

INFORMAL 2.0:

Seeing and Improving Urban Informal Practices through Digital Technologies The Digital Matatus case in Nairobi

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Research team mapping the network.
Source: Digital Matatus

Conceived out of collaboration between Kenyan and American universities and the technology sector in Nairobi, *Digital Matatus* shows how to leverage the ubiquitous nature of cellphone technology to collect missing data for essential infrastructure - including those with high levels of informality. The project captured transit data in standardized form for Nairobi's semi-formal bus system, developed the first public transit map for such a system and made the map and data free to the public, spurring innovation and improved services for citizens.

KEYWORDS

- TRANSPORTATION
- INFORMAL SECTOR
- DIGITAL TECHNOLOGIES
- TRANSIT-ORIENTED CITIES
- BOTTOM-UP APPROACH

While most cities develop sophisticated IT projects to make their organization smarter, the *Digital Matatus* case suggests the value of a much more modest and bottom-up approach: it encourages reliance on common technologies like cellphones to understand and improve existing urban services – that often involve informality – in emerging countries. By developing the first-ever high quality data set and map of the Matatu network (very common semi-informal mini-buses in Kenya), the projects promotes a new, low-cost and more practical vision of smart and transit-oriented cities.

INTRODUCTION

Transportation is an essential infrastructure of a well-functioning city. While in most cities of developed countries, official transportation systems are available and efficient, many cities in Africa and parts of Asia and the Americas still suffer from a lack of public investment in transportation and have to rely on privately run and often informal transportation solutions. In many of these cities, the majorities do not own cars and rely heavily on these semi-formal transit systems, which often are bus systems of various kinds. In a world faced with climate change and many problems stemming from urban car use, this could be an opportunity to build better, transit-oriented cities by investing heavily in improving transit. A first, incremental step to becoming transit-oriented cities involves using technology to better understand and optimize existing transportation systems and building on top of these to move towards well-functioning transit systems.

Nairobi is a typical example of these cities which have to cope with informal transportation solutions. The Matatus network for instance, made up of 80,000 mini-buses operating within the whole country (20,000 in Nairobi alone), has become a central part of Kenyan citizens' daily life. In Nairobi, less than 20% of the population has a car and 70% of the city's dwellers use Matatus every day. In this context, our research partnership, entitled "Digital Matatus", aimed to use modern digital technology to reveal, understand and provoke debates on this traditional and informal transportation network as well as to provide concrete data and information services to transit users and planners. Our project therefore embraces the challenge of informality and promotes the reconsideration of more externally driven and top down smart city ideas in the African context.

1. THE DIGITAL MATATUS PROJECT: THE FIRST MAP OF AN INFORMAL TRANSPORTATION NETWORK IN THE WORLD

The *Digital Matatus* project emerged from the shared concern of all the members of our consortium (Columbia University, University of Nairobi, Massachusetts Institute of Technology and Groupshot) about how to improve public transportation in Nairobi - and in African cities in general. Aware of the importance of informal practices in these contexts, the four partners joined their efforts and expertise in order to produce the first open data set and map of the *Matatu* network.

The first step of the project consisted in an in-depth exploratory field work in the city. After developing a protocol for identifying stops, from September 2012 to September 2013, six students of the University of Nairobi were each given an area to cover in which they were in charge of mapping the *Matatu* network. Through their mobile phones and very simple GPS technologies, they collected information on the bus routes, schedule, stops, etc. This field work represented a major logistical and organizational challenge: contrary to what is common in developed countries, there are neither signals nor ways to identify the *Matatu* network in Nairobi. In parallel, nine

