

ENGINEERING AUTOMATION

OCTOBER 2003

REPORT

www.eareport.com

The Newsletter for Engineering Management

Reprinted from
Engineering
Automation
Report
October 2003
Volume 12
Issue 10
©2003
Cyon Research
Corporation

SmartPlant 3D: Changing the Future of Engineering

By David Cohn

After spacecraft and airplanes, processing plants, offshore drilling rigs, and large ships are among the most complex engineering projects, demanding the skills of numerous engineering disciplines. Those involved often span a natural bridge between the AEC and MCAD worlds. Intergraph's Process, Power & Offshore division (formerly known as the Process & Building Solutions division) has been the leading software provider in this realm for a quarter of a century. The company's SmartPlant family of products provides the tools for producing schematic designs, piping and instrumentation diagrams (P&IDs), and the other drawings and engineering data needed to build these complex facilities. Its Plant

September 2000 issue. At that time, we noted that the company was a strong proponent of the concept that today's technology needs to be utilized throughout the entire lifecycle of power and process plants. "No longer is it simply a matter of how quickly a designer can put lines and circles on a sheet of paper. The key element is managing information and the relationships that are dependent upon this information."

In recognition of this, and also addressing the fact that much of its software was based on technologies and methods that had been around for more than two decades, the Process, Power & Offshore division began a seven year research and development initiative to turn its vision into a product offering a data-centric, rule-driven solution for streamlining engineering design processes while preserving existing data and making it more usable and more re-usable. The fruits of these labors is SmartPlant 3D.

Design System (PDS) is a comprehensive production-focused design and engineering application for plant design, construction, and operations. And Intergraph's SmartPlant Foundation software provides the means for sharing and re-using plant information throughout the plant lifecycle.

Engineering Automation Report last looked at this Intergraph division in the

While existing tools focus on achieving design and have reduced fieldwork, SmartPlant 3D focuses on reducing project schedules and achieving design productivity. SmartPlant 3D represents a brand-new technology, providing what Intergraph sees as a significantly better way to design a plant. The new product was announced earlier this

