Virtual Elevators' Contribution to Sustainable Transport Policies: The Importance of a Smart Regulator and "Not-Too-Smart" Cards

Tristan Chevroulet

Abstract

The most significant contributions of new technologies to the implementation of sustainable urban travel policies appear to be twofold: a better understanding of users' behavior, and the improvement of interfaces between operators.

Smart cards, i.e. chip cards which communicate with the database of a billing company, have the potential to combine the qualities of both of these contributions. But they also raise new problems. In Japan, a financial transactions company is developing a new payment system which coordinates superstore chains and public transport supply. Just as elevators will enable people to move freely within buildings, this system will enable customers to reach the superstores for free from the outside world.

Analysis confirms that this new concept has the potential to stimulate public transport demand. However, three issues need further consideration. First, private businesses may access transportation, financial, and even property data of travelers, which may threaten their privacy. This paper proposes a concept that would prevent such a system failure. Second, small businesses could be discriminated against on the grounds that the turnover they produce does not suffice to bear the cost of running virtual elevators. The study highlights the conditions in which local authorities may require leading businesses to cooperate with smaller ones. Eventually, since virtual elevators may rely upon state transport subsidies while following private commercial profit objectives, the paper also stresses in what matters states and local authorities should require commitments from private partners. The conclusion underscores the importance of public authorities' involvement from the earliest steps of development of the system until and during operation. More specifically, it contrasts two distinct policy requirements: subtlety as the regulator's main quality and "not-too-smart-ness" as a major characteristic of electronic cards.

Introduction

Smart cards have long been sought as a technology that would revolutionize fare payment in metropolitan areas. To date, smart card programs have been implemented in Washington, Chicago, Boston, and other U.S. cities. These implementations, however, have only begun to tap the potential for smart cards to affect the transport system. When applied as a commercial means for implementing sustainable transport policies, smart cards enable new business models that fundamentally question the regulatory system. Ogino (2005) highlights how smart cards can be used for investigating customer behavior, while Bagchi and White (2004) describe smart cards' potential for implementing new payment procedures in public transport. These two features can be merged in developing smart card systems that will enable superstores to offer free transit rides to their customers (Yokoe 2005). Such new services, it is argued, will encourage people to use public transport instead of private motoring. Indeed, superstores already provide free elevators and free escalators within their premises; this paper considers extending this principle to the public transport lines beyond their premises. Hereafter, we will refer to such a service as a "virtual elevator."

The virtual elevator concept is a logical step toward further integration of the transport system (Rothengatter 1991). Such a development is in line with the scenarios for 2020 established by Reynaud and Braun (2001) which stressed that successful innovation in transport would rely more upon improved organization than on pure technological development. By examining a virtual elevators pilot program in Japan, this essay will explore the possibilities of such a scheme and its meaning for actual practice in the U.S. and in Europe.

In Japan, the private sector has recently launched initiatives, such as the new "PiTaPa" program (Postpay IC for "Touch and Pay"), the brand name of the Surutto Kansai scheme, which employs smart cards for billing and financial services. Through these efforts, private companies have shown that they are able to negotiate conditions and tariffs with a wide range of operators to bring them voluntarily into a common scheme, whereas public authorities regularly fail in reaching consensus on similar topics. As a consequence, one may wonder whether the state and municipalities should better give up their regulatory roles and enter such schemes purely as partners, providing public services (a library, for instance) against electronic payments, or if there are still reasons for stronger involvement.

Expected Effects

Long-Term Benefits

Virtual elevators may yield at least five sorts of benefits: corporate profit, business efficiency, retail customer attraction, transit passenger expansion, and improved quality of life. Superstores, public transport companies, and municipalities would share development costs and they could expect returns on investment in the medium-term. Superstores would gain data on customer behavior, expand customer loyalty, attract more clients, advertise more directly, and reduce the number of parking spaces needed. Transport companies will be able to provide services to more users while keeping similar marginal revenue. Finally, municipalities expect to improve access to places, which raises the quality of life of their citizens and makes these places more attractive for tourists.

