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To cite this report: Maruška Šubic Kovač, Petra Pergar Metka Sitar (2012) From Accessibility to the Land Development Potential (ATI), in Angela Hull, Cecília Silva and Luca Bertolini (Eds.) Accessibility Instruments for Planning Practice. COST Office, pp. 159-165.

From Accessibility to the Land Development Potential (ATI)

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Background

In the Republic of Slovenia, the methods of land use planning have been so far focused in particular on the physical balancing of land surfaces for a particular type of land use, and do not take into account the economic aspect in preparing the basis for land use decision-making in the process of spatial planning. A consequence is the irrational use of land. Therefore, the procedures and basic documentation for the decision-making on land use and on the restriction of land use in the spatial planning process need to be improved (Šubic Kovač, 2004).

Urban development is directly interconnected with the construction of technical infrastructure. Housing construction can take place on developed land only. Construction of technical infrastructure, however, is linked with the relatively high (direct) costs. The question is which method of urban development and/or land use zoning is conditioning the lowest land development costs (costs of technical infrastructure) over the long-term period? By the long-term policy of construction, and thereby, of land development (technical infrastructure), housing construction may be adjusted in such a way that the additional social costs of land development, at certain social benefits and in a certain long-term period, are minimised. To this end, we will need to define the appropriate factors and indicators, on the basis of which we will define the impacts of technical infrastructure on land development potential and on the additional social costs and social benefits of construction (Šubic Kovač, 2008).

The accessibility to technical infrastructure is only one factor that has to be incorporated in the model of land development potential, which can be used in the spatial planning process. Taking into account the known land developmental potential under condition of sustainable development and by an appropriate model we may transparently decide on the land use.

In the research only public utility infrastructure (technical infrastructure) defined by Spatial Planning Act (2007) will be included:

- public roads (including drains and public lightening);
- water supply (drinking water supply and (sewage) waste water treatment);
- energy services (supply) (electricity, district heating and natural gas supply).

Conceptual framework and theoretical underpinnings

The accessibility to technical infrastructure is defined in terms of the physical and cost accessibility to the technical infrastructure.

The accessibility to technical infrastructure is measured as the accessibility of the provided land use at the local level, taking into account the capacity of the existing technical infrastructure and the distance from the existing technical infrastructure.

The results of the research by the Municipal Economic Institute of Ljubljana show, that the capacity of the existing technical infrastructure and the distance from the existing technical infrastructure are the most decisive factors defining accessibility to technical infrastructures (Klemenčič, Rakar, Šubic Kovač). Also other authors argue that for the definition of the accessibility in spatial planning it is important that in addition to the spatial dimensions, we take into account the physical and socio - economic aspects of accessibility (Lotfi, Koohsari, 2009; Bisht, Mishra, Fuloria, 2010). In addition also the political goal of the European Communities is that the municipal services ought to provide the needs and expectations of users of public services that are based on: universal access for all citizens and high quality services at affordable prices while ensuring the protection of

the environment, care for vulnerable groups and access to municipal services regardless of the allocation of the settlements in the region.

Under the current legislation of the Republic of Slovenia, the technical infrastructure design generally follows the spatial plan implementation, when it is already too late for the more effective and sustainable planning. The proposed instrument will define the costs and benefits of providing technical infrastructure at the strategic level of planning.

Legal provisions and practice in Slovenia do not promote the observance of the actual costs of technical infrastructure in the planning and implementation phase of land development. Because of that it is necessary to improve the situation and to analyse the accessibility as described above.

Operational aspects

Type of accessibility:

- physical distance, and;
- capacity of the existing and proposed technical infrastructure.

The accessibility instrument is determined by:

- the distance in M/KM, and;
- the capacity expressed by physical indicators of various technical infrastructure elements, and;
- finally in costs.

The distance between the public lines of technical infrastructure and a final consumer (private connectors to a private residential building) indirectly depends on the housing construction typology, settlement density, subdivision of land and, last but not least, on land ownership. The capacity of technical infrastructure depends on the specific technical characteristics, as the width and flow of public roads, quality of and pressure in the drinking water network, free capacities in the sewage systems, voltage conditions, hydraulic and heat conditions in the district heating systems, etc. There are tremendously varied indicators, and certain parameters are relevant for the specific natural conditions only within the studied area, whilst others are relevant for a particular population density only. Thus, we would limit ourselves to defining the key physical indicators for a variety of technical indicators, expressing the capacity with comparable units of measurement.

Finally we will define the social costs and benefits of (non-) providing access to technical infrastructure, taking into account the sustainable development.

The data required are:

- the land use type;
- settlement density;
- housing construction typology;
- land subdivision;
- public/private land ownership;
- technical infrastructure data;
- the distance from the existing technical infrastructure;
- the capacity of technical infrastructure;
- and others.

The majority of the information is directly available for free in public records (for example, in the cadastre of public technical infrastructure); some of data will be obtained indirectly by calculation and some will be based on a survey of different stakeholders in the process of spatial planning and land development. The data will be acquired also in the workshops, some of them from the case study.

Quantitative analysis will be made with specialized computer programmes working by using numerical data. Spatial analysis will be produced in an environment of geographic information systems. They will mainly include working with vector objects while the fuzzy logic methodology is based on the raster objects. Since we already have the appropriate licence for ArcGIS® Spatial Analyst 10, which includes some methods of fuzzy logic, we will test our accessibility instrument in that programme.