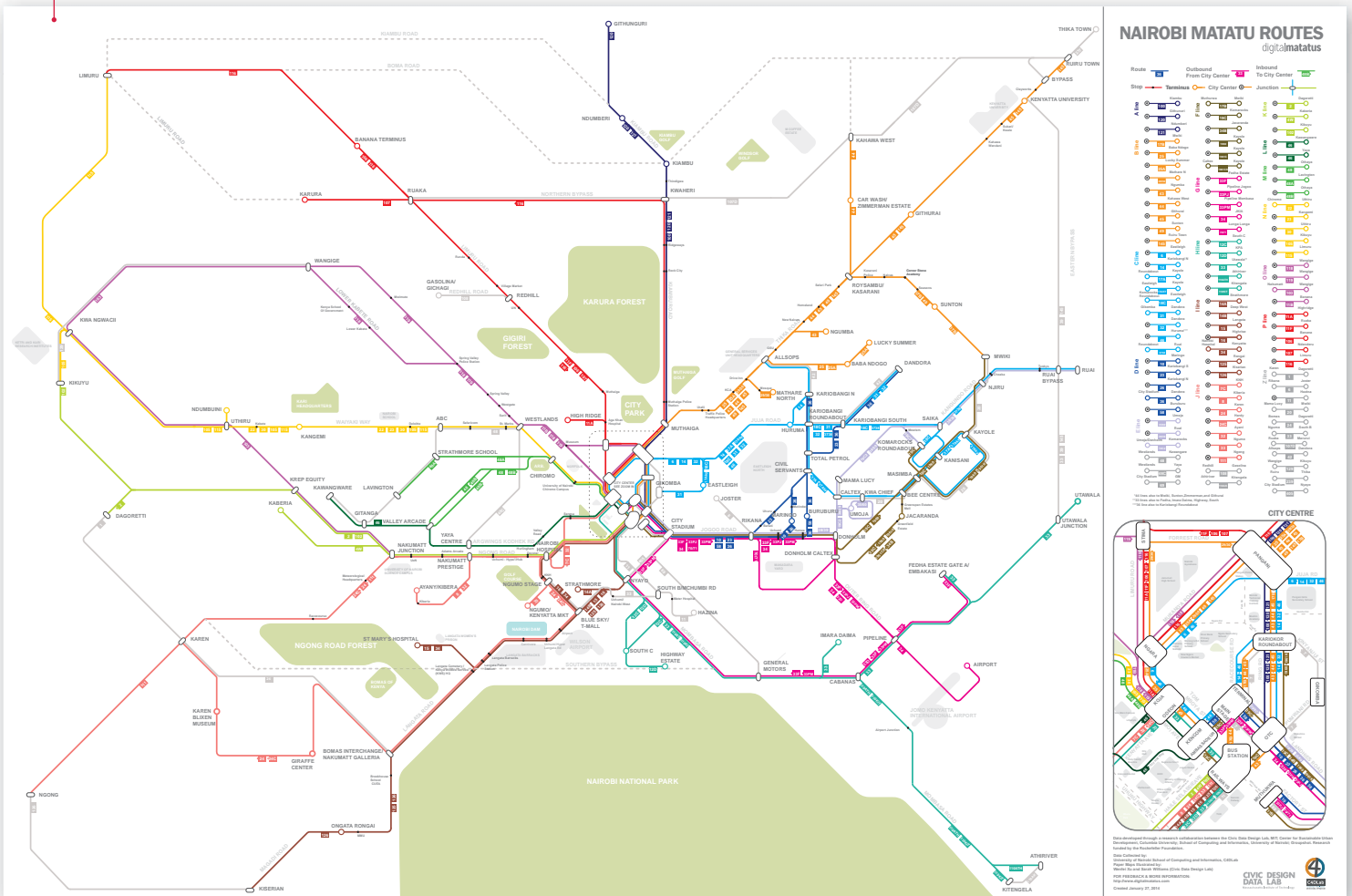
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students from the Massachusetts Institute of Technology were involved at various levels to analyze, process and clean the data collected. The MIT Civic Data Design lab then was able to use this data to create a public transit map much along the lines of a New York or London subway map.