INSIDE
THIS ISSUE

SPECIAL
REPRINT

featuring

Intergraph Process,
Power & Offshore

Madison, AL

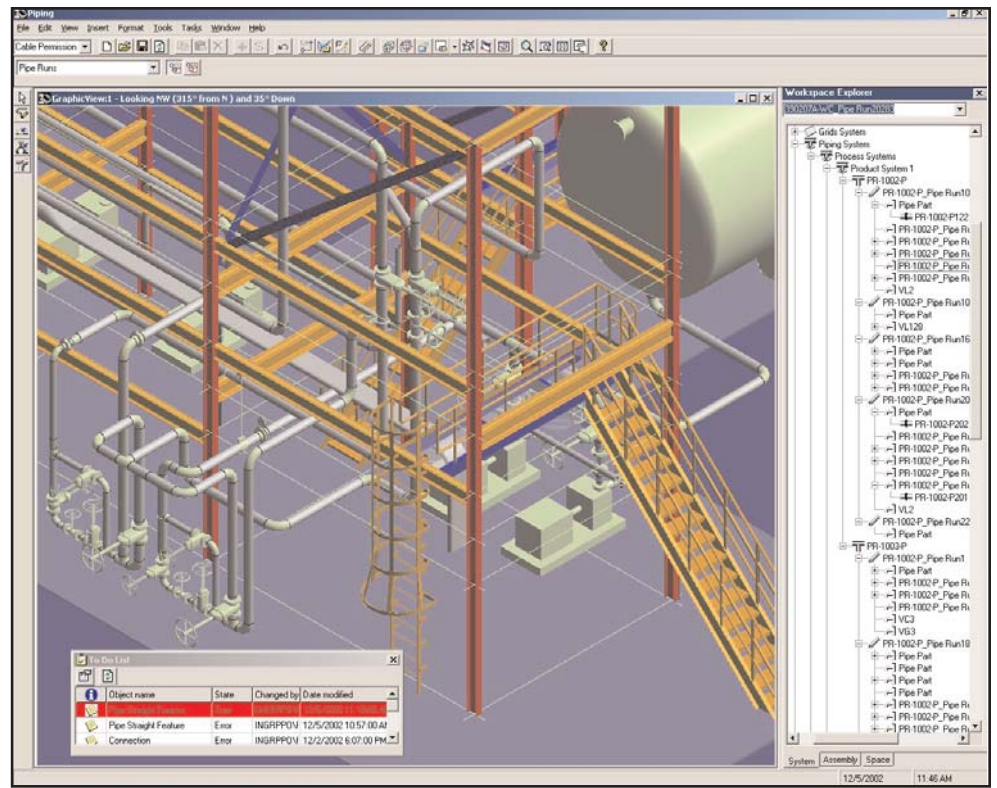
Intergraph Process, Power & Offshore

year and will begin an initial limited commercial release in the fourth quarter through an *Early Adopter Program* providing participating users with a combination of the SmartPlant 3D software and consulting services. Intergraph experts will work with program participants to analyze their current work processes, match personnel skill levels to specific tasks, create a rapid startup training program, and conduct a “mini-pilot” test project to demonstrate the benefits of SmartPlant 3D.

Ease of use

Historically, most plants have been designed using two-dimensional methodologies, often incorporating physical 3D plastic models. In the past decade, computerized 2D drafting and 3D modeling has largely supplanted these manual methods, particularly on larger projects. But facilitating access to data by large, geographically distributed design, construction, and operation teams had not been addressed. Engineering, procurement, and construction contractors need to manage projects involving the concurrent participation of multiple design centers worldwide, while at the same time maintaining project schedules and costs. Similarly, plant operators need to maintain both in-house and off-site design resources both for regular maintenance and the revisions that so frequently play a large part in the lifecycle of most plants. SmartPlant 3D was designed to address these issues.

The SmartPlant 3D software is an entirely new product, built on top of a powerful database, offering significant improvements in ease-of-use while at the same time making it possible for widely distributed teams to work with a single data model. It provides a single software tool for



SmartPlant 3D is the first plant design application that enables global, multi-discipline, concurrent engineering. It establishes and maintains relationships between physical objects and alerts team members when changes impact other designers.

use by all of the engineering disciplines involved in plant design, construction, and management.

The software presents a true Windows-based interface that should make it much more approachable than older systems that required a great deal of user expertise. The simplified interface presents a menu bar and a small number of commands, rather than relying on dialog boxes and extensive pull-down menus and toolbars. Most operations can be accomplished with one or two clicks, drag-and-drop, or right-click operations.

SmartPlant 3D also takes advantage of metaphors originally seen in Intergraph’s SmartSketch software. Complex SmartPlant 3D tasks are implemented as wizards that walk the designer through the sequence of steps needed to execute a complex command or series of commands. The user interface reveals only those input fields and options pertinent to the operation being used. These wizards are displayed as a ribbon bar across the top of the workspace.

This methodology enables users to leverage their knowledge and apply it in all areas of plant design. For example, if a designer knows how to

route a pipe, he can also route HVAC or cableways. Because these tasks are performed in similar ways across applications, the tools allow users to design across multiple disciplines.

Leveraging data-centric technology

In the past, a design was either divided into individual files or portions of a project were checked-out to individual designers. While a designer was working in one of these areas, no other designer could work on that data. When files were checked back in, changes then had to be coordinated with other disciplines.

One of the key defining features of SmartPlant 3D is the fact that it is built on top of a relational database that can be replicated across multiple locations. Project databases may be replicated anywhere in the world to facilitate sharing of the work or to transfer work to a remote location. All of the design disciplines work concurrently in this database and modifications are shared with all users in real-time. This single project database can be divided into partitions that reflect the division of work between sites, and the status of partitions and control of access to those partitions can be changed as project needs change.

