of the area on the Danube side was completed and before the end of the 1980s, almost 85% of the total number of residential super blocks now existing in this territory was already built. Super-blocks TYPE 2 - "Partial delevelling" are most present, with overall characteristics: small (0-33%) percentage of building occupancy, medium to high percentage of water permeability (30-50% to 50-80%), buildings with mix of storeys (lamellas 4-8 + skyscrapers 16-20), medium to high density (350-569 inhab/ha) and presence of primary school in 38% + non-residential uses in 50% of all of this type. Majority of the super-blocks featured a considerable segregation between vehicular and pedestrian traffic. The land use concept was such that this segregation is still retained today.

The morphological approach to land use in super-blocks in the 1980s reveals a traditionally based pattern of 'streets' and 'squares' and smaller distance between same height buildings, something that wasn't seen in the morphology of New Belgrade before.

The 1990s and 2000s

New Belgrade urban structure generally suffered significant changes during this period, which was primarily reflected in the fact that non-residential facilities were built, particularly in the period after 2000. Residential units were built in much smaller number, they were much smaller in size than before and commercial and business facilities were substantially represented. All in all, the construction in this period accounts for about 15% of the up till now built residential capacity in New Belgrade.

Super-blocks TYPE 3 and TYPE 4 are present 'on the concrete' (underground garages with pedestrian traffic and free public spaces on garage roof), with overall characteristics: big (66-100%) percentage of building occupancy, paved land without water permeability, same height buildings, medium to high density (400-530 inhab/ha) and with no primary schools + dominant presence of non-residential uses (trade, business, church). Segregation of vehicular and pedestrian flows is inherent to this type.

Characteristically, this period of constructing the residential units of New Belgrade lacks contemporary approaches; any concerns about sustainable development are missing, although they were seriously tackled elsewhere in the world after the 1990s. Contemporary criteria on energy efficiency are also rarely taken into consideration. For the first time in the history of New Belgrade, the topics such as title issues and private investors are present. According to Blagojević, "Most of the central New Belgrade territory has no history of private ownership and no history of nationalization and confiscation of private property, and, therefore, there is no restitution of land pending regulation. Today, New Belgrade is the capital's frontier where leasing-state owner land has no legal strings attached and thus is up for grabs" (Blagojević, 2014). Private interest now became dominant in the area of urban planning and land policy and it is obvious that it was not the dominant professional standards, but rather the effect of land policy, spurred on by the transition process in the country that had implications in all spheres of life, that essentially shaped the residential construction (related to land use as well) in New Belgrade.

CONCLUSIONS

Land use analysis in which urban morphology tools are applied, is an instrument that helps architects/urban planners to understand the processes in which urban units came into existence and, in doing that, it also helps to provide the data needed to direct, follow and manage these processes in the future. This paper presents an urban morphology based method for analysing a small-scale urban land use in multifamily residential area on the example of New Belgrade, the largest municipality of Belgrade, the capital of Serbia. "By virtue of its location, modern infrastructure and development potential, New Belgrade finds itself at the centre of contemporary post socialist/communist socio-political and economic transition of the metropolis and its region, thus undergoing profound socio-spatial transformations" (Blagojević, 2014). These transformations represent a testing ground for various research, and in this paper it is the land use in New Belgrade from the viewpoint of urban morphology.

As a result, a data base with the typology of residential superblocks of New Belgrade was created: from the perspective of urban land use there are four main morphological types and there are the subtypes which take into account the resulting morphology of the position of the structures on the terrain (a park, a fortress) and traffic, cars-pedestrian flows (segregation, integration). The morphogenetic analysis of previously identified morphological types revealed the predominating trends in the genesis of this area with regard to land use: in the period after the 1990s, private interest extended its dominance to the spheres of urban planning and land policy. Dominant professional standards are no longer essential in shaping the multifamily residential construction (and related land use) in New Belgrade, but the impact of land policy, driven by the transition process in the country that affected all spheres of life.

Findings suggests that nowadays there is a negative trend of using the land in super-blocks in New Belgrade, concerning urban morphology: percentage of land occupancy by buildings is getting bigger, while the percentage of water permeability of the undeveloped land inclines toward zero (almost 100% of the un-built soil in the newly developed super-blocks are covered/paved), Previous morphological concept of buildings with mix of storeys - skyscrapers and lamellas, is changing after the 1990s, by building levelled - same storey buildings on the whole super-block territory. As for the uses - there is a lack of social aspect - with no new primary schools and kindergartens, but a dominant presence of non-residential uses (trade, business, church).

It is important to stress that the purpose of typomorphology (the first component of the proposed methodology) is to create a database that would be required in further work and that, as such, it is not about criticising the types, but only about analysing the spatial development with the goal to create the typology. In accordance with the urban morphology's basic interests, and that is "to establish relationships between complex development processes and the urban form, grounded on the knowledge and understanding of the existing built environment, its specific

forms and previous development” (Niković *et al.*, 2014), the research of land use in New Belgrade in the future should particularly focus on the second component of the proposed methodology, the morphogenetic approach, with further elaboration and possible new ‘readings’/interpretations and supplementation of analyses with new information/data (related to the accessibility of uses, construction coefficient, the number of parking lots, the free space/population number ratio, etc.)

Lj. Blagojević argued for a balance between the processes of urban change towards a market economy and the need for the protection and preservation of the modernist architectural heritage “to be found in the appreciation of the urban landscape quality of the modern city and its housing blocks, and in the perspective of ecological urbanism” (Blagojević, 2012). It may be concluded that by planning for extensive free/green surfaces in super blocks at the early stages of New Belgrade construction, the society had somewhat unreasonably spent the land /the space/ which at that time seemed immense and affordable considering that the land was not burdened with the existing development or with the title issues. Today, on the other hand, we are in a stage when the land is used/paved 100 per cent and this did not lead to better quality areas (in which the user is comfortable and which provides all necessary elements of the sustainable use of urban land). It could be said that while at the very start we may have had the situation of space wasting, we still ended up with the space that is either (over)used or not worth using (that lacks the qualities, such as liveability, sustainability and energy efficiency).

REFERENCES

- Alonso, W. (1964) *Location and land use: toward a general theory of land rent*. Cambridge: Harvard University Press.
- Berke, P., Godschalk, D., Kaiser, J.E., Rodriguez, A.D. (2006) *Urban land use planning - fifth edition*, Urbana: University of Illinois Press.
- Blagojević, Lj. (2004) *Strategije modernizma u planiranju i projektovanju urbane strukture i arhitekture Novog Beograda: period konceptualne faze od 1922. do 1962. godine*, doctoral dissertation, Beograd: Arhitektonski fakultet Univerziteta u Beogradu.
- Blagojević, Lj. (2007) *Novi Beograd: osporeni modernizam*. Beograd: Zavod za udžbenike, Arhitektonski fakultet Univerziteta u Beogradu i Zavod za zaštitu spomenika kulture grada Beograda.
- Blagojević, Lj. (2012) The Residence as a Decisive Factor: Modern Housing in the Central Zone of New Belgrade, *Arhitektúra & urbanizmus: journal of architectural and town-planning theory*, vol. 46, No. 3-4, pp. 228-249.
- Blagojević, Lj. (2014) Chapter 15. Novi Beograd: Reinventing Utopia, in: *Urban Revolution Now: Henri Lefebvre in Social Research and Architecture*. Łukasz Stanek, Christian Schmid and Ákos Moravánszky (eds.). Farnham, London: Ashgate, pp. 301-318.
- Bogdanović, R. (1990) *Urbanizam (urbane forme, urbanističko planiranje)*. Saobraćajni fakultet u Beogradu.
- Cataldi, G., Maffei, G.L., Vaccaro, P. (2002) Saverio Muratori and the Italian school of planning typology, *Urban Morphology*, No. 6(1), pp. 3-20.
- Chapin, F.S. (1970) *Urban land use planning*. Urbana: University of Illinois Press.
- Commission of the European Communities (2006) *Thematic strategy on the urban environment*. Brussels, SEC.
- Conzen, M.R.G. (2009) Alnwick, Northumberland: a study in town-plan analysis, 1960. *Progress in Human Geography*, Vol. 33, No. 6, pp. 859-864.
- Đokić, V. (2007) Morfološka istraživanja u urbanizmu, *Arhitektura i Urbanizam*, No. 20/21, pp. 61-72.
- Engelke, D., Vancutsem, D. (ed.) (2010) *Sustainable land use management in Europe /providing strategies and tools for decision/makers*. LUMASEC URBACT.
- Expert Group on the Urban Environment (Chair: Bach, M.) (2001) *Towards more sustainable urban land use: Advice to the European Commission for Policy and Action*. DETR, UK.
- Gajić, R. (2004) *Parcelacija i fizička struktura grada - primeri rekonstrukcije*. Beograd: Zadužbina Andrejević.
- Gajić, R., Dimitrijević-Marković, S. (2006) Managing integration and disintegration processes in the modern urbanism settlements - the case of New Belgrade. In: proceedings CD of the “*Cities Between Integration & Disintegration*”, 42 ISOCARP congress, Istanbul. Available at: http://www.isocarp.net/projects/case_studies/cases/cs_info.asp?ID=748, accessed 25th Dec 2013.
- Gil, J., Montenegro, N., Beirao, J.N., Duarte, J.P. (2010) On the discovery of urban typologies, CITTA 3rd Annual Conference on Planning Research *Bringing City Form Back Into Planning*, FCT, FEU. pp. 1-14.
- Hillier, B., Stuy, C. (2005) New methods in Space Syntax. *Urban Design Journal*, Issue 93. pp. 32-33.
- Kostof, S. (1991) *The city shaped*. London: Thames and Hudson.
- Krstić, B., Pajović, D. (1987) *Zakonodavstvo urbanizma, arhitekture, baštine, prostornog uređenja, čovjekove sredine*. Beograd: Naučna knjiga.
- Law on Expropriation*, Official Gazette of RS, No. 53/95, 23/01, 19/09, 55/13.
- Law on Land Survey and Catastre and Entering of Rights on Real Estate*, Official Gazette of RS, No. 83/92, 53/93, 48/94, 12/96.
- Law on Planning and Construction*, Official Gazette of RS, No. 72/09, 121/12, 42/13.
- Lloyd-Jones, T., Erickson, B. (2007) Typo-morphological analysis as a tool for urban survey and planning, in: Da Silva, R., Nelson, A., De Souza, L. and Cristina, L. (eds.) *10th International conference on computers in urban spatial planning and management*, School of Engineering of Sao Carlos, University of Sao Paulo, Sao Carlos, Brazil, pp. 120-121.
- Lovell, S.T. (2010) Multifunctional urban agriculture for sustainable land use planning in the United States, *Sustainability*, No. 2, pp. 2499-2522.
- NBG (2008) local paper of New Belgrade’s municipality No.002, July-August.
- Niković, A., Đokić, V., Marić, I. (2014) Revising the position of a city block within the morphological frame of a traditional city: contemporary perspectives, *SPATIUM*, No. 31, pp. 1-6.
- Oliveira, V., Pinho, P. (2010) Evaluation in urban planning: advances and prospects, *Journal of Planning Literature*, Vol. 24, No. 4, pp. 343-361.
- Politika, daily news (2008) April, 18th, appendix: Ekonomija