Digital Matatus map and routes - Source: Digital Matatus



This data collection work enabled us to publish this first-ever map of Nairobi's *Matatus*¹ in January 2014. Contrary to common belief, the project demonstrated that the *Matatu* network was impressively well-organized and complex. A visual analysis of the network reveals how extensive the system is and also how overly centralized the system is in the city core causing some suboptimality in service. Surprisingly, despite the availability of mapping technologies and the critical importance of the *Matatu* system of the city, no one before us had taken the time to analyze and visualize this system.

2. A NEW VISION OF SMART CITIES

2.1. ARTICULATING TRADITION WITH MODERNITY: "INFORMAL 2.0"

While many cities are currently developing a wide-range of sophisticated IT projects aiming to make their organization smarter, we promote a much more modest approach: rather than importing expensive new transportation and IT systems, often generating conflict with existing operators and bypassing the local technology community, we encourage cities to draw on their own universities and technology eco-systems to better understand and improve *existing* urban services – that are reliable and functional (as our map demonstrated) – with very simple technologies.

Most of the time, smart cities are built on a top-down approach. Pursuing the objective of building “*the*” ultimate smart city, big IT companies are developing complex software and high-end technical solutions dedicated to improving the way our cities are organized. IBM's impressive Operations Center in Rio de Janeiro (part of the company's Smarter Cities Program and aiming at overseeing efforts in case of emergencies and crises) is one example of such innovations. Similar state-of-the-art initiatives have been launched in Africa. Google and IBM, for instance, have been trying to set up innovative projects in several African countries for some years, without achieving valuable outcomes. These difficulties are mainly due to the fact that these projects are generally oversized and inappropriate to local conditions. The continent's smart cities development has to be imagined differently, starting from the adoption of a different, more locally driven innovation framework.

Our consortium strongly believes that the informal sector constitutes a window of opportunity for African smart cities. In a context of massive

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urbanization and lack of economic opportunities, especially for young people, the informal sector remains a key component of African economies. Kenya is no exception: most Kenyan urban areas rely on informality, e.g. in slums, transportation system (taxi, collective buses, etc.), street trade, etc. Where most people see a hindrance to development, the *Digital Matatus* partnership considered it as an opportunity. African cities could indeed become smarter by combining these existing systems that work even with high degrees of informality with digital technologies. This constitutes the specificity - as well as the challenge - for African smart cities: how can they use digital technologies to optimize and also transform informal practices, with a bottom-up approach that builds on local initiative, creativity and knowledge?

Unlike many “smart city” projects that use state-of-the-art technology such as drones, *Digital Matatus* relies on tools as simple as phones and GPS technology – which are widely available and easy to use. Choosing this kind of data collection tool was strategic in that it made our project low cost as well as more accessible and suitable to the local context and people's involvement by allowing feedback on the system. Going beyond the mere optimization of a city's transport system, the project hybridized a traditional infrastructure with a modern tool. This constitutes a great lever for leapfrog innovation and can turn into a model for African cities' innovation strategy (and more generally, for cities in countries with high levels of informality in their service delivery). Hence, in spite of recurrent pessimistic stances about Africa's issues, our project adopted an optimistic perspective. The continent, far from being limited to catch-up innovations, is sufficiently equipped to address the “informal 2.0” challenges, perhaps in an even more innovative way than any other – as long as it recognizes and takes advantages of its existing assets, improving technology and local knowledge and capacities.

A matatu in Nairobi. Source: Digital Matatus



¹ <http://www.digitalmatatus.com/map.html>

2.2. THINKING SMART CITIES FROM A SOCIETAL POINT OF VIEW RATHER THAN A TECHNOLOGICAL ONE

Digital Matatus is not about technology but rather about understanding existing practices, expectations and concerns of local people. When it comes to smart cities, technology alone should never be seen as the silver bullet: if one wants a technological project to work, it is necessary to couple technology with a larger user-centric perspective. In the *Digital Matatus* project, this approach has been implemented through three main strands.

