Paper

GeoSpatial location tracking and reporting

Problem

With large mining operations there can be a large amount of people, equipment and material moving around a site at any given time. This creates a complex environment to manage and two distinct problems arise.

Firstly, with the increase of complexity of the operation there is a need to manage the efficiency. Developing strict governance rules for the movement of people, equipment and material allows for the operation to be managed at optimal efficiency, with large operations it is impossible to manage efficiency without an overarching view of the movement on a site. The asset management tools used are often not integrated and leads to different views on the actual situation.

This is exacerbated by the fact that management is separated from the operation, data provided to the managers is outdated or stored in cumbersome "table-like" reports that are hard to analyze and there is no link between the various views.

Secondly, there is a safety concern, some people, equipment and material cannot be allowed in certain areas as this would create potential safety hazards. Ensuring the safety of all involved becomes increasingly difficult to manage as the size of the operation increases and with multiple people responsible for safety there could be overlaps as well as gaps in the coverage of their areas of responsibility.

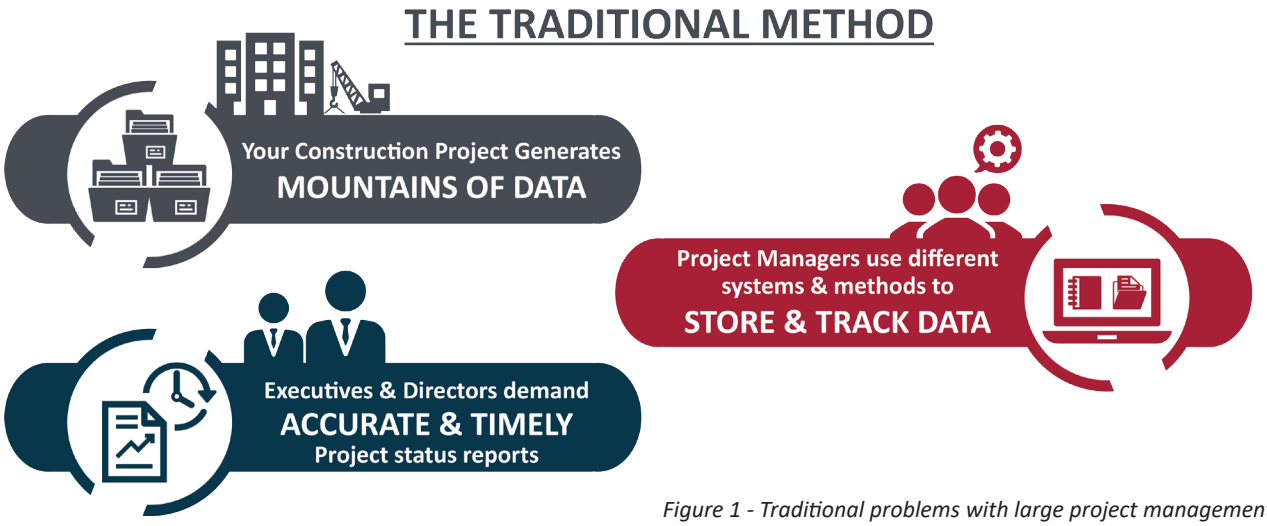

Figure 1 - Traditional problems with large project management

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Solution overview

MineRP developed a suite of products which are specifically aimed at the management of spatial information, the reporting of spatial data as well as integration of the various sources of spatial data. The data is gathered from all the various create systems, for example GPS position systems placed on equipment, RFID tags at entry and exit points as well as access control points, by using mediation platforms specifically built for the data types. This data is then instantiated once in a central data warehouse. This data warehouse is also the store for all the configuration, attributes and business rules of the operation, allowing for one version of the truth, i.e. there is no duplication or differences in data.

MineRP implements a spatial database toolset on this data warehouse which allows for the data to be represented in a single area of space, all in correct relation to each other, further increasing the value of this data as various points of space can now be valuated, measured and analyzed within context.

