

Scaling Real-time Information: A case study of Kampala

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Introduction

In the world's largest emerging-market mega-regions, access to real-time information has the potential to be transformative for commuters; moreso even than for commuters in developed markets. The ability to stay informed about public transport services, traffic conditions, and disruptions can significantly impact the travel experience, enabling commuters to make better decisions, save time, save money, and reduce anxiety. This is especially important in the world's largest megacities, where commuters can spend up to five hours a day in transit.

But while real-time information systems are commonplace in developed cities, in emerging-market cities they are rare because the costs associated with deploying and maintaining the necessary infrastructure are high, and there are regulatory (and other) challenges related to the vast informal public transport networks that dominate in these markets.

This report addresses solutions designed to leap - or sidestep - these hurdles using WhereIsMyTransport's real-time alerts data product. It examines the thesis behind the product's development and its value to commuters and city governments, and it addresses the challenges of scaling a workable solution across emerging-market cities.

Using Kampala as a test city, we will show how real-time information can transform the experience of using public transport, and we'll address some of the problems that must be overcome before a solution like this can work at scale and cost-effectively.

What is real-time information for commuters, and why is it important?

Real-time information in the public transport industry is most regularly denoted by the General Transit Feed Specification Real-time (GTFS-R) format. GTFS-R is a feed specification for public transport agencies to communicate real-time service updates. It includes three components:

- Trip Updates: Provides a real-time update on the progress of a vehicle along a trip;
- Vehicle Positions: Provide real-time vehicle positioning information;
- Service Alerts: Provides information on incidents on the public transport network.

Accurate vehicle position information, which can be used to determine trip updates, requires a GPS device to be installed on vehicles in the network. This creates a significant barrier to entry for many emerging market cities, as its installation is costly, labour intensive and requires buy-in of all, or at least most, vehicles in the network. While such solutions should be welcomed as a positive development, they are simply not scalable in many emerging market cities as they require a challenging and lengthy negotiation process with the fragmented landscape of informal transport operators which dominate emerging-market cities. Additionally, these systems require a central management system to process and provide network-wide data outputs, which requires significant technical capabilities and buy-in from multiple organisations and operators. Real-time information based on GPS data is therefore best suited to formal transport, where drivers and vehicles are more heavily regulated, and organisations have the financial backing to make the initial investment. Even with a larger formal network, transit authorities in emerging markets still struggle with the technological capabilities to collect, process, and make openly available this data. This is evidenced by the fact that amongst the 50 largest emerging market cities, only 2% have complete and openly available real-time data on their public transport networks.

In emerging markets that rely heavily on informal transport, the lowest barrier to entry to provide real-time information at scale and in a permissionless manner is service alerts. Service alerts play a crucial role in enhancing the travel experience for users, and can be generated without the need to access vehicle GPS data.

Real-time alerts hold significant potential in emerging markets, particularly for informal transport users. In these markets, where formal transport systems may be limited or unreliable, real-time alerts can provide a crucial source of information for navigating complex and dynamic transport networks. According to Langford et al. (2020), real-time alerts can enable users to plan their journeys more effectively, avoid congested routes, and adjust their travel plans in response to changing circumstances. Real-time alerts have also been found to positively impact user satisfaction, reduce travel time, save money and improve overall travel experience (Ceder et al., 2017). Wakins (2011) found that transit riders using real-time information were able to save 15% on their commuting wait time compared to people without this information, and that this information helped to increase

satisfaction and ridership with public transport services. This saving primarily comes from improved decision making abilities made available by this data.

Additionally, time saved can be equated to money saved, when that time is directly related to time the commuter could have put into working. This is especially true for workers who operate on an hourly wage, or entrepreneurs who only earn money while working, as is often the case with low income commuters in emerging markets. Time saved has a direct impact on their take home salary, and can significantly improve standards of living.

Rumbo, WhereIsMyTransport's consumer product core value proposition was centred on real-time information on incidents and disruptions for all modes of public transport. Real-time information enabled Rumbo users to make informed decisions about their journey, enabling them to arrive at their destination on time. Equating these time savings to potential increase in income, across Mexico City, Lima and Bangkok, alert delay notifications have potentially enabled Rumbo users to gain a 16%, 13% and 13% increase in total monthly wages respectively. At scale, real-time information has the potential to transform how a city moves, enabling increased efficiency, growth in income and contributing to the positive development of a city.

For informal minibus operators, the same can be said for their service. Up to date information about what to expect on their journey can help them make more informed decisions on when to depart and how to alter their routes to avoid congestion. Clear communication with their passengers can further alleviate hardships caused by delays, allowing passengers and drivers to better plan their journeys. This can result in time saved, fuel saved and more money earned for both drivers and commuters.

In addition to the impact on public transport, real-time alerts have the potential to greatly enhance the travel experience of all road users, including private vehicles and on demand transport. Real-time alerts can be displayed on a map to inform users of accidents, protests, streetworks flooding etc and can also be integrated into routing algorithms to optimise travel time based on real-time traffic disruptions.

AlphaBeta (2016) in a study on the economic impact of geo-spatial services found map services enhanced with real-time data are able to suggest alternative routes and highlight travel times. This in turn increased people's willingness to use public transport by 53%, reducing reliance on private cars and potentially reducing global CO₂ emissions.

