



Unlocking the value of Engineering Information in Facilities Engineering Operations based on ISO 55000

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Lessons Learned from the Past

Offshore O&G: Deep Water Horizon ('Macondo blowout)



Largest accidental marine oil spill in the history of the petroleum industry

O&G Refinery: Texas City Refinery Explosion



Improper start-up procedure followed causing a chain of incidents leading to a vapour cloud explosion

Mining: Meikle Mine Explosion



Application of a mixing motor to solidified PETN & secondary explosion in a nearby storage unit

Chemicals: Danlin Plant Explosion



Rupture of distillation column leading to secondary explosion

Incident

- Defective cement on the well
- Insufficient process safety controls and safety system.
- Industry best practices and government policies not incorporated into O&M process
- Maintenance systems geared toward a trip-&-fail compliance
- Inadequate worker training & reporting capabilities

- Start-up procedure not regularly updated & hence, incorrect
- Lack of sufficient instructions
- Operators allowed to make procedural changes without performing formal MoC process
- Reliance on knowledge from past-experiences and informal work practices
- No policy for effective shift communication, shift turnover communication, or log-books

- Improper localization of hazardous processes
- Variability & limited awareness of procedures
- Unfocused safety walkthrough inspections
- Lack of understanding of process hazards & controls
- Ineffective worker training
- Workers routinely made changes to steps taken

- Inadequate inspections
- Safety systems switched off to save money
- Non-existent emergency response plans
- Localization of the facility and hazardous processes to a densely populated area
- Underutilized safety devices
- Lack of skilled operators

Causes

- Implement formal training program
- Regularly conduct formal PHAs
- Ensure all regulatory requirements are adhered to
- Incorporate industry best practices into work process

- Develop and implement process specific operating procedures
- Consistently execute operating procedures
- Execute pre-startup safety reviews
- Implement formal shift handover practices and system
- Follow formal MoC processes
- Provide access to procedural instructions & supporting info

- Process specific operating procedures & consistent execution
- Tools for access to relevant data
- Properly locate assets
- Conduct regular safety reviews
- Formal HAZOP analysis
- Implement program for training & emergency simulation

- Specify alarm limits automated monitoring of operational parameters
- Perform Risk Based Inspection (RBI) and maintenance
- Develop and practice emergency response plans
- Train workers in operational processes and procedures

Lessons Learned

Operational Integrity Challenges:

Process Safety Information

Requires
Process
Safety
Information
(PSI)

PSM Requirements
(OSHA Appendix to §1910.119 – Compliance Guidelines)

- Process design & technology review
- O&M activities & procedures
- Emergency preparedness plans & procedures
- Training programs
- ID process related hazards (PHA)

PSI Challenges

- ◆ **Broad spectrum of information & sources (P&IDs, 3D models, HAZOPs...)**
- ◆ **Incomplete, inaccurate handover information**
- ◆ **Operational / in-plant changes**
- ◆ **Long information lifecycle**
- ◆ **Changing regulatory requirements**

