DESIGNING TOMORROW'S ADVANCED VESSELS

TRANSITIONING TO 3D MODELING

PRIORITIZING PIPE STRESS ANALYSIS

INSIGHT

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FOCUS ON
SMART 3D IN PRODUCTION

- Fluor
- PV Shipyard
- SKDY
- Kyutech

INDUSTRY NEWS

INSIGHT

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INCREASE OFFSHORE DESIGN PRODUCTIVITY

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ACCELERATE PROJECTS AND GAIN A COMPETITIVE EDGE

Choose the industry's only next-generation, data-centric 3D offshore design solution from Intergraph® for the design, construction, and safe operation of your offshore facilities. With the SmartMarine Enterprise integrated suite of solutions, automated, configurable engineering rules ensure design-to-production accuracy and consistency. Boost productivity by an average of 30 percent and build safety into the design from the start. Global workshare, operations, and life-cycle asset management are also optimized with SmartMarine Enterprise engineering information management, the industry standard for maintaining your platform's engineering design data for decades to come.

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INTERGRAPH®

good timing

Patrick Holcomb
Insight Editor
Executive Vice President,
Global Business Development
Intergraph Process, Power & Marine

> **Observe due measure, for right timing is in all things the most important factor.**
>
> Hesoid

If there's one thing I am absolutely certain of, it's that I do not know what awaits us all next year. The world has been seen a raft of unexpected events in 2011, and I've read a dizzying array of opinions of the future in *The Wall Street Journal* and *The Economist*. It would appear the one constant in all opinions is that they are more negative than they were a few months ago. Beyond that, nobody knows.

However, even this scant knowledge of the future has some value. For one thing, we know that the general appetite for investment risk, anywhere, is going to be lower in the next six to 12 months than it was in the last six months. The good news about this environment is that fluff and hype-cycle technologies will be delayed or canceled, and companies will directionally increase focus on proven opportunities, even if they are more work or less glamorous, or both.

Some of the contributors we have for this issue of *Insight* are particularly well-timed. Fluor has done some incredible work, almost as if it knew this time of uncertainty would come, as you'll see in the title of its article, "Proper Planning, Training and Business Mind-set – Key to Success." You'll also read about the results of another well-timed investment from a company in Vietnam, PV Shipyard, which is transforming itself to be a powerful player in the Asia offshore market with the support of SmartMarine® 3D technology.

While we have only been able to profile a few specific examples in this issue of *Insight*, I can assure you that this sort of trend is common in what we are seeing around the world. Our global society's demand for cheap energy has remained strong, but clients want to achieve energy goals with low risk and high efficiency. That's always a safe bet in any economic environment.

I hope you enjoy reading about some of the successes our clients have found in this issue of *Insight*.

The Time is Right for Smart 3D

INTERGRAPH SMART 3D technology (including SmartPlant 3D, SmartMarine 3D, and SmartPlant 3D Materials Handling Edition) is endorsed and used by the world's industry leaders. The solutions enable proven productivity gains for EPCs and O/Os, improving engineering efficiency and design productivity by up to 30 percent.

Smart 3D offers the industry's most advanced and productive next-generation, rules-based, data-centric 3D design system for automated design in the process, power and marine industries. Automated, configurable rules-based 3D design software enables users to build safety into plants early in the design process, enforcing regulation and engineering standards to increase safety, productivity and quality of operations.

The ARC Advisory Group, a leading industry analyst firm, ranked Intergraph the No. 1 overall engineering design 3D software and process engineering tools (PET) provider worldwide according to its *PET Worldwide Outlook Market Analysis and Forecast through 2015.* »

Red Skies at Night – Sailor's Delight

» Record growth for division led by fastest growing solution, Smart 3D

"Red skies at night – sailor's delight" is sailing folklore for predicting good weather and a smooth ride on the next day. For the first half of 2011, it's been red skies for Intergraph Process, Power & Marine (PP&M). Insight *spoke with Gerhard Sallinger, president of Intergraph PP&M, about the steady growth of Smart 3D and how the technology is boosting productivity for customers from around the world.*

Insight: This year has been quite turbulent for most companies. How is your business doing?

Gerhard Sallinger: From a business angle, Intergraph PP&M is strong globally and our customers are hard at work on major projects. For the first half of 2011, we saw record revenue. All significant countries and industries are showing increasing project activities and confidence. Our product portfolio is in its best condition ever, and more customers recognize the strength of our solutions.

Intergraph has established its market leadership in 3D solutions. Can you discuss the business performance of Smart 3D in particular?

GS: I am very honored to report that ARC, the respected industry analyst firm, recently again ranked Intergraph as number one in 3D technology for every worldwide region and in most industry segments. We are very proud of this key acknowledgment of our market leadership.

Smart 3D (encompassing SmartPlant 3D and SmartMarine 3D) is our fastest-growing solution worldwide. There are

currently more than 10,000 Smart 3D licenses in use, with revenue increasing more than 50 percent since last year! We are very pleased to see such encouraging numbers, thanks to our global customers who have chosen to use this technology in their own workflows.

Are you looking at ways to further enhance Smart 3D technology? How has the solution been accepted by the user community?

GS: We are dedicated to continuously improving our solutions. We unveiled new releases in 2011 that featured considerable enhancements, such as ring headers, which are important to the power industry, and shipbuilding enhancements, key to the marine industry. Our research and development investments are steadily increasing each year. A tremendous amount of our resources has been focused on generating these enhancements for our customers.

During Intergraph @ Hexagon 2011, our annual global user conference, we enjoyed record attendance for our Technical User Forum 3D group meeting. The Smart 3D presentations were also packed during the conference. Presenters shared Smart 3D in production stories reflecting their valuable experiences with the solution. Many attendees learned more about Smart 3D and want to take further advantage of this technology.

What makes Smart 3D so unique?

GS: For one, it's Smart 3D's automations capability. The Platinum Pipe Awards (see page 38) recognize the powerful software rules that only Smart 3D can perform. These rules increase productivity and data quality. For example, Samsung Heavy Industries has eliminated a large amount of manual work thanks to a Smart 3D automation it developed. Engineers can work on design optimization instead of just pushing buttons to perform fairly routine design tasks.

In another example, the new *Export to PDMS Utility* we developed was formally unveiled to the client base during Intergraph @ Hexagon 2011. Grenland Group, a Norwegian EPC which is active in the offshore industry, showed how it uses the translator in production today. The translator gives Grenland the strategic flexibility to work with many different owner operator situations while still continuously building its skills and automation on Smart 3D. This session drew a high degree of interest from our marine industry clients, so much so that we had to bring in additional seating.

Who are some of the key customers now using Smart 3D?

GS: There are so many customers now using Smart 3D. The list is quite extensive,

in the hundreds, so it would be impossible for me to list them all. However, some of the most noteworthy Smart 3D customers include:

- Bechtel Corp.
- China Petroleum Construction & Engineering Corp. East-China Design Branch (CNPCCEI)
- COSCO Group
- DORIS Engineering
- ECM S.A. Projetos Industriais
- ENI Saipem S.p.A.
- Fluor Corp.
- Genpro Engenharia S.A.
- Grenland Group
- Hyundai Engineering Co. Ltd. (HEC)
- Hyundai Heavy Industries Co. Ltd.
- Keppel FELS
- The Linde Group
- UTC Engenharia

These global customers come from a wide range of industries, including oil and gas, power, offshore, shipbuilding and mining.

Can you discuss Smart 3D and its growth in specific regions around the world?

GS: There's a saying among sailors: Red skies at night – sailor's delight; red skies in morning – sailor's warning. The division is seeing red skies at night because our business is broadly diversified around the globe and throughout various industries. For example, in Asia-Pacific, business is brisk with customers taking up Smart 3D technology. We are seeing customers move from pilot testing to full production in significant numbers all over the region, such as:

- **China** – The take-up of SmartPlant 3D has been solid at Sinopec, Shengli Engineering & Consulting and ACRE. Usage has expanded at the Chinese power design institutes, such as East China Electric Power Design Institute (ECEPDI). ACRE has used SmartPlant 3D for approximately 18 months. It has already completed one coking project and has several others underway.
- **Japan** – JGC has moved to production with the DS-LNG project based in Indonesia. Shin Kurushima, one of the most productive shipyards on a per-ton basis in the world, has adopted SmartMarine 3D to help it be even more efficient in its business as a mid-size shipbuilder in Japan. Global Toyo recently announced it would extend via a new global agreement the use of SmartPlant 3D into its worldwide operations.
- **Southeast Asia** – In Malaysia, Petronas has entered into an agreement with Intergraph to use SmartPlant Enterprise as a standard within the company. The same is true for PTT Chemical Group in Thailand. Keppel Fels has expanded its use of SmartMarine 3D for all new designs in its world-class offshore division. Keppel SingMarine and Keppel Offshore & Marine's Shipbuilding Division have both now adopted SmartMarine 3D into their operations.
- **Australia** – The new SmartPlant 3D Materials Handling Edition has been applied to projects via SKM Engineering in Australia. A number of EPCs and owners focused on the metals and mining industry are looking closely at SmartPlant 3D Materials Handling Edition to help them dramatically improve the safety, quality and productivity of their businesses.
- **Korea** – The growth of Smart 3D use is even more profound in Korea. Over the last three to four years, Korean EPCs have become significant players in the global project world – taking projects directly as well as partnering with various Western EPCs on projects worldwide. SK Group's SK Engineering and Construction has expanded the use of SmartPlant 3D into its business. Samsung E&C, Hyundai Heavy Industries and Hyundai E&C have done the same. Doosan Heavy Industries has applied Smart 3D technology on both desalinization projects as well as power projects in several locations, such as the Rabigh 6 megaproject in Saudi Arabia.

Smart 3D is growing in Europe, the Middle East and India, and Africa. The growth in Europe is coming from the nuclear industry in Eastern Europe as well as some strategic wins against the competition in the mining and offshore area in Western Europe. The consolidation of our PDS® clients adopting the latest technology is also well under way.

> **"I firmly believe that Smart 3D is the most comprehensive and powerful 3D solution available in the market today, period."**
>
> Gerhard Sallinger

The Americas are also an area of expanding Smart 3D usage. SmartPlant 3D is growing in the oil sands in Western Canada. SNC-Lavalin in Eastern Canada is also moving most of its projects to SmartPlant

3D. Several major U.S.-based EPCs, including Bechtel, Fluor and URS, have standardized on Smart 3D technology as a corporate direction for most projects. Throughout Brazil, Smart 3D is being adopted by mining, chemical, offshore and shipbuilding customers thanks to expanded economic activity.

We understand that several customers have selected Smart 3D to replace competitive 3D solutions. How does the technology stack up against the competition?

GS: I firmly believe that Smart 3D is the most comprehensive and powerful 3D solution available in the market today, period. We are honored to have recently been chosen by a number of companies who previously used another vendor. New wins against competitors include:

- STX France signed a high-value, five-year agreement to use SmartMarine Enterprise to design next-generation cruise ships, improving design quality and project management.
- China National Offshore Oil Corporation, the country's largest offshore oil and gas producer, selected SmartPlant Foundation to manage the engineering data of its offshore platforms and oil fields.
- Engevix Engenharia, a leading Brazilian shipyard, recently initiated a seven-year lease of SmartMarine Enterprise for the engineering, design and fabrication of floating, production, storage and offloading (FPSO) hulls.
- Aker Solutions, a leading global oil services company based in Norway, selected SmartMarine 3D in a multiyear contract.

After evaluating their options, these companies realized that we offer the most comprehensive solution. We are always happy to meet with businesses who are interested in gaining a competitive advantage by using the most advanced technology.

How would you describe your 3D technology strategy?

GS: It is an interesting coincidence that we have three sides to our 3D strategy. In my opinion, we now have the three best 3D technologies available.

1. First and foremost is Smart 3D for larger, complex, global projects with unrivaled functionality and productivity, through rules, automation, global workshare and multi-model referencing capabilities.
2. PDS may be our longtime 3D technology, but PDS license usage actually grew over the last year – even with the incredible growth of Smart 3D. PDS is still going strong and remains a viable option for various companies as they transition to Smart 3D.
3. Last but not least, CADWorx® is an excellent solution for smaller projects. The acquisition of COADE® Inc. in 2010 not only gave Intergraph access to the world's most widely used, and respected, pipe stress analysis solution, Intergraph CAESAR II®, but also added to our portfolio the CADWorx Plant Design Suite, with its flagship program CADWorx Plant Professional.

The COADE acquisition certainly seems to be paying off in a big way. Can you discuss the recent growth of CADWorx? How does CADWorx fit in the Intergraph family, and what differentiates it from other industry offerings?

GS: Billions of dollars of projects are under way right now using CADWorx. Its ongoing success is testament to the trust that it has gained in more than 15 years on the market. This success continues to be borne out by its ever increasing adoption in the marketplace, which saw more than 40 percent growth compared to last year. Our plan is to triple the CADWorx revenue and number of seats by 2015!

CADWorx is an intelligent suite of products that give smaller companies, and workgroups within larger companies, the ability to produce quality AutoCAD®-based deliverables with speed and accuracy. CADWorx is easy to learn and install, with strong interfaces to laser scanning, and with links to Leica® Geosystems total stations. It also has the ability to perform as-built modeling and produce as-built deliverables, all without leaving the field.