Regulation on common rules for zoning and subdivision, Official Gazette of RS, No. 37/98.

Rofe, Y. (1995) Space and community - the spatial foundations of urban neighbourhoods: an evaluation of three theories of urban form and social structure and their relevance to the issue of neighbourhoods, *Berkeley Planning Journal*, No. 10(1), pp. 107-125.

Salat, S. (2010) The art of medieval sustainable urban design – the case of Toledo, *Sustainable building conference SB10mad*, pp. 1-14.

Stojkov, B. (1997) *Urbografija - razvoj ideje o obnovi gradova u Srbiji 1967-1997*. Beograd: IAUS.

Stonor, T. (2006) An evidence-based approach to spatial planning & design, Available via Space Syntax publications, www.spacesyntax.com, accessed 6th Dec 2013, pp. 1-2.

Vernez-Moudon, A. (ed) (2000) *Monitoring Land Supply with Geographic Information Systems: Theory, Practice and Parcel-Based Approaches*. New York: John Wiley & Sons INC.

Voigt, B. (2003) Spatial economics and location theory – implications for modelling environmental impacts of future development patterns. *Ecological Economics*, Vol. 45, pp. 2-3.

Vujović, S. (1966) Beograd u tranziciji, in Bogdanović, R. (ed.), *Metodološki pristupi GUP-u*, Beograd, DUB, pp. 4-17

Walker, R. (2004) Theorizing Land-Cover and Land-Use Change: The Case of Tropical Deforestation, *International Regional Science Review*, Vol. 27, No. 3, pp. 247-270.

Whitehand, J.W.R. (2001) British Urban Morphology: the Conzenian tradition, *Urban Morphology*, No. 5(2), pp. 103-109.

Whitehand, J.W.R., Larkham, P.J. (1992) *Urban landscapes: international perspectives*. London: Routledge.

PLANNED TRANSFORMATIONS WITHIN RESIDENTIAL STRUCTURE IN THE CENTRAL ZONE OF BELGRADE

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Belgrade's urban transformations largely mirror the Master Plan of Belgrade 2021 and the consequent detailed regulation plans, consistent with the national Law on Planning and Construction. A major negative consequence of contemporary urban transformations in Belgrade's central compact blocks is a failure to create common public or semi-public areas in the center of the blocks, and a complete disregard to their importance. Any transformation in the future needs not only to correspond to the needs of citizens, but meet them on a larger scale, too, while creating an optimal ratio between sustainable development and maximum economic benefits for property owners, the city and the state. Only a good balance between these parameters can create the best possible conditions for growth. It can protect the city against heavy dependence on developers, and allow property owners to invest and save their urban units.

Key words: central zone, compact block, Master Plan of Belgrade 2021, Detailed Regulation Plan, transformation.

INTRODUCTION

The urban development and architecture of Belgrade have been differentiated in several ways within the bounds of the Master Plan of Belgrade 2021 (MP 2021). Typology distinctions that make a specific part of the city clearly recognizable depend on the historical context and different influences, natural and imposed alike. What goes back quite a while in history is that a pre-defined street matrix, without major variations in geometry, regulation, and leveling, has been used as a basis for creating blocks of varying size and shape, sharing some basic characteristics. The existing differences pave the way to a better transformation in the future.

Under the Law on Planning and Construction, the adoption of higher-order plans, including the 2021 Belgrade Master Plan, created conditions for the elaboration of specific units based on detailed regulation plans. The MP 2021, as the planning groundwork, covers an area of approximately 77,600 ha, including nearly 296,000 lots. The continuously developed area covers about 22,000 ha, which is close to 30%.

The changes the economy and society have undergone over time will definitely reflect on land ownership transformation. The terms of possible changes in land ownership, and a rationale behind them, will be defined precisely. High-degree ownership guarantees and a clearly

defined tax policy that can specify the taxes for property owners on a long-term basis are indispensable conditions for investment and long-term sustainability in development. The optimal ratio between the property value, taxation and potential yield must be a key element in defining a long-term policy for spatial management. Consequently, it will shape the development, too, addressing the local needs in line with modern standards.

While the Master Plan was prepared and passed, the main development challenges were poor implementation of urban plans, uncontrolled and illegal residential development, semi-legal residential development, awarded but not developed building land, fading industrial zones, the expansion of "kiosk" economy, devastated transport system, non-regulated urban agriculture, multiplication of dump sites, illegal connections to the public utility infrastructure, unconscious visual impairment of the city. Halprin (1974) speculated that modern city skylines changed as rapidly as several times a year. This has already evolved into the concept of a constantly changing city. The key battle is waged between a static and a dynamic city as perceived by two schools of thought, between the concepts of permanent and ephemeral urban structures. In a simple notion, Merleau-Ponty (2005) maintained that the space is existential, but that existence is spatial as well, reaffirming the spatiality of architecture, its live interconnection with the real world. There is no greater danger in urban planning than the desire to implement the Perfect Urban Planner's Manual in practice at any cost (Poëte, 1929).

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In his comparative history of architecture, Fletcher (1996) recognized the six types of influences that lie in the base of each phase of architectural development: geography, geology, climate, religion, society and history. A step to complement the view was made by Giedion (1969) – it's not a *particular shape* in modern architecture to be considered universal and general; it's rather a *space concept* to come first. The economic potential of a society and developmental prospects are lynchpins to architectural development. If overlooked, they result in unrealistic, quickly abandoned plans. The enormous challenge lying ahead of countries with an insecure economic future is to develop plans and shape their future and needs ten years in advance. Not only do they need to rise to the challenge, but to accept a serious inherent responsibility, too. Only a spatial concept can provide for a firm grasp of the entire space, and the ideas of how to transform it. A more complete integration is needed to include various aspects and dimensions of a development planning policy, e.g., social, economic, spatial, urban, environmental, etc. (Vujošević, 2004).

THE CENTRAL ZONE OF BELGRADE AS DEFINED BY 2021 BELGRADE MASTER PLAN

The MP 2021 has divided the city area into four zones, namely, the central, middle, outer and edge zones. The Central Zone of Belgrade is home to the ever-changing spirit of the city, reflected in its physical structure as well. The analysis of Belgrade's inner urban structure has unveiled the ongoing transformation in the inherited street matrix. More floors are added to the existing buildings, and instead of low-rise structures and deteriorated buildings, up to six-floor mid-rise housing with offices has taken over (Niković *et al.*, 2013). In addition to the question of how to build a city by the modern urban planning standards, Ranko Radović (1995) made another the two, even more complex and intense: how to make it possible for the city to grow constantly, and how to pave the way to its painless yet full organic transformation, which in a sense always entails its disappearance. Any intervention in the central zone invariably brings up the question of the scope of transformation.

According to Venturi (1999), a combination of old and new is the ultimate goal to be strived for, but the ways to incorporate the old should be innovative, too. Tradition should be used to reaffirm and highlight the new. This dialectical game, in which the universal intertwines with the regional, and tradition with the avant-garde, offers the sine qua non for architecture to survive. The dialectical context allows the architecture and urban planning to endure, but it's still a political element. Architects and planners move through the political spectrum in much the same way as the general public, with their growing interest in urban design. This interest can be viewed in two different ways - as a symptom, and as a symbol.

The physical structure of the densely developed city center has been replaced randomly, with complete disregard for the existing and future ambiances, and the conditions of living, disturbing the old, creating the new (Marić *et al.*, 2010).

