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NETWORK THINKING ARCHITECTURAL DESIGN:

Experimenting and working with relational models

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ABSTRACT

The set-up of spatial configurations is an essential topic in architectural design. The logics behind this configuration of spatial networks are significant for architects as it denotes social as well as physical implications. If we accept that design is an experiential process, then experimenting and probing gain much prominence in the process. Experiments lead architects to discover, and then to redefine their design concepts.

This study focuses on the potentials of analytical methods via graph theory based tools and how to apply network thinking in architectural design. The study questions the following: If spatial systems are regarded as networks, how do various network visualization and assessment tools are useful to extrapolate the inherent pattern and the logic? How do space syntax, graph theory based tools and diagrams aid the exteriorization of this logic? How does the architect think through these tools and learn from them?

The topic will be expressed by presenting an experiment from architectural practice. This experiment deals with an iterative process of "a hotel specialized on the elderly and the disabled with rehab centre" (a mix-used building which includes a hotel, a rehabilitation centre and assisted-care apartments). In the design scheme relationships based on circulation scenarios of daily activities and services are modelled and animated by network related tools like Syntactic, the Space Syntax tool in Grasshopper, a plugin for the digital design platform Rhinoceros; a software for network visualization and evaluation Cytoscape, and a mind mapping software TheBrain. This experiment aims to explore how scientific; graph theory based tools feed design thinking and making.

Exploring alternative ways to integrate theoretical and practical implications of network thinking in architectural design is valuable for those in the architectural education and in practice. Findings of the research show that, graph theory based tools provide a useful basis for architects both for making and thinking about architectural space by generating scientific and numerical data. The study concludes with an array of advantages in working with network models in architectural design, and suggests future methods for design analysis and design research with network mapping tools.

KEYWORDS

Spatial Network, Architectural Design, Space Syntax

1. INTRODUCTION

Design is understood as a form of thinking (Wigley, 2007). This complex cognitive thinking can be described as a process of discovery that involves both experimenting and probing (Dursun, 2007). The strategy of providing solution proposals, analysis, evaluation and improvement of these proposals until arriving at a satisfying solution is recognizable right across the design professions (Dorst, 2010). In architecture, solution focused activity (Lawson, 2003) involves a creative process that concentrates on a kind of making (Schön, 1987) which is largely learned and practiced through "action and reflection" rather than trying to find out optimum solutions (Simon, 1996). The architect thinks with different design tools and brings different forms of knowledge together to evaluate designed outcomes during this process. In other words, he/she reconfigures design ideas by learning from his/her designs, testing and exploring the possible effects of his/her decisions.

As reported by Cross (2001, 2007), design practice has its own intellectual culture. This culture concentrates on "designerly ways of knowing, thinking, and acting". Design research literature is full of remarkable quotations that try to make a distinction between science and design. According to Gregory (1966) "the scientific method is a pattern of problem-solving behaviour employed in finding out the nature of what exists, whereas the design method is a pattern of behaviour employed in inventing things...which do not yet exist. Science is analytical; design is constructive." Simon (1996) states that "the natural sciences are concerned with how things are...design on the other hand is concerned with how things ought to be." Similar with Cross's idea, this study does not intend to highlight this sharp distinction between design and science once again. By accepting that architects have their own way of perception, cognition and production, the paper aims to explore how these opposite ways of understanding, intuition and reason, can be brought together in a creative process to build up architects' own intellectual design culture. On other words, it concentrates on alternative ways which science based knowledge or analytical tools can be used to make "non-discursive intuition more rational and therefore more discursive" (Hillier, 1996; Hillier and Hanson, 1997) in the architectural design process. It is suggested that architect is an intellectual actor who is aware of different tools and knowledge resources and has a capability of using them to lead his/her design thinking (Dursun, 2007).

Architectural design involves configuring complex spatial relationships. These include sophisticated links that involve new social connections and their spatial expressions. The architects need to find alternative ways to grasp these transitional spatial formations-complex relationships and their possible social meanings to produce novel encounters. This study focuses on network thinking in architecture and explores the potentials of analytical methods / graph theory based tools in architectural design. In this paper, a sample experimental case from practice is presented, in which various network visualization and analysis tools help to decipher the spatial logic of a mix-used building. By creating an interactive dialog with numerical and graphical data, it is indented to come up for discussion on how architects think through these tools and learn from them.

2. DESIGN AS A SPATIAL CONFIGURATION

One main consideration in architectural design is about setting spatial configurations. As reported by Nourian et al. (2013a) the outcome of an architectural design process is essentially a configuration. Space is substantially defined by the configuration of spatial cells (Dade-Robertson, 2011). Configuration in architecture describes a set of spaces that are connected to one another as a network and points out a relational pattern among these spatial elements. Hillier (1996) explains that configuration exists when relations between two spaces are changed according to how we relate one or other or both to at least one other space. Configurational descriptions therefore deal with the way in which a system of spaces is related together to form a pattern rather than with the more localized properties of any particular spaces (Hanson, 1998). We can describe this pattern as a kind of network, which reveals complex relationships/ interconnections, orders and rules among the spatial elements. The logics behind configuration of a spatial network are significant for architects as it implies social implications. Topological description of space can account for aspects of architectural experience by constraining or generating the possibility of human social interaction (Dade-Robertson, 2011). Relationships between spaces once regarded as mutable, also constitute the potentials of encounters for the users through connections and borders. Thereto, they constitute the basis for the social interactions between users, defining both functional and latent routes, and indicating spatial proximities and neighbours (Kozikoglu and Dursun, 2015). A space does not encode information individually. However, the way in which a space comes together with other spaces to form a structure or pattern reveals information and constitutes the core of spatial experience. This structure or spatial configuration influences social, economic, environmental functioning of cities and complex buildings by mainly conducting human movement pattern (Hillier et al., 1993; Nourian, 2016). In other words, the meaning is structured in architecture through the topological / configurational relationships between spaces that are experienced when we move through space.

