Towards Automation: The Politics of the Discrete

‘Discrete Automation’ is a means to confront and critique existing contexts and prevailing social practices in architecture and construction around digitisation and automation in housing production, offering with it an alternative way of organising architectural production. Drawing from contemporary work on the Discrete—an architectural approach that emphasises part-to-whole relationships as described in the work of Gilles Retsin (Retsin et al, 2019) and others (Sanchez, 2017; Kohler, 2016)—and theory-led design research at XXXXXX XXXXXXXXXXX Lab (XXX) at XXX XXXXXXXX XXXXXX XX XXXXXXXXXXXX, XXXXXXXXXX XXXXXXX XXXXXX (XXX) over the last several years, Discrete Automation aims to provide an alternative framework for production that calls for a re-articulation of architecture’s ontology.

This re-articulation is from a deterministic and hierarchical ontology to one which is determined through the accumulation of relationships over time. This suggests a new understanding of the ecology between things, where the relationship between individuals, society and nature (Kohler, 2016) are not fixed. In a Discrete ecology, the meaning and value of the relationships between different agents is enabled to emerge through their appearance.

The notion of “frameworks of anticipation" is useful in relationship to the Discrete, as anticipatory frameworks aim to meaningfully engage an extended group of stakeholders, mainly the public, in production processes. The idea is that anticipatory practices act in bundles that “move between different spaces and translate expectations from the local to the global” (Alvial-Palavicino, 2016), ensuring scalability of practices. Anticipatory practices is reflected in the Discrete in the work of colleagues such as Daniel Kohler, Gilles Retsin, Emmanuelle Chiappone-Piriou, Jose Sanchez and others in a 2019 issue of *Architectural Design*. As widely articulated in this body of work, the Discrete has emerged as critique of earlier paradigms of digital architecture, as well as the mass-standardisation of the 20th century made emblematic by Le Corbusier’s Maison Dom-Ino (1914). As an approach, the Discrete “asserts that a digital form of assembly, based on [discrete] parts that are as accessible and versatile as digital data, offers the greatest promise for a complex yet scalable open-ended and distributed architecture”. (Retsin, 2019)

This paper will explore the potential of Discrete Automation to provide a ground through which to enable a discussion about what architectural production looks like when architectural production in housing is more horizontal in its ontology, and more equitable as a material hegemony. Discrete Automation will be proposed as a bridge to an alternative form of production that puts agency back into the hands of workers and inhabitants or ‘end-users’ (literally) while also providing an expanding landscape of possibilities for new forms of labour to emerge that can form alternative kinds of societies.

Discrete: Parts and Wholes

Mass standardisation in production in the twentieth century enabled faster production in the post-war environment, enabling for rapid reconstruction of a Europe in urgent need of housing stock. Today technologies of mass customisation and the notion of the ‘non-standard’ from the ‘first digital turn’ means that architects no longer have to think of space as being constructed of fixed elements or objects, (Carpo, 2012) instead end-users can embed their own agency into the way that spaces are shaped. If Discrete part-to-whole relationships are prioritized, architectural parts can be understood as particles of data, or when in a design space as voxels (three-dimensional pixels), that get imbued with information and thus with geometry and tectonics through understanding possible processes of assembly. Customisation is not in the design of architectural parts themselves but in how they are assembled. This is, as Daniel Kohler has aptly observed, the result of “a crisis of objectivity.” (Kohler, 2016) This alternative ontology suggests meaning emerges through “iterative accumulation”, seriality and “recombination [in] different conditions.” (Retsin, 2019)

The Discrete draws from work by Neil Gershenfeld and others on digital materials at the Massachusetts Institute of Technology’s Centre for Bits and Atoms, which defined a digital material as being “assembled from a discrete set of parts, reversibly joined in a discrete set of relative positions and orientations”. (Gershenfeld et al, 2015) Lego-like in their behaviour, digital materials by their very nature are able to transcend scales from the global to the local to the global due to their (geometric, tectonic, structural, material) abstraction. Discrete kits of parts enable an array of combinatorial possibilities using the same self-similar kit of parts. Through recombination, Discrete parts can perform in a multitude of ways both functionally and tectonically, sitting in contrast to the history of modular architecture models which have/had very fixed possibilities.

