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Models and diagrams in architectural design

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Pages: i-xix
The aim of this issue is to contribute to the integration and communication between space syntax specifically, and architectural theory and practice in general. This aim comes both from a desire from our side, and a perceived potential for inspiring and rewarding contributions and developments from and to all sides in such an integration. This is neither a necessary nor obvious aim for space syntax research, but a potential that we would like to explore and a path we would like to see taken. However, we do think this aim comes with a range of consequences and questions to address, and the purpose of this issue is to contribute to addressing some of these consequences and questions through its focus on diagrams and models, which forms only one, albeit arguably a crucial, part of such an endeavour. In stating it in this way, we do not mean to say that other steps have not been taken; it is a way to frame the topic of the issue that explains its intents in a clear manner.

One central question in this aim of integrating space syntax and architectural theory and practice, is that of the always-elusive term ‘design’. Looking at design work in architecture in a wide sense, allowing ourselves to make some simplifications and caricatures in order to bring up some points we believe crucial to discuss, raises a pair of issues that are somewhat problematic from the common ways in which space syntax operates – arguably problematic from the very point of view of some of the clear strengths of the field. One such issue, as discussed for example by Nelson and Stolterman (2012) in The Design Way, is the different trajectories of research and design, where the former tends to strive from the particular towards the general and at times even universal, also taking into account that the degree and kind of generality aimed for varies (Haraway, 1988), and the latter is a process that moves from the general to the specific and particular, or even, in Nelson and Stolterman’s words, the ‘ultimate particular’. While these should be considered rather as general tendencies than absolute facts of such wide and complex beasts as ‘research’ and ‘design’, it points to some intrinsic problems in reconciling the activities of one with the that of the other, and that in order to take knowledge from research into design work, significant translation and adaption is needed to the specific questions and particular situations of each other.

This points to a second issue, albeit indirectly, namely the mode of operation of design work, and how knowledge is incorporated into the various phases of a design process. While consisting of a range of activities with different characters drawing from different sets of knowledge, a central portion of this process remains an activity that is quite elusive, where concepts, ideas, references or principles are synthesised into prototypical proposals. Hillier calls this a ‘generative’ phase, and traditionally in the ASED (Analysis, Synthesis, Evaluation, Decision) model it was called ‘synthesis’ (c.f. Cross, 1977) – which in many cases means black-boxing this particular phase, sometimes under the heading of ‘early’ and ‘late’ stages, even though arguably earlier stages tend to take on a stronger explorative and synthetic character and external knowledge tends to come in more in a later stage.

Notes:
1 Cross locates the root of the ASED model (Analysis, Synthesis, Evaluation, Decision) to the Design Methods conference in London, 1962 (e.g. Jones and Thornley, 1963) and a series of following conferences on design method.
2 It is of crucial importance to remind that we are speaking of parts of an integrated process taking on certain characteristics, where all parts, phases, or steps are reoccurring several times, sometimes rapidly, sometimes more slowly, and there is no set order between them. We are thus not speaking necessity of ‘early’ and ‘late’ stages, even though arguably earlier stages tend to take on a stronger explorative and synthetic character and external knowledge tends to come in more in a later stage.
work is, using Hillier’s (1996) term, that this phase primarily makes use of ideas we think with. That is, references, principles, ideals, theories, and regulations that manage to take the form of something through which the design can be molded and explored can be included, becoming internal to the process; whereas largely things we think of tend to take the role of external inputs, restricted to evaluation, adaption and alteration of proposals but not quite affecting the full range of the work. When stating it in this way, which is done to highlight some problems when relating rigorous analytic methods to design work, it must be noted that the boundary between ideas we think with and of is fleeting, and ideas can be translated between one state and the other throughout the process. There is also the caveat, of course, that it is not necessarily specific bodies of knowledge that are internal or external, as what is rendered internal and external to the design work is highly individual and situational; what can be done, is to point to tendencies, and to how some types of knowledge may be more difficult to translate and internalise than others. Most notable of these, is how most common ways of making use of space syntax, partially due to its remarkable strength as analytic theory and method, places it as such an external input to the process. Such input to design work is valuable in its own right, but largely locks it out from the internal process and the early stage drafts. Perhaps paradoxically, the strength becomes a hindrance, and the aim stated by Hillier to make ideas we think with, such as configuration, discursive, also drives theory towards an ‘external’ role in the design process.

This elusive phase of design can be characterised as operating through production of models and diagrams, be it at an architecture office, at a university course, or a research lab. Diagramming in all its different instantiations is so basic and ubiquitous to these practices that we take for granted its capacity for articulating solutions, explanations, theories and discourses, for suggesting, communicating, and investigating ideas and principles, and even for influencing the collection of empirical data and proposal of experiments. While not to be interpreted as always taking the form of plans, sections or other traditional types of drawings, concepts of boundary, skeleton and structure, projection, line, centre or field, basic in art and architecture as well as in technology and science (c.f. Châtelet, 2000), can be recognised also as central to many of the models used in space syntax.

