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SIGNIFICANCE OF SPATIAL AND TEMPORAL DIMENSION OF URBAN LANDSCAPE FOR ITS TRANSFORMATION

INTRODUCTION

The urban landscape is an open hybrid natural-anthropogenic system as the result of man's impact in time and space. It follows that one of most important tasks to understand the nature of urban landscape is research of its transformation mechanism in time-spatial context. Transformation of a particular urban landscape must be understood in its time-spatial context. Time and space represent two most important universal dimensions, in which the natural and human forces jointly form and permanently recreate natural landscape to urban landscape and imprint it its unique nature. Urban landscape then can be simultaneously understood as material reality, which is the result of a permanent action of man and society in natural landscape, as well as social construction which is the reflection of this action in human society itself. Meanwhile, these two sides of urban landscape influence and enrich each other in space and time.

The goal of the presented contribution is to add several brief theoretical and methodological notes to the meaning and mechanisms of action of time and space in transformation of urban landscape. This is the area where landscape architects can apply their inter-disciplinary education and holistic thinking, while emphasising their professional identity.

The aim of this contribution is to outline some theoretical, methodological and applied aspects while researching such a complicated subject like significance of spatial and temporal dimension of urban landscape by its transformation. The first part of this papers deals with the analysis and synthesis of dimensions of urban landscape. The second part of this paper is addressed to transformation of urban landscape by means of its spatial and temporal dimension.

SOME NOTES TO THE ANALYSIS OF DIMENSIONS OF URBAN LANDSCAPE

Out of the individual views on the notion urban landscape, and its definitions, also generally existing dimensions interpreted here not so much in quantitative sense of the word as rather in its structural and qualitative aspect, can be extracted. We can separate some generally valid dimensions of urban landscape like spatial, temporal, social, cultural, economic, technical and ecological-environmental (See Fig.1).

While analysing the urban landscape first of all it is necessary to characterize briefly its individual dimensions. Out of the above quoted dimensions of urban landscape the temporal and spatial are universal dimensions acting in the same way in various territories. Put in a different way, they are invariable. The remaining dimensions like socio-cultural, economic, technical, ecological-environmental manifesting in various degrees of quality and intensity or clusters, eventually combinations in different parts of urban landscapes and in different time, can be denoted variable. It means that certain combination of the variable dimensions in a given space and time creates a specific type of urban landscape, or what is the same, formation of the urban landscape represents or reflects certain qualitative and quantitative clustering or structure of single variable dimensions of urban landscape set in a given space and time.

Dimension of urban landscape	Main character of dimension	Dimension feature	Material traces in urban landscape
Temporal (TD)	Universal Invariable	Time continuity Time inertia Time accumulation potential	Any directly traces
Spatial (SD)	Universal Variable	Position Distance Form	Any directly traces
Economic (ED)	Special Variable	Econ. productivity Econ. structure Econ. stability	Any directly traces
Technical (TD)	Special Variable	Technical infrastructure and standard	Technical works
Socio-cultural (SCD)	Special Variable	Identity Customs Traditions Skills	Land use forms and land use ways
Ecological-Environmental (EED)	Special Variable	Ecological stability Ecological diversity Environment load	Destruction of ecotops and environment

Tab. 1 Character and features of urban landscape dimensions.

Temporal dimension of urban landscape influences by some of its properties like for instance, momentum, continuity and accumulation, eventually by its evolutionary potential, the proper contents of the urban landscape by



superimposing the individual temporal layers. It means that the understanding of the contemporary urban landscape and its structure inevitably requires inter alia also retrospective analysis of single temporal horizons of urban landscape. Individual properties of temporal dimension, as well as analysis of urban landscape, which are specific parts of urban landscape are treated with more details in work of F. Žigrai (1996).

The second universal dimension of urban landscape is the spatial dimension, and by combination of its two properties: position and extension (area) it defines and allows for spatial location and arrangement of urban landscape.

Socio-cultural dimension of urban landscape fills its "spiritual" contents. In other words, this dimension determines cultural wealth of certain territory accumulating, for instance, customs, traditions and skills of social and ethnic groups. Material reflection of this dimension are the individual forms of land use (types of settlements and houses, arable lands, etc.) More about the theme contain the works of F. Žigrai (1981). Socio-cultural analysis of, for instance, Slovakia is also presented in a comprehensive way in Ethnographic Atlas of Slovakia (1990).

