



City of Houston: Smart Railroad Crossings Project 2022-2023

REAL WORLD TESTING FOR PROOF OF CONCEPT PLANNING Trains and roads – two independent and vital infrastructure systems. Inevitably, they cross paths creating blocked grade crossings that result in:

- \cdot delays for drivers and pedestrian, sometimes resulting in accidents by risk takers
- \cdot traffic jams that increase pollution and toxins that impact human health
- emergency responders (ambulances, fire trucks and police) are delayed when minutes can mean the difference between life or death



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This report is based on:

- Interviews of key stakeholders in February 2024 by Relish New Brand Experience funded by TRAINFO



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City of Houston Smart Railroad Crossings Project Plan Report, May 10, 2023 v3.0 by Jack Hanagriff of Managed Global Solutions, LLC

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INTRODUCTION

Houston is home to 403 railroad crossings and is a national leader for blocked grade crossings and deaths rates at rail crossings. In 2023, the City of Houston, through their innovation office, took steps to find a solution to the longstanding problem of blocked grade crossings. Shifts in social and economic activity due to the pandemic and subsequent recovery was generating a lot of pain points with complaints that crossings were regularly being blocked for as much as 14 hours.

Traditionally there has been only one solution proposed for chronically blocked grade crossing - build an overpass. Not only does this solution require millions of dollars, and sometimes decades of waiting, this solution may not be viable due to a variety of criteria.

Believe in innovative solutions.

A technology based solution for blocked rail crossings seemed like a step in the right direction and Houston's Office of Innovation was tasked with finding the most efficient and cost effective one.

Top Crossings Complaints

- A broken closed gate caused motorists to drive around the gates.
- A train blocked entry into a public school for hours.
- Grade crossings blocked 14 to 20 hours on a monthly basis.
- Pedestrians and motorists endanger themselves as they race the train.
- Pedestrians, even children, duck under trains at blocked crossings.
- First responders delayed on emergency routes.
- Train horns used at crossings wake residents and contribute to a lowered quality of life.

City of Houston Grade Crossing Statistics

903.615 Avg. Annual Daily Traffic

05 Accidents Over the Last 5 Years

Avg. Blockages per Day

Fatalities Over the Last 5 Years

Number of Priority Crossings

403**Total Number of Crossing**

Avg. Vehicles Impacted per Day

Avg. Vehicle Delay per day (hrs)

STAKEHOLDERS

The more complexity there is in a problem, the more challenging it can be to coordinate and deliver solutions. Intersecting bureaucratic agencies, tending to be risk averse, makes novel solution seeking all the more challenging.



Train Companies: You might think that train companies are responsible for blocked crossings and should be responsible to clear them. While this is technically true, they are also trying to be profitable and are an essential player in supply chain.

Houston has **1,800 blocked crossings** a year, with **98%** of them in the East End which has been nicknamed the Railroad Landing Strip.



Department of Transportation (DOT): DOT is the primary coordinator for state, county and local agencies when responding to incidents and emergencies. Using technology such as security cameras, they help to mitigate congestion and assist neighboring districts with transportation and emergency management.

Houston's TranStar is a unique partnership composed of the **City of Houston**, Harris County, METRO and Texas DOT.

First Responders: In larger cities, first responders are already using security cameras to monitor traffic, using dashboards to deliver vital information to dispatchers. Easy, fast, and powerful data delivery in real time is desired for any sort rail crossing solution.

There are three fire stations in the East End and emergency vehicles can get stuck in the Train Trap with all exits blocked. Using Haystax, first responders access dashboards data views of traffic. Fire stations back up each other offering aid to neighboring districts which adds layers of complexity to their needs.

General Public: Residents often bear the brunt of delays which can last for hours, sometimes up to 20 hours. They complain on apps and websites. Also, when things do improve, the public may not notice that improvements have been made.

The pressures of the pandemic compounded the East End's rail crossing blockages lasting 14 to 20 hours on a regular basis. There were a lot of upset people.

Mayor's Office: As elected officials, mayors answer to the people of their city, responding to issues such as these. While citizens may often request an overpass, this solution can take many years and millions of dollars.