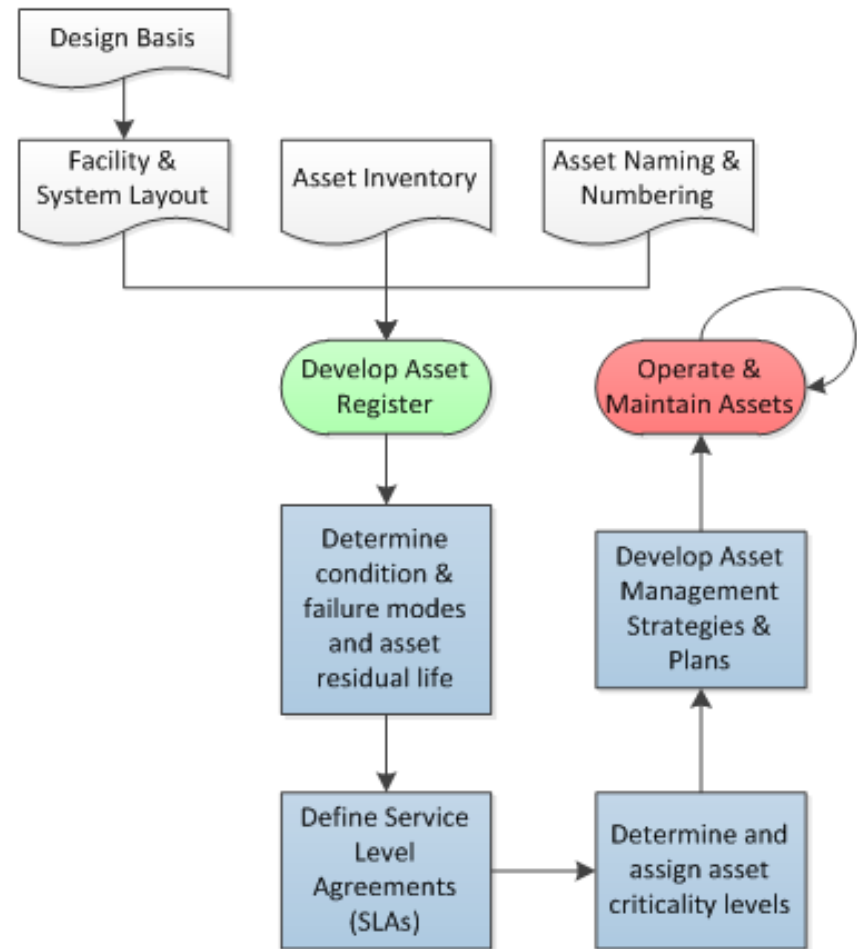
Operational Integrity Top Challenges

Challenge to Improve Safety	Response %	Domain	Challenge to Improve Safety	Response %	Domain
Developing a culture of personal responsibility	67.7	Training & Competency	Variations in internal standards and procedures	23.1	Asset & Process Safety Information Management
Human Behaviors	64.7	Training and Competency	Limited sharing of best practices and lessons learned across the industry	22.1	Asset & Process Safety Information Management
Tendency to focus on productivity over safety	38.9	Operations & Maintenance Management	Missing or poor quality information	19.5	Asset & Process Safety Information Management
Management of Change (MoC)	38	Operations & Maintenance Management	Lack of communication / information sharing across the supply chain	18.8	Asset & Process Safety Information Management
Lack of time to train staff	36.3	Training & Competency	Deficiencies in operating procedures	16.8	Asset & Process Safety Information Management
Lack of personnel competency	32.7	Training & Competency	Inspection and maintenance	16.8	Operations & Maintenance Management
Inadequate training	30.4	Training & Competency	Permit to work	9.2	Operations & Maintenance Management

Top Challenges to Improve Safety Identified by Robert Gordon University Aberdeen Study

Operational Integrity Challenges: Operational Lifecycle / Maintenance Management

- If Standard Naming & Numbering Rules are not Uniformly Applied for ID of Assets across disciplines it is difficult to correlate information about assets
- Functional location structure almost never reflects the process, physical or location based structure
- CMMS Relies on the Assumption that the Plant Configuration is Validated
- Two-dimensional, Static Views of Processes and Facility Layouts are not Fully Effective for Purposes of Hazard Identification
- The Necessary Information is not available at Lower Levels of the Asset Hierarchy



The asset inventory, facility layout & naming/numbering forms the basis of all O&M activities

Operational Integrity Challenges: Training and Resource Competency

- **Educating the Next Generation of Engineers – Challenges with ‘Traditional’ University Engineering Curriculums**
- **Conventional Training Methods are not totally effective in Ensuring workers are Adequately Trained**
- **It is Impractical to Conduct ‘On-the-Job’ Training for Abnormal Situations & Safety Critical Processes**
- **Plant Maintenance Processes involve Multiple Stakeholders across Multiple Disciplines**
- **For Offshore and other Remote Sites, Crews are generally Replaced on a Rotational Basis and Onsite Training is not Practical**
- **Fewer Individuals are Responsible for more Process Units and there is Greater Dependence on Contract Workers for Execution of O&M Activities**



Best Practice Recommendations:

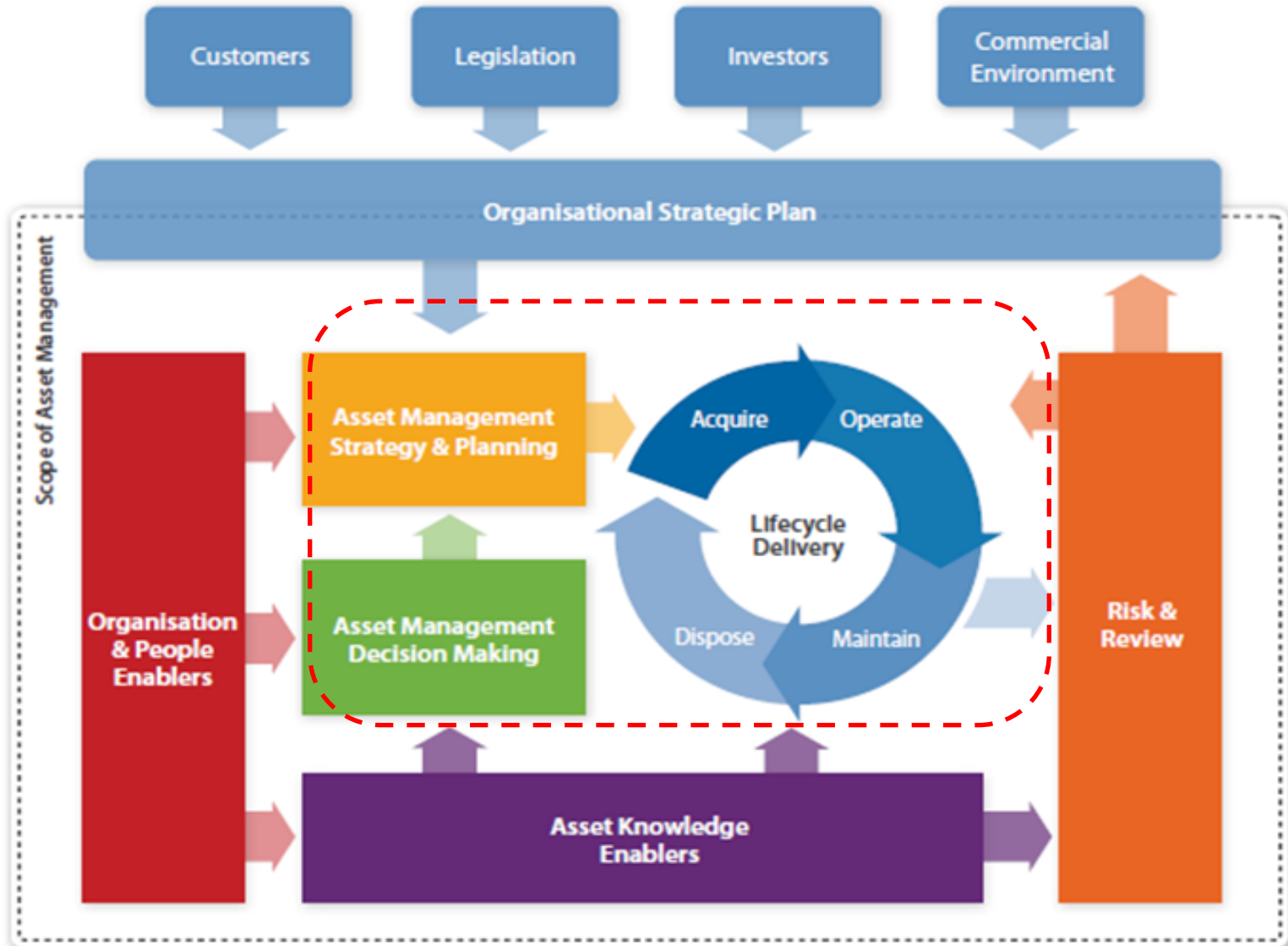
A Standards Based Approach (ISO 55000)

