



0039

The Discrete and the Continuous in Architecture and Design

L Feast

Victoria University of Wellington, Wellington, New Zealand

lukefeast@gmail.com

Folding in Architecture and the Ecology of Sustainable Design

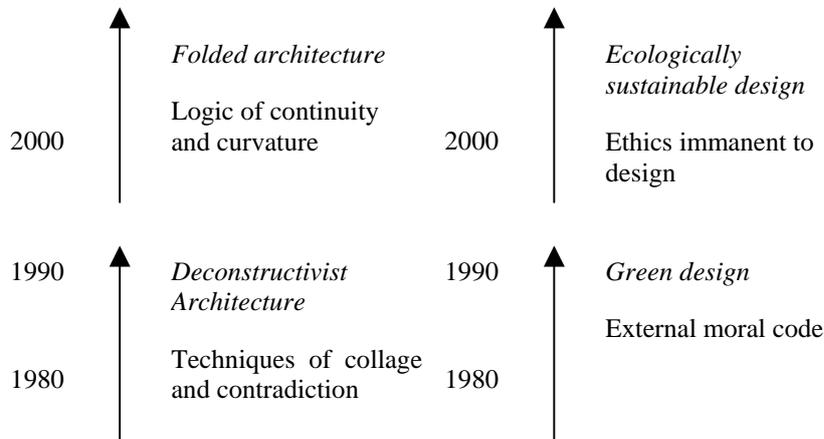
The notion of the environment as a continuous network of interacting flows of information, artefacts and subjects, as characterised by Ezio Manzini's ecological model of design and Greg Lynn's folded concept of architecture, has prompted the development of a variety of innovative techniques that can engage time, change, mobile points of view, and which can reorganise multiple economies, ecologies, information systems, and social groups. These techniques such as scenario building in design and diagramming in architecture, while attached to two distinct traditions do involve a productive overlap of concerns and concepts which can provide useful exchange and dialogue in the investigation of mutual problems of representation, practice, and the relationship of ethics and aesthetics in architecture and design.

In architecture, this increasing influence of a dynamic model of complexity has characterised the displacement of deconstructivist techniques of collage and contradiction established in the 1980's with a folded logic of continuity and curvature in the 1990's. A parallel transition can be discerned in design within the transition from the external moral code of green design to the immanent ethics of sustainable design. The implications and interrelations between the emergence of folding in architecture and of ecologically sustainable design can be productively investigated through their interactive reflection with the distinction made between discrete multiplicities and continuous multiplicities as developed by the philosopher Gilles Deleuze (1925-1995). This distinction in models of complexity can be introduced as a difference between a metric space that can be reduced to an aggregate of points, and a non-metric continuum that can only be qualitatively differentiated in time.

Table 1



Transitions toward Continuous Models of Complexity in Architecture and Design



From Deconstructivism to Folding in Architecture.

In the key architectural text of this period, the 1993 issue of *Architectural design* entitled *Folding in architecture*, Deleuze’s philosophical concepts were employed by a number of theorists and architects in the development of a new *logic of curvilinearity*. This logic sought to displace the fragmentary collage of opposition and contradiction characteristic of the angular forms of deconstructivist architecture, through the integration of difference in the calculus of continuous variation inherent in curved and flexible forms; the production of which was becoming increasingly accessible in conjunction with developments in computer modelling technology. According to Greg Lynn, the editor of *Folding in architecture*, Deleuze’s concept of the fold is of particular importance for this investigation of the “integration of differences within a continuous yet heterogeneous system” for it provides “a theory of synthesis and unity that maintains detail as a discrete moment that participates intensively in the construction of a new kind of whole” (Lynn, 2004/1993, p. 11, 24).

Folding implies a *smooth* relationship between diverse elements that unlike a simple hierarchy or modularity, weaves together a multiplicity of macro and micro scales whose consistency is neither exterior nor super-structural but which is characterised in Deleuze’s terms by “immanence of field without transcendent unification, continuity of line without global centralisation and contiguity of parts without distinct totalization” (Deleuze, 1988/1986, p. 27). According to architectural theorist John Rajchman (2004/1993, p. 78) in his essay *Out of the Fold* from *Folding in architecture*, Deleuze’s concept of the fold offers an original concept of complexity that does not consist in the one that is said in many ways, but rather in the fact each thing may always diverge into many others, as in the ever forking paths in Borges’ fabled garden; a kind of complexity whose fabric can never be completely unfolded or definitely explicated, since to unfold or explicate it is only to fold or complicate it anew. Thus the fold is a model of complexity that does not consist of fragments or ruins of a lost or absent whole, but in the potential for divergence with any given unity. In this manner according to Rajchman,

the concept of complexity is freed from the logic of contradiction or opposition and connected instead to a logic of intervals: it becomes a matter of a ‘free’ differentiation (not subordinated to



fixed analogies or categorical identities) and a 'complex' repetition (not restricted to the imitation of a pre-given model, origin or end). (Rajchman, 2004/1993, p. 78)

The flexible complexity generated by folded architecture is a notion of *complexity in divergence* that can be considered as organic or "biomorphic" and indeed characterised as "ecological" (Hays, Ingraham & Kennedy, 1995, p. 9). This ecological model of complexity has also been articulated in design by a number of authors (Buchanan 2000, 2001; Krippendorf, 1995/1989; Manzini 1995/1992) through the concept of the *ecology of the artificial*.