Houston's Office of Innovation created the Smart Railroad Crossing pilot project to test whether an in-house solution using existing partners could provide a cost effective solution. This multi-partner solution would be compared against a new solution provided by TRAINFO.

PILOT PROJECT CITY OF HOUSTON SMART RAILROAD CROSSING PLAN

Project Lead

With 40 years of experience with the City of Houston working on public safety projects, and recently retired, Jack Hanagriff was tapped by the Mayor's Office of Innovation to return as a consultant to bring the Smart Railroad Crossing Plan to a successful conclusion. With extensive experience, Jack was well positioned to coordinate the players to make a fair evaluation of two distinct grade crossing solutions.

Jack also came to the project with a healthy dose of skepticism regarding claims made on paper. He had previously seen cameras and acoustic sensors deployed in Houston for train horn detection, however these methods required manual validation and were not cost effective. The goal of the Smart Railroads project would be to see how different systems performed in real life situations using measurable data points and clear analytics.



Jack Hanagriff, railroad safety and mobility coordinator at the East End Management District. Photo Credit: Yi-Chin Lee/Staff photographer/East End District

Project Goal

Using readily available technology, develop and implement a solution that can readily detect activities at particular railroad crossings.

Objectives and purpose:

- Gather data to understand, manage and control impacts of blocked railroad crossings
- Provide alerts to motorists and first responders to reduce mobility impacts
- Use data to encourage better collaboration between the community and railroad companies
- Use data to encourage voluntary compliance with the railroad companies and potentially support advocacy efforts for greater local enforcement capabilities
- Alert railroad companies of malfunctioning gates or blocked crossings to expedite response times
- Document quiet zone violations, motorist, and pedestrian behavior, e.g., "Beat the Train" to analyze and design interventions



Solution Options Existing Partner vs New Partner

Existing partner solution – from a pragmatic view, using an existing platform with multiple functions would seem to provide efficiency and reduce the need to engage multiple single service providers.

- Would it be easier, quicker and more affordable to integrate a new function into an existing platform?
- A multi-partner solution was envisioned that used a network of existing providers with custom-designed sensor kits.

New partner solution – new partners have to build credibility behind their claims and often require new training, new spaces and sometimes integration can be challenging.

TRAINFO, a single solution provider dedicated to t alternative solution for the project.

Multi-Partner Solution

The multi-partner solution would center on two main sensor systems, Bosch cameras and the Opt LiDAR detectors, augmented with private camera

Both of these instruments would be integrated into the Houston Smart Hub.

- Private cameras
- Bosch cameras
- Optex LiDAR detectors

• TRAINFO, a single solution provider dedicated to the single purpose of monitoring rail crossings, would provide an

	TRAINFO Solution
tex as.	TRAINFO, founded in 2017, is the only company in North America that is exclusively dedicated to the one goal of solving grade crossing delays and reducing collisions.
	Using their own sensor technology, TRAINFO was excited by the challenge of East End's rail crossing situation. Two types of sensors were used:
	TRAINFO sensorsBosch cameras with TRAINFO machine vision

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The Testing Ground

The East End of Houston is nicknamed the Railroad Landing Strip, characterized for its high density of trains. It is home to the infamous Train Trap, where four railroads operate over three corridors that form a triangle, that when blocked, can literally hold citizens and first responders hostage. Within this setting, crossings known to be frequently blocked by trains were selected for the pilot project.

Setting up sensors and cameras at the crossings came with their own challenges depending on the technology and the geography of the crossing. Most crossings would accommodate only one type of solution, while a few could accommodate multiple sensors. This was helpful to generate an apples to apples comparison of each solution.

