

SmartPlant[®] Enterprise for Metals and Mining

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1. Introduction

The production and transportation of raw materials around the world continues to increase in-line with global market expansion. Long-term demand continues to grow, especially in emerging markets. Supply of raw materials is often restricted due to project complexity and remote project location. Costs are increasing. These issues present difficult challenges to the industry and are a primary reason that market supply is unable to keep up with long-term demand. The industry must pursue new and improved methods and technologies for meeting these critical challenges to close this gap.

The metals and mining industry provides basic raw materials such as iron ore, steel, copper, aluminum, and potash to major sectors of the world economy, including automotive, consumer goods, agriculture, construction, and electronics. The process of getting the raw materials into the hands of end-users presents formidable challenges to the industry – from mining to materials handling, mineral processing, piping, de-watering, smelting, and refining.

The construction of facilities is logistically challenging and quite expensive. Delays and mistakes in materials management send costs skyrocketing. Metals and mining operations often present unique challenges, with harsh conditions in remote locations.

Metals and mining facilities are increasingly complex and large in scope, with mega-projects becoming the norm. There is the logistical problem of transporting heavy raw materials involved in bulk materials handling. Equipment and labor shortages drive costs higher. In addition, there is a growing demand for enforced safety standards.

Managing global spare parts for sites that carry redundant inventory is a challenge. And after construction, process facilities require a high degree of maintenance, so it is critical to have accurate “as-built/as-operated” drawings and data on all equipment in use in the facility.

To extract and process ore and minerals from some of the largest operations in the world requires that facilities for mining, materials handling, processing, and transportation be designed and constructed with greater efficiency and quality. Mining companies are looking for assurances that their projects will be delivered efficiently and within budget and schedule. What is needed to accomplish all of this today is a plant automation solution that provides true workflow-managed integration between the engineering design basis and detailed engineering disciplines – including materials management and field construction. Intergraph® products for the metals and mining industry are designed to help meet these challenges.

2. Improved Delivery of Mining Projects

2.1. Intelligent 3D Design for the Bulk Materials Handling Industry

Intergraph Smart™ 3D enables the design of materials handling systems in a variety of global industries. Smart 3D addresses the challenge of designing and modeling bulk materials handling systems, such as belts, conveyors, and transfer chutes in mining and other conveyor-intensive industries.

Smart 3D helps users design bulk material handling systems and then keep them as-built. The solution offers comprehensive piping, HVAC, electrical raceway, structural, plate work, and mechanical equipment modeling tasks, as well as a specification and catalog manager and a project administration environment.

Smart 3D provides an innovative solution for designing bulk material handling systems through an integrated environment that removes the need for multiple design systems. Smart 3D consolidates the design of surface and underground material handling systems into a single application for a variety of applications, including:

- Belt and conveyor layout.
- Truss and gantry layout.
- 3D modeling and visualization.
- Detailed construction and fabrication drawings.
- Reports.
- Intelligent design modifications.

Another key feature is the ability to design and model sections of the system once, save them to a catalog, and reuse the design on future projects.

Intergraph developed the solution with direct feedback and engagement from some of the leading materials handling system design companies from around the world.

Smart 3D introduces new technology to the industry, with enhancements in:

- Engineering data and design reuse.
- Automated deliverables.
- Modular design and construction.
- Global worksharing.
- Improved management of change across disciplines.
- Standardized specifications, catalogs, and components.
- Visualization of complex designs.

The solution takes advantage of Intergraph's proven technology adopted from successes in similar engineering industries. This technology and its track record of success will help shift the bulk materials handling industry toward best practices seen throughout the global engineering industry.

2.2 System Improvements

Informed decisions can be made early in regards to system design by reviewing the model with the owner at defined stages during design. The model can be quickly and easily changed, based on information coming from these reviews. As the model changes, content for bill of materials and drawings will automatically be updated. This ensures that both the engineering contractor and the owner can make the best possible decisions.

2.3 Process Changes

Improved technology enables improved business processes. Previously, the creation of drawings was the driver to create the 3D model, if a 3D model was actually ever created.

With the change in technology, the 3D model is the source for drawing creation. Drawings become an output from the model, specifically fabrication-level drawings for engineered objects, such as transfer chutes and truss sections. This is a significant improvement over traditional work processes where drawings are created first and modified prior to handing them to a detailer to create a 3D model.

Smart 3D enables you to make and review changes faster in the 3D model before you generate any drawings. This saves significant time, money, and effort throughout the design process. Smart 3D provides:

- Data-centric technology.
- Rules- and relationship-based architecture.
- Automation and data reuse approach.

Smart 3D offers the metals and mining industry the opportunity to implement complex engineering projects in an integrated, data-centric framework. Both engineering contractors and owners can realize significant benefits, such as:

- Access to state-of-the-art engineering technology.
 - Data-centric design, which means deliverables (MTOs and drawings) are created as reports of data that is contained in the database; the application itself is CAD-neutral. All data is stored in the database for later consumption as a report or other deliverable.
 - Enable the front-end loading (FEL) of data to estimate preliminary design, layout, and schedule.
- Design standardization and modularization.
 - Reduce procurement costs through volume purchasing.
 - Faster startup on future projects through catalog reuse.
 - Optimize construction costs through modular construction.
- Optimized drawing generation.
 - Automate construction drawings by “extracting” them from the 3D model.
 - Modifications to drawings simply means re-extracting them from updated information in the 3D model.

2.4 Data Reuse

Intergraph's solution gives you the ability to design and model in 3D and save portions of the design to an intelligent catalog. This catalog can then be reused on other projects – benefiting both the owner and the engineering contractor.

Not only does this positively impact future project costs, but it also greatly reduces project timelines through better engineering data management. The opportunity to “learn” from other projects and apply this knowledge in the future is a marked improvement over existing design systems.

2.5 Modular Design, Assembly, and Construction

Most of the easily accessible mining projects have long been discovered, which leaves the more difficult geographic locations for new project development. Many of the high-quality ores being discovered today are found high in the mountains or in remote deserts, or in other remote locations which are difficult to reach, difficult for workers, and difficult for transporting heavy construction equipment. Sometimes the right labor force is in a different part of the world.

The industry has developed a cost-effective method for solving these problems through modular construction, whereby modules are fabricated in various controlled locations, transported to the project site, and assembled. This provides an effective way to achieve significant cost savings. Intergraph solutions provide tools for performing design and construction of modular systems by allowing an engineering contractor to organize designs by module within Smart 3D and to create construction work planning packages by module with SmartPlant® Construction.

2.6 Standardization across Projects and Contractors

Large mining projects often involve many different engineering, procurement, and construction (EPC) companies that are contracted to work on various parts of the project. It is critical that engineering information coming from each of these contractors follows a consistent standard. This is important for quality and cost control. Standardized, intelligent electronic catalogs that contain specifications, equipment and other components, drawing standards, formats for reporting, and many other elements are essential for proper control of complex projects.