Economic dimension of urban landscape represents some kind of "driving force" of every urban landscape and establishes the limits to the manifestation of other, non-universal dimensions of urban landscape. Economic dimension of urban landscape in difference from the other, non-universal dimensions, does not leave "immediately visible" traces in the territory.

Technical dimension of urban landscape is formed by a particular degree of technical development and state of society, thus able to interfere in the urban landscape. In other words, the nature of urban landscape reflects beside other, also the technical advancement of the given society as represented in a territory by various kinds of technical works.

A relatively new dimension of urban landscape, though of continuously growing importance, is the ecological-environmental. Its significance is directly dependent on the power of the economic dimension, advancement of the technical dimension, as well as ecological-environmental consciousness of the socio-cultural dimension of urban landscape. This ecological-environmental dimension of urban landscape leaves traces as manifested by reduced functionality of the landscape potential and deterioration of quality of the environmental potential of a given territory.

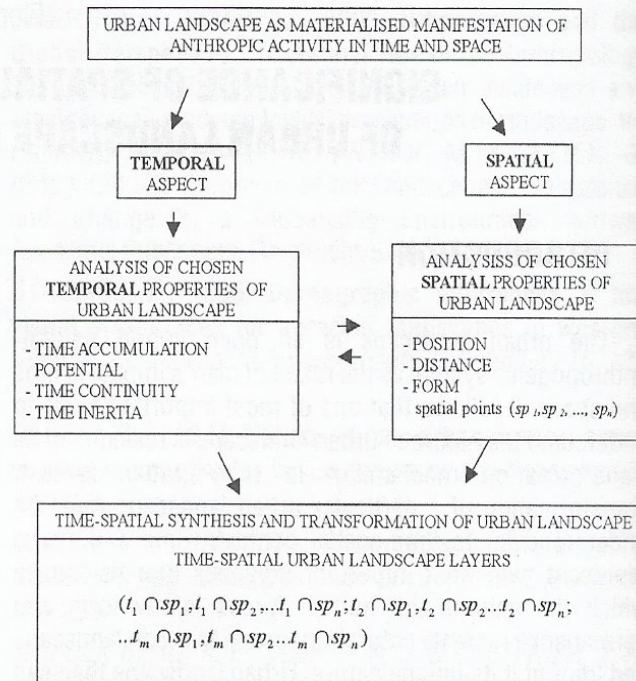


Fig. 1. Scheme of time-spatial transformation of urban landscape

SOME NOTES TO THE DIMENSIONS OF URBAN LANDSCAPE WITHIN ITS SYNTHESIS

In the following methodological step the results of analysis of single dimensions of urban landscape will have to be arranged to such a synthesis that allows reaching the particular aims of research. The key problem research into urban landscape is its apprehension and grasping its complexity. Hence a suitable approach is necessary. We are departing from an idea that urban landscape is an entity that can be written down formalized way in a form of unification of various dimensions: temporal, spatial, technical, economic, socio-cultural and ecological-environmental i.e. $UL = Ti Sp Te Ec So E/E$. In other words, urban landscape can be expressed in a formalized way also by an equation $UL = \text{sum of temporal dimension (Ti) + spatial dimension (Sp) + technical dimension (Te) + economic dimensions (Ec) + social dimension (So) + cultural dimension (C) + ecological-environmental dimension (E/E)}$.

Meanwhile the single kinds of urban landscape differ in mutual quantitative rate of the above mentioned dimensions, especially as far as the technical advancement, economic power, cultural variegation and anthropogenic impact on the landscape and environmental potential of certain landscape are concerned. While examining, eventually solving any problem of particular urban landscape is seems advantageous to start with an analysis of social dimension as this, based on the decision-making process of an individual and society, is the driving force of the activity and influences the scope and intensity of its action. This activity is meanwhile modified as for quality

