THE APPLICATION OF SOFTWARE BASED TECHNOLOGY FOR PROJECT IDENTIFICATION – A CASE STUDY OF SPACE SYNTAX ANALYSIS

S. Mathivathany
Department of Economics and Management, Vavuniya Campus of the University of Jaffna
mathivathany@vau.jfn.ac.lk

Y. Nanthagopan
Department of Economics and Management, Vavuniya Campus of the University of Jaffna
ynanthagopan@vau.jfn.ac.lk

S. Thirugnanasampanthar
Department of Economics and Management, Vavuniya Campus of the University of Jaffna
vs.thirugnanasampanthar@vau.jfn.ac.lk

A. Rukshan
Department of Economics and Management, Vavuniya Campus of the University of Jaffna
rukshan1977@gmail.com

ABSTRACT

Project identification is to develop a preliminary proposal for the most appropriate set of interventions and course of action, within specific time and budget frames, to address a specific development goal in a particular region or setting. Project success is decided on best project identification which provides guidance in setting project objectives to solve a given development problem or to use the opportunity for the development of a particular aspect. The "Space Syntax Analysis" is a science-based Geographical Information System (GIS). In practice, the space syntax provides a fundamental project planning information including patterns of movement, density, land use and land value, urban growth and societal differentiation which can be used for generation and evaluation of project ideas. The research objective is to identify the usage of space syntax technology in the project identification. Moratuwa, which is a large suburb of Colombo city, was selected to investigate the relationships between

spatial layout and project identification. The criteria were used for connectivity levels using space syntax analysis methods such as very high, high, moderate, low and very low. New development project ideas were generated using the space syntax analysis. The result of this study helps to identify the new projects ideas and valuable information for stimulating innovation of regions for sustainable development.

Keywords: *Geographical information system, project identification, project success, space syntax analysis, sustainable development*

INTRODUCTION

Space syntax (SSX) as a theory and methodology has been widely applied in developed countries for the spatial decision making and used as an effective professional practice in urban and regional context. The space syntax has been recognized as a key development in the study of urban morphology and the analysis of urban spatial form and function (Gauthier and Gilliland (2006), Carmona and Tiesdell (2007), Carmona et al. (2003), Cuthbert (2003, 2006). It is recognized in the United Kingdom as a valid standard of evidence for assessing the impact of planning applications, is taught in many universities and professional master-classes and has become a component of policy evaluation for many local governments seeking to address issues of movement and public space in urban design.

CABE (2008), ODPM (2004), DETR (2000). It has also been applied on over 1,000 different urban design projects internationally (Space Syntax Limited, 2008) acquiring a reputation for functional evaluation, successful project identifications and public space design in the professional realm. Space syntax also enjoys academic influence as a theory of space and society of spatial network analysis, and as a means of understanding human way-finding and spatial perception (Hillier, 1996, 2002; Montello, 2007; Seamon, 2007).

The space syntax tools and theories are mostly applied to the planning

profession. This is particularly the case in American planning and design circles, where much effort has been made to incorporate space syntax knowledge into either research or practice.

Lot of top grade journals have been published articles related space syntax analysis in project design fields, built environment - behavior studies, such as those related to obesity and physical fitness.

One of the main reasons for the failure of projects either at early stage of the implementation or not being sustainable after getting into operation stages is low attention given at the project identification and selection stage. Therefore, the purpose of this paper is to critically examine one of the phases of Project Management Cycle which is Project Identification and to identify the usage of space syntax technology in the project identification.

This paper uses the space syntax analysis by using Geographical Information System and qualitative interviews with a series of urban designers familiar with space syntax to explore this question, in particular several key New Urbanist practitioners. An attempt made to identify inherent problems that are commonly overlooked at this stage of project cycle management and to come out with recommendations as part of solutions to the problems.

LITERATURE REVIEW

Definitions of key terms

Project Cycle Management as a tool that describes the management activities and decision making procedures used during the life-cycle of a project. Lucian CIOLAN –Trainer- EU Project Cycle Management: The project cycle follows the life of a project, from the initial idea through its completion.

It provides a structure to ensure that stakeholders are consulted, and defines the key decision, information requirements and responsibilities at each phase so that informed decision can be made at each phase in the life of the project.

