

## Washington Metro Transit Authority - A Big Data Solution

Authors: Yanaisse Arica, Yosra Baccara, Taysir Elgoul, Jelina Guse, Nathan Hahn

Course: STAT 501 Introduction to Statistics and Big Data

Professor: Jennifer Catalano

Clarewood University

### **Background and Problem Definition**

The D.C. Metro system was created in 1976. It is one of the largest public works undertakings ever completed, stretching 103 total miles and serving the second most people of any rail system in the U.S., following only New York City (Sliwinski, 2016).

Washington DC's Metro system is a great way to get to hundreds of popular locations and attractions in and around Washington DC. Its six lines and 91 stations are located in Washington DC and neighboring Virginia and Maryland. The DC Metro system now services an area of approximately 1,500 square miles with as many as 4 million residents. The Metro also recently completed the first phase of the new Silver Line in 2014, which will eventually connect the system to Dulles International Airport in Virginia with the second phase, which is currently under construction. Although continued expansion and additional services have been proposed, over the past few years, the system has been facing a series of long-delayed safety and technical challenges which have grown more and more apparent and crucial to resolve (Sliwinski, 2016). The DC Metro system has been facing many issues during the past couple of years, like safety issues, personnel issues, and technical issues.

### **Personnel Issues**

The WMATA's issues with personnel have led to problems to the overall railway system. Firstly, the WMATA has been unable to effectively staff its central operations team. Only 34 out of the needed 54 operations team members are working six or seven days a week. This would cause the personnel to be overworked and make poor decisions while communicating with train operators and maintenance crews. The radio system that is used makes it hard to team members to hear one another, and there are no strictly followed communication protocols, causing different teams to talk over one another in the airwaves. In addition, there are no industry standard processes for handling incidents and operations and ensuring safety of train operators (Stein, 2015). These problems cause a negative impact on individuals working in the WMATA, riders, and the overall image of the transit system. Faulty communications and poor

training, contributed to rail accidents that killed 14 people: three in 1982, one in 1996, nine in 2009 and one last year in 2016 (McCartney and Duggan, 2017).

### **Technical Issues**

If we take a look at the technical problems that have been facing the DC metro system, we can see that according to FTA reports, an outdated and aging third rail infrastructure has caused severe problems such as electrical arcing, smoke in tunnels, and risks of fire. A lack of central asset management strategy has further led to more problems for the outdated tracks, such as rain derailments and outdated crossties and fasteners. Lastly, there was an inability to balance safety with customer service, hindering the ability to perform effective maintenance reviews. Routine maintenance could have prevented many issues.

One general problem with the metro system is an aging infrastructure and lack of public resources. The Federal Transit Administration gave marginal or poor ratings in 2009 to more than a third of the equipment of the largest rail transit agencies in the U.S. In Washington, Metro officials said they have wanted to replace outdated cars in 2009, which made up more than a quarter of the total system, but couldn't due to lack of funds. Safety concerns are one of the biggest issues WMATA faces, which are caused by an outdated rail infrastructure and lack of routine maintenance. In 2009, WMATA had one of its deadliest crashes after 33 years, which killed 9 people. Federal officials said that the train that rear ended another train was an older model that lacked equipment which might have helped it to avoid the collision, and it had been past due for necessary brake work (Walsh, 2009). Technical malfunctions, some involving automation, an outdated rail infrastructure, lack of routine maintenance, in addition to poor communications and poor training for staff, as already mentioned, have all contributed to a series of rail accidents and safety issues.