and quantity by the technical advancement and economic power of a given society in a particular time and space. In case the intervention to natural landscape is inadequate, eventually too intense it is the turn of the ecological-environmental dimension to response. The above said suggests that every type, eventually kind of urban landscape consists of certain qualitative and quantitative structure of particular dimensions that can be formally expressed by a corresponding code. The task of researchers involved in the research of urban landscape is precisely the one to attempt to decipher the code. Using an objective, eventually nature-centric approach we concentrate first of all on the proper research object i.e. urban landscape studying it by a geo-systemic i.e. geographic approach proceeding from analysis of abiotic and biotic components of landscape further on to human-geographic analysis with its influence on the creation of the contemporary urban landscape. This approach can be formalized as follows:

$$UL = (abio + bio - SoD - EcD - TeD - CD - E/ED) - (SpD - TiD)$$

Using subjective approach i.e. anthropocentric approach we start with the analysis of the socio-economic-technical state of the given territory and observe how and to what extent the man's activity in space and time transformed the natural landscape to the contemporary form of urban landscape. This procedure of study of the urban landscape dimensions can be expressed in a formalized way as:

$$UL - (SoD - CD - EcD - TeD - (SpD - TiD))$$

The first of the scientific directions has for the time being more elaborated theoretical base and methodological instruments. It is obvious of the above exposed that the research of urban landscape requires a systemic approach taking into consideration synergetic action of the single dimensions of urban landscape. Only then we shall correctly apprehend the whole of an undoubtedly very complex body of urban landscape. That beside other requires to pass from isolated to mutually linked interdisciplinary research connected with elaboration of a broad theoretical basis and efficient methodological instruments. The key problem would be the theoretical and methodological aspect of the multidisciplinary and interdisciplinary synthesis. While analyses of urban landscape based in traditional individual scientific disciplines of natural and socio-economic character are relatively well, even though not on the same level, worked out, the overall synthesis of urban landscape has still considerable reserves of theoretical and methodological development. This lagging behind has been caused on the one side by complexity of subject as urban landscape is, and poor preparation of the systemic team research based on synergetic principle with corresponding synthetic methodological approaches on other. There is additional organizational problem related to the management of larger number of researchers of various scientific disciplines. One

of the problems of research of urban landscape dimensions is also certain discrepancy, eventually asymmetry between the individual analyses of urban landscape dimensions. While analyses of nature-scientific character are relatively well worked out, the ones of socio-cultural dimensions do not reach the desirable level. The result is situation when we know relatively well the anatomy, i.e. the "body" of urban landscape, how it functions, its inner links, but in turn we do not know well enough the "spirit" of urban landscape, its esprit or genius loci, the ingredient that makes it peculiar. This asymmetry can grow if a too technocratic approach is chosen.

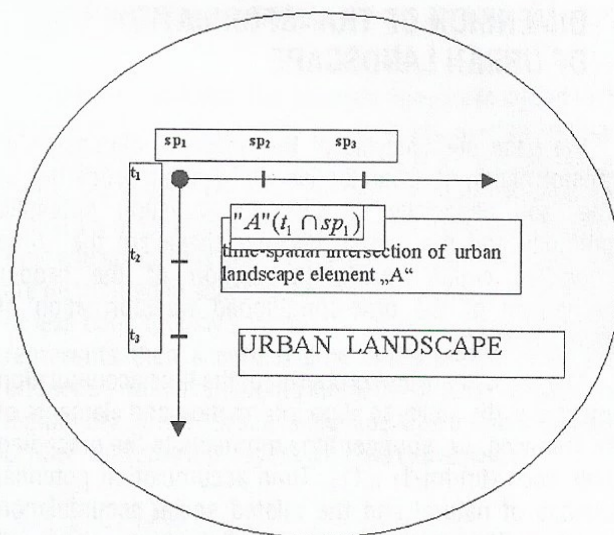


Fig. 2 Scheme of time-spatial fixation of urban landscape element „A“ in intersection of temporal moment t1 and spatial point sp1 within the urban landscape

SOME NOTES TO SIGNIFICANCE OF SPATIAL AND TEMPORAL DIMENSION OF URBAN LANDSCAPE FOR ITS TRANSFORMATION

Considering the evaluation of special literature about urban landscape and as well as my personal research experiences, allowed me to understand the urban landscape as a open hybrid natural-anthropogenic system, which is the result of man's impact in time and space. It follows that one of most important tasks to understand the nature of urban landscape is research of its transformation mechanism in time-spatial context. Time and space are two inseparable and mutually complementing media in which transformation of urban landscape is taking place. The typical trace of changes of urban landscape in time and space is that they occur in permanently, parallel and complementary manner. Meanwhile the spatial change of urban landscape take place in the course of a specific time

