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Spatial Navigation Modelling Technology in Urban Planning Project

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1 ABSTRACT

This article discusses the author's concept of a spatial navigation modeling method under the conditional name "ART-space", which can be considered as a design and analytical technology for assessing the degree of readability and diversity of the structure of a developed or implemented urban planning project in the process of imaginary or real navigation. To demonstrate the analytical capabilities of the proposed technology of mental navigation, we have chosen an outstanding project of the city-district Seestadt Aspern in Vienna (designed by Tovatt Architects & Planners AB), which is underway and has a complex expressive master plan.

Keywords: Spatial navigation, Mental space, Cognitive linguistics, Urban planning, Topology

2 BACKGROUND OF MENTAL NAVIGATION TECHNOLOGY

The modern urban planning policy, focused on active mobility, "pedestrianization", improving the quality of public spaces, makes demands on the architectural and functional diversity, on the content of the urban environment. Significant number of methods that evaluate the diversity of the urban environment using Google Maps, GIS geolocations, real estate registers from the standpoint of modeling pedestrian and transport accessibility, which ultimately leads to an increase in the consumer qualities of the urban environment and to an increase in the capitalization of the real estate itself. In this regard, the possibility of increasing the socio-cultural and artistic diversity of the city through the development of the project method is important, which can also lead to an increase in the economic value of urban space, and further understanding of the "meaning and image of the place". The first step in this direction is the problem of understanding the principles of orientation and navigation of a person in urban planning space, so important basic urban planning scenario projected at the stage of the general plan and then understood by the developer and residents without significant distortion.

The theoretical and methodological prerequisites for the development of the "ART-space" mental navigation technology were, first of all, research in the field: cognitive linguistics (Talmy,1983), semiotics (Toporov,1983), sociology of perception (Lynch,1960), composition in art (Rauschendach,1986), mathematical topology (Willard, 2004). In addition, the author's own research on modeling spatial structures taking into account perception in the direction of understanding syntax language of urban space (Kolontay, 1987).

Today, three-dimensional virtual architectural animations have made it easier to understand the appearance of the projected urban development for the future resident. The illusion of full reality in animation creates the feeling that a stable connection is between the urbanist's project, the future resident and the pedestrian. However, when perceiving urban planning animation, viewers do not use the categories of the "image of the city", justly defined by the American architect Kevin Lynch (1960) - landmarks, boundaries, paths, nodes, districts, since they do not orientate themselves in the proposed space, do not analyze the likely paths and appearance of the development, do not falling into the frame. It is essential to separate the objectives of this study from the multitude of sociological studies to establish the "sense of place ". Where it is more about the phenomenology of urban space, which is the cultural and aesthetic preferences of society and is no longer associated with the ease of movement of a person in the space of the city and the syntax of spatial relations, but with the degree of satisfaction with the content of urban space, its semantics.

Modern cognitive linguistics contributes to building bridges between the mental image of the city's space and the graphic language of the architect. Thus, the French linguist Gilles Fauconnier (1985) declares the existence of mental spaces that precede the understanding of a verbal utterance and exist as ordered sets with elements and relationships between them, as models of imaginary and real situations in the form they are constructed by man. American linguist Leonard Talmy (1983) drew attention to how the prepositions of language – "along", "above", "through" and others - form the geometry of mental space. He emphasized that the content properties of the text are associated with the identification of grammatical, "orienting" spatial categories in the language, such as figure-background, dimension, pattern of distribution, etc., and considers the most important reference objects, both the spatial orientation of the human body and the spatial orientation to the four cardinal points. These direction specialists interpreted as topological semantics. Thus, cognitive linguistics leads to the fact that in language there are categories associated with human corporeality and physical space at the unconscious level that provide a correct understanding of information about the structure of the spatial environment. Regardless of nationality and level of intellectual development, each person will understand the meaning of spatial prepositions of localization "between", “inside”, “around” or prepositions of the direction of movement "through", “from-to”, “along”, “around”. As we have shown in our PhD dissertation research, simultaneously designate three inseparable elements of the mental space structure: center, border and connecting axis-path, the main compositional elements of the spatial image structure in urban planning. The quality of navigation in a city depends on a person's ability to correlate certain buildings, streets, intersections, areas with the structure of mental space - centers of orientation and represent other territories and objects in the language description as zones of influence of the center, i.e. center boundaries, or what is called “neighborhoods” in the mathematical topology of space. The more different buildings and territories correlate with the zone of influence of the chosen center, the greater the variety and content of public spaces perceived from the paths of movement. However, the main element of the set of buildings oriented towards the center will be an object on the border of its zone of influence, that is, located “between” two centers. In this case, such a border building becomes a new center of orientation, and two previous centers that lie on a common axis-path become the boundaries. At the same time, the principle of continuity of navigation and the principle of continuity of topological space are implemented, which in this case leads to a doubling of the level of diversity of urban space distinguishable by a person. The methodological principle of design and navigation "ART-space" follows: increasing the diversity, density of landmarks, readability and content of the urban environment by endowing each spatial landmark on the street grid with unique topological properties - to be a center, boundary, and axis of orientation at the same time, as three topological measurements of any point in the mental urban space. Evaluation of the design solution and mental navigation in this case will mean the identification of the structure of interconnected places with the above qualities.

