Review Article

New Interfaces in the Automated Landscapes of Logistics

Jesse LeCavalier

As a body of knowledge and as an area of work, logistics tends toward the mechanical over the inquisitive – toward the *how* instead of the *why*. In other words, the concerns of the industry typically focus on solving a problem rather than considering whether the problem is a problem at all or, indeed, if it needs solving. Logistics is not alone in this emphasis but since it is an industry dedicated to the management of objects over distance and duration, its operations shape and reshape the built environment and are therefore particularly germane to architecture and urbanism. The transformations that logistics produces are incremental and most apparent at sites of incompatibility, be they physical, legislative, or both. For example, the misalignment of a loading dock height with a tractor-trailer opening creates a small but significant wrinkle in a process always seeking smoothness – a wrinkle that some logistics manager somewhere will try to iron out. Logistics, if we might speak of it in such a way, depends on loose structures and overlapping affinities to navigate these incompatible conditions.[1] The corresponding architectures of logistics become explicit sites for these negotiations and are designed to reduce friction and to enable the rapid distribution of material. They reflect a systems-based approach that emphasises compatibility and nimbleness and might lead us to see logistical installations less as buildings in a conventional sense and more as standardising technologies designed to project a certain version of the world.

Such standardising technologies include not just the physical spaces but also immaterial systems like data management structures. However, even if a realm like data management might be largely understood as non-physical, it nonetheless depends on a material corollary to navigate between the two realms. Much like the way the architectures of logistics can translate between different systems, the bar code functions similarly to translate physical objects into information to be managed. Both building and bar code function as 'loose couplings' to bind multiple realms together. According to Karl Weick, who developed the concept,

> if all of the elements in a large system are loosely coupled to one another, then any one element can adjust to and modify local unique contingency without affecting the whole system. These local adaptations can be swift, relatively economical and substantial.[2]

While seemingly a tool of reduction and over-specification, part of the barcode's power arises from its capacity to adapt to diverse conditions while still creating linkages among ostensibly incompatible worlds.

The barcode is just one of several coupling technologies that facilitate the internal compatibility within logistical systems. Such consistent functionality contributes to an overall internalisation that increasingly characterises logistical environments themselves (i.e. environments *of* logistics rather

than environments *for* logistics). Even if these environments are discontinuous, with multiple types and amounts distributed throughout the landscape, they remain internally consistent and connected. For example, tractor-trailers create a mobile but continuous space, a kind of attenuated continuity, by bridging between warehouses and shopping environments. When confronted with such a condition, Leigh Star's conceptual category of the 'boundary object' helps extend Weick's idea of loose coupling into a more material realm. For Star, boundary objects

> inhabit several intersecting social worlds *and* satisfy the informational requirements of each of them. Boundary objects are objects which are both plastic enough to adapt to local needs and the constraints of several parties employing them, yet robust enough to maintain a common identity across sites.[3]

These elements support multiple associations from multiple groups and are thus sources of coherence and organisation in far flung systems. With these notions in mind, this article explores the emerging landscapes of logistics to better understand how logistics shapes the built environment and to consider some of the potential entry points for design.

The persistent metaphor of flow is often conjured to describe the processes and labour that move material from one place to another. The 'space of flows' that Manuel Castells articulated for us is a important conceptual tool of course, arriving as it did during an expanding understanding of globalisation and its consequences.[4] Logistics emerged as a specialised area of knowledge during this period and is coming to characterise the operations of many of the world's largest commercial corporate actors, including companies like Amazon and Walmart. Propelled by reliable and expanding consumer appetites, the operations of these companies coalesce around logistical priorities, including increasing speed, lowering costs, and externalising their consequences for us, their customers. To do this, those involved in logistics generate both their own ways of being in the world and of knowing the world. These modes are laced with apparent contradictions that illuminate the ambiguities inherent in the industry. [Fig. 1, 2]

For the systems of elements within a logistical system, friction is a constant threat. At the same time, the qualities associated with a healthy urban structure are often the result of friction, both literally and figuratively. Those involved with logistics work to eliminate this friction through 'lubricating' efforts to loosen restrictions, overcome barriers, or to create spaces of exception. One of the key arrays of instruments in this process is familiar to architects – they are the things we call buildings. [Fig. 3]

Logistical buildings proliferate just as logistical companies seek to make the apparatus of their efforts disappear. While these distribution centres and data centres and control centres and continuity centres and risk management centres and shrinkage prevention centres supervise and control vast streams of data, all that seemingly immaterial information often remains physically connected to actual things, each with their own volume and weight and materiality. As a result, decisions made in haste or under duress at a remote workstation can have echoing consequences on the ground, wherever that might be. These could include the real estate processes that automated location software instigates or the miles-long walking circuits of distribution centre workers engaged with the stowing, picking, packing, and shipping of orders.