Grade Crossing Location	Multi-Partner	TRAINFO
4100 N. Braeswood	Bosch	
1200 Durham	Bosch Camera (x2)	
1000 Lockwood	Privately-Owned Camera (Live Trains)	
5900 Market		TRAINFO audio & video sensor
700 S. Lockwood	Bosch	TRAINFO audio & video sensor
700 Sampson Street	Privately-Owned Camera (Live Trains)	
900 Sampson Street	Privately-Owned Camera (Live Trains)	
700 York Street		TRAINFO audio & video sensor
2100 Commerce Street		TRAINFO audio & video sensor
6300 Sherman Street	Privately-Owned Camera (Live Trains)	
5400 Polk Street	Bosch	TRAINFO audio & video sensor
5200 Lawndale	Optex LiDAR	
4000 Leeland		TRAINFO audio & video sensor
7300 Lawndale	Bosch	
1500 Central Street	Optex LiDAR	
400 Hirsch Road	Bosch	TRAINFO audio & video sensor

Performance Requirements

Repeatable and accurate data collection that described the extent of the blockages was a critical deliverable and requirements were listed in detail.

Metrics

- **Functions:** The success of the sensors and reporting solution was based on its ability to detect and record an "event" along with the ability to view it live and recall the video record.
- **Report:** at minimum, the report would need to include date/location for all events along with the ability to filter data. The report should identify peak times for crossings being occupied or blocked and measure the length of time a crossing is impeded.

Audit Guidelines

- 10 randomly selected alerts per week and analyzed
- review video to assess accuracy (pass/fail)
- weekly findings are provided in Excel

Event

- Impeded Crossing start and end of blocked crossing
- **Blocked Crossing** start for when a train is stopped on the track and ends when it begins to move
- False Activation when a traffic control device (lights/gate/both) activates without the presence of a train
- Train Horn Use in Quiet Zone when a train horn is detected
- Validation second camera source to validate audio



Data Capture

- location
- number of occurrences
- date-time of incident
- length of incident
- photo capture of event
- live and recording event



TECHNOLOGY FRAMEWORK

The technology framework was organized around front-end solutions that gathered data through the use of sensors and back-end solutions that provided users access to the data. The back-end included the server/cloudbased dashboard visualization and reporting tools that allowed users to:

- have eyes on real-time video for situational awareness
- access to the recorded video for forensic purposes
- access reporting tools for analysis and business intelligence to help inform decision-making

This framework was the driving force behind the solution parameters, and helped define the requirements for the project.

The technology solutions were primarily focused for the following functions:

- Visual detection and alerting using a CCTV camera with or without analytics to detect the presence of a train and create an alert based on the stated requirements.
- Emergency routing and crossing risk analysis

 using audio sensor-based technology to
 detect the presence and/or probability of
 a train occupying a crossing and assist in
 identifying alternate routes for emergency
 first responders.
- Integration with privately-owned cameras the ability to fetch specific content from privately-owned cameras, such as Livetrains.com, that can be used to confirm the presence of a train on a crossing.

SOLUTION 1 ·

MULTI-PARTNER

The Houston Smart Hub platform would deliver the multi-partner data to users through existing networks. Using Bosch and LiDAR cameras along with acoustic sensors, the partners experimented with data collection and sensor kits were created from scratch to house the cameras.

- The system was designed, installed, and configured to integrate with the Houston Smart Hub video management software platform running on a hardware server provided by, and hosted on-premise, at Houston TranStar:
 - This central hub of information would stream external video and AI technology into the city's network for testing.
 - Bosch cameras were deployed with data and images that were processed by the Houston Smart Hub platform.
 - Data was streamed to first responders and the public for the purposes of rerouting as needed or desired.
- This design concept was a primary reason to use known city vendors and technology brands already in use: Cradlepoint, Verizon, and Azure. During the R&D phase it was found cameras (CCTV) alone could not produce the desired triggering of events, LiDAR and audible sensors were added to the system.
- Artificial Intelligence tools were also added to the sensors to improve identification of events.
- A cloud based architecture was devised to act as the central hub for data and analysis.



Houston Smart Hub

SOLUTION 2

TRAINFO

In 2021, the USA Federal Railway Administration (FRA) contracted TRAINFO to research how first responders can reduce delays at rail crossings. Within this context, Houston was identified as a hotspot for crossings, leading the FRA to provide funding to TRAINFO to support the deployment of a system test as part of the Smart Railroad Crossing pilot project.

