TRACKING APPLICATIONS IN MINING AND MINERAL PROCESSING – CASE STUDIES

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ABSTRACT

Traceability has long been a fairly common requirement in industry, and with the increasing focus on quality and compliance, it is becoming more important. Traditionally well-defined forms of tracking (for example, warehouse stock control , tools tracking, asset tracking, etcetera) are well serviced by existing classes of applications and relatively easily implemented. Where the tracking application requires an interface to plant control systems, the solutions delivered are usually implemented with a combination of existing products, systems integration efforts, and some software development.

This paper looks at a number of tracking projects implemented, the business benefits delivered, and the approaches taken to delivering such solutions. This is followed by introducing a new approach that is being applied to these types of projects, and the applicability of this approach to broader tracking opportunities in the mining and mineral processing industries – particularly where integration with control systems is required.

RESUMEN

La trazabilidad ha sido durante mucho tiempo una exigencia bastante común en la industria, y por la creciente atención en la calidad y el cumplimiento, cada vez es más importante. Tradicionalmente bien definidas las formas de seguimiento (por ejemplo, el control de existencias de almacén, herramientas de seguimiento, seguimiento de activos, etc) son bien atendidos por las clases existentes de las aplicaciones y relativamente fácil de implementar. Cuando el seguimiento de la aplicación requiere una interfaz con sistemas de control de la planta, las soluciones son generalmente entregados a cabo con una combinación de los productos existentes, los esfuerzos de integración de sistemas, desarrollo de software y algunos.

En este artículo se analiza una serie de seguimiento de los proyectos ejecutados, la empresa los beneficios entregados, y los enfoques adoptados para la prestación de este tipo de soluciones. Esto es seguido por la introducción de un nuevo enfoque que se aplica a este tipo de proyectos, y la aplicabilidad de este enfoque más amplio a las oportunidades en el seguimiento de la minería y las industrias de procesamiento de minerales - especialmente cuando la integración con los sistemas de control es obligatorio.

INTRODUCTION

VRT Systems is a systems integration company that specialises in integration projects in the space between control systems and business systems. Our industry exposure includes intelligent transport, manufacturing, defence, utilities, and resources; with a special focus on mining and mineral processing. In terms of application horizontals, we have capabilities in energy management, Supervisory control (SCADA), MES, "Track and Trace" and business systems integration.

Although VRT have been involved in a broad range of tracking projects, in a wide variety of industries, the greatest exposure to track and trace in a specific industry has been developed through a relationship with Xstrata that began in 1990 (then Mount Isa Mines), with the implementation of various production and utilities management systems in Mount Isa. This later spread to the implementation of manufacturing execution and tracking systems at the Copper Refineries in Townsville, and later to a technology partnership with Xstrata Technology to deliver tracking solutions to licensees of Xstrata Technology's "Isa Process" (reusable stainless steel cathode plate) technology.

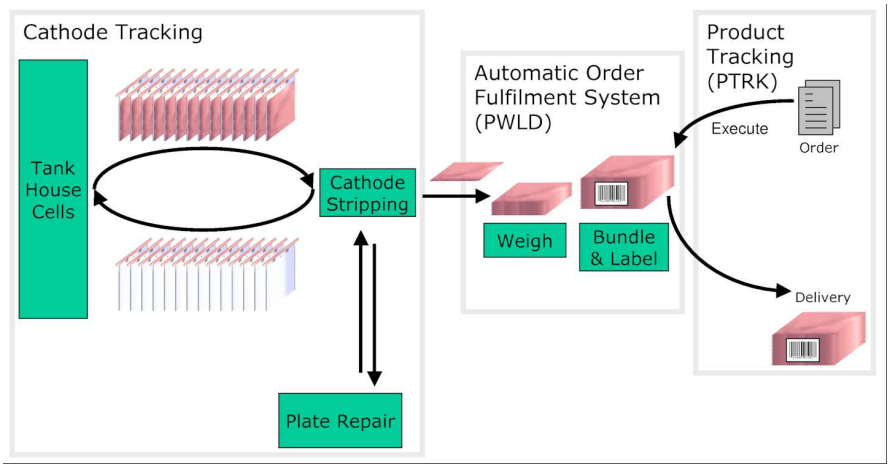
METHODOLGY

This paper presents case studies on a series of systems implemented within a single plant over the period of a decade. At the core of each of these systems was an identification technology, a requirement to provide track and trace functionality, and a need to integrate with the plant control system. The requirement for plant-specific control systems integration often leads to the delivery of systems use that integrate existing technologies, combined together in a bespoke solution.