Whenever a change is made at one location, the information is sent to all the related sites, providing remote users with the most current project data. Then, when designers at those sites refresh their data queries or screens, the changes are immediately reflected. Although the sites are all connected to each other and can take advantage of persistent, high-bandwidth connections, such connections are not required because data is transmitted in short transactions. If communication between sites is ever lost, the local version of the database continues to run using its current information, and changes are simply queued until communication is re-established.

Tools for managing change

SmartPlant 3D establishes and maintains relationships between physical objects. For example, a pipe support is related to both the pipes it supports and the structure to which it is attached. If the position of the pipes or the structure is changed, the program's relationship engine automatically updates all associated objects to reflect the change, or tracks the fact that a change in the design has occurred if automatic changes cannot be made.

If a change results in more than one solution, the designer is notified and can accept the preferred action—similar to the way one would select the correct word when spell-checking a Word document. If a decision cannot or is not immediately made, SmartPlant 3D maintains a “to-do” list, ensuring that others are alerted to changes in the model requiring their attention. This eliminates the need for manual checking later.

SmartPlant 3D can import data, such as P&IDs, from other applications and establish correlations between this data and the SmartPlant 3D model. The system can then also detect changes in this data, enabling the designer to do an on-screen graphical check between the P&ID and 3D model. Any differences are highlighted so that updates can then be made.

Changes in the physical model are often unavoidable even after drawings have been issued. Some of these changes impact issued drawings while other do not. SmartPlant 3D can determine if a particular change is significant to a particular extracted output, such as a drawing or report, so that incorrect or outdated information doesn't get released to the field.

Using design rules

Another powerful aspect of SmartPlant 3D is its enforcement of design rules. Design rules are maintained and tracked by the system to ensure that design intent is maintained as changes are made. Thanks to design rules, SmartPlant 3D is the first plant design software to provide concurrent proactive interference detection.

In the past, interference checking was a labor-intensive, iterative process. Data from various disciplines had to first be coordinated and compared. After analyzing results, designers had to be assigned to correct problems. Instead, SmartPlant 3D continuously analyzes interferences and reports problems interactively. SmartPlant runs interference checks on the database server, removing the burden from the user system. All objects are checked for clashes regardless of whether they are currently displayed.

Clashes are visually flagged within the model according to type, and displayed in an interference list. Double-clicking a flagged item automatically locates and zooms in on the clash for a detailed

view. Designers then have the option of accepting or resolving interferences as they occur while working with the involved discipline engineers to solve the problem, or waiting until related design tasks are complete.

For example, if a pipeline penetrates a slab, SmartPlant 3D immediately displays a red block indicating a clash. To eliminate the interference, the designer can use a simple sketch tool to place a circular cutout around the pipeline, creating a hole in the slab. Since this eliminates the clash, the server automatically removes the clash indicator.

Automating drawing generation

SmartPlant 3D is also the first plant design application to provide automated generation of piping isometric and scaled orthographic drawings, and associated reports, dramatically reducing production time. Rules can be established for each type of drawing, including scale, drawing border and background sheet, font styles, and so on. After spending a small amount of time setting up these rules, drawings can be created as easily as reports produced from a database. As in a report, each drawing has an associated query or filter template that determines the objects or area to show. This template runs each time the drawing is updated. The system then processes the data and creates the drawing using whatever symbology has been defined.

SmartPlant 3D drawings are designed to be as complete as possible, requiring little or no user involvement and eliminating the need for manual editing. Once a drawing and its query are established, anyone can generate the drawing, eliminating the need to have CAD experts involved in drawing production. And because the drawings can be easily generated, there is little need to save actual drawing files for transmittal. Instead, a message with a path to the drawing can be sent to other design centers where the query to produce the drawing can be run.

