

# A Material Movements Case Study

*MineCo has a small nickel/iron mine in a remote and rugged location. Their customers have very specific requirements for nickel and iron grades, applying heavy financial penalties for deliveries that fall outside those margins. However, MineCo's poor manual and spreadsheet-based systems were making it almost impossible to meet those targets. MineCo had the potential to increase income by millions of dollars, simply by improving the accuracy of its shipments.*

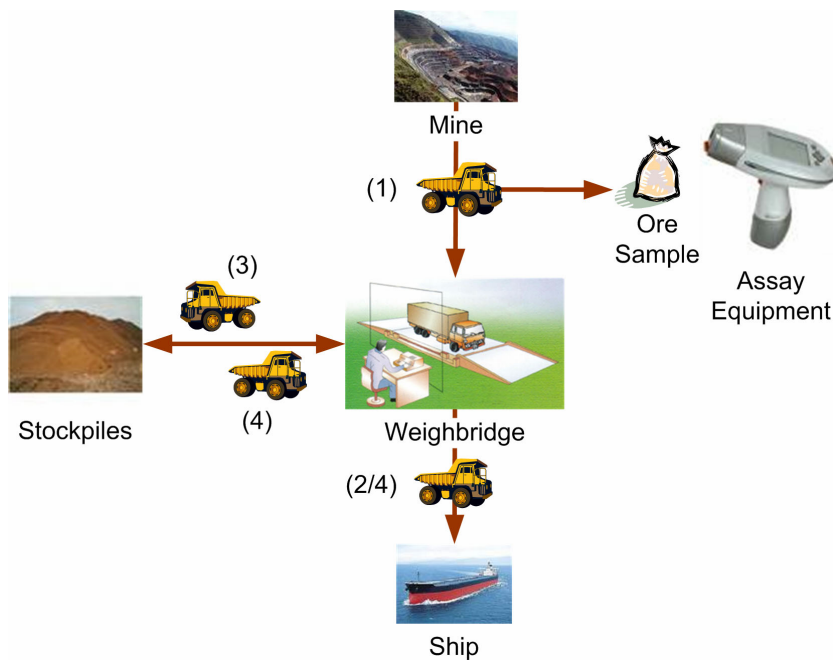
*A XempleX Material Movements solution improved both the quality and availability of ore grade and tonnage data, which lead to significant improvements in revenue for minimal outlay. This solution was tightly integrated with a variety of technologies and proved to be popular with users.*

## Introduction

*Inadequate management of material movements data led to financial penalties.*

MineCo has a small nickel/iron mine in a remote location in a poorly developed country. The environment is tropical, muddy, rugged and harsh. The infrastructure is poor, equipment is basic, and most of the workforce is poorly educated. Prior to the XempleX Material Movements solution implementation, many procedures were verbal- or paper-based, and relied upon multiple sources of sometimes duplicated manual data entry. Under these conditions, data consolidation, analysis and reconciliation proved to be time-consuming, difficult and unreliable.

MineCo's basic material movements between mine, weighbridge, stockpiles and ships are illustrated below.



*Figure 1: MineCo ore travels by truck from the mine to the weighbridge (1), with a sample taken en route for assay. From the weighbridge the ore may go to a ship (2) or to a stockpile (3). Stockpiled ore is transported by truck to the ship via the weighbridge (4)*

*The XempleX Material Movements solution enabled grade and tonnage information to be properly collected, shared and used.*

MineCo's customers have very specific requirements for nickel and iron grades in each delivery of ore. Heavy financial penalties apply for deliveries that fall outside the specified margins.

Unfortunately, poor material movements data collection and analysis methods meant that MineCo rarely met their targets, and so their income suffered.

MineCo had the potential to increase their income by millions of dollars for very little investment. A XempleX Material Movements solution ensured that ore grade and tonnage data were accurate, and that each shipload was blended according to the customer's demands. Each shipload was thus able to raise the maximum potential income for the company.

This paper describes MineCo's basic material movements operations from mine to stockpile to ship. The original procedures and their problems are contrasted with the new solution put in place by XempleX. The company name "MineCo" is an alias, but the project described in this paper was real.

## Sample Grading and Stockpile Assignment

*Laboratory workers would copy results by hand, consult wall charts and radio results on to the weighbridge.*

MineCo employs typical drill hole data and mine planning techniques that broadly predict the grade of ore coming from each location in the mine. However, each truckload of ore is also sampled and assayed in an onsite laboratory in close to real time.

Under the original system, the operator would read the assay results from the analyser equipment display, and then consult a wall chart to assign the truckload to a particular stockpile. There could be as many as a dozen stockpiles, each classified by their blend of nickel and iron grade ranges. The charts were complex, contained errors, and not always kept up to date.

The results of the assay were then sent by radio to the weighbridge. From there the driver was directed to either a stockpile or a ship for loading.

Truck-by-truck sampling creates many data points and an opportunity for accurate stockpile grade assessments, but only if the data is managed correctly. Because the manual system failed to match grade and weight information in a timely or accurate fashion, all this raw and potentially useful information was not available for general use.

Stock levels and grades were instead assessed using land survey techniques and stockpile sampling. Thousands of truck sample and weighbridge results were wasted, replaced by a few samples much less likely to produce an accurate picture of a stockpile's overall grade and size.