(t_1, t_2, \dots, t_m). In this case we talk about the time conditioned transformation of urban landscape. The temporal changes are simultaneously linked to the single points of space (p_1, p_2, \dots, p_n). Then we mean spatially conditioned transformation of urban landscape. From the methodological point of view it is more appropriate to observe these changes of urban landscape first separately i.e. at the temporal and spatial analytical levels and then in their time-spatial synthesis (see Fig. 2).

SOME NOTES TO ANALYSIS OF TIME DIMENSION OF TRANSFORMATION OF URBAN LANDSCAPE

We base our analysis of the temporal dimension of transformation of urban landscape in single properties of time, and especially in time accumulation potential, continuity and the inertia, because these are the time properties which enable the action of the proper mechanism of the time-conditioned transformation of urban landscape.

The most important property of the time accumulation potential is the ability to align information and elements of the following i.e. younger time moments to the preceding older ones ($t_m > t_{m-1} > \dots > t_1$). Time accumulation potential consists of natural and the related social accumulation potential. The natural time potential stores above all biological-genetic information of a particular territory. Social time potential is characterised by accumulation of knowledge, customs and experience of the preceding generations. Accumulation of natural and social time potential manifests in integrated form as the time accumulation effect or time infrastructural potential (see more in F. Žigrai 1996). Significance of the time accumulation potential in research of transformation of urban landscape lies in the fact that, as mentioned above, it gradually deposits single elements and information of the following younger events into the preceding older events. This makes possible to create certain landscape and social structures with accumulated corresponding natural and social information force. Besides, the time accumulation potential indicates the inner force that has been formed longer time, or cohesion of national and social territorial relations. This circumstance can be expressed, for example by the coefficient of favourability of the links of forms of land use and its changes to abiotic complexes, as the result of basin geographical and landscape-ecological research and its practical use in compilation of landscape plans (see more in F. Žigrai 1995).

Continuity represents another important time property, the one when the elements and consequences of preceding events from time moment t_1 continue uninterrupted into the following time point t_2, t_3 to t_m . This also prevents unnecessary losses of natural and social information. Consequently, this property makes possible permanent

transition of one temporal layer of urban landscape into another, which, besides other, allows us an easier research into transformation development of a particular urban landscape.

Inertia as the complementary component of continuity represents some kind of its inner condition and simultaneously mechanism of its action. It is the effect of inertia, which makes possible the proper transition of information of the preceding older event to the following newer one.

$$t_1 \xrightarrow{\text{inf}} t_2 \xrightarrow{\text{inf}} \dots t_m$$

It simultaneously contributes to a more fluent course of single events as the time of action is prolonged and the impact of the properties of the preceding interval on the following ones is milder.

This effect of the inertia, which can act in positive, negative or neutral sense, can fade away and lose the effect. Importance of the time inertia for the study of transformation of urban landscape lies in the fact that it makes possible for us to observe and understand temporal transition of development and change of single forms and ways of land use as material-spiritual carriers of the proper layers of urban landscape.

The above quoted three properties of time act synergetic and not in isolated way. Continuity and inertia simultaneously represent some kind of "active" and "non-material" properties of time, which support and control rather "passive", "spiritual-material" time accumulation potential.

Besides continuous, the space-encompassing, supplementing and mediated action through the natural and social processes and phenomena on the character and development of urban landscape structure and individual urban landscape layers, and the overall transformation of urban landscape is typical for these temporal properties.

In this context time along space can be understood as another or next „source“ of land use while we run into a conspicuous parallel between the time use and space use. Research of the development of time use relating to certain space within the framework of time analysis represents a kind of research complement or a complementary part of space research from the temporal point of view, for instance temporal development of the time use in the framework of human geography.