The logical and systematic process of initiating, planning, implementing, managing and evaluating projects or programs is known as 'Project Cycle Management'.

GTZ (1996) Categorized Project Cycle into three phases such as Identification phase – assess outset situation, establish system of objectives, Concept phase - establish project concept, prepare decisions to implement the project and Implementation phase - operationalize planning, implement, adjust and update planning and terminate project. Westland, Jason (2006) stated that the project life cycle consists of four phases Project initiation, Project planning, Project execution and Project closure. In project initiation phase a business problem or opportunity is identified and a business case providing various solution options is defined. Next, a feasibility study is conducted to investigate whether each option addresses the business problem and a final recommended solution is then put forward.

The project identification and selection of the project cycle is positioned in the Project Initiation Phase. Within the initiation phase, the business problem or opportunity is identified, a solution is defined, a project is formed and a project team is appointed to build and deliver the solution to the customer. Figure 4: shows the activities undertaken during the initiation phase (Westland, Jason (2006).

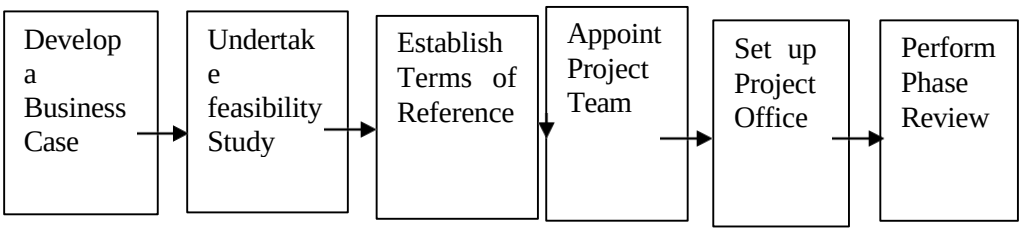


Figure 4: Project initiation activities

Theoretical Background - The Space Syntax Theory in Urban Context

Space syntax theory, a topology-based theory and one of accessibility-related methodologies used for computing connectivity in urban or architectural spaces and designs. In the context of theories, it is applied as the innovation, adoption and Planning Support Systems (PSS) in Urban Planning sectors. Space Syntax (SS) Theory was developed in the 1970s by a group led by Bill Hillier and Julienne Hanson at the University College London in collaboration with researches from several countries (Penn & Dalton, 1994). In general, the SS theory defines a city's structure by its road system as seen from topological perspectives, taking into account the existing connections seen from a relational systematic perspective.

Axial maps are fundamentally based on a relational approach of the set of streets making up road system of a city. This approach allows considerations on the topological attributes that each street establishes with its nearby streets (local connections) or with the whole system to which it pertains (global connections). SS is used for the potential application of the theoretical and methodological configuration frame work on traffic allocation studies.

Although axial map represents the smallest number of major lines passing through the urban system, the segment map involves the fragmentation of each line into several segments, according to the nodes existing in the urban grid. Thus, there would be further integration between the representation from SS

and those traditionally adopted in traffic engineering based on links (segments) and nodes (connections / crossings).

In space syntax, when converting the continuous space into a connected set of discrete units, it uses the concept of convex space partitioning or simply axial mapping. The procedure to generate the convex map involves taking a given spatial structure and partitioning it into a set of "fewest and fattest" convex spaces (Hillier and Hanson, 1984, pp.97-98). The procedure for generating the convex maps is iterative, starting with the identification of the fattest of the convex spaces and then progressively identifying the next largest one until the entire area is subdivided into a set of convex spaces. Then, the axial map can be drawn on this convex map by laying down the longest strait lines that passes through theses convex spaces (Figure 1). On the other hand, traditional way of abstracting street network follows different procedure. It generally uses center lines of streets. Whenever two center lines intersect each other, an intersection is created (Figure 2). When representing the configured lines as a graph, space syntax represents each line by a node and each intersection as an edge, while in traditional method, the situation is vice versa,that is, an intersection becomes a node and a line connecting two nodes becomes an edge.

The resulting axial lines in the axial map can be regarded as the fewest number of visual paths in the existing space where each intersection plays as a turn of sight, which becomes a depth. Thus, in space syntax, only the number of turns along a path rather than actual journey length is counted.