ISO 55000 Standard Series

ISO 55000	Provides an overview of the subject of asset management and the standard terms and definitions to be used (6-Elements)
ISO 55001	Requirements specification for an integrated, effective management system for assets.
ISO 55002	Provides guidance for the implementation of such a system.

***On-Schedule for Publication & Release
in Q1 2014!***

Operations Integrity Management Program Essentials – ISO 55000 Elements



ISO 55000 Elements – A Closer Look...

- Asset Management Policy
- Asset Management Planning

Asset Management Strategy & Planning



- Operations & Maintenance Decision Making
- Resourcing Strategy & Optimization
- Aging Assets Strategy

Asset Management Decision Making



- Technical Standards
- Asset creation & acquisition
- Maintenance Delivery
- Reliability Analysis
- Shutdown / Outage Management
- Incident Response

Asset Lifecycle Delivery Activities



- Asset Information Strategy
- Asset Knowledge Standards
- Asset Information Systems
- Asset Data & Knowledge

Asset Knowledge Enablers



- Contract & Supplier Management
- Asset Management Governance
- Organizational Structure & Culture
- Competence & Behavior

Organization & People Enablers

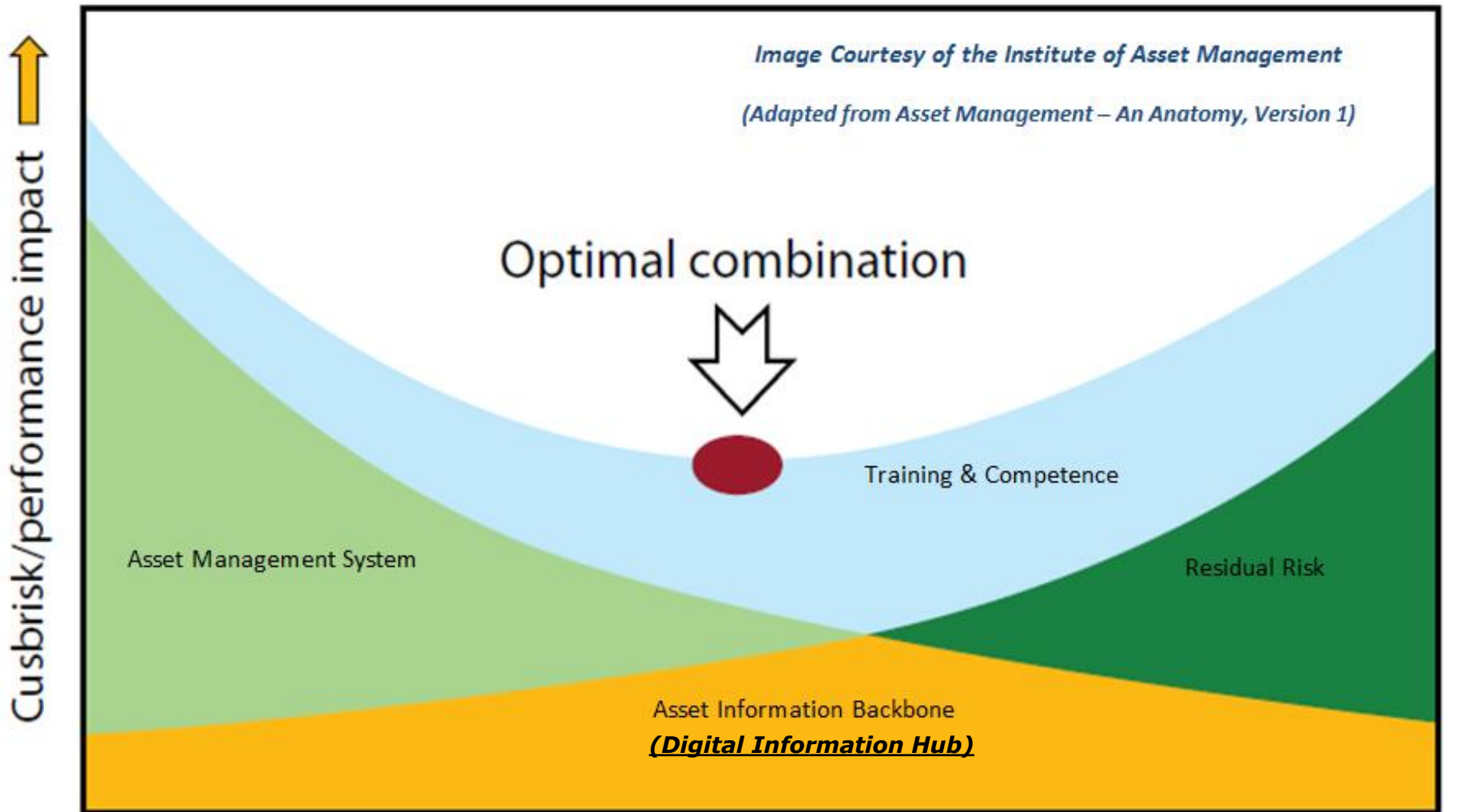


- Criticality, RBI & RBA
- Contingency & Emergency Planning
- Asset Performance & Health Monitoring
- Info Change Management & MoC
- Review, Audit & Assurance