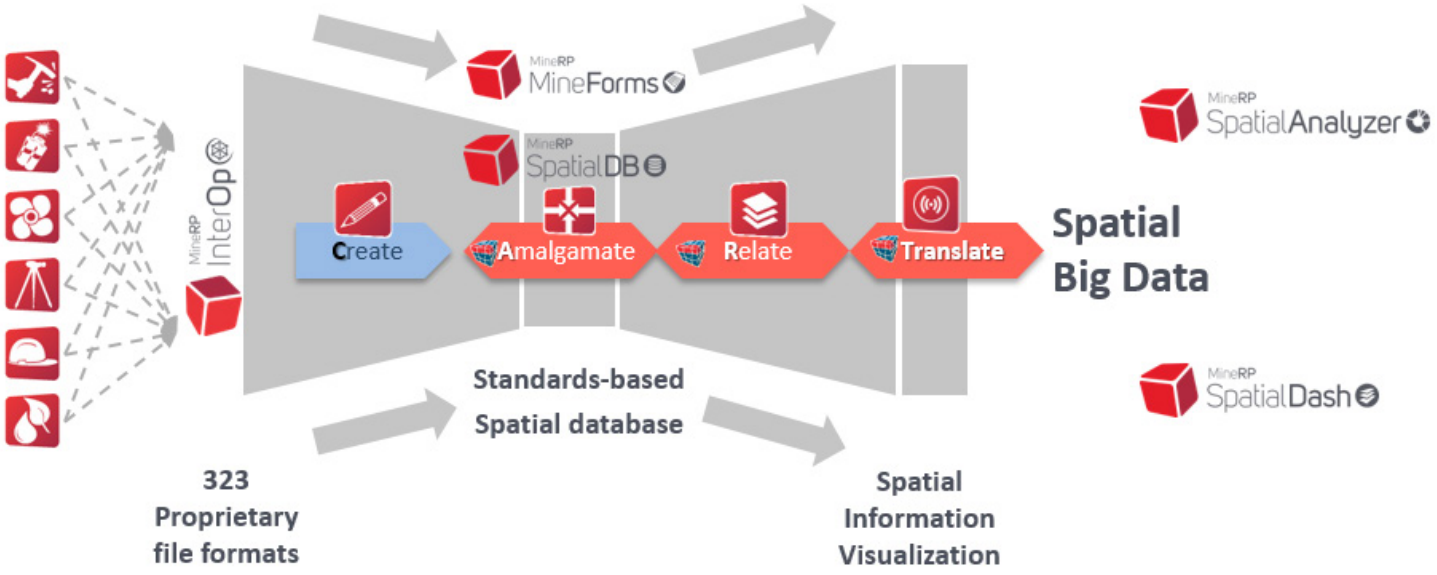

Figure 2 - MineRP Integration Framework

Once this data is gathered, stored and attributed in the data warehouse, the data can then be displayed on a spatial dashboard, accessible via any HTML5 web-browser, which displays the spatial data in specific views which can be overlaid with other data sets, allowing the end-user to formulate specific answers for questions that would not be possible if the data were separated across different platforms.

With the data residing in a common space, the system can then periodically, according to business requirements, analyze the data and perform spatial intersections to check if certain conditions are met and display this information. For example, the spatial database can continuously check if there is a piece of equipment that is required to be in a certain position as required by management, and if this piece of equipment is not in that position it can be displayed to the manager on the spatial dashboard view as an urgent matter to attend to.

Making use of the MineRP business process management tool, the system can be setup with specific processes which can be triggered if an event has occurred which needs someone to attend to or requires that a specific person be notified.

Furthering the example used above, should a specific piece of equipment not be allowed in a certain zone, the spatial database can analyze the real time data received from the positional tracker on the piece of equipment and when the piece of equipment enters a prohibited zone, display this on the spatial dashboard, as well as kick of a digital process to the manager to inform him that there has been an infringement. This process can be configured to allow the manager to send an instruction to the operator of the equipment in question, making use of this process engines ability to send SMS and e-mail messages as well as web-browser based tasks.