The paper reviews the basic scope, design goals, implementation and benefits for each project, and then looks at the development of a general-purpose platform that is now being used to deliver a wide range of projects with similar characteristics. The benefits of this new approach are discussed, and its wider application in the mining and mineral processing industries is explored.

RESULTS AND DISCUSSION

Following are case studies on the implementation of three separate tracking applications within a single plant and Xstrata's Townsville Copper Refinery. In 1997, as part of a tankhouse expansion, CRL engaged with VRT to implement a product weighing, loading and dispatch system using bar code technology, and integrated with their cathode stripping machine controllers. In 2000, a pilot system was developed to extend the bar code tracking of copper product beyond the point of despatch and out into the extended supply chain. In 2004, VRT were again approached this time to assist in the development of an RFID-based cathode tracking system to track cathode plates in-process. The relationship between these three systems are summarised below in Illustration 1: Scope of (and relationship between) tracking systems.



Ilustration 1: Scope of (and relationship between) tracking systems

Case Study – Automatic Order Fulfilment System

Requirements

The scope of the Automatic Order Fulfilment System is "Product Weighing, Labelling/Loading and Despatch" (PWLD). The scope of its functionality can be summarised as follows:

- Receives customer orders from the sales system
- Executes orders
- Batch control
- Assembles bundles to order
- Weighs bundles
- Labels bundles (bar code)
- Prints sworn weigh certificates
- Updates business systems
- Despatch
- Product Accounting System
- Freight Management System

The goals of the design team can be summarised as follows:

- System must be capable of fully automatic operation.
- High levels of inbuilt redundancy (to enable high availability)
- Maximises use of industry standards and existing products (COTS) where possible
- Include facilities for data entry and operator override
- Must be easy to use (and accessible from stripping machine control desk)

System Overview

The system was implemented through the integration of a number of existing hardware and software components:

- Xstrata Technology CSM (Cathode Stripping Machines)
- Mesco automatic weighing system

- Allen-Bradley PLC's
- Rockwell RS-View SCADA and database middle ware (RS-SQL)
- Oracle database and programs
- Allen-Bradley DH+ and Ethernet TCP/IP
- PC's and Microsoft Windows Operating System

An overview of the system architecture is provided below in Illustration 2: Automatic Order Fulfilment System. [2]

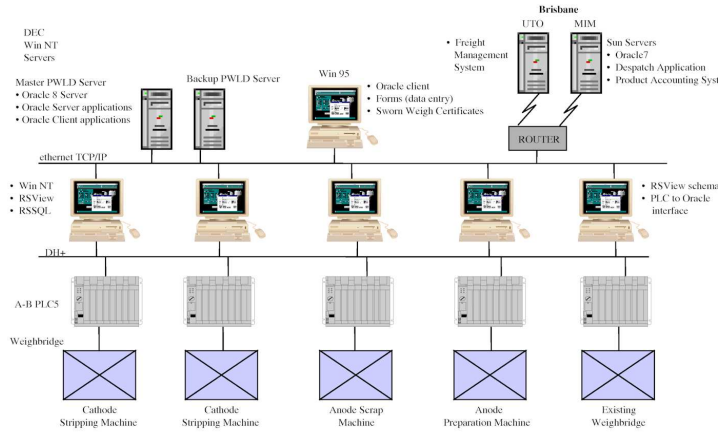


Illustration 2: Automatic Order Fulfilment System

Benefits

Some months after the system was commissioned, a post-implementation review study was performed to quantify the benefits of automating the operation of their product weighing loading and despatch operations. The findings of this study claimed the following benefits:

- A 50% reduction in labour (over existing weighing, loading, and despatch operation) resulting in a saving of approximately $500,000 (AUD) per annum.
- A 33% reduction in the forklift fleet, lading to savings of approximately $150,000 (AUD) per annum.
- A once-off inventory reduction exceeding $6.3 million (USD).

It was estimated that the implementation of this automation project resulted in savings to the overall refinery operating expenses of over 2%.

Case Study – Product Tracking System

In the year 2000, the Copper Refinery requested a Pilot System to evaluate the benefits of extending product tracking further down the supply chain. Despite this being only a pilot system, it proved useful and remained in service for a number of years. A replacement (production-ready) system is currently being scoped to replace the pilot system.

