

Emerging Private Sector Roles in Urban Transport

Case Study of an Innovative Telecom-GIS Solution in Bangalore

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1 Introduction

India's tremendous economic and social transformation has engendered equally tremendous impacts on urban transport and livability. It is also beginning to create unique opportunities for innovation and development. This is a story of a hidden success in Bangalore, highlighting not only *what* is being done to improve urban transport in a growing city, but also *how* it is being done and *with whom*, and the hopeful prospects this creates for the future in Bangalore and beyond. Some aspects of this story could be applied in other contexts, potentially helping to move India to the forefront of urban sustainability in general, and of the emerging New Mobility industry in particular.

In the Indian cities where the information and telecommunications industry has led the way to economic development, the manufacturing, real estate and construction sectors are reinforcing this rapid growth in wealth by responding to and modifying individual aspirations for a growing consumption of private goods, particularly housing and transportation. Such agglomeration forces have increased the pace of urbanization, more strongly attracting migration from rural areas and small villages to new employment and education opportunities and higher standards of living. Both the expectation and reality of rapid urbanization have significantly increased real estate prices, making downtown land

scarce and very expensive for industrial and residential development. As a result, businesses have taken to building private campuses in the urban fringes, where they have the space to develop pleasant places to work that attract highly-skilled employees and to support future expansion, regardless of whether roads or other forms of transportation to the industrial sites exist. Oftentimes, companies build the roads themselves with the support of government agencies that welcome the economic activity. Residential suburbanization follows a similar pattern.

With increasing population, peripheral expansion and a growing economic base, Indian cities have witnessed a tremendous rise in the number of motor vehicles plying on the roads. The existing infrastructure has not adapted to these trends, greatly increasing pressure on road space, and making traffic and other environmental and social conditions increasingly difficult. The predominant policy response is to build new road infrastructure. This has been motivated by two factors. The first is the fear that the lack of infrastructure development is holding back the growth of GDP, which makes India globally uncompetitive. Developing economies have been able to pull their countries forward by investing about 10% of their GDP in infrastructure. The second factor relates to the immediate response to political pressure to alleviate traffic congestion by expanding the road network. This alleviation is only temporary, however; increased road capacity attracts more vehicles and encourages exurban land conversion, leading to longer commutes, ever increasing congestion and accident rates, loss of productivity, excessive fuel consumption and environmental deterioration. Cities now occupy much larger areas and are more congested. It takes at least double the time to travel during peak-hour traffic; 45 minutes can be easily spent going down a short stretch of street.

The rapid transformation of Indian cities poses a new kind of planning challenge, putting pressure on government agencies to provide immediate solutions to complex urban transportation problems, where the confluence of multiple factors and actions—including planning solutions—contribute to the current gridlock. Such complexity requires innovation and flexibility both to move with the country’s rapidly evolving economy and to learn how to do so in a manner that enhances positive environmental and social quality. This is possible through new institutional arrangements that integrate perspectives, needs and tools developed in all sectors of society, particularly in the private sector. One city in India is an example of the successful implementation of such a framework.

In this paper, we describe an innovative approach developed in Bangalore. It combines information and infrastructure provided by the private sector with leadership and support of the public sector to tackle congestion and to stimulate new business opportunities at the same time. We also describe a larger context in which such examples can be applied not only in other Indian cities, but in urban regions worldwide, fostering new and positive roles for the private sector and supporting the emergence of a sustainable New Mobility industry globally.

2 Case Study: Bangalore, India

2.1 Bangalore’s transportation problem

During much of the last decade, an average of 600 vehicles has been added to Bangalore's roads daily, nearly all of them privately owned. For a city historically imagined and built

as an idyllic centre of academic research and a retreat for pensioners, this transformation has been unbearable.

