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FUNCTIONAL-NODAL METHOD OF THE DEVELOPMENT OF STRATEGIC SPATIAL PLANNING DOCUMENTATION

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Subject review

A new generation of physical planning documentation requires adaptation to new economic and many other development plans as well as to new parameters in the development of modern society. In order to ensure quality spatial planning prerequisites for the economic and social development, it is necessary to determine the optimal method of the development of physical planning documents at regional levels. The study included the analysis of possible models of strategic physical planning documentation development; the analysis of the methods of spatial plans development of the counties; and, based on the performance comparison of individual plans, determining the optimal method of their development. This was done for the purpose of determining the methods of developing the new Spatial Plan of Primorje-Gorski Kotar County.

Keywords: *physical planning documents, spatial planning, strategic planning*

Funkcionalno-nodalna metoda izrade strateške prostorno-planske dokumentacije

Pregledni članak

Nova generacija dokumenata prostornog uređenja zahtijeva prilagodbu novim gospodarskim i inim razvojnim planovima ali i novim parametrima razvoja suvremenog društva. U cilju osiguranja kvalitetnih prostorno-planskih pretpostavki gospodarskog i opće društvenog razvoja nužno je odrediti optimalnu metodu izrade dokumenata prostornog uređenja regionalne razine. Provedeno istraživanje je obuhvatilo analizu mogućih modela izrade strateških dokumenata prostornog uređenja, analizu metoda izrade prostornih planova županija te na osnovi usporedbe uspješnosti pojedinih planova utvrđivanje optimalne metode njihove izrade. Izvršeno je za potrebe određivanja metode izrade, novog, Prostornog plana Primorsko-goranske županije.

Ključne riječi: *dokumenti prostornog uređenja, prostorno planiranje, strateško planiranje*

1 Introduction

Following the Croatian independence, there have been significant changes in spatial and urban planning. New urban standards and values, which need to be articulated through the spatial planning documentation, have been adopted and accepted. A new generation of physical planning documentation requires adaptation to new economic and many other development plans as well as to new parameters in the development of modern society. In order to ensure quality spatial planning prerequisites for the overall economic and general social development through spatial planning documentation, it is necessary to carefully determine the optimal method or the level and scope of its development. The first step, of course, is to break down the total space into lower spatial units.

Spatial plan of a county is one of the new categories in spatial planning, which has no predecessor. The first is the developmental spatial plan, which encompasses regional features, and includes normative part (implementing measures). The current practice of the development of regional spatial plans included dividing regions into lower administrative units, or units of local government. Unfortunately, it is very often the case that local governments are established by political decisions, and often the level of the region is not an adequate basis for the elaboration of more detailed development guidelines. In an effort to realize and get a better and more comprehensive view of the Spatial Plan of Primorje-Gorski Kotar County, various approaches to the development of spatial plans and their structuration into lower spatial units were analyzed and studied. Parallel research was done and working methods were debated on, everything in order to choose a competent and good pathway for the planned analytical process.

To determine the optimal method of the development of spatial plans of counties and, indirectly, of other strategic physical planning documents, previous spatial research was analyzed with the purpose of the development of spatial plans of counties, and a new research was conducted. This paper presents the results of a study conducted for the purpose of the Spatial Plan of Primorje-Gorski Kotar County development. Known methods of planning documentation development are referred to generally, while the proposed functional-nodal method is explained in details.

2 Spatial differentiation

Physical planning documents are used to determine purposeful organization, the use and purpose of space, and measures and guidelines for the design and protection of space at any given time, in accordance with a thematic area that is processed. The adoption and implementation of spatial plans are made at the administrative territorial structure. Therefore, plans are typically made for administrative units rather than functional areas. Accordingly, spatial plans are divided into strategic spatial plans (The Strategy and the Program of Physical Planning of the Republic of Croatia; the spatial plan of a county; the spatial plan of the special features areas; and the spatial plan of a city/municipality) and the implementation spatial plans (general urban plan[1)], urban design plan, detailed design plan) [1].

Analysis of space is a basic prerequisite of any form of planning. The problem analysis includes the research of spatial structures, the functional interdependence of objects with location conditions, mutual functional relationships of individual objects, and development. The following regional analyses highly relevant to the issues of urbanization and cities can be highlighted as the basic

ones: the analysis of natural bases and resources, the population-demographic analysis, the economic analysis, the diffusion of innovation as a spatial process, the analysis of urbanization, the urban systems analysis, the analysis of the central settlements, and the analysis of interactions [2].

To establish guidelines for the development of a certain area, its preliminary distribution to the spatial units is necessary. Therefore, when developing the plans, it is necessary to define the scope and the differentiation of the observed area, and make a theoretical vertical division in this regard. It is necessary to make preliminary comparisons, so that the researcher is directed towards those areas that offer him best answers, and are also the basis for the chosen methodological procedure. The space can be defined by using different principles, the most common of which are as follows: the homogeneity criterion, the polarization criterion, the homogeneity and polarization synthesis, the planning region, and administrative statistical units [3]. Accordingly, the basic forms of spatial units are homogeneous, nodal and plan spatial units [3, 4].