Besides its high level of functionality, what continues to set CADWorx apart from its competitors, e.g. Bentley or Autodesk, is its bi-directional links to pipe stress analysis, through CAESAR II, and pressure vessel analysis, via PV Elite®, thereby breaking down design and engineering barriers that can often lead to costly mistakes, even on smaller projects. This integration is so good that we used it as a guide for the upcoming enhancements to Smart 3D – CAESAR II integration that were first demonstrated in June at our global user conference.

Can you sum up what you think about the future direction of Intergraph PP&M?

The first half of the year was our best yet. This is a great sign for our business and signifies the tremendous success we've been able to achieve together, thanks to hard work from our excellent team and our continued dedication to our customers. ■

Jana Miller is editorial director of Insight *and is based in Huntsville, Alabama, U.S.*

BOOST PRODUCTIVITY BY 30 PERCENT

SmartPlant® 3D

Gain a competitive edge and accelerate projects with the latest release of Intergraph® SmartPlant® 3D, the first and only next-generation 3D plant design solution for the process and power industries. SmartPlant 3D delivers at least 30 percent more productivity than any other system available today.

The latest release of SmartPlant 3D offers powerful rules and relationships that automate repetitive tasks, enforce design standards, ensure design integrity, and protect design consistency. Benefit from enhanced support for mega-projects thanks to global worksharing, model data reuse, and safety-centric rules.

To see demonstrations, case studies, webinars, and more, visit www.intergraph.com/go/smartplant3d.

INTERGRAPH®

Proper Planning, Training and Business Mindset — Key to Success

» Creating a competitive advantage at Fluor with SmartPlant Enterprise

At Fluor Corporation, we have had a longstanding relationship with Intergraph. When we learned of the new SmartPlant Enterprise technologies, we took a very strategic approach for the review and evaluation of how they might change our business. We understood that the new data-centric technologies would offer not only much different execution opportunities but also a chance to re-evaluate the legacy processes and organizational structures we have historically used. We coined the evaluation and eventual implementation of the "NEXTGENERATION Initiative" at Fluor. It was created to look at the impact the new technologies would have as well as the work process improvement opportunities that could potentially enhance our execution capabilities. Given how systemic our PDS processes had become over the past 20 years, we realized we needed a proactive approach to successfully deploy the Intergraph SmartPlant suite of technologies within Fluor to be successful. We focused on these key areas:

- Retraining a multi-office global organization in the most efficient manner possible
- Implementing SmartPlant Enterprise applications in an integrated project execution environment
- Determining the work process and organizational changes that position Fluor for a "Next Generation" of project execution
- Implementing a rules-based environment to strengthen our competitive position and support the coming knowledge and experience shortages

Training programs

As part of the NEXTGENERATION initiative, we developed a very comprehensive training program to address the challenges we would face in re-tooling our global workforce. We characterized the challenges we would face into three areas:

- **People**
  - Overcoming resistance and "fear of change"
  - Changing from a "file-based," CAD execution mentality to a "data-centric" approach
  - Driving acceptance of standard processes and configurations such as drawing view templates
- **Technology and training**
  - Analyzing the impacts to hardware, security (especially with SmartPlant Foundation) and infrastructure the new technologies may have
  - Consistent deployment of technologies across multiple offices, countries and business lines and determining how to maintain that consistency
- **Executing projects in an integrated SmartPlant Enterprise environment**
  - Providing effective management of a complex environment
  - Managing the misalignments between SmartPlant Enterprise tools operating within an integrated environment
  - Managing the environment complexities and limitations for joint venture and third-party participation in the environment
  - Overcoming legacy work processes using the integrated SmartPlant tools

The NEXTGENERATION training program we developed was broken down into a series of training curriculum and courses that are designed for specific project roles such as project management, design engineering and automation support.

In many cases, not all training must occur prior to project start-up, so the courses have been categorized as follows:

- **Required** – Mandatory courses that must be performed prior to project execution
- **Just-in-time** – Courses that should be taken at the appropriate time during project execution
- **Optional** – Courses that are taken if and when needed
- **On-the-job** – Courses that typically feature informal instruction or training (i.e., coaching), which is performed through project execution on an as-needed basis

By MICHAEL PYE

Considering the vast size and global distribution of our project execution organization, we designed the program to be as efficient as possible and broke it into the following teaching methodologies:

- **A limited amount of instructor-led presentations** – Intended to be presented by a knowledgeable instructor
- **A significant reliance on self-paced online / computer-based training (CBT)** – These "self-paced" online CBTs include:
  - **Fluor University Skillsoft** training materials accessed through Fluor University that consist of a combination of Microsoft® PowerPoint®, audio, and video demonstrations
    - Enable student to review and grasp content without the assistance of an instructor
  - **SmartPlant 3D Tool Training** – Intergraph "core" tool training delivered using Intergraph's SmartPlant Virtual Training (SPVT)
- **SmartPlant Enterprise NEXTGENERATION Coaching** – Fluor engineering and tool work process training is provided through a series of lessons that focus on what is different on projects executed using the new tools and work processes, such as:
  - Fluor engineering work processes
  - Functional interface impacts
  - Tool work processes
  - Fluor's integrated project execution environment (certified tool configurations)

Deployment

Our deployment approach was divided into three phases:

- **Phase 1 – Office Readiness Training** is focused on ensuring an office is prepared for NEXTGENERATION deployment by evaluating the office IT infrastructure and preparing the "core" resources within the office prior to project deployments
- **Phase 2 – Initial Project (Office) Deployment Training** provides the initial project task force deployment training and provides the office "formal" NEXTGENERATION deployment training and coaching
- **Phase 3 – Ongoing Office Training** is focused on any additional staff training required and the global support and governance program to manage changes to the Fluor-certified environments

We also implemented a support structure to address the global offices in Fluor. The structure included:

- **Core Governance Team** to address overall management of the certified configurations, rule development and enhancements and new release certification and testing
- **Regional Support Teams** who focus on the project support needs within the region and provide the regional SmartPlant Foundation support and management
- **Office Support Teams** who provide direct office-level support and assistance

Integrated project execution

From the beginning, we knew that the focus on full integration would provide significant benefits and value if achieved. For a change of this magnitude to be successful, we did not want to focus on simply the publishing of information into SmartPlant Foundation, but to fully leverage the publishing and retrieval of data into the SmartPlant Enterprise tools where possible. What we did not expect was the overall complexity and lack of consistency between the SmartPlant Enterprise tools that we discovered. We realized that while the Intergraph technologies enabled a lot of capabilities, they are also are extremely complex to manage, especially in an integrated approach to project execution, and can be a challenge for engineers and designers who are used to "document-centric" processes and procedures.

To address this, we implemented what we refer to as the NEXTGENERATION Certified Environments, which are a series of version-specific tools, and SmartPlant Foundation mappings that have been work process-tested and documented for the information managed and behaviors of the SmartPlant Enterprise environment.

We also create a series of training programs to help educate the project task force members on the integration interdependen-

cies and impacts each tool can have on the environment, and how to manage and adapt to those impacts.

We also felt that a comprehensive, well-documented project work process approach was required to ensure that the work process changes desired by Fluor and the impacts the new technology has would be understood going into a project.

The result was a series of project execution guidelines that describe the new tool and the project engineering work process changes to effectively utilize SmartPlant Enterprise at Fluor:

- **Volume 1 – User procedures, project setup and configuration** – Focused on the tasks the design team must understand
- **Volume 2 – Installation, setup and other technical information** – Focused on setup and configuration of the environment
- **Volume 3 – NextGeneration work processes** – Focused on work processes in the Fluor SmartPlant Enterprise environments

Rules-based environment

As part of the initiative, we also recognized the potential an effective use of a rules environment could have in improving not only the productivity of the processes but also in helping address the aging of our workforce. We implemented a process to identify, classify and prioritize rules and enhancements needed for the SmartPlant Enterprise environment. We classified our rules in three areas:

Rule	Description	Complexity
Productivity enhancements	These rules include modeling wizards, design assistants and automated symbols.	Least complex to develop
Design integrity validations	Rules check the designs for compliance with project rules. These may be: • Engineering design rules • Client best practice rules • Industry standards or operations • Construction or safety best practices These help ensure that the level of experience is applied to all projects, regardless of experience level of the team. These rules can be applied as a status check or as a set of services that monitor and manage the design integrity or perform enhanced interference management.	More difficult to develop but provides enhanced value
Rule-based engineering	Complete engineering rule-based reasoning systems offer optimal benefits. For example, Fluor's OptimEyes® system is used for FEED plot model development.	Most complex to develop but provides the highest value

To ensure the continued growth and management of our Fluor Rules Library, we implemented a dedicated development and certification team to develop the prioritized rules and enhancements identified. The Fluor Rules Service Engine is then configured for each project as part of the NEXTGENERATION Certified Environments, ensuring all projects leverage the advantages of the rules service engine and enhancements.

While the path to get to where we are today has required considerable effort and time, we feel we have moved over the crest and can see the momentum building. As of June 2011, we have 14 projects in various stages of execution; with three of those projects being moved into the field. We have a SmartPlant Enterprise environment established in 13 offices across Fluor with several more under way. We currently have more than 850 people trained in the new SmartPlant 3D and SmartPlant Foundation technologies and our NEXTGENERATION work processes, with more than 600 of these personnel located in the Asia-Pacific region (APAC).

Changing the way we do business

Fluor's success with SmartPlant Enterprise has been predicated on the planning, hard work, endless preparation and anticipation of a team over a period of years. Based on our approach, we think this truly has the potential to change the way we do business.

Keep in mind this is not a simple roll-out or decision to make. Consider these key takeaways for successful implementation:

- Establish company standards and work processes you want to be followed
- Document and communicate the standards and work process changes so that they can be consistently applied
- Create an effective training program that will give your users the confidence to effectively utilize the systems
- Establish an organization to manage SmartPlant Enterprise deployments across your enterprise
- Prepare and invest in advance of project execution. SmartPlant Enterprise is not a "plug and play" environment and attempting to "learn as you go" can impact the success you will see and project outcomes

As you approach your decision on implementing SmartPlant Enterprise, think of what your ultimate goals are for your company and how they can best be achieved. Through proper planning, training and business mindset, tremendous value can be achieved. ■

» www.fluor.com

Michael Pye serves as project automation global excellence leader at Fluor Corp. He is based in Greenville, South Carolina, U.S.

By LUTHER WALKE

More Value for Capital Projects

» SmartPlant® 3D delivers new technology advances in interoperability and design reuse

Intergraph's latest release of SmartPlant 3D 2011 further solidifies its position as the preferred automated 3D design solution for executing large, complex capital projects. You will see several individual innovations which contribute to interoperability and design reuse so that you can:

- Significantly reduce the time needed to get projects up and running
- Compress the time schedule required for their completion
- Materially reduce the capital costs for engineering and design

Reference 3D: Interoperabilty with many different 3D models, making Smart 3D the PMC's best friend!

Smart3D can reference and perform clash reporting and provide critical design references on multiple models, with multiple formats, simultaneously. Supported model types include:

- SmartPlant 3D
- SmartMarine 3D
- PDS
- CADWorx
- ISOGEN® PCF
- PDMS
- StruCad
- Tekla Structures
- Speedikon
- AutoCAD
- PlantSpace
- InRoads
- MicroStation
- SAT Export

Since it was first released in SmartPlant 3D 2009.1, Reference 3D (R3D) capability has afforded projects the ability to bring heterogeneous 3D data into a single environment, where it can be viewed and referenced alongside native SmartPlant 3D data. With SmartPlant 3D 2011 SP1, projects will be able to run interference detection between these diverse sets of data as well. This offers tremendous value to all types of projects in multiple market segments, and is of particular value to large joint-venture projects.

Reference 3D is not intended to replace the clash detection within models being delivered by "non-Smart 3D" authoring tools that may be selected by one or more participants on a project. To do so would represent a redundancy. For example, this is specifically why SmartPlant 3D does not afford the ability to perform clash analysis *within* an attached R3D dataset.

Put another way, it is a reasonable expectation on the part of a project management contractor (PMC) that sub-contractors deliver 3D datasets which are reasonably free of internal clashes. Given this, the PMC should have no need to re-run a clash analysis on that dataset (other than perhaps as a sanity check) and, hence, this is not a designated core capability of R3D.

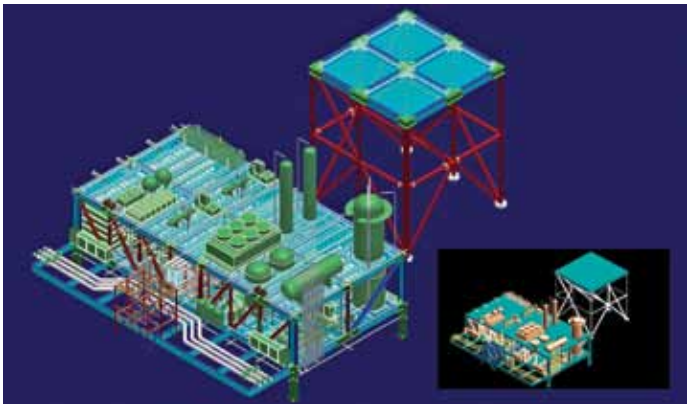
R3D does offer a core competency in the support of workflows in which the 3D datasets interplay with one another. Ensuring the portions of a plant assigned to various sub-contractors on a project do not overlap one another certainly falls within this area. Avoiding even a single major clash on a project can prevent huge costs and schedule overruns. As such, preventing such problems before they occur is an area of keen interest to all project managers and PMCs, but is particularly critical to those running large joint-venture projects. Toward this end, SmartPlant 3D's proven clash engine will now process referenced R3D datasets against one another, regardless of the 3D authoring tools used to create them.