With little sign of this phenomenal growth abating, there is now great worry that without a rapid injection of new infrastructure and public administration, the city's potential for the future may be at risk. New infrastructure can take several years to build, during which time there is likely to be even greater pressure from increasing population and growing affluence. Thus, even as plans for widening roads, adding more buses to the city's fleets, and rezoning areas are currently being implemented, it has become necessary to focus on the management of traffic and transport so that some of the gains can be had right away.

2.2 Towards innovative solutions

With these challenges in mind, a comprehensive program for traffic and transport improvements was initiated, under the aegis of the Chief Minister's office. The ten-point agenda of this program focuses on improvements that can be attained in the near-term, even as the larger task of re-anchoring the city in its new infrastructure is underway. The Bangalore Traffic Task Force, headed by the Home Secretary and whose Member Secretary was the Additional Commissioner of Police for Traffic, was charged with implementing the agenda of the program.

During much of 2006, and until late June 2007, the Bangalore Traffic Police (BTP) systematically examined the potential use of modern information technologies to bring creative solutions to the transport challenges facing the city. It was understood that in a complex environment, the provision of good information to citizens and administrators could vastly improve the rationale behind decisions made by road users as well as public

officials. It was also clear that with the advent of recent Internet technologies, and growing convergence behind the World Wide Web and mobile telephony, there is now an opportunity to develop and use information platforms and systems to make transport information widely available, including in real-time. To this end, an integrated system to facilitate a range of different information needs was conceived under the name Bangalore Transport Information System (BTIS).

One effort which appeared promising from the outset was the potential use of cell phone/GIS data as a tool for traffic information and management, as well as for transport planning. The research behind this focus sought to capitalize on emerging trends in communication technology in three principal ways:

1. Since nearly four out of five adults in the city now carry a mobile phone, the BTP decided to investigate whether, by tracking the number of phones in use at various locations around the city, the level of congestion in each of these locations could be determined.
2. For the same reason—i.e. wide-spread availability of mobile devices—information from the real-time system could be delivered to millions of users in real-time, facilitating more informed decisions by each of them.
3. Since cell phones are typically carried personally, their locations at different times of the day can provide snapshots of intra-day mobility, which is an important driver of traffic.

Together, these capabilities would form the core of the information and management system that was envisioned, and if these could be developed in an integrated manner, the resultant system would provide an important backbone for the administration of public spaces in the years to come.

2.3 Forging innovative partnerships

The idea of using cell phones as proxies for people and converting network data from mobile service providers into traffic information has gained ground slowly in recent years. In some parts of northern Europe, and in a few locations in North America, cities and carrier service providers have created traffic information systems based on mobile logs.

In Bangalore, however, it was planned to create a system in a highly populated urban area, something that had not been attempted elsewhere. In semi-urban and rural areas covered by highway systems, there is great separation between the towers of carrier companies, and it is easier to distinctly detect the movement of people between locations. But in urban areas, there is much higher uncertainty of location, as several roads can lie within the footprint of a single tower. BTIS would have to demonstrate the usefulness of the technology in urban spaces, and if it did, it would be the first instance of such innovation anywhere in the world.

This challenge was addressed and tackled by the coming together of three different institutions, each playing to its own strengths and together creating the capabilities of the overall system. The city's traffic police decided to anchor the development of the system on the governance side, and engaged the heads of various city departments to convince

them of the usefulness of the system that would be developed. Mapunity Information Services, a social technology startup incubated at the city's prestigious Indian Institute of Management, volunteered to develop the algorithms that would convert mobile carrier data into traffic information. And Airtel, the largest carrier service provider in the country, agreed to open its data network to Mapunity for this purpose, and to deliver traffic information to millions of residents through its network.

The initiation of the project, its development, and subsequent management have been governed by very different institutional and partnership arrangements, and it would be incorrect to try to understand them through a linear lens. Instead, we provide separate explanations as to how the various phases operated.