Risk & Review



Solution Framework for Success

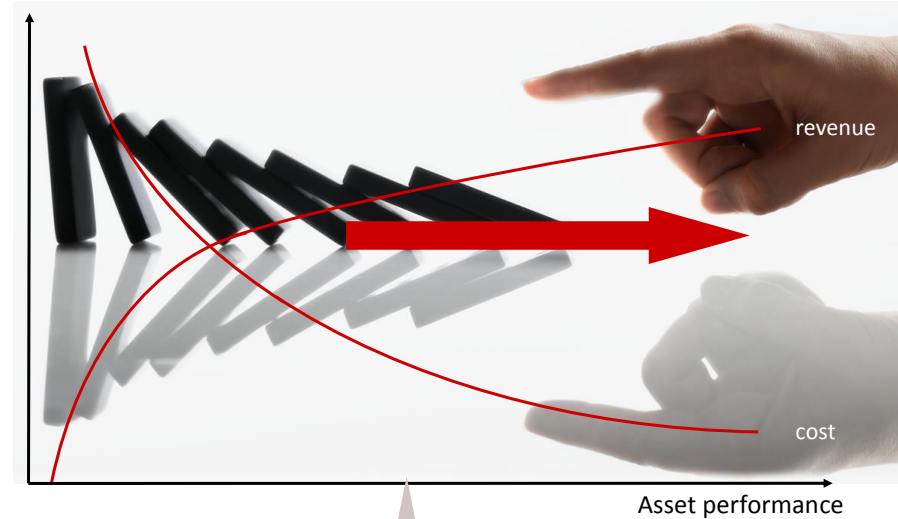


Mix of competing objectives (e.g. preventive expenditure versus residual risks)

Solution Framework for Success

Asset Information – Desired State

- Integrated information storage
 - complete digital plant records
 - integrated digital systems
 - common data access
- Robust information delivery standards and policies
 - As built / as modified data consistency
- Information management processes integrated into the business processes they support