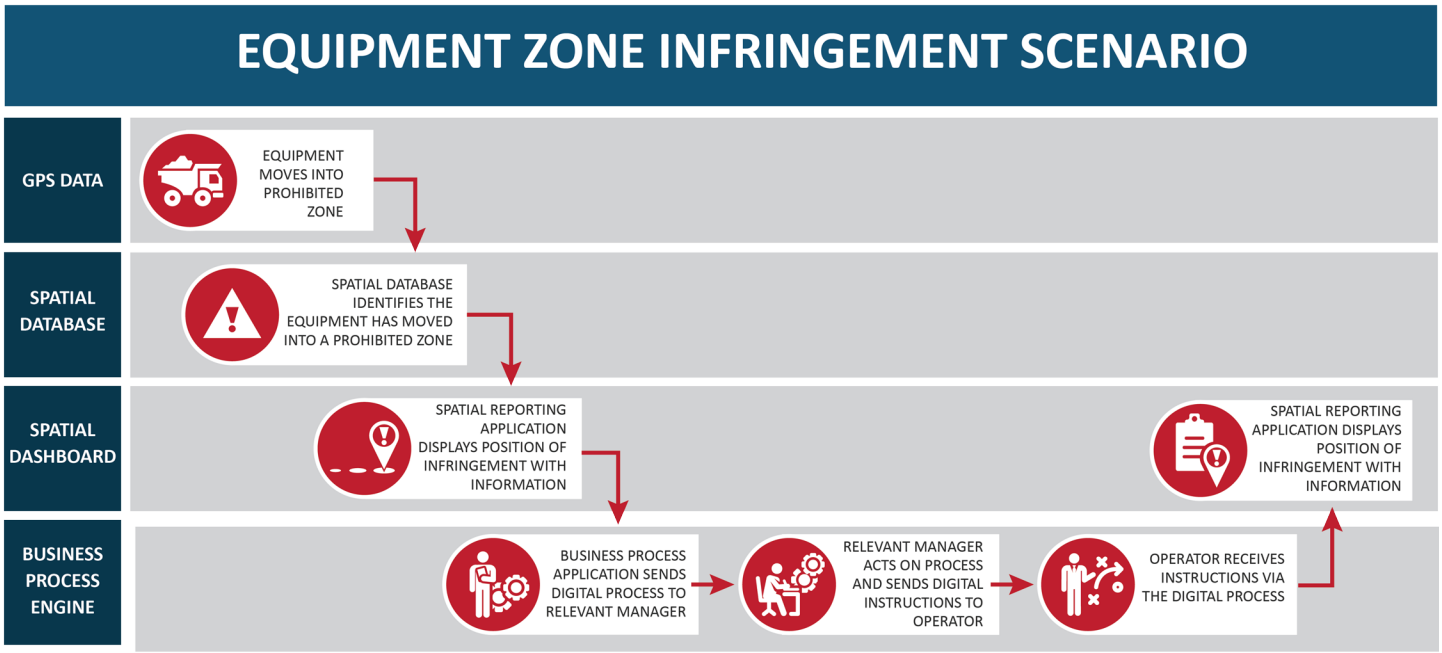

Figure 3 - Equipment location management report

Built into the spatial dashboard is the functionality to add graphs for groups or specific items, which can display the load carried, the time spent in a zone, the time worked or number of people in specific area. These graphs and indicators are highly configurable for the specific needs of the person using the spatial dashboard.

> The MineRP set of tools enable an enterprise view of the operation, allowing for seamless operation wide management of spatial information with the ability to connect digital business processes further enabling the tracking, tracing and audibility capabilities of the system, accessible on easy to use web-browser based tools from anywhere.

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Technical Solution

The solution makes use of various building blocks within the MineRP Enterprise framework, which have all been pre-integrated out of the box.

- External Data Sources (GPS, RFID Location etc. data)
- SpatialDB (Spatial Functions Toolset)
- Mi-ODS (Spatial Data Warehouse)
- SpatialDash (Spatial Dashboard)
- MineForms (Business Process Engine)

MineRP External Systems

Any third party expert or standalone systems to which MineRP InterOp can connect to and make the datasets available in MineRP Explorer

MineRP SpatialDash

A Spatial dashboard that runs in a web environment, able to display GIS like datasets hosted in MiODS, & connects to other GIS data services graphically displaying the Key Performance indicators defined in MiODS

MineRP MiODS

An Intelligent Operational Data Store for spatial and non-spatial data that includes a Persistent Staging Area, Meta Data Dictionary that describes all data entities and Analysis Layer for creating Key Performance Indicators

MineRP SpatialDB

The primary storage mechanism that enables spatial capability for 2D & spatial 3D objects with extended capabilities and functions for hosting mining specific data types

MineRP MineForms

A business process modelling tool for Workflow and creating of Simple Data Capturing inputs for capturing attribute data related to data elements hosted in MineRP systems

Figure 4 - MineRP Product set

The solution architecture includes the MineRP building blocks as well as third party applications and data sources.

