Will the information technologies save planet USA?

Minutes of the fourth session, December 14, 2009

Introduction

Taoufik Souami, Lecturer at the French Institute of Urban Planning

The aim of this program[1] and the objective of the panel is to explore how the question of climate change is constructed in relation to the issues of mobility in the USA, from the perspective of the economy and of innovation—whether technological, social or political. Today's session will explore in particular the role of information and communication technologies (ICT) in the construction of this question in the US. To that end, we have invited two American experts and assigned them different roles.

We have asked Jean-David Margulici to describe the state-of-the-art and the "state" of ICT innovations for mobility, in relation to climate change. Are researchers working on new mobility-related technologies coming up with new solutions that reflect political and economic concerns? Jean-David Margulici is Associate Director of the California Centre for Innovative Transportation (CCIT) at the University of California, Berkeley, and has been working on the subject of smart transportation for some 20 years. We asked Carlo Ratti to help us imagine what certain solutions envisaged today might bring us in the next 30 years. His work lies at the

[1] More details on http://www.ville-en-mouvement.com/cleantech_en/

interface between ICT and design, and even art. We will ask him about the new avenues being opened up by technological innovations relating to sociability and social relations, and about technologies that are more a part of lifestyles and daily habits.

Christian Licoppe, Professor specializing in the sociology of Information and Communication Technologies at Télécom ParisTech

When preparing for the session, we identified two lines of thinking:

First, innovation in transportation increasingly includes the communication technologies. Electric vehicles are the most obvious example. In *After the car*, John Urry suggests three possible scenarios for a world without oil, one of them the development of electric vehicles and their integration into public transportation systems and recharging infrastructures. Vehicles would not be privately owned but available on request for groups of individuals. This kind of system can only exist in tandem with sophisticated information systems that keep users informed of the possibilities of using transportation and its availability. These information systems are not only crucial, but at the centre of the emergence of a new form of transportation, halfway between private and public transport. This means that questions that arise in the sphere of transportation generate a rapprochements with people in other sectors.

Secondly, the world of communication is increasingly connected with questions of mobility and urban environment based around enhanced forms of urban experience. A lot of work is being done on ways of using networks of sensors able to detect biological, emotional or environmental states, either to give individuals data on their own urban experience, or to construct collective representations of augmented urban experience in the form of living maps. These tools enhance individual and collective experience. They have a descriptive function, producing new representations of the urban experience, and they also have a performative role, increasing awareness and potential vigilance in individuals. The performative nature of these systems is one way of changing behavior towards more sustainable models. It corresponds to a shift from the world of communication to the world of mobility.

Science is currently exploring these convergences, which we think are central and are reflected in the development of multidisciplinary projects.

Information technologies, transportation and climate change

Jean-David Margulici, Associate Director, California Center for Innovative Transportation (CCIT)

CCIT was created with the objective of turning research into action. Its goal is to assist the deployment of new technologies in transportation, whether they come from university research or industry, bearing in mind that the government agencies that manage the transportation systems sometimes inhibit innovation, and an innovative technology often comes up against legal and economic obstacles, and problems around the management of change.

One of the priorities in transportation is to reduce greenhouse gas emissions and therefore the total use of fossil fuel vehicles, without restricting mobility. More fluid traffic and carpools are themselves a way to cut emissions without reducing mobility. So much of the problem is the private car and the time people spend in it.

ICT makes it possible to address this problem through electric vehicles, through managing transportation demand by offering alternative methods of transport, through traffic management and through supplying drivers or travelers with information.

Electric vehicles

The Californian automakers Telsa and Fisker produce electric vehicles. In addition, Better Place and Coulomb Technologies, which install charging terminals, were both created by people who came from the ICT world. Indeed, their business model is based on managing the connections between vehicles and the renewable energy infrastructure, which requires software able to make real-time price adjustments based on supply and demand.