Just prior to the initiation of the project, both the Bangalore City Police (BCP) and Mapunity were independently aware of the rising use of cell phones in some western countries to understand and manage traffic-related problems. Discussions between the BCP Traffic Commissioner and Mapunity's CEO about the possibility of trying this in Bangalore made it clear that such a project would require data from a major cellular service provider. The BCP and Mapunity jointly approached Airtel. The project's boundaries were not defined through negotiation, but rather through recognition of mutual benefit from a shared activity. Airtel immediately recognized that its phone towers could be positioned in high-congestion areas, allowing them to serve their customers better. The BCP were in turn interested in the volume of cellular traffic in these areas (as a proxy for congestion). The benefits for both the BCP and Airtel were therefore very clear: Airtel would get permission from city authorities to install its tower

in key areas, and in exchange would share data from all its towers with the BCP.

Mapunity offered its intellectual properties for free, asking only for funding to cover the cost of processing the data and converting it into traffic information, which Airtel readily agreed to do. Mapunity and Airtel held separate negotiations over this cost, primarily to determine whether Airtel would consider it a Social Responsibility—the predominant perspective in the initial stage—or a Business Development effort with clear economic advantages—the current perspective. The actual operationalization of the project was left largely to Mapunity once the towers were installed. Mapunity and BCP held meetings periodically to review the readiness of the project for city-wide launch, which was completed by May 2007.

There was a plan to have a Memorandum of Understanding between all of the three parties (BCP, Mapunity, Airtel) but this did not happen; the cooperative atmosphere was sufficient to keep its momentum going. Each partner was clear that the system would deliver benefits specific to their own objectives. The BCP would facilitate the creation of a system that could greatly strengthen knowledge of traffic conditions in real-time and potentially anchor a robust management solution thereafter. Airtel, as a major corporation, would contribute resources to a social responsibility initiative of great significance to urban areas, and also strengthen its network in the city in parallel (discussed in the following section). Mapunity, as a social technology company, would get the opportunity to work on a compelling social (and environmental) problem through creative use of technology, and was content to receive funding for its work from Airtel. This loose arrangement has held even 18 months after it was entered in February 2007.

The strength of the partnership lay in the clear complementarity of the roles played. Each partner would focus on their own core competence, and the strength of the system would depend primarily on the seamless integration of these strengths. Airtel was expected only to provide data and commission the towers, Mapunity was to process the data and write algorithms, and BCP was to ensure government permission for the installation (in road space) of towers as well as other equipment needed for the project. BCP was involved in the design of the service, and also in determining the particular types of information to be provided. From the beginning, this was presented to the public as a Police-led effort, albeit using private capacities and capabilities.

In this sense, it was an unusual Public Private Partnership (PPP). None of the functions of any partner were being sought to be transferred to the other. It was understood that the Police and the municipality should gain greater capacity for traffic management as a result of this project, and the goal was not to transfer that responsibility to the private sector.

One other key ingredient is 'championing' the project, a role that the Traffic Commissioner played robustly within the halls of public administration. There were numerous questions to be answered, and even administrative obstacles at times, but these were overcome through persuasion and the goodwill emanating from networks of public officials. Too many PPPs suffer without this; their champions are in the private sector. As a result, they end up as mere privatization projects, in the guise of partnerships. BTIS was different, in that it actively sought to build capacity for governance within the police.

There was one final significant strength to the partnership. If successful, BTIS would create—for the first time—a real-time traffic information system for a major metropolitan area without any investment from the city itself. Virtually all of the costs of the effort would be borne by private companies, and the system would be built with very little new infrastructure to be provisioned. As a model for reducing costs in other cities in the developing world, this could be greatly significant.

2.4 Building a prototype

The establishment of a city-wide system would need to be preceded by a proto-type operation in a few locations. To this end, it was decided that a portion of the system would be built covering the key east-bound arterial, Airport Road, and a portion of the south-bound arterial, Hosur Road. Eleven intersections at various points on these arterials were identified for real-time monitoring of traffic.

