“Understanding Technology Advancements in Owner-Driven Capital Project Execution and How They Impact You”

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Data Driven Capital Projects … Target Audience

- Multiple EPCs in JV
- EPC as Project Management Consultant
- Owner-Operator
- EPC with high running costs
- EPC with budget constraints
Let’s Talk Culture Change…
Capital Project Award leads project execution and eventually to... Asset Turnover
Contract … Devil is in the Details
Today do you access & manage project information in an unstructured way?

We asked for an “Electronic Handover” and got Scanned PDF’s.

The vendor only has paper copies. We are just going to have to make do with what we get. It’s somewhere on those disks we received.

My Plant is already built, and I have all this legacy information. The supplier doesn’t even have Excel.

What if this plant information / data was easily available... it’s integrity and quality made known... and made accessible to all stakeholder on single pane of glass.
EPC’s / Owners Have … Islands of information

Operations systems

Multiple document & drawing locations

Physical as-built plant

Line of Business systems

Vendor & Supplier information

Engineering & Design systems
DATA DRIVEN DESIGN CURRENT ADVANCED DESIGN ENVIRONMENT EPC FOCUS

- Knowledge Based Engineering
- Data-Centric Architecture
- Interoperability
- Intelligent Rules & Relationships
- Task Based Modelling
DATA DRIVEN DESIGN CURRENT ADVANCED DESIGN ENVIRONMENT EPC FOCUS

BUSINESS VALUE / BENEFIT

• Improved Quality
  • Captures Engineering Knowledge
  • Consistency
  • Consistent release of deliverables
  • Effectively Manage Change

• Improves Productivity
  • Reduces Engineering Man-hours
  • Allows for ‘Just In Time’ Deliverables
  • Allows real-time concurrent design
Industry Challenges
Work Process the “Core” to what we do
Engineering Work Processes
Then and Now

Sequential

FEED → Detail Design → Construction → Operations

Phased

FEED → Detail Design → Construction → Operations

Concurrent

FEED → Detail Design → Construction → Operations
What is the cultural stress?
Data Driven approach … What would that look like?

- Process and Instrumentation Diagram
- Instrumentation and Electrical schematics
- Process Data sheets and tag indexes
- 3D Model and derived documentation
- Engineering Design Basis
- Vendor Documentation
- Validation, Transformation & Loading (VTL)
Traditional CADD-enabled approach

1. Create / modify original design drawings

2. Copies of the drawings are used to critique the effort and communicate back to the CADD designers.

Periodically – the cycle releases a version (copy) of the drawings to subcontractors and clients.
Data Driven… Intelligent Design Approach

Perform original design and revisions Data Driven

Engineers and Clients collaborate online.

Periodic publication of data, documents and drawings based on status of the schematics and electronic model.

Validated data published for downstream use

Approved Data, Drawings and reports to Subcontractors and the Owner
Data Driven Integration – Quality Control

- Automated correlation and consolidation of engineering data across multiple documents
- Single source of truth
- Automated “yellow off”
- Engineering checking time is greatly reduced
- Quality is increased due to elimination of manual checking errors

Benefits:
- Higher quality designs
- Reduced engineering cost
Integration – Quality Control

- Automated correlation and consolidation of engineering data across multiple documents
- Single source of truth
- Automated “yellow off”
- Engineering checking time is greatly reduced
- Quality is increased due to elimination of manual checking errors

Benefits:
- Higher quality designs
- Reduced engineering cost
Increase safety by allowing engineers to do desktop study at home office before mobilizing
3D Visualization – Leica 3D Point Cloud and Smart 3D model

- Merge 3D point cloud with Smart 3D design model
  - Connect as-built point cloud with design objects
  - Use for expansions, retrofits, maintenance projects, etc.
  - Clash detection between design objects and point cloud

Benefits
- Visualize the design before construction
- Increased quality
- Decrease CAPEX
Materials Management - Key Benefits

- Improved information:
  - Input data once
  - Manage change effectively
  - Execute with a high degree of standardization & less re-work
  - Detect shorts and potential surplus early

- Get the right materials to the work front on time

- Measure the reality of procurement process and supplier performance

- Manage both Project Material Procurement and Contracting within same solution

- Data re-use and capture of engineering best practices with SPRD

- Savings of 1.5% – 3% of TIC reported
Data Driven Approach … What are the key objectives