The existing needs are often subordinated to long-term development. A compromise that might seem to be a

solution, frequently turns into a failure. In most democracies, elections allow them to choose between different political programs, and, by extension, the development models and methods they are offering. The citizens give a mandate to their representative to make decisions and shape the development process. The democratic standards notwithstanding, what matters most is to build institutions, define professional and general standards, and make all the planners and decision-makers accountable for their decisions and the consequences they might have on the society and space.

COMPACT BLOCK TYPOLOGY IN THE CENTRAL ZONE OF BELGRADE

Belgrade's Central Zone is a predominantly residential area, with typical public facilities. Following a classification based on morphological criteria, the inner city center is a fairly compact, urban block type. As a result, urban development issues need to be considered at the block level. The problems that have been identified so far typically arise from the inadequate building stock, occupying the interior parts of blocks and creating poor hygienic conditions, which calls for transformation into a better living environment. At the same time, the urban parameters for compact urban blocks have been defined already, together with urban indicators, distances between buildings, regulation lines, distances between plot boundaries, and boundaries between neighboring buildings. (Niković *et al.*, 2013)².

A typical compact bloc in the Central Zone was elaborated by Regulation Plan for Bulevar kralja Aleksandra, the partition from Takovska to Sindelićeva streets (RP 2001). The objective of the plan was to create the planning fundamentals to improve the existing facilities and structures and develop new ones in the block.

Under the Plan, the Kalenić open market and the surrounding area, from Kursulina to Njegoševa and Maksima Gorkog streets, remain a traditional city marketplace. The section in front of the "Kalenić" restaurant, from Trnska to Baba Višnjina, and the square toward Golsvordijeva St., constitute a signature urban motif that needs to be preserved by all means. Carving a strategy to do so is a delicate exploit. Having quoted T. S. Eliot, 'History can be slavery, history can be freedom, Radović (1995) suggested that one should resist the allure of history by understanding it.

The main reason for concern the residents around Kalenić voiced during the planning process was that the old city spirit, tranquility and quality of life might be lost in the transformation of one of the most expensive areas of Belgrade. They even documented the existence of rare bird species in a tiny green area inside the block, in a bid to preserve the good living environment in the Kalenić neighborhood.

² The typology of compact blocks is defined in MP 2021, as well as the main objective of raising the standards of used space within the blocks. It subsumes building of parking spaces and garages, clearing the interior parts of unadequate building stock, planning new greenery as well as conditions for solar insolation, daylight, natural ventilation etc. (MP 2021, Urbanistički zavod Beograda, 2003, pp. 922-923).

There are outstanding examples as to how to protect the old and meet the need for the new. No one can stop the flow of time, but one needs to understand history and embrace the unfolding processes, which is never an easy task. On the other hand, making a decision without a firm grasp of the process behind is a sure path to mistakes. More often than not, plans tend to ignore reality. Many spatial incidents, a mere euphemism for illegal construction, have been turned a blind eye to, however realistic they might have been. Accumulated over the years, they created an enormous challenge for other developers, pushing back the planning. Planners do bear a lion's share of responsibility, but the fact is that there will be no proper plans as long as spatial incidents are ignored. Instead, there needs to be a hard and fast rule that anything built contrary to the plan must be removed.

Analysis of a block in the Vračar municipality – the Existing Situation

The next chapter describes in detail a compact block in the Vracar municipality, between Kičevska, Molerova, Hadži Đerina and Hadži Prodanova streets, located in the northeast-southwest direction. Inside the 2.22 ha block there are 27 cadastral building lots, and the three publicly owned lots that were used to build traffic infrastructure. Apart from two lots, where the 14th High School of Belgrade and the Association of Scientific and Technical Translators of Serbia are located, this is a completely residential area. There are three different categories of residential buildings: individual housing, the compact city block housing, and the compact city block housing with business ground floor facilities.

There are two poorly-insulated individual buildings of extremely low housing quality. The one at 9, Hadži Prodanova St. is a ground-level structure with an illegal

extension (Figure 1). The building at 10, Hadži Đerina St. consists of a ground floor plus one more, upper floor (Figure 2).

The residential buildings with no commercial space were built prior to the 2001 Regulation Plan. They are of varying quality; some quite solid, others in poor conditions or expected to be replaced soon (Figure 3 and 4). Aside from



Figure 2. The building in 10, Hadži Đerina St.

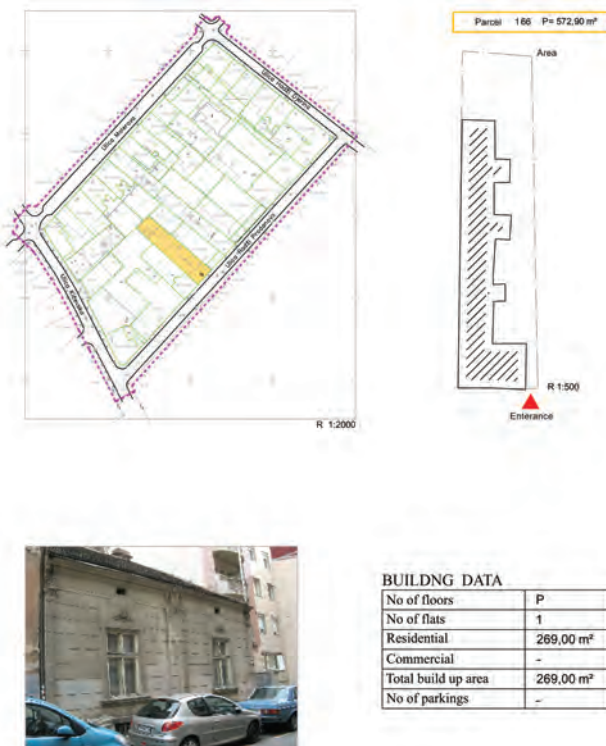


Figure 1. The building in 9, Hadži Prodanova St.



Figure 3. The building in 7, Kičevska St.

the ground floor, they typically consist of two to five upper floors, plus an occasional loft. No parking facilities exist on these lots.

Most of the residential buildings with commercial facilities on the ground floor were built after the 2001 Regulation Plan was passed. The buildings are of good quality, with private garages. They consist of the ground floor, plus four to five upper floors and an occasional loft (Figure 3).

The Table below lists the urban indicators for the existing physical structure.

The Table shows that urban parameters are not uniform, and that the lot coverage values range from 30% to 80%, with an exception of 100%. Lot coverage is taken as one of key elements for analysis, as this is a realistic piece of information, as opposed to the construction index. The construction index is laid out in the Master Plan. The lot coverage and floor structure show indirectly the quality of urban structure, and the possibilities for further

transformation of the block, without impairing the basic qualities in the use of urban space. This is the way that gives a far better conception of capacities in a certain area, thus enabling the benefit expected from development to be maximized.

PLANNED TRANSFORMATION WITHIN RESIDENTIAL STRUCTURE ACCORDING TO MASTER PLAN

The strategy laid down in the Master Plan 2021 suggests that most of Belgrade's residential urban structure should be transformed into a better environment. The process is expected to unfold gradually and simultaneously in various city locations. While evaluating implementation of the plans, especially in the context of a specific policy, it is of key importance to compare the plans and the results at certain intervals, i.e. at the end of the periods of time covered by the plans. Gauging efficiency, effectiveness and cost-effectiveness alone calls for measurable criteria, which need to be defined. The terms like "better environment" involve

Table 1. Overview of the existing situation of physical structure by addresses of lots

Address	Lot surface area - m ²	Number of floors	Gross building area residential - m ²	Gross building area business - m ²	Total Gross building area - m ²	Construction index	Lot coverage - m ²	Occupancy index
Kičevska 7 - Molerova 64	214.30	GF + 3 + A	953.80	32.00	985.80	4.6	214.30	100%
Kičevska 9	517.15	B + GF	-	360.00	360.00	0.7	180.00	35%
Kičevska 11	312.70	GF + 4	945.00	105.00	1,050.00	3.4	210.00	67%
Kičevska 13a, H. Prodanova 1	320.70	B + GF + 3 + A	1,170.00	26.00	1,196.00	3.7	260.60	81%
H. Prodanova 3-5 (High School)	2,013.30	GF + 2	-	2,179.80	2,179.80	1.08	726.60	36%
H. Prodanova 7	429.80	GF + 2 + A	489.60	-	489.60	1.1	136.00	32%
H. Prodanova 9	572.90	GF	269.00	-	269.00	0.47	269.00	47%
H. Prodanova 11	512.70	GF + 5 + A	1,960.35	150.00	2,110.35	3.74	319.95	62%
H. Prodanova 13 and 13a	524.70	GF + 2 + A	887.75	-	887.75	1.7	246.60	47%
H. Prodanova 1	631.20	GF + 5 + A	1,796.00	183.10	1,979.10	3.10	320.70	51%
H. Prodanova 17	674.10	GF + 5 + A	2,668.45	466.55	3,135.00	4.19	475.00	70%
H. Prodanova 19	817.30	GF + 4 + A	1,227.20	-	1,227.20	1.5	219.15	27%
H. Prodanova 21	805.10	GF + 3	1,062.80	-	1,062.80	1.3	265.70	33%
H. Prodanova 23, Hadži Đerina 18, Hadži Đerina 16	712.00	GF + 4 (+RF)	2,489.10	-	2,489.10	3.5	460.90	65%
Hadži Đerina 14	307.00	GF + 3	828.00	-	828.00	2.7	207.00	67%
Hadži Đerina 12	305.00	GF + 4 + A	1,011.00	184.00	1,195.00	3.92	184.00	60%
Hadži Đerina 10	339.00	GF + 1	241.50	-	241.50	0.71	120.75	36%
Hadži Đerina 8	245.40	GF + 4 + A	653.20	142.00	795.20	3.24	142.00	58%
Hadži Đerina 6	410.20	GF + 2 + A	823.15	-	823.15	2.0	228.65	56%
Molerova 66	683.25	GF + 4 + A	2,424.80	-	2,424.80	3.50	433.00	63%
Molerova 68	553.35	GF + 2 + A	828.00	-	828.00	1.5	230.00	42%
Molerova 70	566.80	GF + 2 + A	901.25	-	901.25	1.6	250.35	44%
Molerova 72	360.60	GF + 1	302.60	-	302.60	0.88	168.70	47%
Molerova 74	300.00	GF + 3 + A	897.00	-	897.00	3.0	195.00	65%
Molerova 76	297.30	GF + 3	928.00	-	928.00	3.12	232.00	78%
Molerova 78	508.50	GF + 4 + A	1,370.90	-	1,370.90	2.7	244.80	48%
Molerova 80	526.00	GF + 5 + RF	972.35	79.70	1,052.05	2.0	159.40	30%
Molerova 82	767.10	GF + 5 + RF	1,504.80	-	1,504.80	1.74	228.00	30%
Total	14,427.80		29,866.25	3,821.25	33,687.50		7,300.20	