Asset Information

- ✓ Rapidly accessible
- ✓ Complete
- ✓ Correct
- ✓ Consistent
- ✓ Trusted

Solution Framework for Success

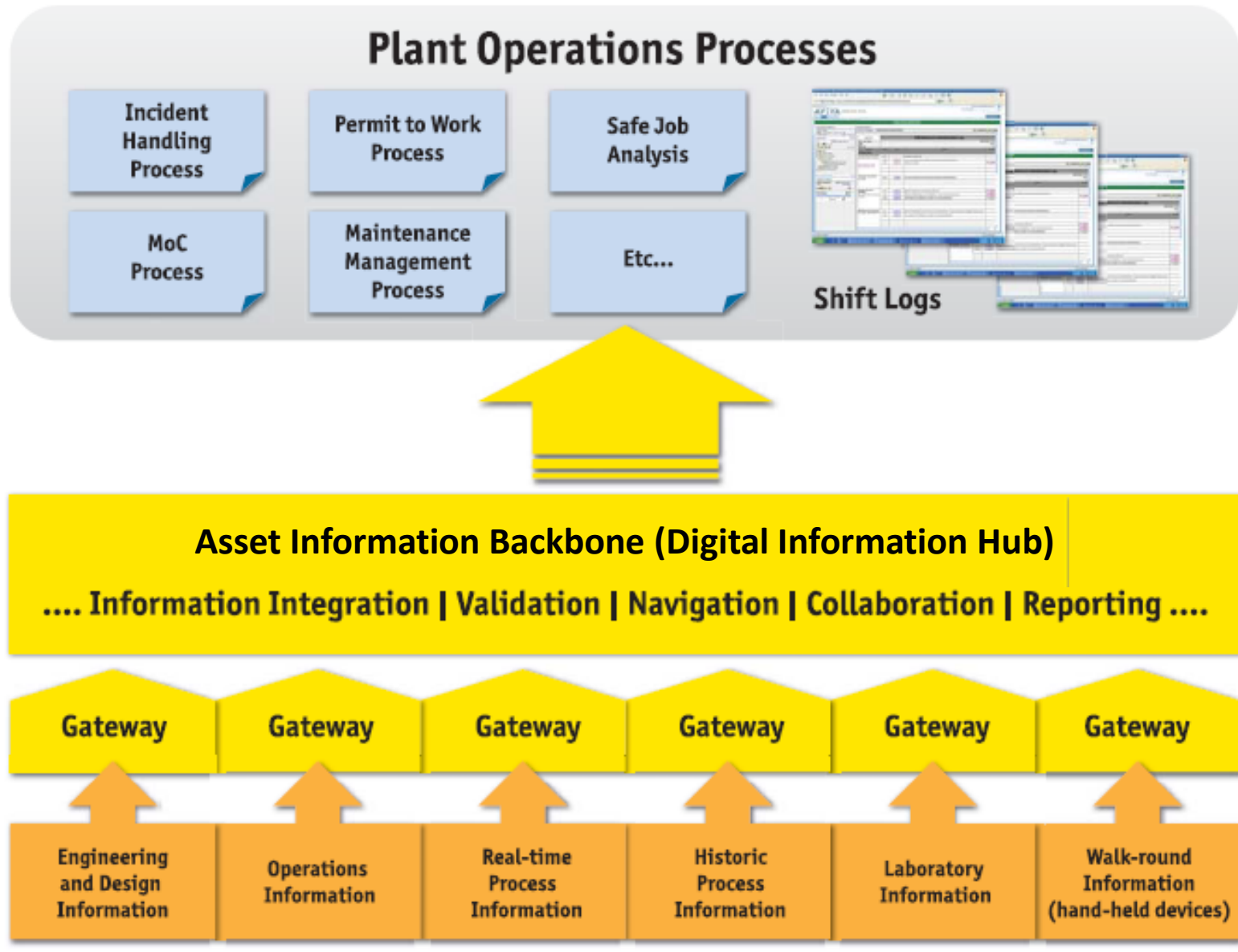
PSI Solution Wish-list

PSI Wish-List

- Ability to **export information** to common applications (MS Word & Excel)
- **Rapid / easy** means of finding data.
- **Access & view** data from other data sources
- **View** information dependencies
- **Validation** of information
- **Configurable** reporting

Solution Framework for Success

Process Safety & Asset Information Solution Needs - Making it a Reality



End User Information Access– Information Visualization

The screenshot displays the AVEVA NET Portal interface. The top navigation bar includes 'Home' and 'Portal'. Below it, the breadcrumb path is 'AVEVA NET Portal > AVEVA NET Pages > Portal'. The main interface is divided into several sections:

- Enterprise Explorer:** Located on the left, it shows the user 'paul.burton' with the role 'VNET-User'. It includes a search bar with 'Any type' selected and a 'Find' button. Below the search bar is a tree view of project components: PipeLines, Piping Components, Piping Segments, Structures, Systems, Valves, Control Valve, and Hand Valves. Under 'Hand Valves', three items are listed: HV-504, HV-505, and HV-506.
- Content Explorer:** Located below the Enterprise Explorer, it shows the selected item 'Hand Valve HV-504'. It includes a 'Documents:' section with a list of files and folders, including '3D Models - (3)', 'Arrangement Drawings - (3)', 'Datasets - (1)', and 'Location Drawings - (1)'. The file '2-15D-YS-66002-ADP31_Sht_1' is highlighted.
- Content Viewer:** The main central area displays a 3D model of an industrial facility with various pipes, tanks, and structures. The toolbar above the model includes options for 'Edit', 'Navigate', 'View', 'Markup', 'Tools', and 'Help'. A message below the toolbar reads 'Click and drag to orbit about a point on object.'

Red circles highlight the 'Enterprise Explorer' and 'Content Explorer' sections. A blue clipboard icon is positioned in the upper right corner of the interface.

Search & Navigate
Discover & Explore
Visualize & Interact

Web-Based Access to ANY type of Information

Content Viewer

Homepage.bmp | IDS 2050B.mhtml

Content Viewer

SWP 005.pdf

AVEVA				Special Work Permit SP1					Permit No: SWP 005																					
sued to: M Bower				Work Covered: Repair of P-0001A																										
act Location: P-0001A				AVEVA Supervisor: D Smith					Tel no. Ex 5237																					
A. Hot work			Y			N			n/a			B. Work at Height			Y			N			n/a									
Refer to procedure				Refer to procedure				Refer to procedure				Refer to procedure				Refer to procedure														
Welding							X						Bulk liquid tank farms						X			Can work at height be avoided?						X		
Flame cutting							X						LPG tank farm and pipework						X			Are weather conditions suitable for work taking place?						X		
Grinding							X						LPG gas filling booths						X			Ladder						X		
Use of electrical equipment (including battery operated tools)							X						Chemical process areas			X						Tower scaffold						X		
Hot work equipment in good state of repair							X						Chemical process pipework						X			Fitted scaffolding						X		
Within 11m of work all combustibles/combustible materials have been removed							X															Roof work - with edge protection						X		
Within 11m of work all combustibles/combustibles that cannot be removed have been protected							X															Mobile elevated work platform e.g. Cherry picker						X		
Camera - Flash off							X															Person performing work is trained & competent						X		
No RED TAG (Sprinkler impairment etc) issued for Area							X						Hot work: To be signed off after work completion:									Equipment tagged, inspected & suitable for use						X		
Fire watcher required & fire extinguisher in area suitable							X						Area Monitored for 1 hour after work completed Signed:									Are suitable precautions in place to prevent falling e.g. harness						X		
Monitor area for 1 hour, then check hourly (4 h) after work is completed							X						Checked Signed:									Toe boards & guard rails required						X		
													Fire detectors put back into service:																	

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Configurable Reports for Identification of Discrepancies in Operational Data & Monitoring of Operational Parameters

Content Viewer

AVEVA Homepage SWSOIMLink

Corporate OIM Summary (HLO Energy)

	Atlanta	Bridgeport	Calgary	Denton	Edmonton	Freeport	Greenville
Process Safety Culture	Green	Green	Red	Yellow	Yellow	Red	Green
Compliance	Green	Green	Yellow	Green	Green	Green	Yellow
Competence	Green	Green	Red	Red	Green	Yellow	Green
Workforce Involvement	Red	Green	Red	Yellow	Yellow	Green	Green
Stakeholder Outreach	Green	Green	Red	Yellow	Red	Red	Green
Knowledge Management	Green	Green	Red	Yellow	Green	Red	Yellow
Hazard Identification / Risk	Green	Green	Green	Red	Green	Yellow	Green
Operating Procedures	Green	Red	Yellow	Yellow	Green	Green	Yellow
Safe Work Practices	Red	Red	Yellow	Yellow	Green	Green	Yellow
Asset Integrity / Reliability	Green	Green	Red	Yellow	Green	Red	Yellow
Contractor Management	Yellow	Green	Yellow	Green	Green	Green	Yellow
Training / Performance	Green	Green	Green	Yellow	Green	Yellow	Yellow
Management of Change	Green	Green	Green	Yellow	Green	Red	Yellow
Operational Readiness	Green	Green	Green	Yellow	Green	Green	Yellow
Conduct of Operations	Green	Green	Red	Yellow	Green	Green	Yellow
Emergency Management	Green	Green	Yellow	Yellow	Green	Red	Yellow
Incident Investigation	Green	Green	Red	Red	Red	Green	Yellow
Measurement and Metrics	Yellow	Yellow	Yellow	Red	Green	Green	Green
Auditing	Green	Green	Red	Yellow	Green	Red	Yellow

