AI AND ROBOTICS FOR THE CITY

Imagining and Transforming Social Infrastructure in San Francisco, Yokohama, and Lviv

Margarita Boenig-Liptsin
Research Fellow, Program on Science, Technology and Society,
Harvard Kennedy School

This article looks at how existing and planned AI and robotics projects in three cities – San Francisco (United States), Yokohama (Japan), and Lviv (Ukraine) – aim to extend or build social infrastructure to achieve a particular desired vision of city life. The author has chosen contrasting cases both to highlight how particular cultures' ways of thinking of the human-machine relationship matters for the kind of AI and robotics are envisioned and developed as well as to surface the core characteristics of AI and robotics-supported social infrastructure that transcend cultural, economic, and civic histories. San Francisco houses many of the entrepreneurs, software engineers, and multinationals that create AI and robotics in various markets, including applications for cities. Its proximity and relationship to Silicon Valley provides a "close to home" perspective of AI city imaginaries. Yokohama was selected as Japan's "Future City" and offers a perspective of government-named and-organized experimentation in the realm of AI and robotics to achieve the so-called "Society 5.0". Lviv provides a nearly opposite (to Yokohama) example in that the city is in its infancy envisioning how AI may transform its future, and grassroots organization drives the current projects.

Margarita Boenig-Liptsin is a Research Associate with the Program on Science, Technology, and Society (STS) at the Harvard Kennedy School of Government. She has a PhD in History of Science (Harvard) and Philosophy (Sorbonne) and her research focuses on understanding the constitution of the human in the global information age. Boenig-Liptsin lives in the San Francisco Bay Area where she works with universities, local communities, and technology industry to apply STS insights to build more just, convivial and democratic societies.

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INTRODUCTION

Efforts by cities around the world to engage artificial intelligence (AI) and robotics for their betterment aim generally to support or extend the "social infrastructure" of the city. Ideas about how the life of each city's resident ought to be constituted, supported, and improved through AI and robotics technologies guide these activities. At the same time, the new visions of AI-and robotics-enhanced cities expose changing social values and norms that we must examine to understand how their enactment may affect urban life.

The meaning of "social infrastructure" can be categorized in three iterations. Traditionally, social infrastructure referred to the subset of infrastructure assets that accommodate social services, for example: medical facilities, schools, community and sport facilities, local government facilities, water treatment, bus stations, parks, prisons and court houses. The term itself is curious because it applies "social," a term we usually associate with human interaction, to infrastructure, which is about physical organization as a means to provide a service. Thus, the services provided by social infrastructure (clean water, education, correction) in this original meaning of the word can be seen as material and institutional supports for a particular way of life. As social media companies became popular, the term "social infrastructure" took on a second and parallel meaning to describe internet services supporting integration of "social functionality" with their products and user interfaces (e.g. login through Facebook or Google; sharing; comments; ratings).

With the introduction of AI and robotics applications into the fabric of city life, social infrastructure is acquiring a third and broader definition. Mark Zuckerberg recently conveyed this broader and far-reaching definition when he revised the mission of Facebook to be to build the "social infrastructure" to support a global community (Zuckerberg 2017). Zuckerberg claims that Facebook technologies, in which AI plays a growing role, provide the foundation for (and are capable of) forging a global social order. For Zuckerberg as well as for other AI and robotics pioneers, AI and robotics are envisioned to have no bounds in their capability to inform and guide aspects of individual and community life. These technologies embody the contemporary promise of automation, which is the substitution of human cognitive and physical labor with mechanical (in this case "autonomous" and semi-autonomous algorithmic and robotic) work. Accordingly, more than just referring to physical assets or internet services, the most recent meaning of "social infrastructure" is the integration of greater autonomous capacity into material, institutional, or informational provision that enable and support society's functioning and wellbeing. The significance of this is that the key balance between the human and social on the one hand and infrastructural and material supports of society on the other hand is shifting, with consequences for who has responsibility for the emergent social order, who is helped and hurt in it, and whose values are built into it.

In this article, I look at how existing and planned AI and robotics projects in three cities – San Francisco (United States), Yokohama (Japan), and Lviv (Ukraine) – aim to extend or build social infrastructure in this third definition to achieve a particular desired vision of city life. I choose contrasting cases both to highlight how particular cultures' ways of thinking of the human-machine relationship matters for the kind of AI and robotics are envisioned and developed as well as to surface the core characteristics of AI and robotics-supported social infrastructure that transcend cultural, economic, and civic histories. San Francisco houses many of the entrepreneurs, software engineers, and multinationals that create AI and robotics in various markets, including applications for cities. Its proximity and relationship to Silicon Valley provides a "close to home" perspective of AI city imaginaries. Yokohama was selected as Japan's "Future City" and offers a perspective of government-named and-organized experimentation in the realm of AI and robotics to achieve the so-called "Society 5.0". Lviv provides a nearly opposite (to Yokohama) example in that the city is in its infancy envisioning how AI may transform its future, and grassroots organization drives the current projects.