3 METHODOLOGY OF MENTAL NAVIGATION

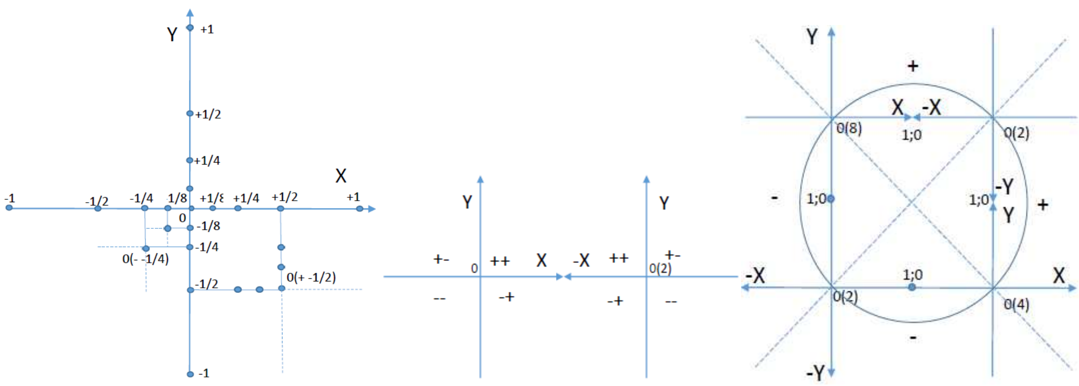
3.1 The elements of the navigation system

The main requirement for this navigation system is to ensure maximum accuracy of the verbal description of the position of a place in an imaginary urban space and on a flat project plan. Landmarks marking a location should be socially and morphologically significant and in intended visual contact with the location. The place "halfway from the park to the school" or "in the middle between tram B stops" is accurate, as opposed to the place "inside area B". Accordingly, places marked with buildings or streets are unambiguously recognized as navigation centers if they are located "in the middle", "between", equidistant from similar objects or places as their boundaries of influence. Any center of orientation is the place of the target of movement or control of the distance to the target or making a decision to change the route. The streets become coordinate axes, and for an unambiguous recognition of the coordinate center, buildings before and after the intersection must expressively change their properties from a conditional plus to a minus with a straight-line movement, and when turning from the conditional street-axis X to street Y, the properties of space should be different, but not contrasting. Traditionally, the center of orientation becomes the socially most significant verbalized objects, indicated on the navigation plan by a point with a distance value of «0». All places in the boundary function are indicated on the plan by numerical values of the distance from the center and are recognized as located “near”, “in front of”, “halfway” (1/2), “a quarter of the way” (1/4) from the center reference, and the farthest border with a value of 1 will be located between the two centers. Orientation axes are a way of establishing mental connections between landmarks in the function of centers and boundaries and function as a route guidance tool for navigation, so the axes can only be straight-line, although real or imagined paths can be of any curvature. Orientation axes can coincide with orienting paths of movement (streets, roads, pedestrian links), and then they are shown on navigation charts with a solid colored line of different thickness, depending on the significance. Orientation axes that do not coincide with the paths of movement, but indicate the location of the final or intermediate target, are shown on the plan by the dashed line of the color of the linked landmarks (in the real space of the district, such axes can form visual diagonal or other connections between landmark objects). Orienting axes-paths of movement in mental navigation systems can intersect only at right angles, and to ensure directionality are indicated on the diagrams by different letter symbols, for example, X for east-west orientation, and Y for north-south direction and are always directed to the most significant border or center. Curvilinear paths of movement are disorienting, therefore, they are divided into segments by orienting axes of movement, and the image "movement in a circle or a curve" will mean movement along an imaginary polygon or broken line.

