RoadLab+
Blueprint for Implementation
Using Citizen Engagement to improve Urban Transportation

ATHENA
INFONOMICS

SAIS

Authors

Ashley Augsburger

Deea Ariana

Gabor Debreczeni

Julienne Lauler

Acknowledgments

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1 Executive Summary

The forerunner of RoadLab+ is a citizen-engagement project called RoadLab, which was implemented in Belarus and Uganda, by the World Bank and the University of California, Santa Barbara, respectively.

This document is a blueprint for the implementation of **"RoadLab+"**, a proposed citizen-engagement project that leverages data from transportation users and government to achieve key improvements to urban transportation systems globally. The overarching purposes of the project, depending on the context, are a combination of - lowered government costs, increased interactions between citizens and the government, and an increased flow of information from the government to the citizenry, all in the context of the state of road infrastructure in the city in question. This document outlines the features and functions of the RoadLab+ as well as proposals for how to implement a potential RoadLab+ application in different types of cities around the world.

The forerunner of RoadLab+ is a citizen-engagement project called **RoadLab**, which was implemented in Belarus and Uganda, by the World Bank and the University of California, Santa Barbara, respectively. In both countries, the program consisted of an Android app that succeeded in dramatically reducing the costs of **road roughness monitoring** for the implementing agency. Neither project however succeeded, or even truly attempted to, gather buy-in and users from the citizenry at large. RoadLab+ is partially an attempt to upgrade the RoadLab framework in such a way that citizens are incentivized to be active users of the application, further lowering government costs, and improving the level of information gathered by the government.

RoadLab+ offers a viable value proposition to both municipal governments as well as users, who range from private car drivers to public transportation providers.

As conceptualized in this report, RoadLab+ offers a viable value proposition to both municipal governments as well as users, who range from private car drivers to public transportation providers. Users would receive exclusive streams of government-compiled data on road closures and road repairs, which would be integrated alongside a drive routing program featuring crowdsourced traffic data, integrated from other users of the app (an experience similar to the Google Maps or Waze interface). The large number of users, and the data they contribute to the app, would generate a comprehensive and real-time view of the state of the city's roads, from road roughness to traffic, offering a dramatic improvement on the state of road-quality data in nearly any city around the world. Receiving this data in a clear, actionable, and centralized format would incentivize the city to pay close attention to it, and ensure the maintenance of municipal transportation systems as well users' happiness.

Beyond detailing the features and functions of the proposed RoadLab+ app, this report further includes a section cautioning against the blanket application of a copy-and-pasted app from city to city. In this section, we highlight a number of ways in which the principles of human-centered design can be employed to ensure that the app is relevant to the unique social, economic and infrastructural features of each city. Incorporating city context and end-user preferences into the design of the app will ensure active usage of RoadLab+, and ultimately play a key role in the ability of the app to achieve its stated goals.

We further outline a broad, globally-relevant user acquisition strategy that can be used to guide the implementation of RoadLab+ in any city. From building key partnerships with primary transportation providers to launching user education and training initiatives, we outline multiple ways to spark and maintain active usage of the app over the long term. Building a committed, active user base is critical to the success of the app, which depends on its ability to incentivize enough people to both passively and actively contribute to the app's database.

Next, the following sections develop a city typology into which cities, globally, can be classified. Based on this typology, we offer suggestions as to how a RoadLab+ project could be implemented in four different types of cities which are categorized based on the city's capacity, transportation mode share and speed, and the managerial ownership of the road infrastructure. We suggest dramatically different styles of strategies for implementation in each type of city, which range from 'world-leading' global cities, to smaller 'secondary cities' in developing countries.

Finally, the report concludes by describing and presenting user interface designs for multiple high-level modules that can be included as part of RoadLab+. This offers a visualization for what the app might look like in practice. While specific designs will be user-driven and highly dependent upon the context of the city, these modules offer a starting point for thinking through what should be included in the app.

The report concludes by describing and presenting user interface designs for multiple high-level modules that can be included as part of RoadLab+.

2 Overview of RoadLab+
Background & Features

RoadLab+ (RL+) is a mobile application that aims to aggregate and analyze data and information on road quality and traffic to improve the quality and safety of urban transportation. The app has two key functions:

- passively and actively collecting data from individual drivers ("users");

- providing a channel for the government to send critical road-related information to users.

By leveraging mobile technology, RL+ enables rapid collection and analysis of large quantities of data at a low cost and across a wide range of road networks.

RoadLab 1.0

RL+ is built upon the existing **RoadLab** platform, designed and built by Belarusian tech firm SoftTeco, The World Bank, and Progress Analytics LLC. RoadLab has been implemented in Belarus and Uganda. The technical specifications of the RoadLab app can be found in a paper titled "RoadLab - Revamping Road Condition and Road Safety Monitoring by Crowdsourcing with Smartphone App," by Winnie Wang and Feng Guo, the implementers of the Belarus project. As they write:

"The project consisted of an app, which faces the individual users, and a data-aggregating portal, which faces the implementing entity. The app runs on all Android devices, such as Android smartphones and tablets. No data plan is required for running this app. All data collected can be synchronized when WiFi is available. The app is turned on automatically, when the speed of vehicles reaches 30km/h. It can also be turned on manually by pressing the "start" or "stop" button. To use the app, the mobile device has to be placed on a stable surface in a moving vehicle, such as on the dashboard or mounted vertically in a cradle on the vehicle's windshield. The app will automatically detect phone positions and strength of GPS signals and remind the user to place the device correctly in order to obtain reliable data. All accelerometer data is collected anonymously to protect user privacy."

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The Belarus implementation of RoadLab was a World Bank pilot project that was created as an attempt to use citizen participation to lower the costs of road maintenance for the implementing government agency.

The Belarus implementation of RoadLab was a World Bank pilot project that was created as an attempt to use citizen participation to lower the costs of road maintenance for the implementing government agency. Prior to RoadLab, the agency spent $250,000+/vehicle to measure road roughness, and the shortage of the specialized vehicle required for this exercise, prevented the agency from having a timely understanding of which roads needed to be repaired the most, which roads presented the most urgent safety concerns for the city, and which were costing the city the most in terms of maintenance. With the app, the government was able to use a larger number and wider range of government vehicles to make these measurements, having found the app's results to be a satisfactory proxy for the pre-app road roughness measurements.

However, because the implementation was so successful in its immediate goal of reducing cost of road observation and maintenance, the second phase - the gathering of data from citizens who drive frequently on these roads - was never implemented.

The Uganda implementation was run and financed by a team of researchers from the University of California, Santa Barbara, working in loose cooperation with a local university in Kampala. They used the app to make one-time measurements in a number of municipalities around the country, in an effort to gather data on the disparities of local road conditions in cities of different sizes and in different geographical areas of the country. They paid locals to drive and use the app, but did not attempt to get citizens to use the app in an organic manner.