From Green Design to Ecologically Sustainable Design

Since the 1960's and 1970's, the ecological concept of the complexity of our world has seen ethical concerns in design become increasingly centred on the impact of products as part of the physical and social environment rather than focused on the personal morality of the designer or on social conditions of production (Whitely, 1999, pp. 196-200). Borrowed from the environmental movement in politics, the term *green* quickly became the buzz word in design culture through the 1980's with a proliferation of "how to be green" design exhibitions and design literature. As suggested by Pauline Madge (1997, p. 46), green design varied from *dark green* to *pale green*, "between those who advocated a radical rejection of the status quo, a critique of the paradigm of modern industrial society (whether capitalist or socialist), and the lighter green idea of modifying existing institutions and practices."

The broadening of the concerns of designers from simply adding environmental criteria into existing design processes, to critically reconsidering design and industrial practice, follows a transition in the 1980's and the early 1990's from pale green design to the darker green of ecologically sustainable design. For example, as proposed Anne-Marie Willis at the international EcoDesign Conference held at RMIT in 1991, "ecodesign has the potential to be more than the reform of existing design, for if taken seriously, it can establish a new foundation for design that could bring economic and ecological need into a new union" (Quoted in Madge, 1997, p. 50).

This possibility for an ecological view to provide a ground for design ethics that is immanent to design rather than in the form of a moral code, is supported by Alain Findeli in his 1994 paper *Ethics, Aesthetics and Design*. Findeli (1994, p. 52) argues that the cartographic *mapping* the world of artefacts in a topological plane which "represents the world of artefacts as a continuous space, [suggests] the possibility of describing it by the means of a unified theory." For Findeli (1994, p. 66, 67) this notion of a continuous topological model enables us "to envision continuity between the technological act and the moral act," such that it is "not necessary to leave the field of design in order to construct a general problematic of design ethics". Findeli's argument is representative of the transition from green design with its emphasis on the political morality of the designer and a professional code of ethics that is external to the design process, to an *ethical attitude* which greatly broadens the scope of design from one of solving problems to, following Ezio Manzini, the concept of the designer as a *conceiver of scenarios*. The influence of Manzini's work has also played a significant role in the transition towards a more continuous concept of complexity in design.



In Manzini's important essay on ecologically sustainable design, first published one year before Lynn's *Folding in architecture*, entitled *Prometheus of the Everyday: the Ecology of the Artificial and the Designer's Responsibility*, Manzini develops an ecological image of the contemporary artificial environment as a dynamic system of interacting flows of material and immaterial artefacts, which relate and compete with each other within a limited space. According to Manzini (1995/1992, p. 220), this recognition of products as elements in a complex network of relations carries an ethical imperative for the designer to choose to participate in the development of a new strategy of consumer production more favourable to the environment, and therefore to a new "sensuous horizon" for design based upon new values and concepts of quality. Manzini argues that the reductive, western enlightenment image of thought where progress is based in the continual and cumulative domination of nature by reason has lost its force today. This culture of doing is characterised by Manzini as really an idea about the democracy of consumption linking together the notion of well-being with increasing quantitative growth. The result of which has been the diffusion of worthless, disposable products lacking in cultural or spiritual significance; products which leave no trace in our memories but do leave an increasing mountain of rubbish (Manzini, 1995/1992, p. 222, 225).

Manzini maintains that we lack a modern day value system of "every day things", and what we need is a new approach to design which he portrays as an ethics of "minute choices", where "caring for objects can be a way of caring for that larger object that is our planet" (Manzini, 1995/1992, p. 239). Here we can see the reflection between Manzini's *ecological* model of minute choices and Lynn's logic of curvilinearity that maintains detail in a continuous yet heterogeneous system.

Like Findeli, Manzini argues that we need concepts that map designs in terms of quality rather than quantity, which will enable us to understand reality without losing what we have discovered about its irreducible complexity. According to Manzini (1995/1992, p. 236), this sense of contemporary artificiality requires an ethics and aesthetics that is not based on universal and absolute ideals but refers to a system of values exhibiting the consciousness of relativity, and that attributes worth to materials and products that in some way are able to embody vestiges of their earlier existences. What Manzini is advocating for here is an ethics not of universal laws, but of dynamic relations between individuals, an ethics that inhabits a similar conceptual space to that explicated by Deleuze's folded concept of the continuous multiplicity.