I examine the projects through the lens of sociotechnical imaginaries, a theoretical framework developed by scholars of Science, Technology and Society (STS), a field specialized in understanding how and with what consequences people use the power of science and technology to re-make the world. In a 2015 work, *Dreamscapes of Modernity*, STS scholar Sheila Jasanoff defines a "sociotechnical imaginary" as a "collectively held, institutionally stabilized, and publicly performed vision of a desirable future, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology" (Jasanoff and Kim 2015, 4). Imaginaries of AI and robotics-enhanced social infrastructure highlight what local officials, entrepreneurs and publics consider to be a well-functioning and good city. They also draw attention to why, in the minds of the leaders, the envisioned social order ought to be supported by autonomous or semi-autonomous technology and technology leaders instead of by civic institutions or elected-leaders.

SAN FRANCISCO

AI and robotics applications in San Francisco are focused on solving the city's growing transportation problem. The promise of AI to process and deliver actionable insights from vast quantities of data, and of robotics to embody these insights into "smart vehicles," has fueled hopes that these technologies can drive recovery from the daily freeway gridlocks and unaffordable housing caused by expansion of the tech sector itself. In the minds of its leaders and residents, San Francisco's capacity to maintain its livelihood, diversity, culture, and international entrepreneurial reputation hinge in large part on its ability to solve the transportation problem.

In this context, AI and robotics provide a luring hope. Particular to the technology of AI is the confidence that its capabilities can surpass – and even be preferable to – human control and judgment (see, for example, Agrawal et al. 2017). Corporations like Google, Tesla, and Uber claim that self-driving cars can drive more efficiently and safely than people and that AI-analyzed information can guide individual and government decision-making especially in historically politically-charged areas, such as where and how to develop

transportation.[1] These claims tap into long-standing and self-proclaimed belief that Silicon Valley's political culture is defined by a distrust of political establishment.[2] This political culture and automation promise of AI and robotics technologies fuels an imaginary in which transportation made "smart" promises to restore to San Francisco the fluidity and diversity of people, ideas, cultures, and economic classes that have long defined it.

The prime example is the City of San Francisco's 2016 application to the US Department of Transportation's Smart City Challenge, in which it outlines the vision for AI and robotics to enable a new kind of social infrastructure transforming city life. The Vision Narrative illustrates the city's ideal "Shared, Electric, Connected and Automated Vehicles" (SECAV) model, which hinges on the replacement of single-occupancy vehicles with "shared and connected" vehicles. In the envisioned state:

SECAV services are fully optimized. Fatalities eliminated. Vision Zero goal met [zero traffic deaths in San Francisco by 2024]. Pollution, noise, costs, impacts minimized. Social equity and access significantly improved. Parking structures repurposed for affordable housing, streets become shared spaces for all (San Francisco Smart City Challenge 2016 Video).

In this vision, AI and robotics optimize transportation by maximizing the efficient use of resources such as energy, time, money, lives, and space. Like an electric car that must plug into an electric infrastructure of charging stations, the AI and robotics solution to San Francisco's problem of transportation plugs into an imaginary of social infrastructure plagued by human-created inefficiencies.

1 See, for example, "A History of BART: The Concept is Born," on the contention around the development of the multi-county Bay Area Rapid Transportation (BART) system in the 1960s.

2 For historical analysis of Silicon Valley's political culture and its relationship to technology entrepreneurs and culture, see Turner 2006 and O'Mara 2015.

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The SECAV solution depends upon casting San Franciscans into atomized "roles" or narrow functions that each plays in the culture and economy of the city. "San Francisco," the Vision Narrative says, "is an ever-evolving community of thinkers, doers, runners, bikers, activists, neighbors, babies, students, entrepreneurs, cooks, up-and-comers and a thousand other roles" (San Francisco Smart City Challenge 2016 Video). The idea behind listing these roles is that each comes with a set of needs, consumption habits, and services that it contributes to city life. Such roles are necessary for AI-enhanced transportation to work according to the following best-practice scenario:

- A CAV [Connected and Automated Vehicles] microtransit provider hired by her weekly arts enrichment program brings Nicole's daughter home while she grabs a workout. Nicole can afford both the new multi-modal [CAV] services, gym membership and the weekly arts enrichment program for her daughter with the money she earns from [sharing] her car (San Francisco Smart City Challenge 2016 Video).