Having a standardized method for capturing, storing, and using catalogs and specifications across all projects is important. Cost, schedule, and quality improvements can be realized through a central storage and retrieval method. SmartPlant Reference Data (SPRD) will allow a company to have a central repository for catalogs and specifications, and will output the specifications in a variety of formats, ready to load into 3D systems such as PDS®, PDMS, and Smart 3D. Once these standards are established within the central repository, they can be provided to subcontractors to ensure that all models, regardless of who is doing the work, adhere to the same standard. This promotes standardized deliverables (drawings and reports) and enables standardized commodity codes to be used for procurement. There is great benefit to this approach and opportunities for cost savings (through centralized bulk material purchasing) and quality improvement (through automated enforcement of standards).

Intergraph can also provide industry-standard catalogs and specifications that plug directly into SPRD, called the Standard Database (SDB). The SDB comes with its own comprehensive commodity code numbering system and a large variety of catalogs and specifications, based on industry standards, ready to use on projects.

Many companies realize faster project startup with this type of standardized approach. They can choose the project specifications from their standard repository and very quickly load their 3D design systems for a faster startup.

2.7 Multi-office, Global Worksharing

One of the key issues that can create problems in project execution is a lack of consistency for sharing and managing work across engineering disciplines, across multiple offices within a company, and across multiple subcontractors. One of the best ways to improve project quality and increase execution efficiency is to improve communication across the organization. SmartPlant Enterprise solutions provide better worksharing and collaboration through their data-centric architecture.

Smart 3D supports the sharing of work globally, which delivers large projects with more flexibility, faster, and with better productivity. Engineering disciplines work together – from a single shared database. True global worksharing is now a reality.

With Smart 3D, new satellite offices can be brought online in hours. The solution offers flexibility by enabling companies to use project resources from anywhere in the world. More engineers can be added quickly when needed by the project. Engineers can work productively from around the globe on a given project, which shortens project schedules and saves on labor costs.

3. Managing Information within Complex Metals and Mining Facilities

Engineering data is a critical asset, and its value increases over time. At each stage of the workflow, more information is added, refined, and linked. Smart 3D provides true workflow-managed integration. The multi-discipline environment is “intelligent” and rule-based. It “understands” the many object relationships that exist within the plant model, and can therefore maintain design intent as changes occur.

In a mining project workflow, initial process flow diagrams outline the preliminary processing method to be used. From there, the project is separated into functional boundaries; e.g., materials handling system, mill process, de-watering plant. These are further divided into functional areas. For example, the mill process would be divided into crushing/screening, SAG mill, ball mill, flotation cells/heap leaching, and so forth.

Each of these functional areas is then detail designed by engineering and approved by the owner. As the functional areas are detail engineered, the volume of information grows exponentially to include engineering details needed for the design and construction of the plant, as well as operating information for each component. This information is critical for commissioning and ongoing plant operations.

Ultimately, all information used for plant design, construction, and commissioning is transferred to the plant owner who uploads it into the operating and maintenance systems to be used throughout the plant life cycle. The data now includes:

- Drawings of the entire plant.
- Tag numbers to identify components.
- Isometrics of piping runs.
- Maintenance recommendations from original equipment manufacturers.
- Operating instructions.
- Manuals.
- Thousands of other pieces of information in a variety of formats.

Intergraph’s powerful SmartPlant Foundation serves as a comprehensive electronic library for the entire life cycle of the plant. It houses the facility’s design and modifications, basically managing the configuration from design to decommissioning.

3.1. Faster Commissioning

Systems completion and commissioning covers the process of taking a project from construction closeout to operations. Every component of the facility must be checked to validate that it is built and installed correctly and functioning properly. Systems and equipment are tested to ensure that they perform as expected. Any defects must be recorded, repaired, and rechecked, and the process is tracked to ensure nothing is overlooked. Fluids and power are introduced to bring the facility online.

Startup is known to be one of the riskiest aspects of operations and proper precautions must be followed. Managing systems completion well can reduce risk, shorten time to market, and improve time in production. Proper planning, up-to-date statuses, accurate information, and well-coordinated activities are essential to delivering the project on schedule.

Intergraph SmartPlant Enterprise for Owner Operators (SPO) Systems Completion Solution provides the tools you need to help you be successful on your next project. It leverages the engineering design basis

that is created during design. This ensures an updated, complete, and accurate design basis for completions and commissioning.

Mechanical completions and static commissioning check sheets, punch lists, and certificate templates are included to help you get started. When the SPO Systems Completion Solution is used in conjunction with other Intergraph solutions, it provides a seamless environment with access to all of the information needed to complete the work, without loading data or scrambling to find current, complete, and accurate information.

3.1.1 Customer Success

An Intergraph customer in Brazil was able to complete commissioning of a brownfield aluminum refinery much faster through the use of a 3D model. Full commissioning of the expanded portion of a plant – from first feed to full production capacity – was completed in 12 days. By comparison, commissioning of previous expansions took 90 days to complete. Both the owner and the engineering company attributed this cost-saving improvement to the adoption of 3D and a collaborative environment throughout the project at all levels of both companies.

3.2. Electronic Data and Document Handover

There is increasing demand from mining owners to take delivery of intelligent electronic engineering information at the end of a project. Owners are realizing that there is great value in using this intelligent information for various aspects of the plant life cycle, including construction, commissioning, operations, and maintenance. This reduces reliance on expensive paper handover and allows information that has already been generated during design to be re-purposed. Intergraph's SPO Handover solution is designed specifically to handle these tasks.

Intergraph's solution supports handover of information created by SmartPlant Enterprise design tools as well as data and documents from a variety of external sources. Full auditable traceability of the data that has been electronically handed over is retained in the database and can be reported at any time.

Intergraph's SPO Handover solution supports incremental as well as final handover of data and documentation. For engineering contractors who need to preserve their intellectual property, data can be filtered so that only select information is transferred.

When intelligent, integrated, rule-based SmartPlant Enterprise design tools are deployed by engineering contractors and maintained during operations, information will be internally consistent and compliant with defined engineering standards and rules.

3.3 Document Control

Large mining projects involve enormous amounts of data and documents that need to be managed and properly controlled. Large volumes of documents from vendors, suppliers, government agencies, subcontractors, and more are continually modified and transmitted among various groups and companies. Changes need to be controlled. Packages of information need to be managed. Approvals need to be tracked.

Intergraph's SmartPlant Foundation offers specific functionality so that you can revise, version, cross-reference, and control engineering documents, traditional documents, data sheets, drawings, and the many other types of documents and information generated during a project.