E-commerce fulfilment targets individual consumers yet relies on collectively funded infrastructure to deliver its orders. At the same time, institutions that were once sites of collective

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 1: When they do anything but. Image: UPS roller platform floor. Photo: Dustin Chambers.

Fig. 2: Logistics governs this movement of things through time and space. Source: Uniform Grocery Product Code Council, *UPC Symbol Specification* (Washington, DC, 1973). Courtesy of Bill Selmeier.

Fig. 3: Entire landscapes of logistics have emerged to enable the movement of things. Image: author.

Fig. 4: Fulfilment creates a wilderness of machines. Image: KIVA Robotics by DAWGHAUS Photography (https://bostonglobe.com, accessed July 30, 2018).

Fig. 5: Walmart's logistics origin story depends on architecture. Image: author.

encounter are obviated by the convenience and affordability that a company like Amazon offers.

Fulfilment isolates consuming subjects by rendering us into consumer profile categories based on broad demographic generalisations. However, rather than make space for the difficult questions posted by collective decision-making scenarios, fulfilment industries foreground the capacity for individual impulsive choice, either through an abstract notion of 'self' improvement or through the intensification of impulsive desires mutated from evolutionary survival instincts. By maintaining focus on these more individualised decision realms and by isolating consuming subjects through gestures of personalisation, fulfilment industries claim to free us from confronting either the abstract but shared responsibilities related to, for example, the 'slow violence' of global warming or the collective immediate action required by contemporary crises of government, economy, or environment.[5]

Logistics creates the problem and offers itself as the solution. Operating at the speed demanded (and promised) by companies like Amazon requires vast commitments to technology precisely to escape the physical commitments of location. Indeed, traveling light, as Zygmunt Bauman might phrase it, is not just about a nomadic lack of commitment but is a deeper organising philosophy that seeks to intensify a lack of attachment; a disencumbrance.[6] Such imperatives contribute to subtle but significant spatial and material transformations including, for example, the slow erosion of architectural boundaries.

With its acquisition of Kiva Systems in 2012, Amazon took a major step toward the eventual displacement of architecture as both human-centred discipline and as static assembly. These systems require only the most minimal of enclosures to create a stable interior climate and flat floor that allow machines to travel easily. Governed by algorithms but apparently acting with their own intentionality, the small robotic drive units (RDUs) appear quietly from the dark of the centre's depths, present their charge and then glide away, only this time to a location different from their origin.

Multiply this path, this linear gesture, this apparent behaviour, by millions. Then imagine that it never stops.

While the scripts controlling these fulfilment circuits are authored by people, the effect on the ground is inscrutable and unpredictable. The RDUs' collective activities politely tolerate the humans among them by patiently waiting for them to finish their work or by quietly waiting for them to get out of the way so that they might be able to get back to the task at hand. To witness this in action is to see a species not yet taught to fear or adapt to human presence. The robots' indifference to the organic lumps that share their space creates its own kind of wilderness, one whose logic remains unavailable to us. [Fig. 4]

The global retail corporation, Walmart, was a pioneer in developing the logistical environment. The company began as a regional discount retailer in 1962 and has since grown into the world's largest revenue generator, earning almost $486 billion in 2017. The closest global rival was China's national power company, State Grid, with $315 billion and in the US, the conglomerate holding company Berkshire Hathaway with $223 billion. While Walmart seems most concerned with Amazon's ascendance, the Seattle-based internet services and retailing company remains a distant twelfth in the ranks, pulling in just under $136 billion in FY2017. In terms of profit margin, Walmart was at 2.8 percent for 2017 and Amazon at 1.7 percent. However, while Walmart's profits shrank by 7.2 percent, Amazon's increased by almost 300 percent. Both of these companies are embedded in the social fabric of the United States and, increasingly, in the urban fabric as well. Both depend on an assumption of the