RoadLab+

RL+ has features and functions that are similar to its predecessor, but it aims to build on the existing features. RL+ will both passively and actively collect data from users that the commissioning agency can use to assess road conditions and facilitate improvements.

RoadLab+ will both passively and actively collect data from users that the commissioning agency can use to assess road conditions and facilitate improvements.

Passively-collected data will be regularly aggregated and analyzed, and sent as reports to the agency responsible for road maintenance (with varying degrees of intermediation based on the city). Types of passively-collected data may include:

Frequency of braking - to identify poor road conditions or heavy traffic.

Bump detection - to identify potholes or broken roads.

Speed detection - to identify areas of slow-moving traffic or bottlenecks.

The app will further enable both users and the municipal government to actively produce data that will feed into the centralized data processing system.

Types of actively-collected data, which are automatically geotagged, can include a user-taken picture of:

Road damage - users can report open manholes, potholes, broken street lights, or other physical issues that can cause vehicular damage.

Accidents - the app would enable users to report accidents on a particular route to measure safety of a particular road or route.

RL+ will also enable government agencies to disseminate data on road conditions, such as:

Road construction – government agencies can push through data regarding planned road construction on key commuter routes, with the app identifying adequate detours.

Closure information – agencies can also provide real-time information on road closures, so that commuters can identify alternate routes.

This information will valuable to users both to optimize commuting routes and ensure passenger safety on roads, among other goals as determined based on the unique context of the city. Figure illustrates the key differences between RL and RL+.

RoadLab vs RoadLab+

Goals	RoadLab	RoadLab+
Reduced costs of road maintenance	✓	✓
Reduced road safety risks	✓	✓
Reduced travel time	✗	✓
Enables active citizen involvement in road maintenance	✗	✓
Enhanced dissemination channels of government-generated data to citizens	✗	✓

Features	RoadLab	RoadLab+
Uses sensors to enable passive collection of data on road conditions, severe road damage, and road safety hazards	✓	✓
Enables users to manually submit reports on severe road damage or accidents, and allows users to view all areas of damage via an interactive map	✓	✓
Sends information with GPS coordinates to local road engineering services	✓	✓
Allows government to report status of grievance addressal to user	✓	✓
A backend that analyzes and visualizes the data generated by users of the app	✓	✓
Provides traffic and navigation services	✗	✓
Enables users to submit locations of accidents	✗	✓
Facilitates a data-stream whereby the government can push time-tagged info (beginning and end) of road repairs and closures to users	✗	✓

3 Issues of Contextualization

This guide to RoadLab+ outlines the prototype for an app that can be implemented across a variety of different types of cities, from Tokyo to Lagos. While high-level modules of the app may be consistent across cities, the UX design, features, user acquisition and implementation plan for each city will however, look very different. Ultimately, the success of the app depends on its ability to attract and maintain a high volume of users who will actively engage with the app and generate data that can be used to address key urban transportation challenges. The design of the app, and its perceived utility to users, are thus, cornerstones of its success.

Tailoring the app design for implementation in specific cities should ultimately be governed by principles of human-centered design, embedding the needs and capacities of end users into the design process. The experience of the people who will be actively using the app, should be front and center of the design process. In this way, implementation of the app in each city will require a significant time investment in understanding the unique attributes of the city and potential users. This will involve, among other things, observation of infrastructural opportunities and constraints, extensive interviews with potential users to understand their primary transportation challenges, and rapid prototyping and iteration on app designs with the target user base.

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Tailoring the app design for implementation in specific cities should ultimately be governed by principles of human-centered design, embedding the needs and capacities of end users into the design process.

The app design should be centered upon the needs and capacities of potential users.

Three overlapping aspects of the design thinking process should be kept in mind when tailoring the RoadLab+ app to specific cities:[1]

Inspiration: *the problem or opportunity that motivates the search for solutions*

The app design should be centered upon the needs and capacities of potential users. The process of uncovering these needs can entail speaking with a range of potential users (i.e. drivers), observing their experiences as they move through their daily lives, or first-hand observation of transportation systems in the selected city. Experiencing current road conditions and bottlenecks through the lens of target app users will be critically important in designing an app that best meets their needs and is more likely to be used.

Ideation: *the process of generating, developing and testing ideas*

After gathering inspiration by speaking with potential users and obtaining firsthand experience of current transportation challenges, the next phase of the design process will entail synthesizing these observations and conversations and distilling them into insights. These insights will feed into the process of tailoring the RoadLab+ app to fit the specific context of the chosen city. A key part of this process is testing prototypes with target users, and using their feedback to iterate on the design and further refine the app.

Implementation: *the path that leads from the project stage into people's lives*

Only after an extensive prototyping process can the final implementation of the app take place - taking into consideration the learnings and feedback from users garnered through testing and re-testing the app design. In the case of RoadLab+, it will be of utmost importance to see how users respond to various incentives embedded within the platform, and how small tweaks in the app design and features influence its usage.

[1] Design Thinking for Social Innovation, Acumen+

4 User Acquisition Strategy

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Successful implementation of the app thus hinges upon a strong user acquisition strategy that incentivizes a diverse user base to download and use the app.

For RoadLab+ to create value for users and achieve its twin goals of improved urban transportation conditions and reduced costs of traffic and road maintenance, a critical mass of users who regularly contribute active and passive data to the app is essential. Reaching a critical mass of users will require different approaches based on the city. It may take the form of key officials and road transportation employees actively seeking to provide this data and incorporate it into their professional daily responsibilities, as is the case in Belarus. Or, it may take the form of partnerships with ride-sharing companies such as Uber or Ola, which would provide the majority of data. Finally, the app could depend upon crowdsourcing from an active and engaged citizenry, with data flowing to and from a variety of different types of road users.

Successful implementation of the app thus hinges upon a strong user acquisition strategy that incentivizes a diverse user base to download and use the app. These incentives will need to be tailored to each city, but there are a number of overarching principles that should be considered in approaching the user acquisition process in each context.

Build key partnerships:

The most efficient method for quickly acquiring a critical mass of users is to work in close partnership with local

transportation providers or associations, who can incentivize their members/drivers to download and use the app. This will enable RL+ to capitalize on network effects to reach a broader selection of users. These partnerships will look different in each city, but examples include: ride-sourcing companies (i.e. Uber, Ola, Lyft), taxi cab or motorbike taxi associations, public transportation agencies, or other groups that regularly interact with large quantities of drivers. These partnerships will generate a critical base of users, after which point usage will accelerate among others, such as private drivers.