Our understanding of a diagram here largely builds on the works of Gilles Châtelet (2000) and Kenneth Knoespel (1999; 2002), while taking into account the works of, for example, Allen (1997), Emmons (2006), Garcia (2010), and others. Châtelet’s description of a diagram, based primarily on the diagram as an externalised, graphic entity, is somewhat in contradiction to Deleuze’s as discussed by Hélène Frichot in her contribution to this issue (Frichot, 2014). It centres on the Aristotelian abstraction-prothesis of diagram – even though Châtelet’s and Deleuze’s work likely developed in dialogue (Desanti, 2000). He states that common for diagrams, although they exist in a multitude of forms and for a multitude of purposes, is that they are concrete abstractions: concrete in that they take form, visualised or visualisable; abstractions in that they represent chosen parts of the world. He further addresses the fact that in order to become a diagram, this abstraction and reduction needs to be radical, focusing on a limited number of characteristics that can be represented in the diagram, and that this reduction by necessity goes so far that diagrams become unreadable ‘as is’, that is, that they require the reader to complete the information, if by so simple information as what x and y axes represent in a scatter. The prosthesis, for Châtelet, comes from this state of extreme reduction of information that means that we will fill in information to make diagrams make sense, and that this process
involves both established conventions, experience, knowledge of what the diagram represents, as well as a range of intuitive factors that inform our understanding of a diagram somewhat unpredictively, and for Châtelet therefore transformative-creatively.

It is tempting here to compare to Libeskind’s Chamber Works, in which Libeskind investigates interpretation and meaning production through making a number of diagrams following a set of principles, which he then interprets, that is, strives to ‘find’ meaning in. Evans notes it as:

‘His procedure is therefore more like augury than writing: first form the signs, knowing only how, never what, and then look to see if they signify anything; sometimes they do, sometimes they don’t, sometimes good news, sometimes bad, sometimes nothing. Such a procedure shifts the weight of meaning from behind to in front, from before to after, from the verifiable to the unverifiable, and, as we have already noted, twentieth-century interpretation finds these positions difficult to identify – let alone deal with.’ (Evans, 2000, p.484)

To an extent, Libeskind here demonstrates the generative aspect of diagrams we speak of; it is not necessarily that they participate in the articulation of architectural proposals, but that they generate interpretations and meaning constructions that are not necessarily put into them in their creation.

This parallel is further interesting, although one should make it with great care, as some recounts of early space syntax research indicates that rather than making the axial and convex maps to find out something specific, they were made, analysed, and various values calculated and represented, after which it was discovered how some of these related to the now established primary empirical correlate movement flow. We do acknowledge that there are many differences between Libeskinds and Hillier’s and Hanson’s work; the maps of Hillier and Hanson are stringently derived from maps of settlements using a defined number of principles, whereas Libeskind’s diagrams are geometric and follow principles but are otherwise fully ‘invented’ on a blank background. The parallel lies in the explorative mode of doing the diagram/map first, and searching for its meaning after, but also in that rather than a distinct representation of something ‘real’, that is, an existing entity, the axial line and conversely the axial map is an invention, from which meaning is drawn. That this meaning is often, depending on one’s position, supported or provided by correlations to different phenomena such as pedestrian flow rates is an important difference but arguably more on the level of what makes the axial map meaningful to use than on the fundamental level of diagrammatical invention. Such a view can be supported by how research has focused on certain types of phenomena – specifically walking – models that respond to these particular phenomena such as segment analysis have grown in importance. At the same time, these models do not allow for other analyses found, for instance, in The Social Logic of Space, such as the degree of ‘axiality’ of space.

However, while a dominant form of confirmation of the meaning and relevance of syntax models and diagrams is correlation studies, it is not an exclusive method and more intuitive or reasoning analysis is also common, often referred to as ‘visual analysis’ of VGA analyses or Axial Maps, in relation to phenomena or mappings of phenomena.

To an extent, Libeskind’s work here caricatures the argument Châtelet makes, as Châtelet means that more information is being read in a diagram than is there – and that this constitutes a creative component in all diagrams. Quite clearly, the degree to which such information addition depends on knowledge and norms vary between diagrams, and some diagrams such as scattergrams may turn mostly incommunicative without prior knowledge of their conventions. However, also more strictly defined diagrams have ‘byproducts’ of this kind, leading to perceptions and ideas being generated in their interpretation beyond the strictly defined content.
Models, to a certain extent, are similar to diagrams in that they are 'concrete abstractions', but arguably their purpose as well as their degree and type of reduction is different. In this, we more or less exclude directly representative models of buildings in their finished state, and focus on conceptual and explorative models in design work that are made both to clarify ideas and concepts and to explore and investigate the same. They therefore vary greatly in detail, but remain in a stage that is not quite a solution, be it as studied in this thematic issue through generative modelling by Jane Burry, as proxy models as by Enriqueta Llabres and Eduardo Rico, or as interactive models exploring chosen principles of architectural projects as by Lucy Helme, Christian Derix and Åsmund Izaki. Models to a higher extent take a system character and work with a certain degree of 'wholes', that at different stages of work can take on different degrees of detailing and specificity. Conceptual and explorative models, arguably, grew in importance with certain developments of the 'digital' in architecture, as computer generated models were central to the works recapitulated by Gregg Lynn in *Archaeology of the Digital* (2013), further demonstrating how models take on investigative, prototypical roles rather than distinctly final solutions. The early models presented in the anthology, however, remained tightly controlled works compared to some of the more explorative seen in some of the contributions to this issue, or in the recent AD publication edited by Menges and Ahlquist (2011).

We do not mean to unify all diagrams into one kind of use here, nor all models. We rather mean to point to some characteristics common to diagrams as externalised, graphical representations, even if the degree to which different characteristics are present in different types of diagrams lies both in application and interpretation, focusing on analytical, explanatory, illustrative, generative, or other properties. However, the reduction into concrete abstractions is also a powerful operation for analysis as well as design, when trying to understand specific components or their interrelations, such as when space in space syntax analysis is reduced to the concrete abstractions of axial lines, segments, convex spaces or isovists. These concrete abstractions and their relational properties both elucidate and exaggerate certain properties of space that, as has been repeatedly shown, capture properties related to various forms of social, economical, cultural or other behaviour.