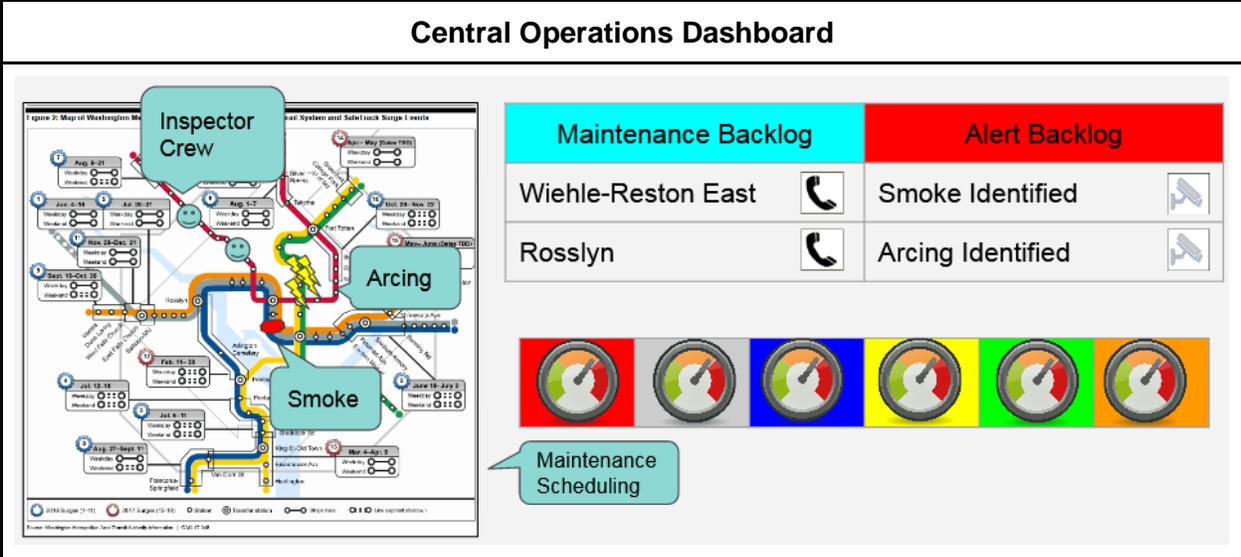
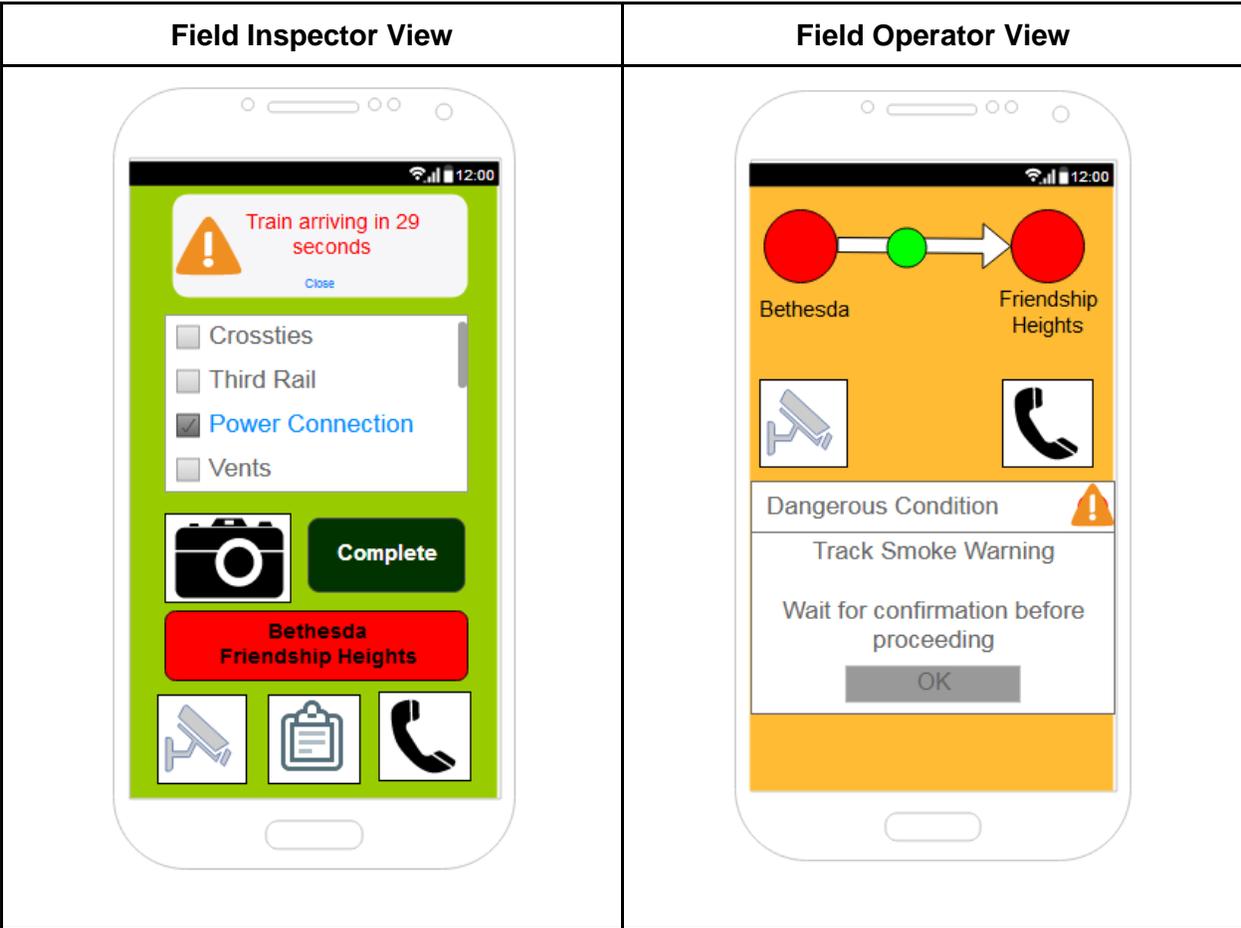
### **Solution Development**