Advertising campaigns:

Raising awareness of the app among target users will require targeted advertising campaigns reaching a diverse variety of drivers. Potential channels for advertising include billboards on roads, mobile-based ads, or messages sent via mobile operators. Partners, such as Uber, might also advertise the app via their platform or networks, as part of their partnership with RL+. Advertising campaigns should center around a core message that is of immediate relevance to potential users. This message will be tailored based on an assessment of what people care about most in the particular location of implementation, conducted jointly with local partners. For example, in places where traffic issues are most likely to motivate individuals to use the app, a campaign slogan of "Get Home Faster" might be the best way to reach the target user base. If safety concerns are driving usage, rather, the focus of advertising campaigns might be different.

User training:

The app implementing agency (whether government or a third-party) may consider providing training for target users on the app functionality. In the beginning phases of implementation, training should be provided as part of the pilot process. Over time, training could become a part of the onboarding program for new taxi or Uber drivers, or it may be provided as part of the government's driver registration process. If people are unfamiliar with the app, they are unlikely to use it, making training essential to engendering active usage over the long-term.

Advertising campaigns should center around a core message that is of immediate relevance to potential users. This message will be tailored based on an assessment of what people care about most in the particular location of implementation, conducted jointly with local partners.

The implementing agency may consider providing incentives for users to download the app, and for ongoing usage.

Incentivize downloads and immediate usage:

The implementing agency may consider providing incentives for users to download the app, and for ongoing usage. This might involve, for example, a free taxi/Uber ride provided upon downloading the app. When providing download incentives, however, it is important that the agency mitigate the risk that users will simply download the app and never look at it again. In this way, the agency must also consider ways to ensure active, ongoing usage. A potential drawback to ongoing incentive schemes may be encouraging false reports of issues. So, potential programs will need to ensure that they are not incentivizing users to haphazardly report road issues, which will reduce the integrity of the app. A better mechanism would be tapping into natural incentives; for example, by ensuring that the app results in active feedback from governing agencies. Incentive schemes will need to vary contingent on context of implementation- such as socio-economic status of users, perceptions of government, timing of the app roll-out (i.e. during election years, users might be suspicious about the true end goals of the app), and demographics of the target users, among others.

5 City Typology

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RoadLab+ has the potential to be successfully implemented in a variety of locations across the world, and can be contextualized to benefit the target cities.

Typology Factors

RoadLab+ has the potential to be successfully implemented in a variety of locations across the world, and can be contextualized to benefit the target cities. This report elucidates three key attributes of cities that meaningfully impact the strategies that will have to be pursued to successfully implement RoadLab+. They are the following:

The level of municipal government capacity to deal with data

- *Categories:* low, medium or high

- This will be defined based on qualitative assessment of the following:

  - Existence of current government-led programs that integrate ICT or data to achieve improved service delivery.

  - Existence of strong communication and data management systems within the government.

  - Level of government accountability.

- *Inbound data:* The level of government capacity to deal with high volumes of inbound data from app users will influence the speed and effectiveness of collecting, managing and synthesizing data from RoadLab+ to produce clear and timely outputs for those responsible for road maintenance.

- *Outbound data:* The level of government capacity to produce outbound data that is useful to users of the app (i.e. road construction info, road closures, etc.), will influence the incentives for users to actively use the app.

The types of vehicles most commonly used, and the average speed of traffic

- *Categories:* buses and para-transit, motorbikes and slow-moving vehicles, private cars moving at or above a certain speed.

- The primary types of vehicles on the roads will influence-

  - **the variability of the data:** buses tend to follow the same routes, while taxis or private cars might take varied roads,

  - **the value of the data:** whether the speed of traffic on vital roads is high enough for the data to be useful, and,

  - **user acquisition strategies:** it might be easier to incentivize bus providers to partner with government to use the app, vis-à-vis private car or motorbike owners.

- The usage of different vehicle types and the speeds at which they operate determine whether the current RoadLab technology would need to be altered before implementation.

Buses tend to follow the same routes, while Taxis or Private Cars might take varied roads

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The agency that maintains the roads will influence the speed at which RoadLab+ is used to achieve key delivery goals of transportation-related service, such as pothole repair, road paving, and/or improving drainage systems.

The type of agency or organization that maintains roads in the city

- *Categories:* municipal government, non-municipal government, private firm

- The agency that maintains the roads will influence the speed at which RoadLab+ is used to achieve key delivery goals of transportation-related service, such as pothole repair, road paving, and/or improving drainage systems. If a municipal government maintains roads, for example, there may be political incentives to improve roads quickly, and feedback loops will be tighter. If private parties manage roads, the data generated by the app can be used in a contract performance oversight capacity.

Key Assumptions

Two factors should be considered basic assumptions in order for RoadLab+ to be successfully implemented as described in this document:

Government support for RoadLab+ implementation:

It is assumed that the government is hiring the implementing organization, and therefore a base level of acquiescence and support for the program exists. There will also be an assumption that the government is willing and open to share data about transportation issues within the public sphere.

Presence of necessary technology infrastructure:

It is assumed that the minimum viable technology infrastructure is present in the city to support the implementation and active use of RoadLab+, such as 3G connectivity and smartphone penetration.

Excluded Factors

Beyond the factors listed above, a variety of other factors were considered due to their potential influence on the implementation of RL+ in various contexts. Ultimately, these factors were deemed to either not have an effect on RL+ implementation or to be well-proxied by other factors already defined above. These included:

Population of the city:

It was decided that given that RoadLab+ doesn't need many users to be useful (the Belarus implementation was found to be successful with less than 100 users), it is unlikely that a city will be too small for this type of project to succeed. Further, potentially-influential factors related to city size, such as traffic or institutional capacity, have been adequately captured by the three categories discussed above.

Primacy:

It was decided that whether or not a city was a primary city was meaningful only as a consideration of whether the city was in-charge of managing its own roads, and in the subsequent impacts on feedback loops, transparency and effectiveness of government accountability mechanisms. These factors are better measured by the third category, which details the party responsible for road maintenance.

Density:

It was decided that this was reasonably proxied by the type of vehicle most commonly used.

Road quality (% of roads paved):

It was decided that this did not greatly influence the operations of RL+, beyond its correlation with other factors that the typology captures more directly, such as city's capacity to use data generated by the app and average speed of traffic.

Income per capita and inequality:

The effect of income on RL+ operations would occur through access to smartphones, vehicle types used by drivers, and government capacity to deal with data, all of which are currently represented in the typology categorization.

Key city types

Research on a cross-section of global cities from different regions of the world has yielded four types of cities that are exceptionally common. These types are a combination of the categories discussed under the Typology section. The attributes of each type will influence the implementation of RL+ in the given context. The four types are:

Type 1: "The World-Leading City"
Government has high capacity to deal with data, mobility consists, in large part, of cars moving at or above a certain speed, and roads are maintained by commissioning government (i.e. the city). Example: Tokyo, Japan.

