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Representation as research: Design Model and Media Rotation

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1 Introduction

Digital modes are increasingly influencing the process of representing, producing and thinking architecture. Based in a rational domain of problem solving, computational strategies often develop along a projected route. The digital employs administrative control and information management over a maximum amount of project parameters through systemic delay. The final result is displayed as multiple perspectives, renderings, animations and other forms of highly persuasive representations. Has the rhetoric become the object of design? Is representation merely illustration?

It might be suggested that, on the contrary, representation is research. This paper addresses a design methodology that frames representation as an instrument of invention which is not an end product but an active component at phases of ideation, conceptualisation, experimentation and visualisation in the creative design process.

In our work as architects and educators, with a shared background of building practice through the office and through academic research conducted in the Master Of Architectural Design studios at the University of Sydney, we regularly apply two strategies that frame representation as an integral design component.[1] The first, the Design Model, is a generative engine that drives idea and concept through different forms of representation at key moments in the design process. The second, the Media Rotation, is a strategy of discontinuation and conversion of representational components in analogue and digital media, in which each respective medium delivers material, structural, organisational project characteristics that are incorporated into the design in a multiple iterative process.

Design Model and Media Rotation are further relevant for design communication and critique as strategies that cultivate and stimulate collaborative thinking, shared knowledge and team development in a professional and educational context. They employ and generate design principles and operative techniques that can become part of a continuous archive.

In a context of contemporary shifting environments, dynamic-change operations are increasingly a subject for architecture. In a digital realm, temporal spatial sequences, form generation processes or operation mappings adequately investigate and display shifting data-scapes such as growth simulations, occupancy changes or traffic patterns.

Yet we have observed that design solutions often remain one-dimensional if exclusively explored in a singular medium. Hence, demonstrative, explorative or behavioural forms of representation are specifically required for dynamic architectural solutions, integrating interactive performance criteria on a variety of levels from structure to material. Design Model and Media Rotation use modes of conversion

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that transfer project information from data to matter and in reverse, hence complex effects of interactive, responsive or behavioural spaces can be developed. This departure from illustrative towards semantic, communicative and directly modifiable representations then might enable unprecedented solutions, and open a plane for moments of serendipity.

The paper first discusses different approaches of design methodologies (linear, reflective, explorative) and their effects on representation. The paradigm of an explorative design methodology with the generative principles of a Design Model is introduced, and a typology (conceptual, mathematical, phenomenal models) and genealogy (variations of a mesh principle) of Design Models are explained. The paper then discusses change options in different contextual planes (analogue versus digital) through conversion in a Media Rotation. Finally, a logic of invention that authorises representation as research is demonstrated by a studio project.

2 Design methodology: representation and research

Although computational techniques were introduced to the architectural process decades ago, both the architecture profession and its academic side are still exploring the possibilities of 2D and 3D techniques and software in order to generate conceptual, organisational or structural aspects of architecture, and to formulate criteria and standards. Computational software programs such as AutoCAD, Catia and Maya, Rhino, 3DStudioMax or FormZ, support an acceleration of development and visualisation. Digital technologies integrate numerous parameters, produce unrivalled representations in imagery and illustrations, and display an unlimited range of typological solutions, design complexity and spatial variation. Yet a predominant stream of architects uses this software as an optimised method for drafting work, building documentation, and data management. Applied to this extent, the new medium merely repeats components of a traditional design process in more efficient ways.

We have observed both in our professional work as architects and in an educational environment, that the moment a designer becomes skilled with computational tools, more often than not the design is then primarily developed in digital representations. Unusual perspectives and still-novel modes of animation are persuasive because of their perfected forms of display. Yet unresolved results might be displayed too readily, too convincingly. The designer concentrates on the tool rather than the process.[2]

We suggest that a default moment is primarily situated in the exclusiveness of a design medium, whether digital or analogue, and further effected by the chosen design methodology. And while all design methodologies are based on specific premises and techniques, they also considerably vary in their approach to the relationship between creativity and calculation. Such an approach can be considered as linear, reflective or explorative — through its nature, a design logic defines the role of representation, and with that, process and result.

A generic linear design strategy departs from a framed design problem with specified information and critical threshold conditions (square metre,

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programme, budget, client profile, etc.) Such a linear development establishes a striation between two options at a time and runs progressively towards a particular design solution. Representation is here the final element of a result-oriented process, its emphasis being communication and visualisation.

Digital techniques are specifically prone to such a development because they employ a binary strategy for highly controlled design processes. Derived from a rational domain of problem solving, most software structures are based on a linear route. Thus, if idea, concept or construction are developed exclusively in the digital realm, then this pre-formulated approach necessarily projects its solution ahead.

From our understanding, the exclusive use of a medium with a linear methodology renders the design process only partially effective. A controlled phasing usually dismisses intuitive passages and individual interpretations. Yet if intuitive and rational design components are considered equate, a design process can be enhanced by a methodology that incorporates both, through a hybridisation of media and techniques that consequently inform each other.

