Critical Technics in Architecture: A Cybernetic Approach

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In recent years, there has been a revisiting of the twentieth-century debate surrounding the viability of planned economies and the supposed necessity of market structures, in the face of a declining neoliberal world order and the emergence of new kinds of techniques for processing information that can arguably provide an alternative to market structures. However, this is an insight that has by now informed a number of different views on alternative techno-social principles of productive coordination that are not premised on utilising price signals for resolving questions of organisation, distribution, and agency.[1] These range broadly from seemingly progressive surveillance-technocracy capitalism to especially authoritarian forms of neoliberal capitalism that can both be said to have 'broken free of the shackles of democracy' through the application of new computational technologies.[2] There is therefore a sense in which research concerning data gathering and sensing techniques is arguably tied to a tendency toward different (yet presumably equally un-equal) forms of productive, distributive and social coordination.[3] With this development comes the emerging possibility for a moment of reconfiguration that relates to how these questions are dealt with. One main issue with this observation is that the horizon of that reconfiguration is limited to a very narrow, ideologically defined window of change, dominated primarily by the notion of surveillance capitalism.[4]

Formal complexity

In keeping with this larger tendency, the field of architecture currently lies at the end of its first digital turn, in a nascent second digital turn.[5] Digital technologies have taken on an increasingly important role both as themes within design problems and within the design process itself. There is a rich (recent) history of cutting-edge computational techniques and insights applied in architectural design processes, starting from the first experiments at applying chaos theory and complexity theory by figures such as Peter Eisenman and Charles Jencks, through Christopher Alexander and Cedric Price and their early forms of patterned and generative architecture, and leading eventually to the iconic parametricism of architects such as Zaha Hadid.[6]

This tradition, although certainly more varied than presented here, seems to have concerned itself primarily with the application of the notion of complexity to aesthetic questions – what we might call formal complexity.[7] However, this application leaves something to be desired when taking an immanent view at the capabilities and fundamental functioning of technologies of computation. For this, the work of twentieth-century cybernetic theorist Stafford Beer provides an excellent jumping-off point. Beer was part of the second generation of British cybernetics.[8] His work differed from many of his more commonly referenced peers in that he placed emphasis on the relation between what amounts to an organisational system's *relative democratisation*, and its ability to function in the face of complexity.[9] As such, Beer was concerned primarily with the way in which computation enables and informs particular ways of exercising control within (and not over) complex systems. Formal complexity as an approach to computation reflects what Beer described as using a computer to do quill-pen administration: 'we insist on retaining ... those very limitations of hand, eye, and brain that the computer was invented precisely to transcend.'[10]

Rather than applying digital technology to solve problems in a similar but more expedited way compared to traditional methods, Beer argues that the logic of computation demands a reframing of how we think of problems.[11] Instead of applying computation as an administrative tool, it allows for exploring reality in a different way: through modelling, computation opens new approaches to problem-solving that allow one to interface with multi-causal, complex realities. In some sense, Beer argued for what has become known by now as a general ecological approach to computation.[12] This was a prompt to come up with a different way of using computation; that attempt led him to conclude that what is paramount for any system to be viable is that it is democratically regulated. Democratic control was for Beer the key to avoid catastrophic failure for societal institutions in the face of a changing material environment – a radical cybernetic approach to organisational strategy as an adaptation to what seemed in his eyes an inevitable collapse of the institutions of mid-twentieth-century state capitalism.[13] At the core of this approach lies a belief that practices dealing with physical assemblages – of people and material – are fundamentally concerned with 'the organisational'.

The discrepancy between this approach and the application of digital techniques in architecture as practised today might already be categorised as a general problem, purely because it can be taken to mean that the field of architecture has not yet come to grips with contemporary technological reality and the opportunities it provides for rethinking how problems are constituted in organisational terms, and, more crucially, what appropriate approaches to these problems entail. However, this general observation points towards a much deeper and consequential problem for the field, namely that through a lack of understanding of these technologies, architecture loses its capacity to mediate how they are applied within the built environment. This equates in turn with a reduction in possibilities for architects to engage critically with these developments from their own specific expertise and concerns, positioning architects as 'secondary authors'.[14] To keep up with technical development, and thus to stay relevant as architects, it is crucial that we elaborate on how architecture can critically incorporate digital technology into its activities as a field, rather than allowing the structural mechanisms that underlie much of the development of these technologies to dictate what is and what is not relevant in today's built environment.[15] This highlights the relevance of coming up with a new framework for applying computation within architectural design, attempting to go beyond the pretension of an autonomous body of knowledge centred on 'the singular building', toward an understanding of architecture as a body of knowledge that is premised around and within organisational practice.