These selections represent a baseline for evaluation structuration and space protection. In this way, the categorization of space with a wide range of analytical possibilities is obtained. Just by recognizing the fundamental division of space into space units (SU), the importance and role of transport and transport infrastructure in the overall spatial planning can be noticed. Transport and space seen as an economic system are repeatedly interdependent. They are parts of the dynamic system that is determined by external influences. It can be shown through the formation of a complex space-transport model that is defined by taking into account a wide range of components. That way, the retroactive effect of individual components can be felt as a positive or negative experience [5].

Typically, the differentiation of space is done on smaller pieces of specific features such as regions, units, areas, districts, etc., using an analytical (differentiation starts from large units (state, county, local government, etc.) which is divided into a system of smaller parts) and synthetic (regionalization starts with smaller spatial units which are based on similar characteristics grouped in the region) approach.

Table 1 Possible differentiation of space according to functional characteristics

Rank	Functional division	Functional characteristics according to public functions	Administrative division
I.	(R) Region	university, government, hospital, opera, etc.	county or counties,
II.	(mR) Micro-region	colleges and/or high schools, governmental branch-offices, a smaller hospital, theater	district, municipalities,
III.	(SU) Spatial Unit	high school and/or elementary schools, local government, health station, community center	area of one or more municipalities/cities
IV.	Structuration inside the town	elementary school	local district

Source: Štimac, M., et al. Prostorno planiranje regije-teorijski zapisi s primjenom, Županijski zavod za održivi razvoj, prostorno planiranje i zaštitu čovjekova okoliša, Rijeka, 1997, p. 5

As noted, territorial and functional division of space is the basis for structuring the physical planning documents [2, 3]. In addition to the analytical process, which is used to determine the functional division of space, in everyday communication and data collection on space, the basis is the administrative division. However, such a division of space cannot be equated with the functional differentiation. The disparity in their space coverage is often very explicit, especially as the administrative boundaries are subject to frequent changes, often under political influence. Regardless of the discrepancies, in the primary methodological approach the analytical differentiation of area can be shown in the following forms:

- functional differentiation of an area – by characteristics (individual or collective): macro-region, region, micro-region, space unit.
- administrative differentiation of an area: groups of counties - large spatial planning unities (central, northeastern and Adriatic Croatia), counties or more of them, groups of municipalities (cities), municipality (city) or more of them, town or working/tourist zone.

In the process of synthetic regionalization, the basic unit is a spatial unit, which is also the lowest rank of analytical differentiation. In this context, the fundamental task is to determine and define the SU. This is the basis for further consideration, regardless of the theoretical model, as well as the basic unit of articulation of space in the complete analytical process, from the situation assessment to final use measures and protection of space.

3 Functional-nodal method of the development of the regional spatial plan

In the spatial planning process, starting point is crucial; it determines the direction and intensity of the plan development. Therefore, setting the basic methodological premise which defines guidelines and bases for the development and protection is one of the fundamental questions.[2)] Then based on the data on the situation in the area and clearly defined development goals, the concept of the plan is defined.

Spatial activities can be predicted in different ways and using different methods. According to Padjen[3)], two main approaches to predicting the use of space can be mentioned: the traditional or evaluative (intuitive) and the model approach. The first approach is based on professional knowledge and experience of a man and a good knowledge of the area for which the expected changes in the future use of space are to be assessed. Its advantage is that it allows meeting the current and the future use of space, and all important spatial specificity of the observed area can be captured. Therefore, the implementation of this procedure is recommended when sufficient data on the use of space is collected, when they are analyzed in detail, when limited resources are

available to create space-transport studies, and if the prediction of the space purposes does not require many details. The greatest weakness of this approach is the subjectivity of evaluation and the risk that a particular phenomenon is wrongly estimated or explained. In contrast, the model approach focuses on simulating the development of space purpose and on quantifying the phenomena, and the mathematical study of mutual relationships. It allows processing unanimous phenomena and relationships, testing requirements, and quick and easy testing of alternative uses of the space. Its disadvantage is, however, that it requires a large amount of data and a lot of time. For the purpose of quantitatively predicting the space purpose, several models are applied; the most famous is the Lowry model.

To develop a Spatial Plan of the Primorje-Gorski Kotar County (SP PGKC), the method which was used is a derivative of a variety of methodological procedures. It was developed specifically for the needs of the regional spatial plan, but is applicable to all types of structural spatial plans. Because of its special features and thematic approach it is called the "Functional-Nodal Method". It consists of a sequence of activities that include the following:

1) functional selection of space (forming the relevant traffic zones),
2) structuration of space sensitivity (analytical assessment of space),
3) structuration of poles and relationships (forming the focus and functions of development), and
4) establishing the plan concept [2].