When forming a navigation system, actions to transform the city as a physical reality into mental spatial geometry, convenient for design modeling, are important. These actions represent a cyclical process: Transformation of physical elements of the city into point, linear and spatial (planar) elements of physical space. Transformation of physical elements into an orienting topological structure by establishing distance relations between designated centers and boundaries along the axes of motion. Ensuring the distinguishability of centers, boundaries and axes by assigning or identifying marking properties, i.e. verbalized functional, morphological, semiotic characteristics of the real urban environment. All three actions can be simultaneously. Based on the foregoing, we assumed that the elements of the "image of the city" by K. Lynch went through the first and third transformations, but the syntax between the elements turned out to be problematic.

3.2 Typology of basic mental navigation systems

The number of possible types of basic mental navigation systems and ways of orienting a person in space is limited to three types. This is due to only three mentally distinguishable ways of movement of a person in space: "from borders to the center", "between opposite borders through the center", "from one side to the opposite side along the border and around the center". The resulting images of spaces correspond to topological figures - a circle, a belt and a ring, where the belt is isomorphic a circle or a broken ring. Taking into account the structure of the mental space, each type of navigation uses and models either the center, or the axis, or the boundaries of the space. The image of the city will be different if spatial navigation is forming from the Kremlin in Moscow, from the Champs Elysees in Paris or the Ringstrasse in Vienna. The mental and topological size of the same physical space of historical Vienna when navigating from St. Stephen's Cathedral will be perceived to be much smaller than when navigating from the Opera building on the Ringstrasse, where the number of related landmarks and their metric distance from the Opera will be much greater than in the first case. Mental navigation is carried out by assessing the distance of all landmarks between themselves and the center of orientation, measured by the number of meters in physical space and the set of related elements-landmarks in the topological mental space. Considering that the described navigation process means a constant mutual transformation of the metric space and topological, we will obtain the simplest navigation system by converting a flat rectangular Cartesian coordinate system into a topological coordinate system in accordance with the above described and logically established requirements for the unambiguous readability of navigation elements.



Figures 1-3.

3.2.1 <u>Monocentric navigation system</u>

The main difference between a topological space as a set and an empty Cartesian space is the boundedness of the first. Therefore, the extreme boundaries of the coordinate navigation system on opposite axes X and Y will be the index "1" as the maximum distance. The center of navigation by index "0", and internal

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landmarks in the function of internal boundaries and centers of lower order will be limited to three values, intervals movements: "half way" -1/2, "quarter way" - 1/4 and "half a quarter way" -1/8 (Fig. 1). The 1/16 interval is mentally difficult to imagine and is excluded from the coordinate navigation system. The four values of the distance of the boundaries from the center are characterized by a change in the physical properties of the landmark boundaries (size, color, functional structure, etc.), as well as the topological properties as a function of an independent center of orientation, since each boundary is equidistant from the main center and is nearest other boundary. We interpret the plus and minus numerical values of the boundaries as distinguishing properties of landmarks-places on the principle of a pair of contrastingly different properties and a pair of similar properties. Graphically, this means that within a single coordinate navigation system, only four distinguishable colors can be used at the same time to distinguish the properties of axes, centers and boundaries. At the same time, each of the 17 places on the axes is characterized by a unique topology, where the mental presentation of any place presupposes ideas about all the other 16 places. In symbolic terms, each border must contain a particle of its center, and the center, in turn, must absorb all the properties of its borders. This may be a special architectural and artistic task of an urban planning work. Further division of space presupposes the formation of new axes and paths of movement that intersect the main coordinate axes only at reference points with established numerical values. In this case, the point boundaries of the center are transformed into linear ones, and when the axes are closed, the spatial boundary-area and the center of the new coordinate system are constructed. The proposed monocentric navigation system controls the perception of space and is a “syntactic pattern” for further understanding the language of the urban area space and its “sense of place”.