Furthermore, in recent years several projects have emerged that explicitly intend to subsume architectural and urban design to the creation of new markets through intensive data gathering, guided by the concept of the smart city.[16] At the basis for these developments is the underlying ideological assumption that the future built environment will be privately owned and operated, including its virtual and physical infrastructure, a move toward a form of surveillance capitalism in keeping with the previously described horizon for change in economic control.[17]

The point of this article is to demonstrate that the only way to harness the emancipatory and productive potentials of computational technology in architecture is through a general socialisation of the architectural process. This would allow architects on the one hand to circumvent the commodification of architectural form and on the other to retain a distinctly architectural sphere of influence around the application of digital technologies within the built environment. More fundamentally, it could provide architects with a method to contribute to a futurity that defies contemporary capitalist realism, through an architectural form that presents itself as a form of realist intervention which can re-organise itself toward desired futurities.

Critical computation

The tendencies described in the previous paragraph call for an examination of the way in which technology is used within architecture. To that effect, this article proposes that we rethink the role of architecture in the application of technology and the role of technology in architecture. I will relate this to one set of digital technologies, which can broadly be categorised as computational design. This might be rephrased as conceptualising how computational design techniques can be used critically. The word critically is used here to refer to a capacity to generate alternatives; a critical use of technology, then, is the application of a technology in such a way as to engender alternative paths of development that are not necessarily limited to the logic of contemporary capitalism.

From this it becomes clear that it is necessary to dispense with the notion that technology is inherently geared towards certain value systems, what might be called a substantive theory of technology. Instead, using the work of Gilbert Simondon and other authors who subscribe to the same position, I argue in the first section of this article for a relational approach to technical development, one based on systems thinking and a particular strand of cybernetics. The reason for this is twofold: it is only through an open-ended conception of technical development that we can arrive at any meaningful formulation of an alternative kind of technicity, rationality, or future. Secondly, the previously described ideological premises for contemporary projects that deal with computational design, and the growing tendency to position architecture as a field for data-gathering within surveillance capitalism together present a certain urgency for architects to develop a grounded position from which to formulate an alternative application of these technologies. This is something that a substantive theory would simply not allow for. Instead of resignation, we would do well to say that architectural value 'is too valuable to be left to capital', echoing philosopher Brian Massumi.[18] As such, I posit, using the literature on cybernetics, that a further integration of sensor technology into the environment likely will not contribute to the overcoming of so-called technical alienation within the built environment. Moreover, later in this article I present the claim that generating any form of emancipatory futurity through computational technology within architecture requires a reorientation of the technicity of the built environment towards the notion of an embedded intelligence in a distinctly politicised and socialised form.

Technical development

Gilbert Simondon describes the development of technics as the shaping of a technical object towards (internal) functional demands.[19] This is referred to as a kind of self-sufficiency – the technical object 'unifies itself internally' towards being a concrete technical object.[20] This is an abstract process, where a technical object's constitutive components become more and more interoperable over the course of their development through 'concomitance and convergence' of multiple, different functions into singular multipurpose structures.[21] Technical objects, for Simondon, behave as evolutionary beings that mutate toward their own inherent fitness curve; the key difference in this regard between natural (living beings) and technical objects (artificial beings) then, is that the former already exist as concrete objects.[22] What is crucial in Simondon's terminology is that the term technical object does not refer to one specific object in space. Instead, it is a more abstract term that refers to a set, or branch, of technologies, such that one would say all attempts at building a combustion engine are part of one unitary, abstract combustion engine.

It is concretisation, for Simondon, that informs the primary path of formation that technologies take, in turn even spawning new branches for other technologies over the course of their development. Simondon's philosophy of technology allows us to think of technicity as an open-ended but structured process, bound to its own internal logic of coherence.

Locus of technical control / technical culture

But what does Simondon have to say about the external factors that constitute this process, the associated milieu of the development of a technology? Within fields of research that study the development of technology, there are several theories that seek to explain how technologies are construed; the clearest division here lies between what might be categorised as a constructivist theory of technical development and an instrumentalist theory. It is relevant to combine a reading of Simondon with the critical philosophy of technology outlined by Andrew Feenberg, particularly his concept of the 'technical code'. For Feenberg, a technology is a scene of struggle between the workers or operators of a technology, and those who manage it – both have their own connotations with a technology and its development, and thus their own requirements and demands of that technology. Feenberg, in this sense, follows Bruno Latour's formulation of a 'parliament of things'.[23] Contrary to Latour, however, Feenberg identifies that there is no levelled-off network of actors without power or hierarchy; instead, political struggle is inscribed in the way a technology manifests over its lifetime. What is stressed here is the ambivalence of technology – as a process, not a thing. Feenberg describes technology as a structure that develops over time and is influenced from myriad directions, and similarly influences the culture it is embedded in – a relational account that resembles Simondon's notion of modulation. This leads Feenberg to the conclusion that what is needed is to democratise technical development through 'a shift in the locus of technical control'.[24]