As is the case with native Smart 3D data, the process for detecting interferences is highly configurable and can be run either locally on the client or in full real-time mode via processing on a server. It should also be noted that this interference checking of externally-generated 3D data is fully compatible with projects running SmartPlant 3D's global workshare configuration.

> **"The cost savings resulting from using SmartPlant 3D on a project more than compensate for any additional cost required by the export operation."**
>
> Luther Walke

R3D's ability to prevent interferences between heterogeneous 3D datasets represents a sea-change in clash avoidance on complex, joint-venture projects, promising to support ongoing growth in the size and diversity of capital projects for the next decade and beyond.

Another area of critical interplay between the various design regions of a capital project's design is at the boundary conditions, in which myriad piping connections must be created and



managed. These connections are of critical interest to the project for several reasons:

- Coordinates of connected piping in the 3D model must accurately represent where that piping will ultimately exist in the physical plant
- Precise connection positions are required to drive proper pipe lengths for connecting lines
- Required fittings – flanges, unions, couplings, etc. – must be accurately identified for procurement
- All mating accessories – bolt/nut sets, gaskets, etc. – must be accurately identified for procurement

R3D's creation of intelligent connections between native Smart 3D and R3D data will significantly increase the accuracy of material procurement on all capital projects using SmartPlant 3D. Similar to interference detection, this capability offers particularly high value to large, diverse joint-venture projects in which multiple partners using multiple 3D authoring tools may be involved.

Smart 3D export to PDMS: Have your cake, and eat it too!

Unfortunately, in situations where the RFP specifies delivery of the final "As Designed" model in Aveva's PDMS format, project managers have been forced to sacrifice internal continuous improvement and switch their teams to new tools all too frequently. With this capability, a project manager can satisfy alternative exchanges in PDMS, and still enjoy the many advantages of modeling with SmartPlant 3D, such as:

- Improved schedule and cost efficiencies
- Superior data integration
- Error minimization via the rule-based architecture

With the release of SmartPlant 3D version 2011 SP1, projects finding themselves in this situation now enjoy a different option: the project can be executed with SmartPlant 3D and subsequently converted for delivery using the new *Export to PDMS Utility*[1]. As a result, project principals can now select SmartPlant 3D for use on projects independent of the format specified for final handover. This, in turn, enables the decision to be driven solely by business considerations (i.e., selection of a 3D authoring tool that will allow project execution at the preferred cost and schedule). In this regard, it is of significant note that projects have already begun selecting SmartPlant 3D on projects even though final handover of the 3D model is required to be in PDMS format. It is a logical conclusion that such decisions are driven by appropriate cost-benefit-analysis by project principals, leading them to conclude:

- SmartPlant 3D's new *Export to PDMS Utility* is effective at generating native PDMS models of a quality suitable for handover to the owner operator
- The cost savings resulting from using SmartPlant 3D on a project more than compensate for any additional cost required by the export operation

SmartPlant 3D's *Export to PDMS Utility* offers a straightforward, customizable, yet robust solution for delivering Smart 3D data to project stakeholders in the PDMS format. Data translation is fully intelligent (where supported by PDMS' architecture), thus providing the ability to deliver a 3D model that is completely modifiable within the PDMS application.

Extraction and conversion of all relevant object types for structural, equipment and piping disciplines are supported in the initial release of this functionality. Support for the extraction of business classes for other engineering disciplines will be delivered in subsequent releases.

Intergraph understands the complexities that can be imposed on a project when translations are required. Capabilities within SmartPlant 3D's *Export to PDMS Utility* specifically help manage this aspect of the cost of ownership.

This primarily takes the form of built-in tools which aid in generating the required mapping between Smart 3D and PDMS catalog and specification data. For example, prior to an export operation, the mapping files are automatically checked to ensure all required information is present and, in many cases, will automatically generate any mapping data that is found to be missing.

An additional mechanism for lowering costs associated with the export utility is delivery of the required mapping for most of PDMS' delivered sample catalog data for the structural, equipment and piping disciplines.

Finally, the export operation is highly configurable. The 3D data can be exported and delivered at the minimum required level of intelligence while – at the same time – ensuring full graphical fidelity is always maintained.

CIS/2 interchange of structural data

Enhancements to SmartPlant 3D's ability to interchange structural data with third-party applications have been delivered in the latest release as well. Conformance to the CIS/2

[1] Export to PDMS Utility has also been made available in SmartPlant 3D 2009.1.

standard continues to be reinforced for all structural data types, both for import as well as for export operations. This is a normal capability in popular detail design applications like AceCad, Design Data's SDS/2, and Tekla Structures.

To better support production workflows typical to most projects – data exchange with detailing applications, for example – the time required for the import operation has been significantly reduced. Additionally, both import and export operations are now batch-enabled, using Intergraph's proven Batch Services™ technology. In this way, data exchange operations can be packaged as scheduled jobs to be run directly against the model database. This not only facilitates the load-balancing of IT equipment, but also alleviates any need for direct interaction with the 3D environment.

Model data reuse

The latest release of SmartPlant 3D continues to deliver against the key value proposition of design reutilization with enhancements to the Model Data Reuse (MDR) command, first delivered in the product's 2009 release. With 2011, the MDR command will automatically identify and replicate all assignments within SmartPlant 3D's key supplementary hierarchies: the work breakdown structure (WBS) hierarchy and the assembly hierarchy. For required relationships to be created, the required hierarchy objects – both for creation of WBS associations and that of assemblies – are automatically created during the MDR process.

This level of sophistication in design reuse further benefits project schedule and cost, both through the reduction of direct labor expense as well as through decreases in the costs associated with non-conformance. Assignments of objects to WBS items – which can number in the tens of thousands for a given WBS type – do not have to be manually created for the replicated datasets. As a result, business constructs of various types – ranging from transmittal packages for procurement and fabrication to contracts for painting, testing and commissioning – are made readily available to the project as part of the replication process.

WBS assignments for subsequent isometric generation are predefined, ensuring not only savings in direct labor but a high level of accuracy as well. Finally, the automated replication of assembly objects and child relationships ensures all pipe spools are generated so that unique piece mark numbers will be accurately output to those isometric drawings when generated.

Appreciating the "future value" of 3D data

Smart 3D models are a capital asset belonging to the authoring company or the owner operator to whom it is transferred at project completion, and they can be used for a wide array of training and engineering uses during operations and maintenance.

The ability to realize future value of this asset is largely dependent upon its reusability, either on other SmartPlant 3D projects or via interchange with other value-added or cPLM applications.

With SmartPlant 3D 2011, Intergraph maintains its commitment to maximizing this value by leveraging the product's data-centric, object-oriented architecture to deliver high-value design reuse and data interchange capabilities. ■

www.intergraph.com/go/smartplant3d

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Fast Track to Success

» PV Shipyard establishes technology standard to deliver offshore projects

Petrovietnam Marine Shipyard (PV Shipyard) specializes in construction, conversion and repair of diversified types of mobile offshore drilling units and marine facilities. The shipyard was established in Vung Tau City in 2007 to meet the growing demands of the offshore oil and gas industry in Vietnam and the region.

As a growing company, PV Shipyard faced the challenging mission of developing capabilities to design and build offshore facilities such as jack-up rigs, as well as acquiring the necessary skills to support its operations. The company has ambitious plans and strives to be the preferred contractor for offshore jack-up projects in Vietnam. It was highly critical that PV Shipyard prove its capabilities and make a mark in the industry to establish itself as the premier design and construction company in Vietnam for offshore facilities.

In 2009, only two years after its establishment, the shipyard was awarded its first project to design, build and deliver a 90-meter LeTourneau Super 116E jack-up rig. PV Shipyard needed to implement next-generation engineering technology to ensure quality, accuracy and automated processes in producing the deliverables required for this project and all future projects. This is aligned with the company's long-term goal of taking on global projects.

The perfect fit

After an intensive evaluation of all the solution providers in the market, PV Shipyard chose Intergraph and the SmartMarine 3D solution to design and build its first jack-up rig, with local distributor support from Credent Technology, Intergraph's partner in Vietnam.

"As a young and dynamic company, we needed a reliable and proven vendor that could support our goals as we drive our business and establish ourselves in the market," said Phan Tu Giang, managing director of PV Shipyard. "We are very impressed with SmartMarine 3D's rule-based, automated technology, which is the perfect match for our requirements."

SmartMarine 3D is the world's most advanced offshore and shipbuilding design solution, featuring breakthrough engineering technology that is data-centric, knowledge- and rule-driven to improve delivery schedules, with increased detail and manufacturing design productivity of up to 30 percent. SmartMarine 3D provides PV Shipyard with the capabilities it needs to gain and maintain an edge in a highly competitive industry by improving safety, increasing quality and boosting productivity.

Fast implementation

PV Shipyard purchased SmartMarine 3D for its group of young engineers, most of whom were recent graduates. Intergraph and Credent fully supported PV Shipyard's training program, providing in-depth training and giving the engineers the opportunity to use the application on a pilot project before implementing SmartMarine 3D for the jack-up rig project.

"Intergraph was very committed in helping us. It provided PV Shipyard with dedicated local support through Credent," said Phan Thanh Son, engineering manager at PV Shipyard. "Intergraph also has extensive industry experience, providing us with great advice, which we appreciate very much. It is clear that we made the best choice when choosing Intergraph and Credent as our technology partners."

Within six months, PV Shipyard moved into production, utilizing SmartMarine 3D for detail design and modeling of the jack-up rig.

Delivering results

The implementation of SmartMarine 3D was a tremendous success for PV Shipyard. The company was able to complete the design of the jack-up rig on time and within budget, and it is on track to deliver the rig within the planned schedule.

"We are the first company in Vietnam to use 3D technology to design and model jack-up rigs, and it has been very successful for us," said Phan Thanh Son. "SmartMarine 3D reduced the

By EILEEN TAN

time involved in the project by 50 percent, bringing down costs significantly, while improving the quality of design and delivery."

Enterprise integration

Today, SmartMarine 3D is the 3D engineering and design solution of choice for PV Shipyard, and the Intergraph solution is used for all its offshore projects. PV Shipyard was also a 2010 Golden Valve award winner with its SmartMarine 3D model in the Judges' Choice Offshore category.

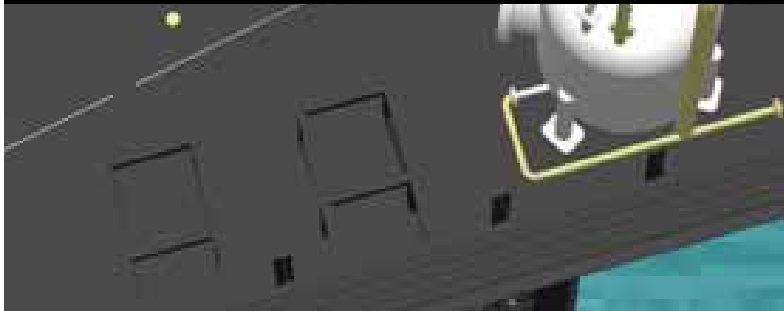
The company has now expanded its use of Intergraph technology by selecting other solutions from the comprehensive SmartMarine Enterprise suite, including SmartPlant Foundation, SmartPlant Instrumentation, SmartPlant P&ID, SmartPlant Electrical, SmartPlant Reference Data and SmartPlant Review. PV Shipyard will use these solutions in an integrated environment for the design, construction, production and planning of offshore facilities for improved efficiency and quality.

"We are preparing for our next major project. The implementation of an integrated suite of SmartMarine Enterprise solutions will enable us to meet our productivity requirements," said Phan Tu Giang. "We are confident we will gain even more business benefits, and the Intergraph solutions will prove to be invaluable to us at PV Shipyard."

About Petrovietnam Marine Shipyard

Petrovietnam Marine Shipyard was established in 2007 with a goal of implementing the policy of the Vietnamese government to develop the manufacturing of oil and gas drilling rigs in Vietnam. PV Shipyard specializes in the construction, conversion and repair of diversified types of mobile drilling units and facilities, including a wide range of complex offshore structures. With the aim of creating technical solutions with international standards, and completing projects of high quality at a competitive price, PV Shipyard expects the Vietnamese mechanical manufacturing field to reach a higher position with the industrialization and modernization of the Party and State in the near future. ■

Eileen Tan is a contributing editor for Insight *and is based in Melbourne, Australia.*



Designing Tomorrow´s Vessels

» Advances in marine design software boost productivity

Reprinted with permission from the autumn 2011 issue of LNG Industry *magazine.*

To achieve major productivity and cost-efficient breakthroughs, a solution is required that can manage today's accelerated speed of change and provide significant returns on investment in technology. A broader horizontal strategy is needed that extends across a variety of domains:

- Engineering
- Business
- Material management
- Production
- Life-cycle management

Most importantly, ships and marine structures must operate within a strict regulatory framework and in a safe manner, often while transporting hazardous materials. Having this safety structure integrated during intelligent design is an obvious advantage for globally competitive shipyards.