The Isomorphism of the Fold in Architecture and Ecology in Sustainable Design

The transition in architectural theory from deconstructivist techniques of collage and contradiction to the smooth curvilinearity of folded architecture follows a shift from a discrete space that maintains oppositions in tension, to a continuous intensive space where difference is not limited to contradiction or confined to by constraints of the same. In a similar fashion, the development from green design to ecologically sustainable design has transformed design ethics from a transcendental moral code to an immanent design ethics of dynamic relations between individuals.

In light of these arguments, design ethics can be considered without recourse to essential universals, and instead through processes of continual folding, unfolding and refolding, ethics becomes more of a



Foucaultian *art of existence* or a *style of freedom*, where one continually creates and recreates oneself in order to give life the most beautiful possible form, both in the eyes of others, of oneself, and for future generations (Foucault, 1988, p. 259). This continuity between ethics and aesthetics is maintained by Manzini in his call for a new qualitative sensuous horizon of design, because it is through aesthetic experience that ethics and everyday life are folded. This call for a new ethico-aesthetic paradigm in design is reiterated by Deleuze:

For there is no other aesthetic problem than that of the insertion of art into everyday life. The more our daily life appears standardised, stereotyped and subject to an accelerated reproduction of objects of consumption, the more art must be injected into it. (Deleuze, 2004/1968, p. 365)

Aesthetics now develops a pragmatic attitude, it becomes functional in that its problematic is to reconnect us with the world through the creation of events which in turn open us up to the non-human universe that we form an ineluctable part of.

The concepts of complexity investigated here, the folded multiplicity and the ecological network, represent concepts of a dynamic form of consistency between heterogeneous elements, and hence both are inherently temporal concepts. Indeed, the relations between folding in architecture and ecologically sustainable design can be further explicated through the investigation of their respective engagement with time. However, in order to fully appreciate the particular trajectories taken by folding in architecture and sustainable design, we must further examine Deleuze's distinction between the static nature of discrete multiplicities and the inherently temporal nature of continuous multiplicities.

Discrete Multiplicities and Continuous Multiplicities

In the philosophy of Gilles Deleuze the question of complexity is related to the concept of difference. Deleuze's philosophical project seeks to think difference in itself, a positive concept of difference that is irreducible to identity, analogy or resemblance and which destabilizes dialectical opposition to open the way for a new critique of philosophy. (Deleuze, 2004, p. 37)

According to Boundas (1996, p. 83) Deleuze's ontology considers two aspects of complexity with what he calls discrete and continuous multiplicities, concepts which are based on Henry Bergson's reworking of the distinction originally made by the mathematician G. B. Riemann between discrete manifolds and continuous manifolds. This distinction defines discrete multiplicities as extensive magnitudes whose nature remains the same after they are divided, and defines continuous multiplicities as intensive magnitudes whose nature is changed each time they are divided. According to Deleuze's interpretation of this distinction,

[A discrete multiplicity] is represented by space... It is a multiplicity of exteriority, of simultaneity, of juxtaposition, of order, of quantitative differentiation, of difference in degree; it is a numerical multiplicity, discontinuous and actual. The other type of multiplicity appears in pure duration: it is an internal multiplicity of succession, of fusion, of organization, of heterogeneity, of qualitative discrimination, or of difference in kind; it is a virtual and continuous multiplicity that cannot be reduced to numbers. (Deleuze, 1991/1966, p. 38)



The articulation of the distinction between discrete and continuous multiplicities is of significant importance to Deleuze's philosophy of immanence, because the failure to differentiate between the two multiplicities can become the source of transcendental illusions. This division between the discrete and the continuous also determines the division of complexity into two tendencies, for example the distinction between space and duration, and between extensive and intensive properties. By briefly examining these differences we can gain a greater understanding of the inherently dynamic and temporal aspects of a continuous multiplicity, with which we can better critique the relations between folding in architecture and ecologically sustainable design.

Extensive and Intensive Physical Properties.

Following DeLanda (2002, p. 26-27) in his reconstruction of Deleuze's concept of multiplicity with scientific resources drawn from 'Complexity Science', we can understand extensive properties as quantitative magnitudes such as length, area, and volume, which can be defined as *intrinsically divisible*. For instance, if we divide a volume of water into two equal halves we end up with two volumes, each volume half the extent of the original volume. Intensive properties, on the other hand, are properties such as temperature, speed or pressure which cannot be divided in the same way. For example, if we take a volume of water at 90 degrees of temperature and separate it into two equal parts, we do not end up with two volumes at 45 degrees each, but with two volumes at the original temperature. However, the temperature of a volume of liquid water can indeed be "divided" by heating the container from underneath and creating a temperature difference between the top and bottom portions of the liquid. The flow of heat alters the density and in turn the viscosity of the fluid, such that their interactions move the system away from equilibrium and changes it qualitatively. If the temperature difference is made intense enough the system crosses a critical threshold and undergoes a sequence of physical changes in kind, the defining expression of a continuous multiplicity. In the terminology of complexity science, the system undergoes a cascade of *symmetry-breaking bifurcations* that changes the hydrodynamic flow pattern of the fluid from the bland steady-state of thermal conduction, to the cyclic form of thermal convection, to the "chaotic" pattern of turbulence and finally a phase transition from liquid to steam.