An alternative to a linear methodology is what Schön has termed a 'reflective conversation'.[3] The reflective design process is singular and specific, subjective and interpretative. Variables of solutions are generated, tested, abandoned or optimised, in pursuit of design versions and adaptations. Slippages, overlaps or misinterpretations are not considered mistakes in a calculated, predetermined process, but understood as potential for alternate unprecedented solutions.

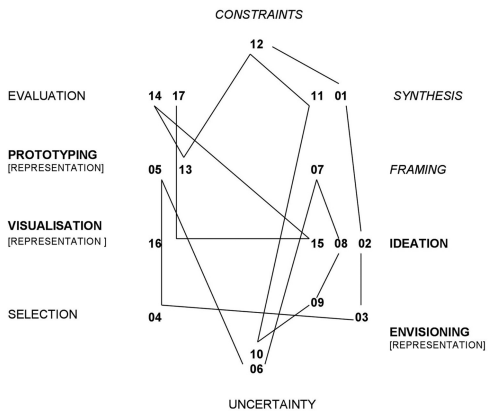
In order to enable a repeated feedback through unprecedented sub-solutions, two conditions of the creative design process play an important role: namely, a clear distinction of its phases, and an open path of procedure. Moggridge describes such an open structure of the design process in which phases are grouped in a circular arrangement,[4] yet the process itself does not develop in a linear manner.

Instead of a linear development, through phases taken in a consecutive order, representation: is assigned to different phases in the process structure, fulfils different tasks and requirements, and is repeated if necessary. This consequently means that different forms of representation are employed, and so representation becomes an instrument for description as much as for investigation in the key phases of ideation, envisioning, visualisation and prototyping (Table 1). Representation thus embodies, and adjusts equally, display, content and process components. According to the stage the project passes, representation changes characteristics, from approximate to precise, from communicative to explorative, from diagram to detail. Each phase of the design process requires different methods and techniques of representation, and feeds its singular or multiple solutions as raw material back into the design cycle.

Yet a distinction between a reflective feedback on a process segment, and the active pursuit of unprecedented results itself establishes a threshold of the logic that drives a design process. Downtown describes design as a speculative assertion in which the fabrication of design, production knowledge and experience are essential, rather than 'The Design' — the result of the process.

In what is essentially a propositional context, designers explore, experiment and test by using

Table 1. Design Process, after Moggridge, 2007. Author's diagram as a variation of Moggridge's diagram from B. Moggridge, 'People and Prototypes: Elements of the Design Process', in, B. Moggriddge, ed., *Designing Interactions* (Cambridge, Massachussetts, MIT Press, 2007).



> activities . . .we call designing. This choice of the word is important: to say they engage in designing loses the distinction between process and outcome. . . . Design is a way of knowing that is labelled with a verb, not a noun.[5]

Design is then neither result nor technique, but the performance of a creative process driven by a logic that equally employs calculation and creativity. While linear methods pursue one path, and reflective design methodologies review and integrate unforeseen chance solutions, explorative methodologies further take an open process structure into research, in which representation simulates, describes and produces. Thus, representation becomes operative, it can take different shapes, it can pass through media and still pursue the same concept, and effectively change without losing its substance.

An explorative methodology is also strongly associated to what Grosz terms:

> . . .a logic of invention as opposed to an Aristotelian logic of identity, reflection, reason, self-containment. A logic that yet has to be invented. . . [such] a logic of invention is necessarily expansive, ramifying, and expedient, producing not premises so much as techniques, not conclusions so much as solutions, not arguments so much as effects.[6]

Such a design methodology opens the design process for moments of serendipity, in which latent design solutions can emerge. It thus may work as a strategy for not only a production of design techniques, thus enhancing the resultant variation, but it also becomes a strategy for producing ideas.[7] Grosz also stresses that such a logic of invention employs '. . .ingenuity, experimentation, novelty, specification, and particularity as its main ingredients. It would not seek to be certain but to incite, to induce, to proliferate.'[8]

Representation is, then, defined by experimentation and particularity — rather than superimposing a predetermined scheme, or producing random results, the design method generates a framework for principles, and continuously reworks it from inside the process.

The strategies we describe as Design Model and Media Rotation establish such a framework; thus enhancing an explorative design process and employing representation as research. Both together

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form a design methodology that investigates the essence of an idea through detailed representations, in different techniques and hybrid mediation.

3 Design Model: typology and genealogy

The term 'design model' originally derives from computer-modelling strategies. Computer modelling is applied in different scientific disciplines, where calculable models reproduce or simulate results from experiments obtained in real-life situations. These models form an integral part of a linear *schema* that proceeds according to regulatory phases and that is administered by previously defined rules and threshold conditions. According to Alhir, Giesecke, Eden and Kazman,[9] phases commonly include the problem-definition phase (situating a problem domain, data collection and division into sub-problems), the phase of analysis and concept framing (establishing basis criteria, developing an analytical model and representation of stages), the design model development (exploration of principal characters and rule set-up for system requirements), the application phase (implementation activities to build a system, problem adaptation, parameter introduction), and the verification phase (testing activities, confirmation requirements met or restart of process). The design model thus reflects validity in the design or research process through a successful completion of all phases, in respect to criteria formulated beforehand and negotiated in the process.