* G - Ground Floor; RF - Recessed Floor; A - Attic; B - Basement



Figure 4. The building at the corner of 13a, Kičevska St. and 1, Hadži Prodanova St.



Figure 6. The building in 17, Hadži Prodanova St.



Figure 5. The building in 11, Kičevska St.



Figure 7. The building in 19, Hadži Prodanova St.

a large degree of personal feelings to it, and how successful a transformation into a better environment is might be difficult to validate. This is why an integrated planning process is almost impossible to implement.

The compact block typology is largely associated with the Central Zone of the Belgrade. A small number of these blocks

are planned to be transformed into typical central blocks, where almost half of the area will be dedicated to central facilities. Most of the blocks, on the other hand, will keep the present-day features, but with improved parking facilities, etc. The objective is to improve over time, and increase considerably the standard for use of space in the compact blocks. To build new garages and parking lots, convert the

Table 2. Planned buildings, i.e. lots with expected replacement of buildings – Group A

Address	Lot surface area - m ²	Use	Gross building area - m ²	Occupancy index max.	Lot coverage - m ²	Max. number of floors
H. Prodanova 7	429.80	residential	1,504.30	60%	257.90	GF + 4 + A (RF)
H. Prodanova 9	348.60	residential	1,220.10	60%	209.15	GF + 4 + A (RF)
H. Prodanova 13, 13a	271.00	residential	948.50	60%	162.60	GF + 4 + A (RF)
H. Đerina 10	234.80	residential	821.80	60%	140.90	GF + 4 + A (RF)
Molerova 72	293.75	residential	1,028.10	60%	176.25	GF + 4 + A (RF)
Total			7,850.00			

Table 3. Buildings to be kept in the present condition - Group B

Address	Lot surface area - m ²	Use	Gross building area - m ²	Occupancy index	Lot coverage - m ²	Number of floors
Kičevska 7 - Molerova 64	214.30	residential	985.80	100%	214.30	GF + 3 + A
Kičevska 11	312.70	residential	1,050.00	67%	210.00	GF + 4
Kičevska 13a, H. Prodanova 1	320.70	residential	1,198.75	81%	260.60	B + GF + 3 + A
H. Prodanova 1	320.55	residential	2,109.00	99%	319.55	GF + 5 + A
H. Prodanova 15	370.65	residential	2,117.00	87%	325.00	GF + 5 + A
H. Prodanova 17	551.40	residential	3,135.00	86%	475.00	GF + 5 + A
H. Prodanova 19	549.60	residential	1,227.20	40%	219.15	GF + 4 + A
H. Prodanova 23 - H. Đerina 16, 18	712.00	residential	2,489.10	65%	460.90	GF + 4 GF + 4 + RF
Hadži Đerina 14	301.00	residential	828.00	69%	207.00	GF + 3
Hadži Đerina 12	290.00	residential	1,195.00	63%	184.00	GF + 4 + A
Hadži Đerina 8	165.50	residential	795.20	85%	142.00	GF + 4 + A
Hadži Đerina 6	252.00	residential	823.15	90%	228.65	GF + 2 + A
Molerova 82	420.65	residential	1,504.80	54%	228.00	GF + 5 + RF
Molerova 80	361.30	residential	1,052.05	44%	159.40	GF + 5 + RF
Molerova 78	286.00	residential	1,370.90	85%	244.80	GF + 4 + A
Molerova 76	278.50	residential	928.00	83%	232.00	GF + 3
Molerova 74	281.60	residential	897.00	69%	195.00	GF + 3 + A
Molerova 66	693.25	residential	2,424.80	63%	433.00	GF + 4 + A
Total			26,130.75			

Table 4. Buildings allowed to be extended (floor/s added) – increased capacity - Group C

Address	Lot surface area - m ²	Use	Gross building area - m ²	Occupancy index	Lot coverage - m ²	Number of floors
H. Prodanova 21	542.40	residential	1,487.90	49%	265.70	GF + 4 + A (RF)
Molerova 70	394.25	residential	1,380.00	63%	250.35	GF + 4 + A (RF)
Molerova 65	383.50	residential	1,288.00	60%	230.00	GF + 4 + A (RF)
Total			4,155.90			

Table 5. Planned buildings, i.e. lots where buildings are expected to be replaced – Group D

Address	Lot surface area - m ²	Use	Gross building area - m ²	Occupancy index max.	Lot coverage - m ²	Number of floors
Kičevska 9	517.15	Commercial activity	2,327.20	70%	362.00	B + GF + 4 + RF - B + GF + 5 + RF

* G - Ground Floor; RF - Recessed Floor; A - Attic; B - Basement

central core of each block into open space wherever possible and open new green areas, to let air and light into the blocks and improve the general quality of infrastructure are the ways to do it. The plan is to develop the compact blocks further without disturbing the compact block concept.

One of key deficiencies in planning the central zone blocks is the disappearance of shared space within. There are three key reasons for this phenomenon: building rules

in the Master Plan referring to both land parceling and architecture; the parcels are privately-owned construction land; Under the Belgrade Land Development Public Agency's policy, it is impossible to define a publicly-owned land within the blocks, which might be offered for sale and developed for a specific purpose. The agency's policy contradicts the strategy for improvement of living conditions as defined by the Master Plan.

The planning and building policies have expanded construction on the one hand, but also raised the question of housing quality (the blocks with no air flow, a lack of green areas, no socializing in shared spaces, dehumanized standards of living).

This is also the example of a failure to include the principles of economy into the planning process. On the one hand, there is the illusion of growing savings, convenience and an expanding building industry, while a long-term damage is made to the living environment, no conditions are created to improve it and the total economic benefit is reduced. In this way, immediate benefits and quick yet ephemeral positive effects are put before the genuine advantage for citizens, local governments and the state alike. Planned architectural forms are the fundamentals of the physical structure of a city. In the urban structure, these forms are the most diversified, the most visible, and the most static.

Planned types of construction /interventions

The building rules pertaining to compact city blocks define the following types of building: newly planned buildings (Group A), buildings to be kept in their present condition (Group B), buildings to be extended (Group C). The planned types of interventions are covered by the overview below, including all the parameters defining a future physical structure.

Group A consists of the lots where buildings are expected to be replaced. Business and commercial units can be built on the ground floor of such buildings, but this is not mandatory. Maximum urban indicators are given as follows: percentage of commercial space is 20%, max. occupancy index is 0.6 (60%), max. number of floors is Ground floor + 4 + Attic (+Recessed floor). Minimum percentage of green areas is 15% of the lot area. Distance of the building from an opposite building is min 2/3 of height of the taller building, but not less than 10 m. Distance from the rear lot line is min. 2/3 of height of the building, but not less than 8 m, unless there are openings of residential premises.

Group B is consisted of buildings to be kept in their present condition (without increasing their capacities) and without parking provisions. Lot occupancy index ranges from 0.4 (40%) to 1.0 (100%), with max. number of floors: ground floor + 2 + Attic up to ground floor + 5 + Attic (+Recessed floor).

Group C consists of the buildings to be extended (floors added) within the planned urban parameters, maximum coverage index is 0.6 (60%), max. number of floors is ground floor + 4 + Attic (+Recessed floor). Minimum percentage of green area is 15% of the lot area.

The tables presented above show maximum possible development parameters.

Policy of construction, development of building land, and obtaining land lots, leads to the situation where the initial costs of construction are such that every developer wants to earn the maximum profit, and build the maximum number of allowed squared meters of space. This turns us to the starting point discussed in the sections above. What is lost with such policy, and what is to be gained. The big

outstanding issue is: in our urban planning do we have to learn incessantly from (our own) expensive mistakes, or is it more reasonable and better, faster and less costly to learn from other people's mistakes? Human settlements are those complex areas of our activity and culture where reality and direct experience of each person is the highest judge and measure.