From this point of view, our hopes were that an issue focused on models and diagrams in architectural design may contribute to an exchange between players in the field; if, as we believe, many architects look at space syntax and read it as models or diagrams, and the understanding of what diagrams are and mean is different, it becomes crucial for the field’s relevance and discourse to address this to be able to enter a dialogue with theorists and designers in an expanded architectural field, and explain theories, findings, and representations, as well as to rigorously define how things need to be read and understood. For example, we have often encountered a misreading of the space syntax analytical diagrams as design proposals and models of human behaviour: for many briefly introduced but not well versed in space syntax theory, the axial map represents an idea that people move in straight lines and that, conversely, a solution with longer straight lines is better. We argue that this understanding comes partially from the diagrammatic character of the representation, and partially from the modus operandi of diagrams in architectural theory and practice. That is, it comes partially from the abstracted way of representing and analysing space and the layers of interpretation that are required to make sense of them, and partially from conflation of correlated behaviour with the analytic model. Many of these interpretative layers work on an intuitive level (c.f. Châtelet, 2000), where expectations and

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5 This based on a large number of presentations, lectures, seminars, and workshops where this often comes up for discussion; while not always a question or perception, it repeats itself often enough to be related to as common.
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6 Kaye uses the example of Michelangelo Pistoletto’s series of exhibitions Doors to illustrate how important expectation and memory is for our understanding of that which we are about to encounter, or are currently seeing, pointing to how many of these works turn either incomprehensible, or get a completely different meaning, if one has not seen the earlier works when looking at the latter. Similarly, expectations and experience of what diagrams show heavily influence what one sees in them already on an intuitive level.

7 As for instance in Tabula genealogico-geographica plantarum se- cundum ordines naturals Linnaei (1789), available in Praelectiones in ordines naturals plantarum, ed. P.D. Gieske (Hamburg, 1792). In this diagram Linneaus sorts plants into families that form bubbles, placed in relation to each other based on family closeness. (c.f. Emmons 2006, p. 444).

memory heavily influence what one sees in them (c.f. Kaye, 2000). Other layers come from the general processes of interpretation as production of the reader (c.f. Ricoeur, 1981) that at times work in conflict with explicit explanations or definitions due to experiences, habits, and overall understanding of that which is being read, which arguably makes representations work differently in different contexts and different situations.

Set in relation to design work or architectural discourse, we believe that the contributions to this issue demonstrates that a focus on diagrams operates in several directions instead of asking what one can contribute to the other. We believe the papers of this issue are contributing to a more narrowly defined space syntax discourse and to a wider defined architectural discourse, operating in large parts of such a range without individually carrying the burden of covering it wholly. It also allows contributions to not get caught up in the specific links of analytic models and design work, whilst contributing to such an understanding through the specific foci presented in each individual work, and enters a dialogue between or a both/and of discussing, in Hillier’s terms, analytic and generative thinking. That is, the discussions of diagrams and models have purchase not only on design or on architectural design work, but on space syntax as theory and as research practice as well. Focusing instead on models and diagrams, tied to computation, also allows us to re-situate space syntax in the architectural discourse, distinct from a geographical or traffic planning discourse, where it may appear differently – and we will take the freedom here to briefly, in broad brush strokes, make this historical re-situating.

Models and Diagrams in the rear-view mirror
While the history of diagrams in architecture is co-dependent on definitions of architecture as well as diagrams, it is worth pointing out that with the rise of modernism and functionalism there emerged functional and organisational schemata that detached themselves from plans and other somewhat more direct representations of geometry, taking the forms of bubble diagrams, flow diagrams, and activity diagrams, as well as the diagrams of Le Corbusier’s modular man (to name a few). Originating in the 19th century and Linneaus’ studies of plant life (Figure 1), as well as inspired by drawings of electrical circuits, the bubble diagram became one of the more prominent features in architectural work (Figure 2). These diagrams, according to David Emmons (2006), were not innocent in the construction of the functionalist idea of behaviour and relation of form and function. The bubble diagram requires that which is diagrammed to be divided into entities that can be related, or specifically to nodes in a graph which can then subsequently be linked with the links containing nothing aside its specific relating of entities to one another. Since the idea of functionalism was to graph ‘living’, the nodes needed to represent distinct activities with shared properties. However, since the bubbles also were expected to represent spaces so as to be directly relevant to sort out architectural organisation and solutions of a project, and this in an increasingly direct manner, this meant that the very notion of making a bubble diagram of a house, required first that activity was bundled into discrete units, and second, that these discrete units could be related to discrete spaces. In this way, in order to be able to create bubble diagrams and flow charts, not only architecture but life had to be re-thought, and the bubble diagram, without laying all blame on it, significantly contributes to the correspondence thinking criticised by Hanson and Hillier (1987) in a very concrete manner, and on a wide range of scales. To a large extent, this depends on the use of the diagram to organise buildings, the conflation of social or functional diagrams with spatial diagrams, and the effects on understanding social processes, psychology, and relations between people and architecture that this entails.
Figure 1:
Tabula genealogico-geographica affinitatum plantarum secundum ordines naturals Linnaei (1789).

Figure 2:
Diagram of Relations.
Emmons (2006) points further to how similar transformations of diagrammatic work take place in early modernism, in how flow diagrams developed transformed from representing general flows of activities, such as the main direction and flow of cooking (Figure 3), slowly but surely began to be interpreted as intended or ideal movement patterns of those doing the cooking, whereas this arguably was never intended. Such transformation through interpretation and consecutive re-application is in line with Châtelet’s argument of the transformative effects of diagrams, although is also dependent on the loose definitions with which these diagrams were worked.