Financial Model

The virtual elevator model is similar to frequent flier programs, in which program participants receive "air-miles" that can be redeemed for a given range of rewards and benefits, especially free air tickets. In frequent flier programs, a percentage of passenger fees are set aside to pay for the subsequent redemption of rewards. Surutto Kansai expects the PiTaPa scheme to run on a 2 percent fee (Yokoe 2005, slide 58) to be paid by all customers. Virtual elevator schemes differ from frequent flier miles programs, which offer regular customers a special reward worth one hundred Euros or more. Virtual elevator schemes provide all customers with a regular reward that only has a relatively low monetary value.

Using the word "elevator" as a metaphor for free public transport connections to superstores suggests that all people who simply "are within" superstores may travel for free, which is indeed what they do when they use elevators. Yet, this logical option may prove extremely expensive in practice. Therefore, we will make a distinction between two different virtual elevator schemes: the "common virtual elevators," which are common to all people who visit a department store (row 1 in Table 1) and the "customers' virtual elevators," which only customers who buy something can benefit from (row 2 in Table 1).

Keeping in mind that both virtual elevator schemes entail important operation costs, customers are not likely to accept paying extra fees to finance the trips of "free riders" who visit superstores without spending any money. In the following considerations, the name "virtual elevator" will therefore be applied to the "customers' virtual elevators" category (row 2 in Table 1).

Table 1. Typology of Schemes that Associate Business to Free Public Transport Services: "Miles" and "Virtual Elevators"

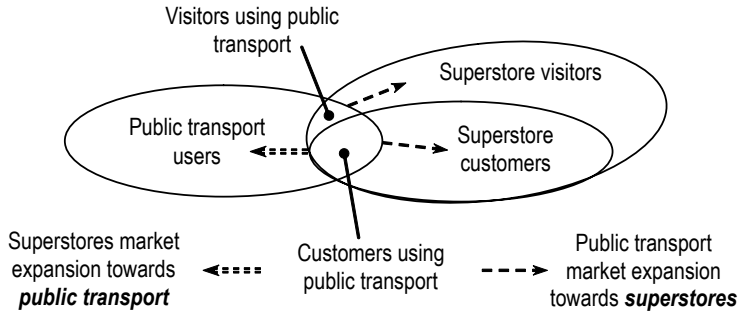
Scheme	Conditions	Who Benefits?	Who Pays?	Cross-financing
"Common Virtual Elevator"	Be within an affiliated shop	Any visitor who travels with public transport	Superstore (all customers who buy something)	All customers pay a fee of about 2% of shopping expenditures that finances the "common virtual elevator." However, the 2% figure seems optimistic, since the scheme shall prove expensive, as all visitors may enjoy free rides, even those who spend no money at all at affiliated shops.
"Customers' Virtual Elevator"	Spend money at affiliated stores	Customers who buy something and travel with public transport	Superstore (all customers who buy something)	All customers pay a fee of about 2% of shopping expenditures, while only part of them actually use the free transport service
"Miles"	Regular travel and spending at affiliated shops	Customers and frequent transport users	Superstore (all customers) and transport co.	Fee of about 1%, which is included within the spending. Frequent in air transport business. Many miles unused (threshold effect).

New Market Potentials

Virtual elevators encourage superstore customers to use public transport, while they simultaneously encourage public transport users to visit superstores and shop within their premises. Hence, virtual elevator schemes represent typical "win-win" agreements between superstores and transport operators. Both seek to gain new clients from the group of the others' customers: they share markets which are complementary, and which do not compete against each other. Such a clear-cut and positive situation seldom occurs in practice.

The apparent autonomy of the virtual elevator concept could give the impression that there is no reason for any sort of state involvement. Still, we will see below that this kind of development is likely to generate problems that market forces do not resolve.

Figure 1. Market View of the "Virtual Elevator" Scheme (Free Rides): Superstores Seek to Attract Public Transport Users, while Transport Companies Expect to Derive New Users from Affiliated Stores



Outcomes and Questions

We shall inquire how the overall system (smart cards, virtual elevator scheme) may change the life of citizens: more precisely, how it may influence users' private lives, modify competition between businesses, and impinge on the use of public resources. Three assumptions have been made:

1. Any customer who spends money at an affiliated superstore or company gets a free day-return on a public transport line that gives access to the business in question (virtual elevators are dedicated to customers only).