The Discrete enables an architecture of regenerative (eg. can be replaced, updated, recalibrated) recombination in real time according to changing needs or contextual conditions. By being embedded in cross-disciplinary discourse on digital materials, discreteness allows for a single set of building elements to be contextualised in different contexts, according to the needs of that context. Importantly this can be done without starting the entire process of design, fabrication, assembly all over again or extending the production chain as in existing models of production, as a Discrete approach has a multitude of combination possibilities built in to its very nature. The prototypical and generic nature of a discrete set of tectonic building elements enables the heterogeneity of contemporary experience to impact on and inform, the realisation of a Discrete system. Part-to-whole relationships allow the composition of architecture to be informed by the complex interaction between geometry and culture.

The Architectural Labour of the Discrete

Key to the Discrete has been the development of architectural parts which can be managed by human labour or automated labour: small enough to be made by easily accessible digital fabrication technologies, and large enough to be assembled together into buildings. The whirring of CNC machines, 3D printers, foam cutters and robots will quickly become commonplace as Moore's law continues to decrease prices and thereby increase accessibility to these technologies. Conventions for using vacuum forming (Figure 1), casting (Figure 2), foam cutting (Figure 3), sheet timber (Figure 4) and pre-cast concrete (Figure 5) all can be re-articulated through Discrete Automation to be lighter, easier to handle, reusable and recyclable.

The parts created by these forms of production infrastructure can be assembled, disassembled and reassembled, making initial capital investment in buildings have a much longer lifecycle, able to adapt and change without huge ecological implications in terms of resource waste. In this sense, Discrete Automation is not a manufacturing process that is less automated. Nor is it the full automation in the sense of the fully digitised factories of automobile manufacturers like Tesla or grocery suppliers such as Ocado that barely hang on to their demoralised workers in favour of working towards completely dark factories where no lights are needed. It is not the automation of robot bricklayers or robot bartenders. It is not the digital economy of Uber and AirBnB or the real estate charade of WeWork. It is a horizontal ecology for the production of living spaces, in which architectural labour and spatial practices can be computed, and recomputed, and computed again and again with maximum consideration of its impact on resources and labour; both nature and humans.

Figure 1, Digital assembly constructed of self-similar vacuum-formed cast concrete parts, NAME OMITTED, LAB OMITTED, 2017

The Lies They Tell

Housing is the most banal typology worldwide, an indicator of a society's wellbeing and a technological space where social practices become inscribed in its very organisation. It thereby is an important ground to

explore the context of and potential for Discrete Automation. As the neoliberal financialisation of land and property continues to threaten the world's poorest, most vulnerable and under-resourced who are being provided with inadequate housing stock, (United Nations) sociologist Saskia Sassen writes "housing has become […] a financial instrument that has lengthened the distance between itself and the underlying asset (housing) to an extreme." (Sassen, 2012) This instrumentalisation of housing as a form of power and control has become a tool to continue a process of Othering. You are house rich, I am house poor.

And yet architecture and construction industries have been complicit in these asymmetries in power and production. These industries have amplified and supported the financialisation of the housing market with difficult and precarious labour models (FLEX & Stride, 2018) and the use of practices such as speculative land banking to increase long term profits. (BBC News, 2018) Governance is also not excluded from contributing to these these practices. In the United Kingdom decades of conservatism around the governance of land and property originating with 'Right to Buy' in the Housing Act of 1980 has further supported this deregulation of housing and development. (Monbiot et al, 2019) These practices are lies told to protect long term profits and the privileged profiteering individual, with little consideration of the wellbeing of society at large.