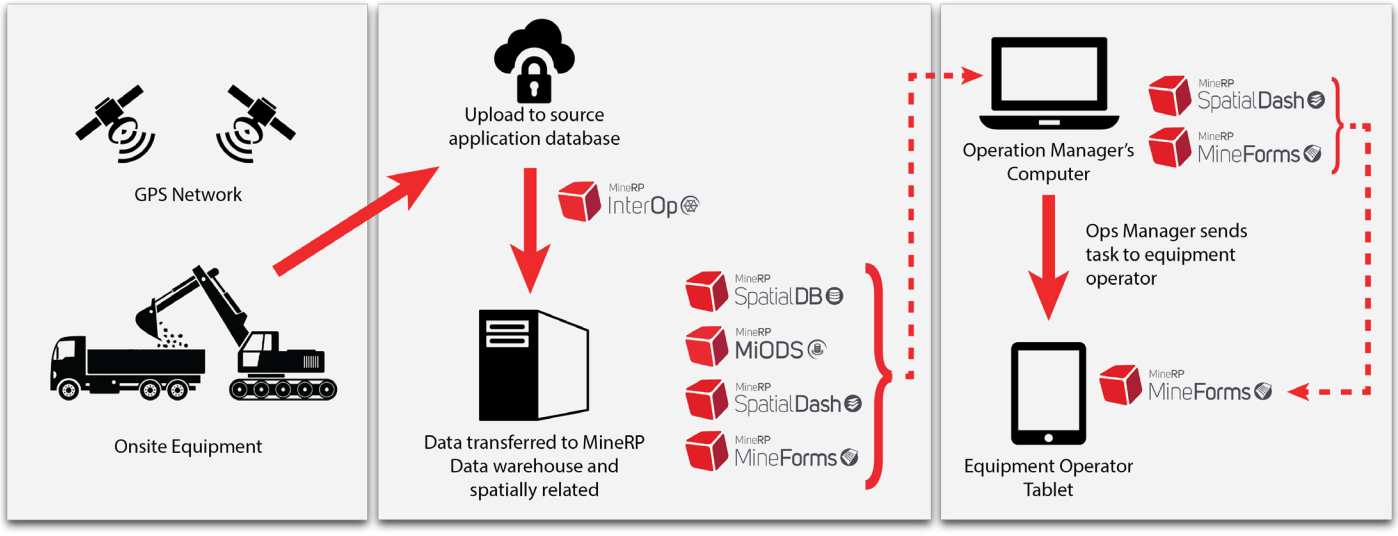

Figure 5 - Solution Architecture

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The solution integrates into any existing spatial positioning system in place. This system tracks various properties of the asset, most importantly the position using the GPS system.

The GPS location of the asset is then relayed to the original system's cloud database using the local area network. As soon as the database receives the new position the data is transferred to the MineRP MiODS spatial warehouse through a specific connector which transforms the spatial data to the OGC spatial standard. The data is then added to the spatial database which checks the new position against business rules, such as restricted zones etc.

Once the new spatial data has been imported into MiODS it displays on the end-use-specific SpatialDash view. In order to view this data, an end-user will open SpatialDash in any browser on any device and select the relevant view. SpatialDash can be accessed over a local private network, or a public internet network protected by domain authentication, depending on the client's requirement.

Depending on the views selected and the end-user's requirements, the user sees the position of the asset in relation to other spatial information. Should there be zones that are prohibited, this can be displayed to the end-user as a red polygon. Similarly, an asset, such as a truck, that is outside of this zone will appear as normal truck but will turn red as soon as the vehicle enters this prohibited zone. The poll-rate at which the real-time data is displayed within SpatialDash can be adjusted to the specific need of the client.

As soon as the truck enters a prohibited zone, the SpatialDB identifies this infringement. SpatialDB then initiates a digital business process, which identifies the spcific asset, the operator of the vehicle, as well as the designated operations manager of the truck according to its attributed data.

The process initialized immediately sends an e-mail notification to the operations manager containing all the information regarding the incident. This is available to the operations manager in MineForms, the business process engine provided by MineRP.

In the scenario demonstrated below the piece of equipment in question will be a truck.

Figure 6 - The SpatialDash view shows the designated areas that a vehicle is allowed to collect material in green, dangerous areas in yellow and prohibited areas shown in red.

Figure 7 - The vehicle has now entered a green area, which will not cause a notification to be sent to the operational manager, but the system will keep track of the time entered as well as time exited.