Researches on network systems mainly make use graph theory based tools. Graphs serve as mathematical models of network structures (Easley and Kleinberg, 2010) and present a language for talking about structural features and potentials of network systems. According to Barabasi "graphs or networks have properties hidden in their construction that limit or enhance our ability to do things with them. The construction and structure of graph or networks is the key to understanding the complex world around us. Small changes in the topology affecting only few nodes or links can open up hidden doors allowing new possibilities to emerge" (Barabasi, 2002).

"Network in architecture focuses on systematically mapping relations among spatial elements through their shared and relative characteristics, in other words, neighbouring and attracting qualities in rule-based dynamic network models. The "relations of the relations" and "the protocol between the rules," that refer to the order and the scale that the rules will be enacted during the design process, are of prime importance in these models. By observing the effects, the creative process can be interpreted as a kind of choreography, one in which "pace" is also interrogated for the elements of the parametric model." (Kozikoglu and Dursun, 2015).

The use of graph theory based tools in architectural design is mostly executed as description of spatial form (Alexander, 1964; March and Steadman, 1971) and the application of these tools in generative design in a creative way remains limited. Attempts for searching possible spatial forms in an automated, systematic procedures (Mitchell et al., 1976; Steadman, 1983) are followed by the evaluative works (Hillier and Hanson, 1984, Hillier, 1996) that intent to discover "social performance" (Nourian et al., 2013b) of designed spaces. In recent years, there have been attempts to bring these ideas together to transform configurative ideas into desired geometric compositions (Nourian, 2016). The main idea of Nourian and his colleagues (2013) is about "going from abstract graph description of spatial connections to topological planar embedding of that graph, analysing that graph in real time and finding feasible geometric cell configuration that admits the proposed graph connection". Significance of this kind of work is coming from its emphasizes on spatial exploration process in which designers have full intellectual control and get objective real time feedback on the spatial qualities of their design. These approaches provide communicative tools between designer and his/her design by presenting evidences for searching geometric rules and formal possibilities.

Application of graph based tools in a creative manner in design process is valuable for architects who develop their ideas by "making" and learn by "doing" (Schön, 1987). This study mainly concentrates on graph theory based tools in generative design and explores their contributions to design process in formal compositions both topologic as well as geometric. Main interest is on the dynamic "space making process" in which space is evolved by evidences on interactive interpretations of what architects design.

If we accept architecture "as a system composed of interlocking elements, operating as a kind of biological mechanism and evolving on many fronts" (Lima, 2011), can this graph theory based tools be used as creative thinking machines for architects to play with in architectural design process? The authors concentrate on the architectural design practice to put this main research argument into more comprehensive debate. The last part of the study explores how these scientific, graph theory based concepts and tools could feed design thinking through an experiment from architectural practice.

3. AN EXPERIMENT FROM PRACTICE: ELDERLY CARE HOTEL AND REHAB DESIGN SCHEME

3. 1 ARCHITECTURAL PROGRAM DESCRIPTION

MASYT is a project of a centre for health tourism in Antalya, Turkey (Figure 1). The client is the owner of three facilities totalling 450 beds for mentally disabled, elderly care and rehabilitation patients that are distributed in the same region and she was determined to transfer her expertise into a touristic stay basis. The brief of the project prompted the following three topics in one facility: health and tourism centre for the disabled for an optimum stay of one week, therapeutic stay of minimum 3 weeks as well as long term rehab program for orthopaedic and cancer patients an average stay of 2 months complemented with assisted living apartments as final homing mostly for patients tied to bed up to 1-2 years.

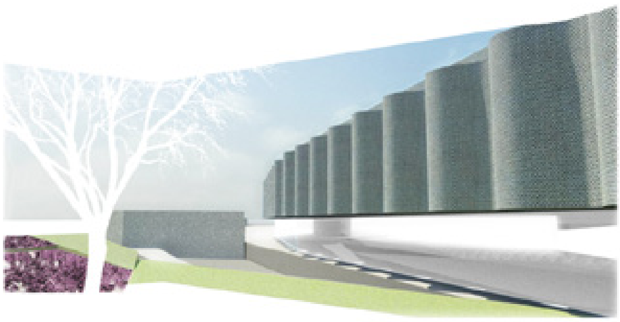

Figure 1 - MASYT, a project for a centre for health tourism for the elderly and the disabled

Although the program required the similar, if not the same professional care and management expertise, the spatial needs, and neighbouring requirements are very differentiated between, the more touristic weekly stays of the incoming guests and the therapeutic stay of the cancer or orthopaedic patients, to the longer stay of elderly care residents. There are several locations in the project that will enjoy common use, however the tranquillity and emergency requirements are different from the rehab unit which is basically a health facility with an emergency hall that is quite the opposite in atmosphere than the entrance hall of the intended 4star hotel. Such considerations urged for a deliberate probing into the programmatic requirements and spatial relationships together with the client.