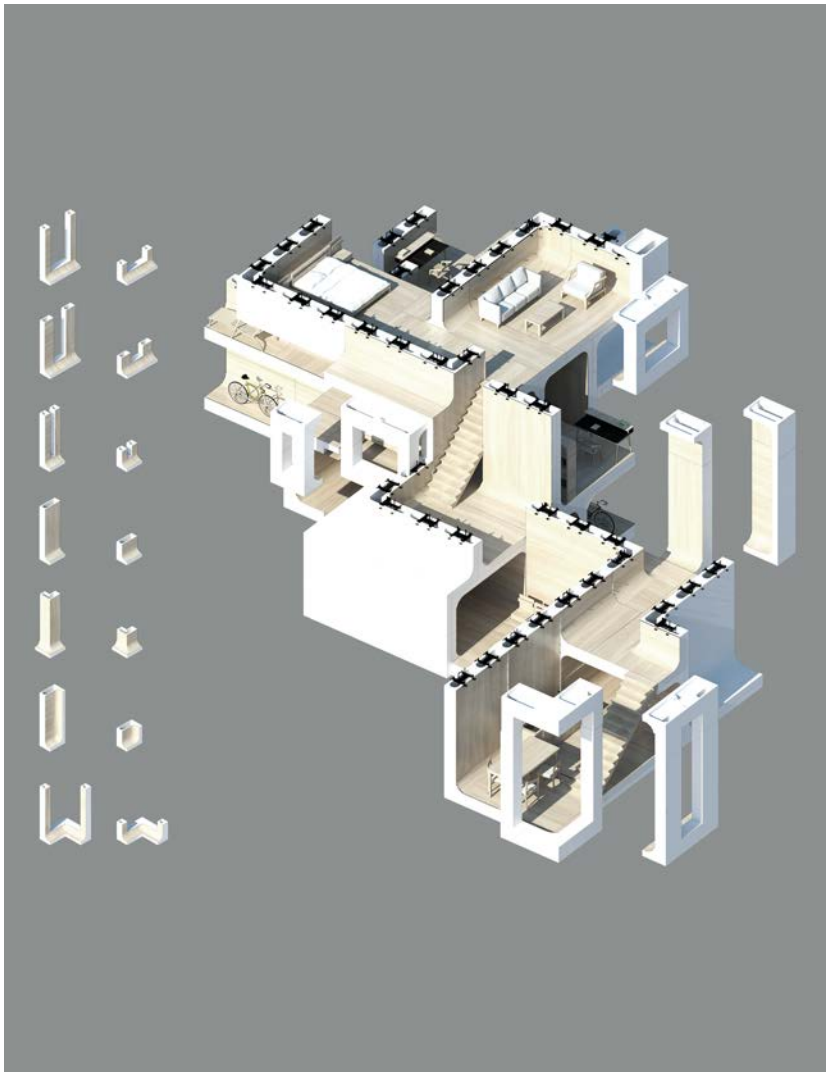

Figure 2, Spatial assembly of concrete-cast foam moulds allowing for recombination until permanent arrangement is determined by a network of stakeholders, NAME OMITTED, LAB OMITTED, 2018

On a global scale, the construction industry has been among the slowest industries to adopt digital processes and technology innovations. (Agarwal, Chandrasekaran & Sridhar) Alongside the issues of financialisation, labour and governance mentioned above, this slowness to adopt digitisation has contributed to high prices and low productivity; resulting in good quality, safe housing being inaccessible to the vast majority of people and a workforce supply in crisis. No one wants to do the dirty and dangerous work of construction unless they absolutely have to. An entire generation has been dubbed the 'Other', a generation bound to low pay, low

reward work and precarious rental contracts due to their insatiable avocado-on-toast consumption (said tongue-in-cheek), as the possibility of secure home disappears along with the Baby Boomers. Productivity levels in construction have remained the same since the mid-20th century. To break this “deadlock […] will require movement from all players.” (McKinsey Global Institute, 2017) But who will begin move first against these powerful stakeholders of the built environment?

Architects have a rich history of productive disobedience, from Le Corbusier to Antoni Gaudi to Superstudio to Assemble, but the artefacts they create do not. The building blocks that make up buildings—slabs, columns, beams, etc.—are designed, planned and put together through production processes that have not changed much since the industrial revolution. Life has transformed dramatically in the last 150 years. Yet the very matter and the way we conceive of the elements of what constitutes a building or a process of production for a building has been relatively unaffected by the overarching paradigm shift towards digitisation of the last several decades; the fixity of functional building elements remains.