A difference in extension is a difference in quantity because it is a difference in degree, and therefore static. A difference in intensity on the other hand, is dynamic and temporal because it involves a sequence of events that produce a change in quality. The distinction between static, discrete multiplicities and dynamic, continuous multiplicities is also revealed in Deleuze's explication of the notion of time as *duration* as developed by Henry Bergson in *Time and Free Will* (1889) and *Creative Evolution* (1907).

Time and Duration.

According to Deleuze (1991/1966, p. 37), Bergson conceives of duration as a case of a transition that endures a change that is substance in itself. This distinction between the familiar form of "clock time" that can be divided into a series of points (seconds, minutes, hours etc.) and the continuous form of time as duration, can be examined for example in his analysis of movement in relation to the well known paradox of Zeno's arrow. According to Boundas,

It was Zeno who showed that an arrow will not fly if it has to pass first, one by one, all the discrete points at the discrete times of an extended manifold; it will not fly because movement cannot be



reconstituted on the basis of instants any more than being can be reconstituted on the basis of presents... instants, being durationless snapshots of movement, cannot be the building blocks of movement, because the latter presupposes mobile segments of duration... [it is] because a continuum cannot be reduced to a discrete manifold (to an aggregate of points) that movement cannot be reduced to that which is static. (1996, p.83).

If a sequence of events in a process has no effect on time, then time becomes merely a container for the events happening in it; it would be the denial of time as becoming, and consequently remain only a parameter unaffected by the transformation it describes. Rather, in Deleuze's words, "Time itself unfolds... instead of things unfolding within it" (Deleuze, 2004/1968, p. 111). According to DeLanda (2002, p. 102), Deleuze's duration is a concept of *virtual* time, in which the emergence of metric or extensive properties of temporality should be treated as an intensive process by which a virtual continuous multiplicity (duration) progressively differentiates into actual discontinuous spatio-temporal structures ("clock" time).

Deleuze understands duration as more than a theory of temporality; he sees it as a link to the development of an ontology of the virtual, as pure becoming without being. The concept of the virtual presents a notion of a universe in continual variation, where individual beings do exist, though not as fully formed entities but as a continuous multiplicity in which entities actualize themselves through differentiation. Deleuze's concept of the progressive differentiation of a virtual continuous multiplicity into actual discontinuous spatio-temporal structures must be understood as a strictly immanent process, the articulation of which offers an original theory of innovation. As described by Ansell-Pearson and Mullarkey,

A conception of evolution in terms of a virtual multiplicity is opposed to the idea that we are only ever dealing with an actual kind. If we approach evolution in terms of an actual or spatial multiplicity, then time becomes little more than the process of mechanically bringing about the realization of pre-existing possibilities. The notion of the virtual, then is opposed to that of possibility. An application of the notion of possibility is to be delimited to closed systems; however, in the case of an open system, such as the evolution of life, the notion of a virtual multiplicity is required... [The concept of the realization of the possible is inadequate because] it deprives evolution of any inventiveness or creativity. If the products of evolution are given in advance, in the form of pre-existent possibles, then the actual process of evolution is being treated as pure mechanism, then we are providing ourselves with a real, that is ready-made (performed) and that comes into existence through a series of limitations. In the case of the virtual, however, the situation is quite different, for here the process of differentiation does not proceed in terms of resemblance or limitation but rather in terms of divergent lines that require a process of invention. (Ansell Pearson & Mullarkey, 2001, p. 21)

Deleuze qualifies this concept by stating that "while actual forms or products can resemble each other, the movements of production do not resemble each other, nor do the products resemble the virtual that they embody. This is why actualization, differentiation, is genuine creation." (1991/1966, p. 106)



The distinction between discrete multiplicities and continuous multiplicities, between the virtual and the actual, and the theory of innovation implied by the unfolding of the actual through a progressive process divergent actualisation, has had important implications and interpretations in architecture and design. In the next section I will investigate these interpretations through the temporal design techniques of the diagram as developed in architecture, and the concept of scenario building as developed in design.