Planning is a process that is essentially meaningful only if it is on a long-term basis and covers as many parameters as possible, particularly those developmental and economic. Evaluations and effects have to be considered in the time perspective and cumulatively, and that it is up to the decision-maker to evaluate which benefit is the biggest and the most applicable in a given situation. There are such situations when the immediate benefit will be more substantial, and when decisions that are unfavorable in the long run are accepted consciously. However, both situations have to be planned clearly, and decisions also have to be defined in a clear way.

Changeability of urban forms, urban structures are the core feature of a city. What is new and typical for urban morphology are not changes per se, but the dynamic nature of such changes, their rhythm and variety, the speed of these processes. The dynamics of changes is conditioned by many factors that are not coordinated at this moment in our situation. The speed of preparation of plans, the speed of provision of necessary permits, the speed of construction, the crisis in the real estate market, all this contributes to the situation where all players in urban planning and construction overlap and trip one over another. Childs thinks that the shape of the city of future presupposes an adequate solution to a range of other problems, but that the city itself is not the goal for itself or the final stage, but it is to serve the community.

Planning is a continuous process and the fate of plans has to be monitored constantly. Speed is important, but most often, going too fast does not go alongside with the planning process. Key decisions, and important decision, with long-term effect on the condition of space, cannot be, and must not be made in a rush, without a comprehensive analysis. An essential change in the planning process has to take into account all elements in the process and needs to consider all of them.

In all times and changes, this question raised by Radović (1995) can probably be posed in several ways, such as: What should the architecture of today express, what should it speak of, which goals and symbols of what beliefs and hopes should it serve? For whom, for what client?

CONCLUSION

Typical characteristics that make a certain part of the city distinctive, such as the compact block typology, arise from the historical context and different influences – natural as well as man-made. It is important to recognize the influences, and to create a planning policy to correspond to the nature of the existing typology. Social events, economic activities, political processes, technological changes and scientific procedures develop at an increasingly faster pace, and the period of time in which social, economic, political, technical and scientific

structures become obsolete - shorter and shorter every day. When it comes to the context, architecture grows from two seemingly opposite plans, synchronically and in a complex dialectics. On the inside, it grows from homes, space and needs, and on the outside, from the environment, climate, available materials, production, a contractor's techniques, the given spatial situation, situation of the settlement, the morphology of the nature or a city.

A major negative consequence of contemporary urban transformations in Belgrade's central compact blocks is a failure to create common public or semi-public areas in the center of the blocks, and a complete disregard to their importance. Planners must be quick to react, having prepared and analyzed properly. This is the only way to incorporate the active planning process in modern society, while keeping the essence of planning intact and paving the way to sustainable development.

REFERENCES

- Fletcher, B. (1996) *A history of architecture*. Oxford: Architectural press : Butterworth-Heinemann.
- Giedion, S. (1969) *Prostor, vreme, arhitektura: nastajanje nove tradicije*. Beograd: Građevinska knjiga.
- Halprin, L. (1974) *Gradovi*. Beograd: Građevinska knjiga.
- Poëte, M. (1929) *Introduction a l'urbanisme*. Paris: Boivin.
- Marić, I., Niković, A., Manić B. (2010) Transformation of the New Belgrade urban tissue: filling the space instead of interpolation. *Spatium*, 22, pp. 47-56.
- Merleau-Ponty, Maurice (2005) *Phenomenology of Perception*. London and New York: Routledge.
- Niković, A., Manić, B., Marić, I. (2013) Mogućnosti primene mera prilagođavanja klimatskim promenama pri projektovanju i planiranju užeg centra Beograda i integrisanja u strategije održivog razvoja. In: Pucar, M., Dimitrijević, B. and I. Marić (Eds.), *Klimatske promene i izgrađeni prostor: politika i praksa u Škotskoj i Srbiji*. Beograd: IAUS.
- Radović, R. (1995) *Vrt ili kavez: studije i eseji o gradu i arhitekturi*. Novi Sad: Prometej.
- Radović, R. (2009) *Forma grada*. Beograd: Građevinska knjiga.
- Venturi, R. (1999) *Složenosti i protivrečnosti u arhitekturi*. Beograd: Građevinska knjiga.
- Vujošević, M. (2004) The search for a new development planning/policy mode: problems of expertise in the transition period. *Spatium*, 10, pp. 47-56.
- Urbanistički zavod Beograda (2001) *Regulation Plan for the Bulevar kralja Aleksandra street, the partition from the Takovska street to Sindeliceva street*, Official Gazette of the town of Belgrade, No. 15/2001.
- Urbanistički zavod Beograda (2003) *Generalni plan Beograda 2021*. [Master Plan of Belgrade 2021], Official Gazette of the town of Belgrade, No. 27/03.
- Law on Planning and Construction (Zakon o planiranju i izgradnji)* (2009) Official Gazette of the Republic of Serbia, No. 72/09.

URBAN HERITAGE RECONSIDERED: REDEFINING THE PLANNING APPROACH TO HISTORICAL AREAS OF NOVI SAD

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The beginning of the 21st century was marked by significant socio-economic changes in Serbia, which influenced urban environment and development strategies. Novi Sad, the capital of the Serbian province of Vojvodina, also followed this pattern, adjusting to the new social and spatial dynamic. The shift from a socialist to a neo-liberal model of planning was visible in different spheres - the system of stakeholders was altered, public funds were substituted with small private investors, while existing regulations were either overlooked or interpreted in a questionable manner. Simultaneously, the newly established real estate market mostly focused on the areas around the traditional urban core which underwent a process of quasi-regeneration. Used only as an opportunity for new speculative development, it did not have any respect for either tangible or intangible heritage. However, a decline in real estate development (since 2009) has created a setting for a different planning approach to include consideration of problems of heritage areas. Considering the socio-economic background of recent urban transformations in Novi Sad's inner-city neighbourhoods, this article analyses the context of the problem, provides recommendations for improvements in the approach to planning, and introduces guidelines and rules for site-sensitive urban and architectural design.

Key words: built heritage, inner-city neighbourhood, urban regeneration, site-sensitive urban/architectural design.

INTRODUCTION

The process of political and socio-economic transition of the Republic of Serbia, although delayed due to the civil wars in former Yugoslavia, showed many similarities with other ex-communist countries in Central and Eastern Europe. The urban systems were exposed to enormous pressure caused by several factors - the powerful currents of globalization, the advances in information technology, drastic shifts in the service sector and numerous challenges imposed by the international financial markets (Dimitrovska Andrews, 2005). As a result, the urban development of cities shifted toward a neo-liberal concept as the appropriate framework for the growth of the urban economy. This was a logical consequence of a global trend which emphasized the significant role of cities in the world economy.

The case of Novi Sad, a medium-sized European city and the capital of the Serbian province of Vojvodina, followed a similar path focusing its development on central areas characterized by existing built cultural heritage and

historically significant sites and buildings. However, during the first decade of the 21st century these areas were exposed to major political and social changes which transformed the historical spatio-cultural environment. Considering both the general European context and the specific current development of Novi Sad, this article emphasizes the importance of preserving the valuable physical substance of the inner-city neighbourhoods through the process of regeneration and using new mechanisms, guidelines and instruments.

The methodology used in this article relies on critical discourse analysis of the identified phenomena. It provides an insight into the current European urban practice implemented in medium-sized cities and examines transformations of their inner-city neighbourhoods. The case-study of Novi Sad presents and analyses the main features of the recent spatial, social and economic development, considering the scale and impact of transformations in the central zones. Responding to detected local problems and dominant global trends, this article suggests site-sensitive regulation in the urban and architectural design of the areas with heritage qualities. At the same time, the article defines a set of crite-

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ria to be used in order to create a specific typology of identified areas and to facilitate precise application of guidelines, rules and instruments, in accordance with the actual condition and importance of a site.



Figure 1: The central city area of Novi Sad
(Source: Urban planning, Development and Research Centre - Urbanizam, Novi Sad)

URBAN TRANSFORMATIONS OF HERITAGE AREAS: URBAN CORE VS. SURROUNDING NEIGHBOURHOODS

The shift from the industrial to post-industrial city has manifested itself on numerous levels of urban life and its spatial framework, but it is obvious that the main imperatives of further development are related to the quality of its environment. Therefore, the urban economy strongly depends on the mixture of city image, its identity, culture, accessibility and safety (Roger and Fisher, 1992), which underlines the importance of urban design. However, the process of urban revitalization, frequently driven by the logic of neo-liberal capitalism, has shown certain inconsistencies and failures, especially in the case of heritage areas. In giving priority to the economic interest of stakeholders, numerous cities have lost important elements of their urban atmosphere with a resulting decline in their quality of life. It was, therefore, necessary to establish a new system of urban indicators and guidelines incorporating a new approach to urban planning in specific surroundings. This approach took into consideration both physical and social elements and created a sustainable framework for the future improvement and development.

The problem of challenging heritage areas represents a common issue in all contemporary cities, but it has a special significance on the level of medium sized urban nodes², which also have to compete on the global scene.

² Medium sized cities in Europe are defined by the Forbs criteria (2000): 1) at least 100.000 inhabitants, 2) listed in specialized rankings, 3) the presence of at least one company headquarter.

