RFID Centre of excellence

March 12th, 2009

Ore and Waste Tracking

Business Case Study

SHIP2SAVE OVERVIEW

Mandate
Our mission is to surpass our customers' expectations with our innovative and timely delivered solutions that can strengthen today's supply chain management systems with tomorrow's cutting-edge RFID technology.

History
Montreal (Quebec) based Ship2Save specializes in designing and implementing innovative RFID solutions for the Transportation, Warehousing, Mining, Sea freight, Retail, Consumer Product Goods (CPG), Aerospace, Oil & Gas and Automotive industries in North America. Ship2Save develops and deploys customized hardware and software systems that integrate into the customer's existing legacy systems while working with the specific industry standards of each customer's particular market niche.

Ship2Save's unique product lines, flexible and proficient software, business development models, and distinctive deployment services, offer our customers cost effective and high quality solutions to meet their operational goals and logistics requirements. Our onsite RFID research and development facilities provide warehousing and logistics services for the testing and deployment needs of every project. In-house experts validate all project aspects without disruption to the customer's normal operations. Subsequently, RFID deployment is accelerated while development costs are minimized, resulting in an overall clear improvement to our customer's bottom line.

Expertise
Ship2Save combines its experience and know-how to successfully accomplish all its projects with:

- 20+ years of hands on experience in supply chain management
- Focused, industry-recognized expertise in RFID technology
- Award-winning software development patterns and practices
- Renowned RFID experience on a multitude or projects, pilots and deployments
- In-house software development and system integration teams
- PhD-level project auditors and engineering team support

EXECUTIVE SUMMARY

This document outlines and describes an ore tracking project designed to reduce the number of occurrences of wrongful delivery of ore and waste material within designated chutes by mine operators. Operational mistakes such as the reduction of overall materials, and the loss of ore wrongly sent to waste disposal areas, directly impact the bottom line.

The objectives of the project were the following:

- To time-stamp and identify the incidence when ore or waste is introduced in the wrong chute, and to avoid contamination or loss.
- To introduce accountability of mine operators by determining operational deviation.
- Reduce costs associated to materials sent to the wrong area.
- Reestablish equivalence between the ore reserve evaluation and the percentage of sample grade at the mill.

To achieve these objectives, a RFID technology based asset tracking system will be introduced into the existing operational processes at the mine as described in this proposal.

The system is composed of pre-encoded RFID tags, antennas, readers and a customized middleware, and will capture tag readings going through RB1, RB2 RB5 Grizzly's, and LP3 conveyors at the moment the tag is dropped at the Grizzly.

These tags, encoded with a unique serial number, will indicate material provenance when read by a group of antennas. This unique identification information combined with operator assignment will give a clear view of when and who has misplaced materials.

In a process such as this, it is essential to have the right number of tags and antennas. Only then will enough valid real time information be obtained for proper measures to be taken to stop or reduce recurrent and costly occurrences.

Upon completion, the project will potentially generate a return on investment within three months merely by reducing the number of waste material misdirected into an ore chute.

It is expected that a speedy positive change of behavior of mine operators will result from the work accountability instilled by the RFID process in place. Additionally, an increase in ore grade evaluation will possibly be observed by the mills' sampling team. This will likely closely match or be greater than the total estimated value of the mine with each ore sampling, correlated with the rate of positive change in behavior of the mine operators.

The present ore tracking project requires major elucidation of various processes, and as such, the current document is presented at a greater level of detail than a standard proposal.

SITE SURVEY RESULTS

The following sections list Ship2Save's findings and understanding of the processes, equipment, and operations at the mine.

Operation Hours

- 24 hours a day, 7 days a week operation
- Administration staff works during the day shift; there is a lack of supervision during the night shift.
- Shift changes occur between 7:00 and 7:30 am / pm.

Pain-Points

- Muck misrouting. Waste is entering the ore stream and ore is being disposed of as waste. This misrouting can occur from one of the following:
    - Haulers are unaware of the muck type located at gobs, guess the type and treat it as such.
    - Haulers are intentionally dumping muck into the closer chute to increase their hauled tonnage (to increase their bonus).
    - Haulers working a development are unaware of the muck type, guess the type and treat it as such.
- Tonnage allocation. The mine needs to properly allocate the ore tonnage to one of the two main locations. There are dedicated ore bins. Ore from the wrong mine is being dumped into the wrong bin. This can occur because haulers are intentionally dumping muck into the closer chute to increase their hauled tonnage (to increase their bonus).