Comparing the Network Representation of Roads

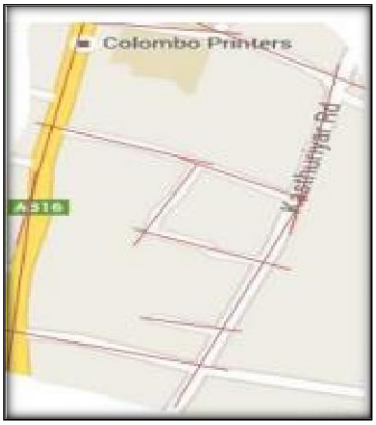


Figure 1: Real Road Network Figure 2: Traditional Network Figure 3: Axial Map

SS theory aims to establish a relationship between the spatial structure of citi es and buildings, the spatial dimension of social structures and broader social variables. It seeks to reveal both the logic of architectural space at any scale and the spatial logic of societies (HOLANDA, 2002, p. 92). SpaceSyntax theory understands that the spatial distribution of flows through the city as an essentially morphological and topological question, that is a functional result of the urban configuration and project identification as well.

Review of the empirical researches

Project identification is important to assess outset situation for establishing system of objectives. GTZ (1996) categorized project cycle into three phases such as identification phase, concept phase (establish project concept, prepare decisions to implement the project) and implementation phase (operationalize planning, implement, adjust and update planning, and terminate project). Westland's (2006) project life cycle consists of four phases including project initiation, concept, implementation, and monitoring. During project initiation phase a business problem or opportunity is identified and defined with a business case that provides various solution options. Next, a feasibility study is conducted to investigate whether each option addresses the business problem and a final recommended solution is then put forward. After the solution is defined, a project is formed, and a project team is appointed to build and deliver the solution to the customer.

According to Manual on Project Cycle Management (2009), the project concept should be relevant to priority local needs and consistent with policy priorities. In the project identification stage, project ideas are developed using different technologies, and assessed the relevance as well as the feasibility. This is important to determine the scope of further work required during the formulation stage for individual projects.

Space syntax is used for a construction) project identification practices worldwide, for urban design, building design and design education professional. Space syntax was pioneered in 1970s by Prof. Bill Hillier, Prof. Julienne Hanson and colleagues at The Bartlett, University College London.

Built on quantitative analysis and geospatial computer technology, space syntax provides a set of theories and methods for the analysis of spatial

configurations of all kinds and at all scales. The space syntax approach has since grown around the world in a variety of research areas and practical project applications including archaeology, criminology, information technology, urban and human geography, anthropology, and cognitive science. Dursun (2007) discussed the roles of space syntax in design through case studies in real design projects as follows. First, space syntax serves as a language for thinking and talking about space in the dialogue between architect and designed space. Second, it merges science-based knowledge into design process, which constitutes the core of "evidence-based design" (Hanson 2001). Third, space syntax provides tools for architects to explore their ideas, to understand the possible effect of the design, and to let them evaluate their design beforehand. Fourth, space syntax gives a chance to architects to evaluate the designs as living organism experienced by inhabitants.

Space syntax provides a configurative description of both urban structure and architectural space and attempts to explain human behaviors and social activities from a spatial point of view. Most space syntax studies concern issues related to urban patterns, but the method is also relevant for studies on the scale of urban and architectural design.

Space syntax can produce a kind of knowledge which supports architects to find out how well their designs might work; what kinds of properties their design solution has, and so on. In practice, urban planners and designers can predict pedestrians' movement flows before the actual development of real urban systems and buildings by analyzing the morphological structure of the design plan using space syntax.

It makes the deployment of non-discursive intuition more rational and therefore more discursive (Hillier and Hanson 1997). Space Syntax seems to offer a natural platform for such methods (Jiang, 2002), with its ability to

handle geographic and geometric data associated with attribute information, to easily perform spatial, mathematical and statistical calculations, and to visualize the results. These previous researches and its findings and ideas were very helpful for this research.

RESEACH METHODOLOGY

This research is depended on the primary and secondary data and analysis with interview data as primary. Further, field study and observation of the city formation and existing functions of the area were used to get primary data. Secondary data were collected through Profile of Moratuwa Municipal Council area and Statistical Hand Books and map of the regional road network were used for this research. In order to develop the concept of urban configuration and the identification and measurement of the relevant configuration features.