Here the technology enables the hypothetical (or perhaps real?) Nicole to outsource daily tasks, readjust how she spends time with her daughter, and reframe her economic standing in relation to personal health services and her daughter's education – all enabled by "her car" as part of the the AI and robotics-driven transportation revolution of the "Smart San Francisco City." The imaginary of AI- and robotics-improved social infrastructure in San Francisco transforms the meaning of "public" transportation from transportation that is provided by the local government in the service of all residents to all residents being themselves recast as "microtransit" consumers and providers. According to this imaginary, San Francisco life is optimized, economized, connected, and highly individualized. The technology solves the problem by helping to remove perceived human inefficiency, reinforcing an idea of citizens as "micro" role-based consumers and providers of services.

YOKOHAMA

One of the least common applications of AI and robotics to city life is being developed in Japan. It is a search for how these technologies can be used to maintain the economic vibrancy of Japanese society while its population steadily ages. This problem is felt acutely in Japan's city of Yokohama, which characterizes itself as having a "super-aging" population:

- the city is facing the issues of a super-aging society. According to one estimate, the number of senior citizens will reach one million [out of 3.7 million] by 2025. The most important thing for the creation of a vibrant city in such circumstances is economic activity (FutureCity Yokohama 2013).

As this statement suggests, beyond providing care, the problem of Japan's aging population is how to keep people's economic activity up as they age. The Japanese government, academics and industry leaders are thinking about the elderly's special needs (mobility, quick medical response, recreation) as they go about daily life in the city and imagining how AI and robotic might be used to address each one. For example, Fujitsu has developed

a product called "UBIQUITOUSWARE," a combination of core module (accelerometers, barometers, gyroscopes, microphone, magnetometers, vitals, GPS, temperature and humidity sensors) and a proprietary algorithm to analyze inputs from these sensors for applications that include monitoring patients, learning about their behavior, and providing more "intelligent care" via nudging human caregivers or integrating with AI-empowered robotic caregivers (Fujitsu 2017).

Residents of Yokohama are subject to experiments with these kinds of applications. The Japanese government has designated Yokohama to be Japan's "FutureCity" – the national site where public and private organizations can actively experiment with technologies to improve and sustain a particular kind of elderly experience in city life. The city is also a "regulation sandbox," where new and flexible policies are in place to encourage technological development (CNBC 2016). Yokohama was selected for this role because its demographics and other metrics are similar to those of other Japanese cities, with the argument that any solutions developed for Yokohama can be more easily transferred to other cities (FutureCity Yokohama 2013). In addition, Yokohama is already a technology hub in Japan. Japanese technology companies like Fujitsu are headquartered there and international companies are establishing branches there, such as Apple's new R&D center, whose focus is on AI research (Wuerthele 2017).

From the perspective of the Japanese government, this kind of experimentation with AI and robotics technologies for an aging population is not just a solution to a problem, but the active building of a new society called "Society 5.0." According to Japanese Prime Minister Shinzo Abe, Society 5.0 is a project name for a society literally and metaphorically (as indicated by the "4.0" to "5.0" designation borrowed from the practice of naming software versions) built upon Industry 4.0 technologies (AI, Big Data and IoT, sensors, and robotics) "to overcome the challenges coming from an aging society with low fertility" (CNBC 2016). The Japanese government's strong role in setting the goals (Society 5.0), sites (Yokohama) and rules (regulation sandbox) of experimentation with AI and robotics reveals holistic, concerted effort that prioritizes social development through economic activity.

Experimentation with AI and robotics solutions to the problem of aging population in Yokohama under the banner of Society 5.0 offers a unique imaginary of social infrastructure. Thinking from the perspective of technology solutions, the problem of aging in the city becomes an information problem: how to collect, analyze, and deploy back information to people and devices so that they can assist and enhance human function as people lose their biological abilities. AI is envisioned to make up an invisible, ever-present system of information exchange and analysis that enhances urban infrastructure to make it more possible for an aging population to live with greater pleasure and independence for longer, with specific ties to economic frameworks (access to services, consumption). In the Yokohama imaginary, AI and robotics can help to lay the foundation for an inclusive future urban society where technologies step in as "intelligent" crutches for human frailty.