The load on the operations team of the WMTA, combined with requirements for additional safety checks from the failure of past safety checks on the aging infrastructure of the WMTA means that there are increased opportunities for mistakes to occur in rail operations that cause accidents. There are two factors that could have the best impact on the system. Firstly, the WMTA should use video analytics to cut down on the necessity of in-person inspections as much as possible and provide better insight into field conditions without necessitating continual manual monitoring. Secondly, the WMTA should develop an effective alert and communication system that is not as reliant on a central operations team for field operators to perform their tasks.

Video analytics is a new and emerging field, and there are very few companies that provide effective video analytics solutions. However, video analytics capabilities could cut down on the possibility of errors caused by both faulty inspections and inaccurate planning by central operations. After cameras have been setup to monitor sections of track, a manual effort would be underway to set up video cameras to monitor variances in track activity. A baseline would be setup to determine track stability. Since a major concern was the cross ties, video analytics could be used to identify if there were specific crossties in a state of disrepair along a section of track. This information would be transmitted to a central database and generate a report. In addition, the cameras would be able to determine if there were sparks being generated from the track or smoke being generated along a section of track that would pose a danger to trains traveling through that section. Upon recognizing these factors, the video analytics system would store the information in a central database, which would generate a report.

The WMTA also needs to use a more effective system of communications to ensure that central operations and field operators and inspectors are on the same page about the current state of the metro system. Firstly, with a system of alerts based on video analytics, the central operations team will be able to focus on what they most need to address at a given time. Secondly, the central operations team needs to be able to push alerts to the relevant field

operations team members. After review of an incident from the video analytics system, they should be able to immediately create an alert for field operators. In order to cut down on analysis time to find out who needs to be informed, the system should use geolocation services tied in with a mobile app for use in the field. Individuals that are near or potentially crossing that area that has been impacted will receive the alert on the mobile app. After receiving the alert, the field operator can choose to accept the alert from central, or select an alternative option to patch through to a centralized group communications channel to ask additional questions about the incident. Because all of the actions of individuals would be tracked through the system, it would encourage a culture of accountability throughout all the operations teams.



Data Management Partners

In 2009, IBM issued a press release regarding how it was assisting the WMATA with tracking related to its systems. Their asset management software tracked 12,000 bus stops and train stations, 106 miles of track, 1144 rail cars, and 1500 buses. The software system also managed nearly 180,000 work orders per month. In the press release, they cited that their tools enabled the WMATA to perform effective preventative maintenance. Unfortunately, these tools did not prevent the issues that would plague the WMATA as accidents and deaths associated with the transit system rose ("Washington Metro Uses IBM Software to Keep Mass Transit System Safe and On Time," 2009). However, the WMATA should continue to partner with IBM, as they can provide more advanced data solutions so long as the WMATA ensures that their processes and communications are well documented and followed consistently across all operators. In addition, they should look to smaller firms to provide insights to particular parts of the data that stand to benefit the most from optimization (Schartz, 2015).