Author turn to the technique of the data processing from configuration studies to known as axiality.

The application of this technique initially involves the graphic representation of the Moratuwa MC area.
Urban street network based on the cartographic information of the area.
This linear representation of space has been achieved using the smallest possible number of straight lines over the existing streets. From an axial map, it is also possible to build a “segment map”, which segments each axial line at its intersections, allowing an analysis of street seg ments. Then the integration index (topological accessibility or permeability) was used for the analysis which constitutes one of the most usable measures of space syntax.

The integration level of a road system can be calculated both as a function of the integration radiusof the system as a whole or as a function of a local radiu

s involving the integration level of each road with its surroundings.After the construction of axial and segment maps of these systems using Geographical Information System, the Depth map software was used for the calculation of the connectivity matrix and configurationally measures and to identify their configurationally features according to the variables from space Syntax studies including local and global mean depth measures and local and global topological integration measures. Very high, high, moderate and low or very low criteria were used as integration levels using space syntax analysis methods. Axial maps of the street network of the Moratuwa Municipal Council Area and of the road system were built separately.

After that, new axial lines were constructed based on the geographical pattern of the road system into the existing axial lines using Geographical Information system.

Simulation activities were made to check the potential level of the integration. Then based this simulation work, there have been given some recommendation to take the decision for the creation of best urban integrated form.

Analyses always consider a 2D layout model. All of them start from the subjective process of separating elements of spatial configuration. The subjective step involves considering all the visibility obstacles. The result is an estimated model where open public space is bordered and painted in contrasting colors (like black and white). The next step was to draw the possible smallest number of the longest lines of movement (lines of sight) in space. The whole space should be covered with them to show all the possibilities for movement. It represents the relationships of accessibility between all axial spaces of a layout model.

Axial lines which represent spaces are presented as circles (nodes) which are

linked by lines showing intersections with subsequent axes. Nodes are numbered according to the numbers on the axes. The number of immediate neighbors that are directly connected to a node is a local measure of connectivity. The algorithm described below serves to examine axial maps and count all four syntactic measures. The result of axial map calculations, a spatial accessibility map, or spatial integration maps are obtained, where lines representing the most accessible spaces are marked red, and the least available blue. The algorithm used to calculate the shortest paths from one topologically specified point to any other point on the map. Such an operation is performed for each segment of the map. It turns out that the obtained results are almost always the same as the ones from studies where users are counted empirically.

There are four syntactic measures calculated such as connectivity, depth, control value and local and regional integration.

Connectivity measures the number of neighbor axes directly connected to a space.

Depth or degree of depth was counted in a graph and is determined by parameter k. Parameter connectivity considers immediate neighbors and depth considers the neighbors of the k-th degree. Connectivity and depth measures can be written as a sum:

$$Ns = \sum_{S=1}^{m} s \times$$

Connectivity iff m = 1
Local depth off m = k 1< k < l/local depth (until k =3)
Regional depth iff m = 1

Where, k – Parameter, s – operator (s is an integer), l – the shortest distance, Ns – the number of nodes with the shortest distances. Where 1 < k < l, usually three steps are adopted for the calculation of local depth, i.e. k is equal to 3

(this means that we consider lines within three steps from an axial line).