Mine Conditions

- Mine temperatures:
    - Max: 174° F (79° C)
    - Min: 60° F (15° C)
    - Average: 110° F to 140° F (43° C to 60° C)
    - Humidity: 50% to 70%
- Muck at one operation is relatively fine and soft (less than 2" in diameter)
- Muck at second location is large and hard (7" to 10" in diameter)
- Muck can be dry or moist

Processing

- Ore can be processed three ways:
    - Auto-clave circuit: For ore coming from the open pit
    - Roaster: For ore coming from underground
    - Heap-leeching: No longer used at The mine

Blasting

- Blast velocity moves at 6000 feet per second.

- Blasting is done twice a day; between 7:00 and 7:30 in the morning and evening (during shift changes).

Machinery

- Scoops:
  - Have built-in scales to measure tonnage.
  - 9.5 yard scoops are the largest in the mine. They hold about 9 tons of muck.
  - They also have 7.5 yard and 6.5 yard scoops. These hold about 7 and 6 tons of muck.
- Crusher:
  - 5% to 10% of muck passes through the crusher.
  - One fixed jaw and one oscillating jaw.
  - Reduces material to 2' x 2' dimensions. It has a screen to filter out smaller items from passing through the crusher.
- Rock breakers:
  - Five hydraulic breakers operate ,Each one has a 12' x 12' metal grate with 1' square holes.

Hauling

- Every 10th scoop has a sample collected for inspection.
- Hauling of ore to waste ratio is 8:1
- Worker calls into dispatch every 5 to 10 buckets
- Hauling can be done from a stope, development, or gob.

Forecast Accuracy

- A discrepancy of about 15% currently exists between what is forecasted to the mill and what the mill actually reports.

Software

- Pitram:
  - Developed by MicroMine.
  - Software used by dispatch to monitor haulage.
  - Uses SQL Server 2005
- Simplicity:
  - Uses SQL Server 2005
  - Software used to monitor hoisting.
- acQuire:
  - Developed by acQuire Technology Solutions Pty Ltd.
  - Used for forecasting and bolt hole management
  - Uses SQL Server 2005

Hoisting

- Production hoist is located at one location
- No direct hoisting at the second operation. Muck is extracted via truck through the portal or trucked to main location and hoisted through its production shaft.

RF Spectrum

- Known spectrum usages:
  - 2.4 GHz – WiFi communication
  - 125KHz – AeroScout Exciters
- There were no discernable interference in the 902 MHz to 928 MHz band at:
  - RB1
  - RB2
  - RB5
  - LP3

Tag Testing

- A tag (white pill form-factor) was tested onsite to evaluate its physical durability. The following three tests were performed in the specified order.
  - The tag was deposited into a muck pile. A 9.5-yard scoop picked up the muck containing the tag. It then dumped the muck and scooped it up again. Finally, it dumped the muck and spread it out. The tag was located and shown to be in almost perfect physical condition.
  - The tag was placed onto the ground and repeated run over by the scoop's front left tire. Again, the tag came out in almost perfect condition.
  - The tag was placed onto the ground and the scoop's bucket was lowered onto the tag and back-dragged. The bucket was angled downwards to maximize the weight placed onto the tag. In addition, the bucket was pushed downwards enough to lift the front wheels off the ground. Approximately 25 tons was pressing down onto the tag (the tag did not sink into the muck). The tag was back-dragged under these conditions for about 10 to 15 feet. The tag suffered moderate damage. The end plugs were knocked loose and the exterior encasement was heavily scuffed.
  - The tag did retain its original shape and was still readable by the RFID equipment.

PROJECT SCOPE

Objectives

- To identify the moment when ore or waste is introduced into the wrong bin in order to avoid contamination or loss.
- To identify operator deviation and retrain personnel if required.
- To reduce unnecessary material handling (misrouting) and processing in order to reduce loss of income.
- To regain equivalence between ore reserve evaluation and percentage of ore sample grade at the roaster.