With Intergraph SmartPlant Enterprise's unique integration and data sharing capabilities, documents can be closely integrated with corresponding engineering data so that you have complete access to critical project information. Effective and consistent management of documents with auditable traceability is essential to demonstrate compliance with environmental and government regulations, and manage the vast numbers of documents that describe a complex mining facility. Projects require a comprehensive document management system to manage these enormous volumes of documents and to organize them for a structured handover to operations.

Intergraph's document management solution comprises a comprehensive set of work processes for document control, including:

- Central allocation of document numbers.
- Capture of document metadata.
- File archiving.
- Distribution and review.
- Subscription.
- Check-in/check-out.
- Online approval and transmittal of documentation internally and externally.

It supports full revision history and linking of documents to tags, referenced documents, contracts, disciplines, and more to facilitate flexible retrieval.

3.4 Management of Change

Maintaining the accuracy of essential plant engineering, maintenance, and operations information is vital to safe, sustainable plant operations. Management of change is a safety-critical process. Unauthorized design changes and changes that have not been properly evaluated prior to implementation pose a major risk factor to plant asset integrity. Vital changes that are not implemented after evaluation also pose a risk factor.

Many well-known examples exist in the industry where poor management of change during operations have been a direct or indirect cause of major incidents claiming lives, destroying physical facilities, adversely affecting the local plant environment, and damaging company reputation. This has led to a growing focus from regulatory authorities on the management of change process as part of process safety management (PSM).

The process of managing change on operating plants is very complex. The normal situation for any plant is for multiple changes to be under evaluation and implementation at any one time. The complexity is further compounded by:

- Changes overlapping in scope.
- The need to manage multiple alternate solutions to proposed changes.
- Changes being cancelled prior to implementation or postponed for potential inclusion in future turnarounds.

This dynamic nature of the engineering design basis can result in incorrect as-built information being supplied to projects, leading to incorrect assumptions that may affect the accuracy of safety analyses or result in delays or additional costs.

Traceability of plant changes and auditability of the management of change process is essential to demonstrate compliance with increasingly stringent regulatory requirements.

SPO provides an out-of-the-box process for managing plant change. This process provides rigorous management of change (MOC) of engineering information with full traceability and audit trail and provides a basis for successful, compliant asset integrity management to satisfy international standards.

The preconfigured MOC process includes an electronic workflow for managing the review, authorization, design, and approval of changes in the engineering design basis, and optionally the notification of maintenance to perform changes by creating notification records in the computerized maintenance management system (CMMS), such as SAP® PM.

3.5 Information Portals

A typical mining project generates large volumes of data and documents from many different sources and formats. Good decision support across all of these systems is critical for cost and quality control. This involves ready access to information coming from these different sources and being able to assess how changes to information in one system will impact other systems.

Owners are also in need of information as the project progresses and the challenge for engineering contractors is how best to provide this information in a secure and controlled way.

This access is offered through a common, intuitive, role-based Web portal. Data is available via drill-down of the plant structure, structured queries, or from 2D/3D graphical navigation of the plant. The Intergraph solution provides access to selected functional location and equipment data in SAP EAM. The maintenance planner can interrogate the system by functional location or equipment number. A plant engineer can use a tag number to seamlessly access design data and SAP PM. With additional integration, users can access data from the DCS and content management systems such as LiveLink, Documentum, and SharePoint.

Web portal based on SAP NetWeaver® technology is available for users who wish to adopt SAP NetWeaver as a standard portal. For other users, the standard SmartPlant Foundation portal based on Microsoft portal technology is available.

4. Operational Excellence

It is important that plant asset information be up-to-date so that correct decisions can be made regarding performance improvements for Operations and Maintenance. When intelligent tools are used to create the engineering design and the data from these systems are made available to Operations and Maintenance through electronic handover, this data can be used to update other mine systems, such as the control system, engineering health management, and SAP PM with any design changes coming from ongoing sustaining engineering. It is important that this engineering data be controlled under MOC. The process for keeping asset information current and relevant throughout the enterprise is a key component of maintaining operational excellence.

4.1 Asset Integrity

Mining owner operators recognize that ensuring process safety and asset integrity is no longer an option in today's business environment, but a prerequisite to retain their license to operate and to deploy safe, reliable production at the lowest sustainable cost.

While the financial benefits from implementing PSM programs are difficult to quantify, industry surveys show that PSM investment positively impacts bottom-line performance. Improving safety produces a return on investment ranging from a factor of 3 to 8 according to the American Society of Safety Engineers.

The most significant benefits include reductions in:

- Insurance costs.
- Worker compensation claims
- Incident investigation
- Training of replacement workers
- Improved production

PSM involves everyone who works on a plant or is in any way involved with supporting a plant. It comprises a set of discrete but closely interrelated elements or work processes. While each PSM element in itself provides a benefit, complete PSM can only be achieved by managing all the elements as a set of highly integrated processes. Of course, a PSM or asset integrity management (AIM) program is only as good as its weakest link. For example:

- AIM is only as good as the management of change process.
- Operating procedures are only useful if they reflect what is in the plant.

Intergraph provides extensive support for the management of PSM and AIM programs based on providing a single integrated framework to support PSM elements in correlation with the engineering design basis and with third-party applications through interoperability.

Providing a common platform for PSM/AIM based on SPO has the benefit of ensuring a common approach and consistent information and work processes across the organization.

4.2 Better Decision Support

Enhanced decision support is an industry expression for having all data, documents, and records available to support correct decisions. Enhanced decision support is achieved through the ability to easily and quickly reference all information related to the mine, including real-time data, repair records,

inspection records, reliability calculations, and more, regardless of geographical location or data contained in a specific software system. Analysis of the engineering design intent, plant configuration, maintenance records, real-time data, inspection data, reliability calculations, and operational data is a cornerstone of understanding the historical and future performance of equipment and processes.

Engineering design intent and vendor data and documents should be available to support decisions. This includes the ability to view, print, and markup any type of documentation.

SPO provides the right framework for collecting and organizing this information for better decision support during mining operations and maintenance.

4.3 Support for Reliability, Inspections, and Maintenance

Sustainable engineering means that:

- Engineering documentation is always up-to-date.
- An audit trail exists of all changes.
- MOC exists.
- Mine information is always available to the user in a quick and easy manner for correct decision support.

Losing mine information integrity will also lead to loss of control of other enterprise systems, such as SAP PM, DCS, and equipment health management. Control of the engineering design basis is the foundation for strategies that provide up-to-date information to support operational systems for maintenance, reliability, and inspections.

Synchronizing the engineering design basis with other mine information systems is critical. The DCS real-time data needs to be accurate, equipment working within expected limits, and associated engineering data and documents up-to-date and valid. It is important that the correct equipment is being tracked by SAP, reliability, and inspection groups.