Time in Architecture and Design: Diagram and Scenario

According to Michael Speaks, Lynn's argument that "architecture must move" from which he develops his practice of "animated form" (Lynn, 1997) through the use of computer modelling and animation software, is flawed. Lynn's focus on formal complexity appears to interpret the dynamic nature of a multiplicity in terms of a spatial concept of time, not in terms of a qualitative change. Architectural form precisely does not move, though neither is it static – it endures. Instead, Speaks argues, Lynn should focus on "an animate form of practice" rather than "animate forms" (Speaks, 2001/1998, p. 583).

Animated moving forms represent duration in terms of a spatial concept of time because this understanding confuses movement with the space that movement passes over. According to Linstead and Mullarkey (2003, p. 6) "movement, like real time, is qualitative and processual," though we often try to describe movement in terms of space "this is based on an illusion that space is prior to movement, that we move in a container called space." Thus Lynn's computer animations of changing forms, once built in the actual world, lose their quality of movement and begin to endure. In order for design to engage with the qualitative change of duration, it needs to be investigated in terms of flexibility of practice rather than form. One of the design techniques developed in architecture that has attempted to engage with the continuous multiplicity of duration, has been the *diagram*.

Diagrams in Architecture

In architectural design processes, one response to the increasing complexity of the contemporary environment and the arguments of folded architectural discourses has been a renewed interest in the use of diagrams in the design process (Corbellini, 2006). The diagram is a representational technology which, according to architect and theorist Stan Allen has "capacities not only to take measure of the already existing complexity of the new urban field, but also intervene productively in the city today with proposals that are open and optimistic, devoted to affirmative change rather than commentary and critique." (2000, p. 40) The diagram has also been the focus of great attention in relation to the ongoing "crisis of representation" in architectural theory, as a technique which can operate with greater effectiveness than the perceived inadequacy of the deconstructivist approach, which Allen argues has been "to register the instability of the system through representation of instability" (2000, p. 5). Allen argues that diagrams,

propose an open-ended series of strategies to use with in the indeterminate field of the contemporary city. They propose new scenarios, provoke unanticipated combinations and allow incremental adjustment over time. They leave space for tactical improvisation of the user in the field. Whatever coherence is attained is always a provisional stabilization of the mobile forces of the city, not set down in advance, but developed in practice. (2000, 44-45)



The pragmatic capacity that Allen's description grants leads towards an understanding of the diagram as closer to a technique of strategic planning and intervention, rather than as a form representation. This alternative reading relates to the existence of two streams of research in revival of the diagram and diagrammatic thinking in architectural discourse, a view supported by DeLanda in his article in *Diagram Work* the principle publication on diagrams published in 1998, vol. 23 of *ANY: Architecture New York*. DeLanda (1998, p. 30) locates the first stream of research developing from engineering and cognitive science where diagrams have been analysed as a discipline specific form of knowledge, namely visual knowledge, which focuses on diagrams as a form of representation able to rapidly convey crucial aspects of a particular problem and in turn possible solutions. The second stream of research into diagrams, DeLanda situates within the philosophy of Deleuze and its subsequent architectural interpretations, where the diagram has no intrinsic connection with representation and is concerned with the morphogenesis of form.

Morphogenetic Diagrams

The distinction between representational and morphogenetic diagrams is related to the different concepts of innovation implied by the mechanical model of the possible/real and the creative model of the virtual/actual. Where the diagram is understood as an informational representation, such as with the much of work of Toyo Ito, MVRDV or Rem Koolhaas, where the "walls" of the built form resemble the drawn lines of the index they're based on, the operation of the diagram can be argued to be acting in terms of a more or less faithful mechanical realisation of a predetermined possible form. The situation also occurs according to Ednie-Brown (2000, p.74), where the diagram is inserted as a process between the intention to build and the built result, which though often involving impressive and whimsical computer based animations and uncontrolled variations, like Lynn's animate forms, which to some extent gives the design an experimental edge that is untamed by normative standards, in fact still fails to overcome the mechanistic model of innovation, because, by trying to suggest movement in now still form as a kind of memory or snap-shot of forces, it ironically brings about a diagramming of Bergson's concept of false or spatial time.

This criticism is maintained by Sanford Kwinter, who specifically criticises "the advent of electronic gadgetry" in architecture for being still caught in "fashionable neo-mechanisms". Kwinter argues that architects should free themselves from mechanistic paradigm "through the relentless invention of techniques whose task is to materialise the incorporeal [the virtual] by embedding everything in the flow of time" (Kwinter, 1998, p. 62). Kwinter argues that the diagram must be durational, not timeless, but acting in time and with time, and that one misunderstands the diagram when one understands it as a template rather than as a flow. Brian Massumi supports Kwinter's position that architecture plays a privileged role in bringing these processes of the diagram to the foreground not only of public and cultural appearance but also to the more subtle zone of experience. He argues that the degree that architecture fulfils this role depends on "whether something continues to spring beyond the completion of the design project and even beyond architecture's disciplinary boundaries", it depends on "how the continuity of the virtual is fed forward, across the variational doses of chaos, into the intended form; as the building settles into the fabric of everyday life" (Massumi, 1998, p. 46). The actual materiality of the built form must therefore be understood as a becoming without being, a kind of continual formation, an openness to change living on at the experiential edge of the finished form.