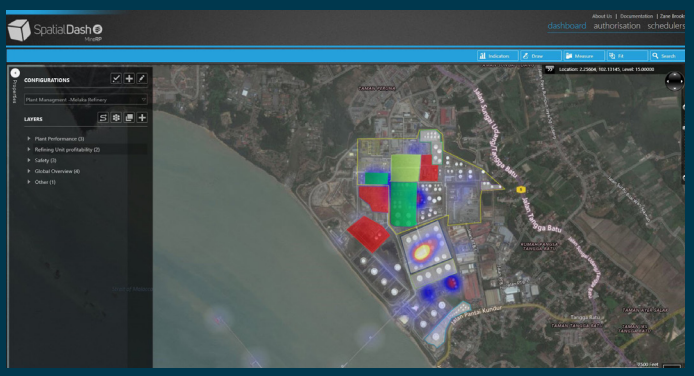

Figure 8 - Demonstration of designated zone, with a layer showing a heat map of areas where inspections have taken place

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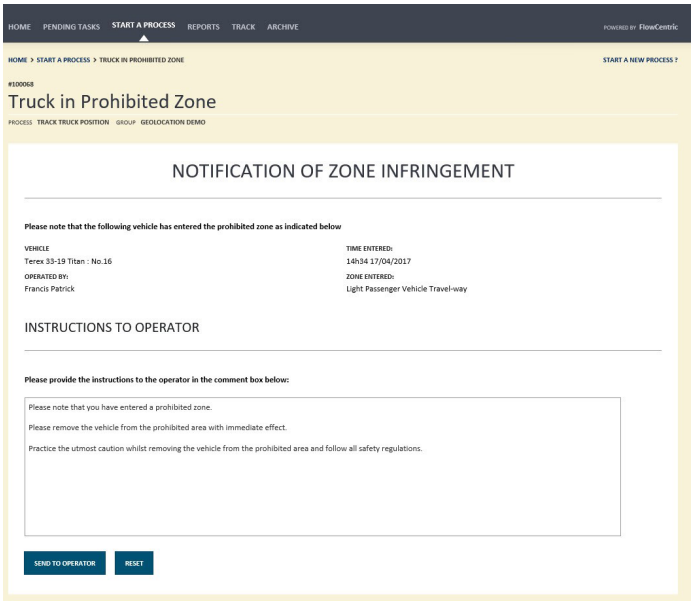

Figure 9 - The screen which the operations manager will see when a truck has entered a prohibited zone

To kick off the MineForms process, the operations manager responsible for the vehicle sees all the relevant information and enters an instruction for the operator of the vehicle. Once the operations manager has entered his instruction, the process will pass the task to the operator.

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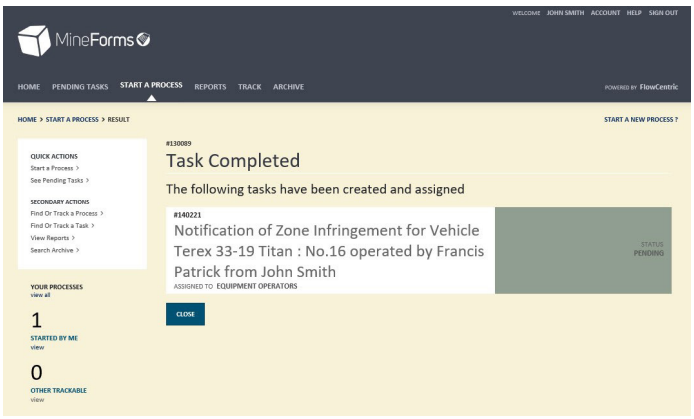

Figure 10 - The instruction has been assigned to the operator of the truck

The operator receives an e-mail, sms and notification within his MineForms Pending Task list.