Diagrams and computers
In this light, it may be possible to attempt describing the historical origin of the computational methods used in space syntax and their relation to diagrams. One of the first applications of computers into architecture was HIDECS-2, a Fortran program for the analysis of design problems developed by Christopher Alexander and Marvin Manheim (1962). HIDECS-2 formed the basis of the method the explanation of which became Notes on the Synthesis of Form (Alexander, 1964). Alexander’s design method used graphs already, albeit applied in this case as a form of describing the interdependence of programmatic and functional requirements, rather than relations between spaces as in space syntax. Diagrams in a general sense played a central role in Alexander’s method as the means through which these requirements could be articulated into design proposals (Alexander, 1964, p.84-94). Robert Somol (1999) has pointed out Alexander’s own observation that the most significant contribution in Notes on the Synthesis of Form was ‘the idea of the diagrams’, to the extent that Alexander claimed the ‘design methods’ movement, as for instance in the ASED model and the conferences discussed above, had misunderstood his contribution, misplacing the emphasis on the process leading to
the diagrams, rather than in the study of the diagrams or patterns themselves (Alexander, 1971). What perhaps escaped Alexander’s observation was that his extremely formalised design process, based on graphs and set decomposition, was also highly diagrammatic, as both graphs and sets are mathematical concepts which are often associated with graphical representations such as dot and line diagrams, trees, or Venn diagrams, which Alexander extensively used in his explanations. Incidentally, a related approach to Alexander’s analysis of the design process, also highly dependent on its diagrammatisation, can be found in Kinda Al_Sayed’s contributions to this Issue, ‘How Designs Evolve’ (Al_Sayed, 2014), which examines the different stages of the evolution of a design through the concept of the linkograph.

These two elements involved in Alexander’s seminal use of computers in architecture, namely, the analysis and rationalisation of the design process and its partial (or even total) automation, together with forms of representing architecture diagrammatically, were to dominate the developments of the following decade on the relation between architecture and computers – the period in which space syntax first materialised.

During the decade following the publication of the Notes, a substantial body of research developed on computational representations of architecture at Cambridge, closely matching the Alexandrian concept of diagram. This effort was mostly carried at the Land Use and Built Form Studies (LUBFS) under the direction of Lionel March. At LUBFS the theorist, in the words of March, became ‘something of a collector, not of objects but of mathematical models, of abstract schemata into which the data can be organised’ (March, 1976, p.xi). The work developed at LUBFS combined the interest on numeric models of the time, partly a result of the availability of computers to university researchers, with the predominance of the structuralist discourse, which favoured the interplay of mathematics, language and form, and allowed the interaction of fields ranging from anthropology, sociology or geography to biology, mathematics or physics. An example of a computational diagram relevant to our discussion – and to space syntax – which developed at LUBFS consists of the representation and analysis of spatial adjacencies as mathematical graphs (March and Steadman, 1971, p.242-334), a work based on methods previously developed in facility management and building layout (Levin, 1964)9.

Thus, at the beginning of the 1970s, architecture in the UK had at its disposal a range of mathematically formalised diagrams and a structuralist theoretical outlook, exemplified in the ‘quantitative revolution’ that had been taking place in geography. In an article published in Environment and Planning B, which would later develop into The Social Logic of Space (Hillier and Hanson, 1984), Hillier et al. (1976) proposed a space syntax research programme characterised by a strategy based on ‘the analysis of artificial systems like space patterns and social patterns for inherent formal structures which might contribute to their knowability’ (p.148). Hillier et al. emphasise the difference of their approach with those prevalent at LUBFS, in which rather than starting from mathematical models, it takes a looser, ‘syntactic’ approach, which tries ‘to build a theory of patterns, with a close respect for the evidence but without too much regard for early justification in mathematical terms’ (ibid., p.149). The concept of ‘morphic languages’ consequently put forward aims both to describe abstract principles behind characteristic patterns in a set of phenomena that may allow their knowability, and which can explain the generation of their morphology. Morphic languages can thus be seen as the rules generating specific diagrams of spatial organisation, if we consider diagrams in Châtelet’s terms as concrete abstractions. Thus space syntax can be interpreted as a complex and rich theory of diagrams and their generation in

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It is worth pointing out that like the graphs used in space syntax, the work of March and Steadman differs from the early 20th century common use of bubble diagrams in that they distinctly represent spaces and geometry rather than spatio-functional units, even though the degree of rigour in definition of what constituted ‘a space’ at this point in time was less developed than in concurrent space syntax research. March and Steadman investigated the affordances and constraints of geometry and adjacency for a range of things, but their graphs and diagrams remain representations primarily of geometrically defined space.
architecture in relation to social structures, a sort of diagrammatology based on material constraints and social forces.

The idea of morphic languages and the interest of pattern generation from basic principles as focus of study can be clearly seen in *The Social Logic of Space* as well as later work. In *The Social Logic of Space*, the generation of settlement patterns based on simple socio-spatial principles of combination takes a crucial role in the discussion, which further meant that the rapid generation of settlement layouts following basic principles became important (Figure 4). Hence, so were computers. At this point in the development of space syntax, it appears from an outside reading that the role of computerised methods leaned more on the side of *generating phenomena* than on the side of *mathematical analysis*. The latter was still largely made by hand, whereas the former were largely generated algorithmically in computers. Arguably, the possibility the digital here brings to rapidly generate layouts from simple basic principles is crucial for the possibility to conduct the line of reasoning of beady ring settlements and other patterns in *The Social Logic of Space*, just as the development of Axman, WebMap and DepthMap have been crucial for developing the analytic side of space syntax research. The contributions of Paul Coates, Nick Dalton, and Alasdair Turner, amongst others, therefore must be understood as pivotal to the way the field looks today, and continues to be through the continued works of researchers refining, developing, and revisiting the modelling and analytic principles through new software as can be found in the contributions by Sophia Psarra, Tasos Varoudis and Sam McElhinney to this issue (Psarra and McElhinney, 2014; Varoudis and Psarra, 2014). It has similarly been central to much of our own work resulting, for instance, in the SPOT family of applications and the Place Syntax Tool.