Type 2: "The Unconstrained City"
Government does not have capacity to deal with data, mobility consists of motorbikes and low-speed vehicles, and roads are maintained by a government other than the commissioning city. Example: Lagos, Nigeria.

Type 3: "The Impressionable City"
Government has some capacity to deal with data, mobility consists primarily of buses and paratransit, and roads are maintained by a private or semi-private enterprise. Example: Sao Paulo, Brazil.

Type 4: "The Under-Resourced, Capable City"
Government has some capacity to deal with data, mobility consists, in large part, of cars moving at or above a certain speed, and roads are maintained by a government other than the commissioning city. Example: Granada, Spain.

"The World-Leading City"

STOP

In these cities, urban transportation consists of private vehicles, as well as a combination of buses and rail providing public transit.

Government capacity to deal with data	High
Primary type of vehicle/traffic	Cars moving at adequate speed
Road maintenance management	Commissioning municipal government

This city type reflects most primary and some secondary cities in developed countries, as well as exceptional high-capacity cities (i.e. Curitiba) in developing countries. These cities are global thought leaders in urban transportation. They already generate and analyze substantial amounts of data on their infrastructure and mobility in the city. In these cities, urban transportation consists of private vehicles, as well as a combination of buses and rail providing public transit. Frequently, walking and cycling have a large role in urban mobility as well. Road quality is mixed to high, with shortcomings being caused by heavy usage. The roads are maintained by the commissioning municipal government entity.

Case Study Example: Tokyo, JAPAN

Population	14 million in city, 38 million in metro area[2]
Mobile access (in Japan)	93% mobile penetration; 55% smartphone penetration (nationwide)[3]
Data Capacity	High capacity to deal with data: The Tokyo Smart City plan was released 2015, and the city has multiple transportation-focused apps that assist in trip planning and provide real-time information on public transportation, including interactive maps..
Income	The average income per capita in Japan is $36,000/year, with 16% living under Japan's poverty line of $17,000/year.
Primary modes of transportation	Transportation mode-share within Tokyo: 48% rail, 37% non-motorized, 12% private transport, 3% bus.[4]
Ownership and Management of Transportation Systems	Rail and most metro are privately-owned, with Japan Railways being the major player. Busses are owned and operated by Toei (the municipal government), and also by subsidiaries of the private train companies.
Use of public transportation	The public transportation system as a whole moves about 37 million passengers per day in the metro area and the city serves as the hub of the nation's economic activity.
Key transport problems	• Public transit overcrowding at peak times • NIMBY opposition to new transit infrastructure • Mono-directional peak flows • Lack of joint fare systems • Congestion[6]

Transportation mode-share within Tokyo:

48% rail

37% non-motorized

12% private transport

3% bus

[2]http://www.worldatlas.com/citypops.htm
[3]http://nbakki.hatenablog.com/entry/2014/06/20/125616
[4]http://www.lta.gov.sg/ltaacademy/doc/J11Nov-p60PassengerTransportModeShares.pdf
[5]http://www.citylab.com/commute/2011/10/why-tokyos-privately-owned-rail-systems-work-so-well/389/
[6]http://www.jrtr.net/jrtr04/f02_nak.html

User Acquisition Strategy

Types of Users: who are they?	• Taxis • Buses • Private cars • Government-owned and operated non-transit vehicles • Ride-sourcing companies (i.e. Uber)
Value Proposition: why would they use RL+?	• Reduce vehicle maintenance costs - use of RL+ data to improve road conditions will mean less wear & tear in vehicles and reduced costs of maintenance. • Identify more efficient routes - real-time outbound data on traffic, road construction and road closures, including detour suggestions, will enable users to avoid areas of congestion and reduce travel times. This is particularly important for taxis, for which faster travel would be associated with more passengers and a higher value from fares. The public transit agency can coordinate bus route changes due to repairs and issue closures through app.
Marketing & Distribution: how would we reach them?	• Require government-operated vehicles and/or government-regulated taxis to run the app while in operation. • Partner with public transit agency to run the app on buses and/or with taxi companies (either regulated taxi companies or ride-sourcing companies like Uber). • Promote to drivers of individual vehicles as the exclusive mobile source of government-generated repairs and issue closure data, combined with standard traffic-guidance.

STOP

Require government-operated vehicles and/or government-regulated taxis to run the app while in operation.

Government Usage of Data

In the "world-leading city," the commissioning government has substantial capacity to aggregate, manage and act on the inbound data generated by RoadLab+. It is also equipped to generate and disseminate the necessary outbound data for users. Feedback loops are easy to close in the "world-leading city" as the RoadLab+ data is transmitted to the government agency responsible for road repairs, and confirmation of the repair flows back to the originator of the repair request quickly and transparently.

In the "world-leading city," the following data flow is utilized, with all steps publicly viewable on the public-facing online interface of the RoadLab+ project:

1 If the user of RoadLab+ actively reports a critical road issue:

a The data flows to a newly created data management group within the government body responsible for the issue.

b The group filters the request by grouping similar location problems (in an effort to curtail duplicate requests from making their way to the road repair team), but creates a unique ticket for each report to allow for appropriate data management. The collected data can be aggregated for user analytics reasons; for example, learning which users contribute the most useful complaints over time.

c The group sends the repair request to the agency responsible for road repairs, and informs drivers who frequent the road or area that repairs will be made.

d The agency makes the repair, and informs the data management group. [Optional: The agency sends a picture of the completed repair.]

e The data management group informs the originator of the complaint that the issue has been fixed. [Optional: The group shares the picture of the completed repair.]

In the "world-leading city," the commissioning government has substantial capacity to aggregate, manage and act on the inbound data generated by RoadLab+.

f | Optional: The data management group asks drivers in the area to confirm (with a simple y/n response) via SMS or in-app survey, regarding whether the repair is satisfactory.

2 | For road quality issues that are passively reported by users:

a | The data flows to a newly created in-government data management group.

b | The group tracks users and the data they have submitted, to gain understanding of what types of users generate the most useful data (i.e. if one important road is only commonly covered by one type of user), and also to inform and thank users whose data particularly contributes to better understanding of road conditions.

c | The group analyzes the data and makes priority judgments about road repairs, considering the volume and type of vehicles that make use of the road segment, as well as whether repairs in the neighboring area should be done simultaneously.

i | The group also coordinates with other government agencies who may propose other repairs in the area.

d | The group sends the repair request to the agency responsible for road repairs, and informs drivers who frequent the road or area where repairs will be made.

e | The agency makes the repair, and informs the data management group. [Optional: The agency sends a picture of the completed repair.]

f | The data management group informs drivers who drive area roads frequently that fixes have been made.

g | Optional: The data management group informs originators of the issue, that it has been addressed. [Optional: The group shares the picture of the completed repair.]

h

Optional: The data management group asks drivers in the area to confirm (with a simple y/n response) via SMS or in-app survey, regarding whether the repair was satisfactory.

