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SPACE SYNTAX IN URBAN RESEARCH

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Head: Dr. Harnos, Zsolt

Head of the Department, Professor, MHAS

Corvinus University of Budapest, Faculty of Horticultural Science, Department of Mathematics and Informatics, 1118 Budapest, Villányi Str. 29-43.

Supervisor: Mezősné dr. Szilágyi, Kinga

Professor, CSc

Corvinus University of Budapest, Faculty of Landscape Architecture, Department of Landscape and Urban Design, 1118 Budapest, Villányi Str.29-43.

The applicant met the requirement of the PhD regulations of the Corvinus University of Budapest and the thesis is accepted for the defence process.

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Head of the PhD. school Supervisor

The Regional Doctoral Committee of the Life Sciences of the Corvinus University of Budapest appointed the following Reading Committee for the open defence in its decree dated 2007. October 02. (ÉTDT-PhD-177-2007)

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CONTENT

LIST OF FIGURES AND TABLES

Figures

Tables

1. PRELIMINARIES AND OBJECTIVES

1.1. The scientific preliminaries

From the middle of the 20th century until the 1990s the progress of modern environmental sciences produced such results that went far beyond the merely environmental protection related and in practice mostly technological aspects of research formerly prevailing. The document known as the Bruntland Report, which was published in 1987, placed the environmental aspect into a lot wider context (e.g.In HALL and PFEIFFER, 2000) and so was the definition of sustainable development born. The thought central in the concept is the utilization of resources respecting the interests of the future generations and with consideration of the social, economic and environmental aspects at the same time. Both the meaning of sustainability and sustainable development and the definition in the related UN document stirred debates in professional, scientific and political circles, which have not been closed yet. These have been centred around the definition itself and its interpretation in everyday life.

The **sustainable development of a settlement** can be characterised with a process, in which the quality of life develops in a way that the production of social and economic goods does not jeopardise the survival of the environmental elements, and assure their continuous improvement.

The description of the development process is basically rooted in the schemes of human thinking or in the interpretation of phenomena observable in nature. With respect to settlements the subject of research in different rationalist and empirical approaches are the urban (settlement) structure, form, and space. In settlements urban structure or space differ depending on if we examine the social (e.g. age structure, population density), economic (spatial arrangement of production and service enterprises), or environmental factors (built e.g. rate of building-up, natural environment, relief). In the general concept urban structure is the overall spatial arrangement of socio-economic processes of a settlement, which, with respect to the physical systems, corresponds to urban form (SCHWAB 1992; ANDERSON et al., 1996). Urban space is the building stone of structure and form, which in itself has specific features (borders, surfaces, extension, meaning, symbolism) and which establishes connection between the often abstract socio-economic structure and the physical "environmental" structure. Townscape is the visual manifestation of urban space fitting in a given structure (CULLEN 1971), which is both the functional and physical element of urban landscape.

Space syntax theory and method published in 1984 by HILLIER and HANSON and further developed by e.g. HILLIER 1996 and.; JIANG and CLARAMUNT 1999, JIANG et al. can be ranked among the empirical, system theory based approaches. The theory is based on meetings and social contacts happening in urban spaces. The core thought is that the type and intensity of connections realised at different locations can be explained with the structural features of space, as the social decisions affecting the structure of space are influenced by the regulations of social relations. In the approach "the egg and hen" problem can be traced, as while in the creation of urban physical space social decisions play a crucial role, in the course of their making they become one of the most deterministic factor in social relations. In a given era the structure of urban space is the result and the cause of social decisions at the same time.

Different societies attribute meaning and patterns determined by buildings to certain places. According to the theory of space syntax social processes stand behind the formation of space structure and patterns. The structure of urban space is not only the mere footprint of the social structure but also characterises the society with respect to the way it controls its system of relations in a space with specific morphological and functional characteristics. On the basis of this – in contrast with the anthropological approach – it can be stated that the organisation and the meaning of urban space can be examined in itself, which might as well lead one to the regulation and symbolic system of the organisation of social space.

The research-theory systems examine the system of urban space determining urban form in comparison with the social, ecological, and cultural systems. In this sense physical environment loses its social meaning and so does the social meaning its physical content: the form is material, while society remains pure abstraction. Space syntax theory undertakes the solution of this problem: in its interpretation physical environment is not only a system of artificial and natural objects which can be characterised with style and functions but its spatial organization establishes connection with the order of human societies.

1.2. The aims of research

The main structurising idea of my research is, that the townscape evolved as the result of the continuous conflicts of historical scale between society, economy and natural environment of settlements or urban quarters. Therefore townscape is a medium broadcasting the material and aesthetic values of the urban processes dominant in a given moment. The main objective of the research is to show the connection between the space syntactic manifestation of historical scale urban

development processes and townscape characteristics evolving as their result, as well as to prove the applicability of space syntax analysis not only in urban structure but also in townscape research.

The research is basically of methodological nature, it examines the possible research fields space syntax can be used in, the adaptation of the method in Hungarian scientific tradition and its applicability in the description of the historical scale formation of townscape.

As the foundation of research my assumption is that with the space syntactic analyses

- the social and physical structure of spaces of settlements can be reliably determined,
- the structural features and the types of various settlements and urban quarters can be properly described,
- the traditional descriptive methods of townscape research can be complemented.

