KENYA

Police Electronic Crash Records and Analytics

Lessons from a Pilot in Nairobi

Smart and Safe Kenya Transport (smarTTrans)

How DIME Supports Governments in Making the Most of Digital Systems

WHAT IS DIME?

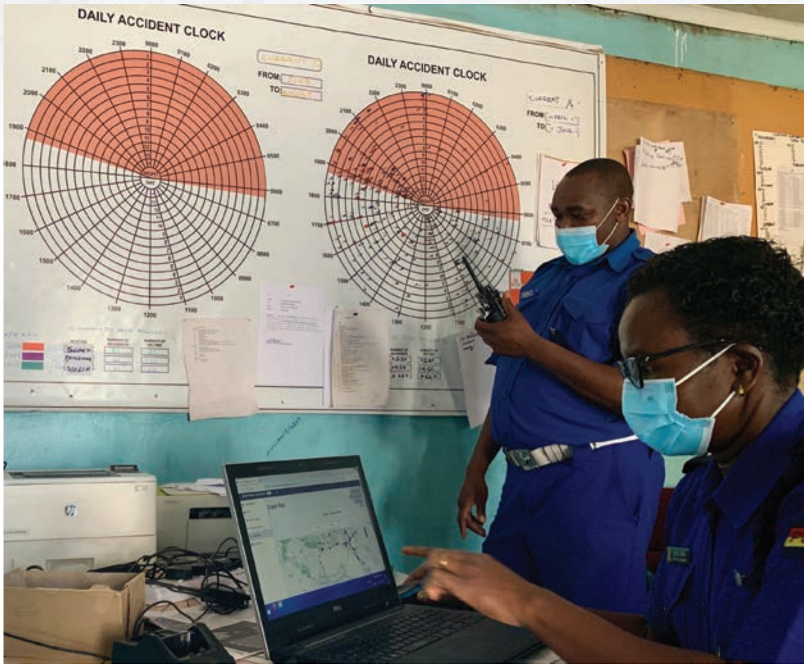
The Development Impact Evaluation (DIME) department at the World Bank brings data science and economics expertise to support governments in the use of data and evidence to improve delivery and effectiveness of development programs.

HOW:

DIME works side-by-side with government agencies to build data systems, strengthen client skills, and create digital tools for clients to interact with their data and improve the efficiency of government services and investments, thus, supporting country capacity for digital transformation. Further, DIME conducts iterative and adaptive field experiments to optimize delivery and programs' success.

OUTPUT:

Materials that inform the architecture design and improvement of existing and planned national systems for electronic records include: (1) the testing and development of features of the systems that increase usability and usefulness; (2) reports and toolkits to operationalize lessons learned; and (3) dashboards and pilot systems with the related logic and open-source code.



Governments around the world are leveraging the power of technology in transformative ways to realize the promise of digital government: improving public service delivery, administration, and social value by enhancing how government functions and interacts with its citizens. Yet, most digital government projects in low- and middle-income countries (LMICs) underperform.[1] Piloting and learning how best to realize the benefits of information communications technology (ICT) in government functions is crucial for developing strong national strategies for digital transformation. It will help harness ICT solutions' potential for reaching the Sustainable Development Goals (SDGs), such as halving mortality on the roads (SDG 3.6), the case discussed in this brief, and improve

[1] *World Development Report 2016: Digital Dividends, World Bank*, https://www.worldbank.org/en/publication/wdr2016.

the availability of high-quality, timely, and disaggregated reliable data (SDG 17.18).[2]

In most LMICs, crash records are paper-based with thousands of reports printed and stored in stacks. Indicators on when, where, and how road crashes have occurred are estimated manually and reported in aggregate with a significant amount of time, cost, and effort wasted every time a report is issued. Systematizing the collection and analysis of data takes even greater effort at the beginning, but the idea is that the information is then generated automatically and can be used to inform potentially life-saving decisions.

The Police Electronic Crash (eCrash) pilot system was started on this basis: to enable digital data collection to improve the efficiency and quality of crash data, deliver real-time information on road safety indicators, generate automated official police reports and data analytics, and thus improve road safety planning, monitoring, and response. This is a component of a larger project called Smart and Safe Kenya Transport (smarTTrans), a collaboration between the Development Impact Evaluation (DIME) department at the World Bank, the National Police Service (NPS), and the National Transport and Safety Authority (NTSA), among others, to improve road safety through better data and analytics. First, the project digitized around 17,000 paper crash reports between 2012 and 2021 from the 14 police stations in Nairobi and created the first crash map of the city. Then, the eCrash pilot leveraged this learning and conducted multiple rounds of field testing to optimize new system features to secure availability, efficiency, and quality of crash data and analytics. The amount of learning that was generated clarifies why prototyping is a necessary step in the design of any national system to optimize design, operability, and usefulness. The eCrash pilot system records indicators from the crash scene, including: (i) the location, time, cause, and severity of the crash; (ii) type and number of road users involved; (iii) characteristics of injuries and deaths; and (iv) the health facility used for emergency care. The system autogenerates NPS official reports on crashes and feeds data into a dashboard with real-time maps, tables, and figures for NPS and other agencies' road safety policy planning and response (see box 1). The lessons learned have fed into the new national road crash data system financed by the African Development Bank and the European Union through the Sirari Corridor Accessibility and Road Safety Improvement Project: Isebania-Kisii-Ahero Road Rehabilitation.

[2] *World Development Report 2021: Data for Better Lives, World Bank*, https://www.worldbank.org/en/publication/wdr 2021.

This work also supports the World Bank-financed Horn of Africa Gateway Development Project (HoAGDP) by generating higher quality road safety indicators and building institutional capacity within NTSA, NPS, and other road safety authorities.

Pilot eCrash System Process

NPS staff and frontline officers worked with the World Bank team to develop a "test, learn, and adapt" loop and create a direct channel to the authorizing environment of NPS. After an initial discussion in 2019 led by the Inspector General and with participation from stakeholders within NPS, NTSA, and the World Bank, the pilot eCrash system was developed, field tested, and adjusted during 2019-2021. Two police stations and their police officers participated in the pilot under the guidance and leadership of the Nairobi Area Traffic Police Headquarters and its staff. Their participation and feedback were critical in ensuring "realism" and "feasibility" of the proposed approach and features. The pilot system focused on data entry for all crashes that require a police situation report, which includes crashes with injuries, fatalities, or significant damage to vehicle(s) and/or property.