Sophisticated applications dedicated to plant and marine industries provide specifications for outfitting design. The best solutions can automatically generate typical drawings and reports. However, to reach the highest levels of automation, the system must be able to:

- Introduce automation in the workflow
- Capture design intent
- Maintain design intent while the design and building conditions are changing

Even the simplest 2D and 3D generic CAD systems allow for "macros" to address repetitive tasks. But the application of these macros is left to the designers' discretion. For example, rules are not triggered automatically, as in the case of the "smart occurrence."

A smart occurrence is just one feature of SmartMarine Enterprise, the latest solution for design, construction and life cycle management of ships and marine structures, aimed at business process improvements, not only at design improvements.

Design-for-production process

Currently, out of many solutions available on the market for LNG vessel design, only SmartMarine 3D is able to support three different structural views with a unique association between them to avoid redundancies and duplication of design work. The views follow the usual design macro-steps: conceptual (basic design), detail design and manufacturing. The SmartMarine 3D structural business objects (BOs) feature is able to follow the various phases of the evolving design in terms of attributes and graphical representation, i.e. from thickened surfaces at the beginning of the design to solids during detailing, and 2D contours when it comes to defining the cutting paths for piece-parts to be sent to production.

The way the relationship (between the BOs in various maturity stages) is defined, propagated and maintained has been patented. It represents a key element in dealing with structural topology that is essential in shipbuilding structural design. Logical connections representing the relationships during the early stages will automatically become assembly connections during the detail design. Assembly connections will automatically generate important BOs like welds. This is valid for any vessel designed with SmartMarine 3D.

Many of today's dedicated shipbuilding and offshore systems still use 2D views to define and interactively detail structural elements. This is quite inefficient in complex areas. Moving to a fully-integrated 3D design brings an additional competitive advantage. In the case of SmartMarine 3D, this benefit must be added to the advantages that full integration and automation provide. Automation saves time, provides consistent accuracy and improves design quality, positively influencing production processes and schedules. Ultimately this allows for more comprehensive basic design and simultaneously shortens the delivery time.

Finally, it is important to mention that SmartMarine 3D's "design-for-production" paradigm includes planning during any of

the design stages. This frees users from the constraints of outdated computer-aided design when applied on LNGs or other complex and technologically advanced vessels.

Customization of rule-driven design

Detail design of vessels is a tedious, non-value-added, error-prone, time-consuming task. Rule-based automation, however, shows great potential and benefit. Rule-driven detailing provides the ability to enforce industry and company standards and to generate the automatic creation of objects and reports. The description of the ship (design constraints, structural strength), assembly methods and production database can be governed by rules that can be modified, adding elements or cases, according to the needs of the vessel or the yard standards and procedures.

In the currently available out-of-the-box rules, the penetration details (e.g. the stiffener crossing a bulkhead or a deck) is solved by using an attribute assigned to the plate system. By default, a plate system can be water-tight or non-water-tight. More often, it is the nature of the space bounded by the plate system that determines whether a penetration should be tight or not. If one of the two spaces (compartments) is a "structural tank," this, of course, must be tight. As a result, all penetrations in the bounding plate systems of such a tank should be obtained with appropriate, fully welded collars. At the same time, all penetrations inside a structural tank or outside a tight compartment should be solved with typical clips instead. This is just one example of the possibilities to change the rules and to increase the level of rule-based automation. Functional subdivisions of the ship (e.g. different fire-proof zones, or safety zone or arbitrarily defined user-zones) can be used to trigger dedicated rules and corresponding solutions.

Full, 100 percent automated detailing is, of course, the final goal. The best users of SmartMarine 3D structural already exceed 85 percent of automatic "remodeling" usually required when transitioning from preliminary design applications to detailed design. This is achieved by combining an out-of-the-box solution with users' customized rules.

It must be noted that the target of "fully automated detailing" does not exclude the possibility for the user to interactively overwrite singular cases. However, this should be limited and considered an exception to the rule.

SmartMarine 3D's rule-driven solution streamlines design processes, preserving existing data and making it more usable without duplication. A substantial reduction in man-hours spent on structural detailing has been obtained in various kinds of vessels, including LNG carriers.

Full interdisciplinary integration

The structural model is fully integrated with the 3D outfitting model, carried out in a "seamless" process through basic design, detailed design and construction without remodeling. Changes to the hull form or to the position of any plate system (e.g., bulkheads or decks) trigger the automatic update of the related structure and,

given permission, also trigger the re-positioning of the outfitting components related to the modified structure.

Structural openings generated by pipe/duct/cableway penetrations are all generated automatically following appropriate rules, generally dependent upon the tightness of the parent plate system.

The ability to treat the model of a LNG vessel holistically during all phases of the design, together with comprehensive, interdisciplinary integration and a planning task able to manage any 3D business object, provides yards a considerable competitive advantage.

Data sharing vs. data exchange

Traditional CAD/CAM systems evolved from a paradigm in which the software application would read/write to files. In mechanical CAD systems, this often meant that a file represented a part, and that visualization or digital mock-up software manipulated how the parts were assembled together. This methodology is still appropriate in discrete manufacturing companies where the parts can be isolated, and various tools – from concept design to manufacturing – can all work on the same file format.

CAD for the process, power and marine industries originated from the same roots, but exposed some fundamental limitations. A single file could not support the size of a whole ship, nor could it accept simultaneous input from multiple users. Consequently, the LNG ship model would be divided into many files, where each file may represent a chunk of the ship, therefore missing the possibility of synchronizing the complete systems (piping, instrumentation, electrical, etc.), that span across these files.

The simplest solution for most software vendors was to leave the CAD engine largely intact, but develop software (PDM) for their tools to communicate between the files via a database application. This software would manage the interfaces, whether they be logical (e.g., from/to) or physical (e.g., coordinates) connections between the files. This approach applies equally to schematic (for example, to accommodate "off-page connectors") and 3D software applications, and works fine up to a point.

In other words, as shipbuilders started to optimize their vessel designs into configurable blocks to support experienced design and building strategy, the integrity of the network systems (piping, electrical, instrumentation) was put at risk as each discipline and each chunk of the model modified its data within each file.

The development of digital mock-up (DMU) software partially addressed this problem, essentially putting the whole model back together again to ensure the connectivity/integrity of the interfaces between each file.

Intergraph's SmartMarine Enterprise suite of tools is data-centric. A user interacts with the application that reads/writes to a multi-user, multi-discipline database, as opposed to a CAD system that reads/writes to files on the file system. Filters allow specific data to be retrieved from the database in a user-friendly manner without having to write complex queries. All the deliverables, like drawings and reports, are extracted in the same way (via queries to the relational database) at any point in time during the project.

The total integration of the engineering data in a single-source data entry enables quick identification and resolution of potential problems. Timely information and project reporting are available through seamless interfaces with corporate financial, accounting and planning applications. In addition, data-centric systems:

- Deliver a reduction in the number of staff required for project management
- Increase standardization across projects and programs
- Provide overall cost savings of 5 to 20 percent of total project costs when used in conjunction with earned value techniques and sound project management procedures

Production impact

Since manufacturing capabilities usually do not reside in a single geographical location, distributed manufacturing and "just-in-time" generation of manufacturing data is an essential part of the solution. It begins with pre-nesting material ordering and it continues through the actual cutting of the parts. Production facilities often depend on the capabilities of local workshops and require a flexible solution to transform the engineering part into a manufacturing part. Through user-defined rules, this transformation process can be automated based on local workshop requirements and capabilities.

Building blocks are defined in the early stages of design. This enables the definition of assembly and sub-assembly structures, specifies the work-center assignments and determines assembly sequencing. Without rework, this will be refined to the lowest level during the progress of the project. A building simulation can be provided at any stage of the project.

Planning data can be linked with schedule information (master and procurement) so they can be aligned with the build strategy. The links with external/third-party planning and scheduling systems are easily made, especially with Microsoft OLE-enabled applications. Such tight integration makes changes and schedule updates smoother and more efficient.

All relevant production data is exported to Production Management Systems (PMS), NC cutting machines, profile-cutting robots, welding robots and pipe cutting/bending automations. Error reduction prior to production represents substantial cost savings. Complex floater 3D structure can be easily solved with appropriate functions and the use of a sophisticated user interface. Besides weights and CoGs, the assembly planning task enables the definition of the assembly orientation, the footprint and the mounting sequence, which are all prerequisites for the

automatic generation of building instructions for the workshop (including dedicated assembly drawings).

Through user-defined rules, different production scenarios can be checked to determine if parts can be manufactured in other locations without being modified. All parts of the workflow can be managed and reported on, sorted by block, zone, section or item.

With all of these tools, accuracy has improved in vessel design, significantly reducing the total amount of labor hours needed. This enhances efficiency and reduces cost in the building dock. Logistics for materials distribution has also dramatically improved following similar improvements in planning and scheduling. Besides drawings and other paper outputs that can be produced at the shop floor ("on-demand"), the digital 3D product model is also available for assembly, dimensional and any sort of quality checks.

In summary, the latest available technology for ship design helps to provide solutions for integrated cPLM (capital Project Lifecycle Management) systems by offering a suite of data-centric design tools and a workflow-oriented integration framework that shares engineering information with the extended enterprise. It promotes:

- **Data sharing** – Controlled release of data to domains for various applications to reuse while initial source data continues to progress
- **Inter-discipline data reuse** – Retrieval of released data into application via interaction with "to-do" list
- **Consistency** – Inter-disciplinary data comparison

This makes it possible to ensure that engineering goes first, prior to operations, to gain a clear project overview and to achieve and maintain data integrity, which is the prerequisite for error-free schedule shrinkage.

In the coming years, automation will continue to grow to a level compatible with the very complex, one-of-a-kind (or short-series) large capital projects. Overall production time will continue to shrink to a level compatible with the business model of the yard.

For example, large shipyards ("ship factories") will produce ships faster with full control of the schedule. Small to medium shipyards ("assembly shipyards"), whose competitiveness is determined by their production flexibility and minimum overheads, will produce vessels more efficiently, including subcontractors in all phases of the project, with full control of the process and the costs. ■

www.intergraph.com/go/smartmarine3d

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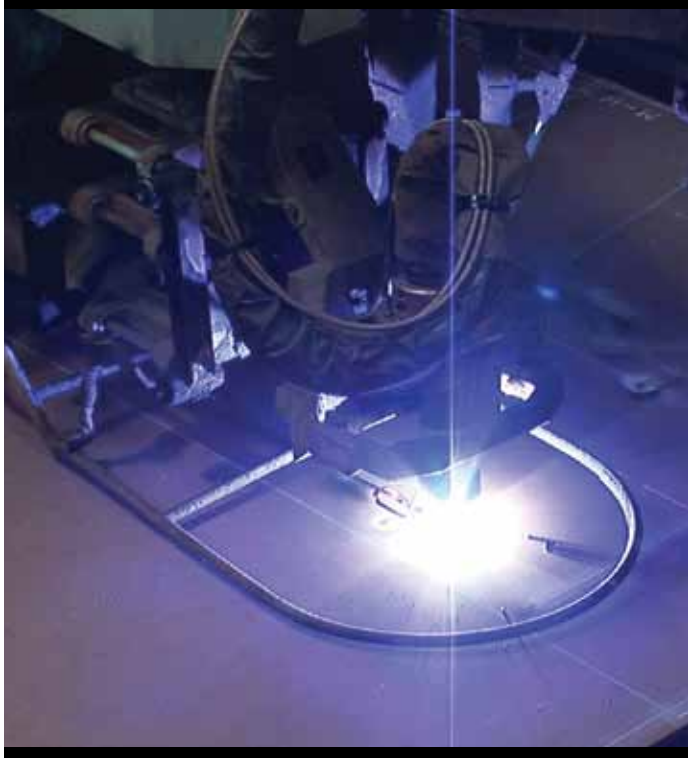
EFFICIENCY GAINS FOR DESIGN AND CONSTRUCTION

Reprinted with permission from the June/July 2011 issue of Marine Propulsion.

Shin Kurushima Dockyard has adopted Intergraph's SmartMarine 3D design and modeling tool to increase productivity. One of Japan's most productive yards, the system enabled the company to include and enhance its own sophisticated automation rules to achieve greater efficiency without compromising quality. Kyushu Institute of Technology has also adopted the software for use in its shipbuilding design research.

SmartMarine 3D is a key component of Intergraph's portfolio, which provides the capability to design and build offshore structures and ships from design and fabrication to operation and maintenance in a single, integrated environment. ■



SKDY demonstrated the cutting of a steel plate through the use of SmartMarine 3D at BARI-SHIP 2011 in Japan.

From Traditional Layout to Integrated 3D Modeling

This article is reprinted with permission from the September/ October 2011 issue of IT&Production.

The early stages of project design have become increasingly relevant as the pressure to reduce development costs and to increase the accuracy of cost estimates mounts:

- According to a study from the Construction Industry Institute, more than 80 percent of a project's total cost is committed within the first 20 percent of the total project's design time
- Another study by Independent Project Analysis Inc. (IPA) showed that only four in 10 projects completely finish the front-end engineering phase which produces the cost estimate

Therefore, tools that provide the engineer time to properly analyze options and to determine accurate costs will have very high value.

Plant design has found new ways to evolve from "traditional" layout studies (Microsoft Excel® for material take off [MTO], 2D CAD for plot plans and cost estimation based on internal data, heuristics and approximations) to a higher-quality, more accurate 3D modeling design. The vision is for the models created during conceptual layout studies to be reused for front-end engineering packages and even for detailed design, with no data transfer or remodeling. Even if this doesn't happen, the more accurate the 3D model, the better the cost estimate.