- Error-reduction
  - single-point of data entry
  - Faster evaluation of technical design

- Faster execution
  - expedite flow of design decisions,
  - digestion of collaborative decisions and changes

- Design reuse
  - Optimization of the design base with expedient adjustments
## Project Information Management Transition Capability Matrix - Capital Projects

### Capital Project Execution

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>Only providing the minimum to the client for handover to O&amp;M</td>
<td>Senior principal engineers being used across multiple projects</td>
<td>Understands value added services, “Total cost of ownership” and “Cost of Unreliability”</td>
<td>Embracing newer technology but still thinking in a document-centric world</td>
</tr>
<tr>
<td>Processes</td>
<td>Little or no project execution methodology, lack of mature processes</td>
<td>Project, and HSSE management strategy in place. Monitors data integrity</td>
<td>Reliability centered maintenance (RCM) used in the design decision process.</td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>No deliverables defined, client leaves what to handover to the contractor</td>
<td>Data centric tools used in best practice configuration of the project</td>
<td>Data centric tools defined for project execution including form, format, timing…</td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>CAD is the major tool, paper/PDF deliverables. “Excel” is the best database</td>
<td>Data centric tools defined for project execution including form, format, timing…</td>
<td>SmartPlant Foundation used as central hub, QA/QC processes in place</td>
<td></td>
</tr>
<tr>
<td>Culture</td>
<td>Holding onto old work process, not taking advantage of newer technology</td>
<td>Embracing newer technology but still thinking in a document-centric world</td>
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</tbody>
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New Technology sometimes leads to …

Whew! We FINALLY recovered our previous rate of productivity – let’s regroup before we try anything else!

Q: What is really happening here?
Data Driven Focus…. Deltas for Success

The ‘Smart’ Implementation

Technology
- Integration / Consistency Checking
- Workshare
- Rules-based Design / Knowledge Capture
- Design Automation / Data Reuse

Work Processes:
- Enterprise Work Processes and Integration Capability Statements
- Complementary Workflows, Procedures & Best Practice Guidelines

People (Organization):
- Project Organization, Roles & Responsibilities Optimization

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Handover Design to Construction and Owner
Data Driven Construction – Construction Schedule
Review 4D Capabilities
Data Driven approach …Information Handover – A Commercial & Contractual Challenge –

Project Characteristics

- Contracting strategy
- Schedule
- Project structure (JV)
- Geography & location
- IT Landscape

O/O Objectives

- Monitor project progress
- Establish operational readiness
- Support inspection & maintenance
- Prepare turnaround and extension projects
- Demonstrate compliance

Scope Cost Technology
## Data Driven approach …
## Digital Handover Content Integrity Spectrum

<table>
<thead>
<tr>
<th>Unintelligent</th>
<th>Smart</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Un-integrated tool-data</strong></td>
<td>SPF Fusion</td>
</tr>
<tr>
<td>DVD/Paper</td>
<td>Structure, Transformation &amp; Loading (VTL)</td>
</tr>
<tr>
<td>Best left in a filing system untouched as a physical record</td>
<td>SPO Handover</td>
</tr>
<tr>
<td>+ Silos of content that can be updated</td>
<td>+ Provides fast access and navigation of linked content which can be linked to operations systems &amp; tasks</td>
</tr>
<tr>
<td>+ Ensures quality and integrity of the content</td>
<td>+ Ensures that information can be exploited on-plant and used for ongoing engineering upgrades &amp; plant turnaround projects</td>
</tr>
</tbody>
</table>
Data Driven approach… for Owner Operators – Integrated Handover –

Value Summary
- Early project management visibility
- Accelerated and improved start-up and commissioning processes
- Reduced information management cost at handover
- Reduced modification cost
Data Driven Value for the Owner Operators – Lifecycle Value Propositions –

Leveraging the Engineering Information Asset

- Operations & Maintenance
  - Minimize unplanned downtime
  - Reduce OPEX
  - Minimize Health & Safety Risks
  - Demonstrable Compliance