Requirements

The scope of the system can be summarised as follows:

- Track groups of bundles

- Despatch advice to customers
- Movement Table – contains expected receipt dates at various transport nodes
- Location as of last scan
- Reports:
  - Inventory
  - Work-in-Progress
  - Overdue
- Reconciliation of freight account

Design Goals:

- Data replicated in scanner and central database
- Automatic data uploads
- Supports end and intermediate nodes
- Operator data entry and override
- LAN, dial-up and wireless connections
- Data transfer authentication

System Overview

- Industrial, high power laser scanners
- Oracle central database
- XML format for data communications

Benefits

- Managing WIP – $120 to $170 million (USD)
- Reduced inventory (US$1.5M for each 1% reduction)
- Reduced delays
- Improved security by way of faster detection of losses
- Daily reconciliation is possible
- Time saving in monthly reconciliation and resolving discrepancies
- Improved freight account payment – reduced labour, improved accuracy
- Manage supplier performance – contract reviews
- Accurate despatch advices allow improved production planning by customers

Case Study – Cathode Plate Tracking

In the year 2004, Xstrata Technology approached VRT about the possibility of using RFID technology to track reusable cathode plates within the tankhouse. This is a closed-loop application in that the plates and ID tags remain within a closed environment.

Requirements

Scope:

- Individually Identify each cathode plate.
- Identify separate batches (generations of plates)
- Track cathode through whole of life – asset life-cycle.
- Track cathode to cell level.
- Measure cathode performance.
- Analysis and reporting top assist in process improvement.

Design Goals:

- Durable to plant conditions – bar code and other ID schemes have failed in the past.
- 100% (or close to) read reliability
- Flexible solution – Xstrata Technology are seeking to package this and offer it as part of their "Isa Process" range of technologies. End-User plants vary in terms of configuration, control methodologies, and control systems equipment.
- A packaged a solution – not out of the box, but an integrated set of tools to tackle RFID (and other) tracking projects with a need for systems integration.
- Offer flexibility in tracking – reconfigure to different plant layouts, offer off-site tracking, despatch, receipting etc.
- Offer flexibility in control systems integration.
- Easily supportable – effective remote support.

System Overview

The project began with trials of RFID tags, readers, and casing materials. Once proven the focus shifted to developing a tracking application to meet the stated requirements. The results of the RFID system development is the subject of another paper [1] and so this paper will (as has been done for the two previous case studies) look at the technology integration issues and benefits.

The approach taken with the platform design was to identify applications that could offer the required functionality, and "pre-integrate" them into a packaged solution that is easily adaptable and can be integrated into client plants relatively easily.

- To meet the requirement for flexibility in tracking, we identified a warehouse management and logistics application. This can model the locations in a warehouse and in a supply chain, track many hundreds of thousands of items, of thousands of different product types, in many and varied packaging and storage methods. A warehouse is laid out in terms of areas, aisles, bays and shelves, whereas a refinery tankhouse has aisles, sections and cells.
- To meet the requirement for flexibility in control system integration we selected a Supervisory Control and Data Acquisition (SCADA) software package. This includes drivers for a wide range of control systems, a historian, and an event manager.
- To allow flexibility in the types of tracking applications that could be developed, a web-based application framework was selected.

The software integration focussed on uniting the various software applications around a common database, and providing interfaces to allow the applications to communicate. An overview of the approach is shown below in Illustration 3: Software Integration Approach.