3.1 Functional selection of space into spatial units

The goal of the first step of the functional-nodal method is to establish homogeneous spatial units and their ranking. The basic division of space begins with a region. The region is a planning category, which encompasses a wide range of the space size, and is divided into several subgroups that are graded into regions (R), micro-regions (mR), spatial units, zones, etc. Spatial units are formed by the hierarchical pattern, from larger to smaller parts, and are usually related to the selection of the region areas. Depending on the level of a spatial unit, these elements are changed or updated. On the basis of functional units, gradations and the capacity of activity as well as facilities in the space are interpreted.

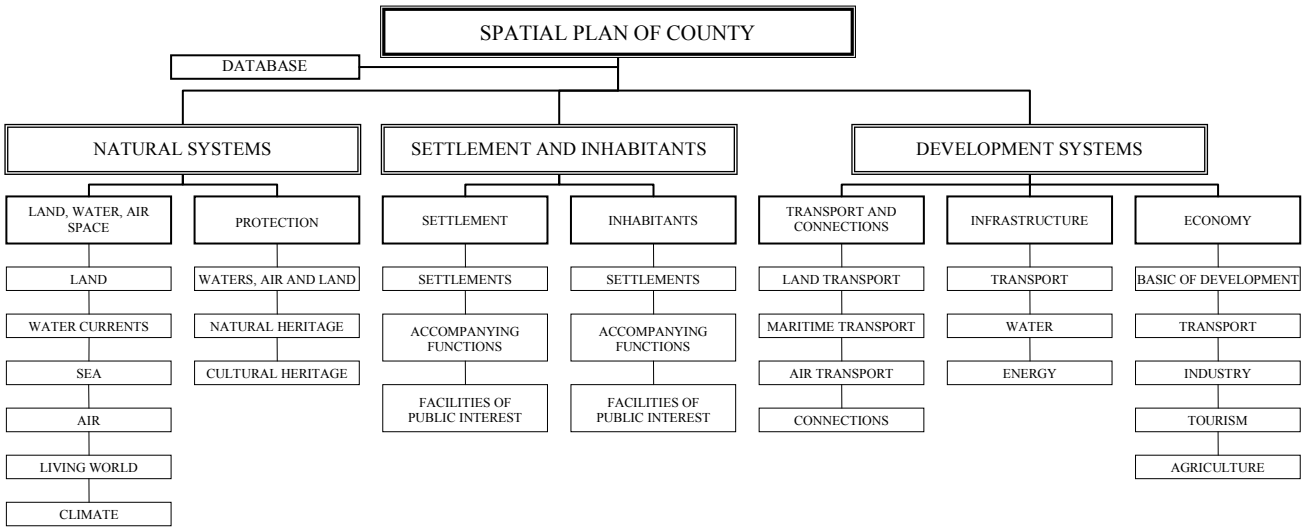

Figure 1 The scheme of spatial phenomena gradation
Source: Spatial Plan of the Primorje-Gorski Kotar County, Službene novine Primorsko-goranske županije, 14/2000, 10/2005, 50/ 2006, 08/ 2009

Any discipline that is unambiguous in space (it is not supposed to overlap with itself) is selected by the same amount of divisions as the information and knowledge obtained by researchers enable. The scale can range from two categories (prohibition of construction or without prohibition of construction) to an infinite number of categories. However, given the level of the county plan and the need to define measures to implement the plan, three to five categories are recommended. By simple overlapping of the areas of the same category, we get the entire county divided into selected categories.

By grading the phenomena in space, the features are determined by rank, type, intensity, amount, and the method of influence on the space. Gradation is done separately for each feature in a way that it is structured by rank. In the pyramid concept, groups are divided into segments, segments are divided into thematic areas, thematic areas into topics, topics to subtopics, etc. The process of forming zones occurs gradually, by dividing the elements in vertical and evaluating the phenomena of groups, segments of the thematic area to topics or subtopics. After the evaluation (empirical method), spatial identification of the lowest rank of phenomenon is performed, which is compared with the other chosen topic of the same rank.

To determine homogeneous units, the criteria that define characteristics of each area are set. Based on the above criteria, common (prevailing) characteristics of space are determined, and the relation of relationships between specific topics is set, which is used to perform gradation and selection of the phenomena in the observed space. The selection and choice of the criteria features depends on the specificity of the observed space. Evaluation of the space is performed using the graded indicators of natural and anthropogenic[4)] features. It is important to include all the reference features of the

space, evaluating and ranking their quality, capacity, size, etc. Then, natural features define the fundamental value of the space while anthropogenic features determine the degree of space exploitation. The quality of evaluation depends on the analysis of individual parameters. In the gradation of the evaluation of elements two classes are determined:

- basic criteria: towns[5)] (division by size, content of accompanying functions: education, healthcare, management), inhabitants, economy,
- corrective criteria: transport (branches and the structure of transport), infrastructure, natural features, space protection, special features (bordering areas, international traffic corridors).