Yet in an architectural context, the Design Model has a different status. Recent architectural magazines and periodicals display examples of what can be understood as a form of design model (cardboard sketch models, elastic bands, 3D organisational diagrams) side by side with the architecture — thus the design process has entered the public arena. For a professional and academic audience, these epitomes of the design process are often as important as the actual building, because they are representations of the architect's thoughts: they are what produces the architecture.

> UN Studio describes the design model as:
> . . .packages of organisational or compositional principles supplemented by constructional parameters. The design model does not include site-specific information; it exists at a more abstract level and may be implemented in various situations and projects.[10]

The Design Model is the generative engine that forms idea and concept into architecture, independent from scale and programmatic requirements. Furthermore, from our understanding, its real formative power derives from a capacity of perpetual transformation to process and adaptation to project data. It frames the essence of concept and idea through different shapes, because this framework of rules and settings can be constantly edited and adjusted. It exists in a number of operative representational modes; it explores the materiality and fabrication consequences of the design principles in texture, structure, behaviour or phenomena, investigating these from a multiplicity of angles. The Design Model frames and partially explores an uncompromised solution of architecture before real-time requirements set in. Although abstract, its representations require precision, coherence, logic and aesthetic in each step of the project-definition process.

Design Models might also be differentiated according to their effect. While illustrative models are

Figure 1. Conceptual (Duchamp) 'Why not sneeze Rose Salavy?' by Marcel Duchamp (152 marble cubes, sepia bone, bird cage painted white, thermometer), in C. Tomkins, *Duchamp—Eine Biography* (Vienna, Carl Hauser Verlag, 1999), pp. 274–275.

unalterable, precise representations of concept or solution, other representations are dynamic, such as semantic models that describe a phenomenon or simulate a behaviour of features or elements, or communicative models that work the content through an alteration of matter, form, or shape during conversation.[11] These last two can be described as explorative or operative representations.

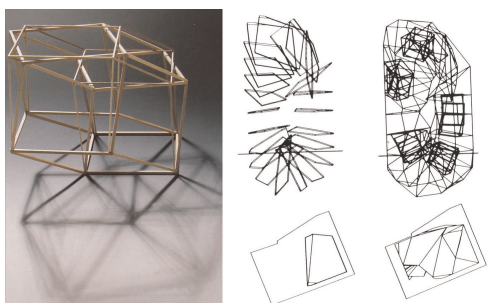
Design Models are characterised by organisation of parts and whole, by materiality, structural properties and detail characteristics. Relationships between singular parts, their connection to or detachment from other parts and towards the whole are defined through techniques of fragmentation, displacement and seamlessness.[12] Design Model types can range between principles with different emphasis, methodology and context, such as conceptual models (inclusiveness, inversion, blur), mathematical models (parametric organisation, pivotal points, interval conditions), geometrical models (fold, mesh, Moebius band, Klein bottle), or phenomenal models (optical, force impact, cause-effect).

Consequently, a Design Model, according to the principles with which it works, elaborates, even produces its own techniques, arranges its component parts and specifies its shape, structure and material effects. A conceptual Design Model such as Duchamp's object assemblage (Fig. 1) merges disconnected components.[13] In its fragmented arrangement the parts maintain their individual character, yet are related through the affect of material properties (temperature, weight, colour).

In contrast, the 'Manimal' (Fig. 2) is a hybrid based on a principle of inclusiveness. A seamless mediation technique merges layers of existence of different species — snake, man and lion — onto one singular plane.[14] The 'Klein Bottle' (Fig. 2) depends equally on a seamless transition of a continuous surface, a representation provided by digital calculations of the object. These Design Models share an ambiguity of shape and alienation effects that intersects programmatic, mathematical and narrative criteria.

Most Design Models can variably be explored as analogue or digital investigations, even those based on geometrical and mathematical principles. Eisenman's 'Diagram Diaries' (Fig. 3) give an overview of form transformations in which principles of operation — scaling, rotation, shift, striation, blur — are legible through sequential superimposed representation.[15] Lynn's 'Embroyologic House' uses form genealogies the disguise their production techniques, yet displays principles of shape variation that operate through aesthetic preference (Fig. 4). [16]

Design Models are three-dimensional explorations that partially reveal consequences of the principles



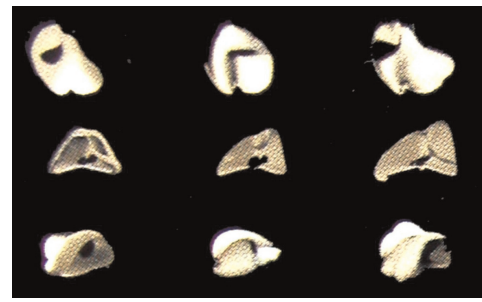


Figure 2. Inclusive Principle in 'Manimal' and 'Klein Bottle' (UN Studio); B. van Berkel and C. Bos, *UN Studio: Design Models, Architecture, Urbanism, Infrastructure* (London, Thames and Hudson, 2006).