About the same time that these developments were taking place, architectural discourse was being reshaped under the aegis of postmodernism, which involved particularly a criticism of modernist rationality and the architectural tenet that form must follow function (see for instance the anthologies of Hays (2000) and Nesbitt (1996), continued by Sykes (2010)). Large portions of today’s architectural discursive context is a direct heir of this postmodernist turn, a characteristic that is especially evident in the use of computers in architectural form generation (c.f. Menges and Ahlquist, 2011; Lynn, 2013), but seldom to the representation of its spatial organisation and its relation to people, something Jane Burry develops in further depth in her contribution to this issue (Burry, 2014). It also shows in the use of diagrams as conceptual devices primarily (c.f. Garcia, 2010), as operational devices to further designs or ideals, or to conceptualise architecture on an abstract level inspired by works of for instance Derrida and Deleuze, something discussed in depth by Hélène Frichot in the first paper in this issue (Frichot, 2014). Space syntax, we argue, is in a privileged position to address this relation in the contemporary context in its potential to bridge between stringent and rigorous analytic
work and input on many levels to creative work. But in order to do so, it also needs to be contextualised in relation to current architecture theoretical paradigms represented in the discussions, practices, seminars, critiques, debates, and practices of the discipline and practice. We here use plural because if there is a field such as ‘architectural discourse’ it is highly heterogenic, and often characterised by critique of and positioning in relation to one another, such as how ‘parametric design’ and ‘participatory design’, or ‘critical theory’ and ‘post criticality’, can be seen as being in opposition to one another while simultaneously in various degrees of dialogue and interdependency. This need for contextualisation exists because such paradigms define the field of knowledge underlying the generative or synthetic portion of design work. We believe that the concept of the diagram, which a decade ago dominated architectural discussion (e.g. Eisenmann, 1999; Allen, 1997; Somol, 1999), may work as a vehicle for such re-contextualisation, particularly in relation to concepts such as that of ‘morphic languages’ noted above.

With their theoretical baggage and context, recapitulated in Hélène Frichot’s contribution to this Issue of the Journal of Space Syntax, diagrams allow us to consider an eventual ‘expanded field’ of space syntax, in which the application of space syntax related computational methods to design by Helme, Derix and Izaki, the methodological efforts of Llabres and Rico, or the relation between space syntax and other computational approaches in architecture explained by Jane Burry, together with the contributions of researchers from within the space syntax field such as Sophia Psarra, Tasos Varoudis, Sam McElhinney and Kinda Al_Sayed, can function as beacons and reference points within that field. This ‘expanded field’ brought about through the reading of space syntax as a discipline of architectural models and diagrams will hopefully allow it to engage in an informed critique of contemporary architectural discourses and to contribute even more to an architecture that is undergoing profound transformations, as a result of the computerisation of its methods, representations and media.

Of course, there is more involved in the field than the models, diagrams, or images that at first may appear to be the target of the issue, including mathematics, logics, and theories of space and society. However, we would claim that much of this is integrated in the models and diagrams used, rather than external and understood through the graphical representations – a view we believe is shared for instance in Hillier et al. 2012. That is, models and diagrams are much more than ‘mere representations’, they are active parts in research as well as design work, in theoretical formulation, and in devising methods and strategies of research. Diagrams are mathematical, even if intuitively so, and they require a reduction and abstraction of that which is diagrammed that is radical to the point of by definition producing theory; there is no way to reduce anything to diagrams without theoretical positioning, without making decisions of a rather significant impact on what should be included or excluded, and how to sort that which is in. In this sense it is not only analytical or descriptive, but a generative activity on several levels of theory – something often underestimated in research in general (Knoespel, 1999, 2002; Châtelet, 2000).

In this process, diagrams and models also become and provide frames of thinking - that is, what can or should be analysed or taken into consideration, how things are or could be related, what the different entities are that could be related, and so on – something deeply explored in space syntax as it comes to how to understand configurations of space, and what these spaces that are configured are. These are commonly the axial line, the convex space, and the isovist (Figures 5-7). But through the development of space syntax, a wide range of diagrams have been used to analyse and interpret
space, some of which do not share a similarly mathematical analysis but remain on a graphical-interpretative level primarily, and the meaning of which is sometimes not fully elaborated on or developed further, such as the range of interface maps presented in the social logic of space. Of note is that these contain not only ‘interface maps’ in the direct way as perhaps considered more recently, showing relations between public and private space in a node-link diagram, but also converse interface maps where links are drawn where, and only where, there is no permeability link (i.e. where there is a blank wall), and decomposition and converse decomposition maps, showing where there is continuously constituted space and continuously non-constituted space respectively. Within the field, there is also a constant questioning and revisiting of these models and diagrams, expanding, refining, or altering them both technically and in their interpretation, as demonstrated not least in the contributions by Psarra, Varoudis and McElhinney to this issue.