Box 1. Examples of Road Crash Data, Records, and Analytics across Government Institutions

National Police Service (NPS). Enforces rules and regulations according to the Traffic Act and provides official records of crashes from the scene of the crash and investigative reports for official uses, such as legal prosecution or insurance claims. Police records are the official record of crash details, including the location, time, persons involved, as well as the cause and severity of the crash, all of which require data systems to ensure crash data quality, standardization, and coverage.

National Transport and Safety Authority (NTSA). Conducts the following, among others: (i) road safety audits at crash blackspots, which require data for identification and analysis of high-risk crash locations based on crash severity and fatalities; (ii) monitoring and evaluation of road safety designs; (iii) design of policies to reduce the number of road crashes, which requires knowledge of risk factors given by indicators such as the numbers of injuries and fatalities; and (iv) management of comprehensive road safety databases integrating data from multiple transport sector stakeholders, such as traffic police, motor vehicle registration institutions, and insurance agencies, among others.

Ministry of Transport and Infrastructure and road authorities, such as Kenya National Highways Authority (KeNHA), Kenya Urban Roads Authority (KURA), and county transport bodies. Manage, maintain, and build roads and the infrastructure to decrease the risk of crashes, such as pedestrian bridges and signaling, medians, and crosswalks. These types of infrastructure require high-quality data on where crashes with pedestrians happen and where other infrastructure-related interventions are needed.

Other road safety stakeholders, such as the Ministry of Health and insurance agencies. The Ministry of Health collects data on emergency medical services, post-crash care, trauma management, and health outcomes for crash victims. Insurance agencies assess and manage claims from road crashes. These are examples of other agencies that collect complementary data on road traffic crashes that could be integrated with crash data from the police and other bodies to monitor and measure road safety and crash outcomes.

Pilot eCrash System Features

The eCrash pilot is meant to inform an integrated system that compiles information on crashes with standardized entries and automated reports for inter-institutional road safety measurement and monitoring. The components of the system are described below.

1. Data Entry Processes to Support Recording Standardized, Complete, and High-Quality Crash Records

The analysis of the 2018–20 crash reports helped build a better understanding of the characteristics of crashes (for example, locations and concentrations across locations, time of day and week, cause, and severity) and data quality issues (coverage, completeness, and standardization of reports). The analysis of crashes revealed, for example, that less than 1 percent of the road network is implicated in 50 percent of the crash injuries and deaths, 65 percent of deaths are pedestrians, and 39 percent of crashes occur in the evening hours. The analysis of data quality revealed that 5 percent of the police records did not include enough information to determine the location of the crash, and 2 percent had incomplete information on the code for the cause of the crash.[3] These indicators are critical for understanding risk factors where crashes are concentrated and supporting the design of better policies. Therefore, the development of the eCrash data system focused on standardizing the reports to ensure 100 percent compliance with recording key crash indicators.

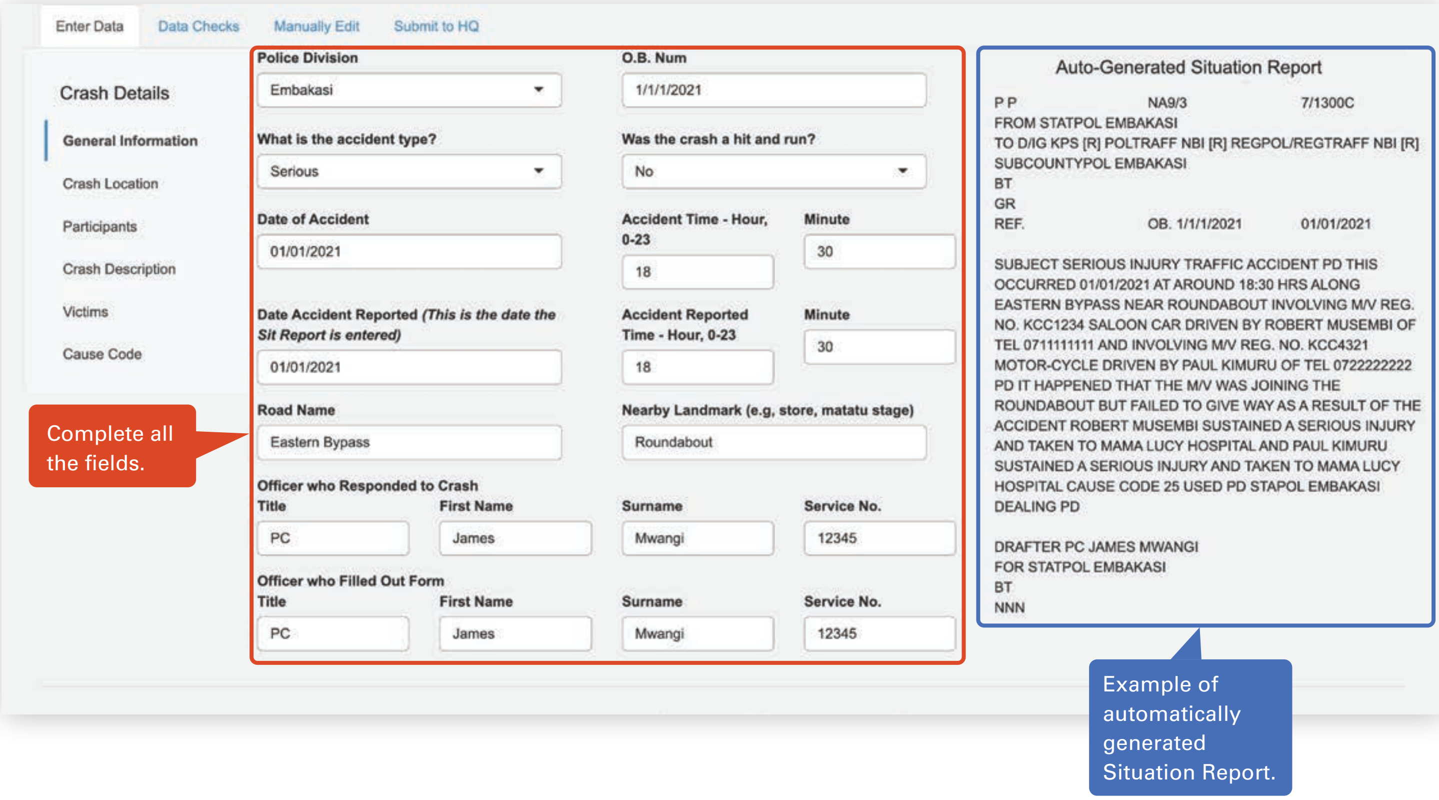
To do so, the features of the system include real-time quality data entry assurance and a data structure that allows for auto-generation of reports and aggregated data, including the following:

- ***Standardized indicators instead of open text fields*** help to reduce errors and increase standardization across crash record entries. The eCrash system uses standard indicators in the data entry forms (see figure 1a) with constrained choices, such as single or multiple selection options and the use of drop-down menus.
- ***Data filters*** are used to facilitate data entry efficiency and accuracy, as well as to minimize errors, by checking the logic and consistency of key data fields. For instance, different details are required for vehicles versus pedestrians involved in road crashes, and the eCrash form only activates the relevant fields for each to minimize data errors and facilitate data entry efficiency and accuracy for officers.
- ***Logic and consistency checks*** are used to ensure variables have reasonable values. For example, we expect that the date of the crash should be within an expected range of the date that the crash was reported by NPS, and automated consistency checks can help to confirm this and avoid potential data entry errors.
- ***Completeness checks*** help to avert common issues of incomplete information, and data validations are included so that officers cannot proceed if the value is missing for critical indicators. For additional indicators, any missing data or fields that are not completed are listed in a separate data review screen with a full list of missing variables for officers to review and check before proceeding (see figure 1b).
- ***Autogenerated text for real-time review of crash records based on data inputs*** shows how the data will appear in the final crash report. The eCrash system compiles the standard indicators entered by officers in the data entry forms into crash reports using a side-by-side window that automatically reflects the data as they are entered and presents how they will appear in the final report (see figure 1a, right panel).
- ***Real-time HQ review*** allows the traffic HQ to review crash reports and provide feedback to the officers, if required, on any data inconsistencies before approving and finalizing. If feedback is provided by the HQ and adjustments are requested, the officers then have the chance to edit, revise, and resubmit the report for approval (see figure 1b, right panel).

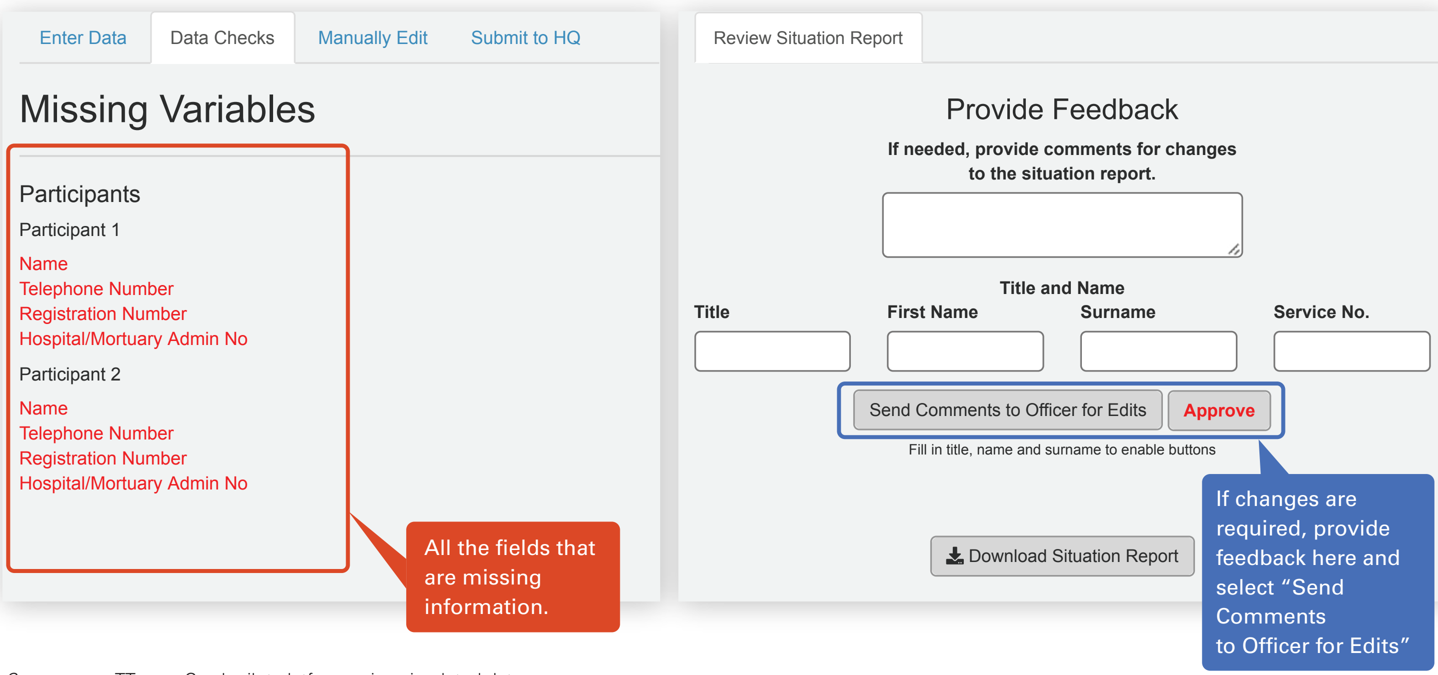
[3] For the 2012–20 period, 70 percent of deaths are pedestrians, and 41 percent of crashes occur in the evening hours. The analysis of data quality revealed that 11 percent of the police records did not include enough information to determine the location of the crash, and 27 percent had incomplete information on the code for the cause of the crash.