Figure 3. Rotation, Shift (Eisenman); P. Eisenman, *Diagram Diaries* (Thames and Hudson, London, 1999).

Figure 4. Mathematical Series (Lynn): from G. Lynn, 'Embryologic House', in, A. Rahim, ed., *Contemporary Processes in Architecture*, *AD*, Vol. 70, No 3 (London, Wiley Academy, 2000), pp. 26–35.

they are based on, in delivering a forecast of a sectional element of the projected architecture. A Design Model can investigate principles as diverse as of material formation, shape variations, elastic properties in textures, fields of magnetic forces, structural deformations through compression or optical phenomena under different light impacts (Fig. 5). These models can be described as semantic, behavioural, phenomenal, operative representations that directly testify and evaluate a process.[17] Representation then becomes research.

Further, a research conducted via Design Models enables a collaborative knowledge of architectural design. Previously, magazine imagery illustrated the final building, which consecutively initiated a form or material assimilation, in the worst case an unfiltered copy-paste. Now, displayed fragments of the actual design process enable something entirely different — access to the raw material of design production and thus a continuation of existing design principles.

Through an explorative design methodology, principles can be categorised, classified, transformed. Design Models are part of a history, have precedents, and thus relate to a continuity of design evolution. Principles are both universal and individual. A Design Model is based on a set of universal principles, and is thus independent from authorship and person, but to be effective it must be executed, and in that undergo a process of individual interpretation. In the same manner, its techniques, its logic and its process structure can be developed and shared. A Design Model produces design knowledge through a performative creative act.[18] Each precedent invariably sets a benchmark for organisational, material, structural, geometrical and programmatic criteria that become the foundation

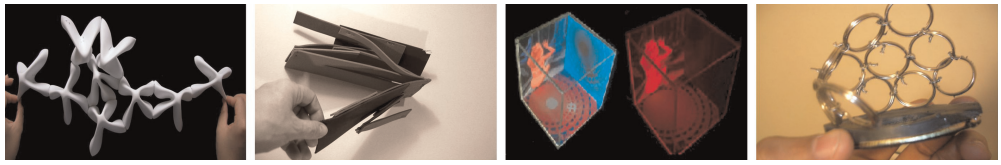


Figure 5. Design Models — Fold as Field; Fold in Strata; Optical-Reflective; Force Impact: unpublished material from a series of design studios at the Faculty of Architecture, Design and Planning, University of Sydney, (For the Master of Architectural Design/ Bachelor of Architecture course (Si Yue Sun [Ellen], reinhardt_jung, Alex Willis, Zubin Vaishnav).

of another slightly differentiated individual proposition.

The potential of a Design Model genealogy is illustrated in Table 2, where Mesh formations based on similar or related principles correspond between domains of architecture, engineering of art. Although the 'Mesh' is the principle shared in these variations of Design Models, each respective approach develops a specific aspect.

A simplified relationship genealogy of the 'Mesh' Design Model can be traced from Semper's observations on textile weaving patterns, to Frei Otto's tensegrity structures that test structural behaviour in a mesh deforming from a regular to an amorphous grid under a force impact. Otto's experimental series was then continued by Nox with a focus on stabilising fields in a transformed mesh, using force impact lines to identify areas of material densification for the development of a structural theme (Soft-office, D-Tower project).

In other applications, the 'Mesh' principle is used to show transitional stages between shapes through a superimposition of a grid and a shift in nodal points, a principle applied by D'Arcy Thompson ('On Growth and Form'). The mesh appears also as 3-dimensional surface organisations with axial-rotated referential lines or planes (such as in the sculpture works by Pollack, Munari, Pearson). Servo use a 3D modular arrangement in which a hybrid of spatial and virtual organisations interact in a responsive field (lattice Archipelogics). Kohmac employ modular components in a structural mesh (Maison Raybould). Mesh organisations of varying line properties, field continuity and module characteristics were also used in the research for a dynamic spatial behaviour (Elastic Space Studio, Master of Architectural Design, University of Sydney).

A Design Model genealogy that pursues similar principles through different design solutions then contributes to a continuously growing design archive of references, rules and techniques for a creative process that serves both a personal architectural language and also generates an expanding body of expertise that can be shared collaboratively.

4 Media Rotation and aspects of conversion

Where the Design Model is the engine, the Media Rotation is the profiler: it generates the appearance of the idea or concept in various media (diagram, drawing, physical model, 3d data, rendering, rapid-prototype, etc) through a method of conversion.

Aspects of conversion address a medium transfer (from one medium into another), but also must acknowledge a collateral shift in concept, idea or principle. McLuhan argues that each medium forms

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Table 2. Genealogy of a Design Model: variations of the Mesh Principle. (Author's diagram, part of research illustration for PhD dissertation; singular illustrations taken from a number of different sources.)