SOME NOTES TO ANALYSIS OF SPATIAL DIMENSION OF TRANSFORMATION OF URBAN LANDSCAPE

Analysis of spatial dimension of transformation of urban landscape leans above all on such concepts as situation, distance, shape, etc., which represent the main

geographic spatial properties. In connection with situation we distinguish the following categories: micro-position, macro-position, physical-geographic position human-geographic position, etc. Physical-geographic position (position in the context of physical geography) is understood as situation judged by means of physical material and non-material attributes, such as properties of rocks, soil or relief. Human-geographic position (position in the context of human geography) is understood as position judged through human-geographic material and non-material properties. Though distance is a neutral attribute, it often plays an important role in judging precisely the human geographic position, i.e. distances of the particular social-economic element or phenomenon from the activity centre. In transformation of urban landscape also changes of physical-geographic and human-geographic position of single urban landscape elements take place.

These changes are evident for instance in the development of forms and ways of land use as an integrated result of action of the natural and social forces on a particular territory and in particular interval. For instance, results of the study which observed changes of land use in Liptovská basin (F. Žigrai, 1981).

SOME NOTES TO THE SIGNIFICANCE OF TIME-SPATIAL SYNTHESIS OF TRANSFORMATION OF URBAN LANDSCAPE

Combination of above mentioned temporal and spatial properties leads to clearer and deeper knowledge of the varied socio-economic and natural circumstances of such a complicated phenomenon, as transformation of urban landscape undoubtedly is. Time-spatial synthesis of transformation of urban landscape are among the most demanding theoretical-methodological tasks of geography that still call for research.

One of the possible approaches connecting the temporal and spatial properties in relation to transformation of urban landscape is the study of forms and ways of land use „as material and spiritual carriers of these elements and layers“. Land use then can be understood as a particular manifestation of human activity and space and time, which immanently accumulates certain historic, economic, social and cultural potential and represents certain point of intersection between the natural assets of territory, technical possibilities and man's knowledge. The present urban landscape is then result of mutual action of abiotic, biotic and socio-economic spheres. Land use or landscape use creates a kind of bridge between the individual spheres, because it is the reflection and result of their actions.

Every urban landscape consists of certain number of urban landscape elements and forms of land use such as field, meadow, settlement, etc. Its temporal and spatial co-

ordinates determine each of these elements. Better said, each urban landscape element is fixed within the intersection of time and space (fig. 3). Certain set of these urban landscape elements with temporally and spatially close co-ordinates creates the corresponding time-spatial urban landscape layers (fig. 4).

This figure, which depicts a kind of matrix of time-spatial relations of urban landscape elements suggests (beside other) that for instance, the oldest urban landscape layers as a whole represent the multiplication or intersection of temporal moment t_1 with individual spatial points p_1 to p_n of the corresponding

$$\text{Urban landscape elements as expressed by: } \left(\prod_{j=1}^n t_1 p_j \right).$$

To the older layers the younger ones were added in the course of time. Meanwhile these layers overlap mutually without any clear transition from one to another. Urban landscape layers are then created by material elements, which are in fact the materialised spirit of human activity in time and space. It is interesting enough that these elements are distributed in space in discontinuous manner and more or less continuously in time. The present urban landscape represents then a certain time compression or a „time briquette“ with overlapping elements or parts of fading out temporally „lower“ urban landscape layers with temporally „upper“ and „the top“ layers which is expressed as

$$\prod_{i=1}^m t_i p_1).$$

Every urban landscape as part of the landscape and their layers (Fig.5) has simultaneously certain composition of these elements or mutually overlapping urban landscape layers, which were formed or influenced by single variable landscape-cultural dimensions as socio-cultural, economic, technical and ecological-environmental. It means that every urban landscape is characterised by specific quantitative-qualitative structure of single urban landscape elements, layers and dimensions set in time-spatial context. Every such „coded“ urban landscape has to be deciphered by progressive steps into its above-mentioned individual parts. This is how we more easily comprehend the development of urban landscape and its proper transformation stages.