2. Superstores and affiliated companies have established close cooperation with (or ownership of) urban transport operators. Municipalities may be involved as well.

3. Virtual elevator schemes are run in densely populated areas with high economic activity, where regular overcrowding occurs at peak hours.

The financial transaction company that launches and runs the complete scheme stands at the crossroads of information, finance and — in short — power. This company comes out as the obvious winner of the scheme. There is no clear winner or loser among the other participants: all have a role to play and the way they play it will determine the impact of the virtual elevator on society, on the economy, and on the environment. The following outcomes and flaws require most attention.

Although elevator schemes have a strong potential for improving participants' access to places in urban areas, advantages remain unclear for society

as a whole: the most important fraction of all citizens are non-customers, who hence miss out on all the advantages, and so do the businesses that stay away from the scheme. Besides, there remain doubts that road congestion problems can be solved just because a number of customers shift from private motoring to public transport to reach a given set of spots in a city. In short, the most significant benefits remain in the hands of participants; these benefits do not trickle down any further.

Weaknesses of elevator schemes show a similar pattern: they mainly affect participants, and they have a more moderate effect on wider circles of society. Two of these weaknesses can be treated properly. First, the potential commercial disadvantage for non-affiliated businesses (more expensive access) is a business issue, even though small businesses may not be able to finance the equipment necessary for entering into the scheme. Second, overcrowding at peak hours is commonly considered as a traffic management issue. Professionals can manage such questions, at least those for which they are trained.

Nevertheless, three other weaknesses appear more critical and should not be left to market forces only. The first is the potential reinforcement of monopolistic cartels. Businesses could build alliances along the transport chain: a superstore could create an alliance with a transport company that stops nearby and with an important estate owner within a given area. The three partners would then provide free trips between the estate and the superstore, which would have the effect of virtually extending the superstore premises up to the estate. Such a strategy could be considered as an unfair competition against non-affiliated stores.

The way wide alliances of businesses may share customer information is the second flaw that can generate potentially severe side effects: how far, for instance, can someone's temporarily insolvency information trickle down the alliance? In the case of a consumer not being able to pay for the goods he intends to purchase in a superstore, would some form of statement reach his landlord's ear? Or could all superstores of an alliance refuse to accept the credit card from someone being involved in a lawsuit with his property owner? And in either of these circumstances, could anyone imagine his electronic public transport pass being purely cancelled until any sort of conflict with alliance businesses is resolved?

The third weak point is that the state and municipalities would lose a substantial part of their sovereignty over public transport strategies if they let private businesses set purely commercial rules for transport fares. There would be an impact on the political agenda in the longer term since such a development philosophy questions the essence of public services for which citizens vote and pay taxes. If access to schools and other non-profit

activities is expensive, while free to large shopping areas, these people may wonder who is ruling the city.

In addition to the above-mentioned weaknesses, virtual elevator schemes provide a wide range of uncertainties for all participants. On the potentially positive side, there are commercial and operational outcomes (for transport companies). Virtual elevators are expected to encourage people to shift from automobiles to public transport, which may increase operators' profitability, while slightly lowering pressure on congested roads. Nevertheless, scientists believe that such "traditional" benefits of information technologies remain unclear (Banister and Stead 2004).

But amongst the uncertainties some may also lead to potentially negative outcomes. Competition is an obvious issue: Non-affiliated businesses located near affiliated ones, especially those which form geographically important clusters of "non-free public transport," will lose clients as they become comparatively less accessible. Then, a risk management question arises: The risks associated with the systems' implementation and ticketing involve important liabilities, for which insurance may be needed. Nevertheless, these risks mainly represent engineering, management and business issues which professionals should be able to keep under control.

The use of public finances raises another question: If the state supports public transport by making land more affordable than pure market conditions would do, by lending money for building infrastructure, or for rehabilitation, or by subsidizing non-profitable services, then it is not clear whether citizens would agree with tax revenues being spent on supporting a transport system which is then used as a virtual elevator on certain lines? Maybe they would if they had a say in where to locate such elevators (near where they live and shop), but such public involvement has not been proposed yet. Here again, the state and municipalities have to play their role and set priorities that match the common interest. Still, the effect of increased demand on subsidized services remains unclear: more travelers enable a more efficient use of the system, which decreases marginal costs. But the benefit may not suffice to compensate for potential additional operating costs, which may, in the end justify higher total subsidies.