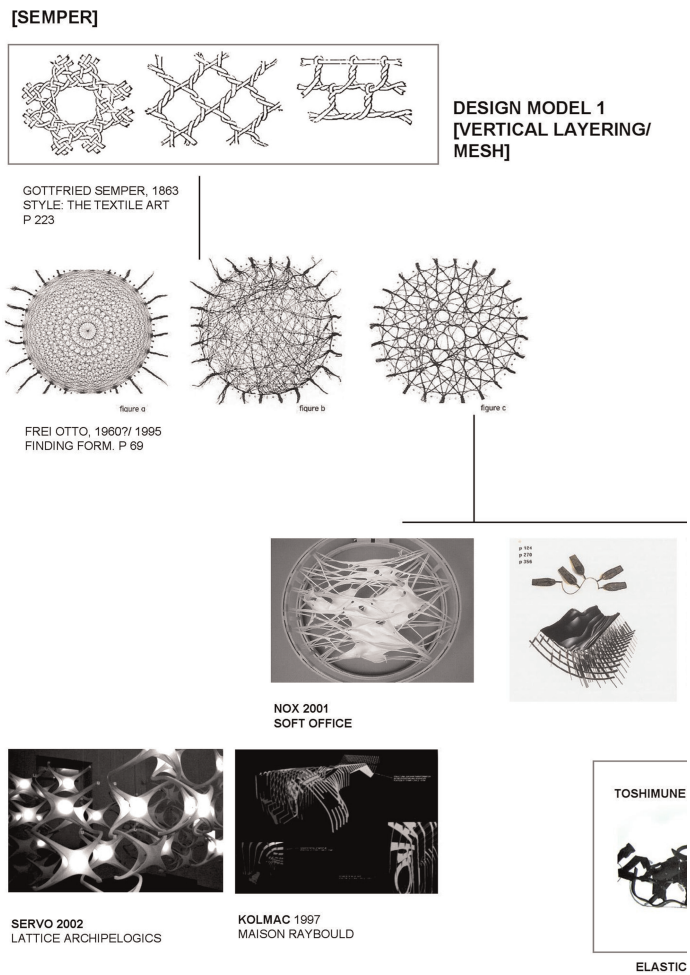

Table 2. Continued.

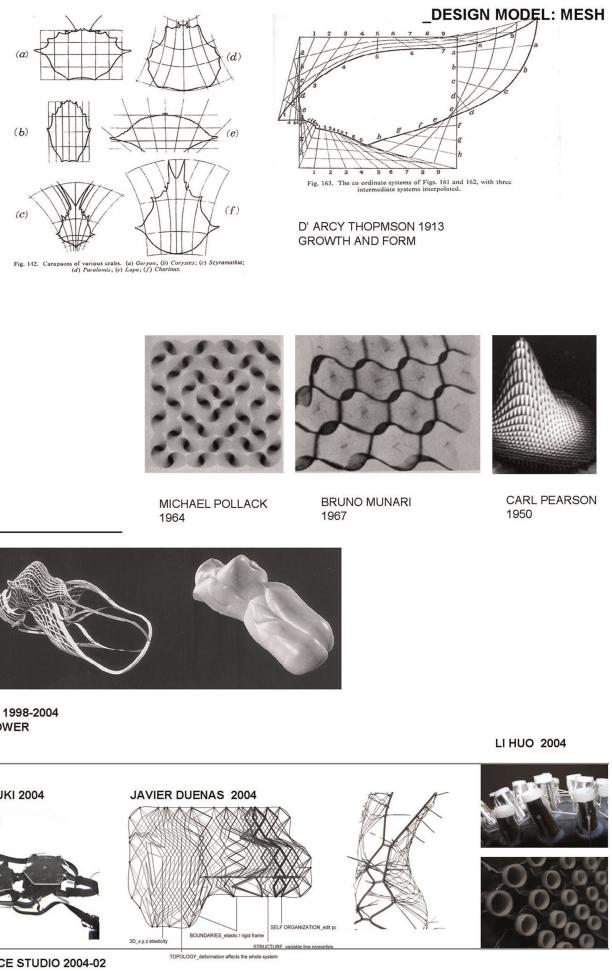

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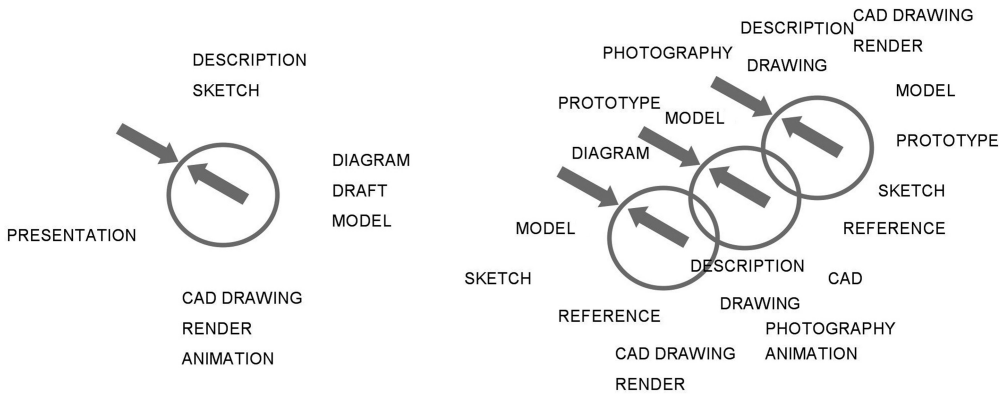
Table 3.1. Linear Process. Table 3.2 Media Rotation: integrative process reinhardt - jung (diagrams).