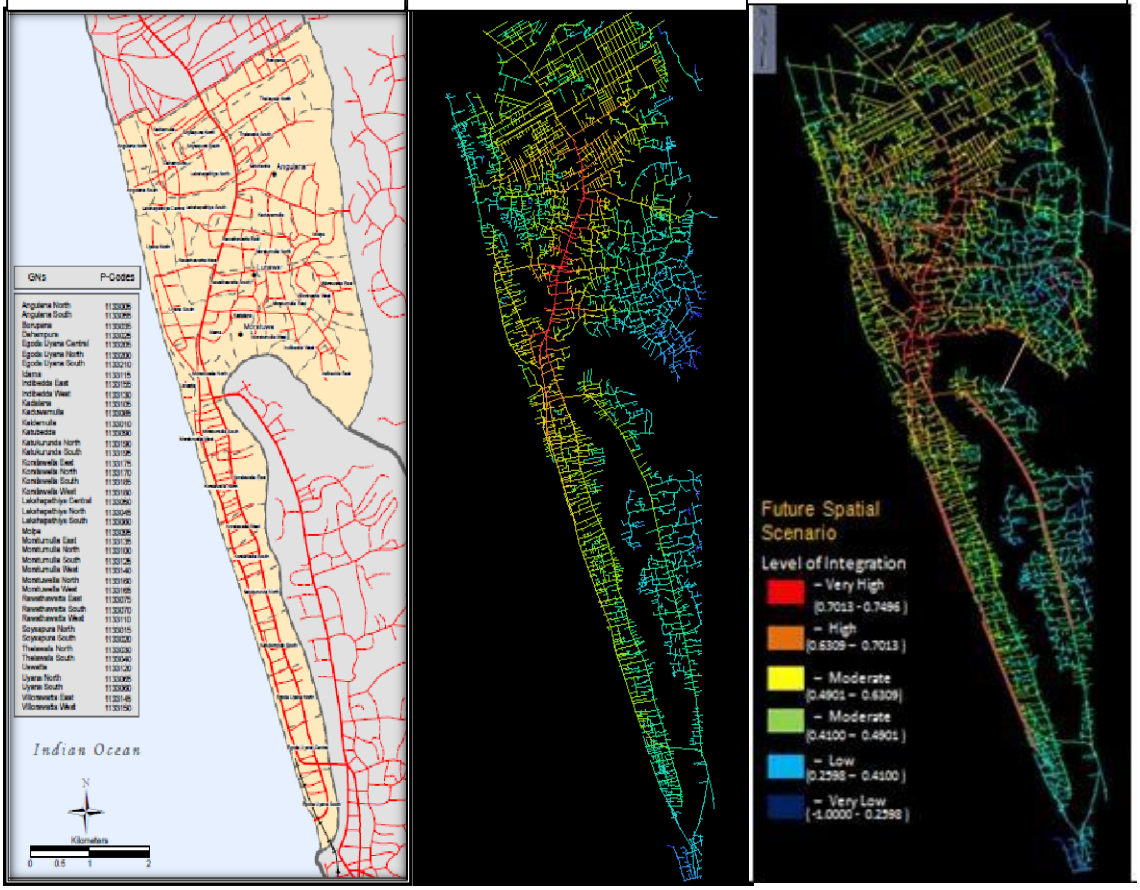
We can also note that connectivity is equivalent to local depth if k = 1. Control valueis the sum of the inverse values of the parameter connectivity of all neighbors from the selected axial line. It measures the degree to which a given space controls access to all immediate neighbors of the axis line. It takes into account all alternative connections. This is a dynamic local measure. Integration also called availability is a variable that refers to how a space is connected with other spaces in its surroundings. This is the key parameter leading to the understanding of the relationships that exist between users and the urban space and it is a global measure. It can be used to predict the potential of meetings in the space, because it is directly linked to the presence of people in a given location. The greater integration of the space, the more people will appear in it.

For this reason, integration is sometimes called accessibility. The most important observation is the fact that the axis system will lead users into the best integrated spaces in that system. Similarly, if less integration means less human presence, and uncontrolled space, it increases the chances of criminal and antisocial behavior in such structures.

DATA ANALYSIS

According to the space syntax analysis final map was prepared. There is a very big potential for the project identification in the study area because high integration (red color) shows in the center grid network area. The integration or accessible areas indication is varying based on roads accessibility. It spreads along some parts of the main arterials roads
(Map:02).