Demand management

Demand is being managed through transportation pricing policies. Urban toll systems, which are being studied in the San Francisco Bay Area, require significant technological resources. In London, almost half the revenue from congestion charging goes to finance the IT system. In addition, California has created special carpool lanes, which are unfortunately underutilized. Having a priority traffic lane is not enough of an incentive. As a result, these lanes are to be opened up to solo drivers, who will be charged for using them. Nevertheless, ICT can contribute to the development of carpools by matching drivers and users. Demand can also be managed through dynamic pricing, where parking prices are adjusted to reflect demand. Companies in Silicon Valley have set up shuttles to attract young people who prefer to live in San Francisco, 40 kilometers away. There is nothing new about shuttles. However, ICT can be used to manage pickup points and to give users real-time information. In addition, the shuttles are fitted with Wi-Fi, so that people can work while commuting. As a result, employers recognize the journey as

part of working time. These shuttles are perhaps the first step in a mass transit system with broad appeal.

Another innovation is car sharing, where supplying a vehicle is perceived as a service rather than a consumer commodity. In addition, billing per mile encourages drivers to be more aware of the impact of their journeys in terms of CO_2.

Traffic management

The public agencies that manage the transportation infrastructures are primarily builders. They are now realizing that they need to change their mindset, to see their job in terms of managing mobility. Here, ICT plays a key role in infrastructure monitoring and in the implementation of traffic management strategies. New technologies can be used to control access to freeways in order to avoid congestion, to adjust speed limits and to manage lanes dynamically in order to keep traffic flowing. The concept of the "probe vehicle" is emerging, with traffic detection technologies, GPS cell phones or roadways with embedded sensors capable of tracking vehicles magnetically.

User information

The purpose of channeling information directly to users is to give them the power to manage their own mobility, whether in the method of transport they use, their route or the times they travel. Combining information on public transportation and road traffic conditions gives the user facts on which to base their choice of the freeway or the train.

This means it is to the advantage of the mass transit operators to make their information as widely available as possible, as happens in the city of Portland, which allows developers of mobile applications to access its data (real-time itinerary and location of buses) to develop user information systems. Very few agencies make their information available.

Crowdsourcing, where decentralized content is generated by the users themselves, can be applied to mobility by putting together a digital map based on information collected from motorists' GPS enabled phones. Compared with ordinary maps, this system has the advantage that the behavior of motorists is included in the composition of the map.

One future concept for driver information is the development of connections between vehicles, with the infrastructure to disseminate information on road conditions and control road safety applications (traffic lights, accident alerts). These networks could also be used to develop assisted driving and eco-driving.

Debate

Xavier Fels, Secretary-General of City on the Move

Do electric vehicles in themselves contribute to smarter mobility?

Jean-David Margulici

Electric vehicles cut CO_2 emissions, but do not inherently reduce individual mobility. On the other hand, it may be that the deployment of electric vehicles will lead to a new economic model, based on battery exchange stations. With this model, the driver owns the vehicle but not the battery, which is only leased, thereby reducing the initial purchase cost. Drivers then pay a subscription which enables them to recharge or exchange the battery when it is empty. This change in billing basis might lead to a change in behavior.

Christian Licoppe

What are the big trends in the models for implementing innovation?

ICT seems to be applied uniformly to a homogeneous world. However, the social world is not homogeneous. How is the public requirement to make transportation accessible to all applied in the projects?

Jean-David Margulici

The development of mobile applications and crowdsourcing is a powerful trend, driven by private initiatives. Groups of transport users motivated by a strong interest in mobility are building new models based on mobile applications, and they influence the decision makers. A Google employee has also taken the initiative to create an application that allows transportation operators to display their data on Google maps for viewing by users. ICT creates the potential for innovative private initiatives.

Empirical studies have shown that road tolls do not have an unequal impact from one social class to another. As regards the heterogeneity of the urban fabric, the *Global Millennium* project, where cell phones were used to put together traffic information, showed that the capacity to generate good quality information is closely associated with an understanding of the context.

Information is relevant to environmental priorities in that it provides better access to public transportation and therefore promotes a shift between modes. Better information means more choice for users.

Jean-Pierre Orfeuil

Making the transportation operators' information available to developers is an idea that would be worth promoting in France, where information is jealously guarded.

Do you see any transfer of approach between different types of network, i.e. from telecoms to transportation or from aviation to roads? Also, it would seem that policies that have been developed to combat congestion also have a positive impact on CO_2 emissions. Do you see any policies emerging in the US focusing mainly on the environmental impact, such as road charging or free access to toll roads for electric vehicles?

Jean-David Margulici

Smart transportation technologies have developed in the last 20 years. Combating congestion also reduces emissions, by shifting mobility to mass transit services, carpools or car sharing systems.