Houston's notorious 'Train Trap' posed an exciting challenge for the company. While confident of their solution's accuracy and effectiveness, TRAINFO relished the opportunity to test its capabilities against industry leaders. TRAINFO was curious to examine the blockages and consider how one blocked rail crossing might impact other crossings. Does the configuration of the Train Trap exponentially increase the number of blocked and cleared rails? Upon request, TRAINFO added cameras to fulfill the requirement of a two-prong verification system.

The TRAINFO solution included:

- TRAINFO audio sensors were deployed and configured within three days
- their patented system which includes:
 - machine-learning algorithms
 - proprietary sensors and integration of data from across the rail network
 - blockages can be predicted up to 10 minutes before a train arrives
- a tie into 911 dispatch systems (note that TRAINFO offers tie into traffic management systems and roadside signs but were not included in the pilot project)





Smart Railroad Crossing Solution #3 **Trainfo Sensor with** Camera



Supporting Visual



Verification Solution Live Trains Camera





FINDINGS ·

During the installation and configuration, testing and validation, data analysis, and usability study, there were a number of challenges that revealed the intricate nature and complexity of deploying Al-detection technology at railroad crossings. These factors point to best practice considerations for wider deployment:

- Environmental conditions impact where you can actually place cameras and audio sensors if placed too far away the sensors won't work properly.
- The audible-based sensors proved to be much more reliable and less environmentally challenging in terms of placement, installation, and configuration.
- Visual verification using camera technology proved to be instrumental, especially in cases where there was an anomaly in the detection, such as something other than a train triggering an event.
- For research purposes, a camera was required to be installed along with the audible sensor at "quiet zone" locations.





Solution 1: Multi-Partner

Package 1: Bosch camera placed at 4 locations

- Camera event data is sent to the Houston Smart Hub creating bookmarks
- NOTE: Environmental challenges at 2 locations and are stricken from the study
- \checkmark 2 locations successfully and consistently detecting a train activation of the crossing
- \times 2 locations were unable to consistently detect when a train stops

Package 2: Optex LiDAR camera

- Event data from LiDAR is sent to the Houston Smart Hub creating bookmarks
- Data was successfully captured, however the results varied based on the installation and configuration of the LiDAR
- ×1 location was unable to detect trains, likely due to lack of ideal placement
- \checkmark 1 location could detected a train, however, there were lost communications

Additional observations:

- Time to deploy: it took several months to configure and design the kits
- Camera/sensor placement: challenging in terms of power required, poles available to attach to, along with placement on pole for optimal angle for line of sight
- · Camera/sensor kits: built from scratch, custom kits with guite particular needs to be able to install for good data
- LiDAR was good at dialing in, but, depending on the distance and angle it could get confused in what it was observing.
- · Bosch cameras took too long to adjust and optimize to dial in the information
- Truck taken for trains, shape of rail cars, lighting conditions, weather all impact the ability of the sensors to sense incidents
- Accuracy in detecting incidents: 50 to 80% (open and close

Display outputs and reports:

• Accessing historical data: not easy

Solution 2: TRAINFO

Package 1: TRAINFO sensor placed at 4 locations

- within the TRAINFO information solution
- \checkmark All 4 locations successfully and consistently detects train stopping

Package 2: TRAINFO Sensor with Camera at 3 locations (1 quiet zone)

- TRAINFO information solution
- \checkmark All 3 locations successfully and consistently detected an activation at the crossing.
- activate (lower), nor was there a train observed during the viewing of the video.

Additional observations:

- Time to deploy: plug and play
- and connectivity
- Dashboard display integrated seamlessly with HayStax
- company was operating over multi-use tracks

Display outputs and reports:

• Accessing historical data: Data is easily used to benchmark performance

• Set to detect trains and transmit alerts to GIS mapping, data analysis and reporting dashboard all

 \checkmark All 4 locations successfully and consistently detects the train activation of the crossing

• Set to detect trains and transmit alerts to cloud-based application for GIS mapping, data analysis and reporting dashboard, plus visual validation of incidents using camera snapshots all within the