Map:1, Study Area- Moratuwa D.S Division	Map:2, Existing LINEAR SpatialForm	Map:3, Proposed POLYCENTRIC Spatial Form

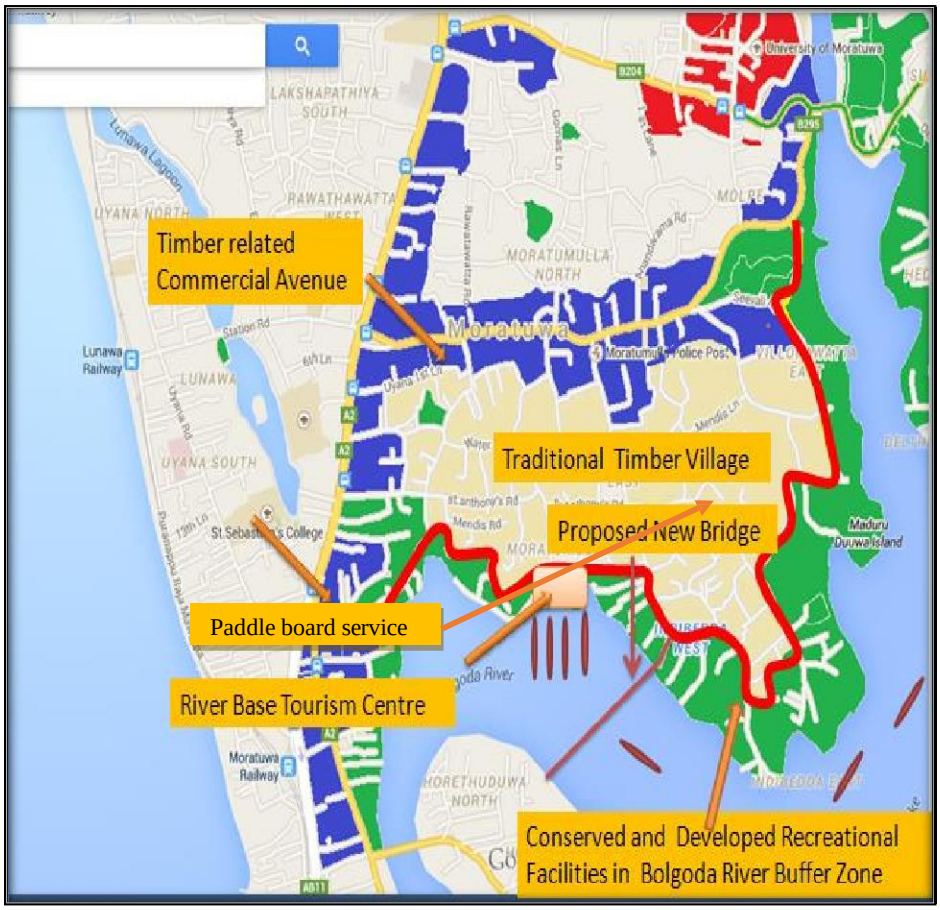


These parts of roads are the high integration roads segments in Moratuwa Area. This is not enough to the further development activities and integrates to all physical land areas.

Therefore, there was a need to reroute the planning assessment through these scientific analysis methods. New linking roads identified and applied into the space syntax analysis. According to those analyses, new simulation space syntax maps were prepared for some new project ideas and special development activities (See Map: 05).

Based on the proposed polycentric spatial form of the area some new projects

were identified (Map:04).



Map:4, Identified Future Development Projects

New simulation space syntax maps show the critical pattern of the main roads and indicates the different kinds of pattern in the road hierarchy and new project ideas.