Figure 3, 6-axis cut EPS foam blocks assembled into prototypical tower typology, one of several housing typologies explored for this project, NAME OMITTED, LAB OMITTED, 2017

In a capitalist mode of architectural production, buildings keep becoming ever-more complex, with huge production chains, difficult to interpret regulations and extensive layers of parts upon parts difficult to maintain or fix, but why and for who? Who benefits from this? Certainly not the people who do the physical labour to create such complex forms of construction paid by the hour or day to secure nuts and bolts, nor those who live in these spaces, unable to understand where the best place to hang a picture frame is. Buildings tell these lies to keep processes of Othering alive.

An Economy of Shared Plenty

Housing production globally cannot be disentangled from the ongoing climate crisis and the inability of governments to enact substantial and innovative policy change to prevent ecological disaster. Inaction in these arenas disproportionally benefits the wealthy whose financial gain is tied to a politics of exclusionary tactics. (Savage, 2019) This is also a moment when infinite growth as measured by gross domestic product (GDP) is no longer an adequate marker for a country's wellbeing, as infinite growth equals infinite consumption of resources. And as widely reported and confirmed by the 2018 IPCC Report, there is no such thing as infinite resources in today's ecological crisis. (IPCC, 2019)

Now being rapidly virtue-signalled by architects and architecture schools through Architect's Declare and other networks, the implication of architectural production in the climate crisis provides an opportunity, as outlined by the curators of the 2019 Oslo Triennale, to consider creating a form of architectural production that re-inscribes the role of the architect into society through the role of the architect in "proposing alternatives to the unsustainable and unfair paradigm of growth" and constructing a world in which "an economy of shared plenty" can exist. (OAT, 2109)

Discrete Automation goes a step further, indicating that the Discrete can help re-articulate the architect as a citizen rather than as a figure of moral compass as in the 20th century. The architect as citizen means the architect sits alongside the tradesperson, the single mother, the self-builder together in equity and with a collaborative spirit, a rather than standing apart in righteous virtuosity. This levelling of the role of the architect to one which sits in a more symmetrical relationship of knowledge and labour exchange.