For cities, governments and international financial institutions, historic data on the incidents and disruptions can support them in understanding points of congestion, high accident or traffic zones, and areas in need of development.

By providing up-to-date information on schedules, routes, and service disruptions, it is clear that these systems empower individuals and businesses to make informed decisions about their travel plans. Drivers can efficiently plan their routes and schedules, while commuters can optimise their route planning and reduce waiting periods. Additionally, freely available real-time information can bridge the accessibility gap by ensuring that individuals, regardless of their location or income level, have access to timely and accurate information

about transport services. This can lead to more equitable transportation opportunities and improved overall mobility for all users.

Addressing the need for real-time information

To address the need for real-time information that scales across emerging markets, WhereIsMyTransport designed a permissionless approach to generating real-time data. While across emerging market cities there is often no central available source of real-time data made openly available by cities and governments, we knew from working across emerging markets that real-time information exists fragmented across communities: local facebook groups for metro lines, whatsapp groups for informal transport routes or stations, and conversations about accidents and roadworks on social media platforms such as Twitter. The challenge to scale was identifying these sources of information, tapping into these communities, and generating a feed of real-time information that all actors in the network could benefit from.

Not only did we need to address the challenge of finding and making available real-time information, we needed to design a product that could ingest information from these conversations, triage that information, and transform fragmented noise into high-quality signal, providing information on incidents and disruptions to only those affected by them.

It is based on this challenge that we developed our real-time alerts data management platform, known as Corazón. Corazón ingests fragmented data from any digitally available endpoint, transforms this data into relevant alerts on incidents and disruptions, and makes these data available to any digital endpoint - in GTFS-R format and an incident API for location-based service providers.

Building a cost-effective solution for scale

We originally scaled our real-time alerts feed to cover markets where our consumer product Rumbo was active: Mexico City, Lima and Bangkok. We produced hundreds of thousands of alerts on incidents and disruptions across the city, enabling public transport users, in real-time, to be aware of incidents and disruptions on public transport services.

While our real-time alerts feed provided invaluable information to public transport users, the feed was expensive to scale given its reliance on a team of human operators who triaged incoming incident reports and transformed them into real-time alerts. Given the repetitive nature of creating real-time alerts by a human team of operators, we identified an opportunity to automate the production of our real-time alerts feed. Automating the production of our real-time alerts would have several benefits:

1. Automating our real-time alerts feed would enable us to provide the feed globally, without a reliance on a human team of operators;
2. Automating our real-time alerts feed would enable us to provide the feed more cost effectively for clients who have a lower willingness to pay;
3. Automating our real-time alerts feed would enable us to scale our impact to new markets, without Rumbo.

Partnership with Shell Foundation

To address the challenge of automating and scaling our real-time alerts feed, we partnered with Shell Foundation. Shell Foundation is a charity registered in England and Wales, founded by Shell in 2000, that creates and scales business solutions that empower underserved populations to earn a living income through access to clean energy products and services. Shell Foundation supports early-stage technology and business innovations that enhance income by generating greater value for customers and improving affordability in the priority markets of India and Sub-Saharan Africa. Given the value that real-time information can have for public transport and road users, we identified the opportunity to partner together to multiply WhereIsMyTransport's impact by piloting the automation of a real-time alerts feed in Kampala, Uganda.

Kampala as a pilot city

Given Shell Foundation's focus on Sub-Saharan Africa (SSA), and WhereIsMyTransport's vast experience working in SSA markets, we agreed to pilot the introduction of an automated real-time alerts feed in Kampala, Uganda. Kampala, the capital city of Uganda, serves as a suitable representative market for SSA when examining its transport systems and our ability to automate the production of a real-time alerts feed. Several factors contribute to Kampala's representative nature within the SSA context.

Kampala's transport system, particularly the informal sector, operates in a manner that closely resembles other regions in SSA. The predominant modes of informal transport in Kampala are mototaxis, locally referred to as bodas, and minibuses. These modes are also prevalent in other cities and towns across the region, fulfilling the mobility needs of a significant portion of the population (Figueroa, 2016).

The reliance on road-based informal transport and the challenges associated with it, such as congestion, safety concerns, poor infrastructure and lack of formal regulation, are common features observed in many SSA markets (Ali et al., 2017). These features also make real-time service alerts especially valuable to public transport users, given the susceptibility of road-based public transport services to general traffic disruptions.

Furthermore, with an increasingly connected and online population, which has shown promise in delivering real-time transport information in SSA (Marsden et al., 2019), Kampala is a strong representative market to identify both the opportunities but also inevitable challenges in scaling a digital solution in SSA.

What real-time information is available to commuters in Kampala today?