 \checkmark Also, the audible sensor detected a false activation in the crossing signal which was discovered by using the camera to visually determine that the crossing signal was flashing red, but the gate did not

· Camera/sensor kits: come all in one kit and easily interfaced with the base sensor for power

• Camera/sensors were not impacted by weather, nor by trucks providing reliable 100% accurate results

• Having a camera attached to the TRAINFO sensor assisted Houston in identifying which railroad



DISPLAYS & REPORTING

Solution 1: Multi-Partner

Camera data was ingested by the Houston Smart Hub VMS platform and viewed as an incident report and bookmark with video clip/image. Data could be exported as csv file. Event data is limited by available storage capacity.

Solution 2: TRAINFO

The platform has its own builtin business intelligence and reporting capabilities that are much more intuitive, and easy to use. Raw data requirement was one transactional data source.





	Biockage Datails	
Date	Crossing	Duration(min)
10/18/2022 12:50 16 PM	Commente Street	1.0
2/9/2025 1520.53 AM	Commente Street	5.43
V19/2023 11:48:32:FM	Conversion Street	1.4
12/04/2022 11:22:53 PM	Commerce Street	0.54
K3/25/2022 910:11 AM	Commerce Sheet	8.53
10/1/2022 10:10:31 AM	Commente Street	5.57
\$15/2622 18:34:52 AM	Commerce Scent	0.50
10/27:2022 9:34:28 AM	Commerce Street	0.54
11/5/2022 1-84102 AM	Converseste Steen!	9.54
V22/2523 8:31:45 PM	Convenence street	0.50
3/21/2023-6:26.47 PM	Commence Street	0.6
3/24/2023 11:33:25 AM	Commission Street	3.6
5/14/2022 7:4810 AM	Convenience Street	1.6
5/21/2023 6/21/20 PM	Commence Street	0.61
10/17/2022 10/2946 PM	Contenerce Street	0.01
11/15/2022 10:27 13 AM	Commerce Street	1.0
1/20/2023 2.8723 PM	Conservation Stream	9.86
2/11/2523 107.07 AM	Convinence Street	1.71
K5/11/2022 & #8-40/PM	Commence Street	1.0
1/27/2623 10:23:36.4M	Commence Street	9.73
2/23/2623 11/351 AM	Commence Street	0.7
10/28/2022 4:14:33 PM	Commence Street	0.73
12/15/2022 4:5355.AM	Commerce Sheet	3.71
10/28/2022 12:18:00 PM	Commence Street	9.7



INSIGHTS

In the real life deployment of rail monitoring solutions, many lessons were learned throughout the project, critical advice that could help anyone attempting a similar project.

Tips for Testing Sensors

- Sensor Kits the physical hardware that holds the sensors are essential components and its size and ability to withstand the elements is critical.
- **Sensor Locations** it is preferable to have sensor locations on public property, not on property owned by railroads or private property otherwise you will need to seek additional permissions
- Sensor Aiming critical to data collections, sensors have to be correctly positioned to detect the training's sounds and to have unobstructed line of sight which comes with its own difficulties
- Cloud Based Software for testing purposes, the hosting of the was switched from a local network to the Houston Smart Hub cloud to allow for timely system changes to accommodate testing needs
- Firewall Security building safe protocols for new data streams into firewall protect systems can be difficult; real time displays and reporting from TRAINFO sensors were integrated into the existing HayStax system the firewall was a successful integration
- **Accuracy Commitment** the solution providers were pushed to attain the highest possible rate of accurate reporting of blockage events - while 80 to 90% sounds good, the gold standard for the project would be to achieve as close to 100% as possible and which was only attained by TRAINFO
- **Displays for First Responders** while 70" monitors provided by Dell for the stations was effective, the provision of tablets for First Responders to reference while in transit were ideal for real time decision making

Intelligence Insights

Aside from the practical aspects of getting sensors The concept of a smart city is to integrate information up and running, once the information was being and communication technologies, including successfully served up on dashboards and reports, surveillance and transportation systems, to connect there were additional benefits. with the 'internet of things' networks - all with the purpose of optimizing the efficiency of city operations The data derived from the Smart City Rail Crossing and services. Citizens enjoy easy access to information Pilot Project provided valuable insights: that improves livability while also receiving good value for investment of the public purse.