*Data was not used to its full potential.*



*XempleX collected grade data directly from lab equipment and then generated a stockpile assignment.*

XempleX developed a solution to transfer grade information from the mineral assay equipment to a database, ensuring an electronic record of all assays. Most importantly, the system also replaced the manual chart lookup system by recommending the appropriate stockpile for that truckload. This automated stockpile assignment process ensures that no additional charts or staff training are required when new stockpiles come on line.

The next section describes the integration of weighbridge information.

## Weighbridge Operations

*Weighbridge data was difficult to translate into stockpile levels.*

The weighbridge holds the key to the tracking of material movements. It is the weighbridge operator who records truckload movements from mine to stockpile, from stockpile to ship and from mine directly to ship. At MineCo the weighbridge is in a different physical location to the assay laboratory, so data about truckloads from the mine needs to be consolidated with sample grade information.

MineCo was recording all of this information on slips of paper which were later hand entered into a spreadsheet for a laborious consolidation process. Paper slips were often lost or damaged, and data accuracy became a serious problem.

XempleX interfaced directly with the weighbridge system to record all truck movements and their weights in the solution database.

*XempleX integrated grade and weight information.*

This provided a real-time overview of all stockpile levels and progress on ship loading. Assay data from the laboratory was also integrated into the movement records of trucks coming from the mine to produce a running grade and tonnage for each stockpile or shipload.

In the rugged environment of the MineCo site, the weighbridge would sometimes become unavailable due to mechanical failure or a backlog of port traffic. In such situations the operator used to estimate the load weight based on the truck type and capacity.

The XempleX solution standardised and automated this process by substituting a controlled truck capacity figure as the load weight when required. This ensured that all estimates for any given vehicle type would be consistent with each other, and clearly flagged as such in the database.

## Ship Loading

*The mine's entire ship blending process depended upon a single poorly designed spreadsheet working from questionable data.*

The ultimate goal of MineCo is to ship quantities of ore that have the precise nickel and iron grades as ordered by the customer. Each ship is typically supplied from a blend of four to seven stockpiles as well as direct mine feeds. Ideally, the sources should be blended to even out the overall composition of the shipload

Ship loading thus requires an alternating schedule of truckloads from multiple sources to obtain a particular result, plus a method to track the progress of the loading exercise.

MineCo was trying to use an in-house spreadsheet to calculate the loading schedule for each customer's shipload.

The spreadsheet itself was not based on a goal-seeking algorithm but simply calculated a blending outcome based on user inputs. The operator would have to approximate a solution by guessing a combination of tonnages from up to seven stockpiles, and then tweak the numbers until an acceptable result was achieved.

The number of variables involved made this planning process extremely inefficient, and it often failed to produce a plan accurate enough to deliver the desired results

Any change to production conditions such as the addition of a new stockpile would require significant effort to update the spreadsheet, and only the spreadsheet author was capable of the task.

Even had the spreadsheet-based plan been adequate, MineCo lacked real-time tracking to monitor the progress of ship loading. Without reliable stockpile levels it was not known whether the ore of that grade was actually available or yet to be mined. Even if quantities of stock were known, the reliability of stockpile grading system was in question. Any plan based on this process and data would struggle to be trustworthy or useful.

In addition, local conditions could make individual stockpiles inaccessible at short notice. This means that plans often need to be updated at short notice in the middle of loading, and the spreadsheet was unable to do that.

An inflexible and inadequate spreadsheet based on unreliable source data could not hope to service MineCo's needs, nor those of their customers.

*Stock levels and loading progress were unknown.*



*The XempleX solution ensured the quality and availability of data, and offered useful reporting and analysis functions*

The XempleX Material Movements solution addressed all of these issues:

- All data were stored and distributed electronically.
- Grading and stockpiling methods were improved by a systematic stockpile grade assignment process.
- Ship loading schedules were developed using automated goal-seeking algorithms.
- Stock levels and the status of each shipload could be monitored continuously through improved material movements tracking.
- Schedules could be adapted mid-way through loading, based on ore availability and ship loading history.

## About the XempleX Solution

*High user acceptance, easy deployment, easy extension, immediate results.*

The XempleX solution was deployed to MineCo with minimal disruption to ongoing operations. It was tightly integrated with a variety of existing technologies such as the mineral analysis equipment and weighbridge systems.

The new systems were popular with staff at all levels. They found the new procedures easy to learn and follow, and could appreciate the immediate benefits. New screens and data input forms used simple and familiar Windows controls, and each operator saw only those specialist parts of the system they needed to use.

The service-oriented architecture had extremely modest hardware requirements, easily managed in the remote terrain for minimal cost. Even though the PCs on the MineCo site were not networked, the XempleX solution was adapted to use alternative data sharing methods.

The XempleX Material Movements solution was easy to implement and deploy, and can be gradually extended to take on more functional and reporting requirements. For example, a XempleX production costing or Key Performance Indicator (KPI) reports solution would integrate tightly with material movements and mine planning data to form an end-to-end solution for mine business planning.

MineCo plans to expand their XempleX solution, and also use it on other sites.

XempleX solutions of any scale can be tailored to almost any business or technology.

*Solutions for any business.*



## Contact

To find out more about XempleX solutions, or if you are interested in becoming a XempleX consultant, contact:

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