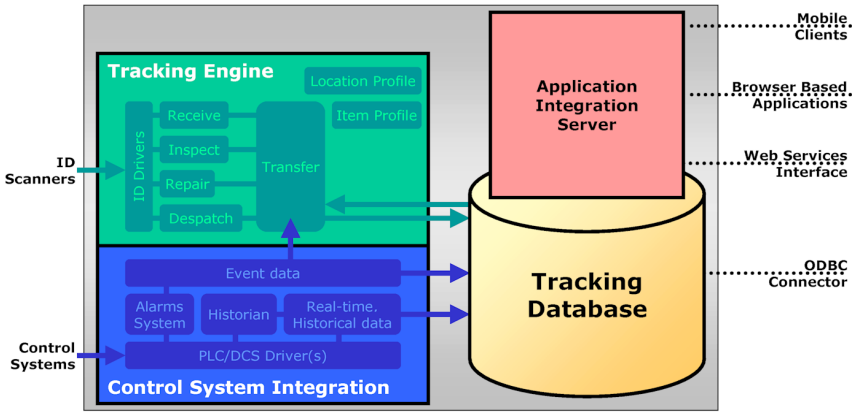


Illustration 3: Software Integration Approach

These components were then integrated together around a common tracking database. One concern when integrating products like this is that software vendors are constantly upgrading, and any effort to provide tight integration is jeopardised in future as vendors upgrade products and stop supporting old versions. To overcome this, OEM arrangements were agreed with the vendors that offered options to software source code and stable configurations. Software was also selected to offer a reduced license cost, greater freedom of deployment, and greater options for support (I.e. Not tied to a single vendor). The result of this work is that we are now able to offer clients a tightly integrated tracking solution, in an industrial hardware "appliance" form factor:

- Industrial PC - "headless" configuration (mount in electrical switchboard, no keyboard, mouse or monitor, access via web browser)
- Fan-less cooling system and solid-state industrial "flash" disk
- Field-swappable hardware (a common "firmware" image can be swapped between units)
- Small footprint (small in size, low-power, low maintenance)
- Proven "LAMP" application stack (In this case, GNU/Linux, Apache, PostgreSQL, PHP).
- OEM SCADA system (MacroView). Existing communications drivers for a wide range of PLC and DCS systems.
- OEM warehouse and logistics application, ported to Linux. Existing drivers for RFID Readers, Bar code scanners, Bar code printers.
- Web based application framework – used application delivery, and to enable web services and XML-based (SOA) integration with business systems.
- Modular, distributed architecture – multiple tracking applications hosted on one unit, a single tracking application distributed across multiple sites and units, or anything in between.

A typical RFID tracking system based on the industrial appliance is shown below in Illustration 4: RFID Cathode Tracking System.

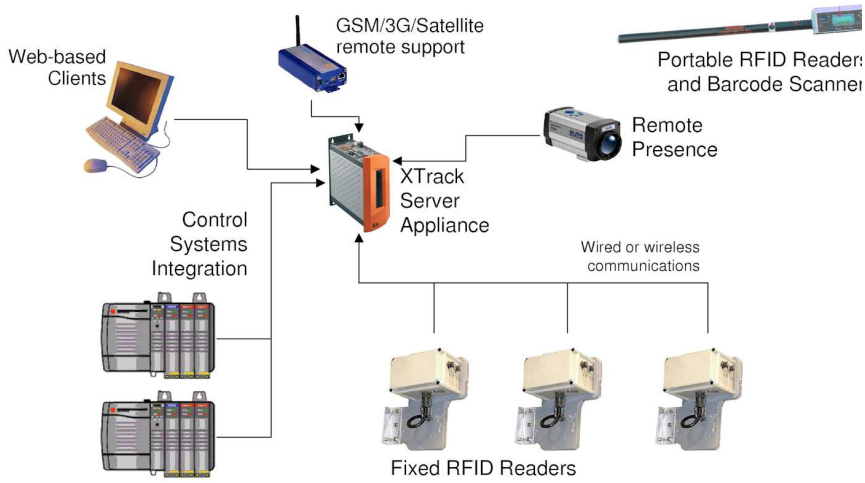


Illustration 4: RFID Cathode Tracking System

CONCLUSIONS

The case studies presented here illustrate some of the potential benefits that can be achieved through the improved tracking of stock and assets. The requirement to deliver a tracking application that can be readily adapted to a range of plant and control system environments has spurred a fresh approach to the implementation of these systems. The development of this "pre-integrated" tracking solution now makes the implementation of a wide variety of track and trace a much lower-risk and lower cost that alternative approaches.

ACKNOWLEDGEMENTS

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NOMENCLATURE

COTS – Common off the shelf (Software)
CSM – Cathode Stripping Machine
DCS – Distributed Control System
DH+ – (Allen-Bradley) Data Highway+, a network standard for control systems.
LAMP – A reference to an Internet technology stack used to deliver web-based applications to an end-users web browser.
MacroView – A brand of SCADA software.
MES – Manufacturing Execution System
PLC – Programmable Logic Controller
RFID – Radio Frequency Identification
SCADA – Supervisory Control and Data Acquisition (System)
SOA – Services Oriented Architecture, an approach used for business systems integration.

REFERENCES

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