At each of these locations, Airtel installed a micro-tower, specifically designed to monitor traffic at the intersection. These towers have a narrow beam angle, and were installed in road-facing directions, specifically to serve only those users who were within this limited footprint. Based on the recommendations of the city traffic police, the municipality granted permission to Airtel for the installation of these towers on public spaces. Airtel also invested in the hardware necessary to download its network data in real-time on to dedicated computers, and made this data available to Mapunity for processing.

The scripts that were developed for processing the data worked on the Airtel machines themselves, and converted this into traffic information at each location. A web platform

for the dissemination of this information was also developed (www.btis.in). The entire traffic information created by Mapunity was also made accessible through text messaging on cell phones, and made free of cost to Airtel users (who constitute approximately 40 per cent of the city's subscribers), as well as to users of other networks on terms to be decided by them (Figure 1).

[FIGURE 1 HERE]

Through mobile Internet protocol, the web site itself could also be seen on higher-end mobile devices with the capability to browse the web. To make the platform a richer and more compelling destination, Mapunity also added a number of features—direction-finding, carpooling, signal education, alert services for regular users, etc.—turning BTIS into a comprehensive presentation of wide use.

The key determinants of the value of cell phone data for traffic monitoring are (a) timeliness of the data, and (b) its accuracy in reflecting traffic conditions. The extremely high volume of data that is generated by phone users in a city of this size has to be properly sifted so that only the particular information that is needed from key intersections is gleaned, and this has to be downloaded and analyzed as rapidly as possible. Airtel is the city's largest mobile service provider, and carries an enormous amount of traffic to serve its 2.7 million customers in the greater metropolitan area.

Through a series of reiterations, Mapunity reduced the volume of the data that would need to be sifted for BTIS, and improved the speed of its algorithms through caching. Airtel's investments in hardware also helped speed up operations. With the full city-wide system now in place, data from Airtel's live servers is converted into traffic information

and made available for delivery through various channels in less than a minute. Users who query the system on their mobile devices are able to obtain answers within 15 seconds, thanks to the priority maintained for this service in the mobile gateway. All this information remains free to the end user.

The typical cell tower's coverage area is a few hundred square meters, and often even a little larger. Even though most of the key traffic junctions are contained within one or the other of the phone company's cell towers, they nearly always include data from a number of users who are not strictly at or near the junction, but instead in buildings, minor roads and other places near the junction. To narrow down the coverage area, Airtel proposed the use of micro-sites whose coverage could be tailored to particular junctions in a way that would largely exclude these additional data.

Following four months of software development and hardware installation, the prototype was demonstrated to the administrative heads of various city agencies—the municipality, the police, the Home ministry, the Urban Development ministry, the public utility companies, and the city's main bus operator. A number of questions about the system were raised by those present, and clarifications were provided by the traffic police chief and Mapunity's CEO. The consent of this group was then obtained for the roll-out of the system city-wide.

This decision would prove momentous. Enough citizens care about the traffic situation in Indian cities to ensure that any attempt to tackle them gets wide word-of-mouth publicity. In Bangalore the active participation of the police was necessary to get the towers installed, but in other cities Airtel decided not to wait for this. The company sensed an

opportunity to pursue both its Social Responsibility goals and business interest in the emerging location-based services industry to build traffic information systems for other cities as well. Within eight months of the launch in Bangalore, Airtel and Mapunity launched similar systems for the other major cities of South India—Hyderabad, Chennai and Delhi. Plans include providing the service elsewhere too, including in Mumbai and Kolkata. With a backbone of information now available, numerous private and public entities have come forward to help develop the system further, and to deepen its social focus. Mapunity has also begun work on expanding its technology to address a wider range of urban administration needs besides transport (Figure 2). This evolution is a success story that is still being told, and could have great implications for the future of urban governance itself in India and elsewhere.