LVIV

In Lviv there exists the imaginary promoted by local technology entrepreneurs that emerging technologies such as AI and robotics can help Ukraine achieve the twin goals of greater national independence and overcoming rampant political corruption by developing the agricultural sector and the culture of innovation.

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Lviv is a center of development of information technologies specializing in IT "outsourcing" by providing skilled and less expensive IT services to foreign companies. AI and robotics services, such as data mining, real-time data science, and integrated deep learning, are a growing part of that activity. In addition to this work, one of the most promising applications of AI and robotics within Ukraine is considered to be the advancement of agriculture (interview Utkin). Agricultural technology projects with AI, such as "precision agriculture," use data analytics about water levels, soil acidities, weather, and fertilizer utilization to assist the farmer in maximizing crop yields. Ukrainian companies like BioSens, KrayTechnologies, and WattCMS, among others, are developing software for quickly checking chemicals in produce, drones for treating crops, and sensors for monitoring the ambient environment, respectively. These efforts tap into Ukraine's agricultural potential as a key part of its national identity – an identity that is mobilized today by politicians and business leaders as a key strategy in the pursuit of Ukraine's economic and cultural independence from Russia and as a means for improving livelihood in the country.

The development of these technologies for applications outside of the city, and sometimes even outside of the country, nevertheless directly influences urban life in Lviv. This takes place through the engineers who work in these industries and live in the city. Employees of the technology sector receive higher salaries than most other occupations in the city, tend to be younger, speak English fluently, and have the ability (documents and finances) to travel abroad. Catering to the IT workforce and to tourists (IT and tourism are designated by the Lviv's government as the two strategic areas for the city's development), the city in partnership with IT entrepreneurs is supporting the opening of trendy WiFi-outfitted cafes, restoring and modernizing its historic public spaces according to Western models, growing its educational institutions (especially for training technologists and entrepreneurs as well as the promotion of Ukrainian arts and culture), and building high-end housing.

Meanwhile, senior Ukrainian technology leaders that grew their businesses in the 1990s and 2000s (such as, Evgeni Utkin, Taras Vervega, Oleh Matsekh) are patrons of projects in Ukrainian cities that combine cultural and technological innovation. Direct investment is transforming spaces of traditional social infrastructure into spaces focusing on the new social infrastructure with AI and robotics. For example, a project to build an innovation center in Lviv's old tram station aims to give locals the physical, material and intellectual resources and skills they need to develop new technologies as well as to sustain their livelihoods in the city (Matsekh 2017; Kenigshtein 2016). AI and robotics technologies figure prominently in the priorities of this innovation center (Matsekh 2017).

Among the old and new generation in the technology sector there is a belief that growing its expertise in AI and robotics and expanding the culture of technological innovation in the city will lead not only to economic growth that gives Ukraine more independence and power but also helps to circumvent the corruption of the existing political system by substituting new forms of power for the old. In this way AI and robotics are envisioned to re-make the city's social infrastructure to support a more just and transparent civic life.

"IN LVIV THERE EXISTS THE IMAGINARY PROMOTED BY LOCAL TECHNOLOGY ENTREPRENEURS THAT EMERGING TECHNOLOGIES SUCH AS AI AND ROBOTICS CAN HELP UKRAINE ACHIEVE THE TWIN GOALS OF GREATER NATIONAL INDEPENDENCE AND OVERCOMING RAMPANT POLITICAL CORRUPTION BY DEVELOPING THE AGRICULTURAL SECTOR AND THE CULTURE OF INNOVATION."

CONCLUSION: COMPARING URBAN AI IMAGINARIES

Sheila Jasanoff and Sebastian Pfotenhauer show that innovation projects can be seen as self-diagnostics of what the city perceives to be troubling or in need of fixing (Pfotenhauer and Jasanoff 2017). In the case of AI and robotics, with the image of intelligent sensors keeping the metaphorical pulse of the city in real-time, the promise that the technology can be a tool for diagnosing and acting upon urban problems is an integral part of how the technologies are imagined to function. Comparing the three cities' self-diagnostic and corrective means, i.e. the way that AI and robotics are imagined to support social infrastructure, exposes important differences in how each city envisions the human collectives it aims to support via social infrastructure development.

In San Francisco, removing obstacles to efficiency means taking the human out of active participation in the driving system. Instead of defining humans as actors who control the technology, social infrastructure enhanced with AI and robotics increasingly treats human beings as information, as data points, and aspires to manage the productive and consumptive activities of these data points to achieve greater efficiency.