Massumi states that to the extent that architecture concerns itself with the “feed-forward of the virtual... it becomes an ethos: an experienced ethic of inhabiting the given” (Massumi, 1998, p. 47). In other words, according to Massumi, the virtual continues in aesthetic experience.

However, Deleuze does not restrict the virtual to experience and the anthropocentrism this can imply but as operating across the inorganic, organic and cultural domains. In fact it is in ecologically sustainable design that I argue that we can find a productive engagement with the continuous nature of duration and a version of the unfolding of virtual that is not only engaged through aesthetic experience. Through the practice of scenario planning and the investigation of techniques of dematerialisation in product-service combinations, ecologically sustainable design has developed methods for extending product life-time through the design of enduring products that are precisely designed to be embedded in the flow of time.

Product Endurance and Scenario Planning

Sustainability in design is a temporal concept that is linked to the idea of sustainable development, in which human activity is conducted in a manner so as to maintain the environment and quality of life for future generations. The concept of sustainability developed as an alternative to throwaway culture and refers to the ability of ecosystems to maintain a form of dynamic stability which enables them to continue over long period of time. Ecosystems are complex temporal structures involving processes operating simultaneously at varying temporal scales which develop resilience through using scale and time strategically. At large scale change happens slowly, and at smaller scale change happen faster. This way shocks to the system are quickly responded to at smaller scales, whereas larger scales maintain the overall continuity. Such that, as Thorp (2004, p. 220) describes, having “varying rates of change within the ecosystem help sustain it.”

The concept of diversity of time scales in the ecological model has also been interpreted in design in terms of product endurance. In response to the implication of a limited environment, the simple strategy of consuming less by extending the life span of products in order to need fewer of them seems a common sense solution. However it was soon discovered that “making a product last long” is different from “making a longer lasting product” (van Hinte, 2004, p.53).

Long lasting products are precisely not eternal products that resist time, but products that have a kind of life to them, products that can endure. In contrast with enduring products, eternal products according to Bruce Sterling, “never lose their value, are never cheap, never antique, never collectible, always the same, they are timeless and in some profound sense dead” (Sterling, 2004 p. 190).

Product durability has been investigated through a variety of different means, involving individualisation, personalisation and through the attempted development of attachment between users and products, however these strategies, though sometimes effective, have often resulted in no more than romantic clichés or gimmicks.

The design of enduring products is more closely related to flexibility to change. This has been investigated by designing products to be resilient to changes in technology and events, through the



understanding of products as assemblages of elements which can evolve at different timescales. The practice of which has been undertaken through allowing for upgradability and repair, and a move to dematerialization through the move to product-service combinations. The motives for the replacement of still functioning products are diverse, but in general it is simply related to the peoples' desire for well functioning and up-to-date products that can meet their changing needs. This implies that design for longevity requires anticipating upcoming possibilities and potential defects, through the creation of dynamic and flexible products which incorporate opportunities for variability and which are prepared for easy future upgrading and repair. The flexibility of enduring products is related to the flow of time and not the "flexibility" suggested by curved forms or computer animations. In terms of design processes, the progressive differentiation of enduring products has been developed in relation to scenario building, a form of strategic planning that can be considered in relation to the diagram.

Mapping Complexity with Scenario Planning

The techniques of scenario building or scenario planning, though unrestricted in application have been productively investigated as tools for strategic planning in ecologically sustainable design discourses, particularly in response to questions of how to facilitate the transition from the current system of production towards a sustainable system, while managing the transition such that it would not also entail a social catastrophe along the way. Manzini argues that the potential to activate this transition requires designers and business, and also ordinary people to give a "strategic orientation" to their activities, and that it will require "considerable planning skills: the ability to generate visions of a *sustainable socio-technical system*, to organise it into a coherent system of regenerative products and services or *sustainable solutions*; and to communicate these visions and systems adequately so that they are recognised and appreciated by a wide enough public to render them practicable." (Manzini, 2003, p. 51 emphasis in the original). Following Manzini, scenario building is then a design method that entails the development of a "set of visions" or maps of certain contexts in the future under certain conditions, which are employed to accommodate multiple and complex elements such that it "not only allows us to overcome the limits of intuition and more simplistic modelling, but also puts us in a better position to choose with awareness and talk our options through in a participatory planning process." (Manzini, 2003, p. 136) Manzini's characterisation of scenario building is closely related to the form of practice argued for by design theorist Michel Speaks when he states that