Nevertheless, although the vast majority of European citizens live in medium sized cities, their resources and organizing capacities are far less challenged by contemporary processes of (global) urban restructuring. Recent research conducted by an international group of urbanists (Giffinger *et al.*, 2007) focused on medium-sized cities in Central Europe, using the existing economic, social and environmental potentials of selected nodes. They were analyzed in order to define possibilities for the development of competitive advantages of cities, within the appropriate niches. The authors emphasized the fact that unlike important meganodes, the medium-sized cities have to be highly specific in their approach, developing a particular aspect of their attractiveness. Since the most important global functions (command and control, business, finances etc.) are mostly concentrated in global metropolises, the lower categories of cities have to be focused on the investments which influence the general quality of life - especially spaces and activities with cultural potential, the value of existing/inherited urban milieu or the recognizable identity of a local community. In that sense, heritage areas could represent a valuable spatial resource, if maintained properly.

The medium-sized cities in ex-communist countries in Central Europe have a lot of similarities - particularly in the size of urban systems and the quality and potential of heritage zones. Additionally, they all had to face similar problems of urban, economic and social transition (Tosics, 2005). Since urban planning has been an issue at national level, the European Environment Agency proposed a platform which would help medium-sized cities of Central Europe to face contemporary challenges (European Commission - Directorate General for Regional Policy, 2011). The platform recognised the local authorities (different levels of government), business development groups, social partners and citizens (community representatives) as participants in the process of identifying visions, instruments and policies for further urban development. The sustainable urban future was underlined as an imperative, achievable through the simultaneous integration of elements related to economy, environment and social life. The sustainable treatment of the existing spatial fabric was indirectly tackled, as an element of improved quality of life, or related to the issues of urban safety and quality of green and public spaces.

The cities within EU, despite their national and regional differences, have synchronized their development within the framework given by the EU administration. Due to the process of globalization, the transformation of urban structure, as well as actual socio-economic change, are similar in both Western and ex-communist countries. Some initiatives, programs and projects address the problem of existing differences between member countries, bridging the gap caused by former development paths. They often serve as transmitters of successful western urban practices, adjusting them to local conditions. For that purpose, a wide range of projects has being funded from the EU cohesion and structural funds enabling not only the expected standardization, but also the promotion of European identity, its uniqueness, as well as cultural and regional differences and qualities. Therefore, funds are especially supportive to programs of local heritage protection and its

proper and sustainable use in the process of contemporary urban transformations.

According to Kivell (1993) the spatial transformations in the EU have been manifested as:

- growth of suburbanization;
- revitalization (re-urbanization) of central areas;
- growth of need for infrastructure;
- growth and decline of particular nuclei (i.e. the relocation of industry from the cities or the establishment of out-of-centre shopping centres in urban outskirts).

Simultaneously, the preservation of the physical fabric of the historic areas has been seen as a new potential for developing the real-estate markets of Central European countries. Therefore, the contemporary urban spatial transformation has been associated with the change in land-use pattern, restitution of private property, privatization, an influx of foreign investments and the development of new economies (Hamilton, 2005).

During the 1990s and beyond, special attention has been given to the areas with certain quality assets: historic city cores and surrounding heritage areas, i.e. housing blocks from the 19th and early 20th century. Both areas have been seen as prosperous in the (newly) established real and commercial markets, which have introduced new demands for good quality apartments, specific commercial and retail use, and development of tourism. At the same time, the built-up structures of the (protected) city cores have been perceived as an obstacle for further development, due to the limitations imposed by the legal framework (the system of heritage protection), unsuitability of the present structures for contemporary needs or the limited capacity of infrastructure supply systems (especially traffic networks and parking facilities).

However, the processes of internationalization and globalization have speeded up urban restructuring of the core areas, influencing new economies based on culture, creativity and the developing tourist industry. Foreign investments in new urban economies have helped Central European cities to start the process of regeneration focused on the declining central zones. Refurbished physical structures and public spaces have triggered the development of the real estate market for old buildings, even when they were unsuitable for modern living needs. In these cases, they were used for small business, start-up firms, specialized shops, restaurants and small-scale cultural production. Nevertheless, gentrification, as a widely promoted model of revitalization, has usually caused a decline of residential functions, traffic congestion and has severely damaged cultural heritage - due to great expectations of investors and conflicts with local heritage protection offices (Dimitrovska Andrews, 2005).

In the meantime, the areas of old neighbourhoods around the city core have allowed more flexibility. Although they present less valuable urban fabrics, their position close to the city centre represent their greatest advantage for investments. Therefore, these neighbourhoods have attracted more attention and the speed of real estate development has increased drastically. The blocks usually consist of badly

maintained nationalized apartment buildings, while in some cases these areas include some of the unused and abandoned zones of old factories and military compounds, with low intensity of use. The existing buildings and public spaces are in poor condition, with obsolete technical infrastructure.

The revitalization of older neighbourhoods has been a process of physical upgrading associated with mostly commercial activities (office and retail use), but also with residential environment of higher quality. These changes have marked the unpopular with local residents and spontaneous process of gentrification. At the same time, the abandoned sites of non-residential structures have been demolished in the process of physical regeneration (for retail and shopping centres) or re-used as cultural quarters, introducing creative industries into existing structures. All these changes have reshaped the image of contemporary cities erasing previous points of reference. Consequently, the collective identity of local communities was redefined or even destroyed, although it might have been used as a competitive advantage.

Considering these processes, Gospodini (2002) makes an important point for the future development of European cities. After analysing their contemporary position in the intensely competitive urban market, she concludes that smaller cities (with less than 500.000 inhabitants) are not visible enough on the global market, but their development prospects are, in general, assessed to be favourable. Their main advantages are openness towards new contemporary economics (new-technology and service industries, educational functions, arts, crafts and cultural industries), easier and less costly modernization of technical and other infrastructure, lower development costs, as well as closer interfaces between built and natural environment. In the context of physical transformations, Gospodini also stresses the fact that the quality of urban fabric (heritage areas and open urban spaces) represents their dominant advantage both for visitors and inhabitants. Consequently, smaller cities must protect heritage areas both from decline and from rapid development in order to attract a steady flow of new investment and new residents. Bearing in mind that smaller (and medium-sized) cities on the European periphery have even lower chances for international recognisability, the importance of good, site-specific urban design should be emphasized as a decisive factor for their future.

Simultaneously, new development in historical areas usually generates a number of problems related to the lack of detailed planning regulation, inappropriate control procedures, a-contextual design of buildings, endangered urban continuity and identity (Dimitrovska Andrews, 2005). Therefore, the recommendations for the development and transformation of inner city housing neighbourhoods, formulated by Rypkema (1994), represent a good signpost for future initiatives. He argues that the existing housing neighbourhoods could provide a sufficient number of homes for mixed-income households, while the process of gentrification - if planned and conducted - should be based on positive discrimination towards long-time residents. Suggesting preservation of buildings as a more affordable option, he underlines historic preservation as a stabilizing social and economic factor for neighbourhoods, which

would provide a sense of the past, its values and embedded memories.

RECOGNIZING THE HISTORICAL VALUE: THE CASE OF NOVI SAD

The traditional centre of Novi Sad covers an area of 35 ha and is protected as a cultural and historical centre by the Protection Act which describes it as a “morphologically balanced and spatially unique urban matrix” (Act on the protection of Novi Sad traditional city core as a spatial cultural-historic area, 2008:11). Originating from the first half of the 18th century, the development of the area could be traced on city maps - from 1745 to 1867 map made by the architect Sauter).

Around the protected city core there is a territory characterized by a mostly radiant pattern of main roads and urban blocks consisting of family houses (single/two-storey buildings), designed in a range of 19th century architectural styles. Within this zone there are areas recognized as historically important for the urban development of Novi Sad (Urban planning, Development and Research Centre - Urbanizam Novi Sad, 2009). Five of them are located around the historical core, representing distinctive functional and spatial neighbourhoods covering between 9 and 44 hectares:

- (1) Jevrejska-Futoška streets (western city axis from the city centre toward Futog village),
- (2) Vase Stajića Street (area with villas built between 1918 and 1945),
- (3) Mali Liman (urban block designed in the spirit of Modernism),
- (4) Almaški kraj (area of single-storey houses with unique urban and architectural features).
- (5) Lukijana Mušickog Street (zone of early 20th century bourgeois houses).

The zone around Jevrejska-Futoška streets is among the most important and it includes housing blocks, public institutions (i.e. secondary schools, a public baths, military barracks, hospital complexes etc.) and scarce public spaces (parks and squares). Almaški kraj has an unusual irregular urban matrix, which is uncommon for the settlements in the Pannonian region. The urban landscape consists of modest 19th century single-storey houses, while its most important feature is Almaška church, the largest orthodox church in Novi Sad (also listed as a heritage building). Zones around the streets of Lukijana Mušickog and Vase Stajića, as well as the neighbourhoods of Mali Liman, are the result of the urban development between the early 20th century and the beginning of the Second World War - the period considered to be the most prosperous in the history of Novi Sad.

During the second half of the 20th century development was concentrated on the western outskirts of the city and the vacant land by the river Danube, where large housing estates were built. The industrial facilities were strategically located in the northern part of the city, beside the new railway corridor with a new bridge over the Danube. The traditional city core and the surrounding inner-city neighbourhoods remained underdeveloped until the 1990s, when the newly established real estate market used the period of political and economic transition to its advantage.