Oregon has been testing a mileage tax system for 10 or 15 years. In the US, all the infrastructures are state-owned and are managed through licenses granted to private operators. However, the state of the public finances suggests that the infrastructures could soon be privatized, which will require decisions on tariffs. Congress's new framework law on transportation in the US, which will be formulated in 2010, could include pilot projects on mileage charging.

From the floor, Ministry of Transport

The road tax on trucks is based on the cost of road maintenance and external factors, including greenhouse gas emissions. As a result, it encourages the use of more environmentally friendly engines.

Michel Micheau, Sciences Po

Are there connections between the strategies implemented to reduce individual car use? Also, who finances the fitting of sensors into the roadbed and how much preliminary investment is required to organize infrastructure monitoring?

Jean-David Margulici

Three strategies have already been put into place at different levels: passenger information, traffic management and demand management. However, attachment to the private car is so great in the US that behaviors will not substantially change without strong political impetus through charging. Modal transfer in cities accounts for at best 1 or 2% of California's CO_2 emission reduction target for 2020.

Mobile phones can collect data on the entire network with no additional marginal cost. In addition, all the traffic management agencies have developed magnetic, optical or radar sensor networks. Using the cellphone system to collect information will not remove the need for these technologies. Nevertheless, innovation is reducing their cost.

Yves Geffrin, Ministry of the Environment

Is the promotion of electric vehicles accompanied by changes in the way electricity is produced in California, in order to meet the additional demand? In addition, isn't there a risk that public information might be inappropriately used, if made available to private operators? Lack of information can be a way of maintaining free space in a place that would quickly become congested if drivers had travelled there.

Jean-David Margulici

Pacific Gas and Electric, which operates in Northern California, is planning to develop new electricity production capacity using renewable energy. California's law on cutting CO_2 emissions requires 33% of electricity to be produced with renewables by 2020.

Some agencies are afraid to communicate their data for fear of losing control and encouraging undesirable behavior in users. The agencies that distribute their data make users sign a contract and retain a right of veto over the use of data.

Caroline Lemoine, Institute of Urban Development, Île-de-France

What do you think about the obstacles to innovation in France?

Jean-David Margulici

In California, I see public contracts, resistance to change and the economic model as day-to-day obstacles to innovation. I imagine that the obstacles are the same in France. On the other hand, centralized policies in France allow ambitious nationwide initiatives, in particular on electric vehicles. In the US, the tendency is more to distribute subsidies "blindly", in response to proposals from local players or companies.

The new technologies in day-to-day municipal practice

Carlo Ratti, Director of the SENSEable Lab – MIT

The SENSEable lab, set up five years ago, consists of 30 students and researchers who study the impact of new technologies on the city.

Ten years ago, Formula 1 teams directed most of their investment to the car and the driver. In the last five years, they have invested primarily in computers, real-time control systems and thousands of sensors located all over the car. These sensors continuously send information on the car's behavior to the control centre, so that decisions can be taken in real time.

A city too functions like a real-time control system. In the last 10 years, numerous sensors and digital networks have been developed within cities, and it is now possible to create real-time control systems by superimposing the digital aspect of cities, made up of sensor networks, on the physical aspect, comprising buildings, space and people. Up to now, urbanism has studied the interactions between cities and people, whereas the interactions between people and technology were the subject of techno-science. It is now possible to develop a new understanding of cities based on the technology dispersed through the urban fabric, in particular in the form of cellphones.

On the other hand, whereas a Formula 1 engine can be adjusted instantaneously to reflect the information sent by the sensors and analyzed by the computers, it is impossible to adjust the width of the street instantly in response to traffic levels.

From this perspective, the city is very rigid.

Nonetheless, citizens can become smart players in the city's real-time control system and bring about change in forms of mobility.

In summer 2006, at the Venice Architecture Biennale, we presented a project in which all the GPS data from every cellphone in the city of Rome were collected and sent to MIT for processing. The population's movements were then displayed on a live map at the Biennale, all in real time during the World Cup final between Italy and France. The results showed little movement during each of the two halves, followed by extensive movement towards the city centre after the victory.