Scenario planning attempts to project scenarios of possible futures... in order to access and make visible virtual paths... which are constructed from analyzing the turbulent environment itself. Scenario planning is not predictive, however, not employed to reduce disorder, thus making the right path or plan obvious. Instead, scenario planning... enhances its own flexibility and adaptability to conditions over which it has no control. (Speaks, 2001, p. 586)

Scenario planning can be seen as a core activity which supports a shift in the nature of design processes from one of solving clearly defined problems, to one of skilful decision making that allows design more flexibility and adaptability to the complexity and uncertainty of future situations. This in turn implies a change towards a projective practice that also opens the possibility for a design ethics that is based on the quality of decision-making process, rather than essential laws.



Immanence and Transcendence in Design Research

The discussion of the operation of the diagram in architecture and of the scenario in design in interaction with the distinction between the realisation of a possible in representation and the actualisation of the virtual through progressive differentiation, in turn relates to the question of immanence and transcendence design processes. The isomorphism investigated here between the folded model of complexity in architectural form and the ecological model of complexity in design suggests an immanent field of design research in the form of a continuous multiplicity that allows for comparison between disparate entities without the need for a total system rather than the unification of architecture and design within a transcendent totality. Deleuze's concept of the continuous multiplicity breaks with essentialism because entities are defined by their response to events, how they are affected by active transformations, rather than on their possession to a set of static properties. A unified design theory is an essentialist combination of the many and the one, whereas a continuous theory is "an organisation belonging to the many as such, which had no need whatsoever of unity in order to form a system" (Deleuze, 2004/1968, p. 182) and which instead inhabits a space characterised by "immanence of field without transcendent unification, continuity of line without global centralisation and contiguity of parts without distinct totalization" (Deleuze, 1988/1986, p. 27).

The overwhelming proliferation of interpretations of Deleuze's concepts of the fold and the diagram in architecture in the last 30 years has produced an "overcoding" and "stratification" of his work. The interactive reflection between the diagram and scenario that I have presented here has aimed to open up a "line of flight" transversal to the two design processes in order to find potential movements of deterritorialization and project a sustainable scenario of development. This trajectory may be further investigated through Deleuze's discussion of the two tendencies suggested by the transcendental form-matter couple of the Hylomorphic schema and the immanent artisanal production of minor science in his collaborative work with Felix Guattari in *A thousand plateaus: Capitalism and schizophrenia* (1987).

"Simondon exposes the technological insufficiency of the matter-form model, in that it assumes a fixed form and a matter deemed homogenous. It is the idea of the law that assures the model's coherence, since laws are what submit matter to this or that form, and conversely, realize in matter a given property deduced from that form. But Simondon demonstrates that the *hylomorphic* model leaves many things, active and affective, by the wayside. On the one hand, to the formed and formable matter we must add an entire energetic materiality in movement, carrying *singularities* or *haeceties* that are already like implicitly forms that are topological, rather than geometrical, and that combine with processes of deformation: for example, the variable undulations and torsions of the fibres guiding the operation of splitting wood. On the other hand, to the essential properties of matter deriving from the formal essence we must add *variable intensive affects*, now resulting from the operation, now on the contrary making it possible: for example, wood that is more or less porous, more or less elastic and resistant. At any rate it is a question of surrendering to the wood, then following where it leads by connecting operations to a materiality, instead of imposing a form upon



matter: what one addresses is less a matter submitted to laws than a materiality possessing a *nomos*.”
(Deleuze, G. & Guattari, F., 1987/1980, p. 408)