The development of technology is underwritten by the way in which it encodes a cultural configuration; Feenberg argues that it is in fact here that technology can serve to cement or lock in emancipatory views in society. After this, it becomes part of the way things nominally are – as a new kind of norm. This constitutes an affective dimension to technical development where it is the imaginaries and visions that a technology brings into the world that create meaningful contributions on a cultural level. Feenberg stresses that it is through this locking-in of imaginaries that the coherence of societal alternatives might be demonstrated and in turn made business as usual.[25] This could be rephrased in Simondonian terms as saying that what matters for Feenberg is the associated milieu that is created through technics. Invention is the process wherein the information contained in this milieu is transduced into a new technical schema – it is passed on as a form of transindividual knowledge.[26] Feenberg then, offers us through Simondon a way of conceptualising technics in a critical way: through modulation of an environment one might influence the constitution of future technics.

This is a useful way of formulating a notion of criticality considering technology as a field of political struggle; what is needed, then, is a way of orienting this modulation towards particular alternatives. What Feenberg points to is the asymmetry of the political arena within which this modulation takes place, centring the notion of a technical class struggle in line with traditional Marxian analysis. However, with his concepts Feenberg is at first glance concerned primarily with resolving the apparent contradictions between reified notions of culture and technology through his notion of a technical culture; his concept of the technical code is ostensibly cultural, a code between participants in society. However, beyond the cultural level, there are internal dynamics and logics that govern how processes unfold within the world. While there likely exist a number of these logics that do have some cultural expression or even take place on the cultural level in their totality, it seems insufficient to restrict one's analysis only to this. This means that rather than modulating the operations and structures that constitute technical objects, it is necessary to examine how one might go about modulating the logics that govern their genesis – the formulation of a metalogic.

Systems-view and futurity

Both Feenberg and Simondon describe the genesis of technology as a system in all but name, consisting of codes, rules and logics that govern the specifics of a technology's coming-into-being. One way of making this explicit is by generalising the common conception of technical development as a linear process from point A to point B, into a multi-dimensional field, where it is the logics that govern the topology of the space of possible outcomes that a particular technology might follow. As Marx and Engels posit in *Capital*, the conditions of a movement beyond capitalism 'result from the premises now in existence'.[27] When discussing these conditions in relation to technology from a Marxian standpoint, the process in which these technologies are produced and the way in which they are integrated into processes of social (re)production take on central importance.

We might interpret this in a way that lends itself to Simondonian terminology: it is only when present organisational and technical conditions reach a metastable state, one of oversaturated potentiality, that transduction into new forms of organisation can take place. A key component of the notion of transduction is that it is a transmission of information *through* material; this is the central thesis of Simondon's work on individuation against hylomorphism, and the place where his concept of modulation comes in. As such, one might more precisely state that this transduction relies on specifically material encodings of organisational forms. Philosopher Bernard Stiegler, following Simondon's work on technics and mechanology, argues that this takes place through the genesis of technical systems.[28] Through internal evolutionary tendencies, technical systems induce internal changes, which necessitate socio-technical changes on other levels of societal becoming. Stiegler notes that 'these adjustments constitute a suspension and a re-elaboration of the socio-ethnic programs or socio-political programs that form the unity of the social body'.[29] This view, which Stiegler terms *'organology'*, underscores the fundamental connections that exist between technical and social systems. As such, Stiegler's work serves to emphasise a point that is central to this article: that there exists a reciprocal relation between technical systems and social systems – both systems forming part of one another's associated milieu. Applying Stiegler's organology to Feenberg's thought points clearly towards a logic that takes place on a separate level from the cultural. In a sense, Feenberg's notion of a critical technology is a form of socially mediated but unidirectional technical genesis: effecting changes in an environment with the aim of changing future technicity. Stiegler argues that these changes in technicity have the potential to be foundational beyond the ways that Feenberg describes – implementing not just imaginaries of alternatives, but in fact generating a localised reconfiguration of the social-political domain. Beyond this, it can be argued that it is technicity itself that enables the concept of futurity.[30] It is through inscription that a reference point can be retained, without which one would be limited to experiencing a present.[31]

To Stiegler, this relies on the premise that ways of thinking are informed by technical conditions: as such, technical objects can be said to create their own subjectivity in those that are subject to their use. A psycho-social individuation takes place through technical objects, which then contributes to collective ways of thinking, thus constituting a circuit of transindividuation.[32] Following Simondon, Stiegler argues that this proceeds through the spatialisation of temporal forms of reason, which today can be said to take the shape of data-gathering through sensing technologies. However, this is primarily a one-way process as well: surveillance technologies impose a particular subjectivity, but the private ownership of these systems and, stemming from that, their black-box nature, do not allow for any reciprocal influence on the logics that govern these technical objects.[33] Where they do, this influence is mediated through an internal tendency toward technocratic barriers; a sufficient level of understanding of and engagement with ambient sensor technology is often required to even have an overview of its capacities and features, and thus, to conceptualise how it might be applied, changed, hacked or adopted. Arguably, this amounts to a cut-off of so-called smart systems from paths of individuation that take place through struggle, transindividuation or democratic control.