Accordingly my research aims:

- The adaptation of space syntax in Hungarian scientific tradition
  The aims of the research serving the promotion of the Hungarian space syntax research:
  - Presentation of the possibilities of space syntax analysis – How does space syntax describe the structure of settlements?
  - Methodological proposals for the application of space syntax, with especial attention to the accelerated urban development processes in Hungary – How can space syntax analysis be used in urban research and planning?
- Presentation of the connection between townscape and the space syntactic factors
  Determination of the major relation between the space syntactic characteristics and the townscape serve the following research aims:
  - Examining the characterisation of townscape and urban regions supported with space syntax – How can the space syntactic interpretation of urban space assist the description of townscape and urban regions?
  - Revelation of distinctions between the space syntactic features of settlement types classified according to their specific environmental assets – What kind of space syntactic regularities can be identified regarding the settlements with distinct environmental features?

2. METHODOLOGY

2.1. The theoretical background of the space syntax analysis

The theoretical background and applications of space syntax is not part of the general knowledge and research practice in spatial sciences dealing with the spatial organisation of settlements (TERRA STUDIO, 2005). Both the theory and the application fundamentally differ from the „prevailing" theories and applications regarding settlement-structure research in Hungary.

Space syntax highlights the connection between **abstract social relations and the physical space** through physical space characteristics. Regarding urban space in general a distinction is made between the inner space of buildings having a particular internal structure, and the outer space (the open space) determined by the buildings themselves. The second – being the prime scene of social relations – determines the formation of social relations through its pure structure. In Durkheim's view (in HILLIER and HANSON, 1984) urban relations can be interpreted through social solidarity. Solidarity or social cohesion can be realised in two ways: through local networks and social networks overarching the whole urban society. The first is the so-called organic solidarity, which can be defined as the outcome of mutual dependence of local actors as well as that of the individual social regulation systems. The second, the mechanic solidarity unites the members of various social groups on the basis of shared ideology and way of thinking.

In line with what is stated above, personal contacts realised in open space either strengthen the organic solidarity (as long as they concern people living in the given neighbourhood) or establish the conditions of mechanic solidarity (when they mean meetings with people from other quarters of the city). Besides the basic differences based on the nature of meetings the emerging relationships also differ with respect to the control exercised over them, as the distinct societies regulate personal connections and the emerging relationships differently. This can be traced in the places meetings take place. The basic ideas of space syntax are the meetings and the control over them as well as the interdependence of spatial configuration behind, which – in this manner – is based on the socio-spatial experience of the locals and the ones arriving from outside the given city or urban quarter.

Therefore, the socio-spatial configuration of urban space is the outcome of a dual process:

- on the one hand the manner of meetings is built from generally applicable, local organic regulations and institutions creating global patterns, which means the dominance of the local politics
- on the other hand it is based on the mechanic solidarity determined by the interconnections between particular elements, and organised along a global ideology. In contrast with the generally approved interpretation of „global ideology" in space syntax global ideology can be defined as an urban level social organising force determining urban life.

The urban form can be described in the configurable system of space syntax. In each and every settlement there is at least one more frequently used urban quarter, which provides the main scene for social contacts or an area where the global functional buildings of public institutions are concentrated. In the first case the limits of open space are determined in „ordinary" streets by „ordinary" buildings, which endow the given quarter with a local spirit. In the second case though the characteristically detached placement of public buildings, global power organises the urban system in a framework composed of monumental constructions. This makes the cities and their quarters appear in basically two different forms: when in space organisation the local rules and politics of naturally evolving social contacts are prevailing and the settlement builds its global system from the local regulations (local → global; like in the commercial cities); or when space organisation is dominated by grand specific spaces with strong ideological impact, which rule over the local regulation systems (global → local, such as administrative centres, capital cities).

2.2. The application of space syntax

Space syntax can be interpreted as a descriptive „language", the components of which („the words") are the various urban spatial units organised into a meaningful „text" along the rules of „grammar", which are the regulations derived from the above outlined theoretical foundations. The space syntactic features of a given spatial unit – having been translated from a natural language into the language of graphs – can be described through the distribution and symmetry values.

From spatial point of view the mathematical meaning of distribution and symmetry can be interpreted as follows: A is symmetric to B if A relates to B as B to A and A is distributive relative to B, if B is reachable from A on more than one routes never crossing one another (Figure 1.)
The relative symmetry value of the graph node (a given spatial unit) suggests how far (expressed through the number of chords leading from A to B) the given spatial element is located compared to the other elements of the system, thus the relative symmetry value determines the global (relative to

the system) space syntactic features, the level of integration.

Distribution is the number of possible starting points, which characterises the strength of space syntactic local control, thus the local connections. By characterising each element with symmetry and distribution values derived from the language of mathematics the structure of space and so the settlements can be determined. Translated into the natural language of space syntax it carries the social meaning of control and integration (HILLIER and HANSON, 1984).