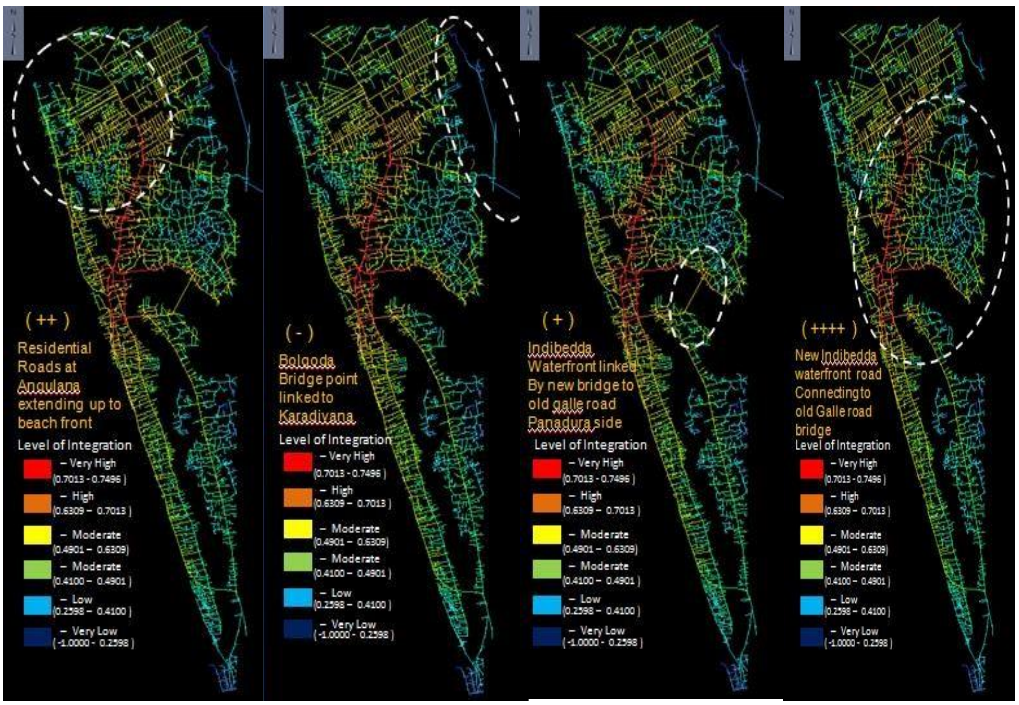
If we take center part of the Study area, more integrated places are shown with grid road pattern. That is why we continue to see the high integration along the Galle road when we analyze the Moratuwa area's road network.

When it becomes a larger urban agglomeration we see few characters in the

network or pattern.

There is sea side linear pattern, Grid pattern and cluster organic pattern as formation of the road network but these are very common in all parts of the area because it also indicates that we are also part of urban agglomeration and it is not very sort of special to Moratuwa only. Therefore, we are small part of a larger urban agglomeration in the spatial planning system and urban planning model.

Map:5**,** New Simulation Space Syntax Map



According to the space syntax analysis final map, there is a very big potential for the urban development in the study area because high integration (red color) shows in the centre grid network area. “The integration or accessible areas are varying based on roads accessibility. It spreads along some parts of

the main arterials. It shows clearly in map.2. This part of road is the high integration road segment in Moratuwa Municipal Council Area.

Projects and ideas were identified based on the prepared polycentric spatial map and given indication of future developments thorough this research using space syntax technology. (Map: 03). The potential of the most viable concepts has been overlooked at the identification phase.

Those are new road project (Extending New Indibedda Water Front Road across Cross Junction along Lunawa Lagoon to Angulana Beach), formation of Traditional Timber Village and Timber related commercial avenue, Recreational Zone project (300m Buffer Zone along the Bolgoda River), River based Tourism Centre project and Paddle board service project.

At project identification stage, ideas came up with project solutions that can have positive contribution to the environment. If not positive the projects should be at least neutral in the pace of their impact on the environment. One of the main reasons for the failure of projects either at early stage of the implementation or not being sustainable after getting into operation stages is low attention given at the project identification and selection stage.

CONCLUSION AND RECOMMENDATION

The project identification stage is important to the sustainability of project. Different scientific software chooses projects from many alternative ideas or schemes that balance between local demands, strategic priorities and research or baseline studies. Project identification should be both demand and supply driven. It should not only be focused on the needs of the local entities but should also look at the overall strategy of the government in particular and donor agencies in general. The needs to consult country's strategy from the allocation of scare resources spatially. The local needs are enormous

particularly in any projects. It is difficult to meet all these local needs with the vast area. Therefore, there is a need to prioritize through different strategy.

The pre-feasibility studies at project identification stages should seriously look at the criteria of selection in order to filter those projects that have versatile effects on the overall economy of the country. Lack of paying attention to this stage or phase of the project cycle can lead to the identification of projects that can lead to failure in meeting the envisaged objectives and goals.

Directions for future studies

Future research has been planned to do with a series of semi-structured qualitative interviews with academic and administrative researchers, architects and designers familiar with space syntax in order to identify major barriers or issues during the application of Space Syntax Analytical Tools. The issues will be raised into two main categories; technical issues relating to the software, technology, and method itself, and social issues relating to the context within which tools like space syntax are learned and applied for innovation and adoption in general, and of Planning Support Systems (PSS) in specific. Further, this proposed future study will be analyzed how these barriers may be addressed.

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