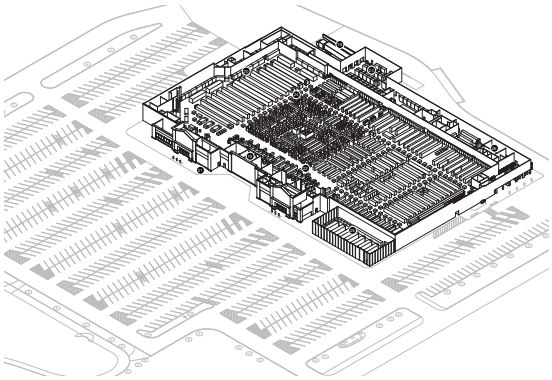

Fig. 6a

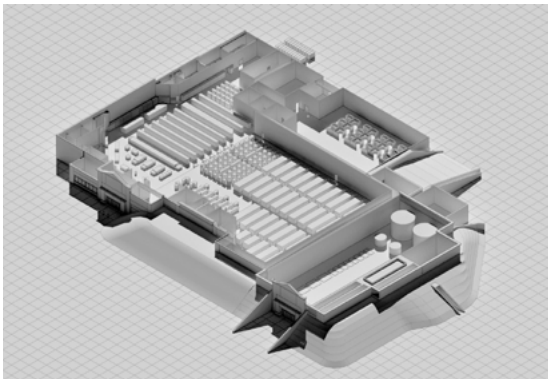

Fig. 7a

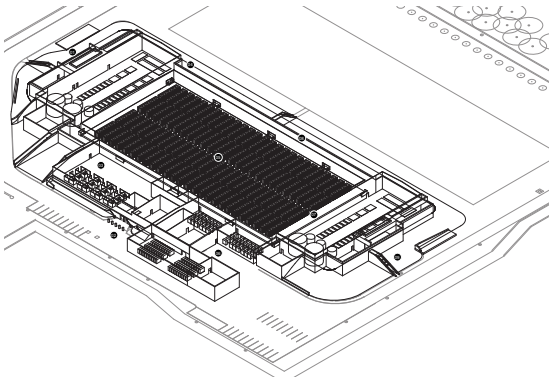

Fig. 6b

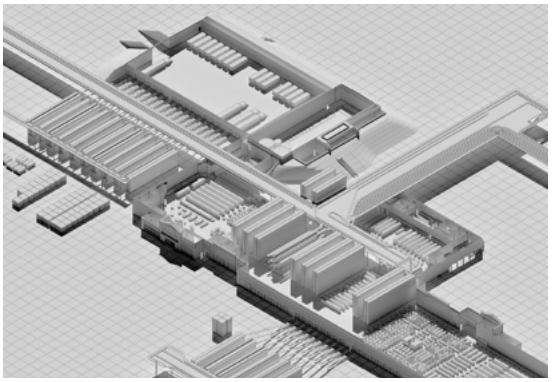

Fig. 7b

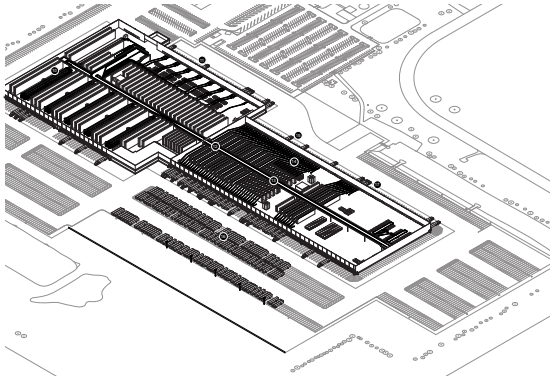

Fig. 6c

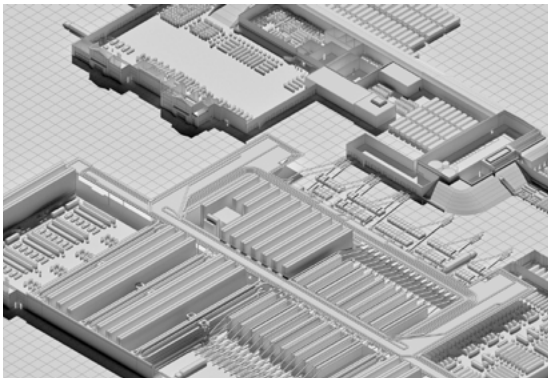

Fig. 7c

Fig. 6a: The Supercentre has content but no form. Image: author.