- Commissioning, Start-up & Handover
  - Accelerate Operational Readiness

- CAPITAL PROJECTS
  - Reduce CAPEX
  - Shorten Project Schedules

- Maximize Virtual Asset Quality & Completeness for O&M
Data Driven or Smart Deliverables
– Delivering Business Value –

Data Driven deliverables enables the O/O to effectively leverage the Engineering Design Basis:

- Maximized efficiency of engineering, procurement and construction activities performed by contractors
- Reduced project costs by improved management of project changes and contractor interfaces
- Reduced project schedules by responding to contractor queries in a timely manner
- Faster gathering of operations & maintenance relevant design details and improved CMMS data loading
- Reduced MRO inventories
- Reduced risk of plant incidents
- Improved quality and availability of plant engineering information during all phases of the plant lifecycle
- Improved knowledge capture and minimized dependence on individuals
- Faster and cheaper turnarounds and revamps

“Achieving plant Owner Operator profitability goals requires a different model of Asset Lifecycle Management and an information management infrastructure that enables effective interoperability among all stakeholders.”

ARC Advisory Group

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Plant knowledge / information represents a “virtual asset” (ARC Advisory)

- Procedures
- Commercial & Financial
- Administrative & History
- Engineering Design Basis

Data Driven deliverables makes it easier for people to manage the continuously changing Engineering Design Basis

- Work becomes more intuitive to perform
- Faster access to relevant information
- Information overflow is avoided
- Work processes become less complex
- Active help and support to avoid errors
- Intuitive, faster and lower effort to document work results
- Easier, more intuitive, faster and lower effort to share knowledge and experience
- Reduced administrative overhead
- Intuitive Training

Continuous Change
Traditional Information systems – vs – Data Centric / Intelligent systems what is the difference?

Most file based systems model their information by the hierarchical cabinet → folder → file paradigm.
- Susceptible to duplicates
- Hard to find information
- Outdated

A data centric system is modeled with the Objects and Relationships that are familiar, like an Equipment and its Documents. This better supports changes through the lifecycle.
- Single instance of objects
- Find what you want by what you know

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Project Information Integrity
Data Driven approach
– Leading Technology –

- A suite of globally market leading applications – made by users for users –
- Support s all disciplines and lifecycle phases
  - All OO and EPC disciplines
  - All lifecycle phases
  - All project sizes
- Easy, intuitive & controlled management of knowledge and information
- Newest technologies and architecture
- Truly open and based on commercial technology standards and supporting many formats, standards, APIs, middleware, etc.
  - Support of international standards such as ISO15926
  - Easy interoperability with third party systems
  - Rapidly growing SP Alliance community
- Modular and flexible
  - Start where the biggest value is
  - No “big bang” thinking
  - Proven on a global scale

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Data Driven approach Owner / Operators
– Selected O&M Benefits –

- Capture & verify plant asset data
- Maintain consistent documentation
- Single point of access to data
- Reduce MRO inventories
- Reduce time needed to be in the plant
- Develop smarter maintenance and inspection plans
- Avoid maintenance & construction errors
- Manage change of plant
- Demonstrable compliance
- Faster and better decision support
- Remove dependence on individuals
- Reduce risk of plant incidents

Reduce OPEX and plant downtime, improve safety
Data Driven approach Owner / Operators – Turnarounds
Data Driven approach for Owner / Operators
– Selected Project Execution Benefits –

- Streamlined turnaround planning
- Reduce project costs by improved management of project changes and contractor interfaces
- Reduce project schedules by responding to contractor queries in a timely manner
- Gather operations & maintenance relevant design details earlier
- Capture & verify the quality of plant documentation produced by contractors & suppliers
- Enable collaboration throughout the project value chain
- Provide a single, central source of truth in projects for all types of engineering information

Reduce CAPEX and shorten project schedule
Benefits

- Faster and better decision making
- Less effort in maintenance & inspection planning
- Faster incident analysis
- Less dependence on individuals

Enabled through

- Fully integrated plant design basis providing a single-source of information
- Reduced time to find data & documents and to answer ad hoc queries
- Access to most current and most accurate information
- Everybody having access to the same information
Data Driven approach – Information Browsing
– Work Process Focused –