Figure 1. Crash Record Data Entry and Report Illustrations Using Simulated Data

1a. Variable entry fields for standardization



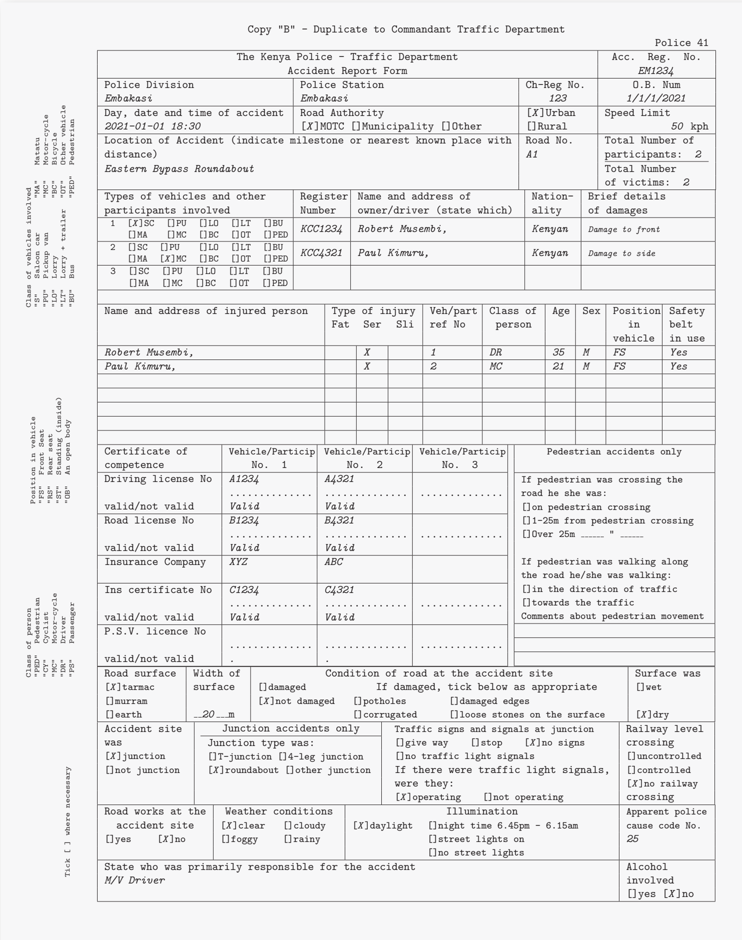
1b. Variable completeness checks and quality review



Source: smarTTrans eCrash pilot platform using simulated data.

Figure 2. Automatically Generated Police Crash Reports Using Simulated Data

2a. P41 individual crash report



Copy "B" - Duplicate to Commandant Traffic Department

Police 41

The Kenya Police - Traffic Department Accident Report Form			Acc. Reg. No. *EM1234*
Police Division *Embakasi*	Police Station *Embakasi*	Ch-Reg No. *123*	O.B. Num *1/1/1/2021*
Day, date and time of accident *2021-01-01 18:30*	Road Authority [X]MOTC []Municipality []Other	[X]Urban []Rural	Speed Limit *50* kph
Location of Accident (indicate milestone or nearest known place with distance) *Eastern Bypass Roundabout*		Road No. *A1*	Total Number of participants: *2* Total Number of victims: *2*

Types of vehicles and other participants involved	Register Number	Name and address of owner/driver (state which)	Nation-ality	Brief details of damages
1 [X]SC []PU []LO []LT []BU []MA []MC []BC []OT []PED	*KCC1234*	*Robert Musembi,*	*Kenyan*	*Damage to front*
2 []SC []PU []LO []LT []BU []MA [X]MC []BC []OT []PED	*KCC4321*	*Paul Kimuru,*	*Kenyan*	*Damage to side*
3 []SC []PU []LO []LT []BU []MA []MC []BC []OT []PED				

Name and address of injured person	Type of injury Fat	Ser	Sli	Veh/part ref No	Class of person	Age	Sex	Position in vehicle	Safety belt in use
Robert Musembi,		*X*		*1*	*DR*	*35*	*M*	*FS*	*Yes*
Paul Kimuru,		*X*		*2*	*MC*	*21*	*M*	*FS*	*Yes*

Certificate of competence	Vehicle/Particip No. 1	Vehicle/Particip No. 2	Vehicle/Particip No. 3
Driving license No / valid/not valid	*A1234* .... *Valid*	*A4321* .... *Valid*	....
Road license No / valid/not valid	*B1234* .... *Valid*	*B4321* .... *Valid*	....
Insurance Company	*XYZ*	*ABC*	
Ins certificate No / valid/not valid	*C1234* .... *Valid*	*C4321* .... *Valid*	....
P.S.V. licence No / valid/not valid	....	....	....

Pedestrian accidents only

If pedestrian was crossing the road he she was:
[]on pedestrian crossing
[]1-25m from pedestrian crossing
[]Over 25m ______ " ______

If pedestrian was walking along the road he/she was walking:
[]in the direction of traffic
[]towards the traffic
Comments about pedestrian movement

Road surface	Width of surface	Condition of road at the accident site	Surface was
[X]tarmac []murram []earth	__20___m	[]damaged [X]not damaged — If damaged, tick below as appropriate: []potholes []damaged edges []corrugated []loose stones on the surface	[]wet [X]dry

Accident site was	Junction accidents only	Traffic signs and signals at junction	Railway level crossing
[X]junction []not junction	Junction type was: []T-junction []4-leg junction [X]roundabout []other junction	[]give way []stop [X]no signs []no traffic light signals If there were traffic light signals, were they: [X]operating []not operating	[]uncontrolled []controlled [X]no railway crossing

Road works at the accident site	Weather conditions	Illumination	Apparent police cause code No.
[]yes [X]no	[X]clear []cloudy []foggy []rainy	[X]daylight []night time 6.45pm - 6.15am []street lights on []no street lights	*25*

State who was primarily responsible for the accident	Alcohol involved
M/V Driver	[]yes [X]no