It is important to note a difference here between early functionalist diagrams and those of space syntax. In the former, bubble diagrams and flow charts developed from a priori assumptions of psychology and behaviour, deduced to activities or entities that then could be directly related to loosely defined ‘bubbles’ of space, equivalent either to rooms or to just locations. In this, they were made to represent the whole of what architecture was to provide. In this way, even if Forty (2000) argues that functionalism was a theory that ‘never was’, the practices of diagramming become generative of theoretical principles of the relations between people and architecture as well as principles of architectural design. In comparison, the entities of space syntax stringently and specifically model space, and neither activity nor a priori assumed relations. While it can be argued they model space in ways that are central to various forms of perception or cognition, instead of a priori statements the field continuously goes through rigorous examination of what, how, and to what extent social, cultural, economical, and other phenomena relate to space, can be related to, and understood from these entities. This makes space syntax radically different from functionalism, even though convex space graphs at times can be deceptively similar to bubble diagrams used in the early 20th century. Arguably this is also why the graphs in space syntax can be found to correspond to such a wide range of phenomena, while not quite representing any specific one ‘perfectly’. However,
they do still frame thinking of architecture, and their use suggests that specific forms of configuration, permeability and visibility are central properties. We are not arguing that they are not, but simply pointing to that for a VGA analysis of visibility to be of importance in a design, visibility properties need to be considered of priority for the design in relation to all other properties being handled.

We do not intend to say that a more analytic focus of the use of space syntax cannot contribute to a design process. If one were to take, for instance, a position such as that of Stanford Anderson (1984) in his text ‘Architectural design as a series of research programs’, published the same year as Hillier and Hanson’s The Social Logic of Space, looking at architectural work as a series of research programs where ideas and solutions are put under stress and are forced to change when encountering the empirical conditions of the situation, there is much room for a well developed analytic theory and practice to contribute. Anderson’s argument, it should be noted, is a blend of proposal of how architecture should work, and how it ‘does’ work in general, but gives another picture and possibility for input of analytic work than, for instance, the ASED model. In such a view it is easier to include prox model-ling as discussed by Llabres and Rico (2014), the small applications presented by Helme, Derrix, and Izaki (2014), or rigorous analysis as seen in Psarra, Varoudis and McElhinney’s contributions (Psarra and McElhinney, 2014; Varoudis and Psarra, 2014). Perhaps one could more deliberately consider the role of the more stringent and thorough analyses often focused on in syntax analysis as that of prox models as discussed by Llabres and Rico, that is, rather than treating them as analysis of outcome, treat them as preliminary possibilities of what might be and forces and flows which direct processes, and which could be the target of reshaping ‘as such’; i.e. work directly with the visibility graphs to explore the implications and possibilities to reach a prototypical or preliminary target that then can be translated back to architectural form without expectations of the end result being specifically or exactly as the developed model. One could argue there are similarities, or at least parallels, between Llabres’ and Rico’s work and Anderson’s text, even if Llabres and Rico work on a much more concrete level and are more outspokenly explorative.

To a certain extent, we argue that this already takes place when involving any analytical model or diagram in the design process. Of course, much has

Figure 6:
Justified of a convex space system of a building, made in JASS developed at KTH.
(From Koch, 2004)
happened in architectural discourse and practice since Anderson’s text, and since the early digital works of Eisenman, Gehry, Hoberman and others, and the role of digital tools today are quite different, but it is worth noting how, according to Lynn, these early works operated with the digital in a very deliberate manner to test specific things, and in order to reach a result often by and large preconceived by the architects. In comparison, Burry’s, Enriqueta and Rico’s, and Helme’s, Derrix, and Izaki’s work presented herein is operating in a more interactive and investigative manner.

It is also here that the distinction between types of models and diagrams becomes most diffuse, and why we do not distinguish between paper types within the theme. In design activity, it is not so easy as to say that one thing is an analysis and another is generative, it is entirely up to the people involved to make use of, understand, and extrapolate what knowledge or production that comes out, and all types of representations constantly meander between roles, providing different input to the process. Through choices of what to be analysed, analysis contains proposals; through what it elucidates, analysis makes proposals; and conversely, all proposals are analyses of what is important, what needs to be solved, how it could be solved, and the way it ought to be solved. Or, as Lundequist (1995) states, since architectural problems are too complex, conflicting, and value laden to be treated as problems solving in a simpler sense, each design proposal becomes a (re)definition of the problem it is meant to solve, that prioritises and chooses amongst ranges of issues selectively, and often arbitrarily. Similarly, this could be said of analytic activity, and especially, when producing models or diagrams of that which is to be analysed. In some cases diagrams that are often used for analytic processes can also serve as generative devices intentionally. A clear example is Thomas Arnold’s (2011) use of all-lines axial maps as both analytic and generative geometries in design so as to expand configurational possibility (Psarra 2011, Autumn/Winter Issue of JOSS 2011).

It seems to us, that however we turn, and however we look at the visual representations used in space syntax, they are not possible to distinguish from theory. That is, theory is integrated into the models and diagrams used, and the models and diagrams developed are integral to the theory itself. It seems further, that this can serve to be highlighted and emphasised, so as to continue and develop, question, investigate, and evaluate

**Figure 7:**

Isovist (top) and VGA (Visual Graph Analysis).

The isovist is made in SPOT by Pablo Miranda Carranza (Markhede, Miranda Carranza and Koch, 2010) and the VGA in DepthMapX originally by Alasdair Turner and now developed primarily by Tasos Varoudis (c.f. Turner and Penn, 1999; Turner, et al., 2001).
this side of theory just as any other part of the field. Furthermore, part of this investigation is a crucial question as it comes to space syntax as an architecture theory, and as integrated in architecture in making, which is one of the future paths we believe could and should be explored, as it shows great potential and promise. It is our hope and our belief that the papers of this issue contribute to these aims and considerations in many ways, providing knowledge, discussion, and criticism that can help develop theory and practice in space syntax in a more narrowly defined sense, as well as offering the same to architecture theory and practice in a broad sense – but also, to draw a number of parallels, links, bridges, or similarities between fields to offer fertile grounds for a continued discussion.