Project Locations

In order to strike a balance between ease of installation (infrastructure) and proper process representation, it was decided to focus the pilot installation to four specific areas:

- RB1 ore
- RB2 ore
- RB5 waste
- LP3 conveyor

Hardware

The Grizzly locations is equipped with the following hardware:

- (2) RFID interrogator, UHF, Gen 2
- (8) Far-field RFID antennas, circularly polarized, high-gain
- (2) Uninterrupted power supply

The conveyor location is equipped with the following hardware:

- (1) RFID interrogator, UHF, Gen 2
- (4) Far-field RFID antennas, circularly polarized, high-gain
- (1) Uninterrupted power supply

The industry-leading RFID interrogator and antennas create a RFID 'portal' through which the RFID tags pass and are read. The UPS provides both power backup and 'dirty' power filtering.

All the equipment are contained in NEMA rated boxes to protect them from dust and water intrusion. The exception is the antennas mounted along the LP3 conveyor, which is not housed in a NEMA box (as exposure to water and dust is less). The antennas are attached to an aluminum assembly which is affixed to the ceiling.

In addition to the mentioned hardware, other equipment is also in place:

- (1) RFID enabled handheld computer, Windows Mobile 5.0
- (700) mining-specific RFID tags

The ruggedized handheld is used to create surveys and to associate RFID tags to the survey (more details in the following section).

The mining-specific tags are used to 'mark' the muck that they are deposited into. They act as a license plate linked to information such as their deposit location, deposit timestamp, muck type, read time, and read location.

All equipment have been subject to calibration and setup performed at Ship2Save's premises.

The mine operation is responsible for the following:

- LAN connectivity to the reader's NEMA box
- Power connectivity to the reader's NEMA box
- Physical mounting of the NEMA boxes according to Ship2Save's specifications.
- Physical mounting of the antenna assembly above the conveyor.

User Process

The proposed user process is as follows:

1. The geologist visits the stope or development before hauling starts.
2. Using the handheld, he enters the location and muck type. He scans five RFID tags to associate them to the survey. He saves the survey (the timestamp and his user ID are saved automatically).
3. The geologist strategically inserts the RFID tags into the muck piles.
4. The geologist repeats steps 1 through 3 at other locations.
5. The geologist takes the handheld to a Wi-Fi zone and uploads the surveys from the handheld using its wireless connection.
6. In the meantime, the scoops begin to remove muck (along with the RFID tags) from the surveyed locations.
7. As the muck is deposited into the RFID enabled bins, the RFID tags in the muck are read. The tag ID, reader ID, and timestamp are recorded.
8. When the muck is transferred out of the bins and moved along the conveyor at LP3, the RFID tags are read again. The tag ID, reader ID, and timestamp are recorded.
9. From a networked PC, the geologist can open a report and view the surveyed tags along with their current status.

Software - OMS

Ship2Save implemented their OMS (Operations Management System). The OMS allows for RFID device communication with a wide-array of compatible hardware. It also enables data collection and transformation of data into any form.