Fig. 6b: The Data Centre has form but no content. Image: author.

Fig. 6c. The Distribution Centre's content is the form. Image: author.

Fig. 7a: DataXpress combines multiple forms of consumption. Image: author.

Fig. 7b: ConDoIt merges passenger and inventory flow. Image: author.

Fig. 7c: Bldg2Bldg interface enables automatic materials exchange. Image: author.

stability of a consumer class that seeks to maximise utility of its spending by 'saving' money on less expensive goods. While Amazon's model demands remote storage and digital interfaces (so that it might plausibly present itself as a store that sells 'everything'), Walmart primarily presents its inventory in its collection of physical stores, nearly eleven thousand of them worldwide. [Fig. 6a]

Walmart relies on three building types: the discount retail centre, the data centre, and the distribution centre. (Figure 8a, 8b, 8c) Walmart calls its retail centres that sell dry goods and groceries 'Supercenters.' They are the most common Walmart building, with three and a half thousand in the United States alone. The company controls the interior layout of the stores so that they remain compatible within their larger logistics system. However, the building uses a buffer zone to mediate the unexpected differences of individual sites. While the interior content is rigidly determined by merchandise forecasting and replenishment protocols, the exterior form is somewhat more malleable. [Fig. 6a]

Walmart has its own data centre that it uses to store information and manage orders. The building consists of a large server warehouse whose perimeter is defined by a tall earthen embankment. While this earthwork creates a stable form, the contents of the building are constantly updated as new technologies are adopted. In this sense, the building is more of an infrastructural processing device with stable perimeter but with a fluid interior. [Fig. 6b]

Distribution centres process Walmart's inventory on its way from suppliers to retail outlets. Buildings like this one are semi-automated switching facilities that rarely contain inventory for more than twenty-four hours. Conventional architectural enclosure is the most expedient way of protecting and securing the processing machinery inside and thus the envelope adheres tightly to the contents. Thus to speak of distribution centres as buildings is to not register their embeddedness within the larger logistical landscape. [Fig. 6c]

Next to this stable collection of building types, the company continues to experiment with new formats, including convenience stores, petrol stations, and other smaller faster formats. With these experimental formats as precedents and as evidence that the retailer continues to seek out new possibilities for its collection of built elements, the following formats are speculative extensions and recombinations of the retailer's base genetic material.

Walmart's need to keep growing makes its logistical mission increasingly critical, especially as Amazon appears more and more likely to overtake the older company. To compete with the online retailer, Walmart has increased its own online presence through, among other things, the acquisition of Jet.com and Flipkart, both large e-commerce companies. These shifts point to an increased need for data management and distribution, especially in and for urban areas.

DataXpress formats provide convenient local access to cloud storage. Sharing space with a food centre, the building type maintains a low profile as it is partially embedded in the earth. Huggers and tenders are on staff to help with questions about data growth. [Fig. 7a]

At the same time, because of its actual stores, Walmart has physical distribution points throughout the country with more than half of its stores within five hundred metres of a city boundary.[7] To support increased automated mobility, ConDoIt fuses transit hub modality with distribution centre responsiveness, piggybacking outgoing transit lines to consolidate Preferred orders, helping to avoid empty back-hauls while maximising customer product exposure. [Fig. 7b]

Fig. 8: Automated reorganization of building elements produces plausible logistical configurations. Image: ‘The End of Buildings’, Jesse LeCavalier, Seoul Biennale for Architecture and Urbanism, 2017.