3.2.2 Two-centric navigation system

The two-centric navigation system is formed by adding two monocentric systems. 1) Addition of two equal systems with the same direction of the axes and the formation of a common boundary with index 1. 2) When the direction of the X axis is changed and two variants of the direction for the Y axis, one of the centers 0(2) becomes the far boundary of the second center 0. In this case, one common main axis of navigation appears, forming a linear mental image of space. The creation of landmarks according to the rule of two variants of addition of focused monocentric structures provides the maximum variety and accuracy of orientation in a two-centric linear navigation system (Fig. 2).

3.2.3 Ring polycentric navigation system

The ring navigation system, as the most complex, is formed by the addition of four monocentric rectangular navigation coordinate systems, or four linear two-centric structures, or four sectors of a circle (Fig. 3). Accordingly, in a ring polycentric navigation system, the rules for constructing a monocentric, linear and proper ring system are simultaneously applied. This means that the same landmarks include three different characteristics at the same time, and the imaginary space in the process of navigation shrinks towards the centers, stretches along the axes between opposite centers and bends about the diagonal axes between paired opposite centers. The opposite directions of the axes and their plus and minus values on the half rings provide the orientation of this navigation system, creating an image of compression on one side and stretching on the other side of the ring of imaginary space. Each of the four centers of the ring navigation system is assigned its own unique value characterizing its distance and level of complexity in relation to the main center of navigation on the ring. The center with a value of 0(4) indicates that this landmark is located on a semicircle, is the center of one space and the most distant border of the influence of the main center of another space with a value of zero. The mentally distinguishable maximum variety of landmarks with different distances from the center in one direction for the ring system it is indicated on the plan as 0(1/8;1/4;1/2;1;2;4;8). For the monocentric navigation system it is indicated as 0(1/8;1/4;1/2;1). For two-centric-linear - 0(1/8;1/4;1/2;1;2).

3.3 Extension navigation systems

3.3.1 “Projection” of boundaries to the center

Real building and real urban environment are not limited to a set of navigation system landmarks. The navigation system is only an important syntactic part of the urban space, protecting it from monotony, ensuring the "socialization" of the physical space by embedding in it the human ability to orientate and recognize the topology of the environment. At the same time, theoretically, an urban environment can be designed, consisting all of unique semantic spatial landmarks. However, firstly, there will always be restrictions on the number of bases of distinguishable properties of landmarks and limitations in the size of the city block and building plan to designate a limited number of unique places. Secondly, taking into account the technology of systematic "collective" urban planning, in reality there will always be an environmental background building and a unique one that orientates in space. With this in mind, the extension of the navigation system applies only to a part of buildings, streets, intersections and quarters of any considered or projected city-area. Extension of monocentric, two-centric and polycentric navigation systems is achieved by transforming landmarks-boundaries into centers of new spaces with new orientation axes and paths of movement. On navigation models, this looks like a mutual projection of the farthest boundaries onto the coordinate centers, which makes it possible to determine the position of the pedestrian observer within the area in relation to the main center, without being on the main coordinate axes. Such a projection is shown as a broken line and is similar in appearance to a perspective view in graphic art. Each type of navigation system has its own peculiarities of extension and "projection" of boundaries to the centers of orientation, which will be shown further on the example of the analysis of the space of the Aspern settlement.

3.3.2 Superimposing of three navigation systems

Mutual conditioning from each other of the center, boundaries and axis as three mental dimensions of topological flat space suggests the possibility of superimposing three types of navigation systems within the boundaries of one physical space (Fig.9). In terms of urban planning, this means that the same area can be entirely organized in three different ways with the achievement of maximum readable diversity. When orienting in it, an artistic effect of variable dimensions of the mental space will arise - a compact circle when orienting along a monocentric system, an extensive ring along polycentric, elongated two-centric belt. The condition for obtaining maximum diversity when three navigation systems are superimposed is the location of the three main centers in such a way that one of them is located in the middle between the other two on an imaginary axis. The second condition is the exclusion of overlapping of some point landmarks or linear paths with others from different systems when scaling. This is achieved by different spacing of landmarks-boundaries for different orientation systems, if all of them are based on a rectangular metric grid. In a monocentric system, this interval must be a multiple of two, and in a linear and ring system, a multiple of 3. Under these conditions, the mutual superimposing of landmarks with the values 1/2;1/4;1/8 in each system is excluded and the space diversity does not decrease.