With Intergraph's SPO and plant information browser, a maintenance engineer can seamlessly access data in SAP PM and in the engineering design basis and then interrogate the system by functional location or equipment number. A plant engineer can use a tag number to access design data, data from SAP, data from the DCS, and data from reliability systems. Equipment inspections can be scheduled and inspection results captured.

4.4 Interface to ERP

Data resides in the CMMS and other operations systems, such as ERP inspection and reliability systems. Keeping this data updated with changes in the engineering design basis is essential to ensure that equipment is properly maintained and inspected and that other processes, such as procurement, have access to the correct data when purchasing replacement parts. Most owner operators depend on manual processes to ensure that plant design changes during operations are reflected in the CMMS.

Intergraph's SPO addresses this problem by providing an automated interface to synchronize changes in the engineering design basis with other operations systems that depend on this data.

The process provided by SPO is highly generic and configurable. The data sent to each system can be tailored per tag type. SPO offers out-of-the-box, end-to-end synchronization for SAP PM. But the mechanism can be rapidly applied to other systems.

5. Supply Chain Management and Procurement

An effective materials management system can integrate the entire material and supply chain work processes. Project teams will have online access to information during all project phases –from engineering through the complete supply chain to onsite management. The business benefits of effective materials management include significant cost savings and increased procurement efficiency.

SmartPlant Materials is the Intergraph integrated life-cycle material, supply chain, and subcontracting management solution. It provides a common collaboration platform and project workbench for all partners in any EPC project supply chain.

5.1 Supply Chain Management

An effective materials management system enables users to seamlessly integrate interchanges with:

- Commodity suppliers.
- Subcontractors.
- Manufacturers.
- Fabricators.
- Freight forwarders.

SmartPlant Materials offers a Supplier Management solution, an integral part of the Material Supply Chain Management Module. You can access historical information on supplier performance during previous projects, define and assign criteria for selecting suppliers based on predetermined qualifications and past performance, and maintain supplier history/details/products and vendor history/ratings. The supplier can register and maintain information via the SmartPlant Materials Portal. This reduces the amount of EPC or contractor effort required for this kind of maintenance work.

5.2 Procurement

SmartPlant Materials provides a central location for the storage of all inquiry and procurement data, and enables effective management of the data throughout the inquiry cycle and all procurement activities. You can greatly reduce the inquiry cycle time by involving the suppliers directly in the process. You can give your suppliers secure online access through the SmartPlant Materials Portal.

Having a central repository for procurement data provides significant opportunities for cost savings through bulk purchasing across multiple projects and multiple contractors. This is particularly attractive for large mining projects where it is common for multiple EPCs to be working on the project.

5.3 Expediting and Logistics

SmartPlant Materials enables continual reuse of data from one department to another, and ensures that data are reliably maintained as subsequent revisions are issued. The Expediting, Inspection & Logistics Module can be accessed remotely through the Internet by third parties such as suppliers, freight forwarders, or inspectors.

Data created during SmartPlant Materials Expediting simplifies and shortens the materials receiving process, whether in geographically distributed job sites or warehouses. You can easily create overage, short, and damage (OSD) reports. Reviewing materials issued to sub-contractors, based on drawings or work packages, saves you time and money.

6. Construction Planning

6.1 Improved CAPEX Efficiency

A major mining construction project involves thousands of workers, millions of details, and numerous complex variables, such as labor, materials, weather, and schedules. How can you manage millions of bits of data every day to complete the project on-time and within budget? How can you turn improved information management into increased field productivity?

The challenge for the construction industry is determining how to make informed decisions based on the most accurate information available and how to manage people and materials in a dynamic construction environment to advance the project in the safest and most efficient manner.

SmartPlant Construction, used in conjunction with Smart 3D and other SmartPlant Enterprise engineering tools, provides construction planners with early access to engineering data. Early visibility of design information and drawings provides construction planners with a valuable tool to build construction work packages earlier, which accelerates construction schedules.

6.2 Scheduling

SmartPlant Construction offers a direct link with Primavera and imports a Level 3 schedule for work package planning. A “scheduler” feature also enables users to select durations, crew size, work week schedules, non-working day, and set dependencies. Users can view, sequence, calculate, and animate schedules. They can now even export detailed schedules back into Primavera. Users can animate work packages in the 3D model that links to the scheduler, then record and save schedules.

7. 3D Visualization of Mining Facilities

7.1 Complete 3D Design and Modeling

Traditionally, materials handling system designs are 2D document-centric, and the industry has typically been conservative in adopting new technologies of intelligent 3D design systems. Smart 3D offers comprehensive 3D design and modeling tools for a true 3D solution. Smart 3D provides a unique solution that enables modeling of the materials handling components in the same 3D design system as the rest of the plant design. This eliminates the requirement of a CAD translation interface, and the model can be taken from feasibility straight through to detail design.

7.2 Importance of the 3D Model

Smart 3D is reshaping the way plants are designed for the metals and mining industry. The solution provides an integrated design environment able to fully support and manage the complexities and scale of these plants. Smart 3D offers close integration among disciplines – structural, civil, process plant equipment, conveying systems, and piping disciplines.

The use of a 3D model allows initial engineering designs to be reviewed earlier in the process by many levels within the owner's operation. Plant operations and maintenance, for example, have ample time to make process improvement suggestions before completion of final design and construction. This can greatly reduce the need for the owner's field maintenance and operation teams to spend months re-engineering portions of the plant to meet field needs. These changes can be implemented before initial construction, saving both time and money.

Early adopters of 3D models in the mining industry report significant improvements in all phases of their projects:

- Improved accuracy of engineering deliverables, with drawing accuracy of more than 50 percent compared to traditional CAD systems.
- Significant reductions in field rework during construction. Compared to an industry standard of six to eight percent, field rework is reduced to less than two percent. This is a direct result of the ability to correct a problem in the model where it is faster and less expensive than correcting it in the field.
- Faster project delivery. With improvements in engineering time and field construction time, projects reach completion faster, turning a pre-operation cost center into a revenue generator for the company. EPC companies also benefit as they can move to the next project sooner, allowing for increased revenue and improved resource utilization.
- Complex designs can be better visualized, which also reduces field rework and design errors.
- Smart 3D is a data centric solution, which means that deliverables are extracted directly from the database, with almost no user interaction. This means that deliverables come directly from the original design, thus increasing the accuracy of project deliverables (drawings, MTOs, etc.).
- Feasibility studies of materials handling systems can be completed in less than half the time compared to traditional CAD, with better accuracy and efficiency in the generation of MTOs and drawings.

Having an accurate and representative 3D model very early in design also enables you to conduct safety analysis and operator training much sooner. This is particularly important with the industry's aging workforce. Secondly, but equally important, is the ability to review constructability and modularity in design as they relate to project execution. This not only promotes cost control, but also enables safety reviews of the construction phase to be performed in advance. This gives you a safer, more secure project site.