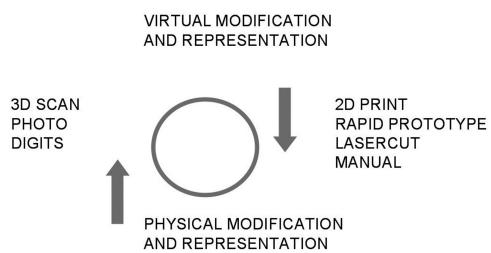
its own context and content.[19] A new medium first simulates its predecessor, and then generates alternate applications for technique or machinery, altering fact through instrument and process. According to Deleuze, a code that passes through a medium is inflected by the medium's inherent method and techniques.[20] Thus, any representation ultimately detaches and transforms the relationship between concept, form and material fact.

Linear design processes close one medium and open another,[21] thus consequently produce finite representations (Table 3.1). In contrast, the Media Rotation we suggest uses an integrative approach in which design elements and partial solutions in different media are cross-referenced and re-inform each other (Table 3.2). Thus, Design Model and Media Rotation in conjunction use a repeated conversion to uncover the latent potential of architectural solutions.

It therefore requires both operator skills[22] to develop a principle in analogue or digital media, and an interface capability of the designer to process a concept uncompromised through matter, machinery and methods. While each medium has its respective advantages of material, structural, organisational or textural properties and techniques, the design methodology and logic mainly inform the design results.

Analogue design techniques and methods (sketching, drawing, cutting, pen, paper, cardboard, wood, assembling laser-cut parts) are physical, modular and gravitational. They support a direct, manipulative and corporeal knowledge of details, texture, construction or space. Analogue methods exist in their respective *gestalt*. An analogue design model can establish connections between heterogeneous elements, within a field of possible interferences. Analogue media use a continuous spectrum of values; they produce

Table 4. Virtual-analogue conversions after Tamke, 2005, Author's diagram as a variation of Tamke's diagram. M. Tamke, 'Crossing the Media', CAADRIA, 2005; *Proceedings of the 10th International Conference on Computer Aided Architectural Design Research in Asia* (New Delhi, India, 2005).



representations, which interact in a realm of material immediacy and re-contextualisation. When change conditions for physical media become limited (in scale, skill, material and form definition), then the conversion into digital media opens a realm of abstraction and further definition — or vice versa, for a digital process development equally benefits from a countercheck by media change.

Computational Dasign Methods use an approach of 'systemic delay',[23] a temporal interstice of conceptual idea and material form. Representations include CAD plans and sections, 3D models, animation, administrative data; and digital design environments thus deliver a potential of controlled research in an homogeneous data field. Different parameters, such as use, occupation, environment, brand or client profile, infrastructural patterns and so forth, can thus, for example, be processed onto an organisational surface. A shift in parameter can be continually integrated and displayed as a form or shape change. But when the process remains in the digital medium, additional information, through material character, production methods and physical properties, is suspended.

The development of a Design Model through Media Rotation also relates to the direction (intake or output) of conversion, accuracy and range of data. Each medium situates particular strategies of transfer in form and matter (Table 4). [24] Generally speaking, a conversion can be processed as specific or approximate, following the precision of machinery or an open interpretation of the designer.

Approximate intake conversions are interpretative systems, such as photography, which describe objects and settings through a variation of viewpoint, lens width or light conditions. In contrast, scanning techniques are processed in a set frame: hence they transfer data far more accurately. Standard, direct out-put conversions of a digital result (animation, rendering, shape) into static representations include 2D transfers such as plot and print, or 3D transfers such as laser-cutting, stereo-lithography or rapid-prototyping.[25] Yet even precise methods of conversion can be used to produce latent solutions, namely through a misuse of machinery and technique. In producing defaults derived from incomplete information,[26] unpredictable results can lead to a sudden understanding of the design problem. A 3D scan can be employed as a sculpting and sketching device that traces movement and rhythm, rather than delivering a copy or explicit translation.[27]Specifically, design

