# 9    Remediating infrastructure

Tokyo's commuter train network and the new autonomy

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In urban centers throughout the world the integration of computer technology into existing crucial urban infrastructures (transportation, water, power) is being welcomed by governments, city planners, and corporations alike as key to the realization of an ecologically and economically sustainable and resilient platform for future society. The urban form emerging from these projects—often glossed as the "smart city"—has for some time captured the attention of scholars in architecture and urban design, media studies, geography, and sociology. However, as the sociocultural anthropologist Brian Larkin suggests, anthropology has only just begun to explore its significance (Larkin 2013). A central challenge for anthropology, I want to suggest in this regard, is to explore the ontologies of this emerging form. What I mean by ontologies draws on an understanding of the term developed in science and technology studies as the "worlds" constituted vis-a-vis the situated and analytical practices and materialities of a given environment (Gad, Jensen, and Winthereik 2015). But it refers more specifically to the kind of thinking that is elicited within that given environment.[1] In placing an emphasis on the relation between ontology and thinking, I share an intellectual and methodological concern with geographer Nigel Thrift, who asks how the advent of smart infrastructure produces a fluid "movement-space" that lends itself to new limits and possibilities of thinking (Thrift 2004). In other words, the question is not what such spaces mean but how they compel us to think and to become. At the same time, my approach departs from Thrift's central assumption in an important way.

As with many analyses of smart infrastructure, Thrift underscores the way in which smart infrastructure transforms built environments from fixed structures into dynamic fields able to respond to changes in the environment.[2] As another thinker concerned with the dynamic quality of smart infrastructure, puts it, the analytical emphasis falls on the way in which urban space becomes "interactive" rather than "delineated" (Steiner 2011). Whereas interactive space is defined as networked and reflexive, delineated space is treated as confining, determined, static, and imposing. As such, the smart city seems in many ways to fulfill the desire of early cyberneticians for the displacement of modernity's "logic of compartmentalization" with a

(postmodern) "logic of connection" (Martin 1998). It is Gilles Deleuze who
then takes up the question of the ontological significance of this new compu-
ter driven networked world, parsing the transition in terms of a move from
institutional enclosures of disciplinary society (á la Michel Foucault) to
modulating networks of "societies of control" (Deleuze 1992).

Deleuze's argument seems wonderfully prophetic in many ways. But the
issue of control that Deleuze raises quickly leads to a dilemma, or rather
paralysis, for thinking about autonomy if we understand the term as referring
to individual independence as manifest in the ability to act free of external
influences. What Deleuze offers, it would seem in this regard, is a cynical
vision in which the moment we break free from the institutional enclosures of
disciplinary society and are on the cusp of realizing autonomy is also the
moment when we find ourselves even more deeply entrapped in a far more
nefarious system of control. Consequently, we find ourselves longing as well
for a return to disciplinary society as a time when autonomy seemed at least
more of a possibility. At least then we were able to nurse the illusion that
there was hope outside enclosure or, better yet, in revolution.

In the following argument, I want to propose that approaching enclosure
and modulation, compartmentalization and connection as entangled rather
than antithetical modalities of infrastructural control guides us to thinking
autonomy not only in different terms but also in a different conceptual regis-
ter. To do so, I turn to Tokyo's commuter train network. Beginning in the late
1990s, Tokyo's largest commuter train operator, JR East, began upgrading its
train lines with an advanced information technology system. Designated an
Autonomous Decentralized Transport Operation System (ATOS), the new
technology works to transform JR East's train network into a dynamic
decentralized smart system that optimizes the flows of trains and passengers
through the city. Yet Tokyo's century-old phenomenon of packed trains
remains the network's defining feature and a modular space par excellence. As
such, the system straddles infrastructural modalities that are typically differ-
entiated as twentieth-century mechanical and twenty-first-century informa-
tional. In situating myself between these modalities, I hope to elaborate this
different conceptual register of autonomy, or what I am calling the new
autonomy of smart systems.