7.3 Laser Point Cloud Integration

Powerful laser scanners can quickly and accurately capture "as-built" 3D images of an existing facility. These images are captured as intelligent point clouds and can be used to visualize and dynamically interact with real-world physical data. The high degree of accuracy allows for precise measurements to be taken.

Smart 3D can efficiently manipulate as-built point cloud data directly within the 3D modeling environment for better retrofit design, construction, and operations. It provides a virtual site within Smart 3D for greater confidence in assessing potential construction and operational impacts of the new design.

8. Engineering Design Basis Carried Forward

Intergraph SmartPlant Enterprise solutions are integrated, intelligent, data-centric tools. When used for engineering design, the resulting data and documentation are validated and consistent across disciplines. And when this information is handed over from engineering to procurement, construction, commissioning, and eventually to operations and maintenance, this validated engineering data is carried forward and reused during each major phase of the life cycle for better decision support. The concept of “single source of truth” can be truly implemented. Design intent is captured and carried forward.

Each step along the way carries the opportunity to add relevant information and pass it along, so that good decisions can be made throughout the life of the facility. For example, maintenance planners who have engineering information about an asset will be able to make better decisions on whether to:

- Maintain now.
- Wait until the next planned shutdown.
- Run to failure.

Procurement and spare parts requirements can come directly from engineering data that has been carried forward.

By carrying engineering information forward, we eliminate costly re-entry of data into operational and maintenance management systems (MMS). Design intent is carried through to operations and maintenance so that good decisions can be made at each phase of the operation.

8.1 Data-centric Tools for Creating Intelligent Designs

8.1.1 3D Design and Visualization

3D design systems are used in the mining industry for detailed design of equipment handling and bulk material handling systems, among other things.

Intergraph’s 3D Modeling & Visualization solution provides true workflow-managed integration between the engineering design basis and detailed engineering disciplines, extending across and beyond the project enterprise. This consistent, multi-discipline environment is intelligent and rule-based. The system understands the many object relationships that exist within the plant model, and maintains the design intent as changes occur.

The environment augments and further extends Intergraph’s data-centric approach by introducing additional engineering “intelligence” to all 3D plant design objects managed within the 3D plant model. It provides for data reuse so that designs from one project can be used in future projects.

It also allows for migration of legacy data from other plant design solutions into Intergraph’s 3D Modeling & Visualization environment. The solution provides powerful, automated tools that enable rapid creation and updating of intelligent drawing and report deliverables from the 3D plant model.

8.1.2 P&ID

SmartPlant P&ID represents a completely different approach from any CAD system because the graphics are a representation of the data. Data is the primary focus, followed by graphics. It also supports engineering standards like KKS, PIP, and DIN.

The tool enables you to take advantage of unique capabilities, such as multiple projects for what-if scenarios. You can compare the what-if scenario with your original design, and consolidate them if the change is approved. Copy your existing design, and during the copy, a transmission routine can modify the original design on-the-fly. For example, change the symbology tag numbers and process data, and then the P&IDs with the newly modified design are recreated from the database. This gives you a valuable jumpstart on your new projects, boosting productivity, data consistency, and innovation.

Plant editing allows you as an engineer to edit all properties for all of the P&IDs in the plant without having to open the P&IDs. Once the P&IDs are opened, the changes will be reflected in the graphics, such as labels.

This extremely powerful capability enhances productivity and enables engineers to make fast, consistent changes. And, since Intergraph supports version control, you can always compare P&IDs with earlier versions to see what has changed and then roll back, if needed.

8.1.3 Instrumentation and Electrical Systems Design

As part of the work process, SmartPlant Instrumentation will expand your functional control system design from the P&ID through macro expansion into the physical design, offering support for new technology, such as fieldbus, and links to vendors, like DCS catalogs.

SmartPlant Electrical will help create safe and reliable power distribution, taking the input from the mechanical drawings and P&IDs to interface with other vendors' analysis products, such as ETAP to verify design. SmartPlant Electrical's Basic and Detailed modules create all of the design and deliverables required for an electrical system, from concept to detailed design.

Please see Intergraph's White Paper [Powering the Mine](#) for more information on using SmartPlant Electrical for mining applications.

8.2 Integration across Engineering Disciplines

SmartPlant Enterprise offers best-in-class engineering applications and a low-risk, step-wise implementation approach to realizing a truly integrated engineering enterprise. SmartPlant Enterprise includes:

- 3D Modeling & Visualization.
- Analysis.
- Information Management.
- Engineering & Schematics.
- Procurement, Fabrication & Construction.
- SmartPlant Alliance Program.

SmartPlant Engineering & Schematics enables process engineers to lay out the plant configuration in SmartPlant P&ID, the application for creating intelligent piping and instrumentation diagrams that serve as a roadmap to the plant. This forms the basis for the detailed design by the instrument engineers and designers in SmartPlant Instrumentation – an application for instrumentation and control systems engineering, design, and maintenance. The SmartPlant P&ID “roadmap” is also used by the electrical engineers for the power distribution system, and the P&ID will drive the physical 3D plant design by the piping department.

9. Business Benefits

9.1 Cost and Schedule Reduction

There are many ways to gain enterprise benefits, including the deployment of standardized catalogs, reuse of modular systems, deployment of data-centric 3D technology, consolidation of procurement systems, and electronic handover of information from engineering. It has been shown that cost savings can be realized by using these systems, in addition to significant schedule reductions. Having a system with a “single source of truth” means reduced time and reduction in errors due to elimination of data re-entry. Cost savings can be achieved through centralized procurement and reduction of design errors through intelligent, integrated design.

9.2 Measuring the Return

To measure the impact of the fully integrated design concept, Intergraph has conducted research among users in peer industries. These users have:

- Reduced engineering costs by 30 to 40 percent.
- Shortened total project schedules by 8 to 10 percent.
- Reduced commissioning times by up to 40 percent.
- Improved field construction productivity by 20 to 30 percent.
- Reduced total project costs by 8 to 12 percent.

Early adopters in the mining industry have begun to embrace the concept, and similar returns on investment are expected in this industry as well.

10. Case Studies

10.1 ECM S.A. Projetos Industriais

ECM S.A. Projetos Industriais Provides Project Design Leadership for Brazil's Mining Industry

Company uses SmartPlant Enterprise tools to manage multidisciplinary information

Brazil can boast of abundant metals and minerals. South America's leading economic powerhouse, Brazil accounts for one-fourth of the world's iron ore output and is among the world's largest producers of bauxite, manganese, aluminum, niobium, nickel, zinc and tin. Recent discoveries of tungsten and copper deposits have further excited the metals and mining industry. And Brazil is deservedly famous for its gemstones – emeralds, amethysts, aquamarines and topaz – which are mined extensively.