3. 2 MIX USE DILEMMAS / COMPLEX RELATIONSHIPS

The project as an economic model as well as an architectural program challenged multi-program, multi-temporality, multi-user and mix use. There are several studies that discuss age and program integration for elderly care and disabilities and search the relation between physical features of the building design and quality of life of the residences (Hanson and Zako, 2005). Additionally, studies on behavioural patterns of elderly care residents have shown a preference for places for higher traffic like corridors gate entries passages. Akan and Unlu (2015) states that elderly users preferred areas such as corridors and block entry areas looking towards the outer space which involved activity rather than places which were originally planned to be the social interaction areas. The diversity programmatic requirements as well as compactness in services purported as possible by the client who had 15 years of experience in disabled and elderly care urged an analytical approach to the design of the layout. To better understand how the system will operate, the potential relationships in the list of rooms are mapped in network diagrams during the initial stages of the design process. This helped to better understand and simplify the requirements.

The method experimented in the iterative "make & assess" sessions for the layout configurations, in short is listed as steps below:

step 1: list relationships between rooms out of the room requirements list,

step2: map layouts in graph tools and read thresholds and conglomerations,

step3: analyse syntactic figures,

step 4: model and extract architectural plans and repeat 1,2,3 as necessary.

In step1 designated relationships are listed as simple as room A connected to room B, the direct access is considered as a relationship (Figure 2). There are more relational data like those places that are visually connected or those rooms that need to be kept a certain distance apart, etc. Such parameters serve the systems intelligence. However, for practicality only "access from one distinct place to another" is the listed parameter. User scenarios as well as regulatory needs are useful information in the preparation of this initial list.

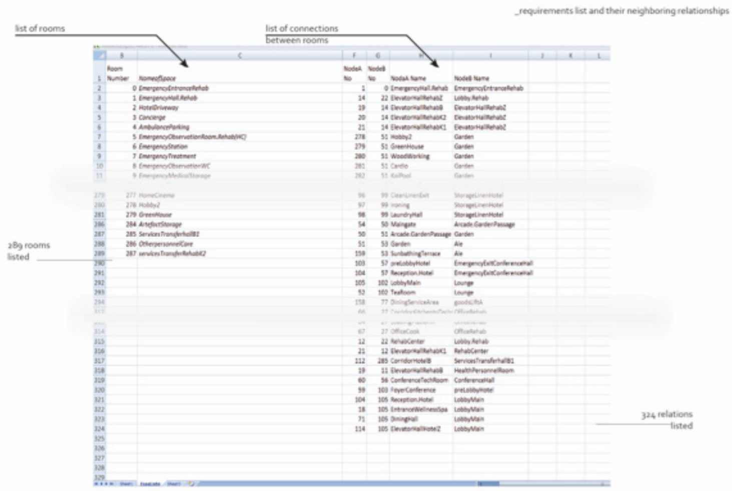

Figure 2 - Relational list of room requirements

Step2 is plotting this relational data (Figure 3). There are various applications for mapping network data, Cytoscape3.4 is used in this process. *Cytoscape* is an open source software platform for *visualizing* molecular interaction networks and biological pathways and *integrating* these networks with annotations, gene expression profiles and other state data (url 2). Although Cytoscape was originally designed for biological research, now it is a general platform for complex network analysis and visualization. This core distribution provides a basic set of features for data integration, analysis, and visualization.

Layout algorithms provided by the software are used for mapping the relational network data. For example, the Prefuse algorithm, or force directed spring embedded layouts enable to visualize the network clusters. Such layouts as opposed to the circular or grid layouts for networks allow reading of compartments, or fragments that may turn into separate floors, separate wings or even distinct buildings. This is especially important in mix use buildings where corridors risk becoming labyrinths and fluent circulation become too dependent on signage and building identity on make-up interventions. In this second step, descriptive criteria for networks such as "average shortest path length" or "edge betweenness" allow deeper reading into the network of rooms.