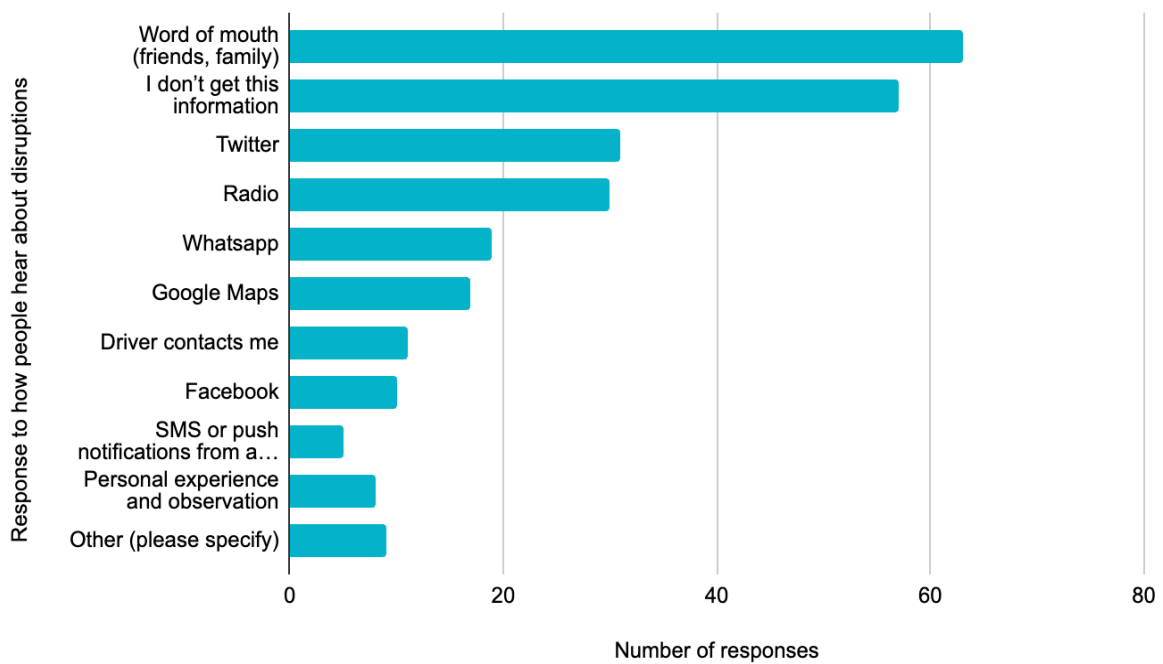
As noted by Kiggundu et al. (2019), Kampala's transport system faces numerous challenges, including congestion, unpredictable travel times, and safety concerns. These issues result in challenges for commuters who often need to arrive at their destination at a specific time.

Prior to the introduction of our real-time alerts feed, real-time information was restricted to a small number of spontaneous real-time alerts on Twitter, select radio stations, and TV broadcasts. Commuters primarily relied on local networks to obtain real-time information, such as physical signage or word-of-mouth. Reliable real-time information was unheard of,

and commuters typically only became aware of disruptions when they were already stuck in them.

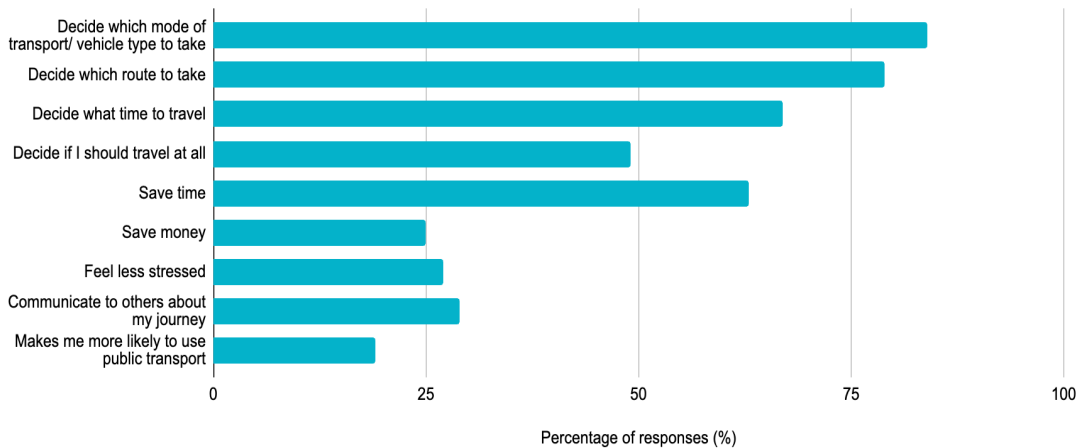
In a baseline study we conducted prior to the creation of a dedicated real-time alerts feed, 70% of the 173 respondents surveyed said they only found out about disruptions via word of mouth or that they didn't get this information at all. The remaining 30% used a variety of online methods including social media and traditional media to find information about disruptions.

Answers to survey questions about how commuters find out about disruptions



We also found that over 75% of survey respondents said that a twitter feed of real-time alerts on incidents and disruptions would help them in deciding what type of transport (boda/minibus), and which route to take. Over 60% predicted that it would help them to decide what time to travel, and it would save them money.

Answer to a survey question about if a real-time feed of alerts on Twitter would be useful



The potential value of real-time alerts in Kampala was significant. Real-time alerts had the potential to greatly improve the commuting experience by providing commuters with the knowledge needed to make informed decisions to 'beat the jam' locally known as avoiding traffic. This, in turn, would enhance the quality of their travel experience and subsequently improve their overall quality of life.

When assessing the alerts landscape in October 2022, WherelsMyTransport's operators found an average of three, and at most seven, alerts per day online in Kampala over a three week period, clearly indicating the need for the lack of a dedicated reliable source of real-time information.