2.2.1. The applicability of space syntax

There have been five ways to examine the applicability of space syntactic analysis in urban research and planning:

1. Space syntactic examination of theoretical urban configurations used most frequently in Hungarian urban research and planning
2. Space syntactic analysis of settlements through the example of Budapest
   The research phases:
   - Descriptive analysis of the urban structure of Budapest – processing literature and regional statistical data
     The brief comprehensive analysis of the statistical data published on the urban zones of Budapest highlights a few major characteristic features of the urban spatial structure (KSH 2003). The examined data:
     - Physical characteristics: residential buildings per 1000 inhabitants, (indicator for the density of buildings), residential units from the pre-1945 period (indicating the historic nature of the quarter)
     - Social characteristics: population density, (indicating the potential intensity of contacts), rate of people with higher educational diploma (indicator of social status)
     - Economic characteristics[1]: commercial units per 1000 inhabitants, number of public catering units per 1000 inhabitants)
   - Space syntactic analysis of the spatial structure in Budapest
3. Comparison of the space syntactic values with the statistical data describing the physical and social structure of the urban quarters

[1] Data collected on district level.

- Totalling the space syntactic values of the structural axes of urban space for urban quarters by using the methods of geo-informatics
- Examining the relationship between the statistical data and space syntactic values by using mathematical statistical methods: calculating regression and determination coefficient

4. Doing research on the structural changes produced by urban development
   - Detailed digitalisation of the axes in the inner quarters of Budapest according to the state of development in 1870 and in 2001: the extension of the digitalised area was determined by the expansion of the urban area shown in the map from 1870; (map of Buda-Pest, 1870; published by Aigner Lajos, Budapest; Budapest Structural Urban Plan (BFVT 1998)
   - Totalling the two space syntactic data bases produced for the urban axes with a resolution of 1000×1000 metre pixels by geo-informatic methods (29×31 pieces)
   - Comparison of the two pixel-based data sets by the distraction of the pixel values produced for the two years and by the description of the changes

5. Space syntactic analysis of the various urban configurations, space syntactic analysis of typical urban structural forms
   - Detailed digitalisation of the axes of settlements and quarters
   - Comprehensive statistical analysis of the space syntactic characteristics

   The examined settlements and quarters (20 in total):
   - Budapest: Internal areas, Inner City, the Castle District of Buda, Middle-Ferencváros, Wekerle-estate, Pestszenterzsébet – garden city-like area, Gellért Hill
   - Hajdúböszörmény: town, central zone, historically fortified zone, peri-urban garden city – residential zone
   - Tiszaújváros: town, central zone, residential areas, TVK factory site, Tiszaszederkény rural-type urban area
   - Salgótarján: town, central zone, Salgóbánya and Somoskőújfalu rural-type urban area

2.2.2. The description of the townscape and its comparison with the space syntactic values

Based on its photo documentation, the examination shows the townscape elements of the case study areas. Their foundation is the description of the townscape sequences, which – besides the style and meaning determined by CULLEN (1971) and the dominance examined by STAMPS (2000) – includes the manifestation of functional loss and disfunctioning (WOOD and HANDLEY 2001). Besides the depiction of the townscape I also determined the space syntactic characteristics of the concerned spatial elements on the basis of detailed characterization of the Inner city zone of Budapest

rendering in logical ways the space syntactic information to particular townscapes, or townscape elements. As the description of each townscape concerns widely known axes and quarters, which have substantial scientific literature background, the conclusions possibly derived from the space syntactic analysis serve with tangible proofs for the applicability of the method in the characterisation of townscape.

The case study areas:

- The axis of comprehensive importance formed by the Danube: The most significant organising axis of Budapest, which divides the city into two urban halves different in nature.
- Middle-Ferencváros traditional urban quarter (bordered by Ferenc Bld., Soroksári str., Haller str. and Üllői str.):, with the sole large scale intervention of the post-socialist period into the urban structure directly affecting the central zone of Budapest, an urban quarter deeply influenced by the Lágymányos Bridge. The quarter is going through a substantial transformation, partly due to the appearance of this new urban structural component.

3. RESEARCH RESULTS

3.1. The space syntactic characterisation of theoretical structural forms

Examining the space syntactic configuration of the theoretical systems it can be stated that the schemes of conscious human thinking produce mathematical regularities in all the cases. The type of symmetric undistorted grid is the possibly most democratic system, where there are no stressed axes and each space component has the same value of control and integration. Therefore the intensity of social contacts is distributed in the possibly most even way. Whichever way we choose to distort the system one or more axes gain significance. By breaking-up symmetry with the same number of elements or by rendering new elements to the symmetric grid system a couple of spatial components stand out to smaller or greater degree. By adding new parallel elements to the system the absolute democratic system changes again and in the case of symmetric arrangement axes ruling the whole system come into being.

The ring-radial system basically shows that an ideology relevant for the whole city already exists, and central zones determined by the radial axes appear in most of the cases. With respect to the varieties it can be stated that if the radial axes meet each other directly a global centre comes into existence, while if they do not – like when the radial axes are connected with irregularly shaped boulevards (crescents) – then only integration centres can be identified, which primarily meeting points of outsiders and the stressed points of the transit traffic.

In the simplest **linear system** the axes with significant role appear along with the changes in the number of elements, therefore with the urban development – under the configuration outlined above – comprehensive mechanic solidarity (i.e. the strengthening of social ideology) can be postulated. The appearance of new elements are prone to happen as a natural phenomenon in case of rural settlement structurally determined by some kind of a physical environmental condition (e.g. relief, water system); in this case the role of settlement ideology is taken over by environmental factors.