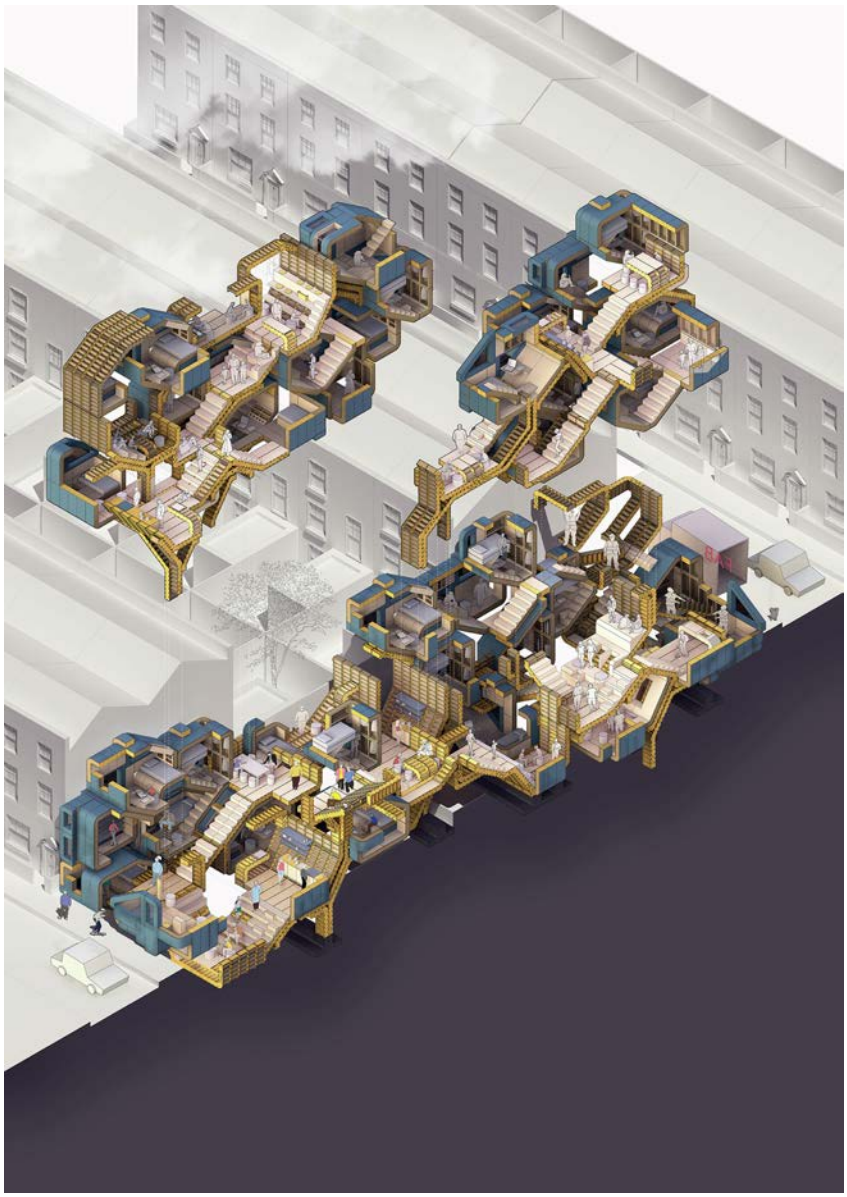

Figure 4, CNC-milled timber and cardboard discrete parts, combined to maximise privacy and shared 'living landscape', NAME OMITTED, LAB OMITTED, 2018

This sits in contrast to many mainstream stories about automation. Digitisation in other industries has provided more efficient pathways for these services and industries to reach people, quickening processing time with ever-increasing computational power, surpassing and even entirely human capacity in many forms of labour. These have proved—you guessed it!—problematic in all kinds of ways from how media companies handle data and privacy (The Guardian, 2018) to the racial bias embedded in many medial services. (Eubanks, 2018) Industries reliant on the knowledge and tradition of skills inheritance understandably is wary of automation. To avoid “automated feudalism”, (Ford, 2015) there must be a model for architectural production where skills at risk given the chance to impact on the values embedded in automation?

The work of Ruha Benjamin outlines that there is the possibility automation can enable the construction of more equitable value systems, as well as more transparent frameworks for decision-making processes. This can be easily extend to housing distribution, as an economy of shared plenty would ensure that abundance is achieved through equitable means, revising existing methodologies reliant on profit-making. Benjamin writes that this is only going to be possible if there is a greater inclusion of diversity in terms of the makeup of the data used to construct the algorithms and other tools that are used in societal reproduction (Benjamin, 2019). Diversity here can be easily extended from race to ethnicity to class to gender to skills and forms of labour. If greater diversity is embedded in housing production, from stages of design to construction to planning, there will also be need to more carefully consider how existing resources are distributed and how resource distribution impacts across communities, as the housing being produced is for the benefit of the many.