Summary of Key Capabilities Provided by The Asset Information Backbone

- **Features**

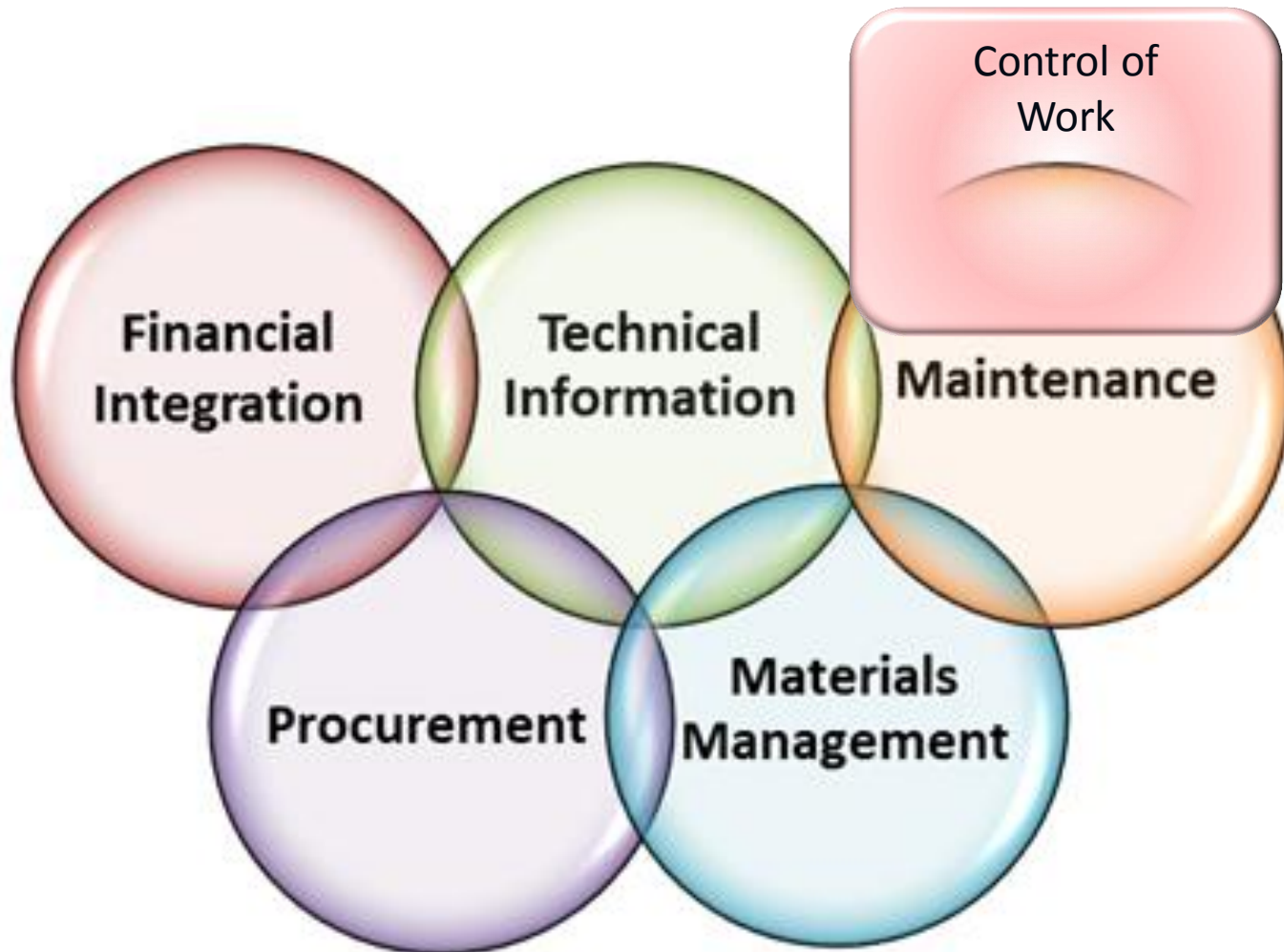
- Structured & Unstructured information is searchable, viewable & available to all authorized users.

- **Benefits**

- ✓ ***Navigate information content*** via intuitive breakdown structures, object links & hot-spotted drawings and models
- ✓ ***Search, retrieve & visualize*** content
- ✓ ***Create and run reports*** to identify data quality issues
- ✓ ***Print & export report content*** in standard formats (e.g. CSV, XML & MS Excel)
- ✓ ***Mark-up & annotate content*** & participate in ***real-time collaboration*** sessions with users across multiple locations.