The issue’s seven thematic papers are thus curated to form a kind of narrative, one out of many possible ones, that moves from a philosophical discussion of diagrams in architecture, through increasingly concrete use of diagrams and models in design towards papers focused on analysis. We believe that it is possible to see a thread from the theoretical and philosophical discussion of Hélène Frichot, through the work of Jane Burry that moves towards concretion but remains primarily theoretical, to more concrete discussions, designs and observations on the use of models and diagrams in design work by Lucy Helme, Christian Derix, and Åsmund Izaki, conceptual investigation of how models could be used by Enriqueta Llabres and Eduardo Rico, and the more pragmatic study of the evolution of plan drawings by Kinda Al_Sayed, to push further into the stringent studies of specific types of models by Tasos Varoudis and Sophia Psarra, towards a revisiting of isovist studies by Sophia Psarra and Sam McElhinney.

Hélène Frichot’s paper, titled ‘On the becoming-indiscernible of the diagram in societies of control’ (p.1-14), begins with a reflection over an ostensibly simple diagram and the range of questions and assumptions it raises, providing an immediate entry into the following discussion on diagrams as projection and power operations in addition to and outside of their immediate use. She follows up with an historical overview of ‘diagram’ in architectural discourse from the late 20th century onwards, and discusses how and why it largely disappeared from discourse around the turn of the century, while definitely not from practice. Continuing through Foucault’s discussion of power and power relations, she reaches Deleuze’s four different, yet interlocking definitions of the diagram: the presentation of the relation of forces; the distribution of power to affect and be affected; the mixing of non-formalised functions and unformed pure matter; and the transmission or distribution of particular features. This means, according to Frichot, that the diagram constitutes strategies independent of graphic formulation. Following, she discusses in depth what this means, in which she also returns to how the diagram in its visual, graphical form relates to these ideas.

Jane Burry (‘The construction of a problem: Architecture modelling after Descartes’, p.15-34) rather addresses the other side of the call – the model. At the outset of the paper, she states that ‘[o]bject making in architectural design has been progressively replaced by engagement with systems’ (p.15), largely empowered by digital tools and the development of ever more powerful computers. Rather than manipulating geometry, according to Burry, designers within the digital paradigm operate through the principles and rules that generate geometry. She also suggests a parallel between the early space syntax generative models of settlement patterns and generative and parametric modelling, while she points to some of the differences between space syntax and contemporary digital design approaches. In her paper, Burry thoroughly goes through the mathematics and philosophy behind the type of models used in computational design and space syntax, again pointing to similarities
and differences between them. Demonstrating and developing this principle discussion through a small series of projects investigating modelling, she continues with a discussion of model space, and how modelling operates in the two, suggesting both difficulties as well as proposing potentials for interaction and similarities and links on theoretical and methodological levels.

Lucy Helme, Christian Derix and Åsmund Izaki’s paper (‘Spatial configuration: Semi-automatic methods for layout generation in practice’, p.35-49) instead more directly interrogates experiences from working with digital modelling and diagramming tools over a number of years. They present a series of projects, the tools developed in their research to help designers work with them, and the character and properties of these tools. These tools vary greatly in what they do, some relating closely to space syntax and others focusing more on other types of form or organisational generation, but as the authors argue, work as best in the iterations where they are limited in scope and ambition and work to give targeted answers to specific questions from the designers. Smaller computational models tailored to project needs, that quite clearly do not provide ‘the solution’ but help with creating and delimiting scopes of action, they argue, work better than attempts to produce all-inclusive generative or analytic software. Furthermore, and this is a crucial point in their argument, they are more easily integrated into a process where analytic or generative tool and designer communicate throughout the process instead of through a black-boxed model of input-output. Such interactivity between digital tool and architect is rare, where the more common generative tools black-box the generation and the designer is left to adjust or adapt either the starting points or what comes out as a result. However, there are problems or questions where such interaction is not quite possible or desired, and the extent to which the applications generate surprising results – which at times is what is sought – varies even if it is always there, also in the interactive ones. This is clearly shown through a series of examples that demonstrate how different approaches are used in different projects. In conclusion, they point to how they have found it pivotal to have a variety of approaches so as to be able to respond to the design problem at hand rather than rolling out the same technology in every situation.

Following this, Enriqueta Llabres and Eduardo Rico (‘Proxi modelling: A tacit approach to territorial praxis’, p.50-67) propose a way of working with models that they call proxy modelling. They discuss the role of time and territory in architecture and urban design, and how difficult it has been to include in design work and proposals, while clarifying that ‘[t]here are certain qualities inherent in the for- mation of matter that can only be engaged with through a design methodology which is constrained and driven by time’ (p.51). They propose that this forces the designer to let go of the notion of a pre-defined outcome and instead fully engage with the process. In proxi modelling, by modelling similitude of territories, that is, small-scale models responding similarly as would large-scale territories, changes and effects can be studied in real time. The idea is that the designer follows ‘a design protocol, generating a path dependent series of interventions which deviate the outcome from its natural state without being fully predetermined as by a fully artificial diagram’ (p.59-61). Their research aims to further develop and quantify what they are currently able to do through physical models, under the conviction that traditional representations such as drawings or maps are inadequate to deal with problems of a territorial scale.