[FIGURE 2 HERE]

2.5 Emerging results and future prospects

It would be difficult to attribute changes in road usage or traffic patterns to the existence of BTIS alone. There are other developments (e.g., road widening, rising fuel prices, increasing number of double-income families, office re-locations, airport expansion), and “defensive” choices that road users make (e.g., not traveling altogether to avoid congested roadways) that also influence road traffic, and whose impacts are difficult to isolate. Notwithstanding, there are a few broad indicators of usage of BTIS, such as growing interest in its carpool information service. At any given time, about 1,200 people are actively looking for carpool partners using the system, and about 5,000 people have found partners through it so far.

The next challenge for BTIS is to develop the technology for user and policy decision-making, so that choices can be made both for live traffic movements (e.g., roads to avoid, nearby buses) as well as for overall transport planning (e.g., identification of areas underserved by public transport). This work is now underway, and involves creating technological management skills within a Traffic Management Centre, as well as real-time reporting skills among constables in the field. These represent considerable administrative and technical challenges, and it would be proper to measure the benefits of the system only after this piece is added to the overall effort. For now, we can say that with BTIS some of the necessary pieces for improved management of urban mobility are in place, and more are being added as we move forward.

2.6 From idea to enterprise class

Through BTIS, Airtel and Mapunity have been able to demonstrate that different, unrelated pieces of technology available in a society can be stitched together to address complex social problems, and that doing so can fulfill the business and social goals of organizations engaged in such work. Still, the creation of BTIS is only the first step towards what is undoubtedly a complex process, namely the development of an information and management system that can help public officials respond to the daily commuting needs of a city of six million people.

There are still many issues that will need to be addressed as the system is developed, such as ensuring uniform and total coverage of all neighborhoods, and developing a sustainable economic model for such projects. There is also a considerable technological challenge remaining to demonstrate that some interesting capabilities supported by

emerging technologies in video, remote sensing and other areas can be scaled to be city-wide systems quickly and affordably.

Notwithstanding these remaining steps, however, BTIS also provides reason for hope on two counts. First, the success of BTIS has given other cities reason to believe that their own complex information and management needs can be similarly tackled. The application of the same technologies to Chennai, Hyderabad and Delhi and other cities in India and beyond is already evidence of this. Secondly, it is apparent that with the first round of technology having been applied to gathering traffic and transport information, the necessary additional developments to create an enterprise class system that serves the information needs of millions of residents will now follow.

The development of enterprise class software to simultaneously serve different needs—e.g. a vehicle tracking system for fleet owners, a passenger information system for the city's bus services and mobile ticketing—requires the participation of other firms whose expertise lies in these areas. Already, Mapunity has witnessed expressions of interest from large corporations with the wherewithal to build such systems, and is actively exploring partnerships with a few of them. Mapunity has also been funded to conduct research in some areas, including the development of a vehicle tracking system, by the International Institute of Information Technology, Bangalore.

2.7 Capacity building in public administration in Bangalore

Developing enterprise class management systems is particularly important because Bangalore, like many other cities in the country, still does not have a functioning metropolitan transit authority that plans for the city's mobility needs and manages the

necessary pieces once they are created. Instead, traffic and transport are managed by a consortium of authorities from different domains, each with some expertise in their own operations but not yet as concerned with the impact of their work in an inter-locking space like transport.

The necessary integrated authority for such governance roles is not easy to establish, since any new entity would require authority over a number of other departments that now function autonomously. Such change is bound to include an uncertain period of transition. An operational information and management system within private industry, on the other hand, may just be the anchor around which a necessary, new structure for urban traffic administration itself could be established.