This line of thought is compatible with contemporary Marxian views on processes of subjectification that take place under capitalism.[34] In particular, they resonate with the notion that different technical (and thus (re)productive) conditions generate different emancipatory goals, subjects and processes, beyond an essentially monolithic, trans-historical understanding of class. In contrast to Feenberg, this is a decentring of a singular historical class struggle as the main engine of technical genesis. Instead, this view relies on the notion that what has changed fundamentally since Marx's time is that there is no longer a concept of a universal, trans-historical emancipatory subjectivity to speak of; as such, one arrives at a theoretical vantage point where different, distinctly historical subjectivities carry their own potential for an idiosyncratic emancipatory futurity. Thus, this is an argument that opens a critical capacity, as defined earlier in this article. Fundamentally, this position comes with several consequences attached. Primarily for this article, it implies an opening up of futurity – not merely beyond transhistorical notions, but in addition beyond what might be referred to as a 'residual linearity and humanism'.[35]

In summary, this section has described how technical development possesses potentials: it can occur across a multitude of paths. As such, it produces what one might term outcomes, which are contingent on material conditions within an environment which determines the limits of technical potential. In cybernetic terms, this amounts to the description of a system.

Complexity and variety

Considering technical development as a system opens a number of avenues of investigation, primarily by allowing us to specify further how that system might be influenced and to ask from which loci and through which logics this might proceed to shape technical genesis toward desired outcomes. This would result in a critical system of technics that takes on the form of a regulator, in traditional cybernetic terms.[36] To characterise this critical system I refer to Stafford Beer, who represents what Stiegler describes as the new basis of cybernetics, as opposed to the popular conception of cybernetics as a military, controlling technicity that is more commonly associated with Norbert Wiener.[37]

Beer offers us a compelling line of reasoning to reject the data-driven paradigm of digital computation that drives on a logic of representation: digital machines 'are pre-occupied with access'.[38] This is in reference to the fact that control-systems, the predecessors to contemporary digital systems, were built to generate intermittent output, in the form of printouts, during a process of computation. The result is a paradigm of computation that is charged with getting representable answers to questions, whereas the most important result of a computational system in the cybernetic view is performative. In his sociological history of British cybernetics, Andrew Pickering emphasises that cybernetics is the navigation of a field *without* a representative mapping of it, as with a steersman (*kubernetes*) navigating toward a distant light on the shore through incremental adjustments. Pickering aptly characterises the demand for overview in terms of representative models as 'an enormous detour … into and through a world of symbols'.[39] This observation can be brought back to contemporary digital practice in architecture: the dominant form of building information modelling relies entirely on the classification of designs into categories, types and elements and on symbolic representation – embraced primarily for the ability to generate intermittent printouts in the form of construction inventory and cost estimations.[40]

In contrast, Beer's position towards hylozoism and the agency of matter seems more in line with Simondon's concept of modulation; both presuppose that material itself can facilitate an operation without a subjection of matter to form, and without the imposition of an ideal, or blueprint that precedes this emergent process of *in-formation*. For Simondon, this is primarily observed within the development of technics according to its own logic, for Beer, it is organisations of people that self-organise. By looking for appropriate types of matter already in existence, one can engage in the world as it is offered, and thus engage it in a relational way.[41] Furthermore, it is for Simondon precisely this attitude of considering an object within its milieu, that opens the space of what is possible – its field of potential. Simondon develops a convincing argument for technicity that is thoroughly embedded in its associated milieu by way of concretisation. He demonstrates that it is through a synergy between a technical object and its environment that new potentialities can be rendered accessible, as with the example of the Guimbal Turbine.[42]

Ultimately, a seemingly similar line of thought leads for Beer to an ambition to formulate a paradigm of biological computation as something radically distinct from what is conventionally seen as computation, even today – as a form of computation that relies on ecological systems that are found as they are in the world.[43] He arrives at this through his concept of exceedingly complex systems, arguing that while our representational logic cannot meet the variety in these systems with adequate reciprocal variety, another naturally complex system such as the complex system of a pond might.[44] Here it is important to note that Beer inherits from his forerunner, the early cybernetician and psychiatrist Ross Ashby, the notion of regulatory variety matching system variety. This resembles a process of adaptation within a system to its milieu, much like the genesis of technology as described by Simondon.[45] Simondon has been described as a proto-cybernetician – as such there are several similarities between his work on technicity and that of later cyberneticians such as Ashby, Pask and Beer.[46]