The main criterion is used for forming the basic shape and position of the spatial unit, while the secondary criteria are corrective factors based on which the definition of the spatial unit is finalized. By grading space, we get units that are functionally complete and independent depending on their rank. Each SU was formed on the principle of the unity of space according to basic and corrective criteria and has its own functional autonomy of the same rank. The number and type of indicators can be chosen arbitrarily, but the quality or accuracy of the formation of spatial units depends on this choice.

Then, it is necessary to perform the synthesis analysis of the basic selection of space that is performed so that the space selection is performed. Here the areas that make a complete natural unit are not divided into smaller parts. Anthropogenic area depending on the intensity and frequency of activities in the space (economic activity, housing, recreation, etc.) are still considered and selected into SU of specific homogeneous features.

3.2 Structuration of the space sensitivity

Categories of space sensitivity or restriction zones are determined arbitrarily depending on the size of the area, the number and accuracy of data, and the desired level of the space selection. The basis for the structuration of the space sensitivity is a natural system. Natural systems are land, air, water, sea, flora, fauna, vegetation, climate, etc. By selecting the topics, summary data on the sensitivity of the area is obtained and is rated in several categories, depending on the data details. Gradation of natural features can be done on several grounds; for example, grouping segments can be determined for the group of natural systems, such as:

a) land: arable, meadows and pastures, rocky ground
b) waters: permanent water currents, torrential water currents, lakes,
c) sea: deep (over 10 m), shallow (below 10 m), fast currents, slow currents,
d) flora
e) land fauna: big game, small game, birds,
f) sea fauna: fish, crabs,
g) vegetation: pine, fir, beech,
h) relief: grade levels in meters, >50, 50÷0 (sea), 0÷100, 100÷800, >800
i) climate: according to the Köppen climate classification
j) climate: temperature in °C, >10, 10÷5, 5÷0, 0÷(−5), <−5
k) climate: snow in cm, 0÷5, 5÷50, 50÷100, >100.

For each of these categories it is necessary to define criteria and indicators so as to set unique criteria for comparison. By using the set criteria, resulting points are selected and spatially defined. These values are positioned in the appropriate category of sensitivity, depending on their number and characteristics. For example, for four categories of sensitivity the following criteria for the space use can be determined:

Category I: area of prohibited construction and alterations in space,
Category II: area of restricted construction and alterations in space,
Category III: area of regulation where additional attention is necessary while forming construction areas, planning the construction or other alterations in space,
Category IV: area where any kind of activity is allowed.

By simple overlapping of the areas of particular natural systems of the same category, the space is divided into the selected categories. With further expertise, conflict and controversies are resolved. These data constitute the fundamental basis for determining the areas intended for defining construction areas and all other alterations in the space.

3.3 Structuration of poles and connections

Poles are used to position foci of interest and activities within specific areas (R, mR, SU). The type of areas or their relationship (rank) also determines the corresponding category, the importance or the rank of the pole. By connecting the poles of the same rank a corresponding network of connections is formed; it can be any form of their relationship and communication (infrastructure). In this way, a very simple and rational matrix of poles and connections is formed and it has its origin in the structuration (division) of space into homogeneous units. Within the functional units that represent a homogeneous space, by positioning and grading of poles, the position and rank (importance) of the focus of development are determined in order to form a network of central towns.

The structuration of poles with the purpose of obtaining a network of development centers can be done in several ways. Economic and demographic indicators are the dominant parameters for the development of an area, in this case for individual functional units. They are based on the data showing the indicators of the previous period, present status, and trends and perspectives. They are determined according to the levels of functional units and are interpreted in the context of spatial planning parameters. The fundamental question for the structuration of space is: How many working places should be anticipated considering the planned economic development? The basis for obtaining the data consists of identifying basic trends of development (annual rate, targeted national income per inhabitant), dominant economic sectors and the structure of the planned activity

(industry, transport, tourism, agriculture, forestry, fishing industry), the planned rate of demographic change in structure, density and ethnic composition with the mandatory extrapolation of the projection of working-age population, and strategic characteristics of the area (border areas, transportation routes). Space protection belongs to the anthropogenic features; it is a very strong indicator of the specificity of a particular area.

Based on these economic and demographic data, the network of towns together with the approximate number and structure of the planned population in towns is determined, or the data on jobs at the functional units, which suggests the gravitating number of the working population. This process created elementary preconditions for the structuration of poles, based on which, according to the rank of centrality which it belongs to, a network of central towns is formed. In this way, through the layered process, which included all the relevant physical characteristics, the system of central towns at all levels and their interrelationship are determined.

When forming a network of towns, the gradation from the first level onwards must be made. This means that the center of SU from different mRs does not have the same characteristics even though it is of the same rank. Therefore, based on additional scores, the analysis of the centers within the same group is made.[6)] For the purposes of spatial planning, when analyzing central towns, simple models which include the catalog of representative central functions are often applied. Central towns are determined according to the degree of centralization so that for each degree one or more representative institutions from primary central functions are determined. Therefore, for the purposes of the functional-nodal method, the Christaller model of gravitational radius of the central town area and the model of determining central towns by catalog of central functions were used [4, 6].