When a drawing is produced, it is time and date stamped so that it can be kept in correlation with the actual plant objects contained in the 3D model. Any changes to the model trigger a notification that the drawing needs to be updated. All revisions to the drawing are stored in the SmartPlant 3D database for revision-tracking purposes.

SmartPlant 3D can also produce drawings in Web-viewable formats as well as in common CAD formats. Data reports can also be easily created and output into Excel spreadsheets.

Data reuse

Knowledge capture and reuse has been a major theme in MCAD. But being able to reuse data is equally important in plant design. Plants are subject to stringent regulatory requirements and require detailed as-built records. At the same time, plants are subject to numerous design modifications during their operation. SmartPlant 3D retains the as-built version while enabling engineers to evaluate future changes, while working with the same single database.

In addition to its tools for designing equipment, piping, HVAC, raceway, civil, and structural components typical in most plant design applications, SmartPlant 3D incorporates features for electrical cabling, pipe supports, and construction planning that are usually purchased as third-party products. SmartPlant 3D also offers specialized functions for offshore facility and topsides of floating production, storage and offloading design. Capabilities include penetration management, weight and center-of-gravity management, reinforced plate connection design, structural manufacturing, and shop floor integration.


Integration and migration

Although it offers many of the same capabilities as PDS, SmartPlant 3D is very much different. For the user, the major differences are the user interface, consistency across disciplines and tasks, and the ability to establish object relationships. SmartPlant 3D also reduces system administration tasks because there are only three components to consider:

- the operating system components (including Microsoft Windows user groups)
- the database (Microsoft SQL Server)
- the application itself

In its initial release, SmartPlant 3D requires that Microsoft SQL Server be installed on each server hosting the SmartPlant 3D database. In the future, Intergraph also plans to support Oracle.

SmartPlant 3D can leverage existing PDS data by referencing the PDS model, and SmartPlant 3D's automated drawing capability can be used to generate drawings for PDS

								
Line List								
Line Number	Nominal Size	Pipe Spec	Insulation	Insulation Purpose		Insulation Thickness ft in	Approv	
		Paint Spec	Insulation Temperature F	Insulation Material				
77-MS-2094	8 in	PU32	User Defined -189.7 F	H	Hot insulated	0 ft 2 in	Working	
77-UW-2190	2 in	PU04	Not Insulated -459.7 F	FBG	Fiberglass	0 ft 0 in	Working	
77-LC-2047	3 in	PE16	Not Insulated -459.7 F			0 ft 0 in	Working	
77-UA-2191	3 in	PU04	User Defined -189.7 F	Undefined FBG	Undefined Fiberglass	0 ft 2 in	Working	
77-IA-2038	2 in	PU04	Not Insulated -459.7 F			0 ft 0 in	Working	
77-BFV-2022	4 in	PE16	Not Insulated -459.7 F			0 ft 0 in	Working	
77-LS-2066	8 in	PU32	User Defined -189.7 F	H	Hot insulated	0 ft 4 in	Working	
77-LS-2065	8 in	PU32	User Defined	H	Hot insulated	0 ft 4 in	Working	

tion and migration of legacy data, but advises against simply trying to migrate existing work processes to SmartPlant 3D. Instead, it hopes to work individually with customers to develop an optimum implementation. The company foresees most SmartPlant 3D implementations offering the opportunity for Intergraph to provide ongoing consulting services in addition to the

SmartPlant 3D is the first plant design application to provide automated generation of all drawing types and associated reports, such as line lists.

models or models that include both PDS and SmartPlant 3D data. Piping specifications and associated catalog data can also be migrated from PDS to SmartPlant 3D. In the future, Intergraph will support translation of the PDS model data into SmartPlant 3D. Referenced PDS models will be included in drawings, reports, interference checks, and database queries, but PDS data cannot be modified through SmartPlant 3D.