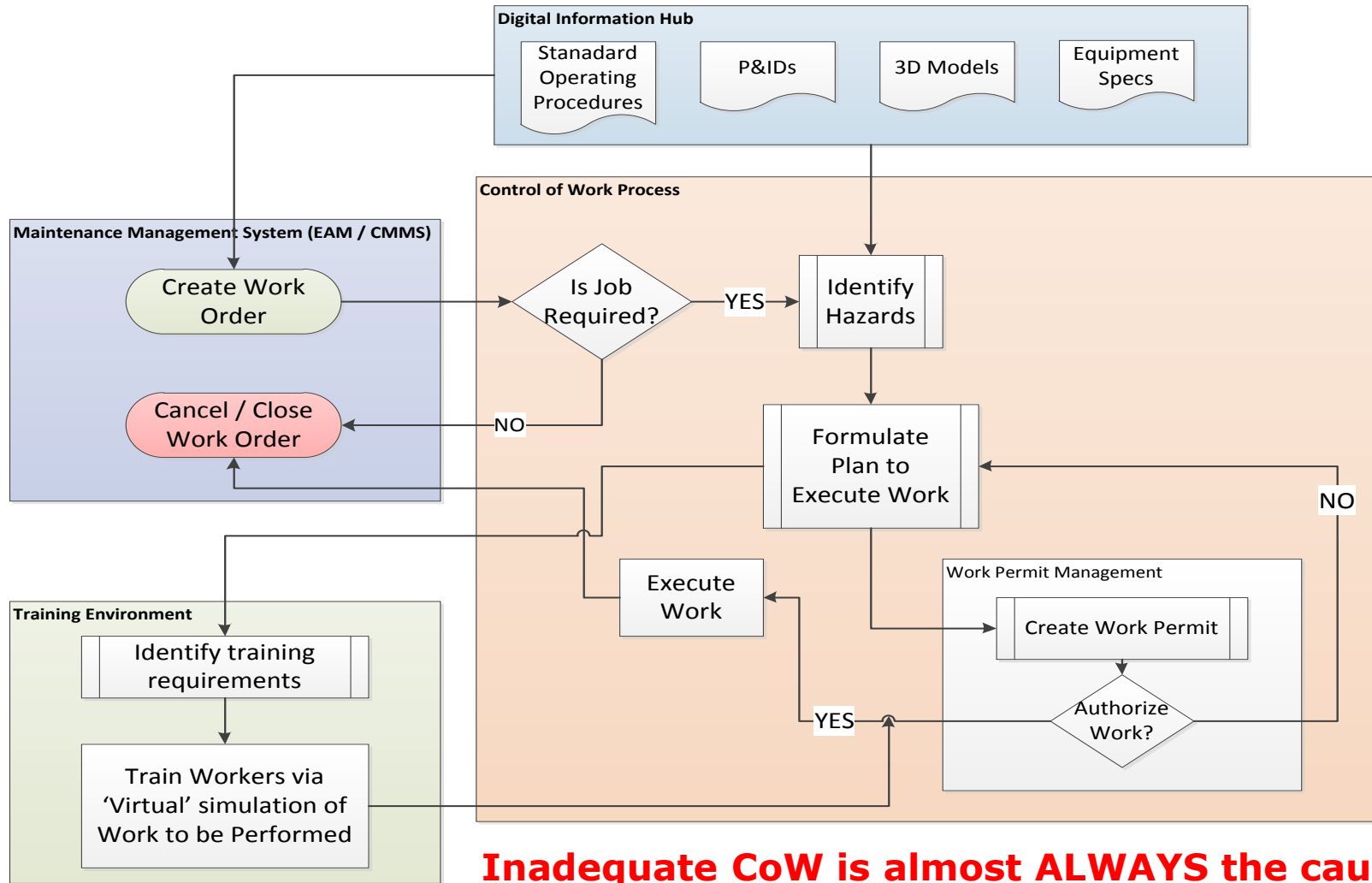
Solution Framework for Success

Taking the 'Traditional' Asset / System Capabilities a Step Further – Control of Work (CoW)



Solution Framework for Success

'Control of Work (CoW) 101'

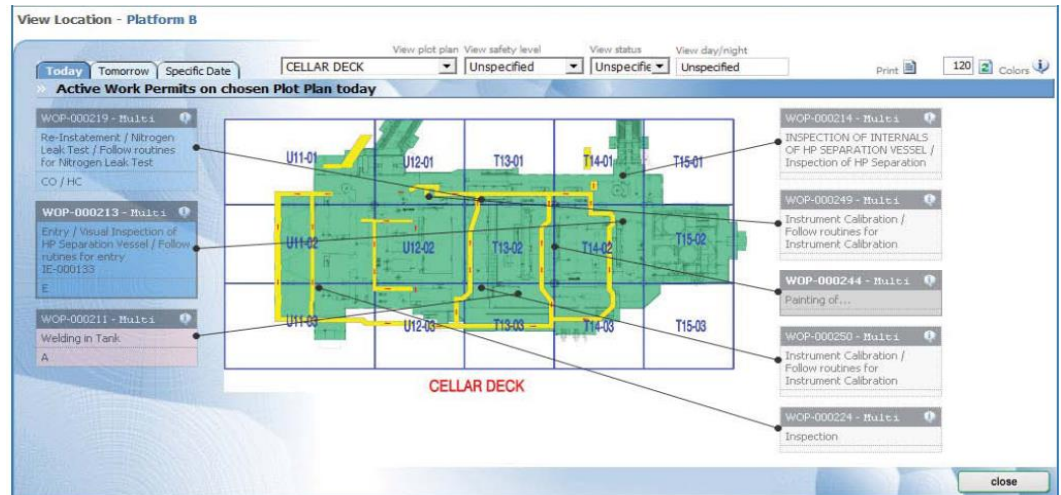


Inadequate CoW is almost ALWAYS the cause of Personal Injury & Major Incidents!!!