- Public Safety: TRAINFO 's information solution was able to help monitor non-functioning gates and reveal the risky behaviors of pedestrians and vehicles who defeat the safety mechanisms and cross under or around trains.
- Community Buy-in: High quality reliable and accurate data can back up and confirm citizen's complaints, and conversely state which complaints are spurious in nature. For citizens who feel dejected about the rail crossing blockages, can feel hope that the solutions are being deployed and successes quantified.
- **DOT & First Responder:** TRAINFO's solution serves up an integrated solution for both First Responders and DOT. This means traffic apps and mobile signage that detour motorists are coordinated for optimal effect.
- **Two-Prong Validation:** The deployment of two independent sensors – audio and visual – provided the highest possible confidence in reporting of events for first responders and DOT systems.
- Accurate Rate: TRAINFO's audio sensor, on its own, achieved 100% accuracy rate event detection for this project, fulfilling the criteria for the project.
- Eye-On Advantage: Visual monitoring provides enhanced monitoring that can enhance monitoring of the public's buy in and better helps describe the context of particular blockages as unique occurrences require further insight.

Smart City Integrations

TRAINFO is a single-purpose custom built solution, the only company in North America dedicated to the monitoring of blocked rail crossings. Built by transportation engineers, the solution is expected to deliver at the highest possible standard of accuracy and consistency. And, it's also designed to be a plugand-play solution that seamlessly integrates with existing systems.

As shown in the Smart Railroad Crossings project, TRAINFO provided 100% accuracy in detecting all events. The test was conducted under normal environmental conditions, meaning there were no power outages or hurricanes. TRAINFO, like any system, is subject to impacts from its environmental conditions.

"With TRAINFO, we built trust into the system. Imagine you're in your car driving towards an intersection. But, you're only 80% confident that the traffic lights are showing the right colour. You're going to be very cautious, right? The system just doesn't work if there's such a large margin for error. That's why TRAINFO is committed to striving for a 100% accuracy rate – our clients absolutely trust the data we provide."

- Neil Ternowetsky, Co-Founder of TRAINFO.



RECOMMENDATIONS

This Smart Railroad Crossings Project started with the premise that broad platform technology solutions, with off-the-shelf sensors, could efficiently solve the problem of monitoring blocked rail crossings. A multi-partner solution with with an expanded toolkit has a pragmatic appeal. However, in the execution of the project, and contextualizing the problem as a transportation engineering problem requiring a high degree of accuracy along with seamless and intuitive integrations, TRAINFO

proved to be the preferred solution. Based on the metrics, TRAINFO excelled in the following areas:

- TRAINFO audio sensors provided 100% real time consistent and reliable event reporting
- TRAINFO, coupled with a Bosch camera and supported by the Houston Smart Hub VMS, delivered two-factor validation with 100% accuracy
- Note that "real time" is defined as data output within three seconds of the actual event

- Built-in data analysis and visualizations tools such as the dashboard and reporting tools were embedded in the browser-based user interface which provided easy-to-use and intuitive access for viewing and customizing event data.
- Raw data downloads were available in a csv format which allowed for importing to other third-party business intelligence reporting tools.

The TRAINFO platform is specifically designed for the purpose and focus of detecting trains and the effects of blocked railroad crossings, not just for the City of Houston, but nationwide. In real life conditions TRAINFO showed it uniquely fits the requirements and is well positioned for growth and expansion in accordance with the city's goals and objectives.

Tactical

On a tactical basis TRAINFO offers a number of benefits. In addition to superior data analysis, forensics, it had quicker times to validate and it was easier to validate what was happening in the incident.