Many plant designers opt for a 2D-based solution, or go for simplified 3D modeling using a set of tools designed specifically for this purpose. Typically in this approach, the cost estimation is based on internal historical data. Design contractors use a combination of commercial products and in-house tools. The 3D model is only used during conceptual design and then thrown away.

A step further in maximizing the conceptual design of the plant layout is integrated 3D modeling. A better articulated and more consolidated approach, integrated 3D modeling provides agile, flexible and reusable layout, multiplying the design options and their applicability.

The latest tools available in the market – Intergraph SmartPlant 3D and SmartPlant Layout among them – provide automated pipe routing, and a specialist-simplified equipment library within the full 3D system. In turn, this provides all facilities of the full 3D system to the front-end designer – including:

- High-end modeling
- Interference detection
- Model referencing
- Automation tools
- Deliverables, such as GA, MTO and piping isometrics

There is no model translation – the model developed at the front end just needs detailing.

Front-end engineering

We can recognize two main stages of the front-end engineering process (also known as FEED or FEL):

FEED stage	Inputs and deliverables	Study length and team size
In the first, conceptual layout stage, many different plant layouts are considered to determine which has the best combination of capital cost and operational efficiency.	It is important to include piping because this has such an important impact – for example, the size and placement of pipe racks are analyzed. The inputs to the process may be a simple Process Flow Diagram (PFD) and associated flowsheet.	These studies are normally of very short duration and carried out by small, specialist teams.
In the second stage, a single plant layout is chosen and is then detailed sufficiently to generate an accurate cost estimate. This may need to be within 5 to 10 percent of the actual cost to allow sound business decisions to be made.	An accurate pipe length and an approximate fitting count are key at this stage. An important deliverable is often a realistic model for client review.	The project may last for several months and the multi-disciplinary project team is much larger.

Projects which fail to develop a pertinent conceptual design do not

By DAVID MYALL

achieve the desired business outcomes. The investment fails to meet its targeted returns by exceeding the expected cost and schedule targets, or failing to operate as expected. But many projects (four in 10 according to the IPA study) do not achieve completion of the conceptual stage because of time pressure and the need to keep options open for as long as possible while information is gathered.

Integrated 3D modeling

One of the many advantages of integrated 3D modeling lies in the possibility to streamline engineering design processes while preserving existing data and making it more usable/reusable. SmartPlant 3D provides all the capabilities needed to design a plant, and then keep it as-built throughout its life cycle. This 3D solution reduces design errors, engineering changes and rework. SmartPlant 3D ensures design accuracy and consistency through the enforcement of design rules. Enforcement of the design rules results in increased product quality and reliability by enabling faster and more efficient creation, transfer and review of design interactions. This enables project design teams to make more informed decisions. Integrating the auto-routing and layout solution into the 3D design environment means that these rules can be applied from the earliest stages of the project, minimizing rework.

3D solutions also provide tools for the continuous monitoring of design rules and notification of the impacts of change throughout the design process. They keep track of drawings that have been updated due to changes in the engineering model.

In order to enhance the design capabilities of Smart 3D (SmartPlant 3D and SmartMarine 3D), Intergraph has developed SmartPlant Layout, a solution for preliminary 3D plant layout, which is implemented as an additional task, or discipline, in the overarching Smart 3D architecture. SmartPlant Layout supports proposal development, early design estimates and plant layout optimization. This technology enables preliminary designs to be reused by carrying forward initial layouts into detailed design without additional remodeling – saving time and improving design quality.

SmartPlant Layout enhances the base Smart 3D software by adding a special simplified equipment library and reference data, integrated pipe auto-router, line list integration from spreadsheet or P&ID/PFD and equipment import from spreadsheet. The full range of Smart 3D reports generation (including isometrics) and modeling tools (piping, equipment, structure) are all available to the SmartPlant Layout user, as well as industry-leading model data reuse and referencing tools, a powerful automation layer and full integration with cost-estimation tools. The Smart 3D user can easily mix and match manual and automated pipe routing to rapidly create a single plant model that is completely scalable from the smallest to the largest process plant, offshore structure or ship.

There is another feature which makes SmartPlant Layout unique. While all other products need to perform a full remodel from the FEED output to the main design system they use, Intergraph SmartPlant Layout can act as the front end, regardless of the product to be used for detail design.

Plant layout designers can initially define the location of major equipment, pipe racks and other important space reservation zones used by the integrated pipe auto-router, such as attraction, avoidance and obstruction areas. Supporting this stage, designers can define and apply rules that monitor and enforce the company (or owner operator) design standards to ensure consistency, including layout of pipes inside pipe rack volumes, and minimum nozzle standout distances.

From pipe routing to reporting

SmartPlant Layout uses cost analysis to make choices between alternate routes. The costs need only be relative, or can be based on actual company information. Following initial zone definition, pipe runs are either directly input by the user, imported from an

externally created line-list spreadsheet, or derived from P&IDs. The integrated SmartPlant Layout pipe auto-router then calculates and displays the lowest possible cost pipe routes for a given plant layout and applied rules.

SmartPlant Layout routes PipeRuns – connected sets of pipe with turn, connection and size change pipe components. Each PipeRun has associated reference data – it is linked to a pipe specification that controls many default choices – such as the type of turn and branch component to use in particular situations. In SmartPlant Layout, the reference data is extended to include certain specification-driven, auto-routing-related rules and data. Both the standard and the extended reference data for the PipeRun strongly influence the results of the auto-routing calculations.

The case management feature enables the display and comparison of results from various layouts. At any point in the preliminary design process, you can generate preliminary layout drawings and review models. Similarly, SmartPlant Layout's advanced reporting capabilities help operators to create a wide variety of standard and user-defined reports, including summary bulk materials quantities for cost estimation purposes. In fact, some pre-configured reports are supplied, enabling data to be transferred directly to popular cost estimating systems.

SmartPlant Layout automated pipe routing software was designed to be quick and easy to set up, with a minimum of data. One of the frequently voiced objections to competitive systems was the time it took to define the problem to be solved. SmartPlant Layout rules build on SmartPlant Layout capability, but in addition, take account of the multiple "rules" built into the SmartPlant 3D software that is the core platform for SmartPlant Layout.

By definition, these rules cannot be changed by the user, because they need a change to logic. This type of rule is felt to be so fundamental that enabling the user to modify it would be of little value. Typically, the rule is based on good engineering practice.

An important feature of SmartPlant Layout is that it operates within the SmartPlant environment. This means that all the functions of the piping task for manually routing lines are available to the SmartPlant Layout engineer. Where detail has to be correct, it is often more productive to route pipes manually, particularly in congested areas, and then auto-route to connection points. Designed with an easy interface, it enables an experienced SmartPlant user to quickly adapt to using the front-end tool. Experienced staff can easily be redeployed according to project needs, with limited retraining. SmartPlant Layout provides more options during FEED and reduces material requirement, hence reducing costs. It also provides improved metrics and optimized design and layout, enabling companies to reduce construction time and costs.

Integrated 3D modeling offers plant designers a simple, friendly user environment with state-of-the-art graphics and powerful wizards to assist in performing even the most complex

tasks quickly and easily. Plus, 3D layout planning tools provide the ability to share designs across disciplines in real time, which saves time and money, and produces a higher quality design.

In addition to providing design teams with more time to evaluate more options, more thoroughly, today's advanced tools guarantee:

- Accurate MTO and P&IDs
- 3D models for clients
- Automated deliverables
- Scalability
- Workshare

As they tackle the whole product life cycle, these solutions:

- Promote faster, beneficial production
- Reduce capital cost
- Minimize plant operation cost
- Enable more informed decision making. ■

David Myall serves as managing director of Alias Ltd. He is based in Runcorn, Cheshire, U.K.

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Pipe Stress Analysis — Do I Really Need It?

This article is reprinted with permission from the April 2011 issue of Economic Engineering.

As concern for the safety of plants grows in the future, the requirements for better design will increase. Pipe stress is one of the most important aspects in the plant design process. Yet many users don't really know why it is necessary. But the benefits are obvious, from increased safety to increased efficiency and reduced costs.

Tremendous cost-saving potential can be realized by focusing on optimized design rather than just following a mainstream approach. For example, vessel design costs can be reduced if the nozzle loads are minimized. Expansion loops are less expensive than using expansion joints. The question arises: How can we cross the chasm between restraints and flexibility? How can we promote cost-saving initiatives within tight project schedules?

The weight of pipes and the media passing through them cause deflection. Overstressing the system can be avoided by fitting pipe restraints. The easiest way to do this is to pick a maximum span from a table and position a support. But a temperature gradient causes thermal expansion and the pipe may elongate.

Together with the internal pressure and external loads, the resulting stress can be very high.

In addition, pumps may have restricted nozzle loads, for example. Moreover, some pipe installations have to be rated against wind, earthquake, waves or other external loads. This can be achieved by introducing more flexibility into the pipe configuration, leading to a more sophisticated analysis.

CAE business value

Some companies use their own calculation tools to meet these requirements in limited areas. Rolf Limpert of BASF has compared the costs of simple verification against stress pipe analysis over a long period of time. A significant amount of money and resources may be saved by using a suitable CAE program to find an optimal design instead of relying on conservative dimensioning assumptions.

This simplified stress analysis procedure can be found in Appendix Q of ISO EN 13 480. It uses relatively large pipe lengths for flexibility and reduces loads on nozzle. Also, the ASME Code provides a similar simplified calculation method, but this is not used often, because the method is very conservative.

One of the reasons why erecting plants endures overspending is that there are not enough qualified pipe stress engineers to perform the necessary analysis work. Nevertheless, support from a dedicated CAE tool can help. So, the question arises: Why not use the capability of a pipe stress program and save money? All these demands can be met with Intergraph CAESAR II software that is easy to learn and to use. It is perfect for both professional and occasional users needing an intuitive and template-driven user interface.

Optimized by 25 years of development and feedback from customers, this product now offers a wide range of features, providing the user with an easy way to meet all requirements while saving money. Intergraph's plant design and analysis programs are extremely flexible, totally scalable and trusted by most of the leading plant engineering companies and owner operators worldwide to deliver accurate, reliable results. CAESAR II is the pipe stress analysis standard – a benchmark for all other tools available on the market.

In 2010, Intergraph acquired COADE and rebranded it Intergraph CADWorx & Analysis Solutions. This acquisition offered

the unprecedented opportunity to integrate a data exchange solution between a high-end 3D plant design product and the top pipe stress analysis product.

Intergraph's CADWorx & Analysis Solutions work together to give you the power to tackle the most challenging and complex projects with greater ease and superior results. The biggest value can be gained by integrating CAESAR II in Intergraph software to support design workflows. CADWorx Plant is able to export a native CAESAR II file format and import the results directly into the 3D model without rework. Data consistency is maintained through the whole process. This saves time and guarantees better results.

SmartPlant 3D is able to export most of the data relevant for pipe stress analysis. The results as support, hanger data or changes on the pipe run can be directly read into the SmartPlant 3D database. During this reading process, all the detail data is stored without any loss for further detailing. Since a lot of data about pipe stress is available in the early stages of the project life cycle, engineering changes can be done at much lower expense.

CAESAR II core features

Stress evaluation can be performed in compliance with more than 30 international piping codes to meet local requirements. CAESAR II evaluates fiber-reinforced plastic (FRP) and buried piping. Interfaces to other programs speed up data transfer and reduce errors. Comprehensive material databases from most codes available on the market are ready for use.

Many other valuable calculations are included. Maximum flange or nozzle loads can be imported and compared with specifications. CAESAR II calculates API 610, WRC 107/297, flanges and more. Pipes and nozzles are checked if they fail due to fatigue problems over time. Plant models in DWG format can be imported to improve the overview of the complete project.

Elements can be placed with the help of visual support. The Expansion Loop wizard uses a cube built up directly on steel supports.

Calculation results are stored in a database and can be exported in a broad variety of data formats. The results can be depicted in standard reports or in a customized layout fulfilling professional documentation requirements. 3D plots or animations can also be added to the results.

Nozzle loads can be exported directly to the pressure vessel solution PV Elite. Since most pressure vessel designers use this software, everyone benefits from this integration. CAESAR II is able to calculate steel structures. The data can be imported from CADWorx, FrameWorks® Plus or other software. This integrated feature can be used as easily as pipe stress calculation. Another remarkable feature that can save a lot of resources is the ability to perform dynamic calculations. The dynamic load factor is typically used quite conservatively, resulting in a lot of money being wasted.

Since the calculation model is already built-up, this feature is worth using. It includes seismic load evaluation, forced vibration, hammer loads, natural frequency, response spectrum, time history analysis, slug flow and more.

ISOGEN is the world's leading solution for the total automation of piping isometric drawing production and the de facto standard CAD system for drawing piping isometrics included in CAESAR II. All the relevant data can easily be picked and placed on an isometric output. Company profiles can be used to deliver high-quality outputs. With the ISOGEN wizard I-Configure™, all parameters can simply be chosen from a list of options. A preview is used to shift all the data into place. Experienced users can also use the Project Manager. After this setup, isometric drawings can be generated for different projects in the same professional quality.