SmartPlant 3D also integrates with complementary products such as INtools (Intergraph's instrumentation design and engineering software suite) and SmartPlant P&ID, through The Engineering Framework, Intergraph's application integration solution enabled by SmartPlant Foundation. Although not a prerequisite for SmartPlant 3D, SmartPlant Foundation extends SmartPlant 3D's capabilities beyond the modeling phase of plant development, providing a wider range of data reuse.

For example, SmartPlant 3D can retrieve, view, and capture P&ID information that has been published to SmartPlant Foundation. Not only can the P&ID information be viewed simultaneously with the SmartPlant 3D project model, but a correlation can be done to visually compare the items in the model with those in the P&ID. As the P&ID is changed, other users need to be aware of those changes. SmartPlant 3D proactively monitors the P&IDs that have been retrieved from SmartPlant Foundation and notifies the user when new updates are available. Users can then populate the SmartPlant 3D model with data from the P&ID and after making the necessary changes, run another correlation check to verify that the model matches the P&ID.

Intergraph will assist customers with the transla-

initial software sale. This should provide an increasingly important revenue stream in the future.

Over the long term, SmartPlant 3D will eventually replace PDS. For now, however, PDS will remain one of Intergraph's most important products. The company states that as long as there is customer demand, it will continue to enhance PDS, adding new capabilities requested by users, other overall improvements, fixes, client-funded development, and integration with other SmartPlant applications.