Characteristics

- User friendly and easy to manage and maintain even for non-techies
- Maximizes existing environmental conditions space, access, view of crossing
- Minimal training efforts and increased ability for adoptions
- Existing integration with Haxstax Risk and Threat Management Dashboard
- Easy accessibility via web browser
- Real time alerting situations provide bullet proof confirmation of blocked crossings
- No administrative costs, which reduces sustainment costs
- Future enhancements to provide native snapshots and integration with Houston Smart Hub's VMS using camera technology for visual verification
- Forensic data capabilities provide authentication capabilities where cameras provide make a visual confirmation to authenticate the data point, useful where:
 - Residents may complain about blocked crossings, but they can get it wrong thinking a slow moving train is stopped, or may simply not observe that improvements have been made.
 - Reliable records can be passed as evidence to the train companies.
- TRAINFO sensor kits worked well in ways that are superior to off the shelf solutions.
- One TRAINFO kit can support other devices and functions
- As cities have strong firewalls, making new data streams into the firewall an additional

challenge, TRAINFO builds and manages custom integrations with vendors like Haystax taking security into consideration before a customer's firewall, helping to ensure a safe and seamless integration.

- Data is shown in highly visual dashboards that quickly that easily indicate incidents which is actional by dispatchers.
- Data is also easy to access as a past record, taking resident's complaint about an earlier stoppage that can be compared to the historical data and verified.
- Real time alerting capability and ability to analyze the data was easy.
- TRAINFO offers predictive modeling tools to alert motorists even earlier in their route of pending blockages.
- Data is highly reliable, 100% detection compared with pre-project of 20% accuracy.
- Both TRAINFO and Houston Smart Hub's cloud systems allowed for easy on-the-go updates to test both systems.
- Dell's provision of 70" monitors in fire house improved monitoring and the provision of in vehicle tablets increased access to first responders on the move.

Opportunities

- Mobile signs for driving routes show signs at multiple bypass points prior to 'last resort' signs
- Reliable data from TRAINFO can be used to negotiate with rail companies while also noting that the TRAINFO solution does NOT in any way require participation from the train company for its deployment or use.

Strategic

Providing reliable data is just step one in solving the grade crossing blockages. You have to know what to do with the data to make it actionable and help solve problems. To make TRAINFO's solution work for any city, it's vital that cities have staff tasked with communicating, managing people's expectations, and understanding the levers that will make lasting improvements.

Characteristics:

- People's perception is subjective, a smart system will provide data to validate perception (imagine a case where it may seem a crossing was blocked for hours, but reliable data shows i was only 20 minutes).
- The project looked at 18 crossings considering a sorts of problems using camera, acoustic sensor and visuals, and included some AI analytics as well. AI used in the Houston Smart Hub solution proved to be particular or fussy in deployment it could not distinguish between incidents that matter and those that don't.
- How bad a problem cities may have with block crossings can be impacted by elements far outside of your control, for instance:
 - During the pandemic people weren't movin so they didn't care or complain about blocked crossings.
 - Post pandemic conditions that saw recove of economic activity and increased supply chain requirements increased the frequence and duration of blocked at the same time people were more active.
 - When business is booming for rail compani they may pull out old engines which are more prone to breaking down, also less use track may become used introducing new areas of blockages.
- Data can actually show what neighborhoods are most impacted and that's not always the most vocal, or complaining of the neighborhoods.
 Sometimes residents are so used to the problem,

	they become hopeless and stop complaining because they don't believe there is a solution.
IS	 In evaluating a system, you need frequency
it	Opportunities
all rs	 Mayors and other elected officials want to be able to report that something is being done about this long standing problem.
as	 Having credible and reliable data to report and track progress is vital to show progress and to validate whether a problem exists (or to the scale indicated .)
ed	• When the solution works, and blockages are reduced, you can measure success by a reduction in complaints.
ng	 By having good data, tracking historical trends, you can state with confidence progress on reduction in traffic jams, pollution and even reduction in first responders time on scene.
ry cy	 Better data that (in)validates residents' perception of the problem promotes better communication.
ies ed	 Firetrucks don't only respond to fires in their neighborhood, they are also called to adjoining neighborhoods depending on the scale of the fire; so protecting the flow paths for these
	 Movements is also important. Lowering blockages in one neighborhood may increase blockages in the another neighborhood.
re	 TRAINFO analytics can show anomalies like nonfunctioning gates which can be reported to the train company.