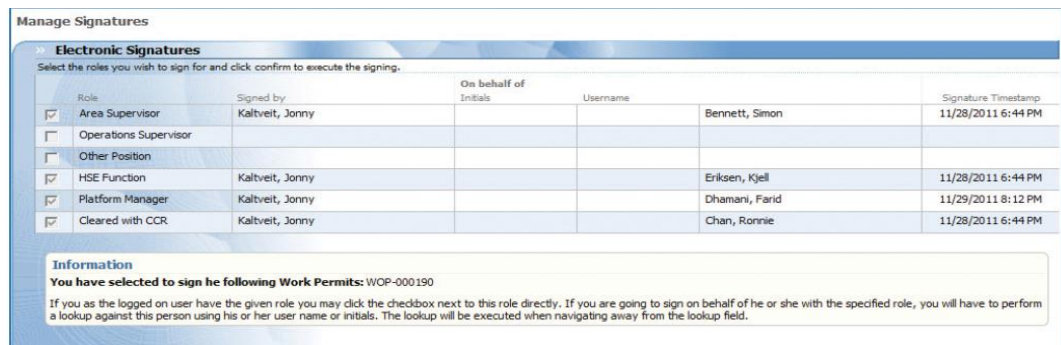
Solution Framework for Success

Control of Work (CoW) – Work Permit Management

- ◆ **Visualization of permits across the facility**
- ◆ **Electronic activation / deactivation of Work Permits & Isolation Certificates**
- ◆ **Ensure Work Permits adhere to defined approval process**
- ◆ **Benefit = Improved regulatory compliance and safety**



Color-coding & plotting of work permits in accordance with a plan of the facility



Electronic authorization of work permits

Solution Framework for Success

Control of Work (CoW) – Integrated Information

- ◆ **Enables access to all related data & documentation corresponding to each Work Permit area**



Summary of Capabilities Provided by the Maintenance Management System (CoW Context) – AVEVA WorkMate

- ✓ Support for **work planning & execution**
- ✓ **Configurable workflow** for safe execution of work orders
- ✓ Support for **barcode scanning** for auto-activation / de-activation of work permits
- ✓ **Electronic Signature capability** for sign off on work permits (including full audit trail / logging of signatures)
- ✓ Graphical overview / **visualization of active work permits**
- ✓ Link to all information associated with Work Permits (e.g. P&IDs, HSE datasheets, Procedures...)

The screenshot displays the AVEVA WorkMate Work Permit Manager interface. At the top, it shows the AVEVA logo and the title 'Work Permit - overview'. Below this, there are navigation options for 'View Location - Platform B' and 'View plot plan View safety level View status View day/night'. The main interface is divided into several sections:

- Active Work Permits on chosen Plot Plan today:** A list of work permits with details such as WOP-000184 (Sandblasting), WOP-000180 (ESD Valve Testing / Follow procedures for ESDV Testing), WOP-000181 (Debris Removal), WOP-000192 (ESD Valve Testing / Follow procedures for ESDV Testing), and WOP-000194 (Re-Installation / Nitrogen Leak Test / Follow routines for Nitrogen Leak Test).
- 3D Visualization:** A central 3D model of an offshore platform with lines connecting the work permit list to specific areas on the platform.
- Work Permit Details (WOP-000180):** A detailed form for a specific work permit, including sections for 'OPERATIONAL AND SAFETY PREPARATIONS', 'PRECAUTIONS PRIOR TO COMMENCING WORK EXECUTION', and 'COMPLETION'. The form includes various checkboxes and input fields for safety and operational requirements.

Solution Framework for Success

Competency Development – Training Solution Wish-list

Training Solution Wish-List

- Realistic training for Emergency situations
- Means to practice infrequently performed tasks & Hazardous Processes
- Simulation of 'real-world' conditions in training exercises
- Anticipation of worker behavioral response in abnormal situations
- Appealing to next generation workforce

Solution Framework for Success – Training Solution & Activity Visualization



Multi-User Virtual Worlds

- Fully interactive, 'real-world' environment where multiple workers can perform pre-defined tasks
- Relevant workflows for training, collaboration, planning & operations
- ***Benefits: Increased situational awareness & facility familiarization***



Storytelling

- Sequence of individually-driven, interactive animated environments to demonstrate the progress of a particular process or production schedule
- ***Benefits: Improved stakeholder comprehension, communication and speed to proficiency***



Applications for Engineers

- Custom visualization tool for engineers, offering an immersive experience of a 3D-model-based environment, with embedded links to data & document management systems as real-time data feed sources.
- ***Benefits: Increased safety, enhanced remote asset surveillance & troubleshooting & improved collaboration for solving issues***

Solution Framework for Success

Training Solution – Embedded Information Portal



Solution Framework for Success

Training Solution – Procedure Engine to Model & Simulate Activity Sequence



- Sample Application demonstrating a Multi-User 'Lock-Out / Tag Out' activity for removing a condenser

Operations Integrity Management Solution Benefits

Excellence in Operations Integrity Management / Optimized Safety Performance
(ISO 55000 Compliance)

Asset & Maintenance Management

- Emergency Preparedness
- Compliance with Asset Information Standards
- Integration of CoW into Maintenance Activities
- Improved Incident Response Rates Coupled With Complete Set of Asset Information

Training & Competency Development

- Resource Competency Assurance
- Assurance that Workers Understand SOPs and Execute Tasks Accordingly
- Assurance that Workers Do NOT Execute Work Orders Without Consideration of CoW Requirements
- Reduced Number & Frequency of Injuries & Incidents

Asset Information Backbone

AVEVA™

Thank you



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