Our research clearly demonstrated that there was a strong desire from commuters in Kampala for more real-time information on incidents and disruptions. Previously, these public transport users operated in a vacuum of information or had to collect the information from different, often sporadic and unreliable sources. Because of this lack of information, they often are forced to leave their homes early in order to arrive at their destination on time, face potential for disruption along their journey and feel great stress and anxiety along their commute. By providing more real-time information in the form of real-time alerts, we would enable these users to plan ahead, reduce anxiety, and choose the best route for their trip based on a real-time picture of traffic in Kampala.

Motion Kampala

Creating and automating a real-time alerts service

Automation can only be achieved with two components. Firstly, there needs to be data to automate, and secondly there needs to be training data. Training data enables algorithms to learn based on patterns and to leverage that knowledge in predicting outcomes. Initially, our expectation was to find a significant number of existing reports on incidents and disruptions online in Kampala that we could automate as we have found in other emerging markets such as Mexico City and Bangkok. However, we quickly realised that there were fewer alerts available than anticipated. In Kampala, there was both a lack of data to automate and a lack of training data in the form of digital sources of reports on incidents and disruptions.

To address these challenges we created our own real-time alerts feed and explored how to ignite and sustain this data based on crowdsourcing. In November 2022, we established Motion Kampala (@Motion_KLA) on Twitter, Kampala's go-to-source for real-time information on incidents and disruption affecting the city. We hired a small local team to ensure our brand felt local and to enable public transport users and drivers to contribute in Luganda, the local language. We chose the name "Motion" because it has the potential to scale to many markets, replacing Kampala with our city of interest, e.g. Motion Nairobi. The word "Motion" was used as it lends itself to the feeling of movement, transport and ever changing city, as well as being simple and memorable.



Our initial approach relied on paying mototaxi drivers, also known as riders in Kampala a small sum to send us traffic incidents via WhatsApp throughout the day. This information served as the foundation for seeding alerts on our Twitter account, encouraging people in Kampala to contribute their own reports. We chose WhatsApp as a platform as it is well known to the many tech illiterate drivers, and it has the ability to consume voice notes, which are often used by riders while on the road.

By adopting this strategy, we not only facilitated the provision of real-time alerts to the public but also fostered community engagement. Throughout the project, we witnessed steady growth in our Twitter account, with an increasing number of crowdsourced alerts received month on month. Simultaneously, we worked closely with the riders, refining and optimising their contribution to ensure the quality of the alerts.

By creating the Motion Kampala Twitter page and establishing an effective process for crowdsourcing alerts, we successfully developed a real-time alerts feed for the city. This approach not only provided valuable and freely available information to the public, but also provided WhereIsMyTransport the opportunity to develop a playbook for entering a market in SSA where no disruption reports existed previously, likely to be the case in many SSA markets.

How did the service perform?

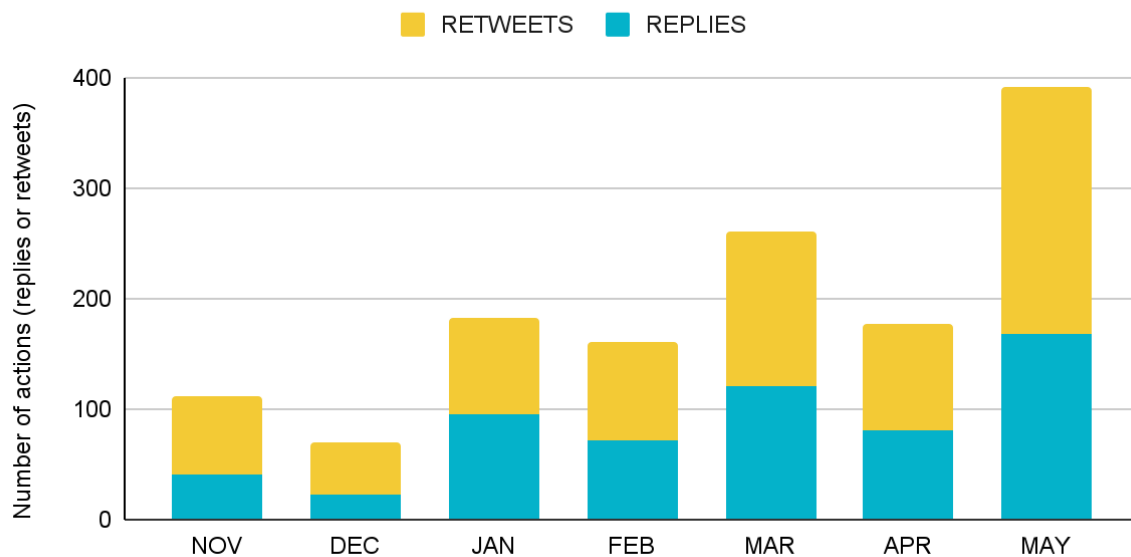
During the project period, Motion Kampala ignited a conversation about traffic in Kampala, and over time became the go-to source for real-time information for road and traffic conditions throughout the city.

On average, between January and May 2023, Motion Kampala posted 583 alerts per month, averaging 20 alerts per day. The majority of these alerts were instances of traffic causing delays, a common occurrence in Kampala. We also regularly published traffic accidents, leaks and flood information. As mentioned, during our baseline data collection in October 2022, our operators identified on average three, and at most seven alerts per day in Kampala. This represents a 6.6x increase in the number of digitally available incidents and disruptions compared to the baseline.