3.2. The spatial structure of Budapest, the relation between space syntactic characteristics and the townscape

3.2.1. The connections between the values of space syntax and descriptive statistics

Between the statistical and space syntactic features aggregated on the urban quarter level relationship of statistical significance can be detected in most of the cases. The strength ofrelationship – apart from the index for the rate of people with higher educational diploma – can be assessed as important if not statistically expressly determined. The relationship between the different values, with the above exception, characterises the system with at least 40% reliability (Table 1.), therefore the spatial syntactic values model the most important statistical data of an urban quarter with at least 40% soundness.

Table 1. The strength of relationships between the space syntactic values and the statistical data

Degree of relation R^2	Population density	Social status	Residential buildings	Historical character	Degree of building-up
P. reg.	0,4414	0,1141	0,5045	0,5215	0,7024
Lg. reg.	0,4139	0,0770	0,5051	0,4272	0,6507
Lin. reg.	0,3864	0,1139	0,3692	0,5192	0,6279
Control R^2	Population density	Social status	Residential buildings	Historical character	Degree of building-up
P. reg.	0,4039	0,1312	0,4923	0,4912	0,6573
Lg. reg.	0,3829	0,1007	0,4848	0,3923	0,6151
Lin. reg.	0,3803	0,1308	0,3862	0,4878	0,6233
Integration R^2	Population density	Social status	Residential buildings	Historical character	Degree of building-up
P. reg.	0,4555	0,1175	0,4982	0,5543	0,7268
Lg. reg.	0,4400	0,0937	0,5076	0,4630	0,6846
Lin. reg.	0,4083	0,1146	0,3519	0,5497	0,6246

The value of integration shows the strongest relation with the statistical values, but due to the factors outlined above the other space syntactic values bring similarly good results. The space syntactic values show the closest connection with the degree of building-up, which is the most determininant in the physical look of the townscape ($R^2 \sim 0,7$). The weakest relation ($R^2 \sim 0,1$) exists with the value of people with higher education diploma standing for social status, characterising the townscape the most direct way. While the relationship with the other values is as strong as 50 %, which among the human and environmental factors can be evaluated as significant (Figure 1.).