Yet the most problematic uncertainty is the one to which the public is exposed: it consists of the misuse or abuse of electronic data. The smart card payment system contains and transfers data concerning purchases, financial accounts, habits, names, locations, phone numbers, and usual travel behavior. Therefore, those who may have access to the whole range of data, legally or not, have the possibility to identify customers extremely precisely, and they would be in a position not only to profit from the situation, for instance by targeted advertising, but even to abuse it. This issue

is crucial because transportation data add a supplementary dimension to citizen privacy: people can be tracked and traced with ultimate precision and in real-time. The following section highlights the sensitivity of this issue.

Privacy vs. Marketing

With real-time tracking and tracing of all cardholders along the network, businesses can further tighten the cybernetic loop that connects them with potential customers. If marketing companies have access to a range of travel behaviors and purchase records which they can match with stimuli to which cardholders have been exposed to, what would prevent them from establishing some form of psychological profile for making marketing far more efficient?

Just imagine this: it is 7:00 p.m., a passenger is coming back from work, exhausted and hungry. One minute before the Ikebukuro station, where he has to change trains, he receives an automatic voice message on his mobile phone:

"Dear Masato-san, you are arriving at Ikebukuro station. Did you know that Tobu stores are launching a new series of "evening-sushi"? I am pleased to invite you for a free tasting tonight. The new sushi bar is on Tobu ground floor, just on your way to Yamanote line. Tasting would just take one minute, you then can catch your Yamanote connection as usual. And, tonight, we can even prepare a small gift dedicated to your wife Yukiko if you just reply "YES" to this message. The free gift will be ready for you at the Tobu sushi bar as you pass by. . ."

Of course the passenger knows that the message has been prompted by a computer, based upon the data he himself provided before receiving the card as well as while traveling and buying things, and he is probably aware that he did nothing more than trigger a program as he passed the platform gates. Nevertheless, such gentle intrusions into private life, carefully tailored according to customers' habits, time and location, is far more persuasive than hundreds of traditional advertising campaigns. And even if the passenger does not follow the incentive he receives at this precise moment, he is very likely to reveal how he reacts to advertisements while he carries his smart card, which lets the data operating company investigate his behavior and then reach him exactly at the moment he may transform an intention to purchase into an act.

Among all of the stakes considered so far, privacy appears to be the most significant. It seems, however, that it is also the most unclear element of the virtual elevator concept. Privacy needs to be successfully guaranteed before

any attempt at implementation. Therefore, before seeking a conclusion on the global concept, we need to analyze the privacy problem; that is, how the personal data would be created, where it would circulate, and what would happen to it after use. This will lead to a new system architecture that should help avoiding the main flaws.

Data Lifecycle and System Architecture

The overall procedures that enable virtual elevators must allow for three types of function: (1) they must transfer data for commercial transactions and marketing analyses; (2) they must analyze data, validate it, send invoices and (possibly) advertise; and (3) they must ensure that privacy requirements are met. The operational process is described as follows:

1) Data collection and transactions: The gates located in superstores and at transport interfaces transfer users' requests to the company that administers the database.

2) Analysis and billing: The database operator checks whether the user is entitled to the services requested and, in the case of the deal being accepted, the billing company gets involved. Usually the companies which provide private data — superstores and transport operators — do not directly exploit it, but rather they gather aggregated (hence impersonal) data for improving their services.

3) Marketing purposes vs. confidentiality requirements: As the case of Japan suggests, the database operator is in a position to make very fine analyses that may serve marketing purposes; nevertheless, such potential is limited by the fact that, according to law in many industrialized countries, the operator must guarantee extremely strict confidentiality. For instance, in the Cyberrail project, under Japanese law, Ogino (2005 B, pp.7–8) proposes to protect privacy by cleverly separating the cardholder's position information from his or her identity data. In this context, the state acts as a regulator, making sure the laws are adequate and obeyed by all those involved. Still, concerns about private or even public Orwellian surveillance remain (Orwell 1949).