It is also worth remembering that numerous attempts to strengthen public administration have fallen short of the best intentions of planners and policy makers. Scholars of administrative reforms (Das 1998 ; Brugmann 2009) have recognized that one reason for the limited success is that the changes that are needed in governance are manifold, and that unless these occur in tandem, the advantages obtained from reforms in one or two arenas may inevitably be lost over time. The development of capacity within government for analysis and management of urban traffic can only be met by the establishment of three inter-locking systems for data collection, for data analysis and decision-making, and for information dissemination (Sussman 2000). A comprehensive platform of transport administration must tackle challenges in each of these areas. With BTIS, the first and the last of these have been substantially addressed, more so with the recent addition of police cameras city-wide. As a public information system directly available to individual

residents of the city, BTIS creates value for users of the information, and provides the necessary base on which to build more strongly. In creating such public information, the system also significantly reduces the asymmetry of information between those in government and the citizens, thereby increasing the potential for informed exchanges between the two, and catalyzing change.

3 Policy Implications and Emerging Private Sector Roles

A key factor in Bangalore's success is the involvement of industry, not only in the development and enhancement of transport and land use solutions, but also in urban governance itself, an approach that has been deeply promoted more generally by Janaagraha¹ and other NGOs and networks in the area. Traditionally, in India as elsewhere, government is relied on to address urban problems, while the private sector is engaged, if at all, in very prescribed ways through an RFP process once the problem and the solution have been defined by the public sector. Innovation for transportation is, in this framework, the domain of the public sector, particularly of planners and infrastructure engineers. This works well when problems are simpler and a few agencies are involved, but the existence of multiple dimensions, conflicting objectives, and rapid change imposes a challenge to determining clear courses of action by government alone. When such complexity and uncertainty permeate a problem, novelty is the key to effective and sustainable solution (Harrison and Burgess 2003; Westley et al. 2002).

¹ <http://www.janaagraha.org/>

The private sector has extensive experience and creativity for business purposes; applying that capacity in a collaborative setting with diverse participants earlier on in the solution-building process promotes innovative approaches (Page 2007). Businesses can apply their marketing expertise and knowledge of human psychological, cultural and practical transportation needs to innovate and commercialize new and more sustainable ways to move people, to move goods, and to move less. What is emerging is an integrated framework, “Public Private Innovation”² (as opposed to Public Private Partnership), in which a more diverse range of stakeholders engage early in collective reflection and description of the challenge of complex urban issues and their own roles in creating the challenge, enabling the development of trust, common understanding, learning and joint responsibility over management goals, thus directing future private and public action. In this manner, ownership is shared, relevant innovation is maximized, and adaptability is enhanced (Berkowitz, Nilon, and Hollweg 2003; Costanza et al. 2001a; Innes et al. 2006; van Eeten, Loucks, and Roe 2002). In partnership with public and non-governmental sectors, businesses can transform products, services, and technologies into solutions that shape and reinforce the emerging New Mobility market, while meeting societal goals at the same time. This goes well beyond the traditional Corporate Social Responsibility or purely design-build roles of the private sector in urban transport.

Beyond addressing urgent societal goals related to urban transportation, Public Private Innovation also catalyses local and global business opportunities. In a world where half—

² This “Public Private Innovation” concept was developed by the SMART (Sustainable Mobility and Accessibility Research and Transformation) Program at the University of Michigan, in relation to New Mobility research and implementation in India, South Africa, and North America.

and soon to be two-thirds—of the population is living in urban regions, sophisticated, multi-faceted and integrated, yet practical transport solutions are in hot demand. This Bangalore success story has brought telecommunications and technology into the urban transport solutions mix. It is just one example within an emerging New Mobility industry (Zielinski 2006), which brings not only telecommunications and technology solutions, but also new services, enhanced modes and products, and innovative infrastructure and design approaches that will benefit society and capitalize on a significant emerging market (Figure 3 shows examples of such services, products, technologies, and design and infrastructure).