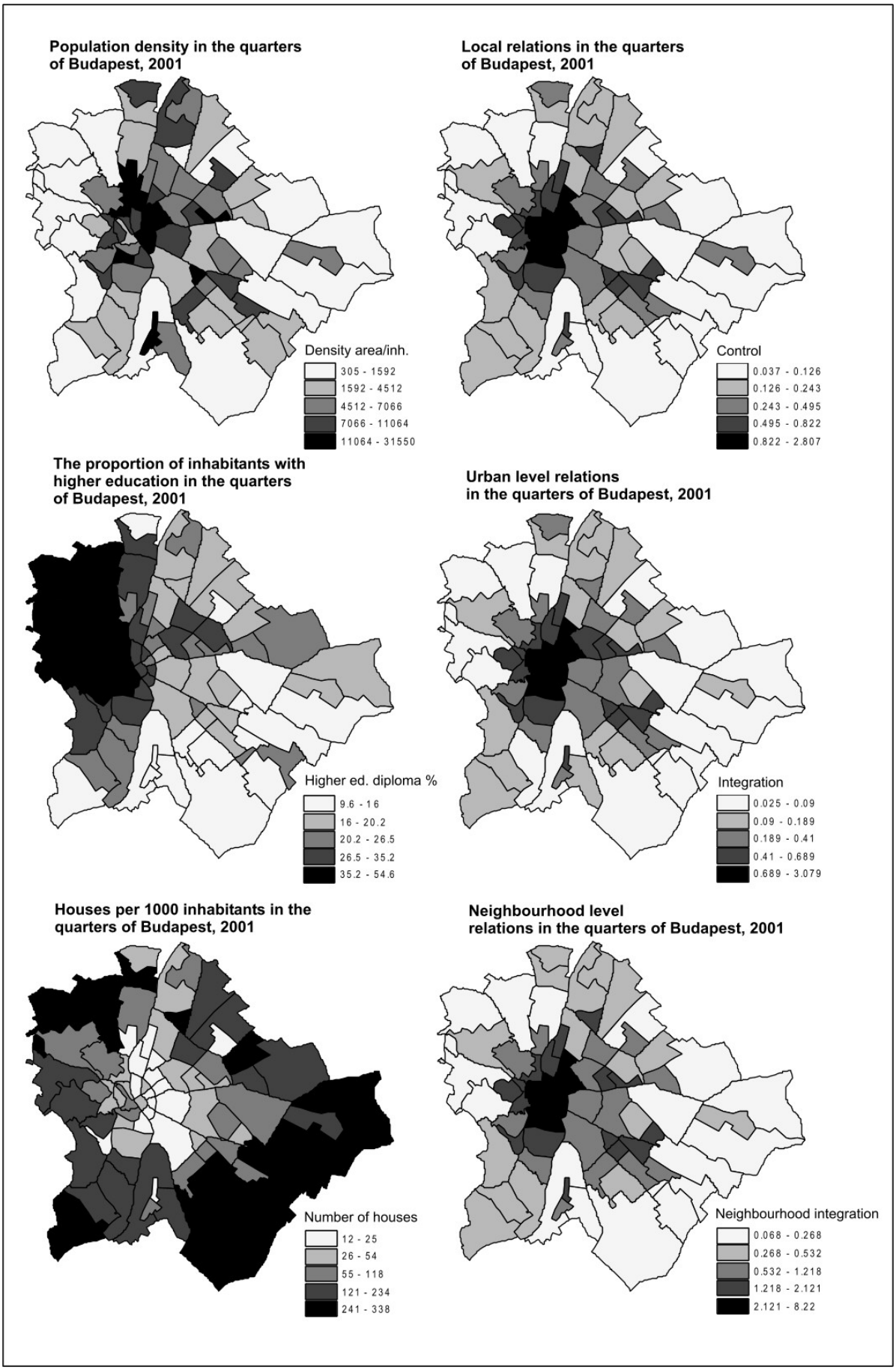

Figure 1. Space syntax values and statistical data
Source of Statistical Data: KSH 2003; space syntax values: author's results

3.2.2. The values of space syntax in the description of urban development

The structural changes occurring in the late 19th century fundamentally influenced the later development of the city, affected today's inner city area and internal and external relations of urban quarters transformed. The driving force of the structural changes was the Grand Boulevard and the Andrássy Boulevard, which are structural elements easily identifiable through their space syntactic values. These elements had a significant impact on the related urban quarters. The area that benefited the most from the changes was Pest, where the urban scale relations affected large areas and the changes coupled with weakening local characteristics created some kind of a unified townscape. For the south-west of Inner-Buda the north-northwest (Lipótváros, Herminamező) and the south (Middle-Ferencváros) parts of Pest an outstanding increase can be detected for all the space syntactic features, which were affected by the structural changes indirectly. The structural changes strengthened the position of the central zone primarily around the northern and southern medieval city gates, connected to Deák Square in the north and to Kálvin Square in the south along Small Boulevard. While Deák Square and the neighbouring quarter further to the north transformed into the administrative centre (town hall, county hall), Kálvin square and its surrounds became the node of cultural and business life, providing the scene for civil everyday life (Figure 2.).

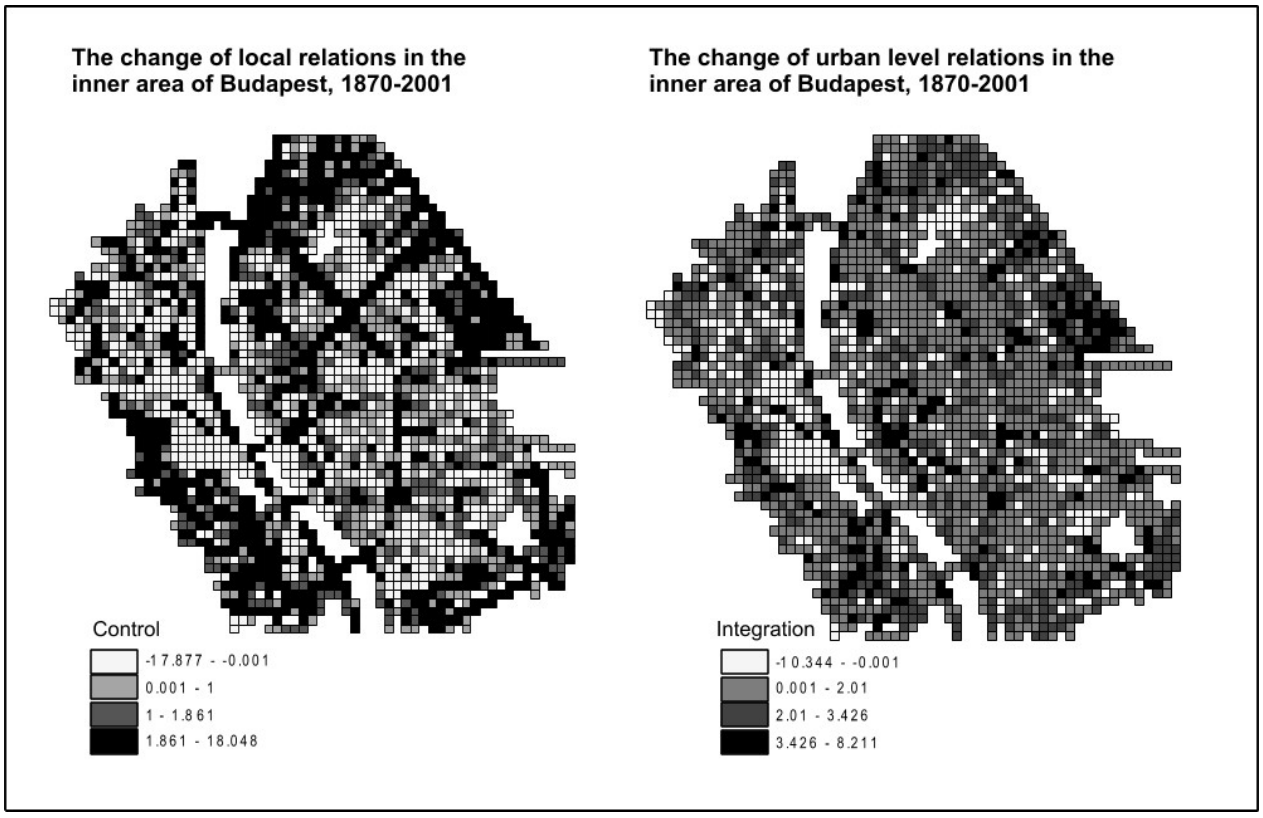

Figure 2. Change in the space structure of the Inner city zone of Budapest on the basis of space syntactic values, 1870-2001

