Optimization of Pipeline Field Inspections Using Mobile Inspection Technique

Mark L. Woynarowich, Kingsley Mbah
Cenozon Inc.
350, 736 - 8 Ave SW
Calgary, AB T2P 1H4
Canada

ABSTRACT

Pipeline operators have been concerned about the quality of field data and its association to assets, resulting from illegibility, omission of critical information, inconsistent reports and inputs from field inspections using traditional methods (paper forms, spreadsheets or email). Typically, the records are sporadic and not available to easily integrate into corporate repositories. This makes it difficult for different business units to access common information and optimize asset management to assist with critical decision making and planning.

Using a mobile device equipped with the inspection app will support pipeline operators with efficient data collection techniques to help eliminate the problem of data quality, availability and usability. The mobile inspection app is hosted in a geospatial environment to provide accurate geographical location of inspection and maintenance activities. This app features: customized forms for various field inspection activities, automatic data transfer capability and integration into pipeline integrity management systems to ensure ongoing reliability and effective compliance management.

This app has received positive market feedback from over 50+ users actively using the app for field inspections, monitoring or mitigation capture. This innovation provides a solution to improve the accuracy and quality of inspection data required for safe operations of pipeline systems.

Key words: Inspections, Spatial data, GIS, GPS, Asset database, Mobile app,

INTRODUCTION

Pipeline operators are facing challenges with the accuracy of field data collection, availability of collected field data to support real-time decision making and integrating collected data in asset database in a geospatial environment for easy visualization of data and locations along the pipeline.

In the past, collected field data from inspections usually takes days/months to get transferred to the central database and inconsistent reporting system has affected decision making and prioritization of identified anomalies requiring immediate mitigation.

Periodic Inspection of pipeline signs is a critical part of pipeline lifecycle management and regulatory requirement to ensure safety of public, asset, and environment.

Mobile app is a designed application that allows pipeline operators/owner to customize inspection forms in a digital format for field data collection to suit business needs, and automatically transfer collected data into asset database. Mobile app collects and gather information using mobile device such as smartphones and tablets.

Mobile app is equipped with GPS functionality and map to support identification of asset location, store collected field data with the spatial attribute (Latitude, longitude and elevation), supports import of basemaps and map visualization, photograph and video recording functionality and file sharing enabled and automatic data synchronization to cooperate repository.

Mobile app was used to conduct various field activities such as pipeline crossing inspections, sign inspections, critical asset (tanks, valves, risers) pigging equipment's, compressor stations, pumps and injection sites, these inspections was performed using customized forms, recorded/stored data in digital format with pictures to support Engineers with timely integrity assessment and decision making in effective and efficient manner.
Using mobile inspection technique for field inspection over the traditional paper-based system is a technology improvement to minimize time spent filling paper forms in the field, time spent entering data collected into spreadsheet, inconsistent data format and illegality of field report.

For the purpose of this paper, inspection methodology, results, findings and recommendations shall focus on inspected pipeline signs/crossings, data collection process and automatic synchronization of collected data into information management system.

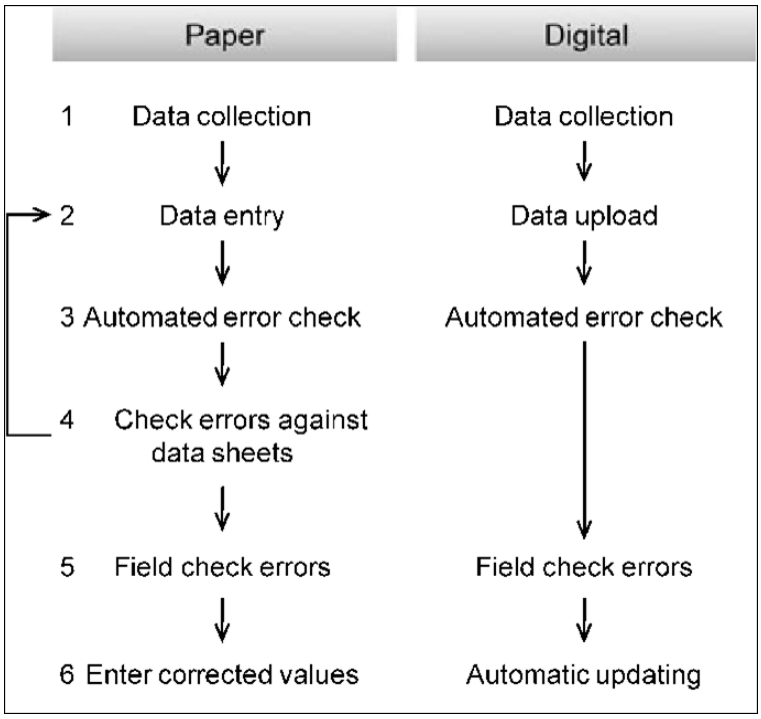
As per of regulatory requirements, Pipeline operators are mandated to perform periodic inspection of pipeline signs as outlined in CSA Z662-15 Section 10.5.3.1-9 and Alberta Pipeline Law Section 68 (1-8), Section 69,70 and 71 (1-5), availability of pipeline information by marking and creating awareness of your asset locations with accurate marking signs will effectively support pipeline integrity damage prevention program, reduce risk to the public and environment.