## Revisiting enclosures

Nothing embodies enclosure in modern Tokyo quite like the packed commu-
ter train. Every weekday millions of commuters throughout the Greater
Metropolitan Area of Tokyo converge on the region's dense web of train sta-
tions to board trains in which they must stand compressed together so tightly
that they can barely breathe. As one commuter described it for me, "you feel
as if your organs are going to be crushed."[3] But Tokyo's commuter trains are
not simply crowded—they operate beyond capacity. On average, during the
morning rush hours train lines carry between 175 to 230 percent beyond

capacity (Mizoguchi 2007). In tangible terms, this means that a train car designed for a maximum of 162 riders will actually accommodate between 300 to 400 commuters.[4] It also means that train companies must stream one train after another to stations with an absolute minimal gap between them in order to accommodate platform crowds. A delay of any kind introduces a vicious cycle, leading to intense platform crowding and more delay, which spreads quickly throughout the network to other train lines. Insofar as trains do not remain congested throughout the day, operation beyond capacity is the central defining characteristic of train operation.

How, then, does operation beyond capacity and the packed train ask us to think about autonomy? At first glance Tokyo's packed train figures as nothing less than a literal instantiation of Max Weber's "Iron Cage" (Weber 1976). It is a spectacular expression of capitalism's rationalizing logic whereby human beings are objectified as mere cargo conveyed in accordance with capitalism's merciless imperatives of mass production. To be a commuter, according to this thinking, is to submit to mechanistic conditioning, to be "trained," as it were, to comply with the operational imperatives of the apparatus. The more rationalized the system, the more intense the training and the less leeway there is for play between its parts."[5] The end result is an increasing loss of commuter autonomy, with commuters becoming mere automatons performing as disciplined cogs in the machine. If we stick to this story, smart technology then enters the picture as effecting a paradigm shift. Specifically, its schema of decentralization, self-organization, and network flexibility are seen as liberating commuters from the rigid dictates of the machine and restoring individual autonomy.[6] Indeed, as we will see at a later point, this is one way in which the introduction of smart systems in Tokyo's commuter train network embraced.

What if there was another way to tell this story in which the move to smart infrastructure did not constitute a radical break from a rigid system to flexible network but rather a transition with continuity? How might this approach change how we think autonomy? The Japanese economist and railroad historian, Mito Yuko, offers an initial avenue toward a different approach when she explains that the system realizes its high degree of punctuality and capacity through its ability to be both precise and imprecise (Mito 2005). This quality, Mito shows, is the consequence of a social and technological evolution whose emergence can be traced back to periods when train companies faced the challenge of drastically increasing capacity without the benefit of additional infrastructure.[7] The formative period was around World War One when an economic boom spurred an increase in demand for rail transport. As one might expect, train companies devoted significant effort to rationalizing operations so as to increase the number of trains per hour and capacity per train. But rationalization is not the whole story. More importantly, train operators learned to finesse the system. That is, they realized that rather than strive for absolute precision, which would demand that commuters and train operators comply with an increasingly rigid schedule, they could surpass the

systems' threshold by increasing its resilience to imprecision. This realization took shape in an informal strategy of organized imprecision that allowed for regular divergence from the schedule (to accommodate platform crowds) followed by the quick recovery of lost time. The strategy was then refined and optimized in subsequent periods of rapid urbanization.