3.2.3. Space syntactic features and townscape characteristics

The central axis of the Danube

The Danube is the most significant axis of the capital city, the most dominant factor in the organisation of urban space. The importance of the hundreds of metres-wide river is also supported by the space syntactic values. The space syntactic values are getting stronger approaching the city centre, in the northern parts of the area under scrutiny the position of the axis remains high, however the urban role of vertical axes gradually decreases. The southern water front section starting at Petőfi Bridge and the northern Buda side waterfront are both axes of negligible importance. However, considering the whole urban system the role of the axes connected to the Danube is undoubtedly outstanding both with respect to integration and control.

The Danube axis is as much deterministic in the townscape as in urban structure. While the river, by its pure width, assures visibility both between the Buda and Pest sides and along the river valley, its presence is dominant both as a visual axis and as a local visual element of space. Role of the axis fulfilled in the townscape is manifested not only in the open space characterised with considerable water surface but also in the bordering vertical surfaces of traffic axes running parallel with the river. These carry distinct importance with respect to the centre-periphery relation, environmental factors, and in the case of the nodes formed by bridges, bridgeheads all outstanding in space syntactic sense.

Ferencváros urban quarter

The characteristics of this case study area significantly differ in its central areas and on its edges. The width of bordering main axes of urban importance ease the dominance of the existing strict vertical borders. Along the axes of local importance in the central areas the space walls depress the passers-by. Space walls are broken up in the nodes: while this break-up at the Boráros Square bridgehead strikes out markedly, at the crossroads of Ferenc Bld. and Üllői str. it is much less detectable, in the central areas in the nodes of local importance they are not typical. Generally it can be stated that the break- up of space walls are dependent on the integration value of urban and district level axes, which can be characterised with space syntactic values (Figure 3).

The dominant function of the axes is traffic, which generate a rather disturbing and confused townscape in the nodes. The city scale axes – and especially their nodes – are different in socio-economic functional respect as well: along with the diminishing rate of integration commercial

function also decreases, the service axes of Middle-Ferencváros – such as the Mester and Haller streets – are also outstanding on the overall urban level.

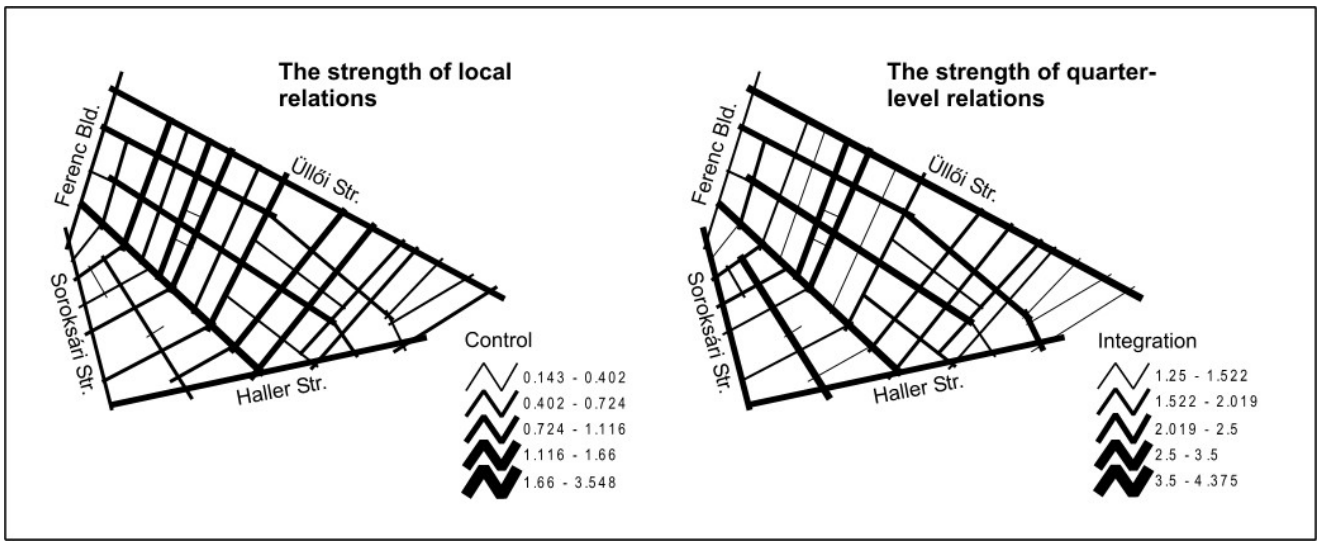

Figure 3. Space syntactic features of Middle-Ferencváros

3.3. The space syntactic features of different urban forms

On the basis of the space syntactic values the possibility opens up in the theoretical way to set up a space syntactic-based urban typology, however the comparison of the space syntactic and townscape features of settlements and urban quarters serve as a concrete proof. The strength of coherence between the control and integration values of the examined settlements indicates the interconnection of the local and global forces shaping space. We can examine on the one hand the strength of regularities – the variance of space elements (R2) – between the control and integration values of certain space elements, on the other hand the dependency rate of space elements on integration, urban ideologies, the regression line steepness of control-integration.