The overall goal is to adapt an advance technology system to support operators monitor, inspection and manage their asset in effective and efficient method. This technology advancement in the industry has helped optimize resources required to perform field inspections and asset data management.

CHALLENGES OF FIELD DATA COLLECTION USING THE TRADITIONAL PAPER-BASED SYSTEM

Due to the amount of details/information required to safely operate, maintain and manage pipeline, collecting of data in different forms and gathering all the collected data in the same format is time consuming, most times result to loss of information and entering this data from different forms into spreadsheets/database can be a complicated process, time consuming and subject to human error.
Historical data shows that performing field inspection using the paper-based system has contributed to inspection additional cost in inspection projects such as inspection reports getting misplaced, scatter and not illegal, collected data ends up getting re-typed into the asset database or spreadsheet thus chances of introducing human error and in most cases error in inspection report could lead to re-inspection.
With this method of inspection decision making, and prioritization of subsequent inspections and maintenance activities are delayed as a result of time taken to transmit this information to the office, data re-entering into spreadsheet or database for availability of data among the various unit in organization.

In most cases, data quality is compromised when filling or completing field inspection report, the most common error found using paper-based inspection reports completed by field inspectors are mostly mistakes from recording GPS data of pipeline and asset location, due to the different format used for measuring and storing GPS coordinate (Degrees, minutes and seconds, Degrees, Decimal minutes and decimal degrees) the different formats used creates complexity in setting the right parameter in handheld GPS unit and appropriate recording of measurement in paper forms. Most field inspectors are not familiar with the differences in the parameter, writing not illegible for data analyst to enter and utilize collected data.
Issues or error from data collection is identified at the time of data entry, error such as inaccurate GPS reading, and recording would place the data in a wrong location, this error is captured during field data entry and analysis in GIS database.
Additional challenges such as attaching and uploading inspection evidences such as photos, reports and checklists to the right locations, associating it to the asset has been a big challenge, and improper labelling of photos makes it difficult upload files to the appropriate location in the asset database and association of the pictures to the right report, pipeline.



FIELD DATA COLLECTION

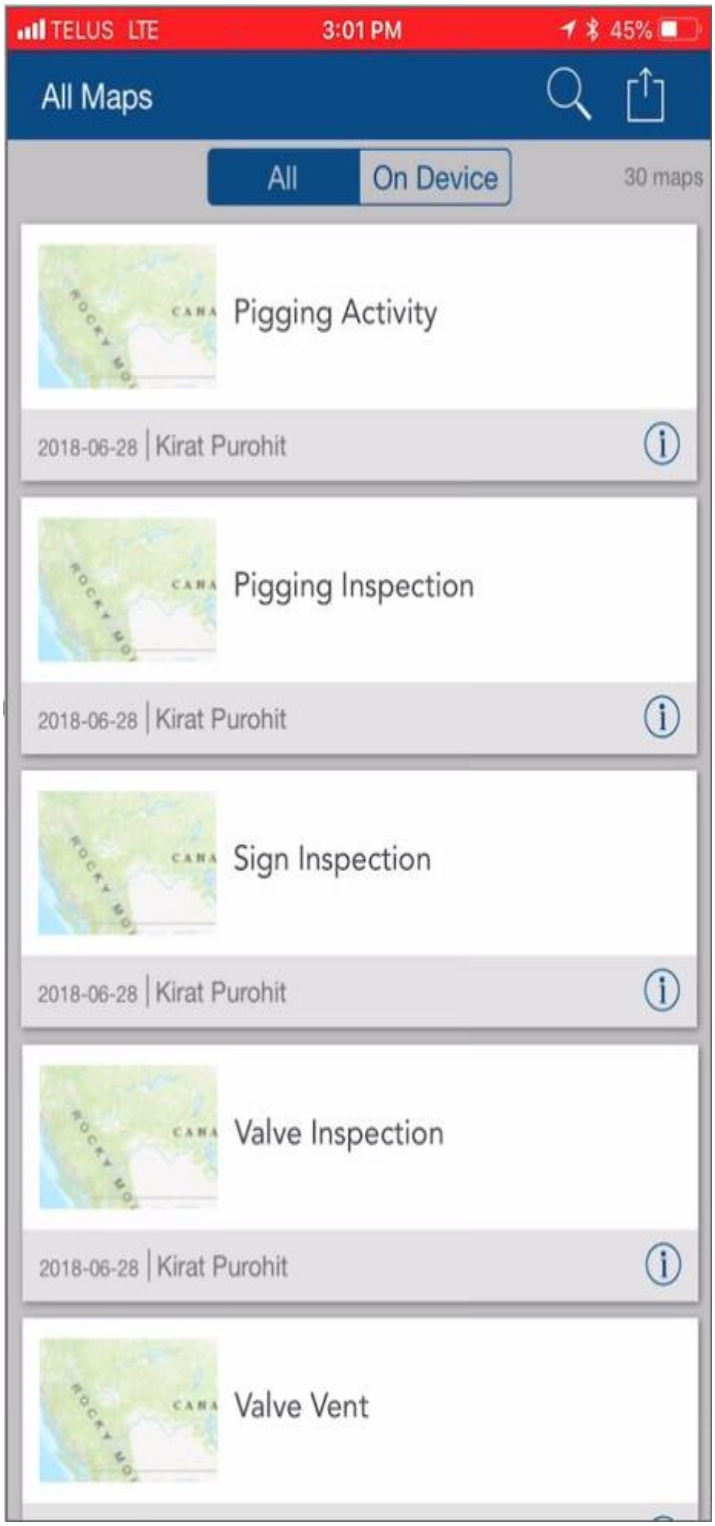
Prior to the implementation of mobile app for pipeline field inspection, operators have been concerned with the quality of data, consistency to ensure that collected data meets both clients, industry and regulatory requirements.
Inspection forms used in mobile app for data collection are designed and customized to capture pipeline operator's specific data, regulatory requirement data, ability to pre-load asset data i.e. license details, dates, inspector name and pipeline materials and drop-down options to collect, populate and validate field inspections with automatic data synchronization into the pipeline operator's asset database.