How does this concept of variety fit in with contemporary paradigms of computational technology within the field of architecture? For some, by taking contemporary technics in the direction of 'animate knowledge', where one might argue that we have today the technical means to animate our inanimate surroundings through ambient sensor technology (by now mostly garnered under the concept of big data).[47] Through this animation some argue we can overcome technical alienation – the seemingly inherent effect by which technics mediate our access to the world as it is constructed through them.[48] This strategy amounts to matching natural variety with technical variety; it is implied that this technical variety would somehow amount to the level of variety that occurs in living systems by the choice of words. Notably, this is a move that follows the principles described so far: in animating an environment through ambient technology, a designer intervenes in the milieu of a system, changing the terms on which interaction between systems take place. Through Ashby and Beer's line of reasoning it could, however, be argued that it is precisely this impulse to seek greater and more complex technics that affects technical alienation. This is a consequence of the inadequacy of technical variety in matching living system variety (which, to Beer, stands apart as exceedingly complex). As a result of this discrepancy, reduction and normativity become necessary tools to keep the technical system viable. This amounts to an asymptotic complexification: a greater and greater animation of technical systems, that might eventually approach exceeding complexity, but for the foreseeable future remains distinctly lacking in variety.

Metastability

If one follows Beer's categorisation, the discrepancy between complexity and exceeding complexity outlined in the previous paragraph points toward a certain limit with regard to how well technical systems might interface with their environment. While I have so far highlighted a number of similarities between Simondon and Beer's work, there are also key differences that become evident particularly with this limit in mind, one of which is particularly relevant for this article: as media theorist Simon Mills argues, Beer and others working within the tradition of his Viable Systems Model (VSM) do not describe a mechanism that accounts for novelty in complex systems. By basing their model on homeostasis and ultrastability, there is little room left for a concept of invention.[49] Accordingly, this view of social organisation works only when one assumes that all interactions are probabilistic – a 'removal of the indeterminism and novelty from the domain of the social'.[50] He further argues that this amounts to a disregarding of politics in favour of technocratic logic, as politics is precisely the mechanism that resolves indeterminism in the social domain.

What Mills's critique highlights most of all with regard to the main question of this article is the importance of invention – systems that evolve through metastability rather than the more commonly described concept of equilibrium stability. In Simondon's terms: going beyond being 'enslaved by the finality of the whole' through unremitting re-organisation.[51] Another way of describing this is as self-production (autopoiesis), rather than solely self-reproduction (or self-regulation). Autopoietic systems can be categorised as systems that can re-inform their internal configurations: through metastability, these systems have the capacity to generate new states, and as such are continuously in a state of becoming, rather than being.[52] Metastability brings us back to Feenberg: his conception of a critical technology relies on a capacity for reorganisation which lies within the political. Bearing the notion of autopoiesis in mind, this can be rephrased as centring the decision-making (and thus informing) capacity of social processes: a step in the direction of a distinctly politicised cybernetic approach to technicity.

Radical cybernetics

Bringing a politicised cybernetic approach to the products and processes of architecture means doing away with architectural authorship along the way. It would entail an explicit move toward an architecture of many hands. According to Mario Carpo, this is something that is probably opposed to the professional interest of many designers.[53] Accordingly, in Feenberg's terms, this is a concrete example of the technical code in action: 'it is specifically armoured against the recognition of many participant interests' through the operational autonomy of its managers'.[54] As such, moving towards a politicised approach requires more than the intention and commitment of individual actors. It therefore points again at the necessity of encoding this move into a technical necessity (what I referred to before as a metalogic).

I have so far argued that one can characterise technical development as a system. Therefore, it is a contingent process that is embedded within an environment – most concretely in terms of the limits to potential, in terms of what is considered possible, and in terms of what is viable. Moreover, considering technics as a system means accepting that it is fundamentally political in nature – for social systems, their capacity for informing is related to the degree to which a system can resolve indeterminacy. This is in turn tied to the level of complexity that a system holds. In order to interface with the exceedingly complex, autopoietic nature of the built environment then, there is a sense in which current models of architectural practice fall short.