From among the 20 urban quarters under scrutiny Wekerle-estate and Middle-Ferencváros show a very outstanding value both for the strength of cohesion and for the dependency rate of integration. This phenomenon appears in those two case study areas, where the planned spatial structure can be connected to one particular historical period, and where the environmental factors did not play an important role in the formation of the structure. These are two quarters where the townscape is the most readable and can be easily interpreted.

Less strong but similar system of connections characterise the central zone of Budapest, the central zone and the low status quarter of Hajdúböszörmény, as well as Pesterzsébet. Here the appearance of global urban policy can be connected to the dominant urban functions of distinct historical eras. In the

formation of the above-mentioned urban quarters natural environmental factors did not have a role. Regarding their townscape these quarters are characterised with a “diluted” version of the unified appearance. In these cases around the distorting elements (church, town hall, tower houses) better or worse urban motives evolved.

For the third, largest group of urban quarters examined it can be stated that the connection of local and global regularities is weak and at the same time the sensitivity of the connection i.e. the impact of global urban ideology on the local regularities is negligible. With the exception of Tiszaújváros and Hajdúböszörmény in the case study areas environmental factors had at least a medium strength impact on the development of space structure, thus the local regularities gained primacy through natural conditions. In the case of this group the eclectic nature of the quarter is also characteristic because of the planning ideology or due to natural conditions but these quarters show the highest degree of diversity as well.

4. CONCLUSIONS AND PROPOSALS

4.1. Propositions

The connection between the socio-economic structure and physical form has long been known. It is approved that social decisions are crucial in the formation of space and that the physical space affect the socio-economic relations. The theory of sustainable development attribute similar importance to environmental factors in the urban processes. One of the guiding principles of sustainable development is that environmental systems mean the foundation of socio-economic processes, environment can be interpreted in complex systems of interconnections. The three factors only together are able to establish the conditions for the mankind to develop throughout generations.

In my interpretation examining the urban structure a fundamental issue of sustainability is, if the built environment sufficiently support the evolution of a uniform urban hierarchy, where the system of centres and sub-centres ensure the satisfaction of social and economic demands. Harmony as the criterion of sustainability is basically a subjective. In my thesis I defined functions (disfunction and loss of function), human scale (dominance), the forms and the quality of the built environment (style and "message") as factors to base the interpretation of sustainability for townscape on.

The applicability of space syntax analysis

The applications of space syntax in the thesis are suitable for making conclusions in general and for specifically Budapest. As part of the space syntactic analysis I identified the centre, the sub-centres and the periphery of Budapest. Based on the theory of space syntax my research outcomes have significance beyond the outcomes based purely on physical or socio-economic examinations, which establishes the connection between the abstract social and economic as well as the physical built and natural environment.

Argument 1.): By using the space syntax analysis I identified those urban quarters, which can be defined as centres.

Argument 2.): By using the space syntax analysis I identified urban quarters, which can be defined as sub-centres, and quarters lacking centres.

Argument 3.): By revealing the connections between the space syntax and the descriptive urban sciences I proved the strong relation between the spatial structure and social processes. I proved that

by the examination of the built environment space syntax becomes suitable to model the complex socio-economic processes influencing the overall urban development, and to identify the place and quality of the major deterministic elements of the townscape.

Argument 3.1.): My research suggests the balance of local and urban level decisions fundamentally influence the structure and townscape of an urban quarter. I concluded that depending on the decision-making mechanisms prevailing in the formation of a given quarter, space structure takes different direction in development, which is rooted in the distinctive nature of urban and local interests.

The connection of townscape and space syntax

The quarters and the concrete urban spaces appear in an integrated form in the urban space, they are considered as its sub-systems. The distinct decision-making mechanisms have varied scope of influence, but contribute to the formation of such city level spatial system, which is to be interpreted on the level of urban landscape. Therefore the appearance of urban landscape is not only the consequence of the urban level ideology, but involve the impact of local regulation systems.

Argument 4.): My research results suggest that a complex system of relations exists between the social decisions with impacts on spatial structure, made on various decision-making levels and the townscape and urban landscape. Regarding this complex system the following outcomes were produced:

Argument 4.1.): I found that the marked appearance of global ideology interpreted on the urban level besides the clear, centrally focused urban structure leads to the evolvement of uniform and well-interpretable townscape. This phenomenon is independent from the attainments of global ideology typical of the given historical era.

Argument 4.2.): According to my research the social reaction given in order to reduce the influence of global space organisation forces is the formation of an urban signal developed under the influence of the ideology and style of the given historical period. The resulted urban elements besides the complex structure and appearance are hard to be understood for the viewer, often in a strange context strengthen the eclectic nature of the city, but at the same time assist in the interpretation of the townscape and the urban landscape.

Argument 4.3.): The thesis points out that the increasingly complex space structure evolving during the urban development process besides the natural environment also restricts the influence of the global ideology of a given era.

Argument 4.4.): By the comparison of the space syntactic values and the traffic functions I found that through space syntactic analysis is also suitable to describe the quality and intensity of traffic functions.

Argument 5.): In the course of my research I came to the conclusion that in the formation of the urban structure the natural environmental factors overwrite the interest of the global urban systems. The impacts of the urban social ideology evolve only where natural conditions do not limit the urban development processes. Natural environment means such force, which strengthen the influence of the local space organisation by this reducing the impact of the attainments aiming at the transformation of the natural environment.