In Yokohama, the imaginaries of AI and robotics enhanced social infrastructures diagnose people's narrowing abilities and growing frailties. As a result of this framing, AI and robotics are brought in to do human tasks such as caregiving as well as to redefine city services around the needs of the elderly. The project of Society 5.0 is to use increasingly autonomous technology to build a new society around changing human needs, which nevertheless remain central.

In the Lviv imaginary the attractiveness of the AI and robotics lies in its promise to correct for the human tendency to corruptibility by substituting technological or technologist action for human and especially political action. Instead of inherent human inefficiency, as in San Francisco, the problem in Lviv is entrenched political culture inherited from the Soviet Union. This culture is perceived to have created the conditions in which it is difficult for people to make good, just judgments when they are put in positions of power. By virtue of their education and nature of their work, technologists are seen as the answer to breaking with this corrupt cycle. The Lviv case illustrates more starkly than the others that imaginaries of AI in the city are themselves a form of social infrastructure, i.e. they offer a systematic, normalized way forward for transforming the society from what it is today to the envisioned future state.

Since the days of its founding in the second half of the 20th c., one of the most poignant questions about AI and robotics has been the way in which intelligent technological systems interact with the people who make them. Would they, like Hal, choose to overthrow the human being or would they, like Siri, become intuitive assistants? Today, the integration of AI and robotics into the fabric of city life to address the most pressing urban challenges reveals the extent to which the culturally-specific relationship between human and machine is still central in driving how cities are imagining themselves as collectives of human beings with AI and robotics. Whether AI and robotics are being introduced to city life to solve the problem of transportation, ageing, or corruption, they reveal what is considered to be problematic with human collectives. The technology's promise lies in the ability to re-build social infrastructural supports of the city in ways that delegate more power to autonomous technological systems and depend less on human decision-makers, viewed as fallible for different reasons.

REFERENCES

Agrawal, Ajay, Joshua Gans, and Avi Goldfarb. 2017. "How AI Will Change the Way We Make Decisions." *Harvard Business Review*, July.

"A History of BART: The Concept Is Born." 2017. Accessed September 21. http://www.bart.gov/about/history.

CNBC. 2017. "CNBC Transcript: Japanese Prime Minister, Shinzo Abe." *CNBC*. May 16. https://www.cnbc.com/2017/05/16/cnbc-transcript-japanese-prime-minister-shinzo-abe.html.

"Fujitsu IoT Solution UBIQUITOUSWARE - Fujitsu Global." 2017. *Fujitsu*. January. http://www.fujitsu.com/global/solutions/innovative/iot/uware/.

"FutureCity Yokohama." 2013. *City of Yokohama*. April 1. http://www.city.yokohama.lg.jp/ondan/english/futurecity/.

Jasanoff, Sheila, and Sang-Hyun Kim, eds. 2015. *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. University of Chicago Press.

Kenigshtein, Ilia. 2016. "Razom IT Speaker Series: Converting a Tram Depot into a Creative Space" *Razom for Ukraine*. May 31. https://www.slideshare.net/RazomForUkraine/razom-it-speaker-series-converting-a-tram-depot-into-a-creative-space-in-lviv.

O'Mara, Margaret Pugh. 2015. *Cities of Knowledge: Cold War Science and the Search for the Next Silicon Valley*. Princeton, NJ: Princeton University Press.

Personal Interview with Oleh Matsekh. 2017. Interview by Margarita Boenig-Liptsin. Lviv, Ukraine. March 6.

Pfotenhauer, Sebastian, and Sheila Jasanoff. 2017. "Panacea or Diagnosis? Imaginaries of Innovation and the 'MIT Model' in Three Political Cultures." *Social Studies of Science*.

San Francisco Smart City Challenge 2016. 2016. San Francisco, CA. http://smartcitysf.com/.

Turner, Fred. 2006. *From Counterculture to Cyberculture : Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism*. Book, Whole. Chicago: University of Chicago Press.

Wuerthele, Mike. 2017. "Japanese Chief Cabinet Secretary Visits Yokohama Apple R&D Center, Confirms March Opening." *Appleinsider*. January 21. http://appleinsider.com/articles/17/01/21/japanese-chief-cabinet-secretary-visits-yokohama-apple-rd-center-confirms-march-opening.

Zuckerberg, Mark. 2017. "Building Global Community." *Facebook*. February 16. https://www.facebook.com/notes/mark-zuckerberg/building-global-community/10103508221158471/.