So it is possible to track the movements of a city population using cellphones, differentiating between pedestrians and drivers, for example in order to analyze the match between bus routes and individual travel requirements. In fact, we are working with the city of Rome's mass transit agency to optimize their bus routes. In addition, it is possible that in the longer term, it will no longer be passengers who have to adapt to bus routes, but vice versa. The capacity to collect real-

time information makes it possible to envisage a dynamic system where demand would determine supply in real time. It can also be used to create an internet of objects.

Real-time control also involves information feedback to citizens. For example, the city of Florence has developed smart bus stops that display real-time information.

We are also working with Volkswagen to develop a smarter system than GPS, which works like a real co-pilot, using information from the city and information collected by the car itself.

And finally, at the Copenhagen summit we just presented the *Copenhagen Wheel*, a rotating system that attaches to the back wheel of an ordinary bicycle to transform it into a hybrid e-bike. The *Copenhagen Wheel* stores energy when the rider pedals or brakes, and then returns it during ascents. You can also connect to your *Copenhagen Wheel* by phone to gather real-time information on pollution, traffic, road conditions or speed and distance travelled. The system can be used to plan your journey and to exchange data with friends or the municipality, to feed into an environmental database. *Screening of a video on the Copenhagen Wheel*[2]

Debate

Christian Licoppe

In the example you have just shown, people are processed as flows, by aggregating individual behaviors. However, the use of identifiers makes it possible to distinguish people while maintaining their anonymity, which offers potential in terms of service. A bus stop can display information that is accessible to any passerby. It is also possible for it to send messages to a person's telephone using their identifier. These two possibilities raise very different questions in legal, economic and social terms.

Also, are you looking at the extent to which the information supplied by *Copenhagen Wheel* may influence cyclists' behavior?

Carlo Ratti

We are living digital traces. We constantly leave tracks that would enable another person to reconstruct our lives, our movements and our purchases. Collecting this information offers remarkable potential by making possible what has so far been impossible, i.e. studying a population simultaneously from the micro and the macro perspective. On the other hand, it raises questions about privacy. These days, the simple fact of taking photos can be an invasion of privacy, since photos can be circulated on the web. Switzerland was the first country to prohibit Google from taking photographs on its territory.

[2] The videos shown can be viewed online: http://www.youtube.com/user/senseablecitylab

All this means that the new technologies offer remarkable possibilities that no one had thought of, but that require a broad public debate on the establishment of boundaries to protect privacy. Older generations tend to find these phenomena frightening, whereas the Young are very keen to use the new technologies to share their private lives in real time. We need to differentiate between the myth of "Big Brother" and a friendly system of information exchange that might be called "Little Sister". Before exploiting the possibilities offered by the use of personal data, we need to set limits and decide on the measures required to guarantee anonymity.

We are currently thinking about ways to measure how users are influenced in their behavior by the information they get from the new technologies. We have created another system, called *Trash Track*, where sensors are added to pieces of garbage and used to track their movements. This system was developed with a few thousand people in Seattle and New York, firstly to help understand the system, and secondly to educate them about the problem of waste management by showing them that our waste does not disappear but is piled up in landfill sites. This might, for example, encourage people to use tap water rather than bottled water.

Jean-Pierre Orfeuil

A study conducted by American researchers[3], by collecting data sent from people's cellphones over several months, showed that the people involved had very uniform travel patterns. It is of quite considerable use to demonstrate that people visit the same places day after day, because in fact not much was known about the "mobility of mobility" from one day or week to another. In short, it's new finding. In addition, we can see how useful it would be delivery companies or home service agencies to be able to track the movements and activities of their employees.

Jean-David Margulici

The study you mention concluded that we tend to be predictable and sparing in our movements. We had begun working on the cellphone data but we stopped because, despite the anonymity of the data, we don't feel that it's ethical to track a person's movements over several months. But despite the ethical problems, this study shows how cellphone data would help us come up with much better answers to many questions in the social sciences. Usually, to simulate travel between two cities, you need to create a starting point/destination matrix, which involves conducting extensive surveys with people as they leave the city. Cellphones would make it possible to collect the information automatically and do without these surveys.

It would undoubtedly be possible to reorganize certain business processes by tracking the movements and activities of employees. Moreover, in addition to the understanding of existing practices, all these tools can lead to the emergence of self-organizing processes.

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[3] http://www.nature.com/nature/journal/v453/n7196/abs/nature06958.html

Michel Micheau

The SciencesPo Medialab, which is modeled on the MIT lab, only has the equivalent of 1.5 full-time researchers. What needs to be done for social science researchers to start using such a resource?