Space syntax in the description of changes in the space structure

Argument 6.): I proved that space syntactic analyses provide a proper method to model the socio-economic impacts possibly posed by the new urban structural elements.

The appearance of new structural elements produced by social decisions in the urban space affect the social relations, the widely interpreted spatial structure and consequently the townscape itself not only by its pure physical being but also in indirect manner. These effects can be detected in space in larger distances. According to the theoretical foundations of space syntax the impacts can be interpreted in social and economic respects.

Argument 7.): I proved that the appearance of new structural elements changes the development potentials of the urban quarters.

Each urban spatial intervention means a new development potential can be made numerical on the basis of its space syntactic features for the various urban quarters. I found that the change could be negative or positive depending on the extent to which it promotes the strengthening of urban processes, the sustainable direction change in the centre-periphery relations, and their results manifested in the urban landscape.

Classicfication of settlements with the help of space syntax

It was a common conclusion of the attainments dealing with the classification of settlements that though it is possible to set up theoretical models, these have serious limitations when it comes to characterising a concrete city or classifying settlements on a wider region. The space syntactic foundation of the settlement classification is the connection-network of urban spaces, which was characterised with control and integration values. I carried out statistical analyses on the totalled space

syntactic values produced for certain cities and urban quarters and compared the results with the literature on their urban development with the following conclusions:

Argument 8.): It was made evident that the classification of urban structures is not possible explicitly by using space syntactic analyses either.

Through my results I proved that – though one cannot meet a clear structure on the urban level – dominant structural forms can be identified in case of certain urban quarters, which can be related to some comprehensive ideology of space syntax.

On the basis of the space syntactic characteristics of settlements and urban quarters:

Argument 9.): I revealed that in Hungary the typical urban structural forms are related to conscious urban planning and construction interventions. The settlements become the special collection of quarters having been developing along global or local ideologies, thus on the city level even the continuity of planning cannot produce unified and classifiable structure.

4.2. The applicability of the space syntax analyses

I see the main advantages of the method to other methods and modelling practice in:

- The quickness and simplicity of producing the space syntactic database
- By using the space syntactic models the structural features are possible to make numerical, the planning error can be minimized,
- By using the method modelling the possibilities of intervention and the forecasting of the impacts becomes considerably more simple

I propose the practical use of space syntax in the preparation and elaboration of regulation plans in the following manner:

- In the examination phase the nodes, axes, and signals furthermore the centres sub-centres and the quarters lacing centres of urban level significance can be identified. Based on these pieces of information the development objectives can be worked out, which assures the structural and regulation interventions desirable from socio-economic point of view.
- In the phase of proposition making on the basis of the research outcomes such changes can be initiated in the existing structure and regulations, that respond to the decisions regarding the centre-periphery relations and the townscape.

I propose the practical use of space syntax to assist the planning and decision-making process concerning the development of open spaces:

- The examination of the built-up area, modelling the existing and the planned construction forms and manners, the determination of spatial connections
- Revelation of the connectivity of spaces bearing distinct functions characteristics and form, the examination of distinct development alternatives
- Development of new green spaces

  Green space ratios and degree of green space supply, furthermore their accessibility can be determined, including the following focuses:
  - The relation of various green space elements to one another
  - Land use connected to distinct green space functions (e.g. protection, recreation)
  - Objects related to green space functions (recreational sites, pathways, etc.)
- Connections of traffic systems (traffic zones)

With respect to open space planning an extraordinary field of research is provided if axes are interpreted not as physical but as visual axes. From the different points – typically from an important physical point of space – the view gained by the viewer can be modelled revealing the limitations generated by the spatial elements created through various architectural, gardening processes. Therefore through visual interpretation visibility examinations can be carried out on the base of which we can assure in the planning process the recognition of each special object or axis. Furthermore according to the planners' and decision-makers' intention (e.g. extraordinary functions, symbolic signs etc.) we can "lead" the users of space, this way calling their attention to the messages hidden in space, form and symbols.

Besides the presented possible applications further fields of use is proposed in the research and analyses:

- Examination of settlement networks from the aspect of development policy and urban development
  - The determination of settlements with central functions, identification of differences between the central functions and the central structural status
  - Identification of the secluded, functionless socio-economically underdeveloped settlements and regions; e.g. identification of the backward micro-regions
  - Defining the major directions and axes of settlement connections, the analysis of centre-sub-centre-periphery relation on various spatial levels
- Landscape planning

- Examination of the diversity of landscape through the analyses of connection systems of regional characteristics;
- Planning of ecological networks

- Traffic system planning
  - Planning the elements of the European and national road system, modelling traffic, traffic prognoses, modelling the socio-economic and environmental impacts of implementation.
  - Planning public transport, qualitative and quantitative analysis of the connections of public transportation networks, revision of the public transportation systems
- Architectural design
  - The analyses and planning of the internal traffic system of buildings.; e.g. large cultural and sports establishments
  - Placement of functions within the buildings according to the different internal traffic networks and the users' intentions

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[2] I conducted research on the topic of space syntax independently as the leading professional manager of Terra Studio (TERRA STUDIO 2003b, 2005), or planner fully responsible for space syntax related topics (TERRA STUDIO 2003A).