STOP

The feedback loops are closed in the "world-leading city" as road repairs are made quickly and transparently.

The feedback loops are closed in the "world-leading city" as road repairs are made quickly and transparently. The data management group has two ways of investigating the repairs – either by the SMS/in-app confirmation mechanism described above, or by observing the differential of the data reported passively by drivers on the road segment before and after the repairs. Originators of the complaint both receive active confirmation that their complaints (passive or active) were acted upon, and can also track statistics for various road segments on the online portal that would be a part of the RoadLab+ implementation in a "world-leading city."

Chaos Box

What if we're talking about a city where the residents regularly make trips beyond the city's jurisdiction, like in New York City, where many people who live or work in the city also make trips to Long Island, or even to other states like New Jersey and Connecticut? Here, if the implementing agency is at the city level, it might wish to share its data proactively with transportation agencies in neighboring jurisdictions, since it will as collateral to its own data collection efforts be collecting data on neighboring jurisdictions, and because its constituents have a stake in good road quality in these neighboring jurisdictions.

A second option would be to situate the app at a regional level, at a (possibly new) agency that is responsible for road quality data aggregation and dissemination, and also for oversight of local road repair agencies, at a regional level. This, of course, introduces problems discussed in Types 2 and 3 below, regarding how to manage feedback loops and accountability mechanisms in a context where the agency in charge of RoadLab+ and its data is not the same government mechanism responsible for the quality of roads in its jurisdiction.
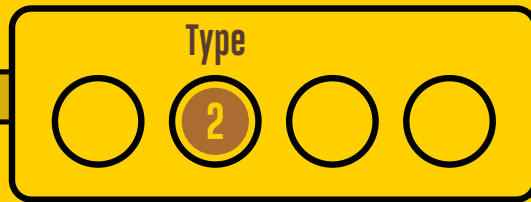
"The Unconstraıned Cıty"

STOP

Urban transportation consists primarily of motorbikes or small vans, often traveling at low-speeds due to dense traffic, and the cities are characterized by poor road quality and road safety issues.

Government capacity to deal with data	Low
Primary type of vehicle/traffic	Buses, paratransit, motorbikes & low-speed vehicles
Road maintenance management	Non-municipal government

This city type reflects a number of primary and secondary cities in low-income developing countries. Central and local governments in these cities often lack the capacity or the technical expertise to gather, analyze and utilize data, or to implement highly-technical initiatives or programs. Urban transportation consists primarily of motorbikes or small vans, often traveling at low-speeds due to dense traffic, and the cities are characterized by poor road quality and road safety issues. Roads are maintained by a government entity or department other than the commissioning city (i.e. a state or national-level transportation authority).

Case Study: Lagos, NIGERIA

Lagos is the second largest city in Africa and the fastest-growing megacity in the world, with a population of approximately 17.5 million, and projected population growth of 6 percent per year until 2025. The population density of Lagos varies from 4,000 to 20,000 (people per sq. km.) and the city employs over 45 percent of Nigeria's skilled labor force[7]. Adoption of new technologies has been rapid throughout Nigeria, with Lagos being no exception. Nationwide, there are 78 mobile subscriptions per 100 people, with access to mobile phones heavily weighted towards urban areas[8].

Government capacity to deal with data

While the Lagos state and municipal governments have recently implemented a number of e-governance, ICT-dependent initiatives, including electronic land use documentation and the establishment of a "Digital Village" outside of Lagos city[9], there is a notable lack of coordination and transparency among government agencies tasked with managing transportation infrastructure. With more than 100 agencies at the local, state or federal government levels playing a role in transport provision and/or services in Lagos, government capacity to effectively collect, manage and utilize transport-related data is relatively low. A World Bank report notes that "Lagos state lacks the institutional capacity for the management of transportation infrastructure to meet the demand of its growing population[10]."

Primary types of vehicles / traffic issues

Buses carry the bulk of the motorized person trips (82 percent) followed by taxis and private cars (13 percent) and the remaining five percent by motorcycles, locally known as okadas. Lagos has a fleet of 75,000 busses that is almost entirely owned and managed by the private sector, namely individuals who own one or two second-hand vehicles that they rent out to drivers on a daily basis. Minibusses, or danfos, make up the bulk of the fleet. There are almost 16 million person trips made daily using buses[11].

Road ownership / maintenance

Within the Lagos State Government, the State Ministry of Transport is the primary agency for transport policy formulation and implementation. Road maintenance and traffic management

Buses carry the bulk of the motorized person trips (82%) followed by taxis and private cars (13%) and the remaining five percent by motorcycles, locally known as okadas.

[7] http://citiesthemagazine.com/wp-content/uploads/2012/03/CITIES_Inflowence_Case-studies_Lagos1.pdf
[8] http://data.worldbank.org/indicator/IT.CEL.SETS.P2
[9] http://independentnig.com/2014/06/lagos-ict-initiative/
[10] World Bank
[11] World Bank

on local government roads falls under the purview of local council development areas, of which there are 18 within the Lagos metropolitan area. There is a lack of coordination among agencies responsible for planning and implementing transport solutions, given that there are multiple agencies at the local, state and federal levels tasked with addressing transport issues[12].

User Acquisition Strategy

Types of Users: who are they?	• Bus and para-transit drivers/users • Private car and taxi drivers • Ride-sourcing companies (i.e. Uber) • Motorbike drivers • Ride-sourcing companies (i.e. Uber)
Value Proposition: why would they use RL+?	• Reduce vehicle maintenance costs - use of RL+ data to improve road conditions will mean less wear & tear on vehicles and reduced costs of maintaining vehicles • Identify more efficient routes - real-time outbound data on traffic, road construction and road closures, including detour suggestions, will enable users to avoid areas of congestion and reduce travel times; this is particularly important for taxis, motor-taxis and mini-buses for which faster travel would be associated with more passengers and a higher value of fares. Ride-sourcing apps like Uber could potentially see more active users of the app if routes are optimized. • Enhance safety - RL+ could integrate a "motorbike" feature to show motorbike-optimized routes that will reduce the chance of accidents for motorbike drivers.
Marketing & Distribution: how would we reach them?	• Partner with owners of primary public transportation providers - minibus association, bus rapid transit providers, motorbike taxi associations (in Lagos, Every danfo and molue is affiliated with one of several associations, the largest being the National Union of Road Transport Workers (NURTW)). • Tailored incentives for motorbike drivers

RoadLab+ could integrate a "motorbike" feature to show motorbike-optimized routes that will reduce the chance of accidents for motorbike drivers.