With the strategy of finessing the system the focus of train operators shifted from maintaining the schedule to maintaining the gap between schedule and divergence. We can see this clearly in the use of the train traffic diagram or, *ressha daiya*—hereafter just *daiya* (see Figure 9.1). As I have explained elsewhere (Fisch 2013), a train traffic diagram is a universal technology for planning and managing a train schedule. Each train line has its own *daiya*, and each line of the diagram represents a single train, with the angle of the line indicating the specified speed of the train on sections of track—the more vertical the line, the faster the speed; and the more horizontal the line, the slower the speed (Tomii 2005). Importantly, the *daiya* is composed of two parts: a planned (ideal) diagram that is developed in accordance data collected on transport demand, and an operational diagram that reflects the
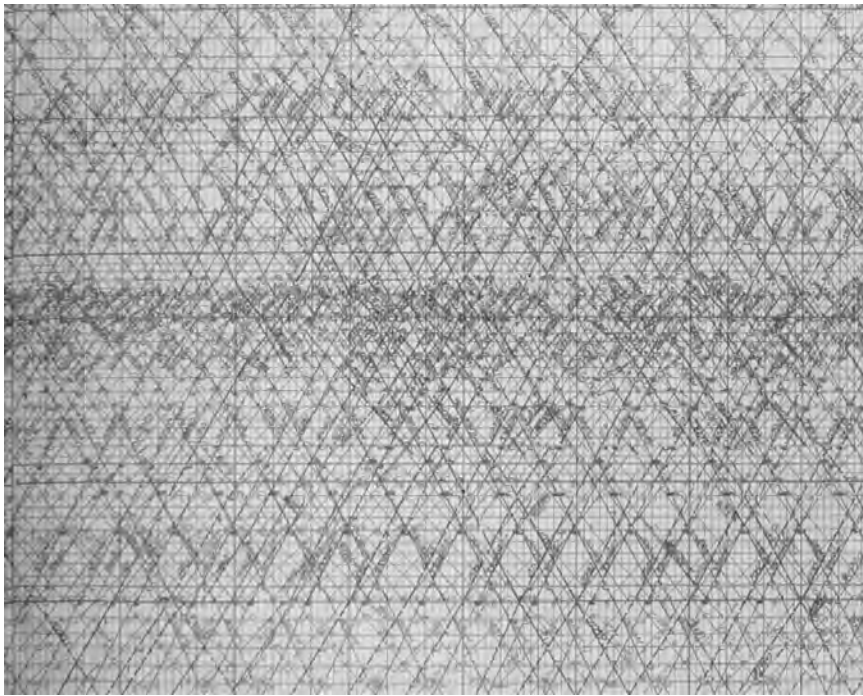


*Figure 9.1* A section from a *daiya* representing two hours of train traffic on one train line.
(Tomii 2005)

lived tempo of the network and is produced in conjunction with the system's actual performance. What railroad operators strive to maintain is the gap between these different *daiya*.

Such attention to the gap recalls what the French philosopher of techne, Gilbert Simondon, explains as the "margin of indeterminacy" of a technological ensemble. Put simply, a technical ensemble's margin of indeterminacy denotes the degree to which its functioning remains open to changes and contingencies within its environment of operation. It is the viable parameter of divergence in the pattern of interaction among heterogeneous elements constituting a machine or technological ensemble, designating a zone of undetermination that is opened in the functioning of a technology. The media theorist Adrian Mackenzie aptly paraphrases the significance of this undetermination in a work that mobilizes Simondon toward a reassessment of technology when he writes, "A fully determined mechanism would no longer be technological; it would be an inert object, or junk" (Mackenzie 2006, 53). As Mackenzie suggests, the margin of indeterminacy is what allows the technological ensemble to "suspend its final determination" such that it remains flexible to environmental changes. Moreover, the more an ensemble is able to "suspend its final determination," the more optimized it performs, allowing it, for example, to operate beyond capacity. Such thinking overturns the logic dictating that the more optimized the commuter train network performs for operation beyond capacity, the more intense its automatizing effect. Instead it suggests that the more the system operates beyond capacity, the more skill and flexibility is elicited from commuters in accommodating the intensification of intensities within the packed train—the extreme pressure of compressed bodies in various stages of fatigue, decay, health, and sickness, the utter silence, the mix of noxious odors from half-digested breakfasts, the smell of stale coffee and cigarette smoke, and the flowery fragrance of shampoos and body soaps.

Importantly, Simondon's conceptualization of the margin of indeterminacy takes us beyond a mere discussion of machine functionality. It presents a philosophical intervention into questions of human autonomy, particularly in regard to the relationship between humans and machines. Specifically, the margin of indeterminacy is the space in which human beings and technical ensembles interact and in-form each other, which is to say human and machine ensemble emerge through a process of co-production whereby the form that each takes is a product of the interaction between the disparate human and machine materialities.[8] Accordingly, the margin of indeterminacy constitutes a space of collective, where "collective" is understood in heteropoietic terms as encompassing the agentive work of both human and machine. The critical corollary here is one that Bruno Latour has worked hard to show us throughout his work, which is that there is no autonomy that precedes collective just as there is no human that precedes a relation with the non-human.[9] But such apparent irreverence for the purity of a human autonomy is of course just a radicalization of Emmanuel Kant's insistence of

the indivisibility of the public and the private or the tenet espoused by such foundational thinkers of anthropology as Emile Durkheim and Marcel Mauss that there is no individual without the social.