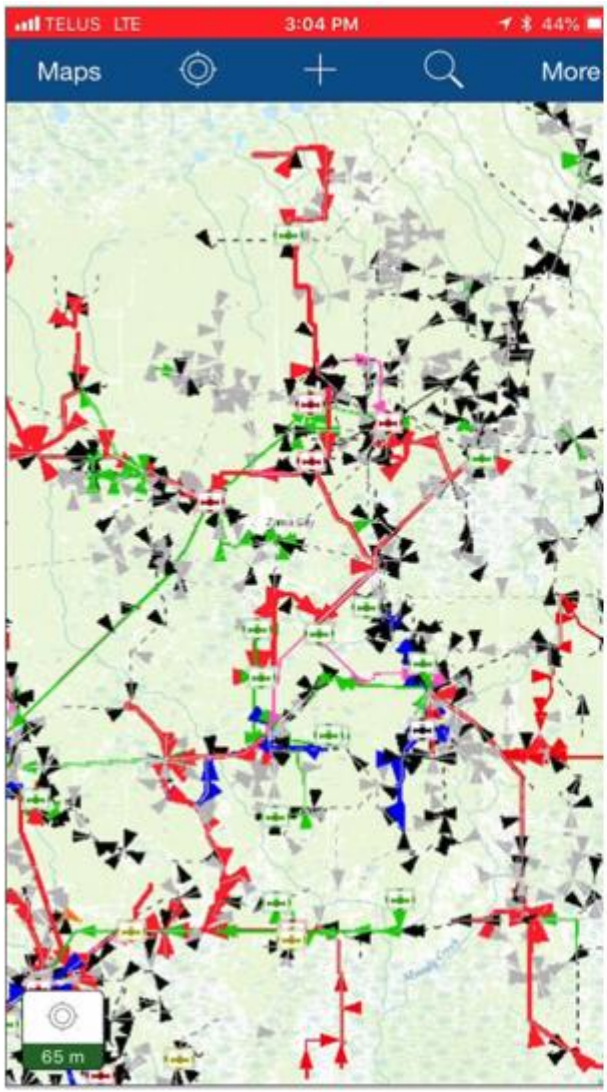
Mobile app data collection is performed in hosted geospatial environment that supports map visualization and location enabled services.
Mobile app was used to perform pipeline signs inspection to verify existing signs, identify missing signs and validate the locations of signs in asset database.
In the past this type of inspection was performed using the paper-based form inspection with a hand-held GPS unit, pipeline inspectors were faced with the challenge of operating handheld GPS and recording