Given Brazil's rich geological endowment, it is not surprising that the largest mining companies in the world have operations there. Many of these major players turn to Intergraph customer ECM S.A. Projetos Industriais to provide engineering, procurement and construction management (EPCM) services for their projects. Included among ECM's clients are global operators such as Australian firms BHP Billiton and Mirabela Nickel (with its Brazilian subsidiary Mirabela Mineracao do Brasil); UK-based Rio Tinto and Anglo American; and Brazil's own Companhia Vale do Rio Doce, now called Vale, to name a few.

Founded in 1984, ECM is a multidisciplinary engineering company located in Belo Horizonte, the third-largest metropolitan area and the capital of the state of Minas Gerais, in the southeastern region of Brazil. ECM's core business is providing project design for the minerals and mining industry, from feasibility studies to plant commissioning. ECM has about 550 employees and has been involved in some of the most significant mining projects of the past decade in Brazil for the mining industry, including the Santa Rita Project (nickel sulphide concentrator – Mirabela Mineracao do Brasil), Sossego Project (copper sulphide concentrator – Vale), Brucutu Project (iron ore concentrator – Vale), Minas-Rio Project (iron ore concentrator – Anglo Ferrous) and Third Pelletizing Project (iron ore concentrator and pelletizing plant – Samarco).

Benefits of integrated engineering

ECM has chosen a number of Intergraph SmartPlant Enterprise solutions: Smart 3D; SmartPlant Review; SmartPlant P&ID; SmartPlant Instrumentation and SmartPlant Electrical. Carlos Henrique C. Vasconcellos, associate director of engineering at ECM, reports that the SmartPlant solutions will help ECM to meet the challenges posed by its complex projects.

ECM looked to Intergraph's software to capture all of the data and make the data available for use through each stage of a project, from engineering up to procurement, construction and ramp-up.

"SmartPlant Enterprise will help us to manage multidisciplinary information and to maintain consistency among all involved disciplines along engineering development," noted Vasconcellos.

"This will result in project consistency and enable us to avoid many problems during construction. SmartPlant Enterprise tools will also help us achieve the desired accuracy for material control during the acquisition phase to meet the project schedule and improve cost effectiveness overall."

SmartPlant Enterprise provides ECM with a flexible system to accommodate inevitable changes faster and more accurately.

Industry customization

In the metals and mining industry, workflow processes vary as ore characteristics vary. Also, unlike chemical plants or oil and gas operations, a processing plant for minerals requires a wide variety of equipment of different types, shapes and systems for handling bulk solids material and slurry. Topographic factors play a very important role in the design of the facility. To adapt Intergraph's suite of applications to the mining industry, ECM customized the SmartPlant Enterprise tools. ECM developed specific symbology for PDF and P&ID files, created a library for equipment and platework, customized reports that met clients' requests or local market requirements, and built a databank of specifications for electrical and piping materials, concrete, structural steel and instrumentation.

ECM distinguished itself early in the process of SmartPlant Enterprise implementation by quickly combining its technical expertise in the development of mineral projects with the technology provided by Intergraph.

Local support

As ECM moved to SmartPlant Enterprise's integrated 3D environment, Intergraph's Brazilian distributor SISGRAPH provided implementation services and training. ECM spent four months training with SISGRAPH and then developed two pilot projects, which took about a year and a half. "Whenever we needed support, we received it from Intergraph ... always on time," according to Vasconcellos.

Migration advice

ECM chose Intergraph for three main reasons: (1) the concept of a centralized database, (2) the availability of Intergraph technical support in Brazil and (3) system integration, which enabled the management of multidisciplinary information.

ECM listened to its clients in Brazil who wanted to use software capable of integrated engineering as a prerequisite to project development. Having made the transition from developing projects in 2D to developing them in an integrated 3D environment, ECM offers encouragement and some advice to other companies contemplating that transition. ECM recommends this step-by-step process:

- Step one: Train the team
- Step two: Prepare the necessary customizations, with help from local Intergraph support, if needed
- Step three: Develop at least one pilot project that will enable you to address any difficulties that may arise as the transition proceeds
- Step four: Progressively enlarge your infrastructure to permit future expansions.

ECM purchased more licenses than it currently uses and has already trained additional employees on the system. "We have bet that this technology will be part of future projects," said Vasconcellos.

www.ecmsa.com.br

10.2 Promon Engenharia

Promon Engenharia Successfully Implements Mining and Metals Methodologies

EPC turns to SmartPlant Enterprise in expanding its industry reach

Promon Engenharia is a Brazilian engineering company that provides infrastructure solutions to key sectors of the economy, including the oil and gas, power, chemical, petrochemical, mining, metallurgy, logistics and transportation markets. Since the company's inception in 1960, Promon has completed a diverse group of infrastructure projects such as oil refineries, petrochemical units, maritime terminals, power plants with transmission systems, steel mills, mining and metals plants, aircraft and automobile plants, and commercial buildings, as well as major railroad, highway and urban transportation projects. The foundation of Promon's success, within Brazil and also globally, can be attributed to its command of engineering and managerial techniques, a highly qualified team of more than 800 professionals and the capability to combine its proficiency with that of its partner companies, which are also leaders in their respective market segments.

Promon has been an Intergraph customer for more than 20 years, aided in implementations by Intergraph's SISGRAPH distributor in Brazil. The company selected Intergraph products based on the "pedigree" of the tools and their use by major engineering companies.

Alumina refinery expansion

When Promon was recently tasked with a project in the mining and metals sector, the company lacked the specific tools necessary to complete the project, an expansion of Alunorte, an alumina refinery in northern Brazil. With a cost of nearly US\$850 million, the Alunorte project consisted of the addition of two new production lines to increase mining capacity at the plant.

Promon sought to introduce mining and metals projects at the company within the 3D environment that it was accustomed to working with in the oil and gas market. Promon also aimed to ensure a consistent flow of information among all the disciplines involved during the detailing process to enable everyone involved in the project to see the work done by others.

Turning to SmartPlant Enterprise

For Promon, based on the results of its previous projects using PDS, Intergraph was a logical source to turn to meet its expanded needs. Knowing the success of Intergraph SmartPlant Materials in the mining and metals industry, Promon implemented this widely used materials management solution in conjunction with PDS. In addition, Promon also added two additional SmartPlant Enterprise solutions, SmartPlant Instrumentation and SmartPlant Electrical.

SmartPlant Materials provides strong management workflow and functions, from preliminary design through detail engineering and purchasing to construction. SmartPlant Instrumentation helps to manage and store instrumentation and control data and provides information life cycle functionality from early conceptual design and engineering to construction and maintenance. And, SmartPlant Electrical addresses the electrical power distribution needs of the entire life cycle of the plant, from concept to detailed design through operations and maintenance, including start-up, continuous operation, emergencies and shutdowns.

