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Title of the Paper Poly-functional zoning as a factor of urban sustainability

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Abstract: Cities are becoming a power of human development and this has made a problem of optimal use of city territory. In 1987 Gro Harlem Brundland commission suggested to make sure a better life quality for current and future generations and paradigm of sustainable and balanced development was aroused on this background. However urban planners do not have a solid attitude on which factors most influence the level of life quality in the cities. This is because factors of market, inertia of development and complexity of urban structure make negative environment to realization of sustainable and balanced development. Sustainable and balanced development can be reached only by regulative management. It is planned by establishing functions of city territories. Nevertheless in the most of countries mono-functional zoning is dominant, what makes set of a single function and this one-way use makes overuse of territory. Poly-functional zoning is an opportunity to follow principles of sustainable development, because withdrawal of zoning can establish all functions. This can impoverish territory in different cultural, environmental, economic, infrastructural aspects. Sustainable development studies are performed as indicators of pollution, energy, environment studies, but are mostly out of sight regulation of urban functions and management. Spatial integrity was dismissed as a part of mono-functional zoning. Therefore in this article we analyze city structure and zoning, which are influenced by permanent material stream. The analysis is based on the idea of metabolic analysis of the city. In

biology metabolism is a unit of chemical reaction in each cell. That let cells to grow, to multiple, to react to environment, to move. This some analogy is used in metabolistic research of the cities and lets us understand how to develop cities in a sustainable and balanced way. Cities transform energy (minerals, environment and information) to anthropogenized system with human biomass and their ideas, and with formed unacceptable object (waste). This is the system of input, recast, storage and output, which is like a fusion of social, economic, technical and landscape processes. They form characteristic of functional zones and priorities of the sustainable use of the zone. We recommend that poly-functional zones can be show by territorial graphs methods. As an example of such methodological approach results of poly-functional zoning research in Kaunas city are presented.

Keywords: Urban planning, sustainable development, poly-functional zoning, metabolistic approach.

1. Introduction

The land-use planners are structuring methodological aspects of their objectives and working sphere. Trying to find optimal use of public territories is based on different priorities, methods and examples. There are clear techniques of zoning and subdivision regulations type plans, the comprehensive plans, financing and planning for development plans [8]. Community opinion, economic use or technical attitude is seen as priorities. In this article we are willing to show the complexity of the problem and the potential to look in technology of planning in a different way. The article suggests, that functional zoning must be made not only for dividing of territory, but also for maintenance of relation between mono-functional and poly-functional using. We can see, that in urban planning the extremeness often is leading, while integral approach is about to forget [15], although in regional land-use planning now the opposite traditions are successfully enforcing [16].

The relevance of this work. Growing reclamation of territories shows conflict of space, matter and time. Therefore urban expansion and development are very involved not only in political and economical guidelines, but also in ecological and social aspects. Urban development designed to facilitate the elaboration of the general spatial concept and land use priorities, determination of environment and values protection conditions, formation of a system of residential, productive and infrastructural areas, regulation of employment of the population, and reservation of the territories for expansion of activity of private and legal entities. Comprehensive territorial planning is regarded as its main constituent. It means complex planning for determining a policy of spatial development of a city, priorities of its territory use and protection and basic principles of management. In urban land management web can see two approaches: extensive development in a territory using surrounding territories and their resources, and more intensive use of territory and resources making independent autonomous sustainable system.

Sustainable urban functional zoning is inseparable from legal, economic, social and ecological regulation. Therefore *the object* of this research is urban functional zoning, while *the target* of this

work is to define the features of urban functional zoning in sustainable development. *The main tasks* are:

- 1) to make revision of present urban functional zoning system;
- 2) to create functional zoning models using new graph methods;
- 3) to define metabolic phenomena in urban planning.