4 Interrelation of transport and space

The key to understanding urban entities lies in analyzing the structure of space and the interrelation between transport and space allocation. Here spatial interaction involves the nature and size of the destination of urban movement of passengers or cargo. It takes into account the attributes of the transport system as well as the space use element which is generated by certain space attractions. The interaction is directly dependent on the level of accumulation of spatial activities and the demand for total mobility [5].

The model of a transport network is composed of a series of entities, segments of the transport network (nodes) that are limited by hubs, traffic zones. In order to determine the spatial distribution of travels that occur in a particular area, the division into traffic zones is necessary. Traffic zones are less physically-geographic, demographic and economic homogeneous units of an area. Traffic zones and other areas are used not only as aggregate and address areas of end points of travel in the transport modeling, but also for an easier and clearer presentation of the results of analyses and modeling. Typical traffic model commonly covers only inter-zonal traffic and ignores intra-zonal traffic.

By understanding the traffic demand of certain zones (depending on their purpose), a clear pattern can be established; with this pattern, depending on the use of space, a diagram of the line of the desired is formed, depending on the requirements for zonal connectivity. The purpose of space, both formal and functional, presents a group of relations with other space uses. Given that each of the purposes of space has specific requirements for transport, traffic is the key factor of activity in the zone and is associated with the specific space use.

In the context of transport planning, defining the traffic zones and directions presents a fundamental prerequisite for quality linking of spatial activities, and represents a critical segment of the mutual cooperation between spatial planners from different disciplines (especially urban planners and transportation planners). It is based on the factors that influence the generation of traffic demand, or otherwise directly affect the flow of traffic on the planned traffic network.[7)] It is known that different uses of space have different degrees of generating travel and that transport connectivity differs according to types and frequencies between particular space purposes, which is especially important when creating traffic projections.

From the viewpoint of spatial planning, traffic zones are predefined by basic parameters of development depending on the level of spatial plan, in our case recognized as a spatial unit. Typically, plans of higher levels, strategically define a particular use of space (potential traffic zone) which is later, through the development of spatial plans at lower levels, designed and determined in more details. Therefore, the term traffic zone is in fact conditioned by the level of spatial-planning documentation it is developed for. It can be concluded that, in relation to the transport network, construction areas represent the analogy to the transport node. Capacity and efficiency of the whole transport network significantly depend on its traffic benefits. Planned defining of spatial units is conditioned by the characteristics of space, while the dotted determining of the focus of development (towns, work, tourist, sports and other zones) is actually an input parameter for the quality design of transport routes which the mentioned foci are connected with. In order to gain the truer, more detailed picture of traffic movements, it is necessary to work with a relatively large number of zones in the phase of spatial-transport planning. Otherwise, certain part of traffic is "lost" or is unrealistically shown in the nodal points of the network. This kind of work on the spatial-transport planning enables setting the planned road network, determines its function (road category), and the optimal shape of the network.

From the standpoint of strategic spatial planning, when conducting traffic analyses, certain urban areas may represent a single traffic zone while extra-urban routes in this case represent a link between two or more global urban zones. It is necessary to unambiguously define the sections of extra-urban traffic routes which enter the town areas, which usually overlaps with the strategic spatial planning documentation. At the lowest levels of both networks, the function of approach to peripheral locations is dominant, while at higher hierarchical levels the base

function is the movement of vehicles. When it comes to traffic routes, it is important to emphasize that unless there are special features, each traffic route needs to meet three conditions of equilibrium: linear, alternate, and time [3].

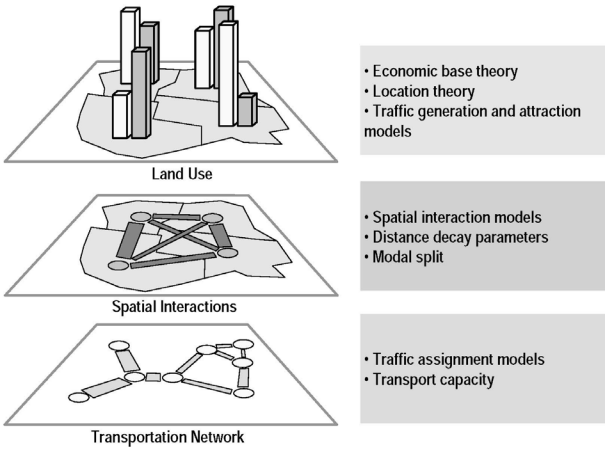

Figure 2 Components of the correlational land use-transport model Source: Rodrigue, J-P, et al. The Geography of Transport Systems, Chapter 7-Urban Transportation, Routledge, New York, 2006, p. 181, (adapted by the authors)

In order to design traffic routes in the quality way, it is necessary to determine the model of traffic demand (the model of travel) written in the form of a matrix of travel. It is made in four steps: generation, distribution, modal division, and travel assignment. The analysis of interactions between traffic zones is mainly done by the gravitational model [5]. When we talk about regional spatial planning, the development plan of the traffic and other infrastructure follows the selection of space by the functional principle. Each level (R, mR, SU) specifies the level (rank) of infrastructure. Thus we get the national, macro-regional, regional, micro-regional, and network at the level of spatial unit. This division is mandatory for all forms of infrastructure, particularly for transport (road, rail, maritime). The connection between certain poles (central towns) has many forms. Based on the functions analysis (transport, connections and energetics) the connection modalities are determined. This primarily means defining the type, shape and rank of connections.