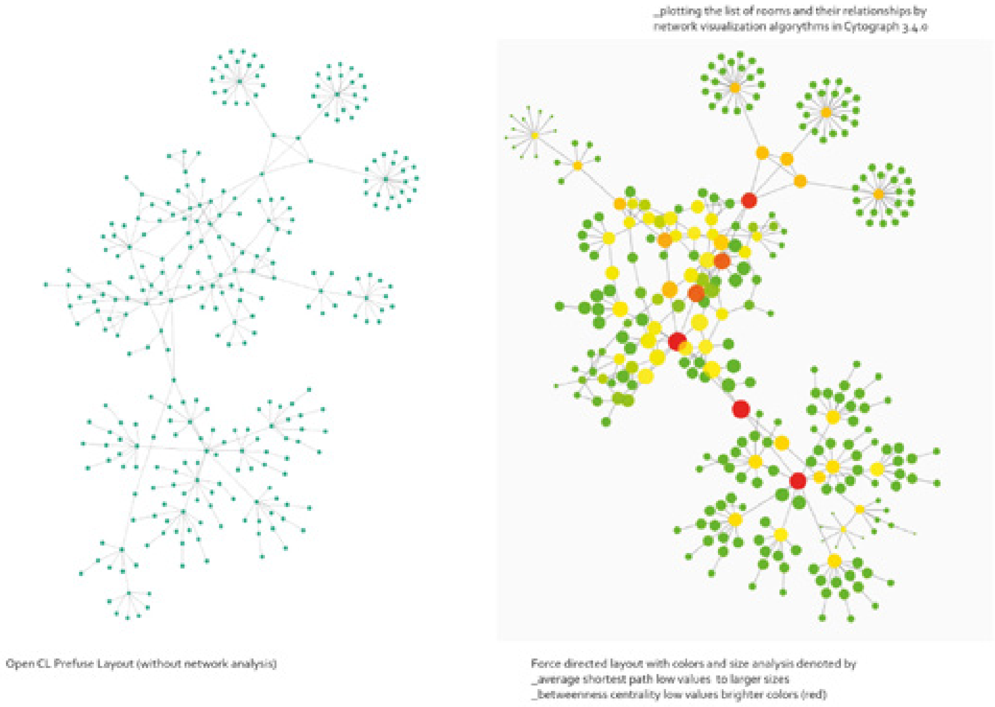

Figure 3 - Network mapping with *Cytoscape*

Step 3 is reading of the space syntax values of the layout for better understanding the extremities and distribution for isolation, entropy etc. (Figure 4). In this case Syntactic, a tool that brings Space Syntax theory into parametric design workflows, is used as a calculation platform. This tool was developed as a plugin that is installed on for Grasshopper (Nourian et al., 2013b; url 2).

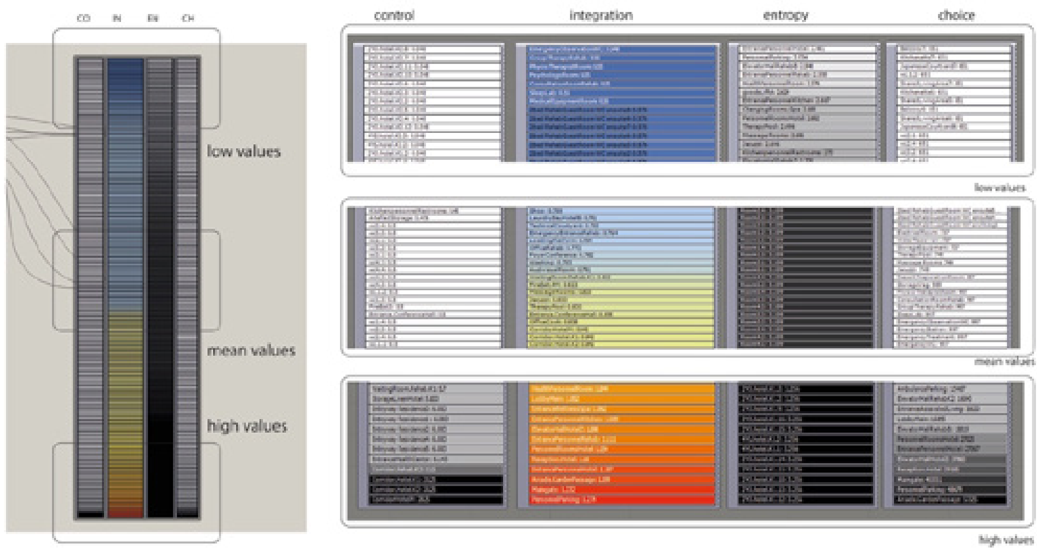

Figure 4 - Syntactic computation of relational data, screenshots

Step 4 is modelling, plan extraction and repetition of the previous steps. The excel file needs to be revised according to the plan revisions as it feeds into both the network mapping and space syntactic programs. Zooming in and out of the relational network, adding/deleting places, rooms or relationships, thus the design exercise is played out parallel to the 3d modelling, as rooms or new relationships are introduced or deleted and/or floors added/subtracted places like elevator hall, staircase halls etc. reshape the network model.

3. 3 THE METHODS IMPACT ON THE DESIGN OF THE SAMPLE PROJECT

In the specific project the method was experimented, the initial spatial requirements as presented by the client were unprecedented, ambiguous, overlapping and complicated. The method enabled to specify security and social thresholds for compartmentalization, vital for the project's success. In a way, by iteratively mapping, plotting and modelling it is possible to visualize the whole organism and to distinguish the organs; the clusters that were separable from one another by courtyards, or where folding vertically for floor repetitions is possible or where separate building arrangements are needed.

One pitfall may be that the initial network diagram is produced out of the relationships that are listed according to a mental pre-existing model, either defined by the client or else designed by the architect. However, as the process is iterated, new relationships are introduced and some of them disintegrated, or buffer spaces intervened, so the process serves as learning, negotiating, discovering and, thus, designing tool. Although the effort in listing relationships is a meticulously one the expressive quality is evidently the strong point of the method. The designer can read the potential conformations and work on them or those that are not preferable and rework the model. The model serves as a design dialogue between the requirements and the possibilities.