Information seeker

Document management

Maintenance system

1. Search Tag Information
2. Search Documents
3. Search by Functional Location
4. Search by Equipment Number
5. Search Documents
6. Retrieve Documents
7. Search by Document No
8. Collect documents from DM
9. Review documents
10. Search in Maintenance System
11. Collect Maintenance Information and report it
12. Review gathered information

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Data Driven approach  Information Browsing
– Engineering / Maintenance Browser –
Data Driven approach … Time Critical Plant Information Access
Data Driven approach Information Browsing – Engineering Browser (WEB) –
Benefits
- Effective management process
- Secure
- Reduced costs and consistent document distribution
- Traceability of check in/out, approvals, distribution and acknowledgement/comment

Enabled through
- Automatic allocation of document and revision numbering
- Multiple ways of locating documentation based on what the user knows e.g. contract, tag, PBS etc.
- Secure document file vault
- Electronic transmittals with workflows and distribution matrices
- Electronic mark-up

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Data Driven approach … Tag Management

– Business Impact –

**Benefits**

- Optimized management of asset replacements
- Substantially reduced amount of vendor documentation and related efforts

**Enabled through**

- Managed relationships between tag, models and assets
- Tag status managements (reserved vs. planned vs. as-built vs. historic)
- Synchronization between tag hierarchies and plant maintenance system

Many Assets and many tags may be related to a standard material

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Standard Material

Pump Catalog

Centrifugal
Model # CP-C-4020

Specifications:
RPM: 1500
Material: Cast Steel 316

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Asset

Tag

P-101

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Data Driven approach … Information Validation & Take-On – Business Challenges –

- Continuous data agglomeration
- Enormous data volumes in transition
  - Data is usually delivered incomplete with errors
  - Limited time / resources to validate data during project close-out.
- Transformation and validation of data from m ↔ n systems
  - Exchanges coming from multiple, Intergraph / non-Intergraph data sources to Intergraph / non-Intergraph data targets
  - Ensure only correct and validated data is loaded into target system
- Impacts all lifecycle phases
  - Greenfield project
  - Handover and operational readiness
  - Modifications & revamps
- Not just a technology challenge
  - Oftentimes a contractual requirement
  - Requires a thorough knowledge of the engineering data, requiring highly competent individuals who are often scarce resources
Project Information Integrity
Data Driven approach … Information Validation & Take-On – Business Impact –

Benefits

- Accelerated and improved start-up and commissioning process
  - It can take up to one year to load operations systems
- Reduced information management cost at handover
  - Costs involved for a $1 billion CAPEX project are typically $10-20 million
- Reduced modification cost
  - Validating and correcting data for a modification can be up to 30% of the modification cost

Enabled through

- Rapid loading of massive data quantities
- Rules based and automated quality insurance for very large data/information sets
- Rules based and automated conversion
Data Driven approach … Project Management of Change – Business Impact –

Benefits

- Reduce the value of change implemented on projects
- Strict adherence to project procedure
- Improved knowledge about project status
- Quicker evaluation, approval or rejection of change requests
- Identification of bottlenecks
- Reduce project management efforts

Enabled through

- Rigorous evaluation of change requests (via predefined workflows)
- Close integration with plant asset data and other project execution processes
- Integration between changes (dependencies)
- Virtual change board meetings
- Comprehensive audit trails
- Powerful management reporting

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Benefits

- Reduce the incidence of claims arising from interface disputes
- Avoid any impact on cost or schedule resulting from issues, disputes, and variation orders
- Reduce project management efforts

Enabled through

- Central management of engineering interfaces and technical interface items
- Proactive identification of problem areas and proactive follow-up (proactive intervention in conflicts between contractors)
- Hierarchical structuring of technical interfaces
- Management reporting
Data Driven approach … Non Conformities / Waivers – Business Challenges –

§ Ensure consistency in review of non-conformities and that relevant disciplines e.g. HESQ are included

§ Ensure that deviations can be linked to changes and technical queries to provide information in context of these related processes

§ Ensure non-conformities are associated with affected parts of the plant to enable ready access

§ Provide auditable traceability of all waivers and deviations

§ Provide visibility of all non-conformities for commissioning and operations and fast access to details

§ Provide reliable link between „non conformities“ and design basis
Data Driven approach … Non Conformities / Waivers
– Business Impact –