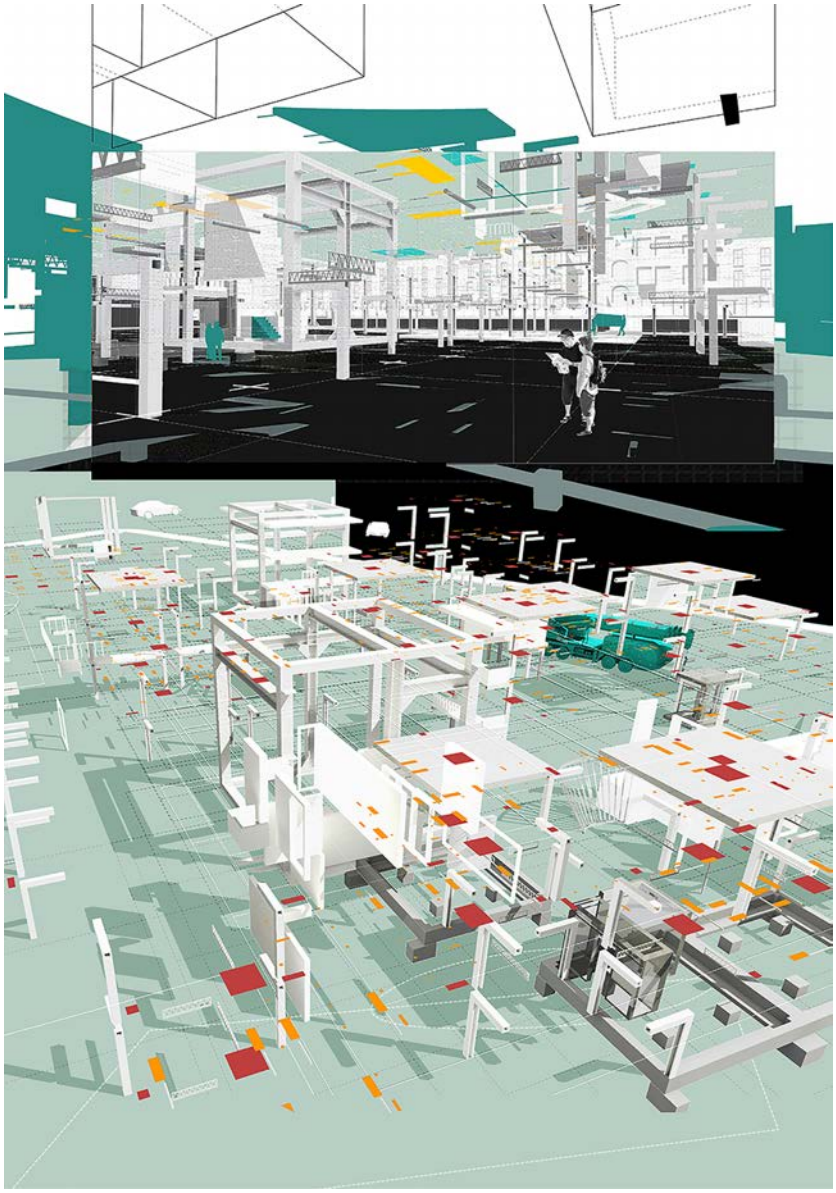

Figure 5, a pre-cast lightweight concrete panel discrete assembly using augmented reality interface for collaborative construction, NAME OMITTED, LAB OMITTED, 2017

Redistribution and Co-Creation

Discrete Automation therefore draws from knowledge that extends from architecture to radical thinking around alternative conceptions of value in the built environment and participatory design in digital innovation. It enables the questioning of existing models of authorship in design, fabrication and assembly of the built environment, by bringing the public closely together with professionals in order to innovate novel models for architectural production. When viewed as an artefact, projects that are outputs of the approach Discrete Automation become a medium of redistributing power amongst the stakeholders – public and professionals – involved in the building and assembly of constructions.

The aim is to be holistic and look at not only design concerns, but also issues in policy and the changing role of the professional, particularly in terms of industry management structures, decision-making and public engagement and the idea of co-creation of value at work. Importantly automation differentiates from other technologically engaged models for production already existing in architecture and construction, such as the fab lab model. Discrete Automation attempts to innovate on this form of production, particularly as the fab lab, as technology critic Evgeny Morozov has written, is an intrinsically neoliberal mode of production. (Morozov, 2014)

The notion of “folk politics” as defined by left-accellerationist philosophers Nick Srnicek and Alex Williams (2015) becomes useful here: the fab lab, as a decentralised mode of production, suffers from an inability to horizontally scale due to a lack of overarching coordination. Even Neil Gershenfeld, Director of the Centre of Bits and Atoms at MIT and writer of the highly influential article “How to Make Almost Anything” (2012) acknowledged the fab lab’s inability to deal with complex logistics.[1] Unless engaged with a much wider consideration of a large-scale rethinking of what the built environment is made of through a more over-arching framework like automation that considers scalability and logistics at its the forefront, the agility of the fab lab remains at risk of being a mechanism to diffuse economic and social agency in patterns of consumption. By combining the generic and open-endedness of the discrete with automation, we can begin to catalyse towards the potential obsolesce of labor, or new forms or frameworks for non-human and human labor that are aligned with other kinds of societies. This emphasises the qualitative and emergent over the quantitative and fixed. The why and for whom questions effectively come to the forefront of this discourse.