Carlo Ratti

MIT's SENSEable Lab was developed on a bottom-up model. Research on the new technologies and mobility must be multidisciplinary. It involves design, architecture, mathematics and the social sciences. So the difficulty is to create synergies between researchers belonging to very disparate disciplines and cultures. That is also what makes it such an exciting experience.

Taoufik Souami

Why were the projects you have described carried out in partnership with European rather than American cities?

Carlo Ratti

The MIT projects are very American, but European or Asian cities are much more exciting than American cities, because they are older. That is why most of our partner cities are European or Asian. American cities are much less interested in getting involved in the kinds of projects we work on.

Anne Querrien, Ministry of the Environment

Pass Navigo can identify a majority of traveler flows. The RATP could break them down to individual traveler level and track people's normal travel patterns, so that in the event of a strike, for example, they could send a message to a user's telephone advising them to take an alternative route. However, the data protection laws do not allow you to break data down to individual level. These laws are an obstacle to many possible uses of data and therefore to the emergence of self-organizing processes. On the other hand, the neurosciences are becoming increasingly important. Scientists have been engaged by large companies to confirm their observations on routines. Others work with politicians to study the impact of an urban project on population behavior.

Carlo Ratti

How will the new technologies alter the physical space of cities? MIT owns one of the biggest computers from the 1950s. Working conditions in the premises where it is housed are very difficult because its architecture was designed to suit the machine and not human beings. In 1990, office architecture was designed half for human beings, half for computers. Today, we can work anywhere with our laptops. Similarly, whereas current urban architecture is designed partly for machines and partly for people, the less bulky the technology becomes, almost to the point of invisibility, the more human beings become the focus of architectural design. The paradox is that

as the technology becomes more widespread, human beings are reclaiming their role in the design of our physical environment. The city of tomorrow will be covered with technological equipment but we will no longer have to worry about the role of the machine. On the other hand, everything will be different, because the buildings and urban structures will communicate with the inhabitants. We are working with the Mayor of London on a project called *The Cloud*[4], looking at incorporating living systems into architecture.

Jean-David Margulici

The new technologies bring together the macro and micro worlds, the digital and the physical. Nevertheless, who is going to organize the sharing of data and operate the internet of objects?

Carlo Ratti

New technology businesses like Google have developed by trial and error, with no business model. The web is a very simple process, but one that has profoundly altered our existence. Yet the internet developed without a business model, without being controlled by any particular company or organization. For this reason, I think that the internet of objects will be built in the same way, but less quickly than expected because of the technological problems of deploying RFID and because of local standards.

Anne Debré, journalist

Is the *Copenhagen Wheel* going to be commercialized?

Carlo Ratti

MIT produces concepts but does not itself control how they are used. For the *Copenhagen Wheel*, we have signed a partnership with Ducati to produce the prototype and discussions are underway on its potential commercialization. I think that the *Copenhagen Wheel* will soon be commercialized, because it is very easy to produce and very easy for users to adapt to. Copenhagen wants to buy 600 of them, because it has decided to replace its employees' cars with bicycles, and they complain about the physical effort involved. Copenhagen aims to become the first "zero carbon" capital in 2025.

From the floor

The amount of digital information in circulation will greatly exceed storage capacity. In addition, decision-making has to become faster and faster. This threatens the old paradigm, based on the extraction, storage, analysis and sharing of information. Now, information will be extracted,

[4] http://www.raisethecloud.org

analyzed, viewed and then either stored or not. So what progress has been made in research into the instant analysis of extracted data?

Carlo Ratti

Our research centre is actually involved in significant projects on the real-time analysis of information. I wouldn’t be quite so pessimistic about the question of storage. Storage is a problem if it is centrally organized. In reality, with each person storing their own information, storage is handled locally, using the memory of tens of millions of interconnected personal computers.

Mireille Apel-Muller

Which of the innovations of the last few years have been adopted by cities?

Carlo Ratti

In 2007, we conducted the first experiment with a city on the sharing of data between people to create a sort of real-time database of social data. This project led to two start-ups on real-time city management, one in New York and the other in Amsterdam. The *Copenhagen Wheel* project will soon take concrete form in a start-up with Ducati and *Trash Track* is going the same way.