One of the typical traits of transformation of urban landscape is that its corresponding time-spatial co-ordinates of the individual urban landscape elements change as well. indicates that spatial changes of the corresponding urban landscape can take place only in the course of certain time

$$t_1 \cap p_1, t_2 \cap p_2, \dots, t_m \cap p_n),$$

while temporal changes of certain urban landscape elements can take place also without their spatial change, for instance .

$$(t_1 \cap p_1, t_2 \cap p_1 \dots t_m \cap p_1)$$

Spatial points Time moments	sp ₁	sp ₂	...	...	...	sp _n	
t ₁	t ₁ ∩ sp ₁	t ₁ ∩ sp ₂	...	...	...	t ₁ ∩ sp _n	$\prod_{j=1}^n t_1 \cap sp_j$
t ₂	t ₂ ∩ sp ₁	t ₂ ∩ sp ₂	...	...	...	t ₂ ∩ sp _n	
...	
...	
...	
t _m	t _m ∩ sp ₁	t _m ∩ sp ₂	...	...	...	t _m ∩ sp _n	
	$\prod_{i=1}^m t_i \cap sp_1$						

Fig. 3 Combination of temporal points (moments - t₁, t₂, ..., t_m) with spatial points sp₁, sp₂, ..., sp_n within the urban landscape

It is then the case of temporal „ageing“ i.e. change of the inner qualitative property of particular urban landscape element without changing its spatial position. This circumstance facilitates inter alia also the origin of historic landscape structures.

Essentially we can use two methodological approaches in research of development of transformation of urban landscape. In the first, a progressive one, we lean on time-spatial analysis at the beginning of transformation of urban landscape and gradually observe the changes of urban landscape up to the present time. The second possibility is the retrospective approach of time-spatial analysis and synthesis. In this case we depart from the present state of urban landscape and retrospectively observe its development into the past i.e. the beginning of its transformation development.

SOME NOTES TO THE PROCESSES INFLUENCING THE PROPER TRANSFORMATION OF URBAN LANDSCAPE

As said above, formation and transformation of urban landscape takes place in space and time. Man or human society and its activities are the initiators of the proper change of urban landscape. Through the social processes such as innovation, diffusion, migration, adaptation and the like single impulses spread in landscape and act on single landscape elements of natural, anthropic or mixed origin. Meanwhile certain secondary or even tertiary landscape structures originate, which are typical for a particular human society and landscape (see more in F. Žigrai 1997, 1999). Material and spiritual carrier of these landscape

structures are the above mentioned anthropocentrically perceived forms and ways of land use. In the framework of research of transformation of urban landscape it is then possible to determine based on ratio and intensity of single land use forms the corresponding coefficients of originality and exploitation of landscape.

CONCLUSION

Three most important conclusions were made on the basis of the above quoted remarks:

- The subject of importance of time in transformation of urban landscape has been paid insufficient attention in the Slovak landscape architecture.
- Successful study and comprehension of transformation of particular urban landscape requires support of theoretical basis and methodological instruments of analysis, but above all of synthesis of mechanism of action of the time-spatial dimension upon the development and changes of urban landscape. This is the area where landscape architects can apply their interdisciplinary education and holistic thinking, while emphasising their professional landscape-architectonic identity.
- More attention will have to be paid to elaboration of methodological apparatus necessary for determination of significance of time-space in preparation of prognosis of transformation of urban landscape in future, using the results of the study of development of Earth in the past.

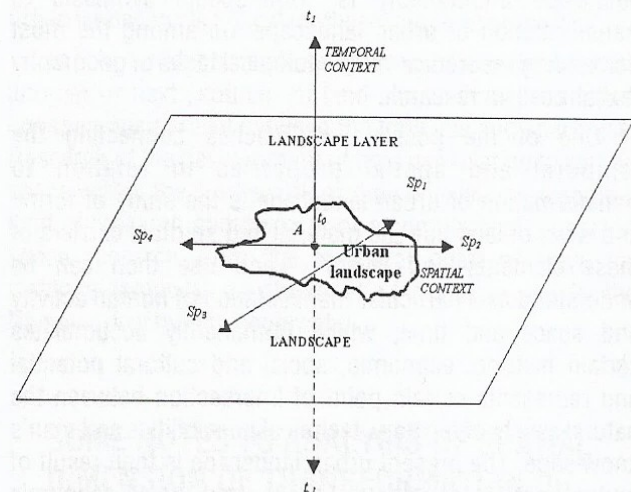


Fig. 4. Urban landscape as part of the landscape and their layers

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