Now we can extrapolate general practice in electronic commerce to the virtual elevator case. On the contract, the "business side" participants (billing companies and database operators, superstores, and transport companies) clearly explain the kind of services they supply to customers and the behavior they expect from them. But customers' questions and concerns are likely to be brought up only later, in the case of a problem. Unfortunately, abuse of personal data, for instance, may put a customer

in a very bad situation extremely quickly, and by the time justice is carried out the damage may be irreparable.

It is extremely difficult for the users to evaluate for themselves, whether there are risks to participation since the full system architecture is not transparent to the user. In terms of data processing, we may expect to find information technology experts miles away from lay people, which would seriously compromise the outcome of any direct dialogue between them. At this point, we see two ways of bringing the parties closer to each other: (a) by providing a sequential analysis, where each information process is carefully described and linked to all those that may potentially follow, or (b) by exploring potential outcomes, actions, and expectations at the most significant steps, after the continuous process has been broken down to a set of "meaningful" snapshots. Even though the first approach (a) would reduce the interpretation gap between experts and lay people, we reject it here since it would still require that potential card users possess a high level of data processing familiarity. On the contrary, the synthetic approach (b) would focus on essential operations which all can understand, such as those listed at the start of this section, i.e. data collection and transactions, data analysis, use of results, plus the final stage of data removal. Experts, then, may consider the issues at stake during each operation and provide answers or design a system architecture that responds to the needs of concerned customers and stakeholders. These issues are displayed in Table 2.

Next to technologies, the steps listed above obviously involve regulatory issues. The problem is that there is no established advocate for the future customers in designing the system. This is due to a deliberate business focus, which, due to market forces, is assumed to encourage customer participation without design input. Table 3, displaying public concern about electronic transactions via smart cards (SDPC, 2004), clearly shows that most questions relate to privacy, not to business. Efficient information technology is, of course, an essential prerequisite for the virtual elevator scheme but, on its own, it does not suffice.

Data operators, state agencies as well as private companies, need to build trust between affiliated partners and customers. They should not only provide detailed information on their objectives and on the data they will handle, but also demonstrate compliance with the regulating agency accountable to the public.

Table 2. Individuals' and Private Participants' Roles and Expectations during the Data Lifecycle

Participants	Data Lifecycle			
	1) Collection / Transactions	**2) Analysis**	**3) Use of results**	**4) Data removal**
Individuals	Provide private as well as optional data.[1] Expect confidentiality	-	Convenient payment	Expect to receive notification after data has been removed.
Billing and database operators	Gather private data and protect against unauthorised access	Expenses & travel behaviour	Check creditworthiness. Produce financial transactions and bills	Store and protect data during a given period of time (contract). Delete data (definitely)
Other stakeholders (superstores, transport co. and other businesses)	Transmit a limited flow of data at tills and portals	Optional part and anonymous aggregates	Marketing, stock or supply management	Remove data (definitely)

[1] Optional data adds information to the mere identification number, but it does not threaten privacy; it may contain age group, gender, customer program affiliations and preferences. On the contrary, name and address belong to private data. They are not considered "optional."

Implementation Strategies

Implementation and Project Lifecycle

Having highlighted the main stakes of the virtual elevator system, we have deepened our analysis of information processing, splitting the process into four snapshots (Table 2), in which we then examined the most sensitive issues (Table 3). As the essential objective of this paper is to consider the contribution of virtual elevators to sustainable transport policies, we now have to connect our findings to the virtual elevators' implementation process.

As it is in a position to control information as well as finance, the database operation and financial transaction company is the "natural" instigator and promoter of virtual elevators. The promoter seeks commercial partners and support from governments, with whom he shapes the project structure and its implementation strategy. Marketing services shall of course have interviewed a selection of potential customers in advance, but we can see that customers are thoroughly involved (Table 4, raw "operation") only

Table 3. Most critical issues from a citizen's point of view. See the importance of privacy and data protection.