In sum, in contrast to the vision I offered earlier of the packed train as an objectifying medium that turns commuters into automatons, thinking from gap urges us to understand that to commute is never simply to submit to a determined technological order. Instead, it involves an active dialogue between commuter and technological apparatus in which commuters remain aggressively attuned to the system's modulating ambience, even if at an unconscious embodied level. At the same time, as the operational *daiya* suggests, the technological apparatus never simply operates according to a given pattern. It must be constantly reconfigured in relation to the shifting pattern of commuter behavior. It is into this configuration of relations that ATOS is introduced as a means of bringing autonomy, not just agency, to the machine ensemble.

## Distributed autonomy

JR East began research and development for its new Autonomous Decentralized Transport Operation Control System (a.k.a. ATOS) soon after the company was formed in 1987 from the privatization and breakup of the once massive national railroad company, Japanese National Railways. The technology was introduced initially in December 1996 on Tokyo's Chūō Line (the most crowded and traffic congested train lines). Since then JR East has deployed ATOS throughout its entire Kanto commuter network. The Tokyo Metro System also began adopting ATOS in the mid 2000s. In general, ATOS replaces a Centralized Traffic Control (CTC) system that was introduced widely in Japan beginning in the late 1950s and is still the main traffic control technology used by many train companies.[10] As with the centralized system, ATOS is concerned with managing the gap between the planned and operational *daiya* in accordance with the stress of operation beyond capacity. How it does that and the results, however, are very different.

Under the centralized system, the gap is administered top-down according to a conventional command and control paradigm whereby a human controller located in a Central Command Center monitors the progress of traffic on a large schematic of the system and issues orders to trains and stations. Insofar as the centralized system was adequate to a certain degree, it was also vulnerable to collapse as a result of sudden surges in commuter demand, which would overwhelm the controller's ability to maintain the gap between the *daiya*. ATOS resolves this vulnerability to a great extent through an engineering principle of Autonomous Decentralized Systems (ADS) called "distributed autonomy" (*jiritsu bunsan*) in which "the functional order of the entire system is generated by the cooperative interactions among its sub-systems, each of which has the autonomy to control a part of the system" (Ito 1993, 130). Practically speaking, this means that computers in each station

manage the flow of traffic in their vicinity. Each station's system then produces an operational *daiya* that it shares with surrounding stations in an information pool called the "data field." See Figure 9.2.

In distributing command and control, distributed autonomy disperses the system's center of gravity away from central command center and into its shared space of communication (the data field), thus increasing system resilience.

In other places I have traced the emergence of the principle of distributed autonomy as a response to the specific problem of how to treat irregularity as part of the regular operational order of complex urban infrastructure (Fisch 2013). My argument showed how the conceptual innovation for the principle derived from thinking the body and immune system of complex living organisms as decentralized systems whose capacity for self-organization allow for enfolding irregularity into a generative metastable order. My concern in that discussion was with how the principle of distributed autonomy realized through ATOS remediates the disorder produced by commuter train suicides and how it then asks us (and commuters) to think the body on the tracks. By contrast, I want to focus here on how distributed autonomy urges us to think autonomy. In so doing, I turn briefly to the concept itself before exploring its ontological ramifications.
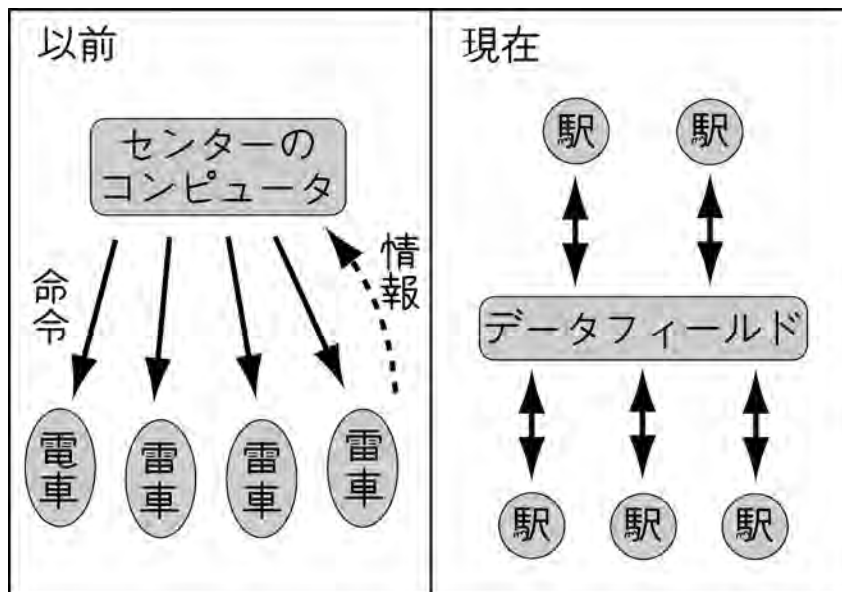