2. Results and Discussion

In this research we use document analysis, theory of generalisation, statistical method, computer data processing, mathematical simulation and cartographical method. All these methods are united by logical-analytical methods. The complex of these methods makes a mixed research between architecture, geography and sociology.

In the first step using ArcGis 10 programme are shown Kaunas city common plan mono-functional territories, connected into poly-functional zones, because Kaunas city common plan is made in a detail level and we can have it as mono-functional zoning example. We should not distinguish separate buildings as different function priority zones. For that reason, small zones which were surrounded by bigger functional zones were united. In this way poly-functional zones were created.

In the second step we show formed poly-functional zones structures, which were made using graph methods. Here we distinguish leading priority and attending priorities. Poly-functional structures have made multi-systems, which unified different leading area priorities. Thus we can make sure, if in the territory one function will not be leading and will not exhaust the territory.

In the third step poly-function intensiveness map was created using Krigging interpolation method. Here by the influence of poly-functional territory and the amount of using priorities, we have formed cells, which reflect the intensiveness of poly-functionalism.

Kevin Lynch was one of the firsts who defined principles of urban environment projection and administration (Lynch, 1981). He stated that urban zoning have to consider four elements: roads, areas, centres, values. Those elements were distinguished using psychological adjustment maps made by Lynch himself. Thus the most valuable principles of sustainable development were formed in Rio de Janeiro declaration.

American architect Andrés Duany proposed urban functional zoning model, which is based on the idea, that city is forever widen [12]. Therefore moving from city centre to periphery gives higher level of naturalness. However nowadays this mono-functionalism is becoming not very common and poly-functional zones started to lead in cities common plans. These zones are formed because of net optimization, which is determined by city metabolism processes.

Research of urban metabolism is being carried out based on industrial ecology, urban geography and urban planning [25]. In biology metabolism is the sum of chemical reactions taking place in every cell enabling the cells to grow, reproduce and respond to environment, move. This analogy is used in the trend of urban metabolism research. Some aspects of urban metabolism research are evident within the theory or strategy of sustainable and balanced development [6] [7] [10].

This trend helps to understand how sustainably developed cities using analogies of metabolism in living organism. Cities transform energy (minerals, environment, and knowledge) into anthropogenic system containing human biomass and their ideas, also producing undesirable objects

(waste). This inlet, use and outlet system is a fusion of social, economic, technical and landscape processes. It regulates city transformations influenced by different flows.

Metabolism stream ideas reflect in the new Anglo-Saxon geography school have large attention to pedestrian traffic. This should be taken as utopia, because whole people streams cannot be entirely managed. This aspect considers various social, energy, health, economy, aesthetics and environment problems [1]. Benton-Short and Rennie have researched the ratio between city and environment, naturalization and antropogenization processes [5]. Alexander analysed the problem of planning process management, when we need to consider nature saving problem [4]. Firstly he analyses theoretical aspects, then tries to review it in the city context.

Cullingworth and Caves explored urban planning process in the USA [8]. They generalized political processes and problems. The same research has been made in the UK [9]. Gottdiener and Budd in 2009 tried to define the main principles how to project cities. Heikkinen and Sairinen in 2007 looked how different social aspects influence urban projection. As examples they took various cities in Finland and looking at their common plans sought for the best planning standard. The sustainable development question remains relevant. Rudlin and Falk [23] discussed how community influences building and how sustainable development influences their relation. Edwards and Tsouros explored how urban systems influence human health and what is the best way to project cities to avoid those problems [14].

Urban metabolism researches practically are making in the intersection of industrial ecology, urban geography and urbanistic (urban planning and design). Metabolism in biology is a unit of chemical reaction in each cell. That let cells to grow, to multiple, to react to environment, to move. This analogy we use in urban metabolism research direction. This direction helps to understand how to sustainable develop cities using analogies of metabolism processes in organisms. Cities transform energy (minerals, environment and information) to antropogenized system with human biomass and their ideas, and with formed unacceptable object (waste). This is the system of input, recast, storage and output, which is like a fusion of social, economic, technical and landscape processes. It regulates transformation of cities; the transformations are influenced by various streams.