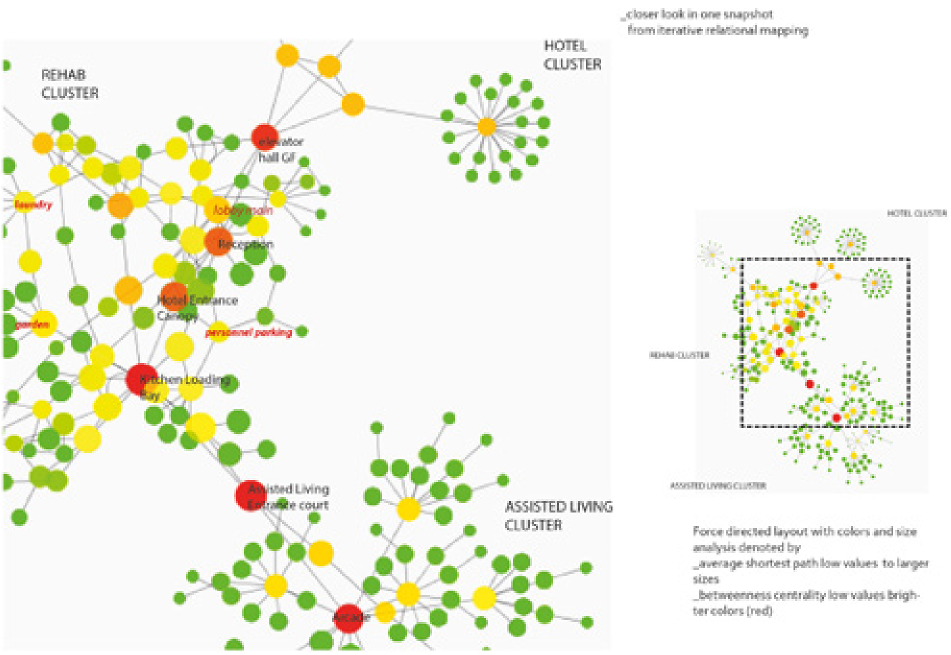

Figure 5 - Closer look in one snapshot from iterative relational mapping

In this example of the health tourism project different program clusters meant not only circulatory arrangements, but also differences in needs for changes in the moods, physical qualities, atmospheres and performances, such as the hotel residents are more mobile during the day, however the rehab rooms are active the whole time and in a frequent traffic, and in parallel and contrast the daily care housing units are occupied whole day but are more tranquil.

Figure 5 is an example of the force directed layout in one of the iterations, in Cytoscape. Here the node size denotes Average Shortest Path Length (low values to large sizes) and their colour denote Betweenness Centrality (low values to bright colours). Major clustering is evident as the three branches of the hotel floors with the bedrooms on the lower left and the assisted living residences at the top, with the skinny rehab emergency branches on the lower right. The three bright (red) units are main gate, arcade to the assisted living and the Loading Bay to the technical area especially the kitchen.

The modelling enables to visualize the major role players in the network of relations, as well as those groupings that may be translated to specific comfort qualities (internal protocols for heating, cooling etc.) as well as separate building / or building part formations. It must be noted that these graphs change in the iterations, even sometime dramatically, because each connection counts (Figure 6).

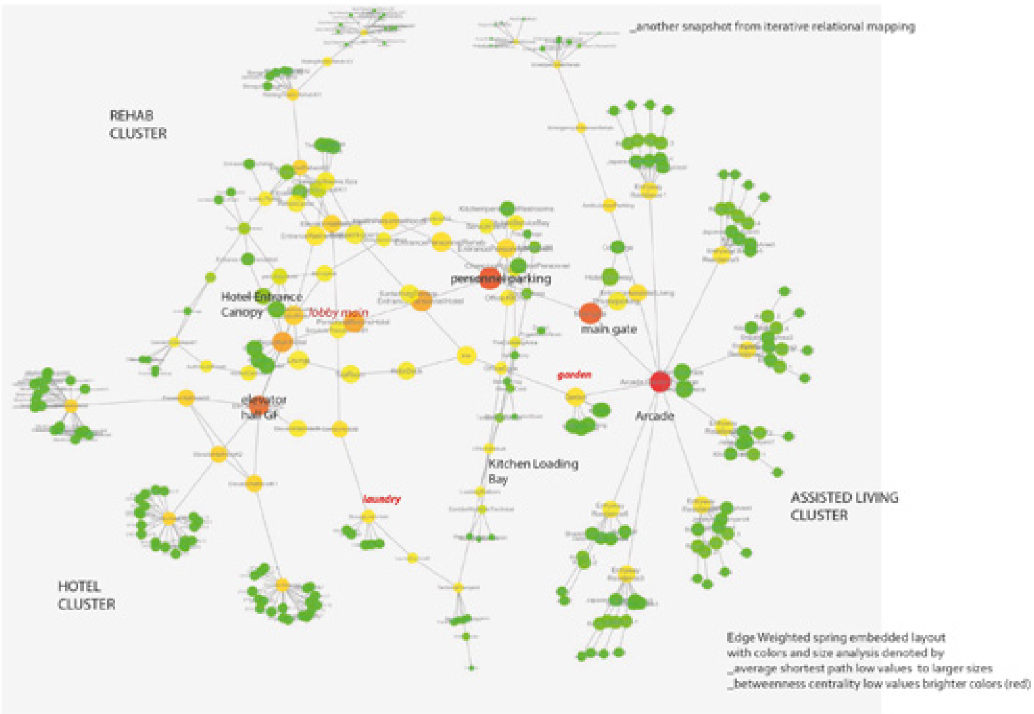

Figure 6 - Iterative Design Sessions: A later visualisation of the spatial relationships mapped in Cytoscape 3.4; Node size is bigger for Average Shortest Path and Brighter in colour for Betweenness Centrality, in this session separate compartments are more unified into one establishment

In graph theory, betweenness centrality is a measure of centrality in a graph based on shortest paths (url 3). Betweenness centrality measures the extent to which a vertex lies on the paths between other vertices. Vertices with high betweenness may have considerable influence within a network by virtue of their control over the information passing between others. They are also the ones whose removal from the network will most disrupt communications between other vertices because they lie on the largest number of paths taken by messages.