CAESAR II improves results and helps users find the best engineering solution. For instance, the Expansion Loop wizard generates the best possible loop for a given value. All the different options are calculated and the best is chosen for each specific case. The seismic wizard transforms the data provided into simple G loads. Many hanger producers have made their data available for CAESAR II. The user simply selects one of them to gain the best results in this mode. There is no need to import further data from other sources.

The same easy option can be chosen for expansion joints. Just choose a company and the wizard inserts all the relevant components into the model. Line numbers from pipes improve orientation because different pipe runs can be easily selected. 3D plots help the user identify possible issues in the model. Color-coded stress models and animated displacements for any load case are available. These visualization techniques help the user to gain an overall picture of the problem, to identify critical sections and to find the best solution. Such tools take the guesswork out of producing accurate analysis, recommend practical design changes and help bridge the gap between knowledge and experience. So CAESAR II changes over the time of usage from a validation to a solution tool. ■

www.intergraph.com/go/cadworx

Jörg Theis is an application engineer at Intergraph Process, Power & Marine. He is based in Düsseldorf, Germany.

A Breath of Fresh Air

» From refrigeration pioneer to global leader in industrial gases and engineering

To this day, the inventions of Carl von Linde and the many ensuing developments are the mainstays of The Linde Group, such as apparatus engineering, the business with technical and medical gases or cryogenics. Its technologies have been used to do everything from cooling beer to launching rockets. The Linde Group is an international industrial gases and engineering company headquartered in Munich, Germany, with a history that goes back more than 130 years.

Carl von Linde developed his groundbreaking refrigeration machine in 1868, which attracted attention from large brewers such as Heineken and Carlsberg. The engineering firm Gesellschaft für Linde's Eismaschinen AG was founded in 1879 and soon became the European market leader.

Industrial gases

Linde moved on to developing lower temperature systems, which ultimately laid the foundation for the industrial gases industry.

By discovering how to produce pure oxygen in 1903, Linde contributed essentially to the rapid spread of autogenous (gas) welding and cutting. And in 1912, Friedrich and Richard, the sons of Carl von Linde, together with their brother-in-law Rudolf Wucherer, built a two-column apparatus that could produce oxygen and nitrogen at the same time.

BOC is born

Another company would cross paths with Linde. In 1880, brothers Arthur and Leon Brin patented a chemical process for separating oxygen. Brin's Oxygen Company Ltd. was founded in 1886. The first commercial application for oxygen was the theatre – more specifically, to the "laterna magica," used in the popular shows at the time, and the lighting in the theatres and concert halls.

BOC had to give up its own oxygen production in favor of the Linde liquefaction process in 1906 after losing a patent dispute. The company was renamed The British Oxygen Company and Carl von Linde became a member of the Board of Directors of BOC.

Two world wars

During World War I, Linde mainly produced oxygen plants for the production of saltpeter, used for fertilizer as well as explosives. Other oxygen plants were built to support metal processing, such as welding and cutting technology. Linde also built refrigeration, freezing plants and cold storage facilities to preserve and store food. During this period, Linde also developed a process for separating coke oven gas to produce a mixture of hydrogen and nitrogen for synthesizing ammonia. By 1929, Linde's son-in-law Rudolf Wucherer built more than 20 new oxygen plants and quadrupled their output.

Through a number of acquisitions, Linde developed from an engineering firm into a manufacturing company. In 1920, Linde took over Maschinenfabrik Sürth, which produced small refrigeration machines for the food sector as well as air liquefying machines. In 1922, Linde acquired a share, and later, the remainder, of Heylandt-Gesellschaft, which was to play a vital role in the rocket program of Wernher von Braun during World War II.

BOC grows with new processes

BOC played a vital role in the vast manufacturing effort after the outbreak of World War I in 1914, since British munitions, tanks, vehicles and shipbuilding all relied on the new cutting and welding technology.

In the early 1930s, the Heylandt system was developed for transporting oxygen in liquid form. This meant that large users could receive bulk supplies quickly and cheaply in special tankers rather than in heavy metal cylinders.

Thanks to its international expansion during the 1930s, BOC was able to develop the production of calcium carbide to make acetylene in Australia, India and South Africa. In 1939, BOC again found itself at the forefront of the war effort in Britain, building an electrolytic hydrogen plant in the UK to supplement supplies of hydrogen used for barrage balloons.

The 1950s were a time of expansion for BOC. The company installed plants dedicated to the production of oxygen on-site at steelworks, and a large volume of gas was provided daily by pipeline. Toward the end of the decade, BOC became involved in rocket testing, supplying gases for Thor missiles.

BOC continued to grow in the 1960s. The discovery in 1965 of oil and gas under the North Sea resulted in growing demand for vessels and components welded with high standards to withstand high stresses at sea.

Post-war economic miracle

Most of Linde's plants were damaged or destroyed during World War

II. By 1946, the company was profitable again. Linde owes its fast recovery to the fact that it did not manufacture any actual weapons and therefore was allowed to continue its existing production program. By 1951, Linde set up additional oxygen plants and was able to put disused plants back into operation.

Linde AG gradually withdrew from the refrigerator business between 1965 and 1967. In response to the requirements of customers in the chemical and petrochemical industry, it moved into large plant engineering.

Global expansion

Under the leadership of Dr. Hans Meinhardt beginning in 1976, Linde was restructured into a technology group with a new strategic orientation. In the following more than 20 years, he made Linde one of the largest industrial groups in Germany with world-leading market positions in mechanical and plant engineering and industrial gases.

In the 1990s, the plant engineering division installed plants in Eastern Europe, the former Soviet Union and China. In 1999, Linde regained its name and brand rights in the U.S., which had been lost as a result of the two World Wars. In the same year, Linde acquired Swedish gases producer Aktiebolag Gasaccumulator AB (AGA). This made Linde the fourth-largest gases supplier worldwide.

BOC's landmark achievements

In 1978, BOC doubled its size by fully acquiring the U.S.-based gases company, AIRCO, to become one of the world's largest industrial gases companies. It enjoyed significant increases in sales of nitrogen and special gases, especially to the food and electronics industries.

In the 1990s, concern over the effects of greenhouse gases led the company to supply non-CFC refrigerants. Meanwhile, BOC's food and drink packaging business expanded and matured, and the use of nitrogen and carbon dioxide for refrigerated transport increased.

One of BOC's biggest investments was to become the world's largest nitrogen plant, built in Mexico by Linde Engineering in 2000. It supplies nitrogen to boost oil production at the world's largest offshore oilfield, located in the Gulf of Mexico.

Realignment for success

In 2003, Professor Dr. Wolfgang Reitzle was named president and CEO of Linde AG. Under Reitzle's leadership, business activities were streamlined. For example, Linde's cooling technology unit was sold to Carrier Corp.

In 2006, Linde AG acquired The BOC Group and sold its Material Handling division, which was rebranded as KION. This made the new Linde Group the world-leading industrial gases and engineering company.

Today the company has more than 49,000 employees working in more than 100 countries worldwide. In 2010, it recorded US$17.9 billion in revenue. The Linde Group's two primary business areas are Gases and Engineering.

Linde is a world leader in the international gases market. The company offers a wide range of gases supply options for customers in industries ranging from energy, metals and chemical processing to food processing, air and water treatment and electronics manufacturing. The company also is investing in the expansion of its fast-growing healthcare business, which includes medical gases and related technology, and is a leading global player in the development of environmentally friendly hydrogen-energy technologies. ■

Linde Engineering designs and builds large-scale plants for the production of industrial gases, including oxygen, nitrogen, argon, hydrogen and synthesis gas, as well as large plants associated with the production and processing of liquefied natural gas and olefins.

1879 Gesellschaft für Linde's Eismaschinen AG Ltd. is founded.

1886 Brin's Oxygen Company Ltd. is founded.

1903 Linde succeeds in producing pure oxygen.

1912 Linde two-column apparatus produces oxygen and nitrogen at the same time.

1922 Linde acquires Heylandt-Gesellschaft.

1946 Linde turns a profit remarkably quickly after the war.

1965 BOC business grows with oil and gas discovery under the North Sea.

1978 BOC completes AIRCO acquisition, doubling its size.

1999 Linde acquires AGA.

2006 Linde acquires The BOC Group.

www.linde.com

» At A Glance

Latest Smart 3D Versions Offer Quality and Productivity

Intergraph has released the latest versions of its next-generation plant, offshore and materials handling design solutions, SmartPlant 3D, SmartMarine 3D and SmartPlant 3D Materials Handling Edition. Collectively known as Smart 3D, they are the process, power and marine industries' most advanced and most productive design solutions with a focus on rules, relationships and automation.

All three Smart 3D 2011 Service Pack 1 (SP1) solutions are now available for upgrade or purchase. They are the most feature-rich, highest-quality releases of SmartPlant 3D, SmartMarine 3D and SmartPlant 3D Materials Handling Edition with nearly 1,200 enhancements and continuous testing over the past 20 months. Key Smart 3D customers have tested the solutions for production.

"Smart 3D is a very advanced and powerful solution which improves design and document quality, as well as data control – all while saving time and resources," said Terje Ørbeck, CAD manager for Grenland Group, an experienced oil and gas EPC based in Norway, and a key SmartMarine 3D user. "Compared to our previous design system, we have improved our workflow considerably. Using Intergraph integrated Smart 3D solutions, Grenland Group is able to compete with larger engineering companies by increasing our quality and productivity."

www.intergraph.com/ppm

Toyo Engineering Corp. Standardizes on SmartPlant Enterprise

Toyo Engineering Corporation (TOYO), a Japan-based EPC, has standardized on SmartPlant Enterprise solutions, including SmartPlant 3D, SmartPlant Foundation and SmartPlant Materials. TOYO will implement the integrated suite of SmartPlant Enterprise solutions at its project execution centers globally.

TOYO sought to implement a leading engineering technology platform across its group of project execution centers in 16 countries around the world under its framework of Global Toyo. TOYO has been a longstanding customer of Intergraph, and the company decided to standardize on SmartPlant Enterprise, recognizing the advantages provided in SmartPlant Enterprise to improve its engineering efficiency and productivity. This is aligned with TOYO's strategic plan to support global project execution. The company will use Intergraph solutions in every engineering discipline, such as SmartPlant 3D for 3D design and SmartPlant Foundation for data and document management, as well as integration.

"We have been utilizing Intergraph solutions for a long time, and it is a natural progression to standardize on industry-leading SmartPlant Enterprise, including SmartPlant 3D, as our engineering technology platform across our offices globally," said Toshio Hayashi, Deputy General Manager of the IT Management and Control Unit at TOYO. "SmartPlant Enterprise will enable us to execute our engineering projects seamlessly under Global Toyo, while enhancing the safety, quality and productivity of our projects."

www.toyo-eng.co.jp

Next-generation Cruise Ships to be Designed with SmartMarine Enterprise

Intergraph has signed a five-year contract with STX Europe, one of the major international players in the shipbuilding industry. STX France Solutions has purchased SmartMarine Enterprise to improve its shipbuilding design efficiency and quality, while achieving better project stages coordination and accurate material management.

The agreement includes Intergraph SmartMarine 3D and SmartPlant Foundation, SmartPlant P&ID, SmartPlant Instrumentation, SmartPlant Electrical Basic and Detailed, SmartPlant Materials, SmartPlant Foundation, SmartPlant Review and SmartPlant Review Publisher. The new system will help STX to reduce design man-hours and to improve its design quality with inte-

gration between disciplines and by sharing standard catalogs along the project life cycle. This will also enable STX to reduce costs.

"We selected SmartMarine Enterprise after several months of evaluation and pilot projects because the software suite proposes a large scope of integrated functionalities, required to design complex works as cruise ships are," said Christophe Dutrieux, CIO of STX France. "It enables us to coordinate activities of hundreds of designers and subcontractors, by sharing the same model, the same catalogs, and by building a single bill of material of the ship. It provides us with the means to reduce design hours, to enhance our design quality and to improve integration and coordination between design and construction."

www.stxeurope.com

Kuwait National Petroleum Co. Relies on SmartPlant Enterprise

Kuwait National Petroleum Company (KNPC) will use SmartPlant Enterprise engineering design and information management solutions to retrofit and increase the capacity of its Mina Al-Ahmadi refinery. To respond to unprecedented growth in the global demand for energy, KNPC will update its plants to increase production. Intergraph's solutions will ensure a longer and more efficient plant life cycle.

After intensive benchmarking of the major plant engineering and operation solution providers, KNPC was convinced that Intergraph's SmartPlant Enterprise best meets its current and future requirements related to production increases, safety and shortening of project schedules. "We are pleased to have Intergraph as our technology partner to support the growth of our refinery," said Mohammad Asad Alawady, Senior Engineer, Engineering and Maintenance at KNPC, Mina Al-Ahmadi. "SmartPlant Enterprise integrated solutions, including SmartPlant Foundation, will enhance KNPC's design process through the effective management of high-quality engineering data for all of our projects."

KNPC will use several solutions, including SmartPlant 3D, SmartPlant Foundation, SmartPlant P&ID, SmartPlant Instrumentation, SmartPlant Electrical and SmartPlant Review. The project will be managed by CyberMAK Information Systems W.L.L (Al-Kharafi Company) in partnership with Atheeb Intergraph Middle East LLC, Intergraph's distributor in the Middle East.

www.knpc.com

China National Offshore Oil Corp. Selects SmartPlant Foundation

China National Offshore Oil Corporation (CNOOC), the largest offshore oil and gas producer in China, chose SmartPlant Foundation to manage the engineering information of its offshore platforms and oil fields as part of CNOOC's Engineering Digital Information System (EDIS) project.