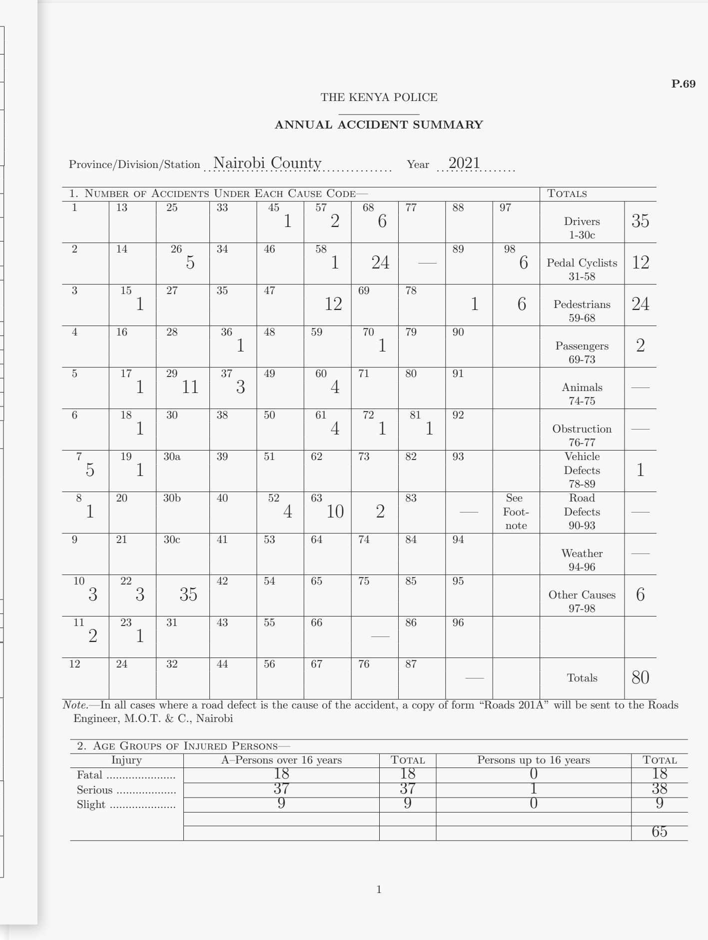
Class of vehicles involved "S" Saloon car "PU" Pickup van "LO" Lorry "LT" Lorry + trailer "BU" Bus "MA" Matatu "MC" Motor-cycle "BC" Bicycle "OT" Other vehicle "PED" Pedestrian

Position in vehicle "FS" Front Seat "RS" Rear seat "ST" Standing (inside) "OB" An open body

Class of person "PED" Pedestrian "CY" Cyclist "MC" Motor-cycle "DR" Driver "PS" Passenger

Tick [ ] where necessary

2b. P69 summary crash report



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THE KENYA POLICE

ANNUAL ACCIDENT SUMMARY

Province/Division/Station Nairobi County Year 2021

1. Number of Accidents Under Each Cause Code—

										Totals	
1	13	25	33	45 1	57 2	68 6	77	88	97	Drivers 1-30c	35
2	14	26 5	34	46	58 1	24	—	89	98 6	Pedal Cyclists 31-58	12
3	15 1	27	35	47	12	69	78	1	6	Pedestrians 59-68	24
4	16	28	36 1	48	59	70 1	79	90		Passengers 69-73	2
5	17 1	29 11	37 3	49	60 4	71	80	91		Animals 74-75	—
6	18 1	30	38	50	61 4	72 1	81 1	92		Obstruction 76-77	—
7 5	19 1	30a	39	51	62	73	82	93		Vehicle Defects 78-89	1
8 1	20	30b	40	52 4	63 10	2	83	—	See Foot-note	Road Defects 90-93	—
9	21	30c	41	53	64	74	84	94		Weather 94-96	—
10 3	22 3	35	42	54	65	75	85	95		Other Causes 97-98	6
11 2	23 1	31	43	55	66	—	86	96			
12	24	32	44	56	67	76	87	—		Totals	80

Note.—In all cases where a road defect is the cause of the accident, a copy of form "Roads 201A" will be sent to the Roads Engineer, M.O.T. & C., Nairobi

2. Age Groups of Injured Persons—

Injury	A–Persons over 16 years	Total	Persons up to 16 years	Total
Fatal	18	18	0	18
Serious	37	37	1	38
Slight	9	9	0	9
				65

1

Source: smarTTrans eCrash pilot platform using form template from the Kenya National Police Service and simulated data.

2. Auto-generation of Individual and Summary Police Reports

The system includes standardized data entry forms that autogenerate reports in line with the current official reporting procedures of the traffic police:

- ***Situation reports (figure 1a, right panel)*** are recorded by the responding officer at the crash scene and submitted immediately after the crash. These reports are NPS' responsibility and may include amendments and/or follow-up situation reports when additional or corrected information is required.
- ***P41 reports (figure 2a)*** are standardized crash report forms that are completed by a police investigator and used for official purposes both internally and externally, such as reporting indicators to highway engineering personnel. They include additional details that are relevant for multiple road safety stakeholders, for instance, detailed data on road infrastructure characteristics at the scene of the crash.
- ***P69 reports (figure 2b)*** are standardized aggregate police report forms that are submitted to NPS HQ monthly, quarterly, and annually with information on road crashes across stations and/or counties, with key indicators at the crash and victim levels. NPS senior officers and management use these reports for review and analysis purposes.

3. Offline Data Collection and System Flexibility Using Laptops and Tablets

- ***Offline and online versions*** of the system enable officers to continue to collect data when internet access is not available.
- ***Availability of the pilot system on laptops and tablets*** is included based on feedback from officers that data entry can

be more user-friendly on laptops. Flexibility is maintained for collecting additional data if using tablets, for example, GPS coordinates from the scene of a crash. The tablet version of the pilot system is one of the components that requires further testing and development based on lessons from the pilot.

4. Customized User Access Levels and Privileges

- ***HQ review, feedback, and approval*** in the system provides different roles for HQ and stations for submitting, revising, and approving reports. For example, "pending HQ approval" indicates that the report has been submitted by the station; "pending officer revision" indicates that the report has been sent back with comments by HQ for revision, corrections, or edits by the station officer; and "completed" indicates that the report has been approved by HQ. This review process was developed in the electronic system to simulate existing processes at NPS for reviewing and submitting reports to multiple departments and stakeholders.
- ***Station versus HQ access*** includes multiple access levels for stations and traffic HQs based on user privileges and roles.