To begin, 30 Promon employees were trained on the new solutions. Although the training lasted a total of three months, all of the users were productive after just two months, highlighting the ease of use of the software.

Throughout the project, Promon discovered a number of capabilities that increased its productivity and helped to expedite the engineering process. With the new software tools, Promon was able to collaborate

with everyone involved with the project to create a better interface, which led to a better understanding of the problems and, as a result, an efficient method of deciding on the best solutions. By applying the knowledge and benefits gained by the project team on previous projects using the 3D model, the company was able to considerably reduce the project's schedule and also refinery ramp-up. Additionally, having a secure source for the maintenance of the engineering data provided faster responses during the engineering and construction phases.

Promon found that using PDS and SmartPlant Materials together with the system integration capability allowed specifications made in SmartPlant Materials to be transferred directly to PDS with no rework required. Also, the material take-offs extracted from PDS could be sent directly to SmartPlant Materials using OMI spreadsheets, increasing the quality of the material data.

Customization benefits

The Alunorte project required some customization of the products to gain optimum productivity. For example, SmartPlant Materials had to be adjusted to adhere to the material coding procedures used by Promon. In addition to a control system that was created to compare instruments between the 3D model and SmartPlant Instrumentation, an interface was also developed between SmartPlant Materials and SAP to transfer the MTO data from engineering to procurement and then to materials control at the job site. Finally, Promon integrated with other solutions, including CAESAR II® pipe stress analysis software, to improve the work processes, which led to reduced errors and project timelines. Throughout the project, the following tasks were completed using Intergraph software solutions:

- All civil, concrete and steelwork (including underground) modeled in 3D
- Piping arrangements developed in 3D for all pipe diameters, including in-line instruments and pipe support elements with real representation
- Main runs for cable trays applied to electrical and instrumentation needs
- All field instrument arrangements developed in 3D
- Weekly clash detection reports created
- Material take-offs for piping directly imported to SmartPlant Materials
- SmartPlant Materials exported all piping specifications to PDS
- Piping arrangement drawings created with detailed information for construction
- Data files exported to be used by steel structure suppliers with detail drawings
- Support index created with dimensional information and weight for fabrication.

Although Promon had expected to encounter challenges with the new methodology that could potentially lead to obstacles and negative KPIs (quality indexes), this fortunately did not occur. As the first project to be completed with the new tools in the mining and metals sector, Alunorte proved entirely successful and the results were consistent with those across other projects that employed traditional methodologies. Pointing to the project's success, the Alunorte refinery is now responsible for seven percent of global alumina production after the latest expansion.

Bright future

As Promon moves forward, the company intends to migrate from PDS to Smart 3D for future projects. Additionally, the interface between SmartPlant Materials and SAP is undergoing modifications to allow new data exchange. Drawing from its 49 years of operation in the world's key infrastructure sectors, Promon maintains that a detailed plan is integral to the successful development of a highly integrated project. The company also emphasizes the importance of a software-trained work group that is capable of carrying out administrative tasks and providing support as needed. Finally, Promon stresses that to achieve a successful project in any sector, users must be mindful that with new tools often come new processes that differ from conventional methodologies. Promon advises that all firms should be prepared to embrace the change.

www.promonengenharia.com.br

10.3 Sinclair Knight Merz

The Future of Materials Handling

SKM collaborates to improve workflows for the mining industry with Smart 3D

Even during uncertain economic times, the mining and bulk terminal industries continue to show their vital role in the global economy. Developing economies in South America and Asia have increased the global demand for consumer products. That requires more raw materials from the metals and mining industry, especially iron ore. Mining companies are expected to deliver their products faster with existing resources. They need every possible advantage to differentiate themselves from their competitors, particularly in today's economic climate.

Delays mean lost time and money. Volatile commodity prices, depleting existing mineral reserves, rising operating costs and increasingly more remote new properties magnify these production obstacles for the mining industry. Two Australian-based firms and Intergraph are proving a new solution aimed at effectively addressing future production challenges in the bulk materials handling area.

While some industries have realized a clear return on investment with the implementation of intelligent 3D and integrated data-centric systems, traditional project delivery methodologies continue to prevail in the mining and materials handling industries. Traditional processes incorporate 2D design, "document-centric" systems and workflows, and contractual interfaces. This results in a workflow that is often repetitive and labor-intensive.

This traditional methodology has prevailed simply because engineering, procurement and construction (EPC) companies have maintained the balance between project delivery and production requirements, and owners have not viewed information from an asset life cycle perspective. When a competitive advantage isn't quantifiable, companies are likely to maintain their current systems and workflows. However, industry growth is causing companies to review methods aimed at improving efficiencies in bulk materials handling system design if they are to meet the increased demand and make the supply chain work.

"Proof of concept" phase

The industry desperately needs a better work process for the design-to-construction workflow of bulk materials handling projects to reduce the time for production and market delivery, and drive down costs. Materials handling system design and delivery are inherent components for complex, multidiscipline industries. For a typical bulk processing facility, 50 to 70 percent of the cost is material-related. Surplus material caused by non-optimal materials management, even to the levels of only five percent, can result in the loss of millions of dollars on an average capital project.

Sinclair Knight Merz (SKM) is working with Intergraph to revolutionize design and construction methodologies for bulk materials handling project delivery.

SKM is a leading engineering, project delivery and sciences firm, working across four broad market segments: mining and metals, buildings and infrastructure, water and environment and power and industry. The firm employs more than 6,000 people in more than 40 global offices.

The partnership focuses on the need for a smarter, data-centric system to enable optimization of standards, design reuse, modularization and worksharing. The partnership is working on a project that is currently in the "proof of concept" phase.

SKM defined the requirements for the new system by reverse-engineering a previously completed project and then developing an intelligent 3D model with current SmartPlant Enterprise technologies to visualize the process. Intergraph is converting the requirements into a new solution which is built around the latest

intelligent 3D technology – Smart 3D. Several factors influenced the selection of Intergraph and its software platform, including:

- Worksharing capabilities.
- Rules-based multi-discipline design.
- Integrated engineering and materials management.

Intergraph also provided the concept to detail design-to-fabrication outputs in a single environment, achieved by product development. Integrated conveying systems, transfer stations and fabrication were identified as key areas to improve engineering and construction delivery.