CNOOC sought to set up a sophisticated information management system and selected SmartPlant Foundation

because the company determined that it is the most advanced and technically superior solution available in the market. SmartPlant Foundation will be used to develop EDIS, which will manage the engineering information of 33 offshore platforms for three of CNOOC's four oil fields, located in Tianjin, Shenzhen and Zhangjiang. SmartPlant Foundation's data-centric capabilities and single-source-of-information concept will support all of the company's requirements, including the management and implementation of engineering changes for enhanced safety, improved quality of data and increased productivity and efficiency.

"We are extremely confident that our EDIS project, built on SmartPlant Foundation, will be successful," said Mr. Jin Xiaojian, general manager of the Engineering & Construction department at CNOOC. "Intergraph has a highly experienced and knowledgeable SmartPlant Foundation implementation team in China to support our EDIS project, and we expect to expand this project in the future to include the rest of our existing offshore platforms."

www.cnooc.com.cn

Events and Announcements

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Engineering Experts Convene to Discuss Safety, Quality and Productivity

Record numbers of attendees gathered in regional users conferences around the world. The events were sponsored by Intergraph's Process, Power & Marine (PP&M) division.

"Our customers have always been Intergraph's key focus. These conferences give us the opportunity to show them how our industry-leading solutions can help them enhance safety, improve quality, boost productivity, reduce timelines and ensure data accuracy across the facility life cycle," said Gerhard Sallinger, president of Intergraph PP&M.

Canada

Intergraph 2011 PP&M Canada was held Sept. 21 in Calgary, Alberta, bringing the country's top process, power and marine companies together for a day of informative sessions and networking among industry leaders.

Keynote sessions featured Barbara Zambon of Shell Global Solutions Canada and Simon Spurrier of AMEC, as well as Charles Evans, chief technology officer for Intergraph PP&M, and Sven Gebhardt, vice president of Intergraph PP&M Canada. Twenty breakout sessions covered the broad Intergraph SmartPlant and SmartMarine Enterprises solution portfolio, along with five Technical User Forum (TUF) meetings.

"Canada is a major player in the global economic community, particularly in the energy and mining sectors," said Don Brundage, Intergraph PP&M executive vice president for the Americas. "The Athabasca oil sands in northeastern Alberta give Canada the second largest proven oil reserves in the world behind Saudi Arabia. Canada is vital to our business, and our Calgary regional office continues to be one of our company's largest to support our many Canadian customers.

"The conference offers an excellent opportunity for industry leaders to come together and discuss common issues affecting engineering, procurement and construction companies and owner operators alike," said Simon Spurrier, Engineering Systems Department Manager at AMEC.

Asia-Pacific

The Intergraph 2011 Asia-Pacific user conferences were held in July and August in eight cities:

- Pattaya, Thailand
- Jakarta, Indonesia
- Yokohama, Japan
- Qingdao, China
- Adelaide, Perth and Brisbane in Australia
- Seoul, Korea

Approximately 2,000 delegates attended user conferences in six countries, marking the highest-ever attendance for these annual user events in the region.

The industry-leading conferences featured Intergraph's next-generation SmartPlant and SmartMarine Enterprise port-

[UPCOMING EVENTS] www.intergraph.com/events

See the conferences, tradeshows and industry events in which Intergraph will participate in areas around the world. Check out www.hexagon2012.com for our annual users' conference, Hexagon 2012, June 4-7 in Las Vegas.

By LEBRON MILES

folios, Intergraph CADWorx & Analysis Solutions and Leica Geosystems' Smart Scanning solutions, offering attendees unprecedented scope and value. Employing the theme "Building a Smarter World," these conferences demonstrated Intergraph technology that empowers organizations to build a smarter world through industry-specific technologies that make processes and infrastructures better, safer and smarter.

Intergraph global and regional management delivered insightful keynote presentations on industry trends and latest innovations, while key customers from around the Asia-Pacific region shared compelling testimonials for delegates to leverage industry best practices. Intergraph's SmartPlant 3D and SmartMarine 3D (collectively known as Smart 3D) solutions – the world's most advanced 3D engineering design solutions – continue to make waves in the industry, drawing keen interest from delegates eager to learn more about Smart 3D technology and leverage it for enhanced safety, improved quality and increased productivity of their plants and offshore facilities.

"This year's record attendance numbers are a testament to Intergraph's unwavering commitment to our customers, in providing the latest technology innovations and supporting their business for continued success," said Thomas J. Doran, Intergraph PP&M executive vice president in Asia-Pacific. "Our successful user conferences validate Intergraph's leadership position in the process, power and marine industries, and we are pleased to see our customers embrace and use our solutions to build a smarter world. We look forward to working closely with our customers as their trusted engineering technology partner, and welcoming them back at next year's conferences." ■

Lebron Miles is managing editor of Insight *and is based in Huntsville, Alabama, U.S.*

INTERGRAPH CADWORX & ANALYSIS UNIVERSITY

CADWorx & Analysis University 2011 (CAU2011) in Houston, Texas, U.S. was held Sept. 19-21 with keynote presentations by Rick Allen, senior vice president, Intergraph CADWorx & Analysis Solutions (Intergraph CAS), and Patrick Holcomb, executive vice president, Global Business Development, Intergraph PP&M, during which Intergraph announced new initiatives and investments for Intergraph CAS products and services.

This year's CAU2011 keynotes carried the theme of "Enhancing Productivity through Collaboration" and focused on the Intergraph CAS vision for plant design and engineering. Emphasis was given to current and future product developments, and the progress made on Intergraph's commitment to integrate the Intergraph CAS products with the company's SmartPlant Enterprise solutions. Also outlined were the increased resources being made available to speed the future development of the Intergraph CAS product portfolio.

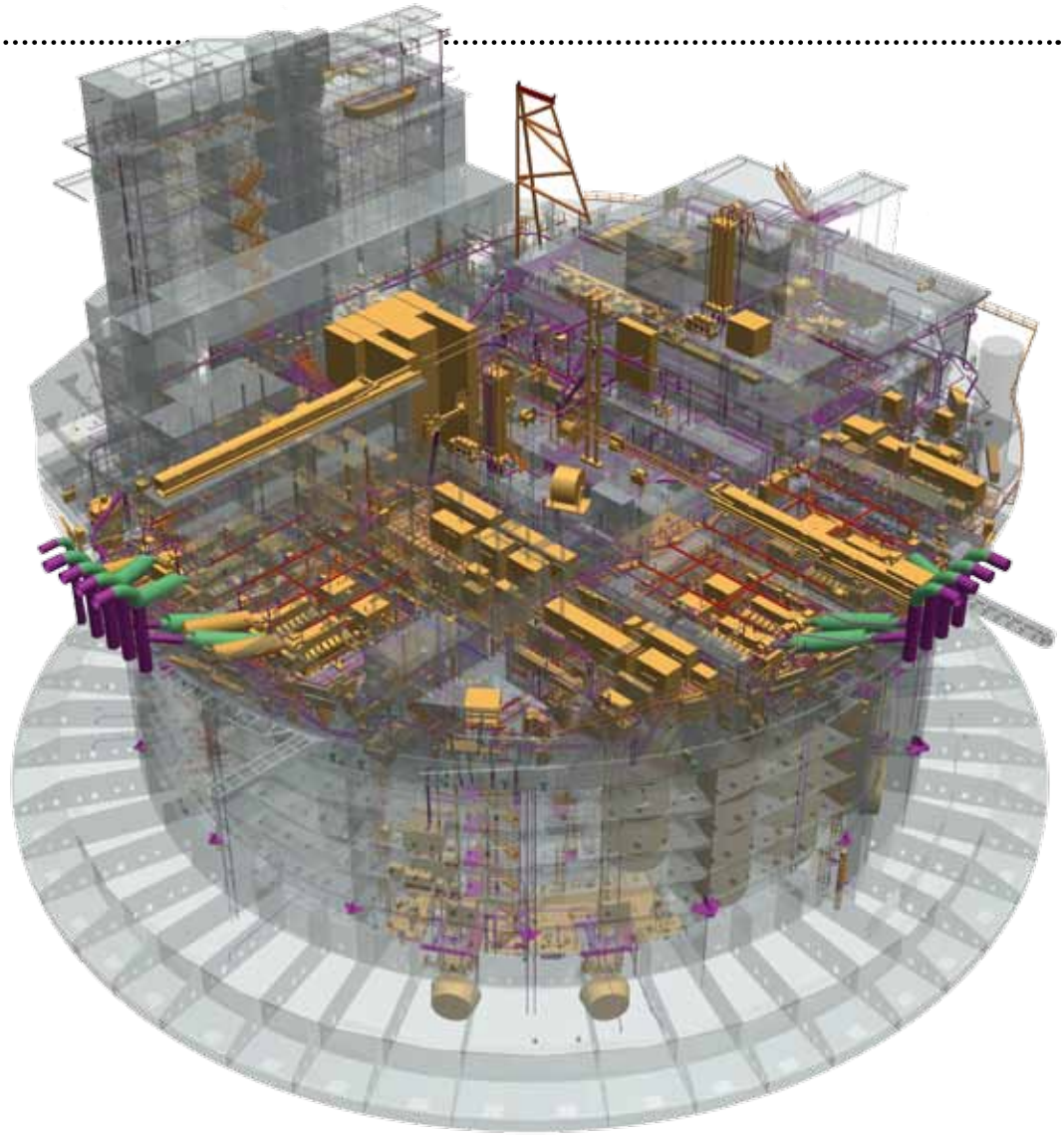
In its fourth year, CAU delivered a quality educational experience that included more than 55 classes and hands-on labs, all delivered by expert users and program developers, plus real-life case histories and development forums to help attendees get more out of their investment.

"CADWorx & Analysis University is always important because it gives us the opportunity to listen to our users and share with them methods to make them more effective and productive," Allen said. "After these three days, attendees will leave with knowledge that would sometimes take years of trial and error to obtain."

Gerhard Sallinger, president of Intergraph PP&M, said, "For many years CADWorx, CAESAR II and PV Elite have delivered best-of-class plant CAD and analysis capabilities. CADWorx has proved itself to be the most effective AutoCAD-based plant design solution, with billions of dollars of successfully completed projects to its name.

"Intergraph acquired the COADE portfolio in early 2010, not only because we recognized the existing synergies that these solutions delivered, but also because of the value of integrating COADE's products with our market-leading SmartPlant Enterprise solutions," Sallinger said. "We are driven to make these powerful synergies available to all of our users, whether they are small engineering firms, larger EPCs or owner operators." ■

The 2011 Golden Valve Winners



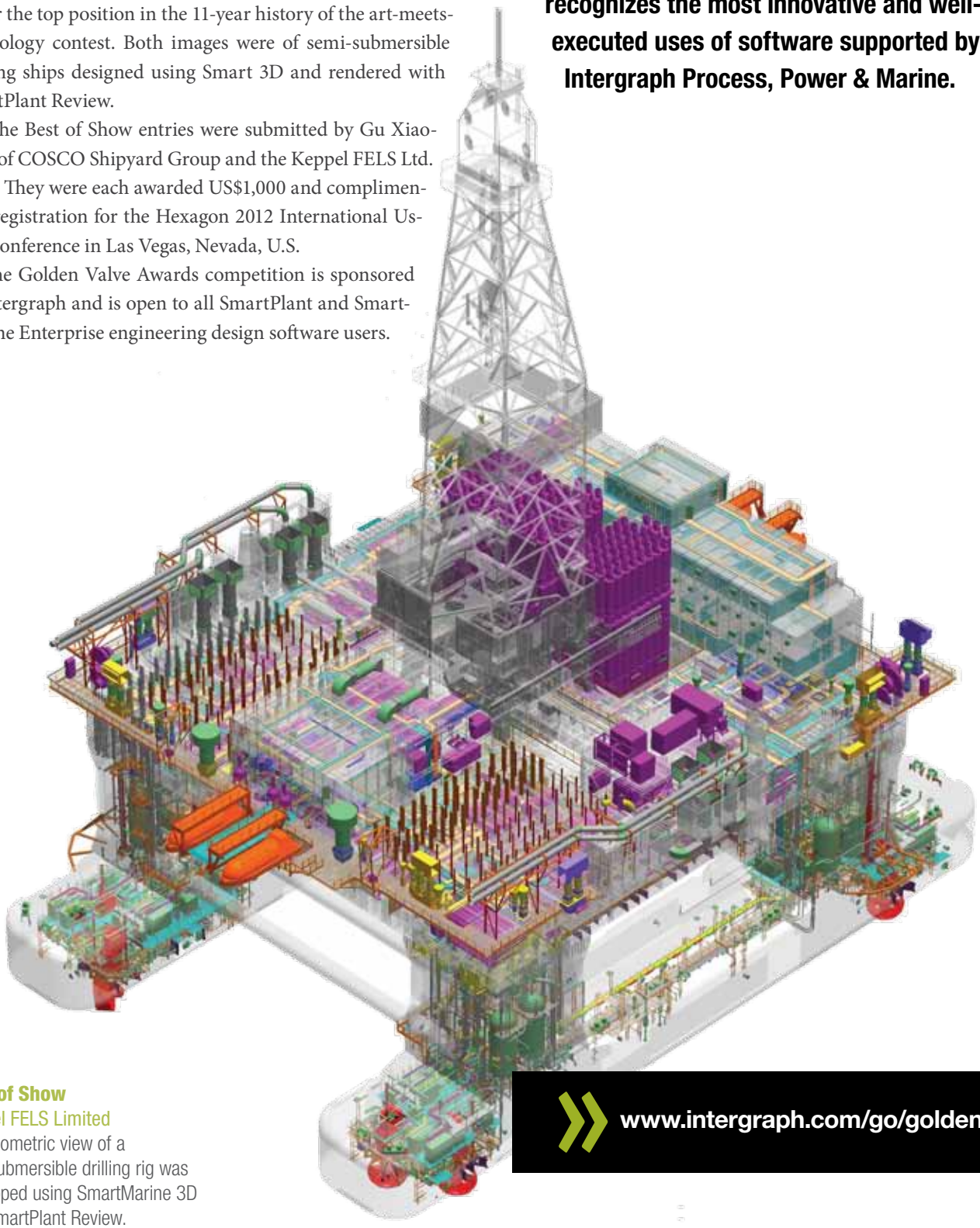
Best of Show
Gu Xiaogang, COSCO Shipyard Group
SmartPlant 3D and SmartPlant Review were used to create this isometric view of the Sevan 650 drilling rig.