The automated environments of advanced distribution demand expedited exchange and delivery of material across facilities. Rather than using tractors, systems can plug directly into adjacent or related fulfilment zones, translating to less downtime, less hurry-up-and-wait, and greater throughput. [Fig. 7c]

The images included here are the results of a project that perpetually reshuffles pieces of Walmart's distribution system to examine their compatibility but also to investigate the spatial arrangements that emerge from their recombination. On one hand, the technical information and the axonometric projection provide credible alibis for apparently absurd building configurations. At the same time, the buildings are not randomly generated but rather identified from patterns that emerge from the cycling combinations of elements. In this sense, the heuristic dimension of pattern recognition introduces some level of subjectivity to an otherwise autonomous process while also simulating the growth of the logistical landscape. [Fig. 8]

Recurring combinations present evidence, not so much of a single configuration but more like a recurring probability – something that tends to 'stick' over time. These sticky patterns suggest emergent logistical environments, freed from assumptions about use, type, or even inhabitation. The logics of standardisation, which are necessary for the function of logistical systems, support this compatibility. Drawing out the absurdity in the process introduces some kind of contaminant into an increasingly sterile formula or a retardant into an increasingly accelerated process. The automatic production of new logistical forms intensifies these inherent processes to generate plausible but unstable images. By creating representations of logistical environments and by subsequently attempting to read them, we not only recognise our own general illiteracy but also see aesthetic possibilities beyond the utilitarian. The logistical 'boundary' increasingly emerges as a site of design investigation even as it becomes more self-referential. To create the frictionless conditions that logistics promises and seeks, it is possible that the contemporary 'loose' relationships of elements might very well be only an intermediate step along a path to a much more tightly organised, and therefore inaccessible, logistical world.

Notes

1. Langdon Winner addresses the challenges of reification when engaging such phenomena. He writes, 'The charge of reification, however, loses some of its impact if one considers that social science consistently reifies concepts such as "society", "family", and "bureaucracy". One is hard pressed to think how it could do otherwise. Since we cannot have all that we wish to talk about immediately present as empirical referents, we must employ symbols to represent phenomena.' Langdon Winner, *Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought* (Cambridge, MA: MIT Press, 1977), 42.
2. Karl Weick, 'Educational Organizations as Loosely Coupled Systems,' *Administrative Science Quarterly* 21, no. 1 (March 1976): 7.
3. Susan Leigh Star and James R. Griesemer, 'Institutional Ecology, "Translations" and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39,' *Social Studies of Science*, 9, no. 3 (August 1989): 393.
4. See, for example, Andrew Ballantyne and Chris L. Smith, eds., *Architecture in the Space of Flows* (London: Routledge, 2012). The volume contains a series of articles, each concerning some aspect of 'flow' in contemporary space, e.g. 'Oceanic Spaces of Flow,' 'Trade Flow: Architectures of Informal Markets,' 'Temporal Flows,' 'Navigating Flow,' etc.
5. See for example, Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge MA: Harvard University Press, 2013).
6. Zygmunt Bauman, in *Liquid Modernity*, points to 'travelling light' as an asset of power because 'holding to

the ground is not that important if the ground can be reached and abandoned at whim.' Zygmunt Bauman, *Liquid Modernity* (Cambridge: Polity Press, 2000), 13.

7. Matthew Zook and Mark Graham, 'Wal-Mart Nation: Mapping the Reach of a Retail Colossus,' in *Wal-Mart World: The World's Biggest Corporation in the Global Economy*, ed. Stanley D. Brunn, (London: Routledge, 2006), 20.

Biography

Jesse LeCavalier's work explores the architectural and urban implications of contemporary logistics. He is the author of *The Rule of Logistics: Walmart and the Architecture of Fulfillment* (University of Minnesota Press, 2016) and an associate professor of architecture at the New Jersey Institute of Technology. He is currently the Daniel Rose Visiting Assistant Professor at the Yale School of Architecture. LeCavalier was the recipient of the 2015 New Faculty Teaching Award from the Association of the Collegiate Schools of Architecture (ACSA) and the 2010–11 Sanders Fellow at the University of Michigan. His work has appeared in *Cabinet*, *Public Culture*, *Places*, *Art Papers*, and *Harvard Design Magazine*. His installation 'Architectures of Fulfillment' was part of the 2017 Seoul Biennale for Architecture and Urbanism as his project 'Shelf Life' was one of five finalists for the 2018 MoMA PS1 Young Architects Program.