Integrating digital systems to help city residents plan seamless journeys

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Introduction

The 21st century has seen a growing recognition of the importance of cities in the world: not only does over half[1] of humanity live in cities, but cities contribute 60 per cent[2] of global GDP, consume 75 per cent[3] of the world's resources and generate 75 per cent[4] of its carbon emissions. There is little doubt that the enlarging footprint of cities, with the rapid rate of urbanization in the developing world, will be where "the battle for sustainability will be won or lost"[5] and, for those engaged in "smart-cities" initiatives, the focus of winning this battle is through the use of digital technology to efficiently manage resources. One of the key sectors for such smart cities initiatives is transportation.

Transportation infrastructures today rely heavily on private car ownership, which is powered by fossil fuels, and public transportation, both of which operate independently of each other. Policy makers believe radical innovation in this sector is needed to move it to a more sustainable system of mobility.

To achieve the goal of sustainable, seamless, and efficient mobility, an infrastructure would be required that would allow residents to move away from private ownership to a combination of car-sharing and public transport. For example, such an intermodal chain of mobility might include taking a rented bicycle to the bus station, a bus to a stop near the office, and then a car-sharing service to the office, covering every step from the point of origin to the last mile. Powered by renewable energy, electric vehicles could make this journey entirely green.

In order to create such a mobility infrastructure, all the services offered (buses, trains, car-sharing systems, charging stations, and payments) would have to be integrated using digital technology in order to provide an urban resident with an easy way to map and take an intermodal journey using her smartphone. This change would transform transportation as we know it today to Mobility-as-a-Service[6] but requires considerable innovation in the various heterogeneous digital computer-based systems (what we might term the information infrastructures), underpinning the physical transportation infrastructure. (For a more detailed account of the ideas of information infrastructure see Hanseth, O. and E. Monteiro, 1998)[7]

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Framing an Academic Project

Academic research on how such mobility information infrastructures would grow from the constituent disparate systems that currently exist in silos has been nascent, especially on the topic of the coordination efforts required. Part of the reason is that many required elements of such infrastructures do not currently exist, and that cities are only just beginning to prototype them.

In our research, we use a theory of digital infrastructure coordination[8] as a framework to unravel the forces that influence the development of a mobility focused information infrastructure, extending it to focus particularly on the influence of temporal rhythms within the coordination. Understanding this has important implications for policy makers seeking to better support smart-cities initiatives. Our research took us to Berlin and a project which was prototyping an integrated sustainable mobility system there.

The BeMobility Case Study

The BeMobility project[9], which lasted from September 2009 to March 2014, was started as part of a concerted effort by the German government to become a market leader and innovator in electric mobility. A public-private partnership between the government and over 30 private and academic sector stakeholders, the goal of BeMobility was to prototype an integrated mobility services infrastructure that would be efficient, sustainable and seamless for Berlin residents. The largest railways operator Deutsche Bahn was chosen as the lead partner of the project, with the think-do tank InnoZ (an institute focused on future mobility research) as the project coordinator and intermediary. Organizations participating in the project ranged from energy providers like Vattenfall[10] through car manufacturers such as Daimler[11] to technical scientists provided by Technical University of Berlin[12].

The project, despite facing many challenges, was able to prototype a transportation infrastructure which integrated electric car sharing with Berlin's existing public transport system. In the second phase of the project, it further integrated this infrastructure with a micro-smart power-grid, providing insights into how such mobility services could be powered by renewable energies. While the integration effort was both at the hardware and software levels, our research studied the coordination efforts related to information infrastructure in particular.

"Integration of all this information is what we now call Mobility-as-a-Service. BeMobility was one of the first projects in the world to attempt to do it." - Member of BeMobility Project

Findings and Discussion

Our analysis showed that individuals and organizations respond to coordination efforts based on a combination of historical cycles of funding, product development and market structures, and anticipated patterns of technology disruption, innovation plans and consumer behaviour. Peoples' actions in contributing to an integrated infrastructure are tempered not only by these past and future rhythms, but also by the limits of the technologies they encounter. Some of these limitations are physical in nature, such as the inability to integrate data due to lack of specific computing interfaces, and some are political, such as blocked access to databases due to concerns about competitive espionage and customer privacy.

Our findings also surfaced the power of the intermediary as coordinator. Contrary to the limited perception of a coordinator as a project manager and accountant for a government funded project, we saw InnoZ emerge as a key driver of the information infrastructure integration. One of the most powerful tools for the intermediary was its role in mapping future rhythms of technology development. It achieved this by showcasing prototypes of different types of electric vehicles, charging stations, solar panels, and software systems, at InnoZ's campus.

This campus itself acted as a mini-prototype where both hardware and software integration could be first implemented and tested. The ability to physically demonstrate how the micro-smart grid could connect with the car-sharing system to enable sustainable energy for electric cars, for example, both surprised and motivated other stakeholders to take the imminent possibility of a sustainable mobility infrastructure more seriously.

Ultimately, business stakeholders were especially concerned about the commercial viability of such radical innovation. Here too the intermediary proactively shaped their thinking by conducting its own extensive social science research on the behavioural patterns of current and future users. For example, by showing that young urban residents were more interested in car-sharing than private ownership of cars, InnoZ made a strong case for why an integrated infrastructure could also be a good business investment.

Implications

As more cities experiment with Mobility-as-a-Service, understanding the influence of rhythms on coordinating information infrastructure is helpful for policymakers. Insights that would be useful to policymakers include:

- Keeping a budget for building an innovation lab where cutting edge technologies can be tested and integration efforts can be showcased will lead to more engagement with stakeholders.

- Working more closely with the intermediary to conduct social research on the mobility habits of millennial urban dwellers will incentivise stakeholders as it will prove a market for the smart infrastructure.

- Anticipating the disciplinary inertia imposed by legacy systems and organizational practices, and countering it by including stakeholders in the working group whose temporal rhythms include innovative product cycles more in line with the goals of the integrated infrastructure.

This study also contributes to the academic literature on information infrastructure development by providing insights on the role of time in coordinating integration efforts. It responds to a gap in the understanding of the evolution of large-scale multi-organizational infrastructures, specifically as they relate to mobility.

References

[1]http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html

[2]http://www.mckinsey.com/global-themes/urbanization/urban-world-mapping-the-economic-power-of-cities

[3]http://www.unep.org/SBCI/pdfs/Cities_and_Buildings-UNEP_DTIE_Initiatives_and_projects_hd.pdf

[4]http://blogs.lse.ac.uk/businessreview/wp-admin/United%20Nations%20Environment%20Programme%20(UNEP),%20Cities%20and%20Buildings%20–%20UNEP%20DTIE%20Initiative

[5]http://www.sciencedirect.com/science/article/pii/S1462901110000298HTTP:

[6]https://en.wikipedia.org/wiki/Mobility_as_a_service_(transport)

[7]http://heim.ifi.uio.no/~oleha/Publications/bok.htmlhttp:/heim.ifi.uio.no/~oleha/Publications/bok.html

[8]http://misq.org/a-trichordal-temporal-approach-to-digital-coordination-the-sociomaterial-mangling-of-the-cern-grid.html

[9]https://www.innoz.de/en/bemobility-20

[10]https://corporate.vattenfall.com

[11]https://www.daimler.com/en/

[12]http://www.tu-berlin.de/menue/home/parameter/en/?no_cache=1