References

- Allen, S. (2000). *Practice: Architecture, technique and representation*. Amsterdam: G+B Arts International.
- Ansell-Pearson, K. & Mullarkey, J. (Eds.). (2001). *Key writings/ Henri Bergson*. New York: Continuum.
- Berkel, B. van., & Bos. C. (Eds.). (1998). *Diagram Work. ANY: Architecture New York*, 23. New York, NY: Anyone Corp.
- Buchanan, R. (2000). The ecology of culture: Pluralism and circumstantial metaphysics. In E. Garver & R. Buchanan (Eds.). *Pluralism in theory and practice: Richard McKeon and American philosophy* (pp. 135-162). Nashville: Vanderbilt University Press.
- Buchanan, R. (2001). Children of the moving present: the ecology of culture and the search for causes in design. *Design issues*, 17(1), 67-84
- Boundas, Constantin V. (1996). Deleuze-Bergson: an ontology of the virtual. In P. Patton (Ed.) *Deleuze: A critical reader* (pp. 81-103), Oxford: Blackwell.
- Corbellini, G. (2006). Diagrams: Instructions for use. *Lotus International*, 127, 88-95
- DeLanda, M. (1998). Deleuze, diagrams, and the genesis of form. *Any: Architecture New York*, 23, 30-34
- DeLanda, M. (2002). *Intensive science and virtual philosophy*, London, New York: Continuum.
- Deleuze, G. (1988). *Foucault* (S. Hand, Trans.). Minneapolis, MN: University of Minnesota Press. (Original work published 1986)
- Deleuze, G. (1991). *Bergsonism*. (H. Tomlinson & B. Habberjam, Trans.). New York: Zone Books. (Original work published 1966)
- Deleuze, G. (1993). *The fold: Leibniz and the Baroque* (T. Conley, Trans.). Minneapolis, MN: University of Minnesota Press. (Original work published 1988)
- Deleuze, G. (2002). *Francis Bacon: the logic of sensation*. (D. W. Smith, Trans.) Minneapolis: University of Minnesota Press. (Original work published 1981)
- Deleuze, G. (2004). *Difference and repetition* (P. Patton, Trans.). London, New York: Continuum. (Original work published 1968)
- Deleuze, G. & Guattari, F. (1987). *A thousand plateaus: Capitalism and schizophrenia* (B. Massumi, Trans.). Minneapolis: University of Minnesota Press. (Original work published 1980)
- Ednie-Brown, P. (2000). The texture of diagrams: Reasonings on Greg Lynn and Francis bacon. *Daidalos*, 74, 74-79
- Findeli, A. (1994). Ethics, aesthetics, and design. *Design Issues*, 10(2), 49-68
- Foucault, M. (1988). L. D. Kritzman (Ed.). *Politics, philosophy, culture: Interviews and other writings, 1977-1984* (A. Sheridan et al. Trans.). New York: Routledge.
- Hays, K. M., Ingraham, C., & Kennedy, A. (1995). Computer animisms (Two designs for the Cardiff Bay opera house). *Assemblage*, 26, 8-37
- Hinte, E. van. (2004). *Eternally yours: Time in design; Product value sustenance*. Rotterdam: 010 Publishers.
- Krippendorf, K. (1995). On the essential contexts of artifacts or on the proposition that “design is making sense (of things)”. In V. Margolin, & R. Buchanan, (Eds.). *The idea of design* (156-184). Cambridge, Mass: MIT Press. (Original work published 1989)
- Kwinter, S. (1998). The genealogy of models: the hammer and the song. *Any: Architecture New York*, 23, 57-62



- Kwinter, S. (2001). *Architectures of time: Toward a theory of the event in modernist culture*. Cambridge, Mass.: MIT Press.
- Linstead, S., & Mullarkey, J. (2003). Time, creativity and culture: Introducing Bergson. *Culture and Organization*, 9(1), 3-13
- Lynn, G. (1997). *Animate form*. New York: Princeton Architectural Press.
- Lynn, G. (Ed.). (2004). *Folding in architecture* (Rev. ed.). Chichester, West Sussex; Hoboken, NJ: Wiley-Academy. (Original work published 1993).
- Madge, P. (1997). Ecological design: a new critique. *Design Issues*, 16(3), 44-55
- Manzini, E. (1995). Prometheus of the everyday: the ecology of the artificial and the designer's responsibility. In R. Buchanan and W. Margolin (Eds.). *Discovering design: Explorations in design studies* (pp. 219-243). Chicago: University of Chicago Press. (Original work published 1992)
- Manzini, E. & F. Jégou. (2003). *Sustainable everyday: Scenarios of urban life* (R. A. Coad, Trans.). Milan: Edizioni Ambiente.
- Massumi, B. (1998). The diagram as technique of existence. *Any: Architecture New York*, 23, 42-47
- Rajchman, J. (2004). Out of the Fold. In G. Lynn (Ed.). *Folding in architecture* (Rev. ed. pp. 77-79). Chichester, West Sussex; Hoboken, NJ: Wiley-Academy. (Original work published 1993).
- Speaks, M. (2001). It's Out There... The Formal Limits of the American Avant-Garde. In O. Eliasson. P. Weibel (Ed.) *Olafur Eliasson: Surroundings surrounded: Essays on space and science* (pp. 572-586). Graz, Austria: Neue Galerie am Landesmuseum Joanneum; Cambridge, MA: MIT Press, 2001. (Original work published 1998)
- Sterling, B. (2004). Untitled. In E. van Hinte. *Eternally yours: Time in design; Product value sustenance* (pp. 178-194). Rotterdam: 010 Publishers.
- Thorp, A. (2004). Time in design. In E. van Hinte. *Eternally yours: Time in design; Product value sustenance* (pp. 214-238). Rotterdam: 010 Publishers.
- Whitely, N. (1999). Utility, Design Principles and the Ethical Tradition. In J. Attfield (Ed.). *Utility reassessed: the role of ethics in the practice of design* (pp. 190-202). Manchester: Manchester University Press.