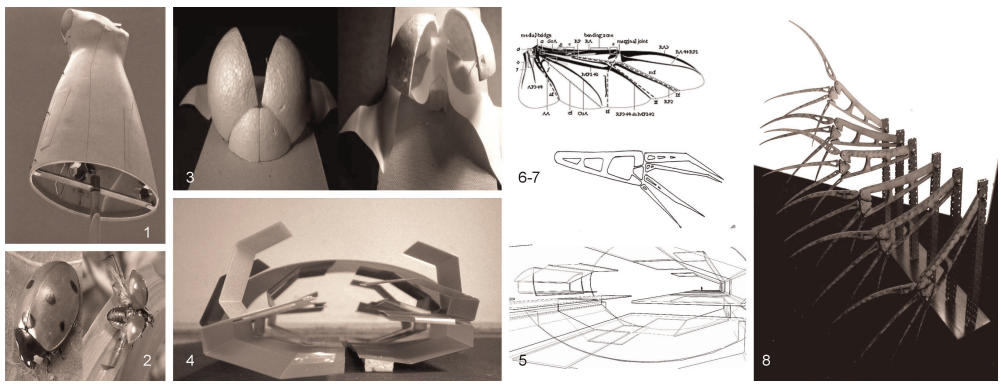


Figure 6. Reference, Analysis, Design Model Tests And Rotation: Prosthetic Surface Studio, N. Patankar. (Unpublished material from the Prosthetic Surface Studio 2006, Faculty of Architecture, Design and Planning, University of Sydney: Master of Architectural Design course.)

methods that improve lasercutting are open for a repeated negotiation: through a process that includes both digital and analogue phases (here 3D data-scapes are segmented — the parts laser cut, assembled — and reworked through differentiated modelling techniques and materials).

In a Media Rotation, the design process thus might develop from a discrete, searching pencil line to a 3D model or redrafted rendering, which in turn delivers the basis for a laser cut forming a 3D material sketch model, which again is transformed in the continued design process. Shape, space, effects and phenomena definitions can thus be indicated in a range of media representations that allow ambiguities and inaccuracies without a premature limitation of the idea.[28] Once these approximations have been filtered through analogue and digital aspects, their respective representations can address architectural shape, space and atmosphere extensively, and further be transformed and communicated.

We suggest that repeated conversions between analogue and virtual media from an early point in the creative process support a precise and explorative design. A medium change submits a feedback based on multiple iterations, in which the Design Model bypasses repetitive design behaviour and over-commitment to a design solution. A Media Rotation might thus be understood as an un-ideal machine for invention, in the sense that it reconfigures the problem space the designer is working in.

5 Applications of Design Model and Media Rotation

Design Model and Media Rotation were applied in a number of design studios run by the Author with the Master of Architectural Design course at Sydney University, Faculty of Architecture. A project resulting from the Prosthetic Surface Studio is discussed here as an illustration (Figs 6, 7).

The Prosthetic Surface Studio addressed the shifting spatial parameters of a transitional environment.

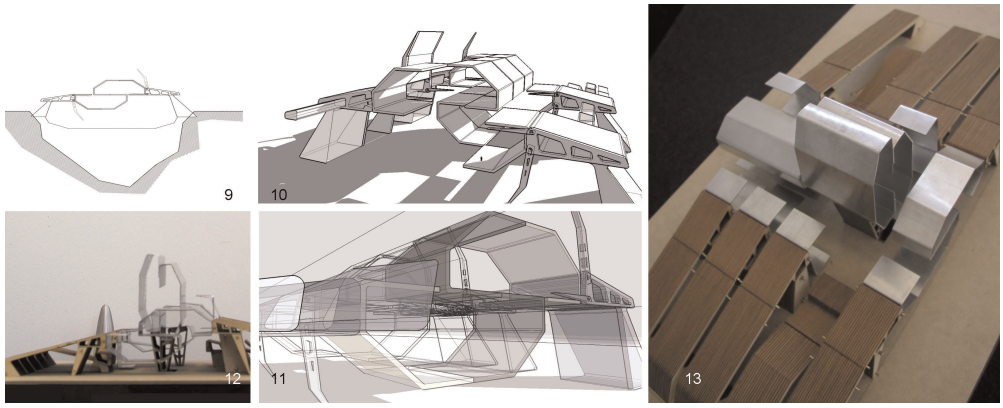


Figure 7. Design Model And Architectural Application: Prosthetic Surface Studio,: N. Patankar. (Unpublished material from the Prosthetic Surface Studio 2006, Faculty of Architecture, Design and Planning, University of Sydney: Master of Architectural Design course.)

The architecture was to be developed as a spatial prosthesis, with a reflective ability to address a change in context and value systems. Specific consideration was given to a dynamic system that would provide reactive, responsive or interactive characteristics in phases from design to construction and use, and thus elaborate a potential departure from the original blueprint.

The design process was structured into a first phase of analysis, cross-reference, abstraction and idea definition, followed by a second phase of conceptual development for Design Model through a Media Rotation and finally, a third phase of architectural application under a parameter evaluation, modification of Design Model and development of an architectural project.

As a departure point, a given work of fashion (here Chalayan's Aeroplane Dress, 1) was referenced in structure and appearance to a bionic specimen, a ladybird (2). An analytic series through analogue approximate models (3) simulated the opening mechanism of its ceratin shell construction and integrated layer structure of internal wing planes. This analysis delivered principles for form and shape, developed according to control parameters such as interstitial space, constructive scheme and contour line.[29] The principles were then further applied in a spatial arrangement (4). A further analysis of the volume structure studied the fields' opening and unfolding in a movement sequence (5), but proved to be too limited as an architectural result.