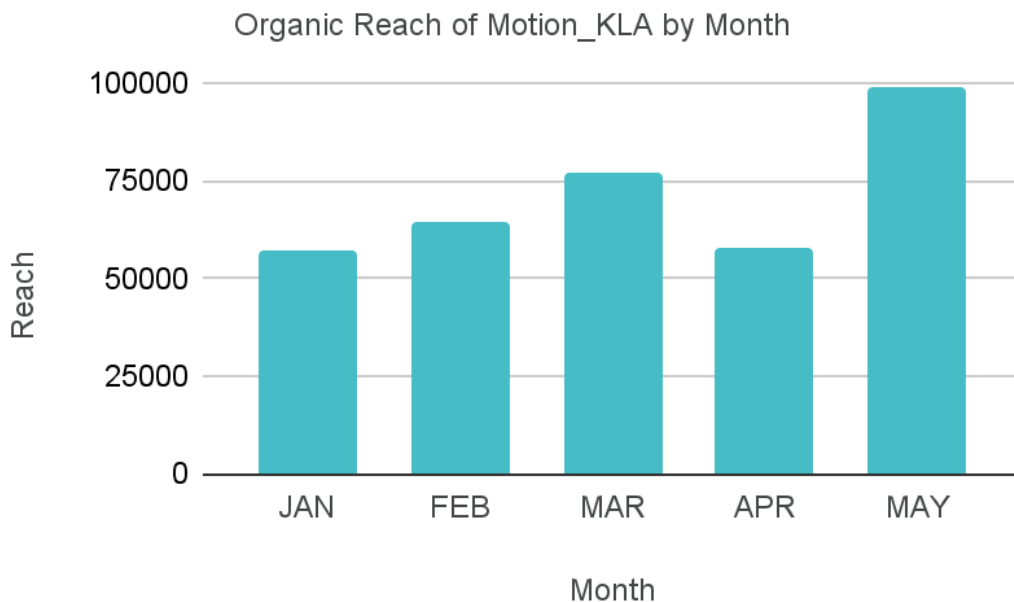
As Motion Kampala has grown, we have observed a steady increase in the page's engagement and reach. We hypothesise that engagement and reach grew over time both as Motion Kampala became the go-to source of reliable information on incidents and disruptions across Kampala, but also as new users joined Twitter in order to access this information digitally.

For a digital product, engagement is a strong proxy for impact. Rarely do people engage on posts that do not impact them in some way. Engagement is the sum of likes, replies and retweets, each indicating different levels of value. For example, retweets (i.e. reposting a message on your own feed) is an excellent measure of impact, given that it is highly unlikely someone would retweet a post if it was not valuable to them or their followers, friends or family. Motion Kampala has grown its reach month-over-month with an increasing number of retweets, indicating that users found value in the information we provided, and wanted to share that information with others.

Organic engagement: number of retweets and replies on organic posts



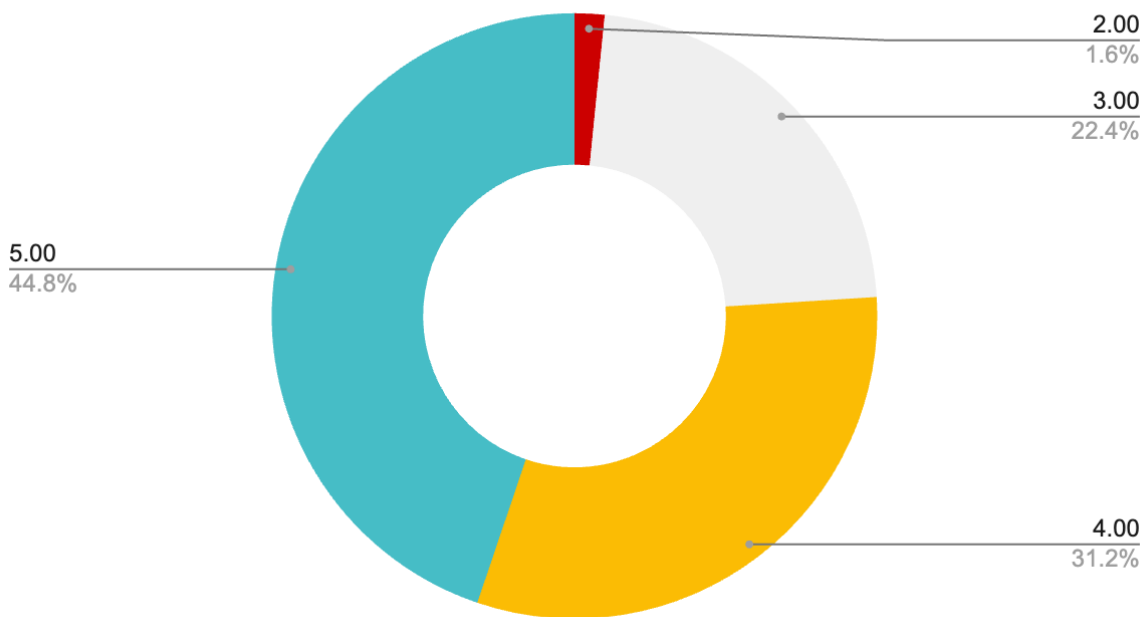
While engagement measures active interaction with our feed, reach measures how many people saw information from Motion Kampala. Since Motion Kampala launched, we've achieved a total reach of ~640,000 users. This represents a significant number of opportunities to provide users with real-time information to enable a more reliable commute.