This becomes particularly clear when one considers the notion of failure and its relation to invention and reorganisation. Stafford Beer's original work on cybernetics hinged primarily on the notion of viable systems – autopoietic systems that can retain their functioning in light of any environmental change, and therefore necessarily have a capacity for self-reorganisation. For this, a system has to sacrifice its direct functionality in the following way: a system that is narrowly functional is limited to a very specific given set of rules; when these rules no longer manage to adequately enable the system to interface with its environment, it fails.[55] Crucially, the specificity of a system's rules constrains the complexity of the system, meaning that it cannot meet the variety of its environment. As such, the point can be made that for a system to be viable, it must have a level of plasticity; it has to be able to reorganise its governing logic in light of environmental change.[56] This is a point that Simondon elaborates on more fully: it is not just that functionality negatively impacts a system's plasticity, but more generally, that it is through a greater level of abstraction away from functional demands that a technical object is made open to multifunctionality, and thus further concretised.[57]

The conclusion of this argument is that for any meaningful concept of change, and thus futurity, to arise a system must be specifically porous in its governing logic, especially with regard to its environment. In the context of organisational systems, this interaction fundamentally relies on humans. If one intends to engender a critical form of technics there, this social basis can be taken to indicate that what is crucial for any sort of autopoiesis to arise is a direct relation between the subjects of these processes and the system that is being designed.

This reasoning can be extended by looking at contemporary literature on the research into artificial intelligence – currently, there is a growing acknowledgement of what might be referred to as embedded cognition or situatedness, and its importance in *nurturing* any intelligence toward greater levels of complexity, influencing both the dominant paradigm in artificial intelligence and, coincidentally, contemporary cognitive science.[58] What is relevant to this article is that there is a sense in which current paradigms of cognition and (artificial) intelligence recognise the importance of *material (re)organisation* in shaping systems' behaviours through the concept of autopoiesis.[59] Moreover, it has been argued that any venture into the creation and maintenance of general intelligence systems seemingly has to rely on a distribution, and thus exteriorisation, of intelligence.[60] This 'offloading of our cognitive processing into the environment' is what allows an understanding of intelligence as a distributed phenomenon – a process that takes place through a network of technical and biological individuals in the Simondonian sense.[61]

Architecture and a critical technicity

Returning to the central question of this article then, it might be argued that one way of modulating the outcomes of technical development lies with this environmental porosity and its relation to cognition as a network of technical and biological individuals. Within an architectural context it is important to emphasise that this environment consists in more than purely the physical boundaries and objects that surround an intervention; instead, the broader positioning of an object within its physical, ideological, technical and social context defines an overarching system-environment that building occupants interface with during their stay in, or use of, a building.

Crucially however, the component that takes this architectural environment beyond the traditional notion of an architectural context, as these aspects are commonly called, is its change over time. By foregoing the nature of architecture as a process that unfolds over time, I would claim that architectural practice is relieved of discussing and perhaps even conceptualising this part of an intervention. As such, one might argue that architecture lacks a form of retention that would enable the formation of a critical technicity in the built environment.

This is especially evident if one considers that the transmission of architectural design intentions relies first and foremost on static images – snapshots of an intervention's lifetime, often limited to the image of a newly built structure. One might thus posit that architecture as a discipline in its current form has no 'memory-for-time' that enables designers to grapple with these questions and to participate in the shaping of futurity when it comes to the lifetime of the building in any conscious manner.

As I have outlined in the previous sections, the notion of development *in se* is premised on change over time. For any meaningful conception of a technical development within the built environment itself, and not external to it, a centring of this understanding of architecture as a system is required, and thus, an understanding of the architectural intervention as a continuous moment – a proceeding intervention. Crucially, one can then consider the aforementioned processes of invention and individuation of technics within the architectural process. From there, if one's aim is to in-form a particular emancipatory futurity, the necessity of a relational approach is apparent: the potential for this futurity, and its proceeding invention, is – through autopoiesis – fundamentally tied to plasticity and situatedness.

If one's intention is indeed to maximise the multiplicity of emancipatory outcomes that a system can generate, then due to the nature of the process of in-formation being premised on the resolution of indeterminism, a key role in this system lies with its integration with one particular aspect of its environment, namely the biological entities that occupy it. A critical technicity within architecture then, is one that is premised on a politicised architectural process, providing the capacity for the emergence of new rules and logics that follow from reconfigurations of the *unity* that defines the total relation between building, environment and user. This is a dance of continuous reinvention on the part of both architectural intervention and occupant, a 'technicity that determines the potentials of a shared becoming' between technical and physical individuals.[62]