[12]World Bank

Government Usage of Data

In this type of city, the commissioning government has limited capacity to aggregate, manage or act on the inbound data generated by RL+, or to generate and disseminate the necessary outbound data for users. This will make it challenging for the government to close feedback loops and use the data collected to actually improve road maintenance, identify optimal (traffic-lite) routes, and reduce safety hazards, among other goals. Without closing feedback loops, it will be difficult to incentivize active usage of the app. In this context, the government has two feasible options for data management and usage:

Outsource data management to a third party (either private, or quasi-private):

The third party would be responsible for aggregating and analyzing inbound data generated by the app users, and compiling this information into outputs that can be easily and immediately used by government. The company would also be responsible for collecting and disseminating outbound data to app users (known construction projects, road closures). This would require regular and transparent communication with relevant government officials responsible for these transportation projects.

The advantage of this outsourcing is that a third party with sufficient technical capacity and human resources will be in charge of managing the system, thus relieving the burden of the government. However, Managing the relationship between the third party and relevant government personnel may be costly, perhaps requiring the company to hire a full-time employee to regularly liaise with government and ensure fluid, streamlined transfer of data. It might also be difficult for this model to reach scale and be rolled out over a large city, given the human resources required to maintain a close relationship between the government and third party.

Simplify the RoadLab+ government portal and data production:

Since the standard RoadLab+ government portal (which is the way that government views and analyzes data generated by RoadLab+) is too complicated for a low-capacity government, a second approach is to allow the government to retain control of

The advantage of this outsourcing is that a third party with sufficient technical capacity and human resources will be in charge of managing the system, thus relieving the burden of the government.

data analysis, but to grant the app itself more authority to analyze and synthesize the data gathered. Instead of an interactive portal which can be used to do creative analyses, RoadLab+ would produce frequent but static reports for government consumption on road quality, traffic conditions, and urgent road issues.

The advantage of this model is that, because the data analysis functions are retained within the government, the processes leading to road repairs and issue resolution can be tighter and faster. The government might find such a system less jarring since it doesn't relinquish any authority to outside parties. However, allowing the app to conduct much of the analysis, without human intervention, may lead to problems whereby the algorithm is unable to differentiate real problems from those that are simply the result of blank or incorrect inputs. This could result in a misallocation of resources. For instance, an input that shows road roughness of "9999" and one that shows road roughness of "BLANK" might lead to the same output - "Re-pave Road A." Without human involvement, it will be less possible to sanity-check these results. Further, this model might curtail potential innovation that could arise from officials seeing the non-aggregated data first-hand. This approach also discourages capacity building in its ideal form, since the government-facing portal is deliberately stripped down. It could also potentially limit the value proposition to users, as lower functionality may reduce the incentives for users to be actively involved with the app.

The advantage of this model is that, because the data analysis functions are retained within the government, the processes leading to road repairs and issue resolution can be tighter and faster.

User accountability through feedback loops

In this typology, road maintenance is managed by a non-municipal government, which may inhibit the ability of the RL+ provider to ensure that the application is working as it should be and that inbound data is being used to quickly and effectively address road maintenance issues as they arise. There are a number of ways that the provider can ensure the closure of feedback loops:

Empower third party:

Make the third-party implementer (if used) responsible for validating the completion of road fixes, through systematic monitoring and evaluation processes.

Crowdsourcing feedback:

send an SMS (pop-up notification) to users as they drive over a particular segment of road that was scheduled to be fixed and ask a quick Y/N question about whether or not the issue has been addressed.

Public dashboard of fixes:

this would ensure transparency and publicly display whether or not the government has addressed the issue (but may raise issues in contexts where governments are hesitant to publicly publish data, i.e. Chennai).

Chaos Box

In some low-capacity cities, there can be a large percentages of roads that are unpaved and unfit to be driven over at the RoadLab+ app's minimum speed of 20 km/hr. As such, the app's passive automated monitoring function will be disabled in these areas, and if we consider these areas to be the city's highest priority (which they may or may not be), then RoadLab+ could cause a mis-prioritization of scarce roadworks resources.

"The Impressionable City"

STOP

Central and local governments have sufficient capacity and expertise to collect, analyze and use data, as well as successfully implement ICT initiatives at the macro level.

Government capacity to deal with data	Mid
Primary type of vehicle/traffic	Buses / paratransit
Road maintenance management	Private / Semi-private enterprise

This city typology reflects a number of primary and secondary cities in upper middle income countries. Central and local governments have sufficient capacity and expertise to collect, analyze and use data, as well as successfully implement ICT initiatives at the macro level. Urban transportation consists usually of cars and buses moving at an adequate speed, although congested traffic can be a problem in some cities. The quality of transportation infrastructure is good and well-maintained. In this typology, road maintenance is contracted out to private or semi-private enterprises, or through public-private partnerships.

Case Study: Sao Paulo, BRAZIL

Sao Paulo is Brazil's most populous city, and one of the top 10 largest metropolitan areas of the world. With a total population of 11.24 million, and a population density of 7,762.3 per kilometer square, it is predicted that by 2025 Sao Paulo will have a population will grow close to 24 million by 2025. 57% of its urban population lives in the central city but growth in the suburbs is picking up. Brazil has the third highest mobile phone penetration in Latin America, with 139 subscriptions per 100 people nationwide. Sao Paulo alone has a mobile penetration of 153.19 percent in 2014 and growing.

Government Capacity to deal with Data

Sao Paulo is a pioneer in open data policies in Brazil. The Sao Paulo City Council Open Data Portal was launched before the federal government portal, going online in September 2011. In other aspects, Sao Paulo is also experimenting with ICT intervention in managing public transportation in the city. For instance, in 2015, the city council carried out trials to improve the management of local bus fleet of 15,000 vehicles by using data analytics. These examples show that while the government of Sao Paulo is committed to investing in digital initiatives, it is still in its early stages.

Primary types of Vehicles and Traffic Issues

A figure of 8.5 million registered motorized vehicles, and 100-kilometer-long traffic jams makes Sao Paulo the sixth most congested city in the world. Traffic is mostly driven by rapid economic growth and a booming middle class. Primary vehicles in Sao Paulo include private cars, taxis, and public and trolley buses.

Road ownership/maintenance

Sao Paulo's highways began to be managed by private companies by law since 1996.

A figure of 8.5 million registered motorized vehicles, and 100-kilometer-long traffic jams makes Sao Paulo the sixth most congested city in the world.