In June 2023, we surveyed Motion Kampla's users and conducted interviews with selected organisations to assess the impact of Motion Kampala.

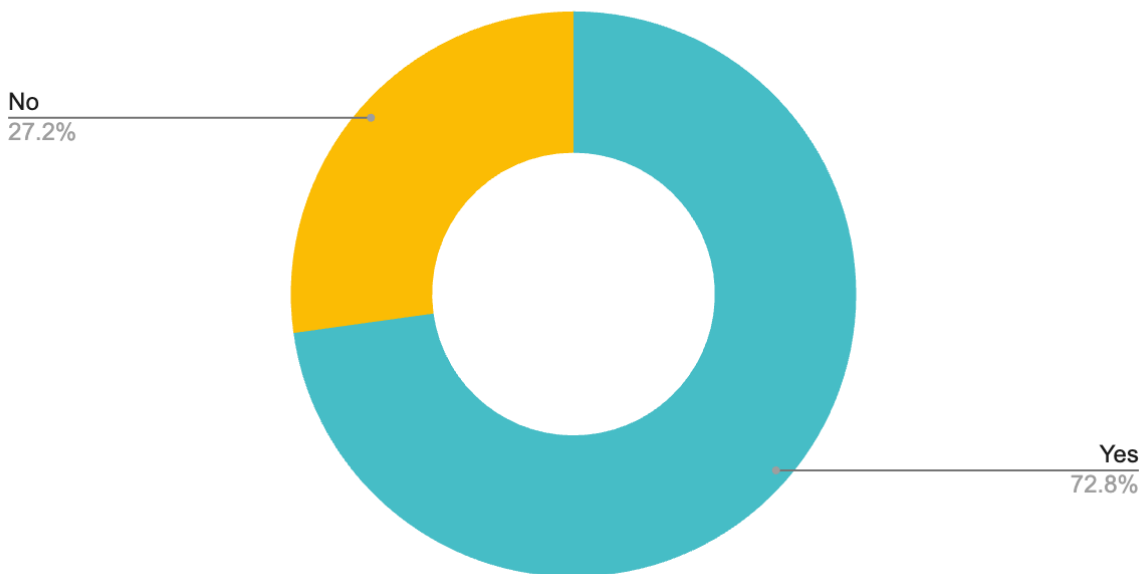
Trust is a key component in a digital product providing information, especially in emerging markets. Many people, for example, face penalties including wage loss for arriving at work late. Trust is thus a useful proxy for understanding the quality and accuracy of the information provided by Motion Kampala. Of the 143 survey respondents, 76% rated Motion Kampala extremely or very trustful.

To what extent do you trust Motion Kampala?



Given the high proportion of survey respondents who say they trust Motion Kampala, it is of little surprise to observe that of the 143 survey respondents, 72.8% of users had changed their journey based on information provided by Motion Kampala. This represents a significant portion of users who optimised their journey based on the information we provided and speaks to the level of trust Motion Kampala users have in the information we provided.

Have you ever changed your journey because of information you saw on Motion Kampala?



Survey respondents also provided qualitative feedback on Motion Kampala's impact on their commute:

"It's transforming the jam delays even give alternative route it's real helping us to navigate" - Female survey respondent

"Motion kampala has been very helpful in guiding me in and out of kampala. It has enabled me plan my journeys in advance and manage my time " - Male survey respondent

"It's a real-time traffic platform that I can rely on before navigating the crazy streets of Kampala on every given day " - Female survey respondent

"Motion Kampala, I like you guys in terms of giving us real-time traffic alerts. We do not have to rely on google maps" - Moses Musinguzi - SafeBoda rider

"Really really love this project" @CharzUX_UI - Twitter follower

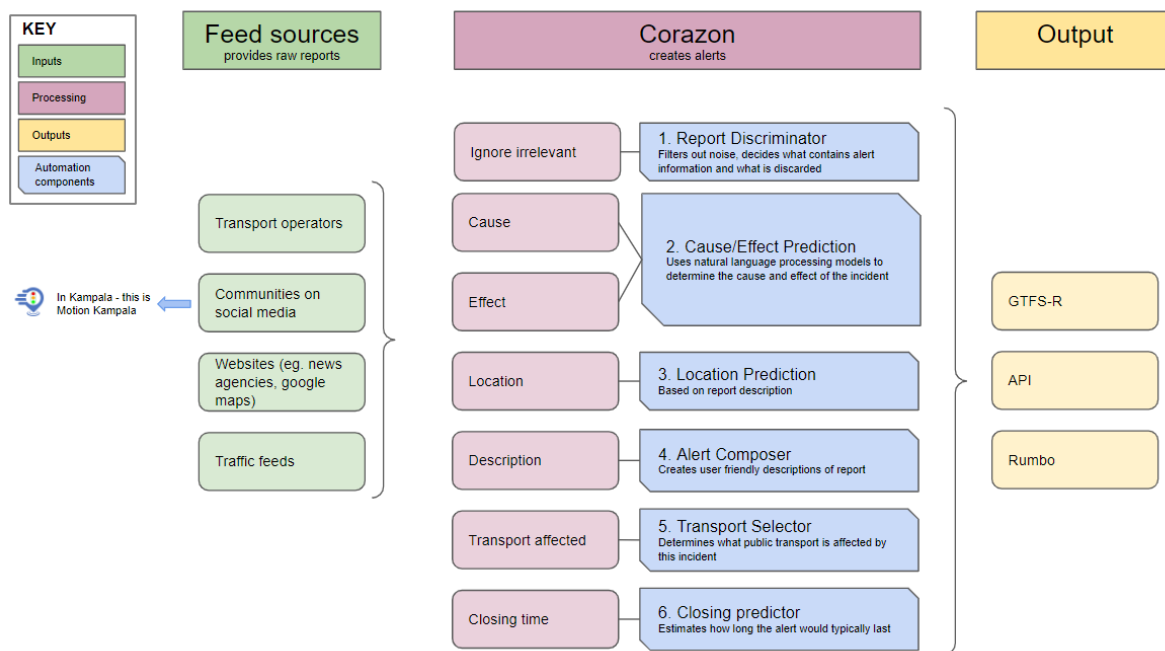
"This one time the Kisaasi traffic lights were off and we were stuck there for about 40 minutes because everyone wanted to pass. Later on that day, I saw Motion Kampala on my feed and I was in shock at how I got the notification."- Birungi Janat (Kampala commuter).