Notes

1. Nick Srnicek, *Platform Capitalism* (Hoboken: Wiley, 2016), 54, 55.
2. Slavoj Žižek, 'Capitalism Has Broken Free of the Shackles of Democracy', *Financial Times*, 1 February 2015.
3. Shoshana Zuboff, 'Big Other: Surveillance Capitalism and the Prospects of an Information Civilization', *Journal of Information Technology* 30, no. 1 (15 March 2015): 75–89.
4. Ibid.
5. Mario Carpo, *The Digital Turn in Architecture 1992–2012* (Hoboken: Wiley, 2013); Mario Carpo, *The Second Digital Turn: Design Beyond Intelligence* (Cambridge, MA: MIT Press, 2017).
6. Douglas Spencer, *The Architecture of Neoliberalism: How Contemporary Architecture Became an Instrument of Control and Compliance* (London: Bloomsbury, 2016); Giuseppe Rega and Valeria Settimi, 'Nonlinearity in Architecture versus Science: Borrowing the Lexicon of Complexity or Exploiting Its Powerfulness?', in *Structures and Architecture*, ed. Paulo J. S. Cruz (London: Taylor & Francis Group, 2010), 167–74; Leonard R. Bachman, 'Architecture and the Four Encounters with Complexity', *Architectural Engineering and Design Management* 4, no. 1 (6 January 2008): 15–30.
7. Rega and Settimi, 'Nonlinearity in Architecture'.
8. Andrew Pickering, *The Cybernetic Brain: Sketches of Another Future* (Chicago: University of Chicago Press, 2010).
9. Democratisation is not Beer's term as used in his technical writing – instead, Beer refers to a kind of autonomy at different levels within an organisation, so that decisions can be decentralised. This was the basis for his management theories and models, where too much hierarchy is seen as inhibitive to the self-organising capacity of a system. See: Pickering, *The Cybernetic Brain*; Thomas Swann, 'Towards an Anarchist Cybernetics: Stafford Beer, Self-Organisation and Radical Social Movements', *Ephemera* 18, no. 3 (2018): 427–56.
10. Stafford Beer, *Designing Freedom* (Hoboken: John Wiley & Sons, Ltd., 1974), 32–33.
11. The creation of complex geometric patterns and forms has been a central pursuit for many architectural

designers throughout the history of the practice, often with very successful and highly complex outcomes in terms of ornamental design. Contemporary design practice in this sense uses digital computational technology in a way that differs little from how it has used pen and paper throughout history – for drawing, geometrical construction and classical calculation.

12. See Erich Hörl, 'Introduction to General Ecology: The Ecologization of Thinking', in *General Ecology: The New Ecological Paradigm*, ed. Erich Hörl and James Burton (London: Bloomsbury Academic, 2017), 1–74.
13. Beer, *Designing Freedom*.
14. Mario Carpo, *The Alphabet and the Algorithm* (Cambridge, MA: MIT Press, 2011), 126.
15. This refers in particular to the external nature of many of these developments to architecture. While there are many architects attempting to 'design their way around' technologies that are in development, their original articulations and manifestations are presumably not elaborated by architects in most cases. This leaves any architectural application as an appropriation of existing invention, and thus risks both shoe-horning technologies into architectural practice, and unwarranted solutionism. See: Douglas Murphy, *The Architecture of Failure* (Winchester : Zero, 2012).
16. Adam Greenfield, *Against the Smart City* (London: Verso, 2013).
17. Adam Greenfield, *Radical Technologies: The Design of Everyday Life* (London: Verso, 2017); Matthew Poole and Manuel Shvartzberg, *The Politics of Parametricism: Digital Technologies in Architecture* (London: Bloomsbury, 2015).
18. Brian Massumi, *99 Theses on the Revaluation of Value: A Postcapitalist Manifesto* (Minneapolis: University of Minnesota Press, 2018), 2.
19. *Technics* refers here specifically to technique, as opposed to the more general English term *technology* which may refer to technique, technical objects and the study of technical objects. See Andrew Iliadis, 'Informational Ontology: The Meaning of Gilbert Simondon's Concept of Individuation', *Communication +1* 2, no. 1 September (2013): 1–18, https://doi.org/10.7275/R59884XW.
20. Gilbert Simondon, *On the Mode of Existence of Technical Objects*, ed. and trans. Cécile Malaspina and John Rogove (Minneapolis: Univocal Publishing, 2012), 26.
21. Iliadis, 'Informational Ontology', 15–16; Simondon, *On the Mode of Existence of Technical Objects*, 28.
22. Ibid., 51.
23. Andrew Feenberg, *Transforming Technology: A Critical Theory Revisited* (Oxford: Oxford University Press, 2002), 30.
24. Ibid., 32.
25. Feenberg, *Transforming Technology*.
26. Simondon, *On the Mode of Existence of Technical Objects*, 252.
27. Nicholas Thoburn, *Deleuze, Marx and Politics* (London: Routledge, 2003), 3.
28. Bernard Stiegler, 'General Ecology, Economy, and Organology', trans. Daniel Ross, in *General Ecology: The New Ecological Paradigm*, ed. Erich Hörl and James Burton (London: Bloomsbury Academic, 2017), 129–50.
29. Ibid., 130.
30. Stiegler's retentions. Similarly, for Feenberg, within technological historicity, this happens through the technical code.
31. Claire Colebrook, 'Futures', in *The Cambridge Companion to Literature and the Posthuman*, ed. Bruce Clarke and Manuela Rossini (Cambridge: Cambridge University Press, 2016), 196–208.
32. Stiegler, 'General Ecology, Economy, and Organology', 137.
33. Zuboff, 'Big Other'.
34. I am here refering specifically to what is commonly known as value-form theory . See Edith González, 'From Revolution to Democracy: The Loss of the Emancipatory Perspective', in *Open Marxism 4*, ed. Edith González, Ana Cecilia Dinerstein, Alfonso García Vela and John Holloway (London: Pluto Press, 2019), 155–67. https://doi.org/10.2307/j.ctvs09qng.15.
35. Colebrook, 'Futures', 13.
36. Roger C. Conant and Wilbur Ross Ashby, 'Every Good Regulator of a System Must Be a Model of That