5. Crash Monitoring Dashboard

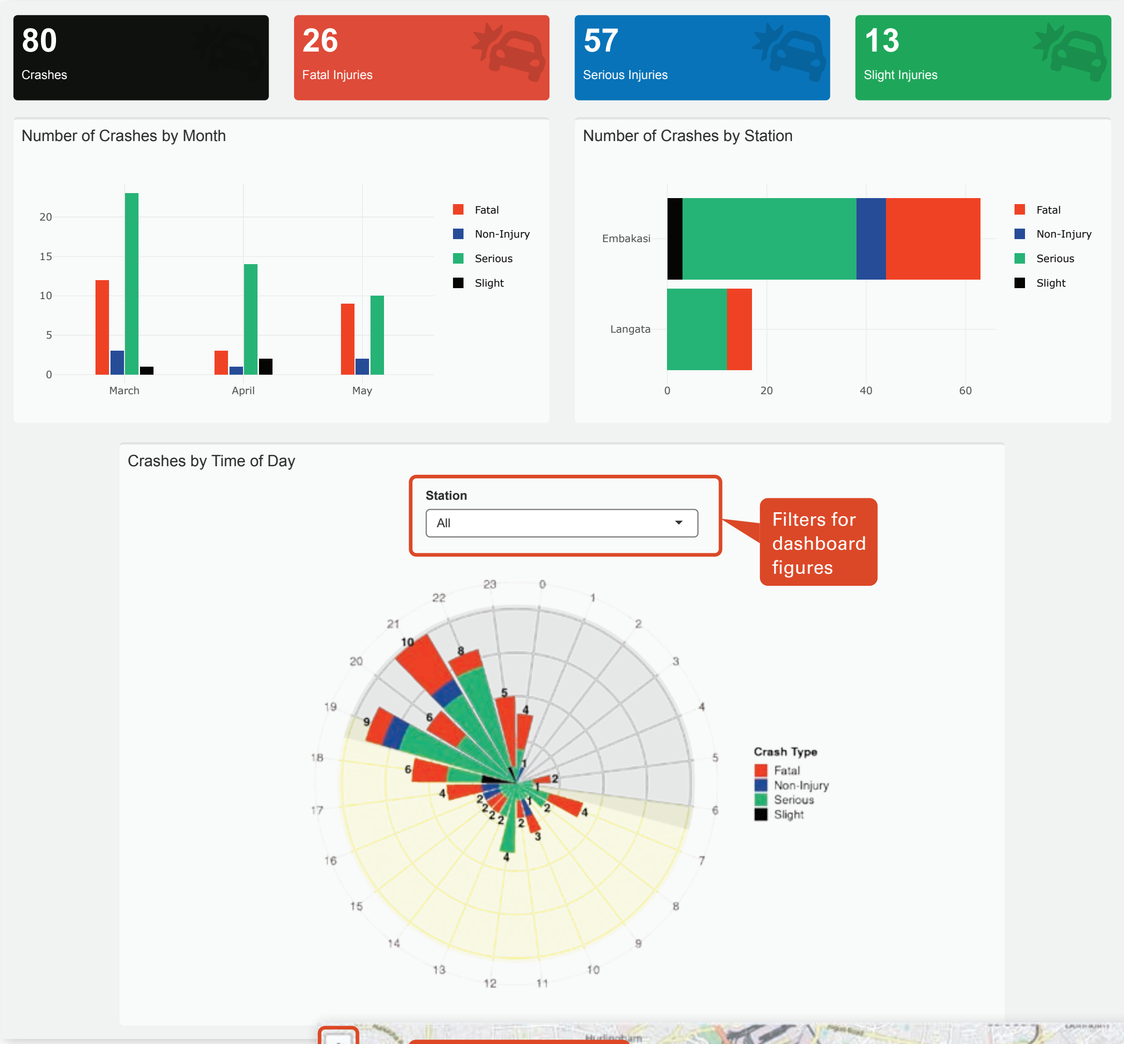
- ***Customized summary tables and figures (figure 3a)*** provide real-time updates on road crashes in Nairobi across multiple fields, for example, crashes and victims by station, crash severity, and cause codes and trends over time.
- ***Real-time maps (figure 3b)*** show the location of crashes at the station and/or county level, including pins with key information such as the crash date, crash time, and severity level of the crash.

6. Sharing and Exporting Reports and Key Indicators

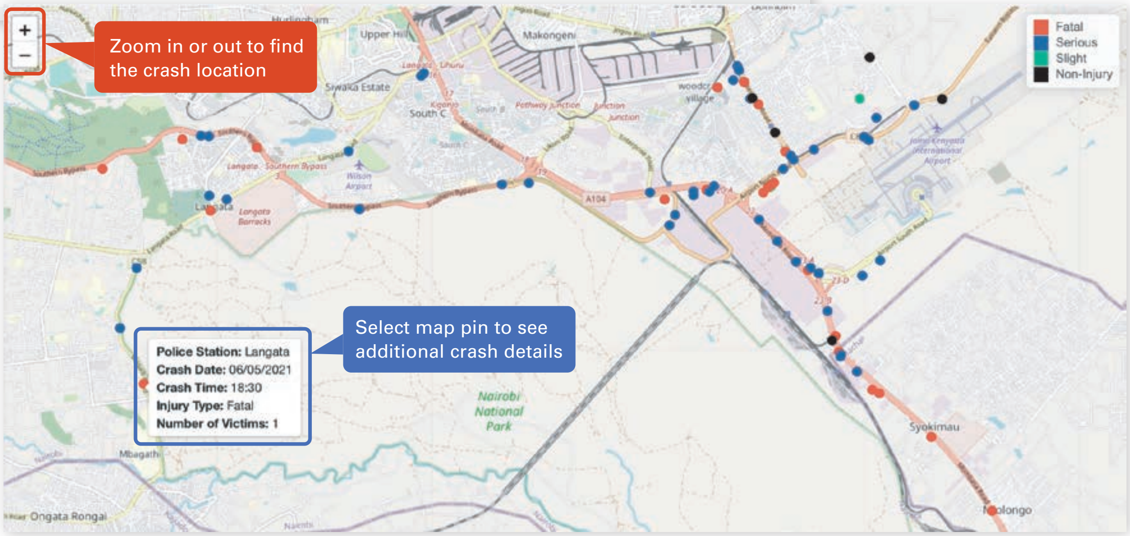
- ***Downloading data and summary information,*** including crash record data, tables, figures, and maps in PDF or Excel forms for all crash records or a subset of records using date and station filters. Customizable user access and privileges are available to restrict which users can download data.
- ***Linking stations with traffic HQs virtually*** allows for immediate transmission of reports to improve efficiency. When officers submit digital reports in the system at local stations, the HQs can access, view, and print the reports in the eCrash system in real-time. A page with the full list of crash records can be viewed by HQs, and if they are currently logged in when an officer submits a new record, the HQs can select a button to pull new data or refresh the homepage. This allows the HQs to view the latest submitted reports at any given time across all stations.
- ***Sending reports by email directly from the eCrash system.*** While the prototype system links the station and traffic HQ users through real-time updating of crash data, system users also have an option to actively send reports by email, for instance, to send an email notification about a specific crash record. This feature also allows stations and traffic HQs to send digital PDF versions of summary reports directly from the eCrash system to regional and national police HQ via email for reporting purposes following the existing police processes.