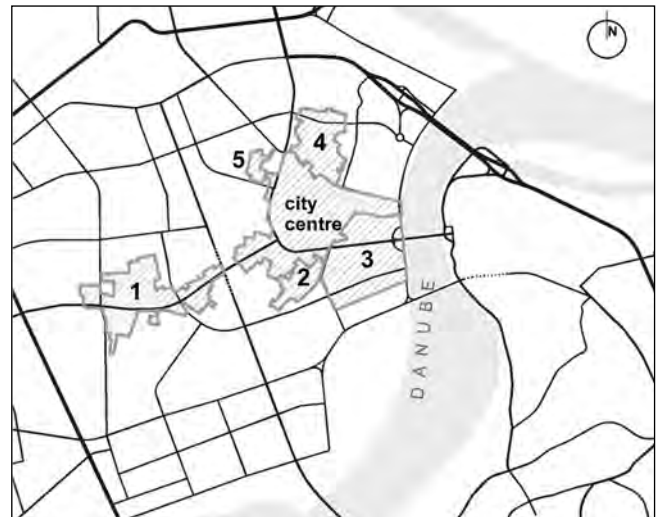


Figure 2: Novi Sad - historically important inner-city neighbourhoods: (1) area of Jevrejska-Futoška streets, (2) Vase Stajića Street, (3) Mali Liman, (4) Almaški kraj and (5) Lukijana Mušickog Street. (Source: Urban planning, Development and Research Centre - Urbanizam, Novi Sad)

Challenging the urban identity: development in the period of transition (2001-2009)

The transition of the political and economic system of Serbia accelerated after October 2000. A new democratic government was elected and a comprehensive process of change started on all levels of society. The urban environment mirrored a transition in the social, economic and spatial spheres due to the modified role of local governments, the profile of stakeholders, the appearing system of investments and establishment of the real estate market. Considering the fact that local governance in a contemporary city has a huge impact on urban development and city image, it was not surprising that its importance in directing urban growth in Serbian cities increased (Stupar and Hamamcioglu, 2006). In this period, local government responsibility was confined to maintaining the primary urban infrastructure, while diverse categories of private investors focused on the construction of business and commercial properties and residential buildings.

The situation in Novi Sad followed the same trend, but the speed and intensity of these changes was additionally increased by the special position and role of the city. Situated on two Pan-European corridors (VII and X) and in close proximity to Belgrade and its airport, Novi Sad was exposed to a commercialization of urban space, intensified development of the real-estate market and a significant influx of money through both foreign investments and a process of privatization. Consequently, during the first decade of the 21st century Novi Sad became the second national champion (after Belgrade) in real estate development (Đivuljskij, 2006) and the extremely (neo)liberal investment climate produced a boom in apartment building until 2008. According to the data provided by the Urban planning, Development and Research Centre - Urbanizam Novi Sad (2009), the annual number of new apartments constructed during the period 2003-2008 was three to five times higher than the average in the previous decade. However, although the real estate development became one of the corner-

stones of urban economic growth, the planning process was unsuited to the needs of the emerging market. During this phase (2001-2009), the central urban core remained largely unaffected, leaving intact several post-war shopping centres unsympathetic to the historic urban fabric. The focus of the construction boom was on residential blocks, mostly in neighbourhoods in the north-western fringes (Detelinara). They predominantly consisted of large lots with single-family houses. The second focal area was on the southern border of the city centre (Grbavica neighbourhood). Meanwhile, there were no significant developments in retail and office space or public buildings.

In general, new development represented an intensive rebuilding of existing urban blocks, without interrupting/transforming the present urban matrix. Existing single-family houses were replaced by multi-family flats (usually of five storeys). At the same time, the previous horizontal regulation remained the same in order to maximize the value obtainable from individual lots. This process, conducted in a very short time, was not accompanied by the necessary development of public services, sufficient parking places, or upgrading and extension of public and green spaces. The introduction of much higher buildings into the existing urban pattern drastically changed the character and physical relations of the space, additionally raising the number of inhabitants. Consequently, the identity of the neighbourhoods was altered, the environmental quality decreased, while urban systems were strained by an unplanned influx of new users. The same logic of forced urban intensification was intended for some other traditional areas closer to the city centre, but the process was stopped due to the lack of finance in 2009, when the global (economic) crisis caused a decline in all construction activities. Although the heritage areas of the traditional city core and surrounding areas remained relatively protected, a small number of exclusive apartment buildings have been built since.

Obviously, the power of real estate markets, as well as profit-led development, can have damaging effects on the old urban structure. The situation becomes especially critical if these pressures result in poor quality of urban design, inconsistent and questionable construction principles and features, implemented without consideration of the environmental context (Balestrieri, 2013). Jeopardizing the inherited values and continuity of these historic areas the city could permanently lose a vital part of its urban memory and uniqueness. Instead, the urban heritage should

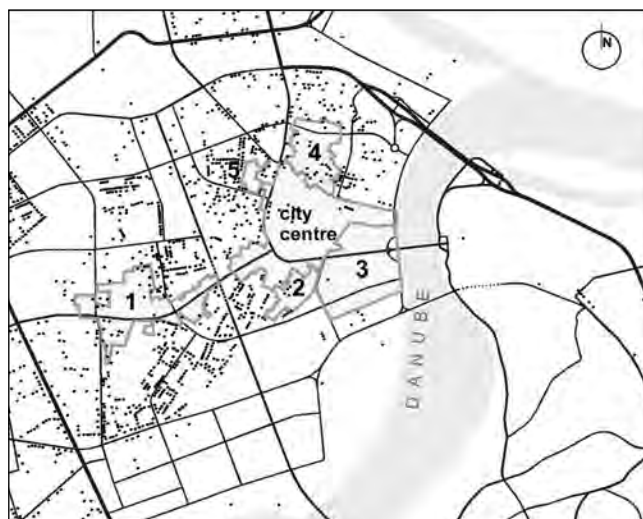


Figure 3: New buildings vs. neighbourhoods with urban heritage: building permission for residential and business buildings (mostly outside heritage neighbourhoods), period 2004-2014. (Source: Urban planning, Development and Research Centre - Urbanizam, Novi Sad)

be cherished as an important (and permanent) resource, whose attraction can generate long-lasting benefits for both the community and the city.

Toward 2030: Re-defining the planning approach

The period after 2008 was marked by a rationalization of investment priorities which brought about some new trends in spatial development. The new urban planning documents (detailed regulation plans, general regulation plans and city master plan) have been under revision, in response to the new investment climate. Work on a new Master Plan for Novi Sad has been initiated, anticipating urban development up to 2030. Relying on an improved methodology and appropriate/updated planning tools, the new vision should provide a different, more responsive approach toward the built urban heritage, reconsidering its value and role in developing a general urban competitiveness.

According to Friedeman (1973), the concept of urban planning should connect forms of knowledge with forms of action, and, within this context, the central point of the normative approach design (Steinø, 2003). Therefore, planning has to have a well-defined idea about the future, the anticipated/expected outcomes of proposed strategies, as well as how the plans are to be implemented. Considering this framework, the built environment should be treated

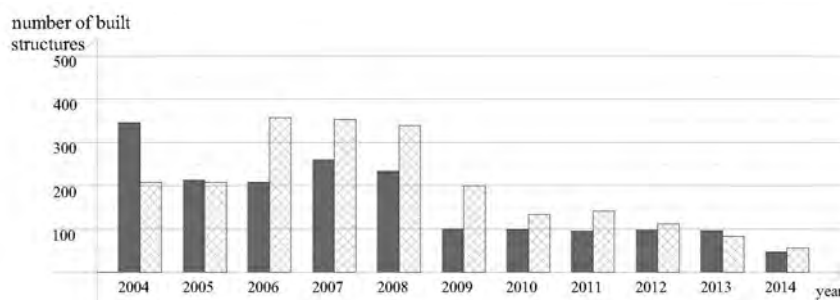


Figure 4: The dynamic of the construction process (2004-2014) - the number of residential (dark grey) and commercial buildings (light gray) (Source: Urban planning, Development and Research Centre - Urbanizam, Novi Sad)

from a normative perspective, which is especially important in areas with heritage qualities. In the case of the new master plan for Novi Sad, it is necessary to introduce a list of rules which will ensure that existing physical structures are taken into account when new developments are being considered. The quality of the existing urban fabric should be analyzed from different aspects, but mostly concentrating on physical design – i.e. the quality and morphology of the urban matrix, as well as the structural and architectural features of the existing buildings. Simultaneously, it is important to define a set of design standards which should be applied to all new buildings. These norms, as an important part of a redefined normative planning approach, should seek to add, to existing areas, new value on the spatial, functional, cultural and environmental levels.

The legal framework in the Republic of Serbia provides at least two ways for the protection of built cultural heritage - passive, as well as active. The Law on Cultural Goods (1994) defines a procedure by which buildings of certain cultural, historic and architectural value may be listed as monuments. According to the Law on Planning and Construction (2009), an urban plan can provide a certain level of protection of the urban fabric, including structures of specific urban and architectural value. Plans, therefore, can provide directives for the treatment of existing structures, as well as rules for shaping new ones. Considering these legal determinants the preparation of the new master plan included within it a Study of the Urban and Architectural design of Novi Sad (2009), which had been undertaken in order to identify areas with significant heritage assets. The Study, as a precondition for finalizing the new strategic document, focused on the recognition of the areas with the highest concentration of protected and valuable buildings and important public spaces. It also stated that some of the existing common practices (i.e. developing lot by lot, high-rise building etc.) will remain, but with some alternation which could provide more precise and detailed instructions as tools to guide new development. The findings of the study have been integrated in the planning process and should be included in the final version of the Master Plan of Novi Sad 2030.