User Acquisition Strategy

Types of Users: who are they?	• Private car drivers • Trolleybus drivers • Bus drivers • Taxi drivers
Value Proposition: why would they use RL+?	• Reduce vehicle maintenance costs - use of RL+ data to improve road conditions will mean less wear & tear on vehicles and reduced costs of maintaining vehicles • More efficient routes - real-time outbound data on traffic, road construction and road closures, including detour suggestions, will enable users to avoid areas of congestion and reduce travel times; this is particularly important for taxis, motor-taxis and mini-buses for which faster travel would be associated with more passengers and a higher value of fares. Ride-sourcing apps like Uber could potentially see more active users of the app if routes are optimized.
Marketing & Distribution: how would we reach them?	• Partner with owners of primary public transportation providers, such as bus rapid transit providers, and taxi associations

STOP

In this type of city, the government has mid-level capacity to aggregate, manage, and utilize the inbound data generated by RL+, and disseminate the necessary outbound data for the public.

Government Usage of Data

In this type of city, the government has mid-level capacity to aggregate, manage, and utilize the inbound data generated by RL+, and disseminate the necessary outbound data for the public. While the government has some technical ability to implement a project like RL+, it would not be without challenges. As roads are maintained by a private/ semi-private enterprise, this complicates the feedback loop. The issue would be in coordinating, managing, and sharing data between government and the private company, which is likely to be prone to bureaucratic hurdles. Additionally, the technical capacity of the private company responsible for road maintenance would need to be assessed.

User Accountability through Feedback Loops

In cities where the government has mid-level capacity to manage and use data, the agency responsible for implementing RoadLab+ plays an important role in the success of the project. Depending on on the capacity of specific government employees assigned to work on the project, the implementation could look like that in the "world-leading city" or that in the "unconstrained city." As such, the RoadLab+ implementers should emphasize to the relevant government agency the importance of assigning high-quality staff to the project. The should also emphasize the importance of demand that feedback loops are completed efficiently, to ensure active usage.

If these guidelines are followed, the implementation of RL+ in "impressionable city" can look much like that in a high-capacity city. In this case, the government is highly responsive to citizens' complaints, and there is transparency in conducting and reporting on road repairs. Additionally, government collaborates closely with the private road maintenance company to swiftly execute road repair requests. In assuming that the government itself has sufficient capacity to manage data-driven projects, there would not be a need to hire an external company to monitor and aggregate data from RL+. With regards to costs, a significant portion of the budget is available and allocated for implementing RL+ ensuring high quality service to citizens.

If these guidelines are not followed, however, the implementation of RL+ may look like that in a low-capacity city. In this case, the government does not frequently respond to citizen's complaints, and is unable to collaborate with the private road maintenance authority on a data-driven initiatives. Even though the government would have some capacity to deal with data, an external company would be needed to help implement RL+. These factors may hamper the quality of service to citizens and/ or minimize/disincentivize citizens from fully interacting with the app.

The implementation of RoadLab+ in "Impressionable city" can look much like that in a high-capacity city. In this case, the government is highly responsive to citizens' complaints, and there is transparency in conducting and reporting on road repairs.

Chaos Box

A further dependency in implementation is whether a traffic and navigation app already has a foothold in the city. Such apps tend to have immense first-mover advantages, especially since the quality of the information provided by such an app is correlated to the number of users it has. As such, if there is an established app for traffic and navigation info (such as Google Maps or Waze), the RoadLab+ project must contract with that app to obtain a data-sharing arrangement so that RoadLab+ can provide comparably good traffic and navigation info to its users. (Of course, its comparative advantage over Google Maps or Waze would remain the app's users' access to government-provided exclusive road closure and repairs timing info.) In a city with no such prior user base, it is possible that the routing and traffic info could be built from scratch upon an open-source system, like OpenStreetMaps, without having to contract with a commercial entity like Google.
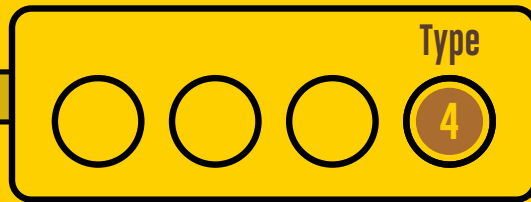
"The Under-Resourced, Capable City"

Government capacity to deal with data	Mid
Primary type of vehicle/traffic	Cars moving at adequate speed
Road maintenance management	Roads are city government-owned and are maintained by a private contractor

STOP

Transportation is car-heavy, but is supplemented by some public transportation options.

This city type reflects average secondary cities in middle-income as well as developing countries. Governments, while relatively well-funded and with bureaucratic capacity, do not necessarily have the data infrastructure, scale, or political will to invest in data management systems. Transportation is car-heavy, but is supplemented by some public transportation options; however, the cities are often not large enough to require extensive public transport infrastructure. Road maintenance is the responsibility of the state or country government, and not the individual municipality. A public company may cover upkeep, but the government may also engage in public-private partnerships.

Case Study: Granada, SPAIN

Population	239,000[13], but fluctuates with student population up to 400,000 (13th largest urban center in Spain)
Density	312 per square kilometer[14]
Mobile access	106% (nationwide)[15]
Income	The average household income in Granada is $76,725
Primary modes of transportation	The transportation system of Granada is based on city buses, taxis and private cars. The city began construction on a tramway system with three underground stops in 2007 and is expected to finish construction in 2016. Traffic is relatively light. The city has a large population of students who attend the University of Granada.

The transportation system of Granada is based on city buses, taxis and private cars.

User Acquisition Strategy

Types of Users: who are they?	• Bus drivers • Taxi drivers • Private cars • Ride-sourcing companies (i.e. Uber)
Value Proposition: why would they use RL+?	• **Reduce vehicle maintenance costs** - use of RL+ data to improve road conditions will mean less wear & tear on vehicles and reduced costs of maintaining vehicles • **Identify more efficient routes** - real-time outbound data on traffic, road construction and road closures, including detour suggestions, will enable users to avoid areas of congestion and reduce travel times; for "Ubers," potentially more active users of the app if routes are optimized

[13] http://www.andalucia.com/spain/statistics/population.htm
[14] http://www.tradingeconomics.com/grenada/population-density-people-per-sq-km-wb-data.html
[15] http://databank.worldbank.org/data/reports.aspx?source=2&country=ESP&series=&period=

Marketing & Distribution: how would we reach them?	• Partner with owners of public transportation providers, including - bus companies, taxi associations, or ride-sourcing companies • Leverage existing public transportation hubs (train stations/bus stops) to promote in high traffic locations

In the "under-resourced, capable city", the government does not prioritize or does not have preexisting systems that can immediately be applied to a data-driven initiative.

Government Usage of Data

In the "under-resourced, capable city", the government does not prioritize or does not have preexisting systems that can immediately be applied to a data-driven initiative. However, its bureaucratic capacity is robust enough that it is able to manage and respond to the daily grievances and provision of basic services for the population.