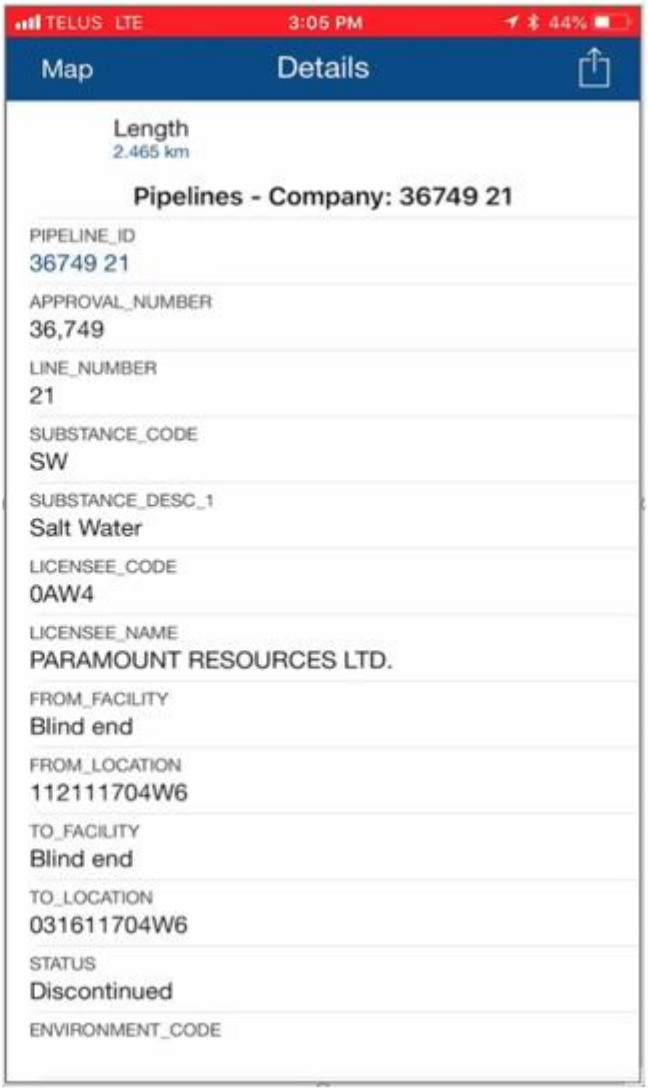
information in the paper forms and individually labelling collected data thus this method created a lot of gap and data quality issues.

The implementation of mobile app provided field inspectors the ability to use pre-loaded pipeline data to navigate to various inspection locations, inspection areas within the project scope and easy visualization of asset and their crossings locations such road crossings, water crossing, boundaries with missing pipeline signs.
Forms used to perform sign inspection using mobile app did not only serve the purpose of report recording but also as a checklist for field inspectors to ensure that all required data are captured, while ensuring consistency in data collection.

This method of inspection has helped pipeline operators/owner simplify data collection with easy visualization of asset in map, association asset to its location using GPS coordinate, ability to create inspection events and record evidence such as photo, videos and document attachment, drop-downs option for easy selection and consistent data reporting with additional optional for comments.