A return to the internal wing hierarchy then focused on its component parts with a classification of nodes, lines of force, joints and skin zones (6). Pursued initially as a sketch and in an organisational diagram, the module shapes were then optimised in CAD for an exact-pattern module production (7). The modules were then laser cut, and assembled in another conversion from digital form to analogue construction, resulting in a successful design model

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that used prototyping through sections of a possible architecture detail, and showed the mechanic principle, gears and couplers (8). Yet an aesthetic criticism of the Design Model framed it as too biomorphic in appearance, and its construction limited to a singular plane definition.

The Design Model was then exposed to an architectural proposal with parameter evaluation, of programme and site alternatives, such as in a cliff (9) or a field condition (10). A test of the dynamic capacities of the surface organisation and further defined programmatic requirements (an aeroplane hangar) in a sectional movement then set a preference for a field site. The 3D digital model (11) was further used to specify interior space and occupancy sequences, to inscribe measures of functional sections in the volume and to determine supplementary formations (fabrication hall planes) and additional programme units (conference, studios and work labs, service units, flats). The final Design Model combined laser-cut and hand-crafted components for a specification of material fields and of stable or moving parts according to the respective section (12–13). Thus, material components, digital representations and formative principles were iteratively modified in the design process, and resulted in an uncompromised, legible Design Model with an operative representation for shifting inhabitation modes.

Conclusion

The paper has discussed a paradigm of design methodology in which representation shifts from illustrative to operative, and becomes an integral design component. Design Model and Media Rotation have been discussed as strategies that might establish a realm that entices the designers to use a multiple iterative conversion between analogue and digital media to maximum advantage, and to investigate a concept through material, texture, structure and shape in a detailed and intuitive way. Representation then becomes research, and continues to inspire.

On an individual, personal, level, a design methodology that uses Design Model and Media Rotation can support the architect's and designer's communication and collaborative sharing of principles, references and techniques at the core of the design process, in an educational and professional context. Through this approach, a reference might be exploited as raw material, a continuous archive is started and a learning curve is set into motion.

Digital modes have not only accelerated development processes: they produce a shared platform between different domains. On a general level and influential for architectural culture, this consequently means related principles and techniques even of cognitive and creative domains such as science and design can be cross-fertilised, used for Design Models, alternate in media and machinery, and may then consecutively be appropriated in architecture. When representation is no longer merely illustrative because its contents are constantly evolving, then architecture as the subject of these representations may also depart from static conditions to become emergent, responsive and transformative — in a real-time presence.

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Notes and references

1. The Author is an architect and principal of reinhardt_Jung, an architecture office run with partner Alexander Jung, based in Frankfurt am Main and Sydney (www.reinhardtjung.de). While our installations, curatorial work, projects and buildings address architecture in a practical realm, concepts and theories are simultaneously explored in an academic and educational context, as here in a studio series with the Master of Architectural Design course at the Faculty of Architecture, Design and Planning, University of Sydney (www.arch.usyd.edu.au).
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6. E. Grosz, 'The Future of Space', in *Architecture From The Outside* (Cambridge, Massachussets, MIT Writing Architecture Series, 2001), p. 112.
7. 'An idea is nothing more or less than a new combination of old elements. [This combination is] not so much a fact as it is an illustration of a general law applying to a whole series of facts. . . .To some minds each fact is a separate bit of knowledge. To others it is a link in a chain of knowledge. It has relationships and similarities. . . .When relationships of this kind are seen they lead to the extraction of a general principle. This new principle, when grasped, suggests the key to a new application, a new combination, and the result is an idea. Consequently the habit of mind can undoubtedly be cultivated.' J. Webb Young, *A Technique for Producing Ideas* (NTC Business Books, 1986), pp. 18 and 25–26.
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17. Geometrical — Surface Folds; Phenomenal — Optical/Reflective; Phenomenal — Force Impact/Cause — Effect, are design models produced with students in a series of Design Studios at the University of Sydney conducted by the author between 2004 and 2007.
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22. T. Fry, *Remakings* (Sydney, Envirobook, 1994), pp. 92–94.
23. 'Systemic delay: by this we mean the temporal interstice of conceptual development between initial idea and its material form.' Rahim continues to explore the advantage of a delay as allowing for a state of open creativity in the absence of material or reality requirements. 'At the deterministic end of the spectrum is the utilisation of material processes, which rely on the isomorphic relationship between concept and object, similar to the philosophical distinctions between the representation of objects perceived (images) and representations of objects formed by the mind (abstractions). Non-material processes abandon this model and begin operating autonomously from it.' A. Rahim, 'Bound Inspiration for Architectural Innovation', in, A. Rahim, ed., *Contemporary Processes in Architecture*, *op. cit.*, pp. 6–7.
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