Benefits
– Avoidance of incidents
– Quicker start-up after incidents

Enabled through
– Central management of Non-Conformities (NCR) and Waivers (Permanent and Temporary) to:
  - Laws/regulations
  - Corporate Best Practices
  - Project Specifications
– Providing easy access to all Non-conformities
– Integration between NCR / Waiver and all aspects of the plant affected on a very granular/detailed level:
  - Plant drawings & models
  - Plant engineering data
  - Changes and Change Requests
  - Technical queries
  - Tight integration between queries, changes interfaces and non-conformities
– Permanent change records
Project Information Quality
Ensure queries are resolved within the time allotted

Reduce risk of claims from delinquent response to queries

Enable auditable traceability of all queries

Provide visibility of any bottlenecks in the query process to allow remedial action to be taken

Ensure tight link to „non conformity“ and „management of change process“

Enable links between the engineering design basis and queries to facilitate rapid identification of relevant queries
Data Driven approach … Technical Site / Queries – Management Reporting –
Data Driven approach ... Systems Completion – Business Challenges –

- Require access to large amount of data and documentation that must be complete, correct and up to date
- Manual intensive preparation of work packs and keeping these updated in line with design development and changes
- Paper based systems are hardcopy intensive and result in a “wall of books” where records are hard to locate
- “Stand alone” IT systems require continual import of data from often many sources
- Multiple MC systems deployed at contractors complicate later phases e.g. hook-up and commissioning and make it difficult to get a real picture of progress
- No reuse of information during Operations e.g. of Shutdowns, Turnarounds and Outages
Data Driven approach … Systems Completion – Work Processes –

**Construction Activities**
- Installation of Piping, Instrument, Equipment, etc.
- Preliminary Equipment Alignment
- Electrical Meggering and Continuity
- Tank Inspection

**Commissioning Activities**
- Cleaning and Flushing
- Energize electric circuits
- Run in motors w/o load
- Final Alignments
- Functional Test Utilities
- Instrument Loop Checks
- Equipment Initialization/Prep

**Operations Activities**
- PSSR, Readiness Reviews
- Performance testing
- System Functional Tests
- Final Walkdowns
- Startup by priority

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**Walk Down Checklists (SCWD)**

**Pre-Mech Comp (SCPM)**
**Mechanical Comp (SCMC)**
**Static Comm (SCPM)**
**Dynamic Comm (SCPM)**

**Punchlist (PL)**

**Preservation (SCP)**

**Goods Inbound (SCWD)**


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Data Driven approach … Systems Completion – Offline Check Sheet Completion –
Data Driven approach … Systems Completion – Graphical Reporting –
Data Driven approach … Establish Operational Readiness
– Systems Completion –

β Business Value
- Accelerate start-up processes
- Reduce information management cost
- Improve auditable traceability

β Key enablers
- Electronic check sheets may be taken offline, completed in the field on ruggedized laptops and data uploaded into the SPO Systems completion solution
  β Goods Receiving
  β Pre Mechanical Completion
  β Mechanical Completion
  β Commissioning
  β Preservation
  β Pre-Start-up Safety review
- Visualize the progress of the completion execution effort at a working and management levels
Data Driven approach … Plant Information Browsing
– Business Challenges –
Data Driven approach … Plant Information Browsing – The Intergraph SPO Approach –
Data Driven approach … Plant Information Browsing
– Business Impact –

Benefits
- Faster /better decision making
- Faster incident analysis
- Less dependence on individuals

Enabled through
- Single-source of information
- Quickly access information
- Access to information in other operations systems via portal
- Access to most current information
- Everybody has access to the same information
- Secure information
Data Driven approach … Requirements Management & Traceability (RM&T)
Data Driven approach … Requirements Management and Traceability – Business Value and Enablers –

**Business Value**
- Assess and demonstrate fulfillment, completion and gap analysis against requirements
- Manage change in requirements
- Improve auditable traceability of all requirements
- Provide demonstrable compliance to authorities

**Key enablers**
- Correlation of Requirements Objects to Engineering Objects
- Review and approval workflow for requirements
- Configuration Management of Requirements
- Change Impact Analysis
- Notification/Substitution/Warning of change
- Graphical reporting
- Determination of Rules and Violations
Mobile Application Strategy – Plant Information mobility
Mobile Applications
– The Business Challenge –

Offshore support activities from vessels
- Subsea intervention
- Workover

On plant operations support
- Maintenance
- Inspection
- Lock-out/Tag-out
- Shutdowns, Turnarounds

Working in remote locations
- Transmission lines
- Pipelines, pumping stations etc.