Data Lifecycle Steps	Questions
1) Collection/ Transactions	What is the exact reason for collecting every single piece of data? What kind of analysis will be carried out and by whom? Who will have access to what data? How is my data protected against any sort of abuse? Where is the database located (country & place)? How long will my personal data be stored? What sort of information do I get?
2) Analysis	How is my privacy protected if data is transmitted to other companies for marketing purposes? (for instance by randomizing, or aggregating personal data) Will analysts intend to carry out cross information traces? (look for interactions between smart card data and data stemming from other payment systems, such as credit cards) What may happen to me in case of abuse of the system?
3) Use of results	Who gets the analysis results? (Just the billing company, or transport companies and affiliated stores as well?) What shall I do in case bills / records do not match with my behavior? (If, for instance, the billing company has failed to deliver free trips, or if fees do not match with actual journeys) May any of the partners use partial or aggregated results for targeted advertising? (such as customer localization and direct announcements by mobile phone)
4) Data removal	Who is in charge of removing data? What is the procedure for doing so? Is any body/institution responsible for checking that no data somehow remains after the process has been completed?

Adapted from: Swiss Data Protection Commissioner, SDPC 2004, p.10.

after the full system has been implemented. At that stage, no important changes can be made for incorporating citizens' concerns and, among others, better safeguarding their privacy.

The state is the only participant which can potentially represent citizens during the earliest phases of the project. It may influence the scheme's conception, implementation, and operation. It may also set the rules that regulate its termination. But state regulation on business activities does not suffice: one still has to suppose that some cases may exist in which law-breakers attempt to read more data than they are allowed to. The main

Table 4. Participants' Roles and Expectations in the Main Phases of a "Virtual Elevator" Scheme

Participants	Scheme proposed	Actions, roles and expectations during project lifecycle			Dismantling
		Negotiation and Consultation	Implementation	Operation	
Citizens	-	-	-	Some of them may benefit from free rides	-
Database and Billing Co	Proposer	Expects Return on investment (ROI)	Coordinator	Database handling and billing; data removal Transmitting of profiles* to partners	Coordinator Database Destruction
Affiliated Superstores	Partner	Expects ROI More clients	Partner, in charge of hardware at superstore	Levy fee Send data for billing Use profiles* to optimize marketing	Dismantle hardware at superstore
Customers at affiliated stores	-	-	-	Pay a fee on all items purchased Qualify for free rides	-
Visitors	-	-	-	No free rides	-
Public transport co.	Partner	Expects ROI More users	Partner, in charge of hardware at stations	Send data for billing Use profiles* to improve service	Dismantle hardware at stations
Public transport users	-	-	Change in habits	More convenient use & charging	-
State/ Municipalities	Provide service requirements	Specify conditions** Right of veto	May provide funding Control	Regulator: May subsidize or levy tax Control	Set minimal requirements Control

* In order to guarantee privacy, the billing company aggregates data into anonymous "profiles" (or groups of non-identifiable individuals) before transmitting them to partners.

** Such as legal requirements (privacy, accountability), ethical issues (use of personal data, fair competition) and development strategies (especially adequacy with mid- and long-term planning policies).

problem is that cardholders have no control of the information retrieved from the cards when they pass electronic gates. Therefore, in addition to designing a system architecture that enables responsibility and efficient information flow, we must also clarify what sort of information participants will store on their cards.

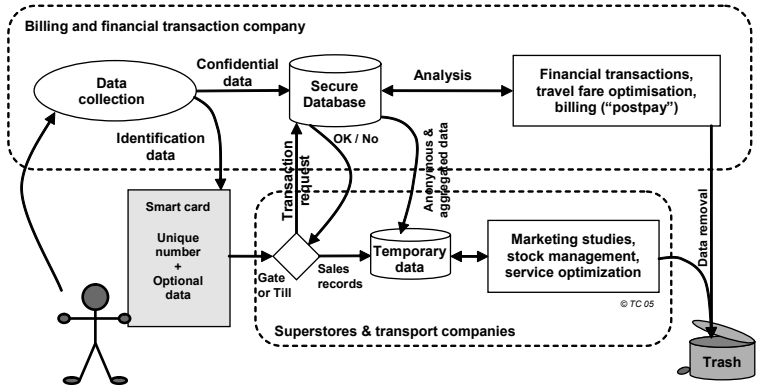
Process and Privacy: How Smart Should Smart Cards Be?