COSCO Shipyard Group and Keppel FELS Ltd. tied for Best of Show in the Golden Valve Awards Competition – the first tie for the top position in the 11-year history of the art-meets-technology contest. Both images were of semi-submersible drilling ships designed using Smart 3D and rendered with SmartPlant Review.

The Best of Show entries were submitted by Gu Xiaogang of COSCO Shipyard Group and the Keppel FELS Ltd. team. They were each awarded US$1,000 and complimentary registration for the Hexagon 2012 International Users' Conference in Las Vegas, Nevada, U.S.

The Golden Valve Awards competition is sponsored by Intergraph and is open to all SmartPlant and SmartMarine Enterprise engineering design software users.

» The Golden Valve Awards competition recognizes the most innovative and well-executed uses of software supported by Intergraph Process, Power & Marine.



Best of Show
Keppel FELS Limited
This isometric view of a semisubmersible drilling rig was developed using SmartMarine 3D and SmartPlant Review.

» **www.intergraph.com/go/goldenvalve**

1st Place

Discipline-specific

Martin T. Ammann Jr.

This image highlights the amount of raceway tray designed for Westinghouse Electric Company's AP1000® containment building. PDS and SmartPlant Review were used for this project.

2nd Place

Discipline-specific

Jakub Zgorzelski and Łukasz Ciepłucha, ORLEN Projekt S.A.

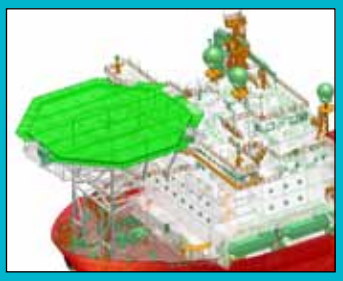
This image of the hydrofluoric acid alkylation unit for PKN ORLEN S.A. in Poland was created using SmartPlant 3D and SmartPlant Review.

3rd Place

Discipline-specific

Young-min Kang, Samsung Heavy Industries

Created with SmartMarine 3D, this image shows a drillship, focusing on detailed steel outfitting objects of the forward area.



1st Place

Rendering and Ray Traces

Bruno Holtz Gemignani, UTC Engenharia

UTC Engenharia chose SmartPlant 3D, SmartPlant P&ID, SmartPlant Instrumentation, and SmartPlant Electrical for the Petrobras P55 offshore platform project.

2nd Place

Rendering and Ray Traces

ECM's Engineering Team, ECM

This iron ore processing plant for Vale in Brazil was designed with the objective to centralize all information in a single database. SmartPlant 3D and SmartPlant Review were used to create this image.

3rd Place

Rendering and Ray Traces

Yudong Liu, CPECC East-China Design Branch

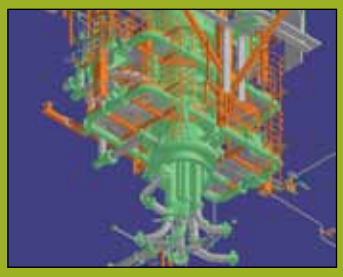
A 10 million ton-per-year atmospheric and vacuum distillation unit is part of a monomer chemical refining project for Sichuan Petrochemical Enterprise.

1st Place

Visually Complex

Birla Saravanan, Grenland Group

For the Åsgard project in Norway, Grenland Group selected SmartMarine 3D, PDS and SmartPlant Review.



2nd Place

Visually Complex

Ethane Project Team, Y&V Ingenieria y Construccion

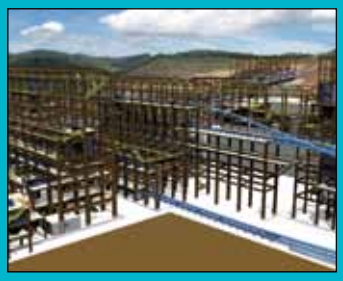
Developed with PDS and SmartPlant Review, this 3D model shows a general view of a plant that will remove carbon dioxide from natural gas.

3rd Place

Visually Complex

ECM's Engineering Team, ECM

ECM chose SmartPlant 3D and SmartPlant Review for this brownfield project. The image depicts an iron ore processing plant revamp for Vale in Brazil.



1st Place

Animation

Casey Fardoun and James Smith, Burns & McDonnell

This benzene reduction plant was laser-scanned using Leica Geosystems technology. The animation incorporates point cloud data combined with the PDS design to ensure design and modeling accuracy.

Judges' Choice, Offshore

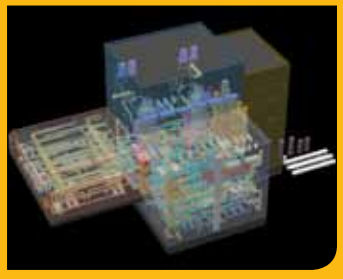
Waldir Pimentel Junior, Genpro Engenharia

This image created with SmartPlant Review focuses on the Petrobras PRA-1 platform modules 12 (process) and 4 (power unit).

Judges' Choice, Power

Penghui Sun & Xu Zhang, Chinergy Co. Ltd.

SmartPlant Review and SmartPlant 3D were used for the high temperature gas-cooled reactor (HTGR) nuclear plant design and construction simulation.



Platinum Pipe Awards

Samsung Heavy Industries, based in Korea, and Promon Engenharia of Brazil received first prize in the Platinum Pipe Awards Competition for most innovative automation ideas for SmartPlant and SmartMarine Enterprise solutions in the 3D and Engineering & Schematics categories, respectively.

SHI's winning 3D entry is based on a SmartMarine 3D rule that automatically arranges cable trays and places coaming arrangements. SHI reports that the automation is being used in production and reduces 400 man-hours per project. A SmartMarine 3D user since 2004, SHI has built the world's largest number of drill ships and has successfully delivered the world's largest marine platforms and semi-submersible drilling facilities. The entry was submitted by Hong Seo Ahn of SHI.

1st Place

Smart 3D

Samsung Heavy Industries Co. Ltd.

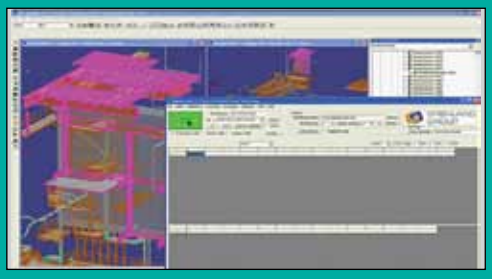
SHI's winning 3D entry is based on a SmartMarine 3D rule that automatically arranges cable trays and places coaming arrangements. SHI reports that the automation is being used in production and reduces 400 man-hours per project.

2nd Place

Smart 3D

Grenland Group

Grenland's winning entry, "BIG," provides a familiar foundation on which to build new applications. Examples are piping progress, structural renaming, center of gravity display, and highlighting view style creation.

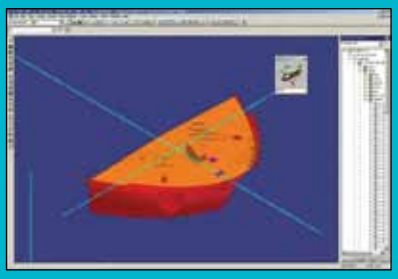


3rd Place

Smart 3D

Samsung Heavy Industries Co. Ltd.

This automation places mooring equipment at the correct location efficiently and easily. It prevents human errors during modeling.



3rd Place

Smart 3D

Chinergy Co. Ltd.

With Symbol Studio, designers can combine all the basic shapes and nozzles into a new symbol entity. Users can easily generate the corresponding source code and data files needed for the Bulkload tool.

Promon captured the Engineering & Schematics automation prize by developing a utility to improve SmartPlant P&ID users' productivity through property grid management. The utility allows the engineer to focus and be presented only with the data and attributes for the task at hand. Promon's Tiago Alexandre submitted the winning entry. Promon Engenharia is part of the Promon Group. Its activities include design, integration and implementation of complex infrastructure solutions for the power, oil and gas, process, and metals and mining industries.

1st Place

Engineering & Schematics

Promon Engenharia

This utility improves SmartPlant P&ID users' productivity through property grid management.

2nd Place

Engineering & Schematics

TAIYO NIPPON SANSO Corporation

Valve accessories are automatically generated in SmartPlant P&ID with this automation.

Engineering & Schematics Excellence Awards Presented to 21 Customers

» Awards recognize benefits received through successful deployment

Intergraph presented the 2011 Intergraph Engineering & Schematics Excellence Awards in recognition of the successful deployment of Intergraph engineering and schematics solutions in customers' organizations worldwide.

Customers were selected to receive the award by the entire Intergraph Engineering & Schematics team for being a valuable contributor in making Intergraph products successful – not only for their own company, but also for the industry as a whole.

The award winners fully take advantage of the benefits that the Intergraph solutions provide to grow productivity, engineering quality and data accessibility in their project execution or plant operations.

Dov Kelner
Bazan Oil Refineries

Shimon Tregerman
Bazan Oil Refineries

Will Brasseur
CB&I Lummus

Gene Haney
CB&I Lummus

Rene van Strien
CB&I Lummus

Doug Nowell
Canadian Natural Resources Limited

Sally Fuidge
Chevron Corporation

Dennis Cooley
CooleyCore Associates

Kevin Saul
The Dow Chemical Company

Dario G Rigaud M
Empresas Y&V

Todd Bordelon
ExxonMobil Corporation

Martin Rittmeister
The Linde Group

Joe Lawrence
Mustang Engineering

Joachim Käding
Raffinerie Heide

Shaia Al Harbi
SABIC

Ahmad Al Abbad
Saudi Aramco

Ali Khan
Saudi Aramco

Manfred Graffy
Shell

Matteo Brignola
Technip

Lorna Barnhart
WorleyParsons

Paul Critcher
WorleyParsons

Joachim Käding, engineer at Heide Refinery, receives the Engineering & Schematics Award from Marcel Gaide, sales representative at Intergraph. From left to right: Thomas Duerr, global business development manager at Intergraph; Peter Hannemann, engineering and maintenance manager at Heide Refinery; Joachim Käding; and Marcel Gaide.

By JOE MORRAY

Going Enterprise

The most common scenario for introducing a new system to a company is to start with a pilot initiative in which an application is used within a particular division to demonstrate that the new system can successfully support the business processes and information requirements of that division. Once that is achieved, the system is deployed to other divisions and/or geographic locations. Unfortunately, new problems often arise during this critical period of the delivery cycle. What happens, and what is different, when you go "enterprise"? Consider these experiences:

Typically, there are "champions" during the pilot phase. These are people who have a specific commitment to seeing the application succeed; this role needs to be duplicated in other divisions. Frequently, the "buzz" is reduced as the third and fourth groups take on the applications. Therefore, it is essential that management identify champions within each new division. The success in one group does not reduce the need for driving champions within each individual new group.

The work processes and information requirements may be different from division to division, and so it is mandatory to ensure that we go through all of the discovery steps within each group. Phases, such as requirements definition, piloting on a small effort, and ensuring that the data models fit the needs of that division, are essential. Although we are always looking to establish corporate standards, it is important that these standards evolve based on multiple best practices within different organizations. It frequently involves more work (the occasional recycle), but ultimately will ensure a broader adoption of the system.

Going from pilot to enterprise requires that the training and support model evolve to a distributed model, which ensures that support is provided in the time zones where work is being done and that the training is delivered in the language that will most enhance the knowledge transfer. Deploying computer-based training allows for multiple languages to be laid into the video segments and ensures that training can be done by the employee at a time and location that fits their needs.

The move to enterprise also requires that communities of use are established, which utilize web-based systems for posing questions and exchanging best practices. These "virtual" user groups are possibly the most critical and innovative step that can be taken when you go enterprise. This virtual exchange of information is one of the most common forms of communication for the younger generation that has been raised on social media.

So, as an application goes enterprise, celebrate the success and recognize that there are some additional steps required for continued expansion. With these additional steps, the roots supporting the application deployment will grow stronger, ensuring a greater return on corporate investment. ■

Joe Morray is president of Trinity Technologies Corp., a process and power industries consulting firm that helps owner operators and EPC firms succeed in the use of information systems. The company specializes in driving companies to align work processes, technology and organizational change requirements for the plant environment.

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