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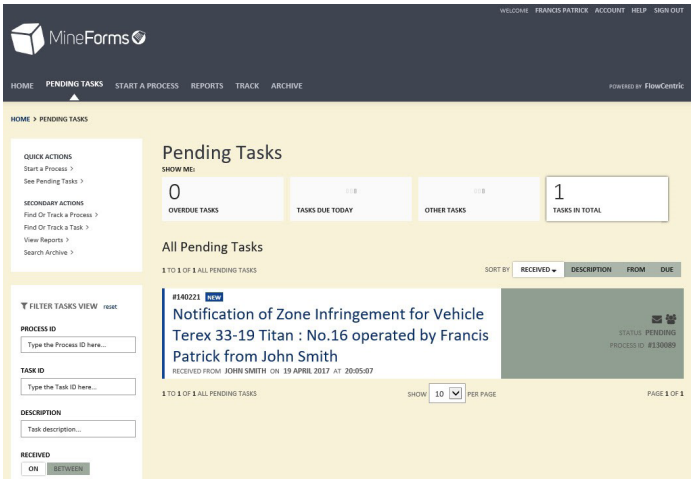

Figure 11 - The operator of the vehicle received the instruction in his Pending Task list

Once the operator receives the notification he can then open the task from either his e-mail or from the Pending Task list in MineForms. He can then review the instructions sent by the operations manager as well as the details regarding the infringement.

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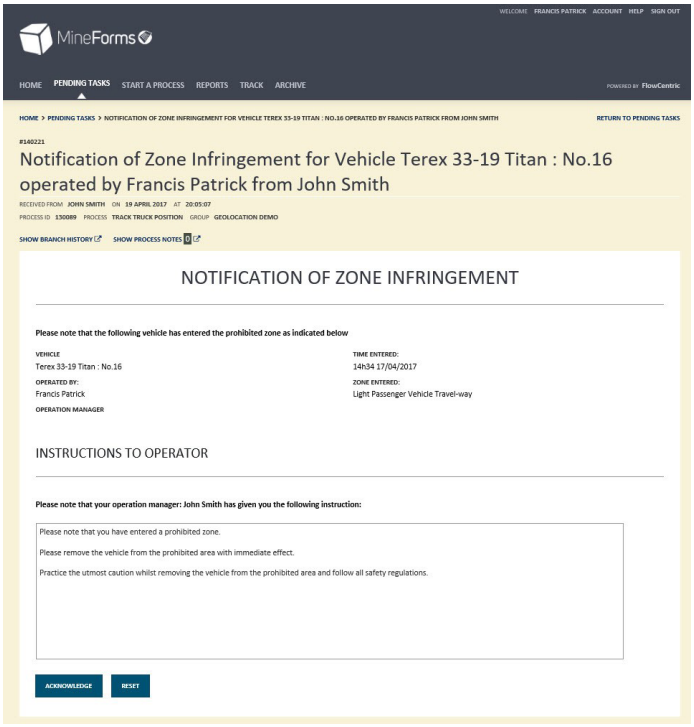

Figure 12 - The task assigned to the operator of the vehicle involved with the infringement with the instruction from the operations manager

Built-inparameters allows for esccelation management where tasks remain outstanding or become overdue.

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The process is fully auditable and traceable both during execution and thereafter.

Using built-in search functions in MineForms the history of any process can easily be retrieved. The ability to search for processes can be limited to certain roles. In the results of a search a user can see the process flow, who performed each task in the process as well as the content of each task.

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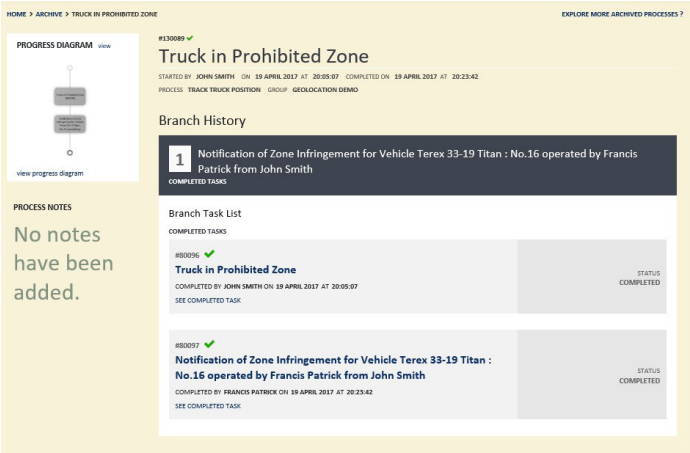

Figure 13 - Results for a search of a specific process showing the steps and process flow

Outcome

By bringing the source data together in a centrally managed data warehouse with the enterprise functionality of the integrated SpatialDash and MineForms applications the solution gives a user the ability to manage the efficiency and safety of various sites across an operation by using a fully auditable and traceable process engine.

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MineRP

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