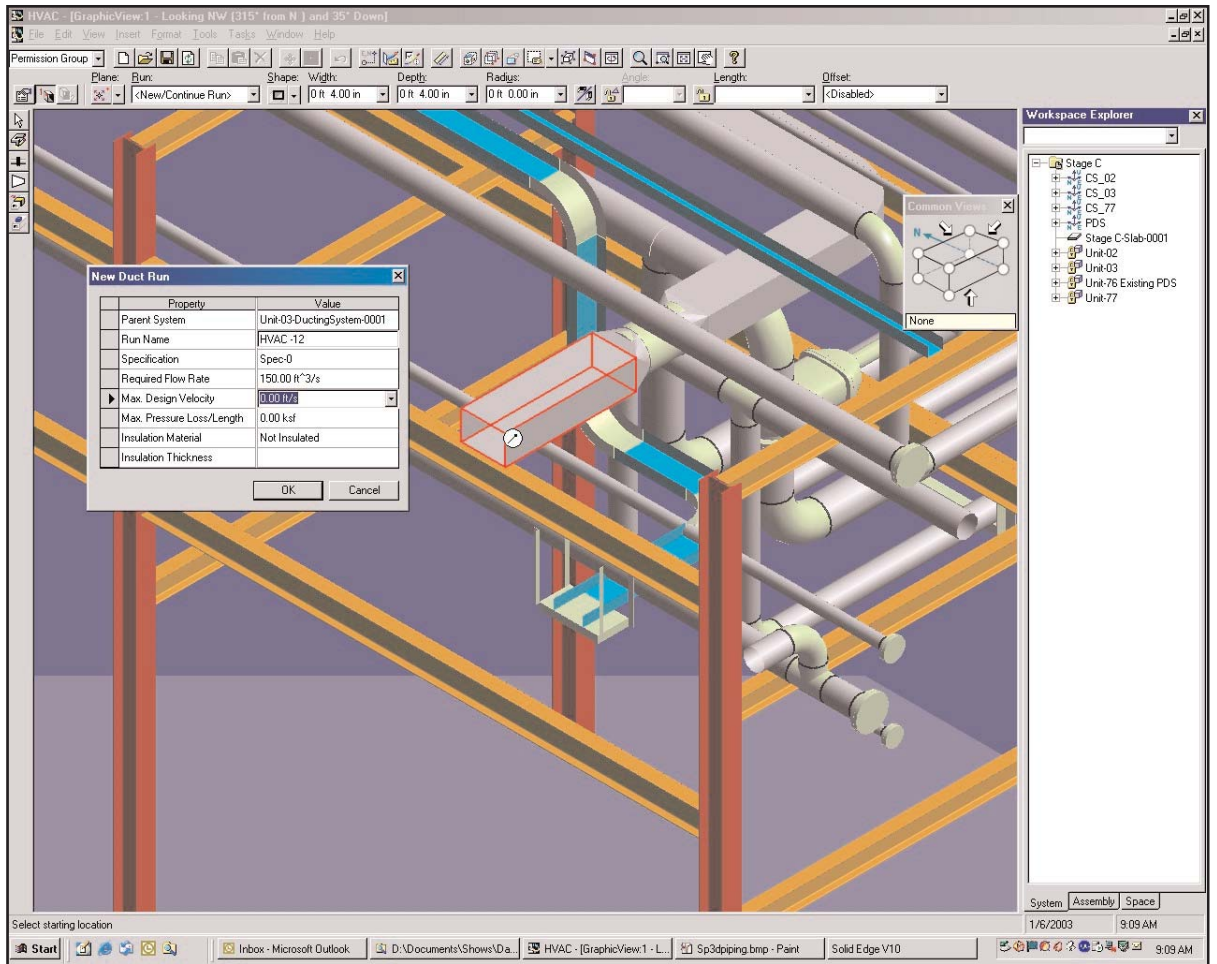
Our View

SmartPlant 3D represents a new evolution in plant design and a high level of automation capability via its design rules and integration capabilities. In a more general sense, it represents another step on the evolutionary path of all design software—a significant step beyond using software to replicate older manual processes toward leveraging computers to capture knowledge and vastly improve the flow of information.

Of course, the success of this step remains to be seen. SmartPlant 3D has not yet begun shipping. At present, Intergraph reports that over 30 companies have expressed a high level of interest in the Early Adopter Program. Those customers will receive SmartPlant 3D licenses at a price below the current price of Intergraph's PDS software. As part of that price, they will also receive approximately 30 days of basic consulting and training services. Intergraph reports that some of its clients are already planning for a second phase of training and consulting to extend the scope of the EAP from designer training to integration with internal systems and work practice organization.

Intergraph Process, Power & Offshore

Intergraph Process, Power & Offshore



A simple, easy-to-use Microsoft Windows interface boosts productivity and reduces the learning curve. SmartPlant 3D provides a single software tool for use by all of the engineering disciplines involved in plant design, construction, and management.

For subscription and back issues information, call: 360-733-0711

Engineering Automation Report
711 Chuckanut Drive N.
Bellingham, WA
98229-6921
+1-360-733-0711
fax 360-733-2964
www.eareport.com

Cyon Research Corporation
8220 Stone Trail Drive
Bethesda, MD
20817-4556 USA
www.cyonresearch.com

The full commercial release of SmartPlant 3D will offer free upgrades to the EAP participants, and the user price for new licenses will increase approximately 20%. This will put the price of SmartPlant 3D in the same price category as PDS and its competing systems. Intergraph also plans to offer additional modules that can be added to SmartPlant 3D to further increase its value, and the company will offer lease options as well.

The new software should also provide Intergraph with many new consulting opportunities. The ability to refine and redefine workflows using SmartPlant 3D will enable

users to take a fresh look at their project work processes and to use SmartPlant 3D in more powerful ways than those possible with their current plant design systems. Intergraph's expertise in the plant design business and their intimate knowledge of the new software puts the company in a unique position to partner with their clients.

In our September 2000 article, we concluded that what Intergraph needed to do was not just reduce the cost of designing plants but also help reduce the costs of operating those plants over their lifecycle. SmartPlant 3D is poised to help accomplish that goal. ■

Contact:

Intergraph Process, Power & Offshore
300 Intergraph Way
Madison, AL 35758

1-800-260-0246 (United States)
1-256-730-3707 (International)
ppo.intergraph.com