Safeguarding citizens' privacy vis-à-vis commercial interests requires not only that personal data should not be used for individualized marketing but that the database operator and billing company are completely independent from the other partners (superstores, transport operators, estate owners, and so on). It is not enough to presuppose that problems are unlikely to arise. Such independence between information and power must be guaranteed by the law, and public authorities should take the necessary steps.

Decoupling information and power means that each time a given task has to be performed, only the amount of information that is sufficient and necessary is made available, which calls for "not-too-smart" cards. This principle may seem abstract, but its application has crucial consequences. To give an example, imagine a very basic structure for data processing in a virtual elevator in which smart cards do not contain any private data (Figure 2): Confidential data is stored at a single place only, i.e. within the transaction company database. Smart cards allow for holder identification (unique number) and they may contain optional data (related to groups, but not affecting privacy). Confidential data is only transmitted in an anonymous, aggregated form to partner companies.

With this structure in mind, let us take a typical case. Customers who intend to participate in a virtual elevator scheme become members after they have indicated their identity, place of residence, and salary to the database operator. These data are strictly confidential. Once the data operator and the billing company have this information, the new member needs neither to carry it along anywhere nor to transmit it to anyone. Then, when a purchase is made, it is sufficient that the salesman knows whether the cardholder is able to pay for the goods being purchased. This means that the smart card may, in this case, only transmit a single identifier, such as a number, which the database operator compares with the client's account and the cost of the goods to be purchased. There is no need to transmit private data, as it is already at the place where the data are being processed.

Figure 2. Data Lifecycle for a Virtual Elevator Scheme in Which Smart Cards Do Not Contain Any Private Data



The case for public transport is quite similar: the cardholder is identified when he or she passes the electronic gates and the identifier is sent, together with the gate location and the time to the data operator for processing. Journey and fare are then determined and the information is transmitted to the billing company. This means that the best way to safeguard privacy, on the cardholder's side, is to strictly minimize the information content of the smart card. Theoretically, that minimum might be a single number. Then it is possible to add another number for cross-checking and, on top of this, the card may contain a few optional pieces of data (gender, age group, and the like) that superstores may directly use for marketing purposes. Still, it is essential that this data not contain any sensitive (that is, mainly personal) information.

Summary and Conclusion

This paper has explored the implications for citizens, the state and other stakeholders, as well as for sustainable transport, of using a single smart card system to charge customers for goods and reward them with journeys on public transport. A special feature of smart cards is that they are able to communicate with financial and billing companies at nearly any distance. The Japanese finance company Surutto Kansai proposes to use a new smart card system as a single means of payment for public transport, superstores, and other purposes. In this concept, smart card holders would receive free journeys with public transport when they shop at affiliated superstores. This fare exemption would be compensated by a fee of approximately 2 percent that would be levied on all purchases. This scheme can be interpreted as the commerce drawing a parallel between public transport and

superstore elevators, with full integration of transport expenditure within the superstore's operating costs.

Such a smart card system not only allows superstores to extend their zone of influence into the external world, but should also stimulate a shift from private motoring towards public transport (Figure 1), hence reducing car-related problems and saving parking spaces. Public transport companies would be able to take new users onboard and they could pass fare calculations for all smart card holders to the billing company. That company could even facilitate the transfer of travelers between various operators of transport because it has the data on all the completed journeys. By gathering the great diversity of metropolitan transport systems into a single and homogeneous unit, the virtual elevator provides a good example of how new technologies enable the invention of a new range of services.

Implementing virtual elevators delivers important assets in favor of a more sustainable urban mobility. Nevertheless, the advantages should not conceal the difficulties and risks. Questions remain about some fundamental issues. First, and perhaps most serious, is the difficulty of ensuring that citizens' privacy is not threatened in that cardholders transmit confidential data to the billing and financial company. Cardholders must receive a full guarantee that data will only be used within the defined framework, and only for the purpose stated and that it will not be transmitted any further. The holder must also be sure that the database will be protected against any unauthorized external access. Finally, all data must be definitively erased after a given period of time, or once the contract has ended. We suggest a system architecture (Figure 2) that clarifies technical privacy issues.