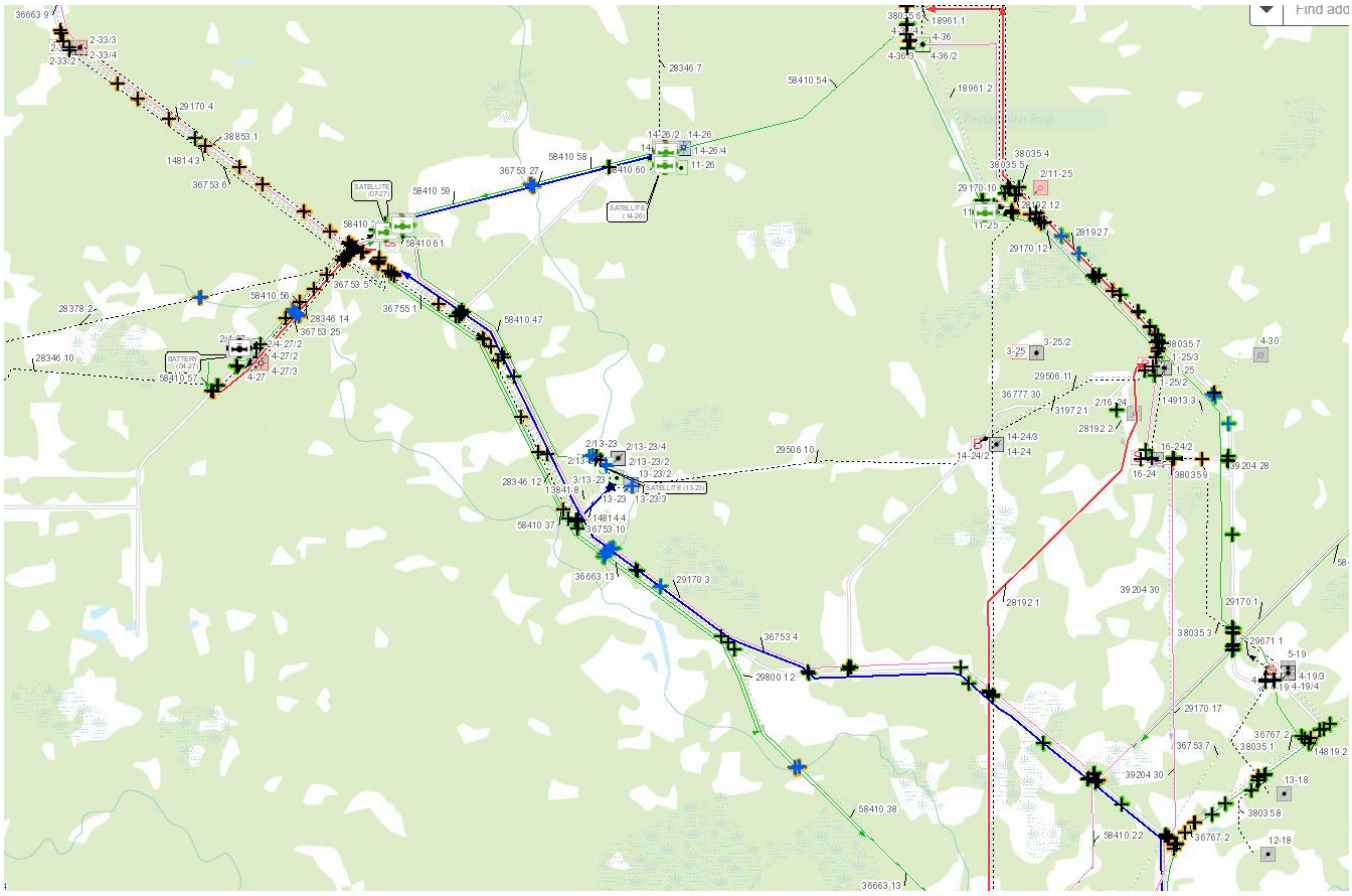


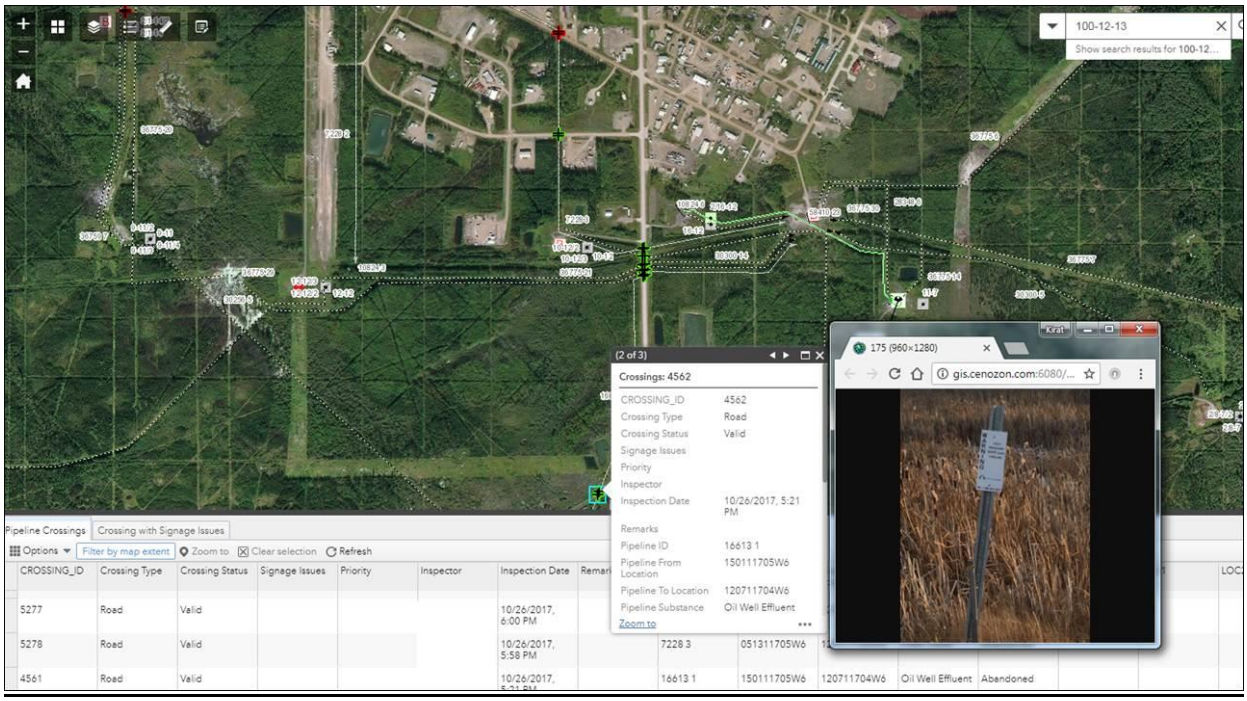


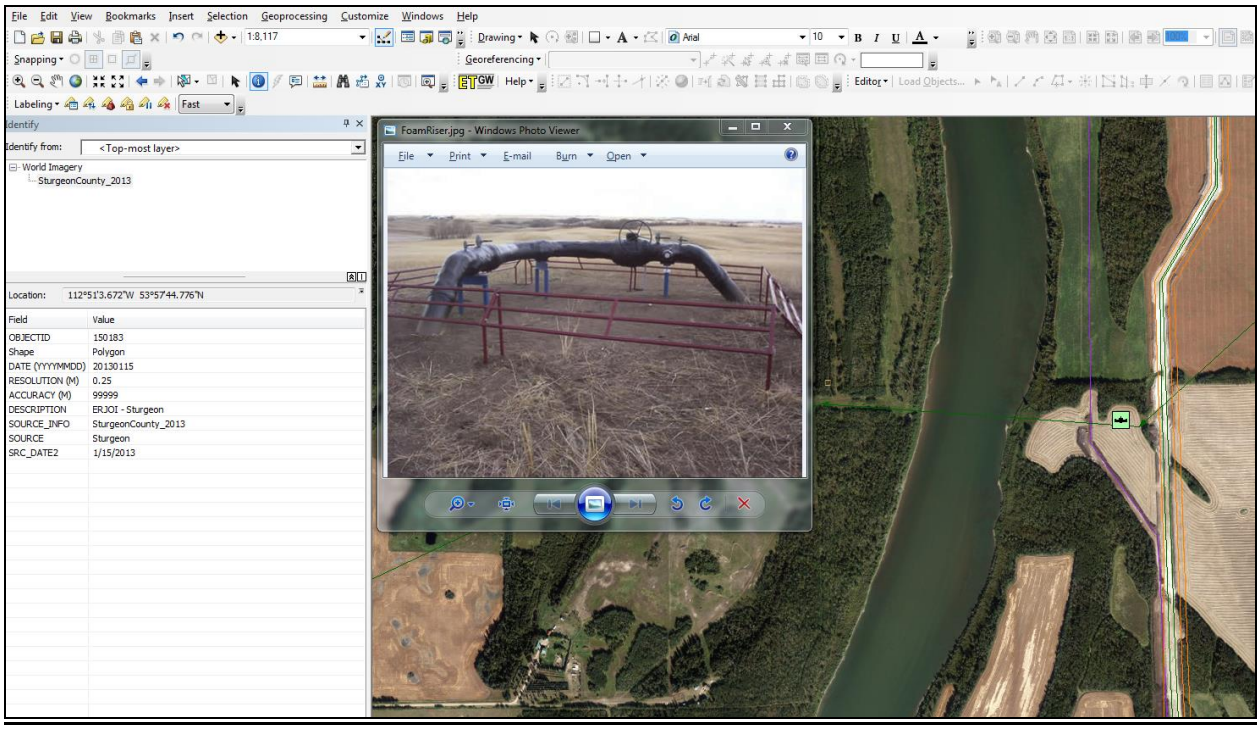
FIELD DATA TRANSFER AND MANAGEMENT

Data transfer and management in the past has consumed significant amount of time and effort, starting from field inspectors travelling hours and days to send in a scanned copy or hardcopy of completed field inspection reports, data analyst spending time to enter data into spreadsheet, database, issues resulting from report illegibility and attaching photographs to the right location/pipeline, with the technology advancement today, the redundancy and re-producing of this report into digital format has been eliminated and time spent has completed went down to 80%

Data collected using mobile inspection application can be visualized, analyzed and edited in interactive dashboard map.




100-12-13
Show search results for 100-12...
(2 of 3)
Crossings: 4562
CROSSING_ID 4562
Crossing Type Road
Crossing Status Valid
Signage Issues
Priority
Inspector
Inspection Date 10/26/2017, 5:21 PM
Remarks
Pipeline ID 16613.1
Pipeline From Location 150111705W6
Pipeline To Location 120711704W6
Pipeline Substance Oil Well Effluent
Zoom to
175 (960×1280)
gis.cenozon.com:6080/...
Pipeline Crossings
Crossing with Signage Issues
Options
Filter by map extent
Zoom to
Clear selection
Refresh
CROSSING_ID
Crossing Type
Crossing Status
Signage Issues
Priority
Inspector
Inspection Date
5277 Road Valid 10/26/2017, 6:00 PM
5278 Road Valid 10/26/2017, 5:58 PM 7228.3 051311705W6
4561 Road Valid 10/26/2017, 16613.1 150111705W6 120711704W6 Oil Well Effluent Abandoned



MOBILE APP IINSPECTION TECHNOLOGY

Mobile app is a leading technology designed to perform field inspections, this app is designed to operate in smartphones and tablets equipped with GPS functionality and ability to display maps to support the identification asset location, store collected field data with the spatial attribute (Latitude, longitude and elevation), supports import of basemaps and visualization in map, photograph and video recording capability and easy file data export, automatically transfer data into cooperate repository

The mobile app platform can be deployed to any smartphone or tablet irrespective of the operating system (iOS and Android). This application is built to support audit tracking (the ability to know which user entered and edited data), visualization of pipeline data such as license data, grade, outside diameter etc) in a tabular form when a line is highlighted, ability to narrow down search by filtering, data overlay(ability to visualize historical inspection results, enabled data sharing and easy migration of data into geodatabase.

This app is design to operate in both online and offline mode, due to the remote locations of pipeline, data connection and no GPS signal is very common, this app using the offline mode to display maps and navigate to the required locations.