Figure 3. Real-Time Summary and Monitoring Data

3a. Crash monitoring dashboard



3b. Crash map



Source: smarTTrans eCrash pilot platform using data recorded by the Kenya National Police Service.
Note: The figure shows the number of crashes across months, hours of the day, and locations for Embakasi and Langata stations. The data are from March to May 2021.

Discussion

The pilot demonstrated the feasibility of police officers implementing digital recording of crashes, generating high-quality data, and creating real-time reports and visualizations of road safety data that can be readily shared with actors and stakeholders in the system. The iterative learning strategy created a development-testing-adaptation loop that optimized design features (operability and usefulness). The process can help the new national systems being developed by NPS and NTSA to address challenges, and it can generate ideas for improving operability as well as generating the best analytics to inform road safety policy and enforcement. The lessons and recommendations are summarized below.

Recommendations and Lessons Learned

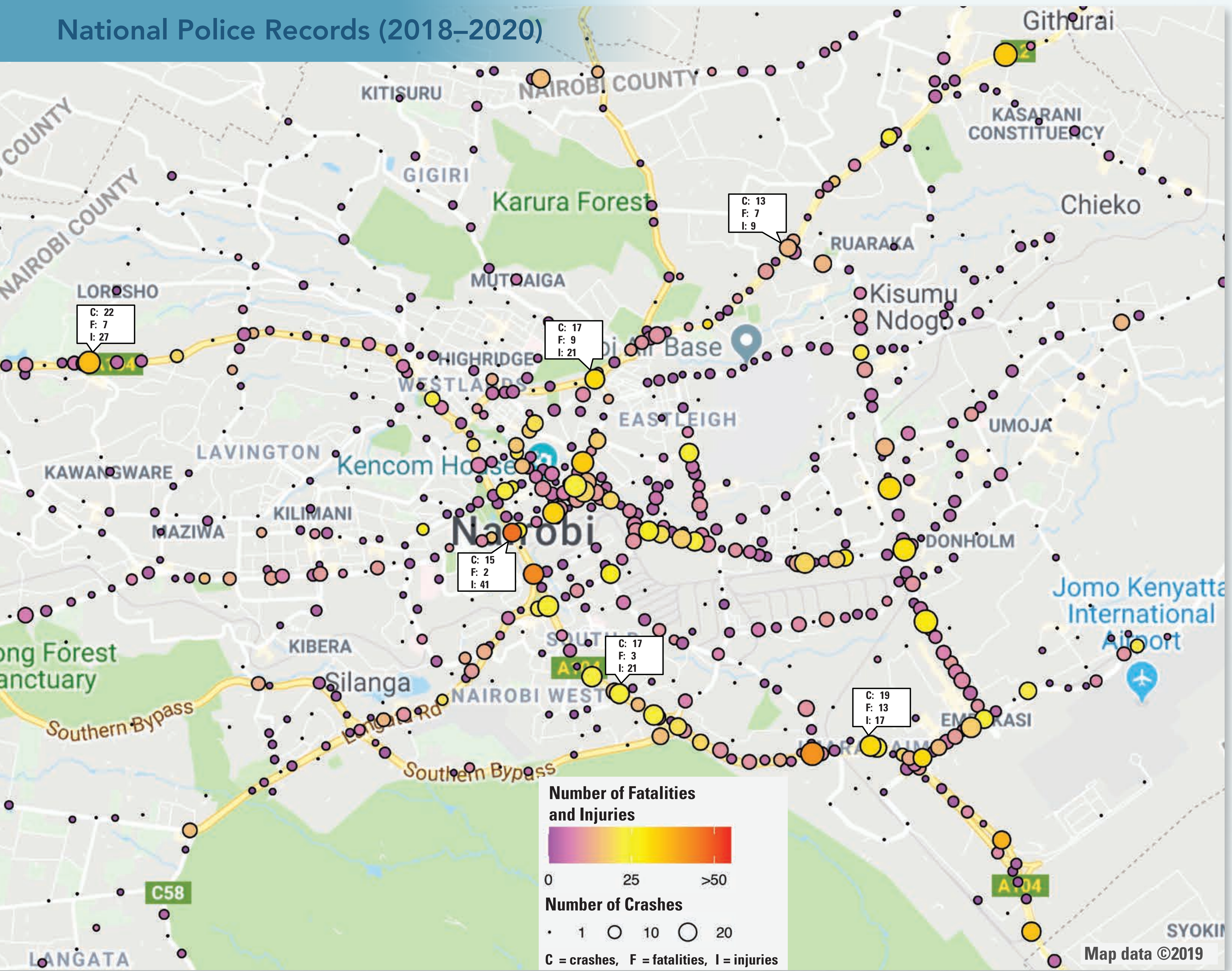
- ***Data recording using variable entry, logic, and completeness checks is critical*** to minimize errors, avert missing information, and ensure automated data aggregation for the purpose of generating reports and standardized records.
- ***Multiple iterations of working closely with the main users are required*** to strengthen the components of the system and fine-tune the logic of data entry and processes to ensure the quality and completeness of the data.
- ***Offline data entry is critical,*** especially for officers entering data at the scenes of crashes where the internet may be slow or unavailable. In this pilot, a "Sync" button at the top of the main menu screen allowed users to synchronize data after entering data offline. Syncing updates all records when the officer is back online, making all records and data available for all system users.
- ***How the data are entered is crucial for translating crash records into actionable reports and analysis.*** The map on the following pages shows an example of a Nairobi crash map after the digitization of historical paper records. This is one example of how ongoing, systematic data for analysis can allow for an understanding of the characteristics of crashes over time and their potential risk factors, which can inform policy responses to improve road safety.