However, the planning tools for the implementation of the intended actions have not yet been developed and the relation between the identified (target) zones and the suggested rules has to be further elaborated and adjusted to local setting(s). Consequently, several aspects need to be considered in defining the criteria for a typological classification of urban areas, their 'profiling' and a proper application of the suggested rules:

1. Historical and geographical aspect

- Historical uniqueness/identity (an area materializes a valuable period of local history, or is developed under unique historical conditions),
- Spatial uniqueness/identity (shaped by natural or man-made restrictions);

2. Urban and architectural aspect

- Consistence of urban morphology (recognizable spatial pattern, diverse urban typology),
- Quality of public space (street pattern, number of

squares, visual connections to urban focal points and other spatial features),

- Number and concentration of buildings constituting a specific protected heritage or conservation area;

3. Planning perspective

- Area of mostly unchanged urban and architectural structures,
- Recent new practice - added or preserved values of spatial quality;

4. Other preferences

- Uniqueness of public, and specifically green, spaces,
- Natural protected monuments (including parks and botanical assets)
- Other reasons (intangible values of an area etc).

In order to direct future development of identified areas with specific urban (built) heritage, the site-sensitive rules should be responsive to detected problems of both urban and architectural design. Bearing in mind possible deviations from planning outcomes, caused by conflicts in the values and interests of different actors, these rules should be adhered to in every project.

On the level of the urban fabric, the set of rules for urban design should include:

- keeping the present profile of the streets (except in cases when a small correction will improve the traffic flow);
- protecting the existing urban and architectural pattern (limits on the height of perimeter blocks and on the volume of new structures);
- preserving quality public spaces and architecturally important buildings, whether they are recognized as heritage assets or not;
- design of new structures which should provide spatial uniqueness and help maintain the existing identity of a neighbourhood.

With respect to the construction of new buildings and their accommodation to the existing visual and historical qualities of the area, the rules relating to architectural design should consider:

- the preservation of street frontage elevations (up to three storeys and attic);
- the retention of existing roof forms;
- the maintenance of local facade designs;
- the use of only authentic materials in facades.

CONCLUSION

The most important issue for urban development in Novi Sad represents its positioning in the group of medium-sized Central European cities. Only within this constellation will Novi Sad be able to fully develop its spatial, social and cultural potential and become a competitive urban node on the global scene. Simultaneously, it is important to notice that the share of public (state) funds in urban development has decreased significantly since 2001, and consequently, the

city has had to search for private investors, whose interests often collided with planning objectives, environmental imperatives or already embedded traditions and urban memories.

The period between 2001 and 2009 was one of the most intense development phases for the real estate market. Searching for well-positioned sites in close proximity to the city centre, a number of small developers acquired segments of the inner-city neighbourhoods, replacing small single-family houses by five-story high, multi-family housing. This trend increased the population density and highlighted the insufficient capacity of existing infrastructural systems and impacted on the overall quality of the urban space. Since 2009, the declining rate of new investments in residential, retail and other commercial buildings has halted construction activities and created a vacuum which might be used for reviving earlier goals for the local economy and setting new visions of economic, social, cultural and spatial development. Maintaining good conditions for future real estate development certainly remains one of the major goals, but only within a development framework which respects values of the built heritage - as an element of urban identity and social cohesion, an imperative of attractiveness and providing the potential for an important competitive advantage on the local and European level. Contemporary trends in urban regeneration have already confirmed this thesis by implementing numerous projects and initiatives focused on old inner-city neighbourhoods.

Some areas of Novi Sad have already sacrificed their spatial identity under the new wave of investments. Using the obvious lack of formal protection, ignoring urban fabric and its heritage substance, new buildings imposed their own logic and rhythm to the space, negating the local cultural context. However, these situations could be prevented by the implementation of agreed urban design guidelines, rules and instruments.

Recognizing the importance of these recommendations, the preparation of the Master Plan of Novi Sad 2030 included a study intended to help reconcile two opposing interests – the will to protect and preserve the urban heritage and the pressure for new development and investment. The new approach introduced site-sensitive rules and standards for urban and architectural design, to be further elaborated in other planning documents. Their implementation should assist planning and architectural practice in the preservation of urban memory and of the atmosphere of old neighbourhoods in the contemporary life of Novi Sad.

REFERENCES

- Balestrieri, M. (2013) Contested Landscapes, Conflicts of Interests Controversies in Planning and Using Space, *SPATIUM*, No. 29, Belgrade, pp. 53-58.
- Dimitrovska Andrews, K. (2005) Mastering the post-socialist city: Impacts on planning the built environment, in Hamilton, I., Dimitrovska Andrews, K. and Pichler-Milanovic, N.(eds.) *Transformation of Cities in Central and Eastern Europe-Towards globalization*. Tokyo, New York, Paris: United Nations University Press, pp. 153-186.
- Divuljskij, A. (2006) *Zašto divljaju cene kvadrata u Beogradu i Novom Sadu? Stanovi su skupi i biće sve skuplji*, http://www.ekapija.com/website/sr/company/photoArticle.php?id=151417&path=IMG_1725.jpg, accessed 20th Oct 2014.
- European Commission-Directorate General for Regional Policy (2011) *Cities of tomorrow - Challenges, visions, ways forward*, http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/citiesoftomorrow/citiesoftomorrow_final.pdf, accessed 20th Oct 2014.
- Friedman, J. (1973) A Response to Altschuler: Comprehensive planning as a process, in Faludi, A. (ed.) *A Reader in Planning Theory*. Oxford: Pergamon Press, pp. 211-216 (Originally published in JAIP, Vol. 31, 1965).
- Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanović, N., Meijers, E. (2007) *Smart cities - Ranking of European medium-sized cities*. Vienna, Ljubljana, Delft: Centre of Regional Science (SRF)-Vienna University of Technology, Department of Geography-University of Ljubljana, Research Institute for Housing, Urban and Mobility Studies (OTB)-Delft University of Technology. http://www.smart-cities.eu/download/smart_cities_final_report.pdf, accessed 19th Oct 2014.
- Gospodini, A. (2002) European Cities in Competition and the New 'Uses' of urban design, *Journal of Urban Design*, Vol. 7, No. 1, pp. 59-73.
- Hamilton, I. (2005) The external forces: Towards globalization and European integration, in Hamilton, I., Dimitrovska Andrews, K. and Pichler-Milanovic, N. (eds.) *Transformation of Cities in Central and Eastern Europe-Towards globalization*, Tokyo, New York, Paris: United Nations University Press, pp. 79-115.
- Kivell, P. (1993) *Land and the City: Patterns and Process of Urban Change*. New York: Routledge.
- Law on Cultural goods*, Official Gazette of Republic of Serbia, No. 71/94/ (*Zakon o kulturnim dobrima*, Službeni glasnik Republike Srbije, br. 71/94), <http://www.zurnbis.rs/zakoni/Zakon%20o%20kulturnim%20dobrima.pdf>, accessed 19th Oct 2014.
- Law on Planning and Construction*, Official Gazette of Republic of Serbia, No. 72/09, 81/09-corr., 64/10-US, 24/11, 121/12, 42/13-US, 50/13-US, 98/13-US/ *Zakon o planiranju i izgradnji*, (Službeni glasnik Republike Srbije, br. 72/09, 81/09-ispr., 64/10-US, 24/11, 121/12, 42/13-US, 50/13-US i 98/13-US), http://www.urbansu.rs/pdf/zakonska_regulativa/zakon_o_planiranju_i_izgradnji24-11.pdf, accessed 19th Oct 2014.
- The act on protection of Novi Sad traditional city core as spatial cultural-historic area*, Official Gazette of Republic of Serbia, No. 07/08 / (*Odluka o zaštiti starog gradskog jezgra za prostornu kulturno-istorijsku celinu*, Službeni glasnik Republike Srbije, broj 07/08).
- Roger, R., Fisher, M. (1992), *A New London*. London: Penguin Books.
- Rypkema, D. (1994) *The Economics of Historic Preservation, a Community Leader's Guide*. Washington: National trust for Historic Preservation.
- Steinø, N. (2003) *Vision, Plan and Reality-urban design between conceptualization and realization*, PhD thesis, Aarhus School of Architecture, <http://homes.create.aau.dk/steino/phd/steino-thesis.pdf>, accessed 20th Oct 2014.

Stupar, A., Hamamcioglu, C. (2006) Chasing the Limelight: Belgrade and Istanbul in the Global Competition, *SPATIUM*, No. 13-14, Belgrade, pp. 27-33.

Tosics, I. (2005) City development in central and eastern Europe since 1990: The impacts of internal forces, in Hamilton, I., Dimitrovska Andrews, K. and Pichler-Milanovic, N. (eds.) *Transformation of Cities in Central and Eastern Europe-Towards globalization*, Tokyo, New York, Paris: United Nations University Press, pp. 44-78.

Urban planning, Development and Research Centre - Urbanizam Novi Sad (2009) *Study on Urban and Architectural design of Novi Sad* / Centar za urbanističko planiranje, razvoj i istraživanje, JP Urbanizam - Zavod za Urbanizam Novi Sad (2009) *Studija oblikovanja gradskih celina i arhitektonskog oblikovanja objekata u Novom Sadu*, http://www.nsurbanizam.rs/sites/default/files/1837-Studija-tekst-grafika_1.pdf, accessed 20th Oct 2014.

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