System', *International Journal of Systems Science* 1, no. 2 (8 October 1970): 89–97.
37. Stiegler, 'General Ecology, Economy, and Organology'.
38. Pickering, *The Cybernetic Brain*, 235.
39. Ibid., 235.
40. Carpo, *The Second Digital Turn*, 5.
41. Ibid.
42. Simondon, *On the Mode of Existence of Technical Objects*, 57.
43. Pickering, *The Cybernetic Brain*, 231.
44. Variety, in cybernetic terminology, is defined as the amount of possible states or outcomes that a system has. See: Stafford Beer, 'The Will of the People', *The Journal of the Operational Research Society* 34, no. 8 (August 1983): 797; Andrew Pickering, 'The Science of the Unknowable: Stafford Beer's Cybernetic Informatics', *Kybernetes* 33, no. 3/4 (2004): 499–521.
45. W. Ross Ashby, 'Requisite Variety and Its Implications for the Control of Complex Systems', in *Facets of Systems Science* (Boston, MA: Springer US, 1991), 405–17, https://doi.org/10.1007/978-1-4899-0718-9_28; Conant and Ashby, 'Every Good Regulator'.
46. Andrew Pickering, 'Cybernetics and the Mangle: Ashby, Beer and Pask', *Social Studies of Science* 32, no. 3 (2002): 413–37; Pickering, *The Cybernetic Brain*; Andrew Feenberg, 'The Internet as Network, World, Co-Construction, and Mode of Governance', *Information Society* 35, no. 4 (8 August 2019): 229–43.
47. Neil Leach, 'Adaptation', in *Architecture and the Machinic: Experimental Encounters of Man with Architecture, Computation and Robotics*, ed. Arie Graafland and Dulmini Perera (Köthen: Hochschule Anhalt, Hochschulbibliothek, 2018), 46–59.
48. David Cunningham and Jon Goodbun, 'Marx, Architecture and Modernity', *Journal of Architecture* 11, no. 2 (2006): 169–85.
49. Simon Mills, 'Simondon and Big Data', *Platform: Journal of Media and Communication* 6 (2015): 59–72.
50. Ibid., 6.
51. Simondon, *On the Mode of Existence of Technical Objects*, 119.
52. See: Francisco Varela, Humberto Maturana and Ricardo Uribe, 'Autopoiesis: The Organization of Living Systems, Its Characterization and a Model', *BioSystems* 5, no. 4 (1974): 187–96.
53. Carpo, *The Second Digital Turn*, 143.
54. Feenberg, *Transforming Technology*, 22.
55. David Bates and Nima Bassiri, *Plasticity and Pathology: On the Formation of the Neural Subject*, (New York: Fordham University Press, 2016), 205–6.
56. Bates and Bassiri, *Plasticity and Pathology*,194–218.
57. Stavros Kousoulas, 'Shattering the Black Box: Technicities of Architectural Manipulation', *International Journal of Architectural Computing* 16, no. 4 (2018): 295–305.
58. Tom Froese, 'On the Role of AI in the Ongoing Paradigm Shift within the Cognitive Sciences', in *50 Years of Artificial Intelligence: Lecture Notes in Computer Science* vol. 4850, ed. Max Lungarella, Fumiya Iida, Josh Bongard and Rolf Pfeifer (Berlin, Heidelberg: Springer, 2007), 63–75; Randall D. Beer, 'Dynamical Systems and Embedded Cognition', in *The Cambridge Handbook of Artificial Intelligence*, ed. Keith Frankish and William M. Ramsey (Cambridge: Cambridge University Press, 2014), 128–51.
59. Ibid.
60. Benjamin Bratton, 'Outing Artificial Intelligence: Reckoning with Turing Tests', in *Alleys of Your Mind: Augmented Intelligence and Its Traumas*, ed. Matteo Pasquinelli (Lüneberg: Meson press, 2015), 69–80.
61. Beer, 'Dynamical Systems and Embedded Cognition', 131.
62. Kousoulas, 'Shattering the Black Box', 6.

Biography

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