Opportunities

- ***Training and technical support for the officers who are the main users of the system*** is critical as the data entry requires familiarity with digital tools. Decisions about the main users of the system require analyzing the conditions for officers at different levels and the potential for efficiency in streamlining data recording at different levels of NPS.
- ***Best practices for using tablets and laptops for data recording*** are a consideration for future efforts and making the most of the resources of NPS. For example, in some circumstances, data recording is more user-friendly on laptops, while tablets have the flexibility to be used at the crash scene. The work of the smarTTrans team found that officers have different preferences, which can guide choices in the development of scale-up systems.
- ***Integration with the broader NPS digital systems agenda and external agencies,*** including the digital occurrence book system within NPS and data-sharing agreements with other agencies, such as NTSA and road authorities, is an important opportunity to fine-tune the system requirements that allow data to be recorded in a way that automatically generates priority summary indicators to measure and monitor road safety over time.
- ***Leveraging the features of the system for further timely data visualizations and data analytics*** to support NPS and other Kenyan agencies in charge of road safety policy implementation, enforcement, and planning has the potential to support the common goal of improving road safety in Kenya (see Nairobi Crash Map).

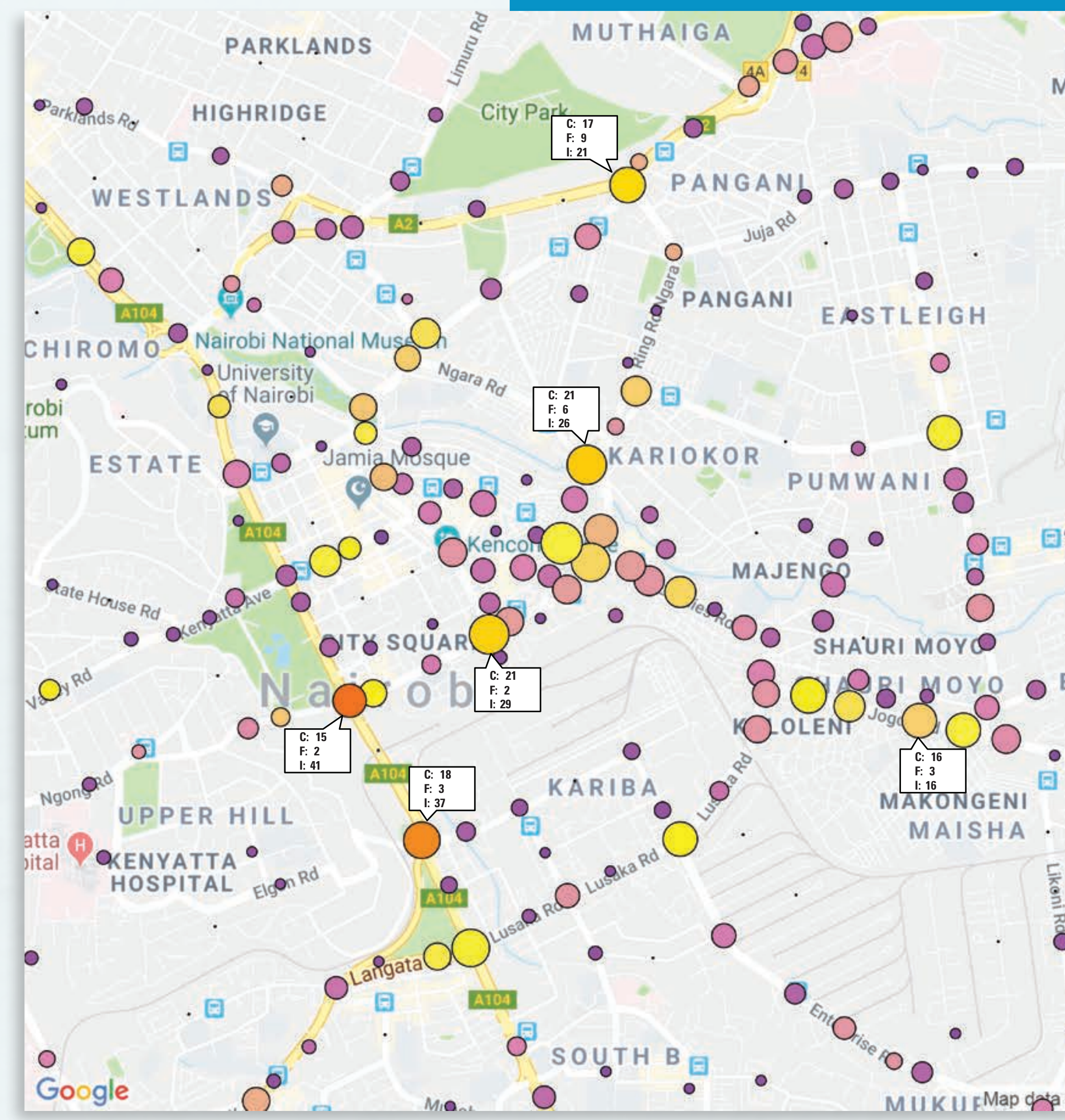
Nairobi Crash Map

National Police Records (2018–2020)



65% of road traffic deaths are **pedestrians**

Central Business District



100 **locations** represent **45%** of deaths and **40%** of non-fatal injuries

Source: smarTTrans pilot platform using crash records from the Kenya National Police Service.
Note: The data were digitized from paper-based records from January 2018 to June 2020. Situation reports (crash reports) are recorded for crashes that have casualties or property damage (i.e., smaller, non-injury crashes are not included in the database).

Team and Funding

This work is part of a collaboration between the National Police Service of Kenya and the World Bank. The research team includes Arianna Legovini, Sveta Milusheva, Guadalupe Bedoya, Robert Marty, and Amy Dolinger from the World Bank. The smarTTrans extended team includes Peter Taniform from the World Bank and the National Police Service team under the authority of the Inspector General, Mr. Hillary N. Mutyambai, MGH, nsc (AU) and led by the Office of the Spokesperson, including Director Corporate Communication/Spokesperson Mr. Bruno Shioso, OGW, SSP Bianca Nzioki, and CI Kahindi Charo, and OC Traffic Nairobi City County, Mr. Joshua Omukata, CP, and the smarTTrans Secretariat including Accident Registry Officers IP Joyce Akoth and PC Maingi Muteti. This work fits within a broader collaboration to improve road safety in Kenya that includes the NTSA, Ministry of Transport, KenHA, and KURA, among others.

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