Discrete Automation is a call for architectural production methods that are socially-engaged, participatory, and equitable in their frameworks. With this approach, the dichotomy between the way things are designed and the way things are realised becomes more streamlined. The role of the architect engages more with the overarching economic and social (cultural) framework of production. The role of stakeholders in a project, particularly end-users, have the possibility to have

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agency in this framework, by engaging with the production chain and informing, and deforming, predicted or possible outcomes. This is not a new idea, having origins in the work of Walter Segal, Christopher Alexander, Cedric Price, Yona Friedman, Richard Deitrich and Jean Prouvé as well as other twentieth century architects. It is important to recall the postface to *The Second Digital Turn: Design Beyond Intelligence*, where Mario Carpo remarks:

> "Technical change does not happen in a vacuum. Inventions may be random accidents, but a new technology can only take root and thrive if many need it and use it. In this sense, as the anthropologist André Leroi-Gourhan argued a long time ago, every technology is a social construction: innovation only occurs when technical supply matches cultural demand, and when a new technology and new social practices are congruent within the same techno-social feedback loop." (Carpo, 2017)

When combined with ideas coming from open-source software and other participatory models of production, agency can be given to a wider set of project stakeholders in any project, including inhabitants who can participate in the co-production of architecture over time.

The Politics of the Discrete

Automation forces questions about how the relationships between parts are structured. As with computer code or in language, the syntax or coordination between automated processes and parts enables an understanding of the role that each part and each process plays. It provides the possibility for the logistical coordination between the Discrete parts of this ecology. And as has been pointed out, automation and technology is not just a technical problem. It is a political issue. (Benjamin, 2019; Eubanks, 2018; Frase, 2016; Winner, 1980)

Powerful political and economic frameworks have maintained the status quo of discontinuous and fragmented production, emphasising a one-off, be-spoke manufacturing process. Attempts to provide a 'universal' solution, e.g. vertically integrated factory-based construction start-ups, fail to learn from the failure of Modernist post-war housing in their sterility. They are often faced with complaints regarding quality control, homogeneity and disregard for contextualism. (Slowey, 2018) In this, the role of the architect is more and more often reduced to that of an aestheticist at the service of neoliberal modes of project development and flows of capital, with the potential to become entirely irrelevant to the production of the built environment.

The discontinuity between digital design tools and techniques and the available design fabrication and assembly methods means building realisation becomes extremely complex, inefficient and costly. (Wainwright, 2015) The processes used to realise a work of architecture is often inaccessible to non-specialists, driving inequity in how tradition and specialist knowledge is valued and suppressing the agency of the inhabitant in how buildings are designed, made and inhabited.

The automation of architectural production methods and construction techniques oft results in the development of problem-solving technologies focussed. The revivalist Taylorism of most

automated technologies brings notions of scientific quantification to automation, replacing human labor through automating manufacturing processes, reducing the risk for mistakes or failures due to human capacity or capability, eg. humans get tired! Automation can aid in reducing unknowns, providing an opportunity to understand and amplify the importance of the processes through which parts come together. As shown, Discrete parts are simple enough—almost dumb—in their geometry and tectonics. Based on the 0s and 1s of computer code, with relatively simple degrees of connectivity and recombination, Discrete parts are designed for ease of communication with automated systems, over time, responding to both to external needs or resources as well as emergent patterns within a given system. Discrete Automation enables the envisioning of a collaborative framework between analogue and automated forms of digital assembly.

Automation therefore has social consequences; it is tied inextricably to the wellbeing of those who utilise it (or are forced to utilise it, like gig economy workers) as a form of labour and those who are affected by its outcomes (whether they are aware of this or not, like social welfare recipients). It asks questions about equity, engages with frameworks for collaboration and the issue of obsolescence. And automation identifies the gaps in logic—in the way we structure and provision our societies—and forces positions on these issues. Automation is the politics of the Discrete.

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