Cities and towns zones of influence are territories beyond cities and towns. Those territories are coherent with common city or town infrastructure, with its further development and use perspective. The streams we can assess as matter movement in territory, which influences the position of poly-functional zones. They form properties of functional zones and determine using priorities of those zones. In this way mixed building poly-functional zones are formed. Figure 1 shows poly-functional zones and material streams which formed the zones. We can see that multi-functional systems of poly-functional zones are the most common. Also we can relate that those areas are with high density and large population in the territories. Therefore poly-functional structures are the most sophisticated in high density areas, which undergo sudden changes after economic and social situation has changed.

In given model functional zoning by is area fulfilled only when separated in macrosystems, which unite poly-functional zones, where leading planning function (bigger round) and additional functions and their trends (smaller rounds) are highlighted. Without high limit of economic development that lets us to regulate the development which lines with the principles of sustainable development. In this scheme the ratio between the mono-functional and poly-functional zoning is maintained and none of them are eliminated; only the good sides are highlighted.

Figure 1. Metabolism in Kaunas city territory

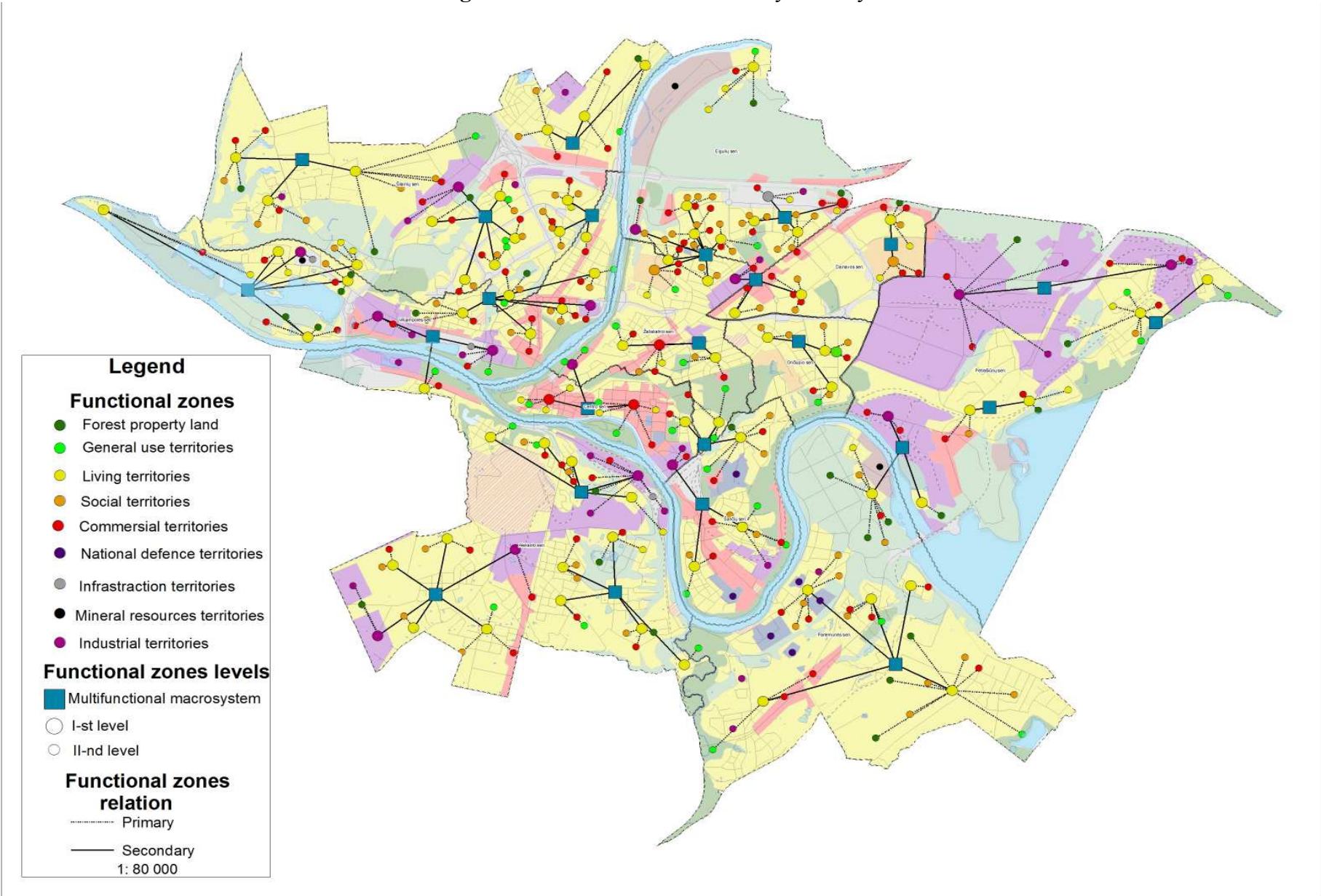
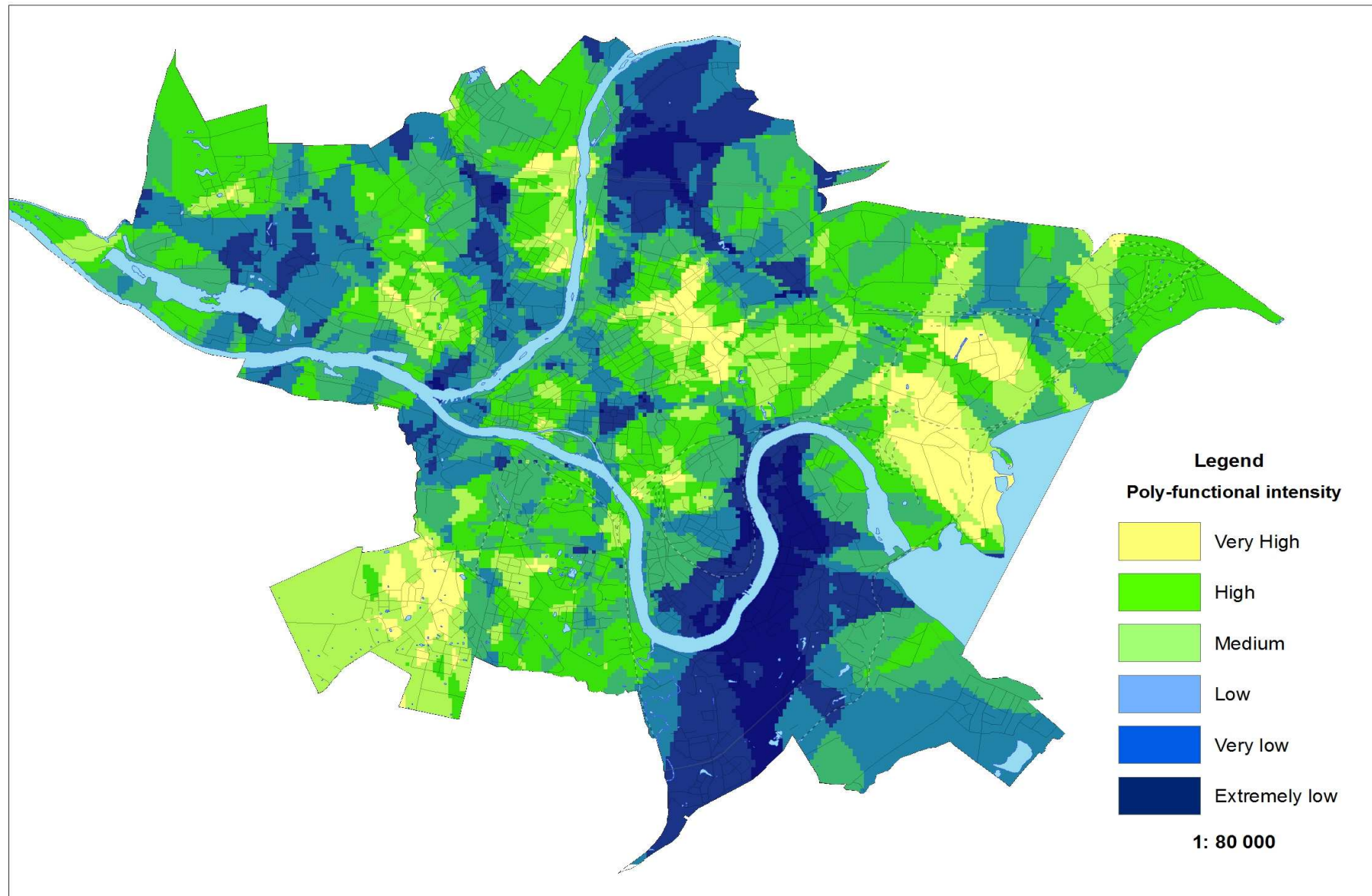