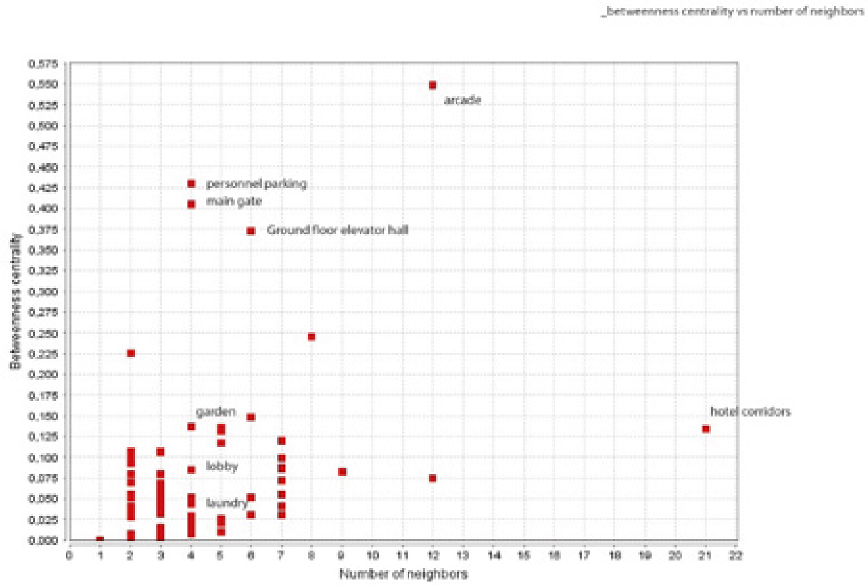

Figure 7 - Betweenness centrality vs number of neighbours

In the design process those nodes (spaces) with higher betweenness centrality are mediated in a spinal configuration, with changes to the external spaces that connect the three main compartments in the facility including the underground service distribution. It became very much evident how the services circulation in these facilities as well as the circulation of the users defines the spatial configuration to the extent that the facility is compact or disintegrated (Figure 7).

The experimented method revealed that a network literacy is worthwhile for the designer in understanding, improvising and explicating on architectural program and functions into spatial configurations. This is possible with the space syntax criteria and computation.

The Syntactic plugin for Grasshopper enables to design with space Syntax criteria. The program reveals depth maps for any node, and provides the Integration, Control, Choice and Entropy values for each node totalling 289 differentiated spaces.

Figure 8 reveals selected six automated justified graphs that visualize distances on depth levels starting from different points in the configuration. The justified graph from main gate shows shallowest graph among the six with the max depth of 9. This graph reveals that the furthermost units are the rehab rooms, which are deepest as they are confined and concentrated therapy stay areas, the users are mostly orthopaedic guest and do not move further than the first circle areas. Whereas the hotel guests arrive and depart fast and frequently and the assisted living units need to be able arrive at the gate without disturbance in case of an emergency. The justified graph from arcade that connects the assisted living apartments to the system as an integral part also presents a shallow graph with the max depth of 10. On the other hand, the justified graph from the laundry hall on the hand reveals a deeper structure with the max depth of 15.

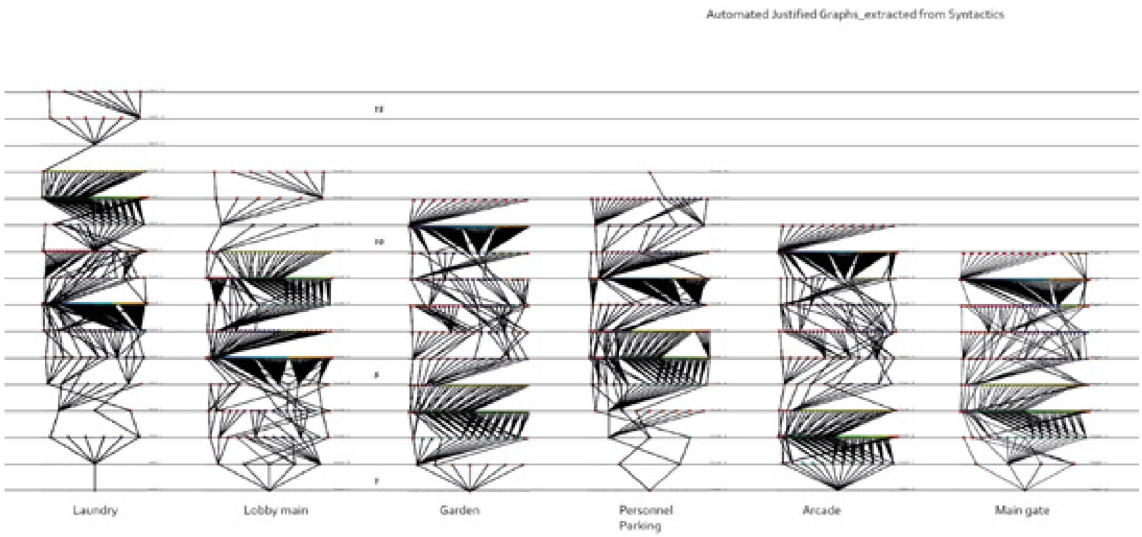

Figure 8 - Automated Justified Graphs Extracted from Syntactic: Laundry, Lobby main, Garden, Personnel Parking, Arcade, Main gate (from left to right)

Through feeding real-time data as tables of relations into the syntax modelling and analysis enables iterative shaping of the relations. Instead of a finished situations analysis, the model is dynamically reorganized.