[FIGURE 3 HERE]

In this larger context of multi-sectoral Public Private Innovation, public leaders in the urban transport sector will need to continue to evolve beyond strictly transport to embrace and link policies related to information and communications technologies, innovation, urban issues, energy, finance and economics, insurance, real estate, social equity and social services, freight movement, tourism, and more. Figure 4 shows examples of industries involved in the emerging New Mobility industry. Increasingly, municipalities are seeing and acting on the value of engaging private sector partners in regional economic development. For example, Toronto, Canada recently launched their regional transport strategy with a key (and significantly funded) component being New Mobility industry (economic) development (Moving the Economy & ICF Consulting 2002). Recently, major multinational corporations have begun to conceive of convincing New Mobility business models. Ford Motor Company's commitment to the Megacity

Mobility Initiative, Cisco Systems Connected Urban Development Program, IBM's SMART Cities Initiative, Ashok Leyland's work on IT-enhanced mobility products are just a few indicators of the significant global market that is presenting itself. They are also indicators of the urgent need to solve serious and growing transportation challenges if businesses and regions are to remain productive and competitive in an urbanizing world. As mode of example, IBM Service Management for Smart Cities supports a shared management framework designed specifically to manage the city through optimization of the urban system, rather than its parts. It does so by providing an information technology framework to collect and analyze data to identify trends and support the swift and cost-effective implementation of change (IBM 2010). IBM has partnered with Cisco Systems in efforts to reduce traffic congestion in large cities, with the goal to create a single intelligent network for traffic management and traveler applications (CISCO 2004).

Policy makers need to be enablers of these initiatives, becoming increasingly adept at removing barriers and providing incentives (both financial and cultural) to Public Private Innovation for New Mobility. Such barriers may include conflicting policies and standards, risk aversion, silo-based approaches, insufficient technical skills or lack of appropriate financing mechanisms to support innovative partnership ventures (Washburn et al. 2010). Incentives can range from providing new forms of financing and partnership support and guidelines, to crafting new overall policy directions, or acting as a link tank for cross-sectoral dialogue and implementation.

[FIGURE 4 HERE]

4 Future Research

A fluid interaction between the business and the public sectors is a key ingredient in Bangalore's success, and research will be a critical piece in supporting such initiatives in the long term. On one hand, the emerging innovation partnerships provide rich information for the evolution of novel and practical definitions and applications of economic development and urban sustainability. On the other hand, new knowledge and diverse methodologies are required for innovation and commercialization to occur and for the partnerships to evolve. For instance, Mapunity has built a valuable dataset with dynamic traffic information that can be assessed against land-use decisions to examine the relationship of a variety of factors (e.g. commercial and residential location choices, urban patterns, travel mode choices, origins and destinations, route choices, length of commutes, and time of travel). This information can then be used as input to spatial and temporal analyses and modeling, which can serve as platforms for further discussion of the impacts of public and private choices (e.g. land-use policy, private development) and of the creation of opportunities (e.g., novel applications of information technology, development of new industries, new business models, new services, products, and design, as well as networked policy-making). Moreover, Mapunity has continued its research into other domains besides traffic and transport in Bangalore itself, and is now building BCity, an information and management platform for multiple domains in Bangalore. This platform, in addition to the transport domain, will showcase the use of similar technologies as developed for BTIS in managing other urban public administration domains, such as environmental quality, tourism, public safety and security, and emergency response.

In addition to sparking innovation, integration of Public Private Innovation with research will enable the necessary trust to develop, fostering a more open dialogue about the roles of each sector in generating the problems and the responsibilities of each sector in defining and creating the solutions. Specific land-use and transportation problems provide rich opportunities for experimentation and exploration of this framework. Beyond these specific cases, this template is more likely than current paradigms to support enduring commitment to the sustainability of urban areas, as the diversity of perspectives and values are represented throughout the political process, and participants can better understand the implications of their present and future behavior in the complex system in which they find themselves (Berkowitz, Nilon, and Hollweg 2003; Gunderson and Holling 2002). Collectively, participants can develop innovative definitions and applications of sustainability generating hidden and not-so-hidden successes for urban transport and beyond, in India and elsewhere.

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