4 SIMULATION OF SPATIAL NAVIGATION ON THE PROJECT OF THE CITY DISTRICT ASPERN

Navigation modeling according to the described theory and methodology “ART-space” should be effective on the scale of urban densely built up compact spaces. It can be a projected area of the city on a flat landscape (which complicates orientation in its space), which can be crossed on foot in 20-30 minutes. For modeling and analysis, we have chosen an outstanding project Seestadt Aspern for 20 thousand inhabitants in the 22nd municipal district of Vienna (designer Tovatt Architects & Planners AB), which is underway and has a complex expressive plan of the territory of 240 hectares. To model navigation, we used the design materials of the master plan in terms of the general urban planning concept of the Aspern area (Fig. 4a), functional (b), zoning of buildings in height (c), 3D model of building, parameters of the street network, etc. The authors of the project made minor changes to the final implemented version of the project, but the basic concept remained unchanged, which we further analyze. The author’s most significant components of the urban planning concept of the district were the following. The northern business quarter at the metro and railway stations; a centrally located lake with landscaped areas in the western and eastern directions; the main shopping street oriented towards the spatial center of the district; the main circular street of the entire district as the Ringstrasse refrain of Vienna.

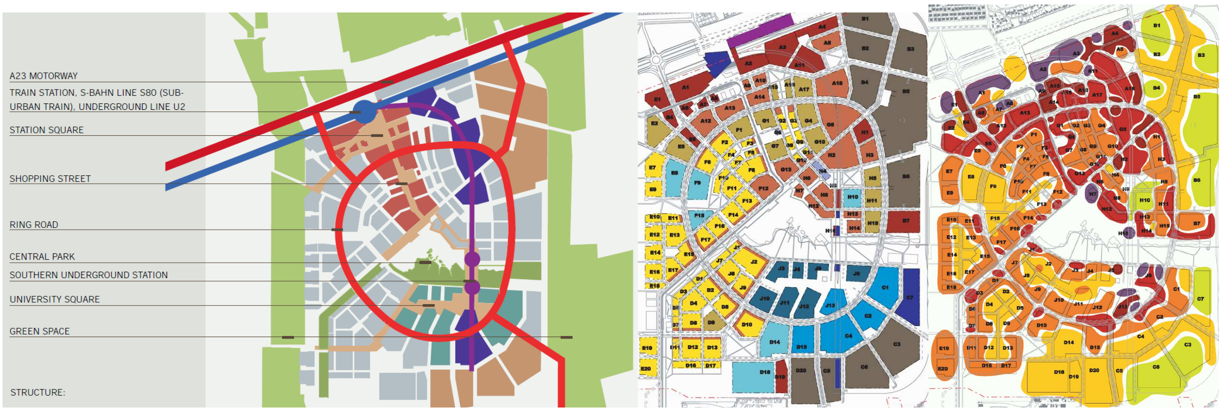
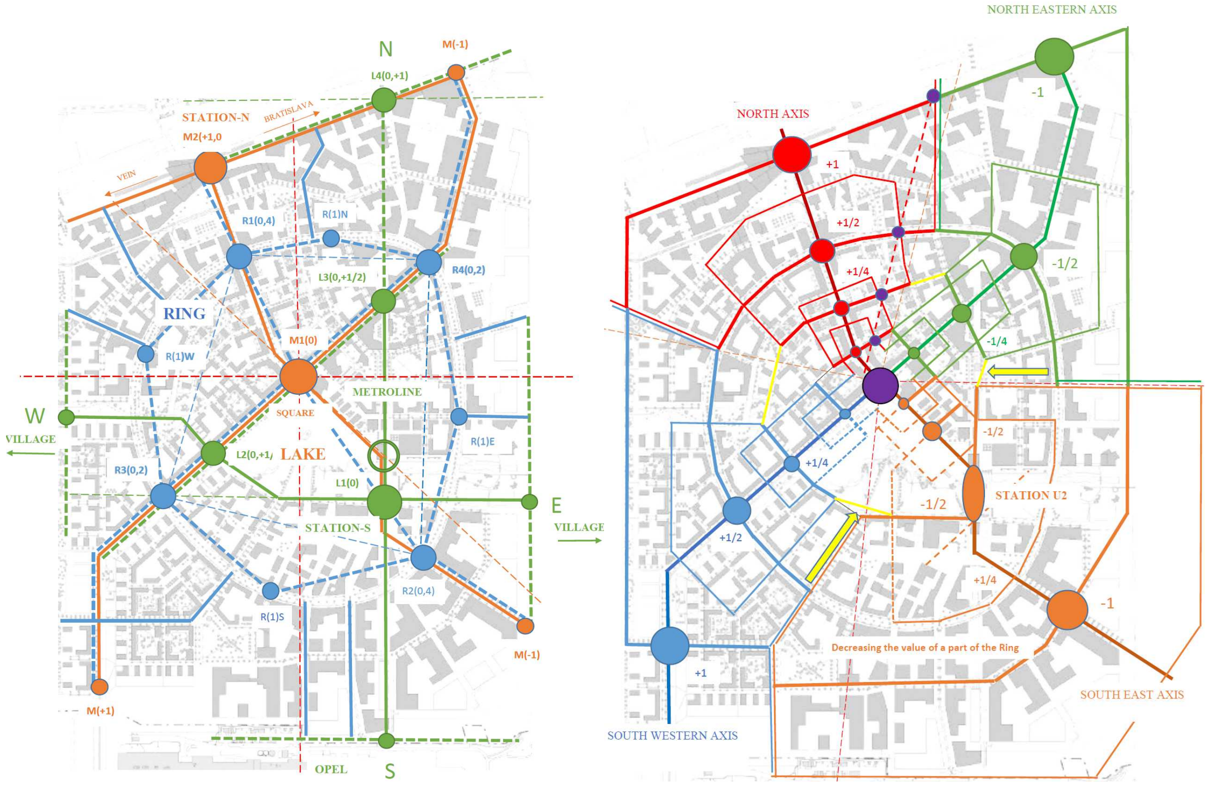