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Transformational

For cities and counties that are looking for a powerful solution, TRAINFO's platform is an ideal tool that can unleash transformational change in public safety. Trains and people have to share spaces and there has to be a give and a take to make it work.

Characteristics

- Predictive models can help further improve TRAINFO impacts.
- Route signage to notify motorists of delays at multiple bypass points to reduce congestion points.
- TRAINFO's platform is easy to implement and provides immediate relief with a modest investment.

Opportunities

- Public safety is job #1 for elected officials.
- Better data results in better decision making.
- Authenticated data is powerful in motivating trains companies to find solutions to reduce blocked crossings.
- Cooperation and compliance becomes consistent when the data is reliable and ongoing.
- Benchmarking with reliable metrics allows officials to report on improvements.
- Real data couched in real life context can help set more realistic expectations for all parties.
- A taskforce or committee can focus efforts on real deliverables and unite groups to speak with one voice.
- Actional and tactical information can, over time, transform plans for spaces shared by trains and people.

TRAINFO Profile

Based in Winnipeg, Manitoba, TRAINFO was built for traffic and transportation engineers. The TRAINFO solution grew out of a need to solve an old problem along with a commitment to excellence that spells trust for its users and the public.

#1 - The desire to solve tough problems.

The trouble with trains and traffic is not new. In fact, it's been a problem at least since the 1910s and even earlier. The last major contribution to rail crossing safety was the level crossing predictor with flashing lights in the 1960s. Today, despite waves of technological advances, the only option available to cities to manage rail crossing blockages was overpasses or essentially wait.

How could it be that no one had solved this problem? TRAINFO set about changing this. They spent two years in research and development working with LiDAR, infrared, visual camera, accelerometers (vibration sensors), and more. The resulting proprietary solutions form the information solution based on TRAINFO sensors, analytics and reporting. TRAINFO is poised to revolutionize rail crossing detection and safety standards across North America.

#2 - The drive to attain 100% accuracy.

Imagine for a moment, if you drove your car up to a traffic light but you're only 80% sure that the red light and green light are accurately working? How confident would you be in driving into that intersection? Traffic lights have to work 100% of the time under normal conditions. And that's the same standard TRAINFO set for solving the rail crossing problem. Today, TRAINFO guarantees 99.99% [or use 99.99...%] accuracy under normal operating conditions.

TRAINFO demonstrates a high degree of impact:

Traffic Congestion

• Demonstrated ability to reduce vehicle delay hours by up to **30%**

Grade crossing safety

• Demonstrated ability to reduce the number of vehicles interacting with active crossings by up to **20%**

911 responder delays

• Demonstrated ability to reduce 911 responder delays at active crossings by up to **95%**

Planning

• Increase the benefit cost analysis of grade crossing separation by 800% through measurement of actual impacts and enabling a single grade separation to provide benefits for multiple additional crossings.

Outcomes for 2024 & Beyond

The Smart Railroad Crossings Project was made possible through the collective effort and will of many companies who donated materials and human resources. The individuals who participated brought a sincere commitment to the project that would see improved public safety and livability for the people of Houston.

The City of Houston uses a Smart City approach, coordinated by Jack Hanagriff to identify, test, and deploy technology solutions to reduce roadway impediments affecting transportation safety and mobility throughout the city.

While the grade crossing problem is perhaps the hardest nut to crack, the implementation of a comprehensive solution can only be fully realized through the deployment of an integrated smart intersection plan.

Smart Safe Streets for All Project

The underlying wisdom that frames smart intersection solutions is the ability of technology solutions to integrate seamlessly to allow for pragmatic choices that utilize the best features of each contributor.

While TRAINFO's cutting edge new sensors are transforming train detection, the ability to easily and reliably integrate with existing systems for a fully deployed solution is really where the public sees value for the investment of public dollars.

The City of Houston is seeking funding to support integrations of 25 railroad crossings and 32 intersections. In this scenario TRAINFO sensors and Bosch cameras will integrate with the Houston Smart Hub's surveillance system and other technology partners to increase public safety and mitigate first responder delays.



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