The accuracy of the GPS using smartphone is relies on the quality of data connection, typically the accuracy of GPS data is within -+ 3-5 m. (9.8 – 16 ft.) in locations with good data connection. The visualization of basemaps helps to identify discrepancies and ensure measurement threshold when measuring GPS location along a pipeline or pipeline appurtenance.

Dashboard Map accessible via Web displaying assets symbolized by inspection status and real time integration and Data synchronization with cooperate asset database.

CHALLENGES OF FIELD DATA COLLECTION USING MOBILE APP

The use of mobile app has quite a significant advantage over the paper- based system however there are still challenges using this method to perform field inspections such as working in remote locations with limited or no data connection, Field Inspectors to readily available for change or not adapting to this method since most people would require on-going training till they get so comfortable with the app.

Working in remote location with limited or no data connection can be a huge challenge in identify pipeline location using the GPS map, in this situation its recommended to download a basemaps directly to your device and use them across multiple maps. Once you have your map offline, you can utilize the map in collecting and editing data, in the same way as when you're connected, as soon as there is data connection, the collected data automatically sync into the asset database.

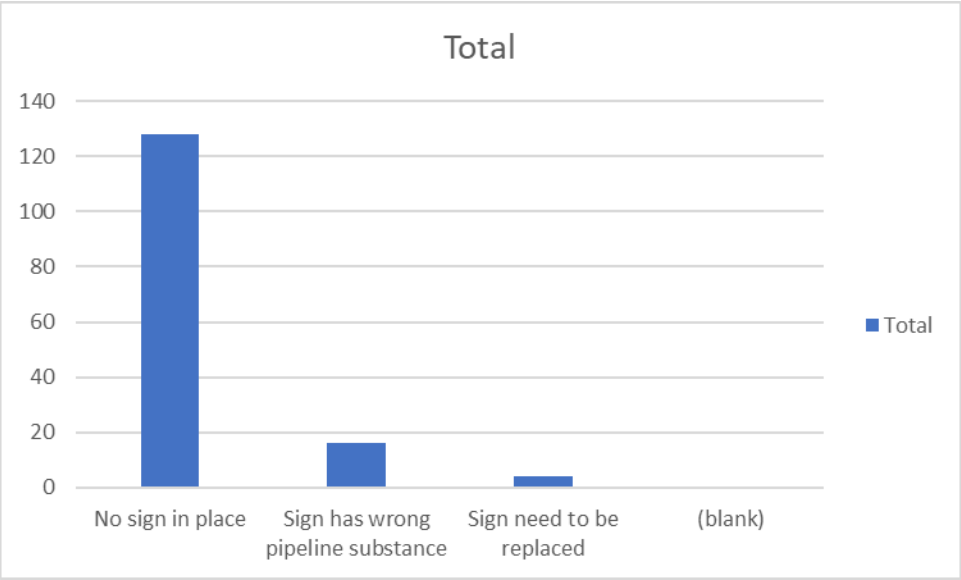
Due to the complexity of using the mobile app and continuous improvement, changes and application update, this requires on going training to field inspectors and data analyst

CASE STUDY OF PIPELINE SIGNS INSPECTIONS USING MOBILE APP

Upstream company conducted pipeline signs/crossing sign inspection for approximately 3,685 Kilometers length pipeline to ensure that all crossings signs are installed in the right location, properly labelled, identify missing signs and validate all existing signs with in the map and seamlessly transfer into asset database for immediate prioritization of the installation of missing signs and correction of inappropriately labelled signs in accordance to requirements stated in Alberta Pipeline Law Section 68 (1-8), Section 69,70 and 71 (1-5) are installed and labeled with the appropriate substance name and required details as per regulations.
Due to the changes in license substance, pipeline replacements, performing signature inspection is very vital to ensure that any changes to the pipeline is updated. Not to mention the remoteness of the operational area which provide its own challenges in a remote region in North Alberta.

Warning signs as part of safety precautions, missing signs or improper labeling could increase the risk of negative impacts. Proper identification is part of bringing awareness to unknown or seen assets such as pipelines. Proper company identification and emergency contact numbers are sometimes to first things general public or industry see. There for accurate reflection of this supports a company's support of their social responsibility. Documenting and ensuring 100% confidence in understanding your pipelines may seem like a small detail, but for a responsible operator this is just all part of normal operations. Ensuring compliance is just an outcome of diligence.

The result below shows the summary of locations without signage, signs with wrong pipeline substance and signs required to be replaced.