Figure 4.



Figures 5-6.

4.1 Modeling basic navigation systems Aspern

Considering that a monocentric navigation system is the basis for the construction of two other systems, it is necessary to identify all variants of monocentric structures, and then determine their mutual combinations to form more complex and diverse linear and ring, providing navigation that is more accurate. Modeling begins with determining the outer orienting boundaries of the area's development, the intersection of the main transport links with the outer borders of the district (distance index 1), mutual intersection of all main transport links as close as possible to the spatial center of the area (distance index 0) to build the main monocentric coordinate system. The next action reveals other places of mutual intersection of the main external connections like a monocentric, two-centric-linear or ring system. Using the spatially, functionally and symbolically the most significant landmarks in the structure of the Aspern area, three navigation systems are formed that allow free movement within the area, constantly realizing the position of a potential observer (Fig. 5). This will be facilitated by a monocentric system (orange) with a potential central reference point M1 (0) - "Square by the Lake" and reference point M2 (+1.0) - "Area near the metro and railway station" as the main outer border and center at the same time. This pair of landmarks defines the location of the Y-axis and all the main street-axes of the district, despite the need for a "diagonal" orientation of the X-axis and the difficulty of tracing the lower part of the Y-axis with a minus index of the outer boundary - M (-1). The linear navigation system of the Aspern area (green) forms its geographic reference to the cardinal points "north-south" and is mentally recognized due to the physical structures of the U2 metro route as the Y axis and the metro station with two exits by the Lake as the main center - L1. The outer border-center in the north (L2) may be the area of the business zone on the links of the Aspern and the prospective development of the area in the north behind the railway. From a functional point of view, a significant street does not support this axis in the project, but in the image of the district, it is very important. The main X-axis in the linear system is formed by the park boulevard on the north side of the Lake and the development of "green links" in the west and east. Significant landmarks in this system should also be the intersections of the X and Y axes with the "diagonal" street. Four center nodes (R1-R4) of the ring navigation system (blue) are simultaneously the border-landmarks of the monocentric structure, which reduces the potential diversity of the spatial image of the area and the need to use four other strategically located landmarks on the ring with the index R (1) that do not have such significant axes as the first four. Real circle movement should be combined with imaginary or visual routing along the direct links between the four centers shown by the dashed line. Further modeling of each navigation system will show the degree of their influence on the integral perception of the space of the Aspern area.