"Building the materials handling solution on top of our existing Smart 3D technology was a requirement for Intergraph to leverage the capabilities our customers have come to expect from the entire SmartPlant Enterprise suite of tools," said Patrick Holcomb, executive vice president of business development at Intergraph Process, Power & Marine. "Smart 3D does this effectively by providing a platform to not only expand existing automation technology, but also extends into technologies needed to drive true business benefits from this new application in this unique industry segment." The objectives of the ongoing project include:

- Creating a database library, comprised of a material/vendor catalog, client standards and designed assemblies/modules that could be reused by the client in future projects.
- Redefining and optimizing standards with integration and the effective reuse of information to improve productivity from engineering to fabrication.
- Promoting modularization and design repeatability, with construction benefits realized from off-site fabrication, pre-assembly, standardized materials management and procurement.
- Streamlining the workflow and interfaces between project phases, reducing information duplication.
- Developing a handover specification, including the provision of the intelligent 3D model as a deliverable, so a company can maintain and reference information throughout the life cycle of a project.
- Improving the timeliness and accuracy of project estimates, using integrated technology to match actual costs against budgets.

When the proof of concept phase is complete, the partnership will expand the initiative and team with an owner operator client to test and refine Smart 3D against actual expectations. SKM and Intergraph plan to continue their partnership seeking ways to revolutionize planning for materials handling facilities.

Dave Medcroft, business consultant for SKM, said, "The productivity benefit is related to engineering producing more outputs for the same effort, nearer to fabrication and construction deliverables."

www.skmconsulting.com

10.4 SNC-Lavalin

SNC-Lavalin Completes Feasibility Studies in Record Time with Intergraph Smart 3D

Rule-based, automated 3D technology enables engineering firm to improve accuracy and efficiency of materials handling projects for increased competitiveness

SNC-Lavalin is Canada's largest engineering and construction company, and is also a major player internationally in the ownership and management of infrastructure. The company set up offices in Australia in 1999 and has since undertaken a number of projects locally and internationally via the Australia-based business.

In Australia, one of the key challenges for SNC-Lavalin is rising engineering costs, and how it can compete effectively with other lower-cost engineering centers around the world. The approach undertaken by SNC-Lavalin's Perth office is to "do more with less", which is to establish a small, very skilled engineering design team that is fully supported by a systems administration team, hence enabling SNC-Lavalin to model content with fewer designers.

As an avid user of Intergraph Smart 3D, SNC-Lavalin in Perth decided to proceed with Smart 3D for its feasibility studies. Its primary goal is to incorporate Smart 3D into its workflows to enable materials handling projects to be done more efficiently.

Overcoming Challenges

- Enhance competitiveness by improving efficiency of materials handling projects.
- Generate accurate deliverables to reduce re-work.
- Improve overall effectiveness of SNC-Lavalin's Perth engineering design team.

Key Benefits

- Increased productivity and efficiency of materials handling projects.
- Improved accuracy in deliverables, including MTOs.
- Reduced project hours and costs.

Realizing Results

SNC-Lavalin's Perth office chose to implement Smart 3D because the unique Intergraph solution enables it to model materials handling components in the same 3D computer-aided design (CAD) system as the rest of the plant design. This eliminates the requirement of a CAD system translation interface, while simplifying model reviews and the ability to get automatic material take-offs (MTOs) for materials handling equipment. The same model can then be taken straight through to the execution phase of the project.

Smart 3D also provides the benefits of automated drawing production and live clash detection for materials handling objects. This enables SNC-Lavalin's Perth design team to work much more effectively than it could before, generating outputs from the model more accurately and easily.

"We chose to use Smart 3D because of the sheer quantity of materials handling work that we would have the potential to win," said Cameron Bauer, design systems manager at SNC-Lavalin in Perth. "It just didn't make sense to use a composite solution when a single software package has the capability to do both process plant and materials handling design."

To ensure that Smart 3D is fully incorporated into SNC-Lavalin's workflows and the design team is able to leverage the most accurate information from the system, the Perth office put extra effort into setting up the project infrastructure and reference data. It added SNC-Lavalin's standard commodity resource codes (CRC) into Smart 3D, along with customized structural steel sections, electrical cable tray specifications,

conveyor idler equipment, and a library of standard, modularized Smart 3D components such as ground modules and standard chute configurations.

Because Smart 3D is wholly housed within a database, it is possible to generate live queries that accurately report the quantities of modeled objects. SNC-Lavalin developed a series of custom queries and used a third-party open source reporting tool to create live web-based reports on the model database. These could then be delivered to the estimating group, which has predefined costs associated with the CRC codes, thereby allowing quick import and cost analysis of the data. This means that SNC-Lavalin is able to provide a more accurate estimate to clients, along with rendered 3D model images of the project.

Using Smart 3D, SNC-Lavalin has reduced the amount of time required to do conveyor modeling by 70 percent, with its use of wizards for generating trusses and plate work helping to greatly reduce design time. Smart 3D automation capabilities – such as placing components along the conveyor belt line with full intelligence and MTO capability – have proved invaluable.

The SNC-Lavalin Perth office has completed three feasibility studies successfully using Smart 3D. The number of man-weeks required for these studies was significantly reduced. For example, for its gold-crushing circuit study, SNC-Lavalin estimated that 42 man-weeks would be required with manual drafting, but it was able to deliver the project in eight man-weeks with Smart 3D, which is a huge 80 percent time-savings. In addition, the MTOs generated by Smart 3D were between 10 to 20 percent more accurate than a manual MTO taken from drawings.

"SmartPlant 3D Materials Handling Edition has delivered significant cost savings while improving accuracy and efficiency, enabling us to compete effectively against low-cost engineering centers," said Bauer.

Moving Forward

The SNC-Lavalin Perth office will expand the use of Smart 3D to other projects, and continue to refine and improve its system customizations and work instructions with each new project. With a global licensing agreement, there is also the opportunity to expand the use of Smart 3D to the rest of Australia and other offices globally.

About SNC-Lavalin

SNC-Lavalin in Australia services the Australian mining and metallurgy sector, including supporting Australia-based clients on their international projects. Its engineering and project delivery services cover a broad range of mineral commodities, and SNC-Lavalin provides services from the conceptual stage of projects, through feasibility study work, to full project delivery, commissioning, and support of the facility for its operating life, and also decommissioning. Its local capability is intrinsically linked to the global SNC-Lavalin organization, providing international capability to projects wherever required. SNC-Lavalin's capability in mining projects includes not only mineral processing facilities but also appurtenant infrastructure.

www.snclavalin.com.au

11. Conclusion

A number of analysts are projecting that by 2025, the need for metals globally will double. Driving this future growth is the expectation that developing economies in Asia-Pacific, Latin America, and India will demand raw materials for products that accompany a higher standard of living – automobiles, durable goods, and computers. Mines and process plants will be needed to meet this demand. The ability to complete a project accurately and on time will put owners in a position to capitalize on these market demands as they arise.

Intergraph's plant automation solutions and global network of offices are providing the industry with the tools and support needed to achieve higher production goals and operational excellence.

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