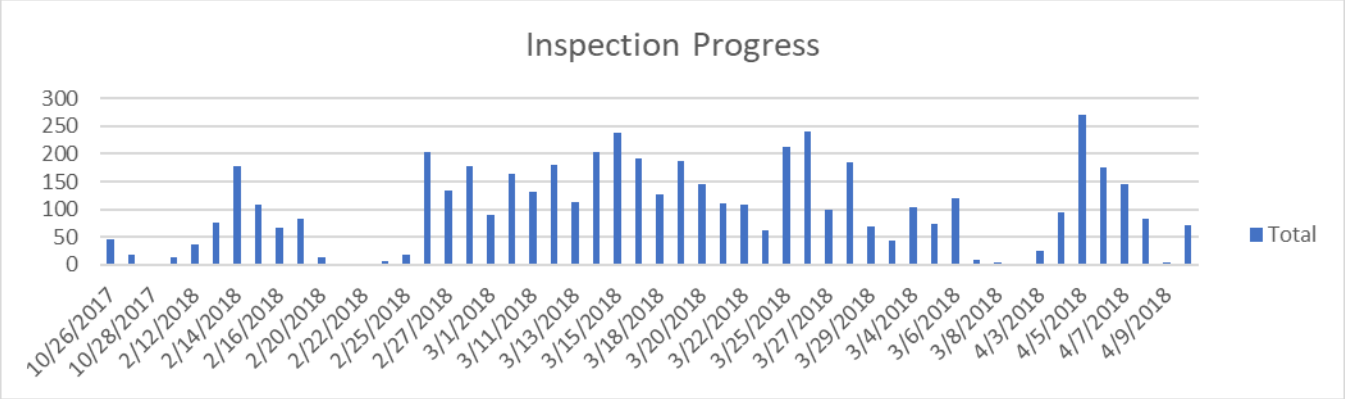
EFFECTIVENESS OF MOBILE APP FOR FIELD INSPECTIONS

Signs crossing inspection was perform on 3,685 Kilometers length pipeline, previous year report shows that this inspection was carried out using 750-man days with a 2-man crew of 5 people. The introduction of mobile field inspection app has reduced duration of this inspection activities and contributed to 60 % cost saving from previous years sign inspection. The efficiencies were increased by pre-populating potential crossing locations in a GIS environment. By doing this the validation not only accurately reflected all “potential” but it identified where past inspections missed where signage was required.

The 60 % efficiency was the one comparable component of this both in Cost as well as Time (effort). The one single factor that was not comparable was the value they now had in association of their inspection to a visually represented system, with digitized data to support it in a single database. The value allowed them to track all parameters of the inspection including pictures. It gave access to completed inspections instantaneously upon completion. Allowed for the tracking all completed, pass and failed inspections to ensure follow and closure of deficiencies. The basis for improving their process is now set, and even more improvements will be made as tangible evaluations can now be made.

The results speak for themselves!

Maximum number of inspections completed in a day is 270, approximately 7100 locations were inspected within 51 days = 250 man-days (2 crews of 2 people, 1 supervisor)



CONCLUSIONS

As outlined in this report the benefit of technology advancement to optimize resources using mobile app to perform pipeline field inspections. This development has recorded many positive feedbacks from different pipeline operators by different stakeholders using mobile app to conduct pipeline field inspection for operations and pipeline integrity program such as;

Asset Integrity engineers expressed satisfaction with the ability to tailor field inspection forms to meet project requirements, business needs and regulatory reporting and the timely availability of inspection data to support prioritization of immediate threats for integrity assessment.

Field Inspectors indicated that the use of drop-downs to select the appropriate data has helped to ensure consistent data reporting, minimized data recording errors, eliminated missing reports due to the automatic data transfer to the corporate repository. and timely availability of inspection data.

Data Analyst expressed satisfaction with the improvement in the quality of field inspection data, reduced time spent in data entry and issues with illegibility of paper-forms inspection report.

This development has recorded positive feedback and success with project cost savings, inspection resources and improved the accuracy of data in GIS database.
In conclusion, the use of mobile app for field data collection has significantly optimized cost, time and risk associated to field data quality.

The most beneficial outcome is all inspections are now easily repeatable, referable and accessible by any approved person to access the information. The client has confidence where they inspected and what was inspected though documentation, and most of all they have a list of deficiencies needing rectification to plan out. This represent continuous improvement with respect to ISO 9000

ACKNOWLEDGEMENTS

This paper is based on results, feedback from a Upstream Company in Alberta that utilized this app to inspect and validate their pipeline crossing signs. Findings and recommendations stated in this material are from the authors.

REFERENCES

1. ANSI/NACE SP0502-2010, “Standard Practice Pipeline External Corrosion Direct Assessment Methodology" (Houston, TX77084 USA)
2. Alberta Regulation 91/2005, with Amendments up to and including Alberta Regulations 244/2017 “Pipeline Act, Pipeline Rules” (Province of Alberta, Albert Queen’s Printer)
3. CSA Group Z662-15 (June 2015), “Oil and gas pipeline systems” (Toronto Ontario, Canada)
4. API 1169 (First Edition July 2013), “Recommended Practice for Basic Inspection Requirements – New Pipeline Construction” (Washington, DC 20005)
5. ASME B31.4-2016 (Revision of ASME B31.4-2012, March 31,2016), “Pipeline Transportation system for liquids and slurries” (New York, NY. 10016 USA)
6. Abacus Datagraphics “ Abadata”