The anatomy of a real-time alert and the automation process

As we built Motion Kampala's user base and published alerts on incidents and disruptions, we simultaneously built out our real-time alert automation capabilities. The real-time alert feed we produced is composed of six steps:

1. Report Discriminator: Reports are filtered using natural language processing. Irrelevant, duplicate, late or out of coverage alerts are ignored and discarded. Only reports that contain relevant information are used.
2. Predict cause and effect: Causes are the root reason of a disruption: car accident, flood, protest etc. Effects detail the consequence of the disruptions: such as significant delays, road closures, detours etc.
3. Location Prediction. Based on the information in the original report, the location of the disruption is geo-located on a map.
4. Alert Composer: The composer writes a grammatically correct description of the alert based on the cause, effect and location.
5. Transport Selector: The transport selector selects what transport is affected by the alert. For instance, if there is a car accident that is causing delays, this component determines what public transport will be disrupted. This is a key value proposition of our real-time alerts feed. Without complete data on the public transport network, many users would be unaware that an incident or disruption is likely to affect their journey..
6. Closing selector: The closing selector predicts, based on historical data, how long the alert should last.

An overview of the real-time alerts pipeline, from feed sources, through Corazón including the automations and outputs



The above automations result in several outputs that can be ingested by third parties. Third party outputs include an incident API - which contains cause, effect, location, prediction and closing time. GTFS-R outputs include the cause, effect, location, description, closing time and the transport affected..

Having an alert that includes this information is critical for third party interoperability, and thus is essential for the monetisation of this feed. A component based system enables a

third party application to parse this information and use only the components they require. For example a third party application may not need description and effect, and may use location and cause only. The ability to separate these out ensures that the data is in a format that is accessible and useful to developers (as opposed to raw reports from social media which may contain any combination of the above, in a random order).

Over the duration of this project we have built each of the components needed to automate the production of a real-time alerts feed. Our model has become highly accurate, and can predict the cause, effect, and location of an incoming incident report with >97% accuracy. However, as with any end-to-end automation, we expect some exceptions to arise. In this scenario we activate an exception report that an operator would moderate.

While we've achieved the ability to automate the production of our real-time alerts feed, we've chosen to maintain a team of operators while we further refine the algorithm and training datasets. With the automation work we've achieved, our operations team has achieved a 3x growth in the number of cities they are able to monitor. Thereby ensuring that we can profitably service new clients and markets, irrespective of their location.

The challenge of Kampala as a pilot city

Kampala was a great pilot market for several reasons: the lingua franca is English making it easier to train our models, the majority of conversations about traffic occur over Twitter, and the majority of public transport operates on the road, making Kampala an ideal candidate for our real-time alerts offering.

However, there were still challenges related to the development of an automated feed.

Variety in feed source, and variety in disruptions is needed to create robust prediction models. However in Kampala the overwhelming majority of disruptions are peak time traffic, which cause delays. This traffic is not brought on by any incident, but rather a daily occurrence due to poor road infrastructure and too many vehicles on the road. Additionally, there are only three other causes that are regularly used in Kampala, leaks, floods and accidents, and these are only used 10% of the time.

We've had to account for this highly skewed distribution of causes and effects in our models, and need to recognise that in this instance, this is an exception. In other cities, the variety of disruptions and effects is more favourable for modelling, and we have built our prediction models with these in mind, rather than with Kampala in mind.

Scaling a real-time alerts service in Sub-Saharan Africa

WhereIsMyTransport recognizes the significant value of SSA as a market, given its lack of openly available real-time public transport information and reliance on road-based informal modes of public transport. SSA includes several of the world's fastest growing cities including Lagos, Kinshasa, Johannesburg, Nairobi, and Accra, among others. Each of these cities contain vast informal public transport networks that could all benefit significantly from the real-time alerts solutions we can provide.

SSA is also experiencing rapid economic growth. Lagos, for instance, is projected to be one of the world's fastest-growing cities in terms of GDP growth, with estimates indicating an annual growth rate of around 7% (PwC, 2017). This economic growth paves the way for technological advancements, creating an opportune environment for WhereIsMyTransport to introduce and monetize our real-time alerts product.