One option is to train a generic data management division within the government that would be responsible for data-related ICT initiatives, including RoadLab+. This is likely to be an easier sell to a small government than needing to commit permanent and exclusive hires to a RoadLab+ effort. Since the government is capable of managing daily grievances and service delivery, such a department would be expected to function well once resources are committed to it.

A second option is to outsource the programmatic management and data analytics to a third-party partner. Once the program is running, if the government does later establish a practice in data management, it can easily reassume control of the RoadLab+ project from this third party.

Feedback Loops

In this type of secondary city, feedback loops are not exceptionally tight, but the government has the capacity to respond to priority concerns. RoadLab+ provides a tool using which a city with relatively strong capacity and optimal resources, would be able to more efficiently respond to problems. Given the lack of overwhelming transportation concerns in such cities, it would not be difficult to leverage RoadLab+ road maintenance information to address outstanding problems and more precisely target areas that are overlooked. This assumes that the government and the road maintenance authority have a relatively close and cooperative relationship by which the data sourced and analyzed through RoadLab+ would be well received and incorporated into road maintenance activities.

A potential obstacle to ensuring tight feedback loops would be the lack of decentralization of the managing transportation authority. It is possible that because the managing authority for the maintenance of roads is situated one level above the municipality, the resolution of identified maintenance issues would be slow. If RoadLab+ is implemented and managed at the municipality level, which functions efficiently, but there is a weak relationship between municipality and state/federal government bodies, the project might not produce the expected improvements or usage, regardless of the municipality's best intentions.

RoadLab+ provides a tool using which a city with relatively strong capacity and optimal resources, would be able to more efficiently respond to problems.

Chaos Box

One potential worry for any type of city, including the "under-resourced, capable city" is that in some cities, such as Chennai, municipal decision-makers are culturally averse to not only the transparency of governance data, but even to its collection. In some of the typologies above, we considered institutional roadblocks to the realization of a city's best intentions with regard to improving service delivery via citizen engagement, but if the agents of the city (i.e. the commissioners of RoadLab+) are uninterested in pushing other agents toward an optimum implementation, then the project is sure to underperform. Thus, it is imperative to assess the willingness, both cultural/systemic and individual, of the future operators of the RoadLab+ architecture, before embarking on implementation.

6 App Design
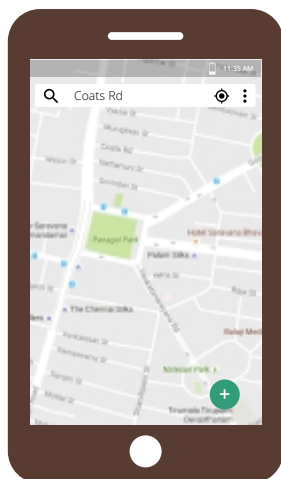
The design of RL+ will need to be tailored to the specific context of implementation. Nevertheless, specific high-level modules will be included in most, if not all, iterations.

Home & Menu

The home screen of the app will be a Google Maps or Waze-style interface through which the user can search for a location or identify optimal routes from one place to another. This feature was selected as the home screen because, in almost all of the typologies, the app's primary value proposition to users rests on its ability to identify efficient routes and avoid areas of high congestion, road work, or poor road quality. Having these features front-and-center is thus important for user acquisition and maintenance.
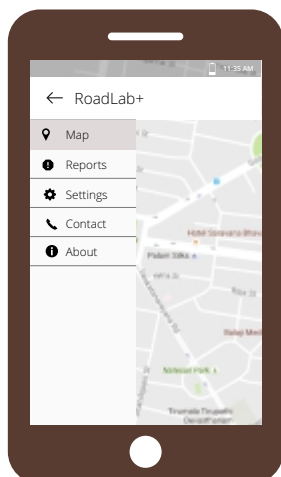
In some contexts, the user may have the option to select their mode of transportation (i.e. bus, car, motorbike, ambulance), and the app will show the optimal route based on the mode of transport.

The app will also illustrate areas of road closure or high traffic through intuitive symbols, and users can click upon the symbols to get more information about the nature of the incident.

Information about road closures, traffic or construction will automatically feed into the routing algorithm, enabling the app to identify the fastest route from one point to another.

Report an Issue

When the user taps the large blue circle on the home screen, they will have the option to "Report an Issue." Tapping this button will take the user to a new page where they will be able to enter as many details about the nature of the issue as necessary. They can choose the type of issue from a drop-down menu (i.e. pothole, broken street lamp, open manhole, black spots, road accidents, etc.), upload a photo of the issue, and write notes as required. The GPS coordinates, date, and time will be automatically populated as soon as they lodge the issue in the system. The issue can then be logged by pressing the submit button. Once submitted, the report will be sent immediately to the app management agency, where it will receive a unique ticket number and be addressed by the appropriate agency.
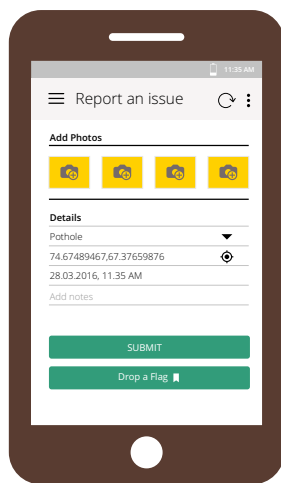
In the case that the user cannot submit the issue while they are passing through the problem area, for reasons of time or safety, there will be a feature by which the user can "drop a flag" and fill in the details of the issue at a later time. To ensure that the user does not forget and in fact fills in the issue details, "dropping a flag" can be linked to a delayed pop-up notification that reminds the user to fill in the issue at a later time. This ensures that the issue is linked to the precise location of the issue (via GPS coordination), but doesn't depend on the user instantly logging the nature of the issue.

7 Conclusion

STOP

This report has illustrated the features that distinguish RoadLab+ from the original RoadLab Application that was implemented in Belarus and Uganda, while providing an implementation roadmap to demonstrate how the app will function in different types of city environments around the world.

RoadLab+ offers a dual value proposition for commissioning governments: both reducing road maintenance costs and soliciting active citizen engagement. This report has illustrated the features that distinguish RoadLab+ from the original RoadLab application that was implemented in Belarus and Uganda, while providing an implementation roadmap to demonstrate how the app will function in different types of city environments around the world. Following this guide, municipal governments will be able to easily tailor the app to their specific city. This will require them to first identify which type their city fits into, ranging from the "world-leading" to the "unconstrained" city, and then altering the app design, functionality and user acquisition strategy to suit that specific type. Using principles of human-centered design and understanding the key drivers of user adoption of each city, RoadLab+ will effectively spur citizen engagement and improve the quality of urban transportation systems in cities around the world.

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