### **Benefit Analysis and Conclusions**

With the changes recommended to the data technology, the WMATA will create a safer, cleaner, more reliable transit service. The introduction of video analytics with data visualization platforms will lead to better response times to areas of critical concerns. Rather than waiting for a video to appear online sparking concern over rail safety, central operations will have the data needed at their fingertips to make the right decisions about when to update infrastructure. With more up-to-date communication channels, miscommunication among WMATA employees will be reduced, and more clarity will be achieved on commonly held goals between field operators and central operators. With better data systems, a greater amount of individual accountability will be brought to all WMATA employees, ensuring that the right action will take place at the right time. Ultimately, these changes will lead to reduced pressure from WMATA stakeholders about issues with the metro system and lower uncertainty about the system's future.

For the transition to a new and more effective metro system, data alone will not fix a broken system. The WMATA needs to strive for excellence in technology, communication, and process improvements to ensure a successful transition to effective data management of its systems. In the past, the only way to solve these types of issues would be to add more individual employees and standardize processes. In today's modern world, the critical pivot point of the transition is how new technologies can help manage overwhelming information with a limited set of staff. This can help cut down on costs and ensure higher quality and consistency of service in ways previously thought impossible. However, this does not mean that data can solve all problems. In particular, the WMATA needs to be critical of its data partners, so that they will not fall into a trap of complacency around unmonitored infrastructure assets and alerts that go unheeded. At the end of the day, change needs to start from strong upper management recognizing a problem and working to set things right for their customers. The SafeTrack upgrades are a start of a longer transformation process for the WMATA, and represent the first step on the journey to providing better public transit for the public good.

## References

IBM Intelligent Video Analytics - Details - United States. (n.d.). Retrieved from

<https://www.ibm.com/us-en/marketplace/video-analytics-for-security/details>

McCartney, R., & Duggan, P. (2016, April 24). Metro sank into crisis despite decades of warnings. Retrieved from [https://www.washingtonpost.com/local/trafficandcommuting/metro-sank-into-crisis-despite-decades-of-warnings/2016/04/24/1c4db91c-0736-11e6-a12f-ea5aed7958dc\\_story.html?utm\\_term=.2b4ba67e75dc](https://www.washingtonpost.com/local/trafficandcommuting/metro-sank-into-crisis-despite-decades-of-warnings/2016/04/24/1c4db91c-0736-11e6-a12f-ea5aed7958dc_story.html?utm_term=.2b4ba67e75dc)

Metropolitan Washington Airports Authority. (2017). Dulles Corridor Metrorail Project - Project Status. Retrieved December 10, 2017, from <http://www.dullesmetro.com/project-status/>

Schartz, E. (2015, August 21). Nightmare Metro Commutes Aside, DC Is Ramping up Its Transit Tech. Retrieved from <https://www.americaninno.com/dc/dc-wmata-transit-problems-big-data-for-better-commutes/>

Sliwinski, M. (2016, May 24). Trouble Below: The Problems Plaguing the Washington D.C.

Metro - Law Street. Retrieved from

<https://lawstreetmedia.com/issues/business-and-economics/trouble-problems-plaguing-washington-d-c-s-metro/>

Stein, P. (2015, June 17). Here are 10 of the biggest problems facing Metro, according to FTA.

Retrieved from [https://www.washingtonpost.com/news/local/wp/2015/06/17/here-are-10-of-the-biggest-problems-facing-metro/?utm\\_term=.cae34dce0c45](https://www.washingtonpost.com/news/local/wp/2015/06/17/here-are-10-of-the-biggest-problems-facing-metro/?utm_term=.cae34dce0c45)

Walsh, B. (2009, June 26). The Metro Crash: A Nation's Aging Transit System. Retrieved from <http://content.time.com/time/health/article/0,8599,1907095,00.html>

Washington Metro Uses IBM Software to Keep Mass Transit System Safe and On Time. (2009, October 7). Retrieved from <https://www-03.ibm.com/press/us/en/pressrelease/28580.wss>