Firstly, we have always been convinced of the importance of engaging future users in the design process of such projects in order to get them onboard and raise their awareness. Thus, from the very beginning of *Digital Matatus*, we have engaged and built strong relationships with local stakeholders, from civil society to the Kenyan government. Many of them have provided the project with a favorable environment and/or direct support:

- **Nairobi's digital ecosystem:** the project has definitely benefited from the energy and innovation spirit of Nairobi's vibrant digital and tech community ;
- **The Kenyan government:** the government, already involved in technological innovation (e.g. it launched Africa's first online government data portal in 2011) has also been very supportive ;
- **Local academic sponsor:** thanks to the involvement of the University of Nairobi, the project has been strongly anchored in the city of Nairobi – which enabled us to rapidly move forward and spread our project within the community.

This strategic networking has been crucial, as it enabled us to gain important support and enhance the spread of the data and map. Local entrepreneurs were the first to use the data to improve numerous apps that help people find their way around the transportation system and local planners and researchers are also using the data and map for enhanced home grown research and planning processes.

Secondly, the objective of the project was not to produce a map *per se*: we wanted to develop a useful tool that could improve Kenyan citizens' daily life. In this perspective, we made the decision to convert the geo-location data collected with mobile technology from a semi-formal transit system to the General Transit Feed Specification (GTFS) data standard (a sort of "global" data language). This was a crucial choice as it enabled our data to be uploaded to Google and Open Street

Maps and easily used by application developers including Google, which now provides the transit app for Nairobi using our data. The construction of the GTFS data was a time-consuming task; however, these efforts were critical as they secured and strengthened the project's impacts. One of *Digital Matatus'* major objectives is now to make its data accessible to developers in order to enable them to develop useful and user-friendly transit applications. In this perspective, we co-organized in January 2014, the "*Transmobility Hackathon*", a 2-day workshop to develop new applications dedicated to urban mobility. So far, six trip planning applications use our data (Ma3route, FlashCast Sonar, Digital Matatu, Matatu Map, Moovit and Transit App). We can also start using this data to more objectively measure the *Matatu* system performance.

Thirdly, our current challenge is to keep our map updated and useful through time. *Matatu* lines are constantly evolving: new lines are created, others stop, and routes sometimes change. As a result, we aim to improve the data collection tools and approach to data collection and make it as simple and easy as possible and explore its usefulness in other cities. Data needs to be constantly updated and our initial data is now a benchmark that allows us, with each successive data update, to see how the system evolves over time. In this next phase, we are focusing on improving the data collection and updating tools to make easy updates of the data in a GTFS format and hence keep the data useful. This is why our consortium recently teamed up with Google for a two-year partnership to help create systems with local actors in Nairobi that can produce updates of the data. In this initiative, we are encouraging users to suggest updates of the data/map and to innovate in a streamlined way to create needed updates. By the end of this collaboration, a sustained system with relevant data updated -eventually in real time- should be accessible on Google Maps and also to local entrepreneurs for their use. Open data for all is essential to the impact we strive to achieve.

This user-centric project has been made possible mostly through the holistic approach of the team in charge of *Digital Matatus*. Relying upon the expertise of three universities (MIT, Columbia University and the University of Nairobi) and one company (Groupshot), the *Digital Matatus* team is made up of very different profiles: academics, technologists, cartographers, story tellers, designers, technology anthropologists, public policy experts, etc. This diversity helped to confront different points of view and to optimize the design process of the project – always keeping in mind our societal goal and providing for ample input from diverse actors including most critically drivers and users of the *Matatu* system itself.

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3. CHALLENGES AND PERSPECTIVES

Digital Matatus – as it invites cities in emerging countries to reconsider the way to innovate and to become smarter – still faces some challenges.