Kinda Al_Sayed (‘How designs evolve’, p.68-90) takes a different stance, studying the way designers externalise ideas in order to investigate them. Her work focuses on the practice of drawing, and more specifically the drawings, where she attempts to
track how similarities persist and changes occur in these representations. This is then translated into design operations, or events, that can be related to one another in various ways, similar to how similarities and changes in the solutions can be. That is, while the preceding three papers try in different ways to address the question through models and diagrams, Kinda adopts a more anthropological stance to look at diagramming, in the form of architectural sketches and drawings, from the outside, analysed through the diagram of a linkograph. The study attempts to draw out knowledge of the interaction between architect and drawing, and in extension of the design process. The study makes use of experiments letting different architects investigate the same design brief, from which the events and linkographs are constructed and can then be compared both in order to find similarities in work process, and to find dissimilarities.

Tasos Varoudis and Sophia Psarra (‘Beyond two dimensions: Architecture through three-dimensional visibility graph analysis’, p.91-108), following, address a question that is often raised in relation to space syntax, but perhaps most specifically to isovist analysis – that of the third dimension, and present a new method extending space syntax to three-dimensional visibility graph analysis. This contributes theoretically and methodologically to the field as well as technologically, and addresses a question that is often posed in relation to the diagrams and models of space syntax. Regular models in the field are primarily two-dimensional with some modelling principles and solutions that allow an intermediate incorporation of three-dimensional properties. They demonstrate how this question needs to be treated both on a theoretical and a technical level. As becomes clear, it is not simply a question of adding another dimensional axis to the generation or analysis of isovists but how this relates to the distribution of isovist origins becomes intrinsically dependent on what is to be understood by adding it, which has far reaching implications for any implementation. Their proposition is that built-in limitations in diagrams and models restrict not only the analytical potential of tool-kits, but also the theoretical strength of a particular approach, in this case space syntax, implying by default that architecture is about what can be represented in two dimensions. It here becomes clear how diagrams and models are theoretical instruments as much as analytical-design tools.

Sophia Psarra and Sam McElhinney (‘Just around the corner from where you are: Probabilistic isovist fields, inference and embodied projection’, p.109-132) take on the isovist analysis in a different manner, suggesting that isovists are ‘bounded configurations’ network-like systems rather than geometrical entities. They present a new approach based on a continuous-time stochastic process of generation of isovists. They focus on embodied vision and projective perception, suggesting ways to understand the links between static, locational perception and singular isovists on the one hand, and build up an understanding of configuration on the other, which includes not only what has been, but what might be (around the corner), and how central our understanding of the models used is to how we develop tools and computation to make use of them. In order to do this, their work includes treating the isovists in their extension when considering how syntactic properties are distributed, rather than as in regular VGA assigning the values to the point of origin, which in addition to incorporating geometrical properties in a formal, mathematical manner allows analysis of overlaps and shape amongst other things. To illustrate and investigate the contribution of their work, they make use of first hypothetical layouts, and then move on to Mies van der Rohe’s Farnsworth house. Through these steps the paper contributes to the discussion of diagrams and their capacity to represent embodied vision as actualised and virtually embedded possibilities rather than static structures.
Guest editorial: Models and diagrams

Koch, D. & Miranda Carranza, P.

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Daniel Koch (daniel.koch@arch.kth.se) is Director of Research Studies for the Doctoral Programme in Architecture at KTH, Vice Director for the research environment Architecture in the Making, and on the board for the national research school ResArc. He has contributed to space syntax research through a number of years, focusing largely on space syntax in relation to architecture theory, and was co-guest editor of the very first issue of The Journal of Space Syntax. In addition to papers, he has been the author of or contributor to a number of books, several of which focus on the relation between architecture and fashion. He is furthermore co-founder of and still active as a designer at Patchwork Architecture Laboratory operating primarily in Stockholm.

Pablo Miranda Carranza (pablo.miranda@arch.kth.se) has been working with computational analysis methods and generative design architecture since his studies at the University of East London under the guidance of Paul Coates. He has worked since as a researcher at the Interactive Institute and at the KTH School of Architecture, both in Stockholm, and at the Aedas|R&D, Computational Design Research in London. He is currently full-time researcher at the School of Architecture at KTH. His work and research, ranging from interactive and responsive spaces to the development of analysis and generative software used within architectural practice, have been both published and exhibited broadly.

Although outside the theme of this Issue, Miguel Serra’s paper (‘Diachronic axial modelling in GIS’, p.133-145) in the non-thematic section describes a technique to observe, record and encode in GIS, the evolution of street network, adding to this discussion the dimension of diachronic representations and the importance of exploring models and diagrams not simply through space, but also time.

Two reviews complete this Issue. The first concerns Ann Legeby’s PhD Thesis at KTH entitled Patterns of Co-presence: Spatial Configuration and Social Segregation (Legeby, 2013), reviewed by Laura Vaughan (p.146-147). The second concerns Victor Buchli’s, An Anthropology of Architecture (2013) and is reviewed by John Bingham-Hall (p.148-150).

Concluding comments
This issue, following an open call for contributions roughly six months before its publication, investigates the role of models and diagrams in architectural design. It does so in relation to space syntax, but not in a restrictive sense. Contributions have been encouraged but not demanded to relate to space syntax, and while the extent to which this is explicitly done varies, we - perhaps obviously - believe this makes significant contributions to the field. Through the interrogations of models, diagrams, architecture, space, design, and computation, the authors also contribute to a wider architectural context, and to ways of bridging divides between fields of architectural studies, in which we include space syntax.

In conclusion, we would like to thank all authors for their contributions, without which the issue clearly would not have been possible. We would also like to thank the Editor of the journal, Sophia Psarra, for giving us this opportunity to guest edit an issue under much freedom and with great support. The editorial team, and here especially Garyfal Palaiologou and Ella Sivyer, have our thanks for their great work. And last, but definitively not least, we give thanks to all reviewers for their thorough and engaged work.

Daniel Koch and Pablo Miranda Carranza
Guest Editors
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