4.2 Internal extension Monocentric navigation system

The distinguishability of the position of the observer on the main paths of movement should be ensured by the contrastingly different properties of the building along the X and Y axes, including the difference in the properties of the space before and after the main reference point - the “Square near the Lake with a high-rise building” (Fig. 6). This is clearly present in the project. Extension of navigation elements occurs step by step by defining centrally located landmarks with distance from the center of 1/2;1/4;1/8 and laying new orientation path axes with new centers and boundaries. Observing each landmark is the center of one space, an axis similar in size to space and the border of a larger space. Graphically, this looks like a projection of the outer boundaries (for example, purple dots) and axes onto the navigation center. Verbal identification of the unique functional and spatial properties of each uniquely located landmark is a confirmation that the semantics of the detailed monocentric system in the project is provided, which is possible only when the project is implemented or when it in design process by the authors themselves. The confirmation of the syntax of the structure is the absence of gaps between the axes-paths when moving along the main radial axes and along imaginary rings between landmarks with similar values and properties, or in any other direction. In the Aspern project, due to the creation of a Lake and a correspondingly complex structure of the southeastern axis (orange color), the rank of the internal northern connection at the Lake increased from 1/4 to 1/2 and the rank of the Ring avenue in the same Aspern sector decreased (shown by arrows). This means that when navigating the monocentric coordinate system, Aspern will be perceived as two relatively independent parts - one is the southeastern sector, the other is all other sectors, and for orientation in the eastern and southeastern parts, it will be more convenient to use a linear system based on the metro line. A socially and functionally significant landmark "University Square", located in the zone of influence of the U2 metro station in the north, but isolated from the Lake and from the Ring avenue, the more significant axes of the first order, will play a local sectoral role of the second order in monocentric navigation. The orientation of the entire space of the Aspern district is emphasized by the gradual decrease in the size of the quarters from the eastern and southern periphery to the center, which is typical for traditional historical cities, but the appearance of an artificial lake in the center speaks of a new ideology of urbanization.

4.3 Internal extension Two-centric linear navigation system

The technology for modeling two-centric navigation is based on splitting a homogeneous rectangular grid into a system of pairs of heterogeneous monocentric systems (Fig. 7). In this case, the pedestrian observer is guided by two main centers or two pairs of centers, as it could be in Aspern, at the same time. For greater clarity of the proposed method, when scaling the axes and boundaries, we did not lay them strictly along the project streets, in contrast to the main centers and axes, which correspond to the project structure. The basis of this linear system is the obligatory difference between the properties of all main axes-paths in the function of centers from the axes in the function of boundaries. As well as the difference in the properties of all axes in the function Y from the axes in the function X, i.e. having different directions, which is marked on the diagram in four colors. Due to the fact, that external and internal boundaries with different properties on each side of the center are projected onto the main centers when extension the structure, the two-centric system makes it possible to achieve a large variety of a coherent, easily readable system of landmarks. Linear

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navigation of Aspern is formed by two X-axes (orange) as if moved apart by the space of the Lake and caused deformations of all axes-paths of the northeastern part of Aspern. Obviously, for the authors of the project of the Aspern district, the rectangular grid of streets was not a priority, in contrast to the adopted radial-ring scheme. Therefore, complex zigzag connections (yellow color) arose between opposite sides of the district along the axis with a index of 1/2 between the planned educational complexes on east and west of Aspern, as well as along the axis with a index of 1 between the northern square near the Station and the southern educational complex.

Figures 7-8.

4.4 Internal extension Polycentric ring navigation system

Ring navigation is possible if the system of landmarks on the ring is connected with real or imaginary straight sections of the path, while the technology of forming a route on a rectangular grid differs from navigation in a circle.

Ring-shaped navigation is the most difficult, but it is able to combine the largest number of landmarks according to two basic scenarios. 1) When moving along the ring between landmarks opposite on the ring without crossing the center (R1-R3-R2 and back). 2) When moving through the center of the circle along axes R3-M-R4 (Fig. 8). Readable circle navigation between opposing centers using four sets of landmarks is possible in only two ways. 1) When all four centers are equal and the subject moves in a circle in one direction, sequentially focusing on each of the four centers. 2) When one pair of opposite centers is more significant and the movement between them occurs towards each other, as in the Aspern project.