- Systems completion
- Goods Receipt
- Mechanical Completion
- Commissioning
- Pre-startup safety checks
- Preservation

- Carrying large volumes of documentation into the field is cumbersome
- Locating the correct data is time consuming
- Data captured in the field requires data entry on return to the office and prone to error
Data Driven approach .... SPO Mobile Apps
– Business Value and Enablers

Benefits
- Eliminate reliance on cumbersome, outdated, hardcopy documentation and data in the field
- Quick and easy offline access to and navigation of information and documentation in the field
- Capture of data, photos and notes in the field
- Avoid the need to transcribe field notes
- App store to download and update SPO applets automatically

Enabled through
- Download of data and documents to mobile MS Windows based PCs
- Simple end-user GUI on mobile PCs
- Offline navigation of data and documentation including 3D models/laser scans and P&IDs
- Offline completion of forms and attachment of photos and notes
- Upload to data and attachments to SPO when network connectivity available

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### BETTER SOLUTIONS FOR BETTER FACILITIES

**SmartMarine® Enterprise and SmartPlant® Enterprise**

<table>
<thead>
<tr>
<th>ENGINEERING &amp; SCHEMATICS</th>
<th>3D MODELING &amp; VISUALIZATION</th>
<th>ANALYSIS</th>
<th>PROCUREMENT, FABRICATION &amp; CONSTRUCTION</th>
<th>SMARTPLANT ALLIANCE &amp; PARTNERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SmartPlant P&amp;ID</td>
<td>SmartPlant 3D</td>
<td>CAESAR II®</td>
<td>SmartPlant Materials</td>
<td>Technology members</td>
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<tr>
<td>SmartPlant Instrumentation</td>
<td>SmartMarine 3D</td>
<td>PV Elite™</td>
<td>SmartPlant Reference Data</td>
<td>Service members</td>
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<tr>
<td>SmartPlant Electrical B &amp; D</td>
<td>PDS®/FrameWorks® Plus</td>
<td>TANK™</td>
<td>Standard Database for SmartPlant Reference Data</td>
<td>Content members</td>
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<tr>
<td>SmartPlant Process Safety</td>
<td>SmartPlant 3D Materials</td>
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<td>Complementary solutions</td>
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<td>SmartSketch®</td>
<td>Handling Edition</td>
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<td>SmartPlant Spoolgen®</td>
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<td>SmartPlant Review</td>
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<td>SmartPlant Isometrics</td>
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<td>CADWorx®</td>
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**INTEGRATION AND INFORMATION MANAGEMENT**

- SmartPlant Foundation and SmartPlant Basic Integrator

**AUTOMATION AND IMPLEMENTATION SERVICES**
Intergraph ranks No. 1 in 18 of 29 categories

- Intergraph is the global leading supplier of:
  - Process engineering tools
  - Engineering design tools
  - Engineering design 3D CAD software

- Intergraph is the leading supplier of process engineering tools and engineering design tools in all its regions: NALA, EMIA, and APAC.

- Intergraph is the No. 1 supplier to many industries, including refining, chemical, oil and gas, mining and metals, pharmaceutical and biotechnology.

“Intergraph has a large and comprehensive product portfolio that provides users with a compelling value proposition. Intergraph has established itself as the premier enterprise engineering company by understanding that engineering data is a valuable corporate asset and must be properly managed at the enterprise level.”

Janice Abel, ARC Principal Consultant

Note: ARC Advisory Group’s PET Worldwide Outlook study includes engineering design (engineering design tools and laser / 3D scanning) and offline process simulation and optimization. To purchase the study, visit www.arcweb.com/research/studies/pages/processengineeringtools.aspx.
Time spent searching for information – reduce time and cost!
Integrating the Engineering Enterprise
andrew.guard@intergraph.com