Figure 2. Poly-functional intensity in Kaunas city territory



The rounds are placed on the places that due to influence the object of the territory. For example exceptional are objects like schools, shopping centres, governing bodies, industry companies, parks. They are like mini-centre of each territory and are influenced by bigger centres. This modelling show that the real provide centres of the cities are not in new town but in leading business function areas or service function areas.

According the scheme the smaller rounds are „1“and bigger - „2“. Poly-functionalism index map was composed interpolating the meanings. Reviewing poly-functionalism intensity index spread, we can notice the most intensive, which stretches from southeast periphery, through centre towards north-east areas and it makes form of banana.

We can see that the formation of poly-functional areas around shopping centres, where the highest flow of people. Natural areas are usually in the periphery of poly-functional zones. Also poly-functionalism is intense in the conversion affected areas. Here residential and commercial areas are formed from industry priority and they dominate in poly-functional zones structure. Therefore, we find that in the industrial poly-functional zones leading is not only an industrial priority, but also commercial.

The most important observation is that the real city centre is located not at the new town, but the peripheral areas where there is a major business and service objects. Beside are formed complex systems. Thus, the principles of sustainable development should be oriented towards the development of complex sites, where possible territory overuse. Overuse should be understood not only as ecological, but as social systems that may be “overloaded” and incapable of performing their functions.

The functional zoning of Kaunas city is in transition from the mono-functional planning to the poly-functional planning [17]. Now it dominated mono-functional zoning zones, but there are a little bit poly-functional zones. One of the first examples of using the method of poly-functional zoning for the municipal comprehensive planning in Lithuania presents the last master plan of Vilnius city [24]. Grow of this methodology in the future will generate a process of the mixed planning.

3. Conclusions

- Poly-functional zoning must be recognized as one of the instruments for realising the idea of sustainable and balanced development;
- Therefore the principles of sustainable development should be oriented towards the development of territories with different functional complexity, but not to merely poly-functional or merely mono-functional zones;
- Overuse of the urban territory should be understood not only ecological, but as social systems that are affected by metabolistic urban streams;
- The urban streams can be seen as the movement of matter in the territory, which influences the positioning of the poly-functional zones and forms functional zones properties, also determines usage priorities in the territory.
- In Kaunas city master plan mono-functional territories dominate because it was carried out in previous planning style and did not take into account poly-functionality of present and future territories.

Conflict of Interest

The authors declare no conflict of interest.