The analytical data derived from the process are interpreted for this feedback. The plugin returns 4 major qualifiers for space syntax: integration, control, choice and entropy (Figure 4). Integration (closeness) is a normalised measure of distance from any a space of origin to all others in a system and it expresses how close this origin space is to all other spaces (url 4). Integrated spaces tend to draw the entire configuration towards the root (shallow justified graphs), segregated spaces tend to push most of the rest of the spatial complex deep (deep justified graphs).

Syntactic analyses show that in this design the most integrated spaces are personnel parking (1.278), main gate (1,231), arcade garden passage (1,198), entrance personnel hotel (1,196), reception hotel (1,159), personnel rooms hotel (1,154), entrance personnel rehabilitation (1,111), elevator hall hotel (1, 089), entrance personnel kitchen (1,089), entrance wellness spa (1,062), lobby main (1,052), health personnel room- elevator hall rehabilitation (1,044), garden (1, 034). On the other hand, the most segregated spaces are emergency observation wc (0, 548), consultation room rehabilitation - physio therapist room- group therapy room- psychologist room-medical equipment-sleep lab (0.550), bedrooms (0,576), fire exit (0,601), emergency station - emergency treatment - emergency medical storage - emergency wc and (0,606), emergency observation (0,607).

Control measures what degree of choice each space represent for its immediate neighbourhoods as a space to move to (url 5). It should be reminded that control is a local measure, since it only considers relations between a space and its immediate neighbourhood, whereas integration is a global measure since it considers the relations of a space to every other space in the system (Hillier and Hanson, 1984). Syntactic analyses show that hotel corridors (20,25), rehabilitation corridor (11,5), entrance health centre (6,142), entryways residences (6,083), storage linen hotel (5,833), waiting room rehabilitation (5,7), garden (5,416), technical courtyard (5,25) are strong control spaces. On the other hand, hotel bedrooms (0,047), dining terrace -terrace - shared terrace - dining service area - rehabilitation bed rooms (0,833) and assisted care compartments (0,111) appear as weak control spaces.

Choice (betweenness) measures how likely on axial line or street segment it is to be passed through on all shortest routes from all spaces to all other spaces in the entire system (url 6). Syntactic analyses show that arcade garden passage (57325), personnel parking (48679), main gate (45551), reception hotel (39165), elevator hall hotel (37803), entrance personnel hotel (27025) have higher values. This means that these spaces have the highest total values of accumulated flow.

Entropy is a measure of the distribution of locations of spaces in terms of their depth from a space rather than the depth itself (url 7). Syntactic analyses show that entrance personnel hotel (2,481), personnel parking (2,533), elevator hall rehabilitation (2,547), entrance personnel rehabilitation (2, 555), health personnel room (2,575), goods lift (2,629), entrance personnel kitchen (2,667) have lowest values. This means that many locations are close to these spaces.

Such findings are the looping feed-in and feedback in the design process. Constant and iterative assessment of the potentials of a node in the network and the networks own qualities ascertain a design dialogue between a designer team or a singular designer' own design methodology. It is possible to assess all nodes in perspective and especially a set of selected nodes and some random selection during the process.

3.4 THE SERIAL EVOLUTION OF THE SAMPLE PROJECT

To display a serial disposition of the project differentiable stages are described below: In an initial sketch from building regulations a volumetric composition that corresponds to the total area requirements is shown in the initial figure (Figure 9). Later in the process the hierarchical mind mapping via the Brain software enabled the visualisation of the branching qualities, then the Cytoscape models are introduced due to layout and the network and visualisation potential of the software, and in parallel Syntactic modelling in Grasshopper enable assessment with space syntax criteria. The project evolved to a more fragmented configuration in the second iteration, and later, the client focused on integrating the services, and the assisted living units re-coupled with the hotel as a new wing, whereas the physical therapy hospital and spa got fragmented only to re-join again in the final stage.

Sample findings from the case study are:

1. The network visualization patterns enable to apprehend the nuances between clusters of rooms. Such as rooms around a corridor is different in the rehab situation than the hotel and much to different in the workshop rooms and assisted living. This is a sound contrast to partitioning spaces in the modern conventions.

2. Network modelling and assessment criteria, and tools like space syntax are valuable to assess multiple data structures like architectural spatial relationships (Dursun, 2007). In further analysis one can denote characteristics of these spaces in the network analysis. The mapping is a tedious one and patience and rereading is necessary during the process. In the exemplified dynamic systems game played in class, the designer is well aware of the dynamic quality, and these tools even accentuate that quality further.