4.5 Navigating three systems simultaneously

The first sign of the readability of the integrated navigation system Aspern is the location of the main centers of the three coordinate systems on a common (diagonal) axis with a relatively equal distance of the center M1 from R1 and L1 (Fig. 9). However, the duplication of axes and landmarks by different systems (color overlay) indicates the underutilization of the distinguishable diversity. It should be recognized that an objective obstacle to the complete separation (without combining) of the three detailed navigation systems is the impossibility of reducing the size of building blocks and, accordingly, increasing the density of the street network. In the considered version of modeling, the navigation axes and landmarks are laid with maximum consideration for the design grid of streets in the Aspern district. It is for this reason that the integration of the two-centric-linear system is only partially possible, given the non-straightness of the internal latitudinal and meridional connections of the Aspern area. In the project, the dominance of the monocentric system is obvious, where its axes-radii coincide with the axes of the ring coordinate system. This means that radial streets towards the Lake will primarily define the location of the observer, and already secondarily by the opposite centers on the Ring (R1-R2; R3-R4). The very potential presence of a linear navigation system is important due to the U2 metro line along the Y axis and the natural X axis from the center L1 (metro station), as well as two centers L2 in the north and L3 in the west. Obviously, the ease of orientation within the area was not the main task of the authors of the project, therefore there are many deformations, gaps, shifts of axes and paths of movement, creating a feeling of a natural historical development of the building, but at the same time, and we see a clear structure of the composition of the space.

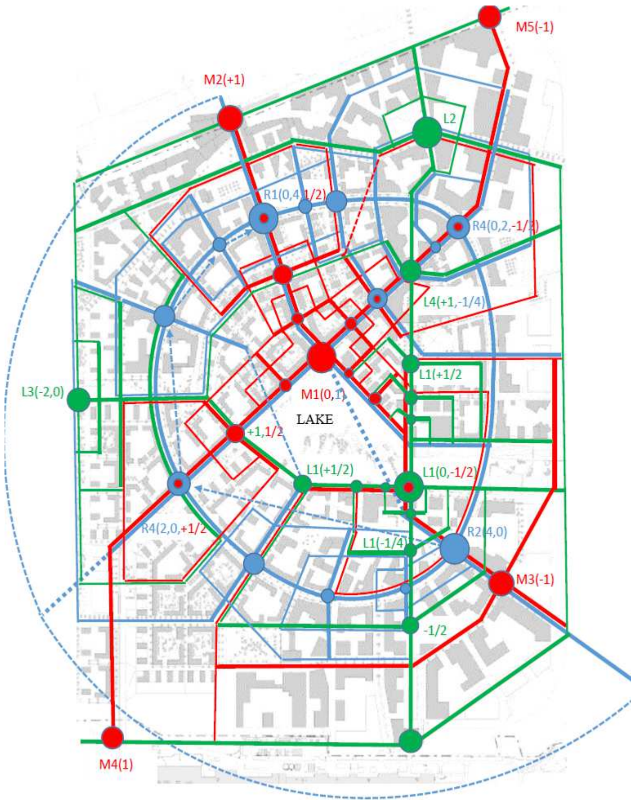

Figure 9.

5 CONCLUSION

The considered method of spatial navigation is the reverse side of the compositional method "ART-space", which can be used both for the development and for the analysis of the design solution in terms of the readability of orienting places and the level of diversity of the spatial structure. The theory and method are based on: 1) the linguistic distinction of the three-element structure of the basic mental space. 2) The rules for the construction, internal development and superimposing of three types of coordinate navigation systems as three dimensions of the urban planning topological space. 3) The rule “to be between” landmark elements in navigation systems and the systems themselves. 4) The semantic rule distinguishing between two similar and two opposite properties of landmarks as a single set. A quantitative assessment of the diversity of space for each individual type of navigation scheme includes the distinction of four properties for point, linear, spatial landmarks at three scale levels of parts (1/2; 1/4; 1/8), which is more than 100 unique orienting elements-places. However, just as any language is not limited to the syntax and the number of words in the dictionary, any city project cannot be reduced to the rules of spatial navigation. At the same time, these rules form a dialogue between an architect and a resident; transmit the important essence of a person into the urban environment - his mental ability to orientate and the ability to perceive the space of an urban area as a work of art. An architect can use these rules to achieve a certain image. The method of analyzing an urban planning project using the example of the Aspern district project confirmed both the applicability of the proposed theory and method of mental navigation, as well as the potential level of high structural diversity and artistic qualities of the district space in the Aspern project itself.

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