References and Notes

1. Abraham, A. Walking and thinking in urban design. *Structurist* **2008**, 47/48, 28-33.
2. Allenby, B. Earth systems engineering and management. *IEEE Technology and Society Magazine* **2000/2001**, Winter, 10–24.
4. Alexander, M. *Management planning for nature conservation: a theoretical basis and practical guide*. Pemberley Natural History Books: London, UK, 2010.
5. Benton-Short, L.; Rennie, J. *Cities and nature*. Routledge: London, UK, 2009.
6. Burinskienė, M. *Miestotvarka [City Management]*. Technika: Vilnius, Lithuania, 2003.
7. Ciegis R., Ramanauskiene J. The Concept of Sustainable Development and its Use for Sustainability Scenarios. *Engineering Economics* **2009**, 16, 28-37.
8. Cullingworth, B.; Caves R. *Planning in the USA: policies, issues and processes*. Routledge: London, UK, 2009.
9. Cullingworth, B.; Nadin, V. *Town and country planning in the UK*. Routledge: Oxford shire, UK, 2006.
10. Douglas, B. Sustainable development. *Handbook of sustainable management* **2012**, 5, 23-37.
11. Heikkinen, T.; Sairinen, R. *Social impact assessment in regional land use planning: best practices from Finland*. Nordregio: Turku, Finland, 2007.
12. Gunnarsson, O. *Environmental, Traffic and land-use systems*. University of Iceland, Reykjavik: Iceland, 2007.
13. Gunnarsson, O. *End of Suburbia*. University of Iceland, Reykjavik: Iceland, 2007.
14. Edwards, P.; Tsouros A. *A healthy city is an active city: a physical activity planning guide*. World Health Organization: Copenhagen, Denmark, 2008.
15. Kavaliauskas P. Krastotvarkinio zonavimo problema [Land management zoning problem]. *Geografija* **1995**, 31, 93-103.
16. Kavaliauskas P. A concept of sustainable development for regional land use planning: Lithuanian experience. *Technological and economic development of economy* **2008**, vol.14 (1), 51-63.
17. Kavaliauskas, P.; Šabanovas, S. New approach to functional zoning in Kaunas city. *Geografija* **2011**, 47 (2), 125-132.
18. Kauno miesto savivaldybės taryba [Kaunas city municipal council]. Kauno miesto savivaldybės teritorijos bendrasis planas [Kaunas city municipality general plan]. Organizer: SĮ „Kauno planas“: Kaunas, Lithuania, 2003.
19. Kauno miesto savivaldybės taryba [Kaunas city municipal council]. Kauno miesto savivaldybės teritorijos bendrojo plano I pakeitimas [I amendment of Kaunas city municipality general plan]. Organizer: SĮ „Kauno planas“: Kaunas, Lithuania, 2006.
20. Kauno miesto savivaldybės taryba [Kaunas city municipal council]. Kauno miesto savivaldybės teritorijos bendrojo plano II pakeitimas/ parengiamoji stadija [II amendment of Kaunas city municipality general plan/ Preparation stage]. Organizer: SĮ „Kauno planas“: Kaunas, Lithuania, 2010.

21. Lynch, K. *A theory of good city form*. The MIT Press: London, UK, 1981.
22. Newman, P. W. G. Sustainability and cities: extending the metabolism model. *Landscape and Urban Planning* **1999**, *44*, 219-226.
23. Rudlin, D.; Falk; N. *Sustainable urban neighbourhood: Building the 21st century home*. Architectural Press: Oxford, UK, 2009.
24. Vilniaus miesto savivaldybės taryba [Vilnius city municipal council]. Vilniaus miesto savivaldybės teritorijos bendrasis planas [Vilnius city municipality general plan]. Organizer: SĮ „Vilniaus planas“: Vilnius, Lithuania, 2007.
25. Wood, P.; Landry, C. *The intercultural city: planning for diversity advantage*. Oxford University Press: Oxford, UK, 2008.
26. Wolman, A. The metabolism of cities. *Scientific American* **1965**, *213*, 179-190.

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