*Figure 9.2* Diagram comparing the former centralized system (left) with the contemporary decentralized system (right). The diagram of the centralized system specifies commands flowing unidirectionally from a central computer with a dotted line and arrow indicating tentative information feedback. The diagram of the decentralized shows information flowing bidirectionally between stations mediated by the data field.
(Yamamoto 2003)

## Self-control versus control of oneself

"Distributed autonomy" is a complicated term in Japanese, in part because autonomy, *jiritsu,* can be written using two different character combinations. Each of these combinations refers to a different notion of autonomy. One way combines the characters for "oneself" (*ji*) and "stand" (*ritstu, tatsu*) to mean "independence." Another combination uses the character for "oneself" (*ji*) with the character for "rhythm, law, regulation, control" to mean something like "self-control." As such, this second combination aligns with the philoso-phical and anthropological notion of autonomy noted earlier that underscores the self as not only always embedded in but also subsequent to a relational framework involving other actors and forces. Autonomy, in this sense, is about a relational dependence, not independence. Accordingly, "self-control" is not the capacity to act on one's own. It is the capacity, rather, to act through interaction—through communication and in moderation and accor-dance with others who constitute the field of one's possibility for action.

The different character combinations make the term prone to typographical error when composing on a computer. I was reminded of this when I mis-takenly used the combination for "independence" when first corresponding via email with Mori Kinji, the Japanese information scientist and engineer who developed the distributed autonomy system. Mori was quick to correct my error. But as it turned out, my mistake was more enlightening than embarrassing as it brought to my attention contrasting conceptualizations of autonomy that have been set in motion with the introduction of the ATOS network. Specifically, there is on the one hand a notion of autonomy that fetishizes individualism and needs to disavow its collective origin in the packed train. And on the other hand there is a notion of autonomy that maintains the enclosure of the packed train as its condition of possibility. This latter notion of autonomy corresponds with the idea of self-control. What is truly innovative about it is that it affords the technological apparatus not just agency but autonomy; it becomes capable of self-control, which is to say interacting through communication and in moderation and accordance with other "autonomous" components of the system, including commuters. Before I look at this instantiation of autonomy as self-control, I turn briefly to the articulation of autonomy as independence.

## From commuter to consumer/individual

Over the course of the last decade JR East has been busy rebuilding and remodeling its network of train stations throughout the Greater Metropolitan Area of Tokyo. As a result of this work, the spaces and passageways between ticket gates and platforms have been transformed from zones of optimized commuter flow into frictionless spaces of festive consumption replete with a wide variety of bakeries, bookstores, cafes, clothing stores, and delicatessens. The impetus behind this immense project is a perceived immediate need to

refashion the commuter network into an environment adequate to Japan's twenty-first information (Egami 2003) and commensurate with an autonomous decentralized transportation infrastructure able "to satisfy the variable demands of each passenger … [and] offer the variable kinds and the variable quantity of transportation, as there are various passengers' needs" (Kawakami 1993). The notion of autonomy that this environment invokes is not the self-control of distributed autonomy but rather a bare-boned and philosophically impoverished understanding of autonomy as owned and absolute in which the commuter figures as consumer/individual—not worker or student— with specific lifestyle needs and tastes. Such a conceptualization of autonomy seeks nothing less than to extract the mass from mass transportation as it transforms the commuter train network into a system responsive to the spontaneous consumer whims of each commuter.