In comparison with other methods of so-called soft intelligence the establishment of the input data requires intensive scientific research work (Aliev, Aliev, 2001), while the application in place is simpler and already built

into newer programmes to work in an environment of geographic information systems (Boroushaki, Malczewski, 2010). This makes it more useful for other stakeholders in spatial planning practice. For the verification of results we will prepare a workshop for spatial planners. Within the framework of the workshop, the participants will be familiarised with the project and the model, presenting the results of the envisaged project by ICT technologies, and asking the participants for their respective opinions on the value of the results.

We will define the basic input data (fuzzy membership functions), then the further empirical calculations can be made by spatial planning practitioners. Since the basic assumption of our model is ensuring the transparency, it will also be easier to interpret the results. The interpretation will be understandable to other stakeholders in spatial planning like municipal managers and public.

Relevance for planning practice

The accessibility instrument will define the location of different degrees of accessibility ranked between 0 and 1. The results will be presented separately (for example accessibility to water services) or they will be combined. The final result will be the expertise basis to help the stakeholders in spatial planning to determine the appropriate planning zones for residential land use.

Analysis within the research will be conducted at the level of individual parcels, whilst the final accessibility instrument will cover the level of the entire municipality. The expertise basis can be used for the strategic and implementing phase of the municipal spatial plan.

The proposed accessibility instrument is under the construction and has not yet been used.

In Slovenia, the methods of land use planning have been so far focused in particular on the physical balancing of land surfaces for a particular type of use, and do not take into account the economic aspect in preparing the basis for land use decision-making in the process of spatial planning. The accessibility to technical infrastructure will be applicable in Slovenia and elsewhere in Europe, where the factors incorporated into the project impact on the social costs and social benefits of different land use in the same way.

In Slovenia, land use modelling and simulation have not been carried out yet. A consequence is that certain vacant plots of building land are not interesting for private investors, whilst certain land uses are causing exceedingly negative external effects, which had not been foreseen at the spatial planning phase. The land use modelling and simulation including the accessibility to technical infrastructure are going to introduce a dynamic model of decision-making on land use in land use planning, based on the land development potential, determined by the (social) costs and (social) benefits.

Strengths and limitations

The developmental potential of land could be determined also by including the factors and analysis of impacts on the social costs, and on social costs and social benefits which ensue from a certain land use type. In the research specific focus will be on the analysis of social costs and social benefits of the residential areas with the differing level of land development (technical infrastructure). In recent studies in the field of cost benefit analysis, the authors argue that the key problem is the underestimation of the investment value and an overestimation of social benefits. Also the social rate of return is not adequately defined (Korthals Altes, 2010). There is also a dilemma whether and to what extent the results of the analysis of social costs and benefits of specific infrastructure projects are suitable at certain stage of spatial planning (Faludi, 2000; Korthals Altes, 2010). The authors conclude (Lichfield, 1964; Evans, 2004) that social costs and benefits are relatively simple to identify, but difficult to financially quantify. Another problem is the changing attitude of the stakeholders toward individual solutions over time.

Within the recent studies of fuzzy logic it was found out, that these studies included the environment protection and the process of "thinking" of all participants in spatial planning (Galderisi, Ceudech, Pistucci, 2008; Phills *et al.*, 2004; Yanar, Akyurek, 2004; Fernandez Ruiz, 2009). According to the comparison of different methods of so-called soft intelligence, the benefits of the methods of fuzzy logic are: the possibility of interpreting the results, the transparency, the gradual process, and the tolerance to imprecise input data. As the only drawback the amount of knowledge needed to create the input data and the impossibility of learning the system is mentioned (Aliev, Aliev, 2001). We believe, however, that the inclusion of several parameters, according to Fernandez and Ruiz (2009), can cause the loss of transparency and monitoring the impact of each indicator. Other research shows the benefit of a small number of key indicators of the accessibility (Bisht, Mishra, Fuloria, 2010).

In Slovenia, the technical infrastructure is designed according to the land use area types in the spatial plan. Therefore social costs and benefits will be determined approximately. The proposed instrument will encourage the analysis of land use decision making and at the same time the transparency, and more effective and sustainable spatial planning.

We are preparing several empirical analyses in order to define the usability of the instrument within the spatial planning practice. The results of the empirical analysis will help to upgrade the scientific and practical aspects of the proposed accessibility instrument.

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Figures

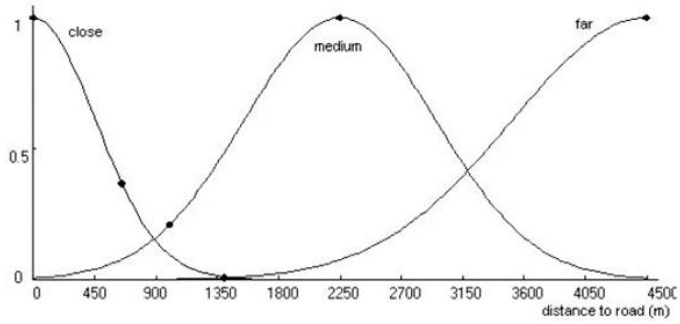

Figure 1 A case of fuzzy membership function according to the distance to the road when defining new locations for industrial sites (Source: Yanar, T.,A., Akyurek, Z. 2004. The enhancement of ArcGIS with fuzzy set theory. ESRI International User Conference, 30. June 2004: 16 str. http://proceedings. esri.com /library/userconf/proc04, 15.12.2010)