3.1. THE POLITICAL CHALLENGE: CONFRONT THE TRADITIONAL TOP-DOWN POLICY-MAKING PROCESS

Since the release of the map, reactions have been very enthusiastic. Many people and organizations such as UN Habitat or consulting agencies are using our data – which is a very positive signal. However, from a political perspective, the project has received a rather cold reception. Decision-makers in charge of transportation and urban planning in Nairobi were used to a top-down and centralized approach, and perceived our project as too innovative and perhaps, transparent. Conceived by civic activists willing to make cities more functional by promoting open source innovation and data-sharing, *Digital Matatus* is radically new for the political transportation establishment. Therefore, even though they appreciate the project, and of course use the data and map, it has been difficult to get them onboard with the larger vision. Since its inception, *Digital Matatus* has not been followed up by any specific public policy although it has raised public expectation around transit information services. This is surely a main challenge and we continue to engage policymakers and engineers and develop projects to demonstrate the power of this approach.

3.2. THE FINANCIAL CHALLENGE: ATTRACT NEW SOURCES OF FUNDING AND INVESTMENTS

Even though *Digital Matatus* is globally perceived as valuable and useful, only a few philanthropists and investors are willing to finance the project which creates an open data commons in transit information. Until now, the Rockefeller Foundation has been the main funder and our priority today is to find new investors from the private and the public sectors. In Africa, there is a lack of adequate public funding to support and scale up initiatives like this. Ideally, governments take an interest in this grounded and locally anchored vision of “smart” transportation.

3.3. THE SCALE-UP CHALLENGE: STRENGTHEN OUR IMPACT IN KENYA AND ABROAD

Finally, our ambition is to scale-up our project, both in Kenya and abroad.

Digital Matatus - and related applications that use our data - can have a tremendous social impact in Kenya. The project facilitates traditional ways of travelling and opens new opportunities for citizens: they can now use their phone to discover places in the city that they may have never heard of and feel more secure knowing where they are going. They can also feel empowered by suggesting new routes or complaining about existing ones. That is why the reach of our data and map needs to be extended and also used as a way to bring transportation planning more to the ground where it belongs. With a mobile and an Internet penetration of respectively 83% and 58%, Kenya has a flourishing digital environment but there is still room for improvement. The spread of smartphones in Kenya will also benefit the project: more and more people will be able to contribute and upload in-time data to suggest updates to our map. Moreover, *Digital Matatus* needs developers that keep creating user-friendly applications relying upon our data to make our map as accessible

as possible and also layer with other forms of data to create new applications and insights into the system. Our team is currently developing further collaboration with *Ma3route*, a popular application that gives trip planning information but also crowdsources information about traffic conditions and crashes reaching around 300,000 users.

Beyond Kenyan borders, many cities (Accra, Lusaka, Managua, Maputo, etc.) have expressed an interest in the project and are at various stages of replicating it. For the *Digital Matatus* team, it is exciting to see how well the approach travels and what adaptations occur as it moves to different contexts. We are eager to share what we have learned during the last four years with interested cities and also create more of a resource center for them so they do not have to struggle as hard as we did at the beginning. In addition, we will face financial and technological challenges: just like in Nairobi, it is difficult to raise funds for such initiatives in other cities and we will need systematic learning procedures on how this approach needs to be adapted to different contexts and transit systems. Despite these challenges, this scaling-up phase is thrilling. We are convinced that we can learn a lot from other urban areas – not only in emerging countries, but also in advanced ones. For instance, applications developed for Western cities such as Uber Pool (organization of shared taxi) or Bridj (Boston-based pop-up bus service) have some similar features to our approach, and we could take mutual inspiration from these ways to innovate using technology to create more efficient transit services that respond to real time demand.

CONCLUSION

Digital Matatus constitutes, in the African context, a breakthrough innovation that invites us to reconsider the more top down, standard smart cities framework. It is crucial to follow a bottom-up approach to undertake initiatives with, from and for citizens. Local practices married cleverly to popular technology to create data, understanding, and service have huge potential for transformation that should be taken advantage of and built upon. Surely, African smart cities will not be imagined and lived by IT corporations like Google and IBM but by urban dwellers, local service providers like the Matatu operators and local technology entrepreneurs themselves.