While many cities in SSA are experiencing rapid economic and population growth, many cities may not yet be technologically ready for WhereIsMyTransport to introduce our automated real-time alerts product. Without existing digital available reports on incidents and disruptions in a city, there is no data to transform and ultimately automate into a real-time alerts feed. Cities such as Cape Town, Johannesburg, and Nairobi have shown promising progress in terms of technological infrastructure and literacy. These cities possess a blend of formal and informal transport systems, and an existing digital conversation about incidents and disruptions in the city, which provides a solid foundation for WhereIsMyTransport's real-time alerts feed.

For less advanced markets like Kampala, WhereIsMyTransport can draw from its experience in this project. In these cases, we would need to develop an alerts feed from scratch, similar to Motion Kampala to generate real-time information where none existed before. If we wanted to only create a feed of information that is monetizable, it is possible to do this relatively cheaply, given our experience with the Motion Kampala project. While cost effective, this approach does require oversight and direct management vs a fully automated feed in more digitally advanced markets.

Monetising real-time alerts

While we have established the work required to produce a feed of automated real-time alerts, that is in theory monetizable, there are still challenges to monetising this feed at scale in SSA.

Many organisations operating in emerging markets, particularly in SSA, function under tight profit margins. Consequently, they require a clear understanding of the potential financial benefits associated with acquiring our real-time alerts data. While it is clear that users benefit from this information, transforming this benefit into a specific cost-benefit for the purchasing organisation is critical to enabling adoption.

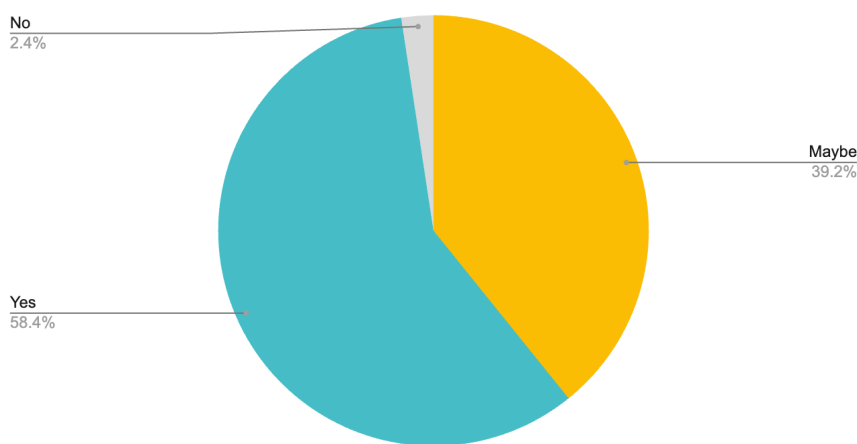
In addition to this, integration challenges are also a major obstacle. These arise when smaller, often local location-based service platforms rely on larger location-based service provider platforms, such as Google Maps, to power their map-based interface. The reliance on larger platforms and their proprietary nature makes it difficult for smaller providers to seamlessly incorporate additional data layers onto the existing base map unless they possess extensive technical expertise.

A third avenue to scaling these data is through licensing to major location-based service providers. However, lower smartphone adoption and digital tool usage, lower GDP per capita and spending power, investor expectations and profitability and the effects of COVID-19 and macroeconomic factors all contribute to many location-based service

providers continuing to invest in developed markets over prioritising expansion in emerging markets.

A final avenue to scaling real-time information across Sub-Saharan Africa could come from users themselves. When surveyed, 58.4% of Motion Kampala users said they would pay a small amount to subscribe to the service. However, charging users a subscription service for this information could lead to disparities where lower-income commuters are shut out from information which could improve the reliability of their commute, arguably the users who need it most. Over time however these subscription costs could be covered by third parties including city governments, new stations, or philanthropic foundations.

If Motion Kampala became a paid service in the future, would you consider paying a small amount to subscribe?



Conclusion

With real-time information about public transport services at their fingertips, commuters in emerging markets can take charge of their commute - and their day-to-day lives - in ways that are transformative.

Of the different types of real-time information that are valuable, alerts that report disruptions are a relatively straightforward opportunity to seize and solve with a scalable, permissionless service.

Using Motion Kampala, our crowdsourced real-time alerts feed, we enabled commuters in Kampala to make better decisions, optimise their journeys for time and money, and reduce the pain of long and unpredictable commutes.

The success of Motion Kampala - the brand and the service - underscores the importance of trust, community engagement, and the role of technology in bridging information gaps.

Motion Kampala is a first step; it has proven the feasibility and the value of a service like this. But there is still some way to go to scale and monetise a real-time alerts service across Sub-Saharan Africa.

As technology infrastructure and literacy continue to improve, the potential for expanding automated real-time alerts feeds becomes more promising - and the barriers to scale easier to overcome. Monetisation is, of course, an imperative, and that too will become easier to address as the macroeconomic situation improves and GDP/capita increases.

It is clear from this project that the positive impact of real-time information for commuters extends beyond the commute to the community at large. By enabling easier, more convenient public transport, we are helping people to help themselves - and each other; we are greasing the wheels of the formal and informal economies; we are supporting sustainable growth; and we are providing equitable and reliable transportation services to help everyone get where they need to go faster, better, cheaper, and more reliably.

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