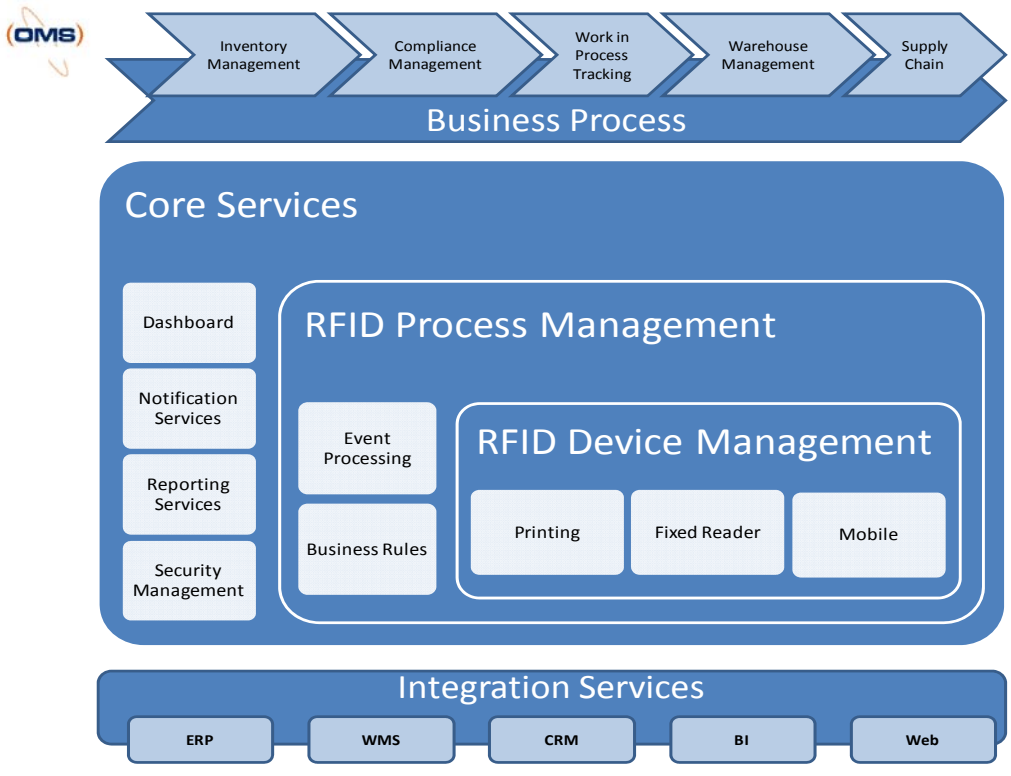
The key advantages of the OMS:

Robust: The OMS is based on the latest SOA concepts and is built on Microsoft .NET and BizTalk technology. It is designed to process a large number of enterprise-critical transactions in real-time.

Flexible: As a result of its open architecture, the OMS application easily adapts to any data type and to various communications protocols.

Modular: A wide range of specific functions can be implemented in the OMS by the quick addition of new modules to satisfy business needs like integration to ERP systems such as Microsoft Dynamics.

Secure: OMS fully integrates with your windows active directory and uses secure communication mechanisms.



Software Requirements

The OMS application must be hosted on a server with at least the following hardware and software specifications:

- 2.1 GHz dual core processer
- 2 GB RAM
- 30 GB available hard drive
- Windows Server 2003 Standard with SP2
- BizTalk Server 2006
- Active Sync 4.5
- IIS 6.0
- .NET Framework 3.5
- MMC 3.0 (BizTalk prerequisite)
- WSE 3.0 (BizTalk prerequisite)

In addition, we highly recommend that the server conforms to the following:

- No VPN tunnel, unless it allows broadcast pass-throughs.
- One IP assignment only.

If the server is unable to comply with the above requirements, additional development time may be required.

Financial study ROI conclusion and Impact

- For each ton of waste entering the ore stream, there is a direct $25 cost associated to the hoisting and roasting. The $25 does not include the lost value from the ore that the ton of waste displaced.
- For each ton of ore being disposed of as waste, there is a $100 cost for handling the material and approximately $220 (1 ton X 0.364 X $575) lost income per ton associated to ore misplacement.
- The total value of the mine reserve is less since the ore grade coming from underground is reduced by waste contamination caused by material mishandling. The total value could potentially be increased by 10% to 15 % (close to 150 million dollars).

Proven and Probable Reserves (at $575 per ounce)			
	Tons (000's)	***Grade (ounces/ton)***	***Contained Ounces (000's)***
Open Pit	***94,914***	***0.128***	***12,194***
Underground	***7,423***	***0.364***	***2,700***
TOTAL	***102,337***	***0.146***	***14,894***

Situation	**Ton**	**Lost**	**ROI Period**
Ore contamination 10% total daily tonnage for one heading	**100 to 200 per day**	**Between $2,500 to $5,000 per day**	**Between 48 and 96 days**
Ore misplacement	**.364X $ 575.= $209 per ton**	**$1500 per scoop**	**66 scoops misplacement avoidance**
Ore reserves	**10% underground book value**	**10% of 7,4 millions tons at grade .364 X $575= $155,000,000 in book value**	**Immediate for shareholders.**