3. The experiment expresses the importance of exterior spatial elements that separate as well as bind the neighbouring organs, which are usually not listed in the built space allocation lists. These units like the canopy, the courtyards, even the alleys and passages play an integral role in the physical, social and service related qualities. In the case of more active and less noise zones, the addition of a compact, controlled outer space that buffers the enables the continuity of services, and separation of the physical qualities. Evidently, this finding supports the research data of Akan and Unlu (2015) regarding on key role of garden space for an elderly care institution.

4. Spatial analyses show that mix use program changes the way of experiencing space for some particular prescriptive design programs such as hotels and hospitals. In this case, some service spaces and their attached units in the spatial configuration such as personnel parking, entrance personnel hotel become important actors that produce and distribute movement in space.

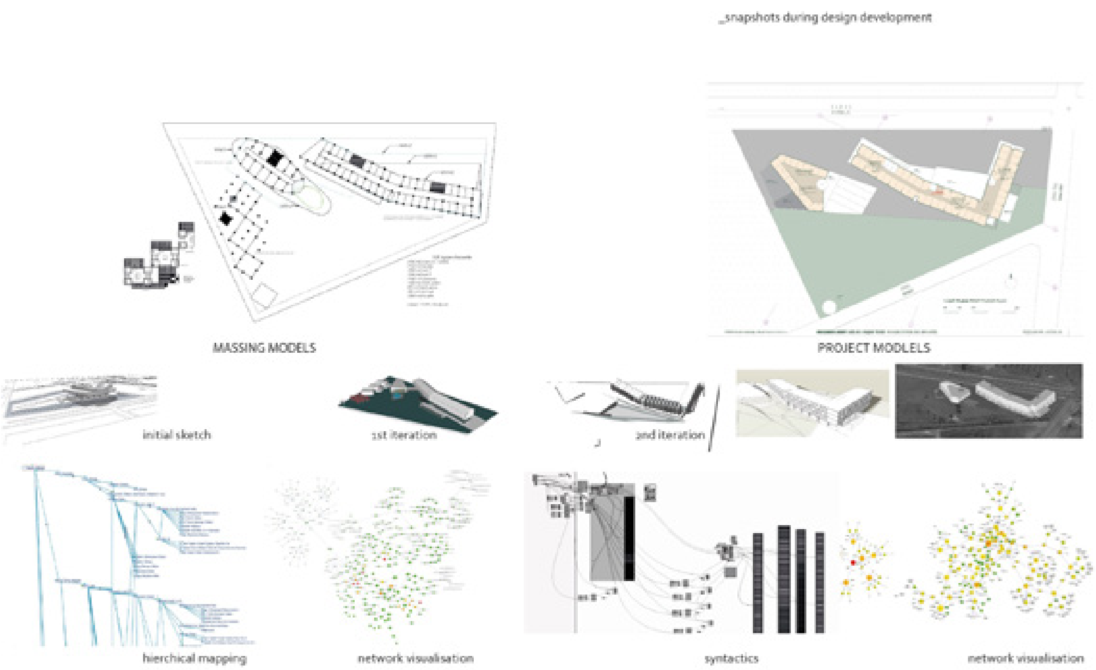

Figure 9 - Upper row, Instances from design evolution, Bottom row Instances of spatial relations mapping in various stages

4. CONCLUSION

In architecture, design activity begins by understanding important features of the program and project site and continues to generate an abstract idea. Architect then transform this idea to concrete spatial formations, a kind of spatial configuration that is inhabited and experienced. By generating different proposals and testing them, the architect consolidates his/her ideas or re-defines them to gain satisfied spatial formations (Dursun, 2007). This study suggests that graph theory based tools can be used in two interrelating modes during this process.

1. To explore the intrinsic nature of built environments and to search explanations about "how the things are". This mode can be regarded as more analytic and scientific but it is very useful to comprehend the spatial dynamics.

2. To evaluate performance of the built environment and to search "alternatives in inventing / making things". In other words, in this mode, main effort would be given to investigate how the designed spatial system might be. This mode can be regarded as more creative and intuitive, but it is very useful to access designed space and explore its possible forms.

The authors suggested that relevant graph theory concepts and produced data sets representing the spatial systems lead to powerful instigation, management, and assessment of configured spaces. As Hillier and Hanson (1997) indicate, these tools have potentials to be the tools with which we can think during the design process. These tools supplement creativity and constitute a generative component within the research/evidence-based design. They also advance design thinking, enable interactive exploration of the effects of programmatic relations on form and suggest a method to structure correspondence of form and function (Kozikoglu and Dursun, 2015).

Based on the research findings, the authors believe that mixed use programs are a major trend in today's architectural programs, and projects intentionally differ invariably to hybridize fragments of urban programmatic units. Syntactic measures and design methodology inform such projects with thresholds and basins of concentration so that the designer can feed in and get feed-back from the project about issues of comfort, security, and scenarios. The network analysis is intelligible as a pathway for the design of the future adaptations of the projects. Architectural program shifts as technologies, policies and needs change, and building adaptability requirements sometimes lead to build-space without identity. However, an iterative design process that is syntactic, enable road map for adaptation possibilities. Filtering the network of rooms into sub networks for potential user footpaths would be useful. Not all users step into all rooms therefore a control space for the generic layout might not be as efficient in the scenario of a user. Open source software tools like Cytograph and Syntactic enable the educators as well as professionals to engage readily with the relatively sophisticated concepts of Space Syntax.

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