A second question relates to the use of public funds that have been assigned to public transport. Generally the taxpayers support public transport by means of state subsidies (for provision of infrastructure, maintenance, non-profitable services, and so on). But virtual elevators have a fundamentally commercial objective. Should they, nevertheless, benefit from public money as well, or should their fares merely reflect true costs? In this perspective, the virtual elevator can be considered as a value-capturing system, by which the stores along the transport line return to the public transport companies a part of the benefit generated by improved access.

Then there is the question of discrimination among stores. Superstores gain obvious commercial advantages when they extend their zones of free mobility into the external world. But this questions the limits of fair competition between businesses: the stores that are not equipped (particularly the small ones) with the electronic devices for running smart card schemes become less accessible. These stores will be discriminated against. Moreover, if the fee consists of a fixed percentage of the sales amount, whereby a customer may get one ticket or none, all shops which

generate smaller sales by customers than the superstores are penalized: in the end, they collect a lower fee, while still having to finance a given number of free tickets.

The obvious leitmotif associated with virtual elevator concepts, whatever they are called, is the promotion of public transport . Indeed, public authorities as well as citizens are keen to consider such initiatives as "sustainable" or, for projects in developing countries, as examples of Clean Development Mechanisms (Kato et al. 2003) and, therefore, worthy of support. We have assumed this so far. Still, one may wonder whether the public transport aspect is being used as a socially strong argument to persuade politicians and might later be extended for also financing "free parking" or "free gasoline" or both. If virtual elevators merely follow business rules, they may extend to any kind of transport. As long as promoters do not commit themselves to stick to sustainable mobility, there is no reason to believe that they will do so. They may extend the scheme to private motorists as well. This issue needs to be clarified. Public authorities can play a role here, discussing the system with the promoters and setting rules that guide the implementation of travel policies, and hence their effects, in the long term.

A customer may view virtual elevators as "free transport," which is only part of the global picture, since they entail important costs. Nevertheless, virtual elevators may be justified, even if the public transport is subsidized. The main issue is to make sure that superstores bear the costs appropriately, without passing them to the public transport system. Assuming that the state's involvement in virtual elevator schemes would not generate obstacles to healthy innovation, there is still is an important need for regulation. The outcomes analysis and the study of the data lifecycle (Table 2) demonstrated the importance of the state's role in terms of privacy: it is hard to conceive that any other authority would ensure that people could preserve their rights. As institutions, the state and municipalities may suggest which questions people ask before entering into any such schemes (see, for instance, Table 3). They may also provide legal support to citizens. Holistic investigation of the virtual elevator lifecycle (Table 4) defines the context in which the state and municipalities have to set rules on privacy and legal limits, and the extent to which these need to be clear. This is what we would call "smart regulation": letting business forces act where they are doing well, especially in innovation, while simultaneously making sure that competition and the quest for profit remain ethical. The uncertainties that surround the implementation process support the argument in favor of the state's and municipalities' strong involvement as a guarantee that the policies follow their "genuine objectives," that is, that they cannot be biased toward mere commercial advantage and possibly environmental damage after their most profitable part has been implemented. Finally, in terms of infrastructure and operational subsidies, the state needs to have a

very clear picture of public money use: when it comes to financing private profit, public resources should be assigned only after services have been exhaustively specified, with clear explanation of regulatory regimes over a long term.

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Tristan Chevroulet *is a researcher at the Swiss Federal Institute of Technology, Lausanne. His research focuses on the interface between transportation, environment, and energy. He has worked as team leader for Daimler-Benz's Smart Car and as associate to the president of a national research programme on the interactions between transportation and the environment (CD-ROM: http://lem.epfl.ch/francais/cd_pnr.htm). He reviewed proposals on transportation and sustainable cities for the European Commission, and he regularly conducts analysis for the Observatory for Transportation in Europe. He wrote this paper during his stay as a visiting scholar at the University of Calfornia Transportation Center (UCTC), Berkeley.*