Key to enabling this realization of autonomy is an autonomous decentralized system integrated with ATOS called the "Super Urban Intelligent Card," otherwise known as SUICA. The technology replaces the conventional paper train ticket and commuter pass with an integrated circuit chip embedded in a SUICA card, credit card, or Smartphone. SUICA also serves as a type of electronic wallet that can be used for purchases inside the system and increasingly throughout the city. SUICA relieves one of the burden of purchasing a ticket with the appropriate fare for a desired destination. One simply enters and exits the system wherever one pleases with the wave of the SUICA-enabled device or card over a sensor on the electronic wicket, leaving the complex fare calculation to a distributed network of computers. On a basic level SUICA is about convenience. But on another level it is about the promises of a frictionless space in which no course need be determined at the outset so at to leave one open to the seemingly endless possibilities of the city and its limitless points of consumption. Nothing conveys this better than the television and train commercials for SUICA that debuted early in the rollout of the new system.[11] The commercials follow the daily adventures of an attractive and fashionably dressed woman in her mid-twenties and her cute penguin companion. The penguin is the official SUICA mascot, chosen for the metaphoric correspondence between its ability to swim smoothly (*sui sui*) and SUICA's promise of frictionless mobility through urban system space. The penguin is presumably the woman's sole companion. The two live together and enjoy a seemingly carefree life of fun and adventure in and around Tokyo's commuter train network. We see them in various commercials riding the train together, taking walks in quaint neighborhoods, shopping for quirky items, sightseeing in rural locals, and so on. Each outing involves some kind of purchase, which the young woman handles the effortlessly with a touch of her SUICA card at a sensor. The commercials always end with the woman declaring, "I live with SUICA," (*watashi wa suica to kurashite imasu*). The phrase carries plain double meaning, referring to the fact that the woman actually lives with SUICA the penguin mascot, and that SUICA provides the means for her to pursue her carefree, self-satisfying lifestyle. As such, the

commercials promote an image of the commuter train network as a medium
for the realization of one's customized lifestyle through frictionless mobility,
spontaneity, and impulse consumption. Conspicuously absent in these scenes
is any reference to commuting, namely packed commuter trains and crowded
stations. The emphasis falls instead on the systems as a medium of leisure,
play, and adventure while the reality of operation beyond capacity is expelled.

## A new autonomy

What if distributed autonomy had nothing to do with the emancipation of the
commuter as individual? What if it were only the persistence of human con-
ceit exacerbated by the tactical and affective elicitations of consumer capital-
ism that leads us to believe every technological development should translate
into some kind of net material and or emotional gain for humans as indivi-
duals? What if distributed autonomy was instead about an emerging machine
autonomy? Indeed, is this not what the term actual implies? In realizing a
technological system with a level of self-control commensurate with the
working of the body, distributed autonomy allows the technological apparatus
to act autonomously. This is not to say that machines become individuals like
human individuals, as this would simply be an inversion of the individualistic
interpretation of autonomy discussed above. Rather, machines realize a cer-
tain "autonomy of will" (as Kant would say) in their capacity for self-con-
trol—to act through interaction, through communication and in moderation
and accordance with a field of autonomous actors. In transforming the
agency of the technological apparatus into autonomy, distributed autonomy
gives the technological apparatus a capacity to act in relation *with* commu-
ters. As such, it takes us beyond what Andrew Pickering calls the "dance of
agency" marked by a "dialectic of resistance and accommodation" with the
technological apparatus in that the machine becomes an attuned and willful
(not just a reactive) partner (Pickering 1995). Just as commuters engage in a
dialogue with the system whereby they cultivate a heightened attentiveness to
the system's modulating ambience, under distributed autonomy the system
returns this attentive engagement.

How might we understand such machine autonomy in more tangible
terms? The information science scholar, Yamamoto Masahito offers some
insight into its quality when he explains ATOS' capacity to handle sudden
surges in commuter demand via an analogy that compares the old centralized
train traffic system to a conventional sit-down sushi restaurant and ATOS to
a "conveyor belt sushi restaurant" (*kaiten zushi*). He writes:

> In a conveyor belt sushi restaurant the sushi chefs prepare the sushi and
> place it on the conveyor belt, from which customers choose the pieces
> they want to eat. The sushi chefs thus do not take orders from each cus-
> tomer and the customers do not place orders. Rather, the sushi chefs
> determine what kind of sushi to prepare by looking at the conveyor belt

and seeing what is being eaten. The conveyor belt is analogous with the system's data field. Because the conveyor belt (data field) is a place where the customer and sushi chef (subsystem) can share information, it makes cooperative data processing possible … . In this sense, we can think of the old centralized system as a conventional sushi restaurant in which the chefs start preparing sushi only after they have received the orders from the customers. That is to say, the customers compel (*kyoseiteki ni*) the sushi chefs to work. With this system, if many orders come in at once the sushi chefs become overwhelmed and the system encounters delays. But in the instance of the *kaiten zushi* paradigm, because the sushi chefs make the sushi according to their own will (*ishi*), there is no peak and they can continue to make sushi (Yamamoto).