Anticipated traffic flows, regardless of the observation unit, are formed from the demand for travel within the observed gravitational area where the total number of desired travels in a zone is allocated to all other zones in proportion to their rates of attractiveness. The rates are determined according to existing laws of distribution which encompass measurable attributes of production and attraction of each zone, and attributes of realization of each travel (selection of the means of travel, travel length and time, total cost of the travel, etc.); these attributes are directly linked to the characteristics of the transport network which they are realized in. Regularities are determined by sampling the existing travels on the existing road network.

Table 2 Model for determining the degree of urbanization

Average share of non-agricultural population	Average share of urban population	
	SU*>R**	SU<R
SU>R	I	II
SU<R	III	IV

* SU – spatial units; ** R – regions; Source: Štimac, M., et al. Prostorno planiranje regije-teorijski zapisi s primjenom, Županijski zavod za održivi razvoj, prostorno planiranje i zaštitu čovjekova okoliša, Rijeka, 1997, p. 10

Necessary prerequisite for the forecast is the determination of regularities which appear in transport and defining the connection between transport and relevant factors which influence its size. Significant information that can be used to identify the traffic demand of a specific area is the degree of urbanization. The way space is used is determined by its purpose, while the level of spatial accumulation points to its intensity and concentration. The majority of human activities, whether it is about economics, social or cultural programs, has multiple functions such as production, consumption and distribution. These functions can occur, depending on the accumulation of space use, in urban areas. Urbanization itself raises the question of the location of industry, services and infrastructure development. The degree of urbanization is an indication of how far the process of urbanization has come to.

It is necessary to emphasize that the analysis of an urban system is based on two dimensions, the hierarchical and spatial. The hierarchical dimension is analyzed in two ways. The first is by applying the rules of size order (based on the assumption that there is a causal relationship between the size of centers and the functional meaning), which can be expressed by the formula: $S_n = S_1 r^q_n$ where S_n is the number of city inhabitants n; S_1 is the number of inhabitants of the largest city; r_n is the ordinal number of the city in the range of cities ranked by size; q is the constant. Another way is to use the urban primacy index that is used for analysis of the hierarchy of the urban system. The index represents the ratio of the largest and second largest city: $I = G_1 G_2$. According to the law of urban primacy, the ratio between the largest and second largest city should be equal to 2. Deviations from this value can be positive or negative.

The spatial dimension of urban systems can be analyzed from the point of the size of the urban system and its topological characteristics. The size (spatial coverage) of the urban system determines its fundamental gravitational area, too. The size of the nodal region is in accordance with the functional significance or the size of the center, which can be divided into daily or local, regional, national, and international. Urban systems by topological features can be regular, irregular and transitional. In the nature, irregular systems are predominant. All the above shows the uniqueness of the classical transport planning process and the new functional-nodal method of spatial planning, which further emphasizes the importance and the role of transport research in the framework of activities related to the development of physical planning at all levels.

5 The plan concept

The basic concept of planning and space use is obtained on the basis of the presented model, by comparing the indicators that define the functional selection of space, the sensitivity of space, the network of towns (and the total construction areas), and infrastructure network. On the surface, which is formed on the basis of the functional structuration of surfaces and the structuration of the space protection, poles and connections are defined. In this way, the basic guidelines for planning and space use are defined. This makes the concept of physical planning defined in its basic framework.

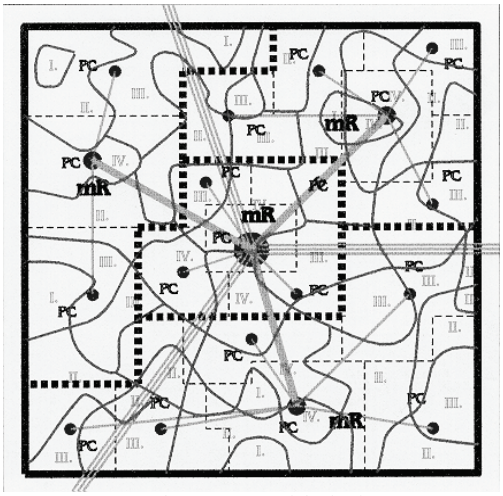

Figure 3 Schematogram of the basic concept
Source: Štimac, M., et al. Prostorno planiranje regije-teorijski zapisi s primjenom, Županijski zavod za održivi razvoj, prostorno planiranje i zaštitu čovjekova okoliša, Rijeka, 1997, p. 24