The conveyor belt, in this analogy is the ATOS data field, while the sushi chefs are the system. We can think of the customers as either train stations or actual commuters since the sudden surge of demand for trains at stations corresponds with the flow of commuters into train stations. Although the analogy is far from perfect, it distills the novel quality of distributed autonomy as endowing the apparatus with the capacity to participate in the shared space of interaction with other actors in the field of operation. What is important to emphasize is first that the problem of packed trains (operation beyond capacity) is at the center of this analogy as the problematic that autonomy as self-control handles, not that which it expels. Second, there is no spoken communication between the sushi chefs and the customers. Rather, interaction takes place through the deep attentiveness of all actors to the condition of the conveyor belt, which is the shared space of interaction (the data field). Moreover, the sushi chefs (i.e. the technological apparatus) participate in this shared space of interaction according to their own "will," their own judgment, not simply as a reactive force. As cumbersome as this analogy may be, it gets to the core of the way in which distributed autonomy elicits thinking the technological apparatus on the threshold of a kind of sentience. This is not about machines on the path to taking over the world as imagined in many dystopic science fictions. Indeed, distributed autonomy does not render human train drivers and platform attendants obsolete. Rather, those human actors now operate *with* the machine as partners in a novel hetero-poietic matrix.

## Conclusion

Are commuters aware of their relation with this new autonomy? I have found that most are surprised to hear about the distributed autonomy of Tokyo's commuter train network. The noise of media promoting the system as a novel means of individual consumption seems to drown out alternative ontologies. And yet commuters who remember the pre-ATOS days do sense that the system has become a more social partner. Yamamoto conveys such

sentiments when he recalls how in instances of disorder prior to ATOS commuters were informed merely that rescheduling was in process (*chōsei chū*) whereas now they receive detailed information of changes underway (Yamamoto 2003). What commuters perhaps do not recognize is that this deepened sense of dialogue reflects the degree to which they have been enfolded into the constitutive space of the heteropoietic matrix and given the possibility of realizing their distributed autonomy.

## Notes

1　In specifying the character of practical ontology Gad et al. (Gad, Jensen, and Winthereik 2015) emphasize its departure from epistemological style of ethnographic engagement that aims to represent the discrete worlds constituted through different cultural practices. Practical ontology shifts the emphasis from a representational to performative mode of engagement whereby the ethnographer is enfolded into the generative processes—not structures—of contextualized practices and materialities.

2　See for example the essays in the edited volume, (Shepard 2011) as well as the work by one of the central advocates of smart infrastructure, William J. Mitchell (Mitchell 1995, Mitchell 2003).

3　Ethnographic field notes, April 2, 2006.

4　This example is drawn from Tokyo's Chūō Line.

5　See Wolfgang Schivelbusch's explication of the significance of "play" in Franz Reuleaux's theory of machine development (Schivelbusch 1986, 19).

6　My argument here extrapolates celebratory approaches to smart technology as developed by such thinkers as William J. Mitchell. See (Mitchell 1995, Mitchell 2003). But we could also include here Michael Hardt and Antonio Negri's argument in *Multitude: War and Democracy in the Age of Empire* (Hardt and Negri 2004).

7　New rolling stock was extremely limited since Japan had not yet developed a robust manufacturing industry of its own at the time and imports from the United States and Europe were curtailed by the international conflict. See (Mito 2005, 76–78).

8　Mackenzie highlights this aspect of Simondon's theory in his explication of information in Simondon as that which in parts form or "in-forms" the machine (Mackenzie 2006, 26).

9　This is a theme that traverses much of Latour's work. See Latour 1993, 2005.

10　I qualify this, "in general" since some of the less congested train lines had not been converted to full CTC control by the time ATOS was introduced.

11　Train commercials are soundless commercials that play on screens within commuter trains.

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