By overlapping all the obtained basic structurations of space, the starting point for more detailed division of space is obtained. The above procedure was used to form functional units, which are generally not consistent with the administrative division of areas (boundaries of counties, municipalities, statistical towns). This discrepancy needs to be balanced because the operational development and implementation of spatial plans is adopted and implemented according to administrative structure. In practice, this is feasible since the areas formed by functional selection can be interpreted and structured according to the administrative division - this especially, since it is only the principle planner settings, or the plan concept. From this point of view, the needs of the plan concept by the content and size are met since the basic determinants of the plan are determined:

- organization of spatial structure: the basic characteristics of each spatial unit; it is derived from the functional selection of the space,
- system of space protection arises from the structuration of the space sensitivity,
- system of town network from the system of poles, and
- system of infrastructure from the system of connections.

In this way, the basic guidelines for planning, use and protection of space are determined, which makes the spatial plan concept defined in its basic framework. Further division can be done by a series of criteria and bases, depending on the need of the research itself. Usually, when making a spatial plan, in further work, the division must be complex and versatile and must include a number of elaborations suitable to the development of a spatial plan. It necessarily includes the functional structuration of space, space protection, a network of central towns and infrastructure systems, all in the context of the set objectives and principles.

6 Practical application of the functional-nodal method

With the functional-nodal method for the needs of SP PGKC the functional selection of space was performed according to the characteristics, and spatial units, which make the threshold of the analytical division of the County, were obtained; they encompass one or more municipalities and cities. Based on this methodology, PGKC is preliminarily divided into three levels. The first level is the level of region and it overlaps with the administrative borders of the PGKC; the second level consists of 5 micro-regions; and the third level is made of a total of 14 spatial units. The territory of the Primorje-Gorski Kotar County is administratively composed of 15 cities and 21 municipalities that totals to 511 towns[8)]. The above division makes it obvious that there are discrepancies between the functional and administrative division of the PGKC.

Furthermore, besides the characteristics, space division was performed according to its use by using the criteria based on the space protection. The type of space use is determined by the category of space sensitivity and is divided into the following surfaces: protected natural heritage; protected cultural and historical heritage; protected agricultural and forest land; geotechnical characteristics of the land; protection of drinking water sources; protected coastal areas; and the areas and parts of the endangered environment.

After defining the functional units of the SP PGKC, among other things, the primary transport network of the corridor is defined – the routes and nodes – and is selected to those of the national and those of county importance. For the purposes of the development of the Spatial Plan of the PGKC, the role of the county (and its parts) in the overall transport system in Europe (a network of European corridors) and in the transport system in the Republic of Croatia is specifically analyzed. Projected traffic demand generation and, in this regard, the design of traffic network of international and national significance was done primarily based on the analysis of the merchandise traffic generator, or the traffic demand of the Rijeka port and the working zone of national significance. Moreover, traffic trends of other northern Adriatic ports were analyzed, as well as projections of their future traffic together with the prediction of a certain part that the Rijeka port might have in it.

For designing the transport network of the county significance, the functional division of space was respected, with a special appreciation of the explored division into spatial units, then on the fundamental foci of development, and on the defined separated construction areas of the county-level (working and tourist zones).

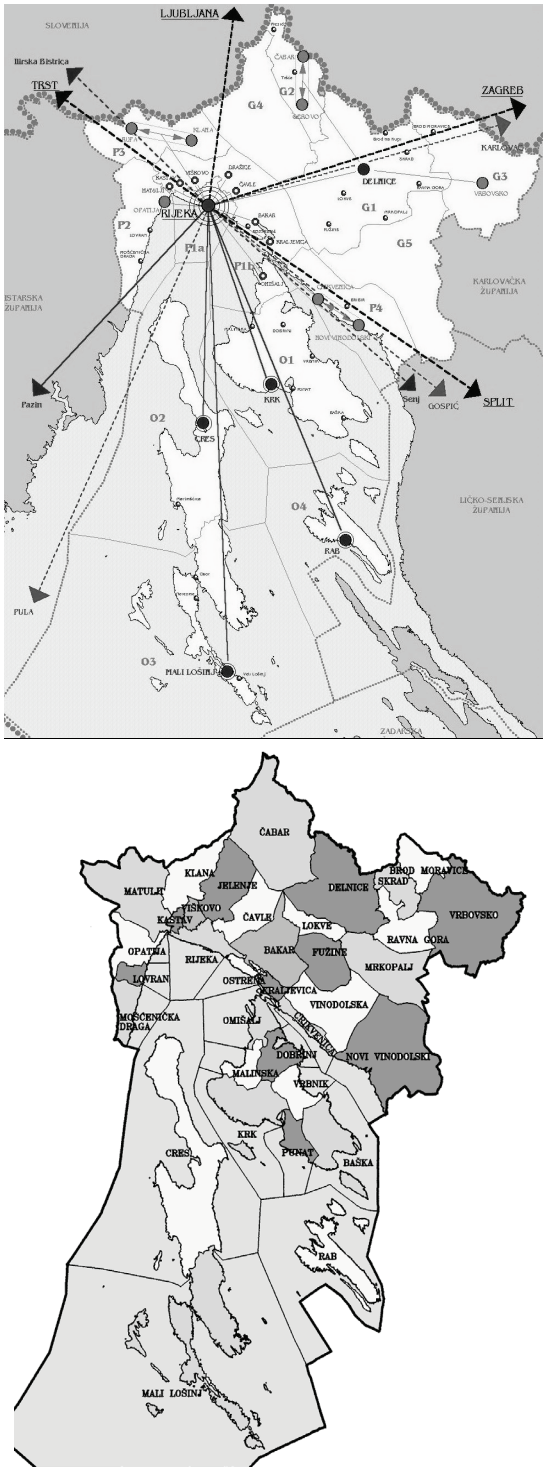

Figure 4 The division of the PGKC considering the functional units and poles and the administrative structure
Source: Spatial Plan o fthe Primorje-Gorski Kotar County, Službene novine Primorsko-goranske županije, 14/2000, 10/2005, 50/2006, 08/2009, adapted by the authors

7 Conclusion

In early 2011, the development of the new Spatial Plan of the PGKC started, and it was necessarily preceded by a performance analysis of the methodology of the plan development from 2000 based on the functional-nodal method. The method is based on empirical research conducted. It was found that the county area can be divided into smaller spatial units by many criteria, depending on the needs and goals. In this way, smaller spatial units of specific features, which enable the analytical procedure of better quality in the process of analysis and synthesis, are formed. The sequence and scope of activities in its implementation are defined, and it was preliminarily tested in the area of the island of Krk. After the mentioned pilot project showed satisfactory results, it was applied to the whole area of the Primorje-Gorski Kotar County.

The analysis of planning experiences of other counties found that the differentiation of the county space was based mainly on the administrative division into local government units, and only theoretically an overview of the historical, geographical and political spatial divisions was made while the division of space according to functional characteristics was usually completely absent.

It is obvious that the functional-nodal method in the segment of determining poles and connections largely relies on the fundamental postulates of transport planning. This was certainly helped by the fact that the center of the PGKC is also the main transport hub of Croatia, or the origin of the Vb pan-European corridor, and transport is one of the basic economic branches. It was found that the indicated spatial distribution of the PGKC based on the functional-nodal method met expectations and provided high quality results while allowing sufficient autonomy to local communities when developing spatial plans of cities/municipalities. The method is applicable to all strategic physical planning documents and represents a significant scientific and professional breakthrough in the field of spatial planning.

8 References

[1] The Act on Physical Planning and Construction, Narodne novine, 76/2007, 36/2000.
[2] Štimac, M. Prostorno planiranje u praksi, Glosa, Rijeka, 2010.
[3] Marinović-Uzelac, A. Prostorno planiranje, Dom i svijet, Zagreb, 2001.
[4] Vresk, M. Grad i urbanizacija: Osnove urbane geografije, peto dopunjeno izdanje, Školska knjiga, Zagreb, 2002.
[5] Krpan, Lj. Integralni prostorno-prometni model urbanističkog planiranja, PhD thesis, Pomorski fakultet u Rijeci, Rijeka, 2010.
[6] Grgurević, O. Grafička interpretacija sustava hijerarhije centralnih naselja središnje Hrvatske. // Prostor. 1, 1(1993), pp. 95-117.

Reference notes

1) The Act on Physical Planning and Construction (Zakon o prostornom uređenju i gradnji) (NN 76/07, 36/09) completely omitted this level of implementation documentation.
2) Cf. Štimac, M. Prostorno planiranje regije, Zavod za razvoj, prostorno planiranje i zaštitu čovjekova okoliša u Rijeci, Rijeka, 1997, pp. 16-24.
3) Cf. Padjen, J. Metode prostorno – prometnog planiranja, Informator, Zagreb, 1978, pp. 95-96.
4) Anthropogenic features include towns and its functions, population, other areas of human activity (separate construction areas), developmental systems of transport and connections, infrastructure, and economies.
5) The system of central towns presents a planned network of towns to which the role of development generators of its gravitational field is allocated in a planned way. The aim of

planning of such a town system was gradual homogenization of the development of certain areas of the county, spatial distribution of population, working activities, and other functions in the county area.

6) Therefore, in our example Gerovo does not have the same characteristics as Novi Vinodolski, for the same reason as the centers of higher level Delnice and Rijeka are not of the same rank even though they are the centers of mR. Further, it means that Gerovo and Novi Vinodolski, although they belong to the same rank, do not have (and need not have) the same facilities (education, health, administration, etc.).
7) Such as the data on the size, characteristics and population distribution, employment, accessibility and level of space utilization, and the general development policy of the observed area.
8) Of which 385 towns have less than 200 inhabitants (77 %) or even 94 % of the towns have fewer than 1000 inhabitants.

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