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

Sloane Whiteley, Senior Consultant

AVEVA Enterprise Solutions

Lessons Learned from the Past

Offshore O&G: Deep Water Horizon ('Macondo blowout)	O&G Refinery: Texas City Refinery Explosion	Mining: Meikle Mine Explosion	Chemicals: Danlin Plant Explosion	
				
Largest accidental marine oil spill in the history of the petroleum industry	*Improper start-up procedure followed causing a chain of incidents leading to a vapour cloud explosion*	*Application of a mixing motor to solidified PETN & secondary explosion in a nearby storage unit*	*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)

X

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)

X

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**

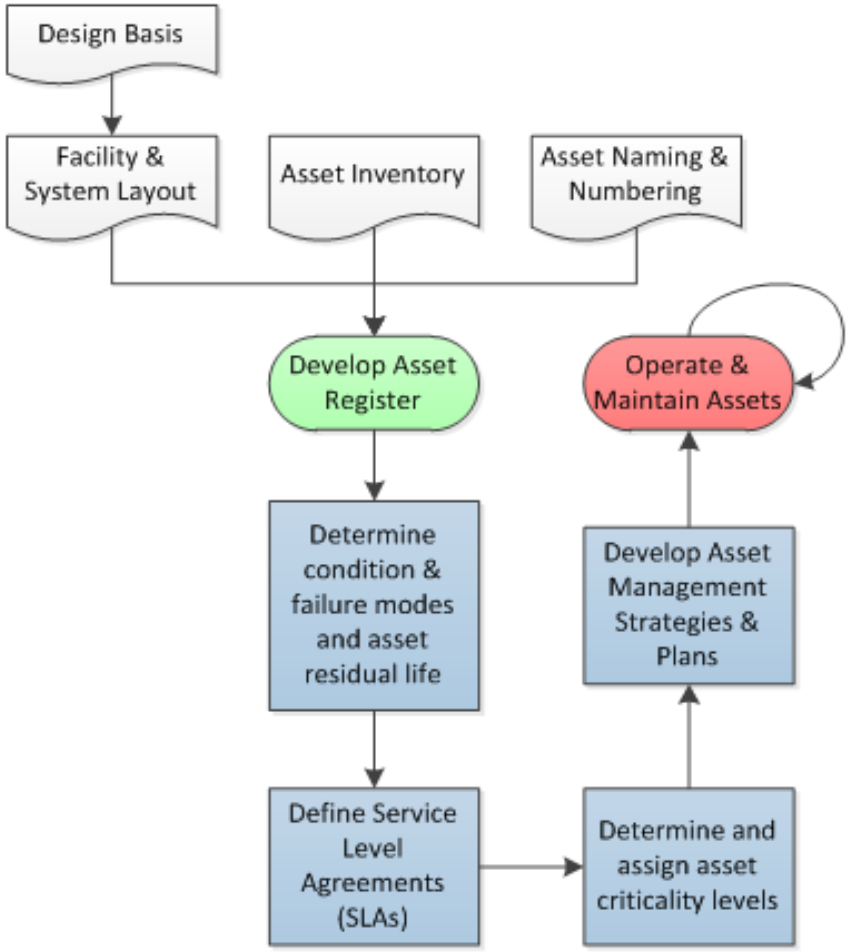
Operational Integrity Top Challenges

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*

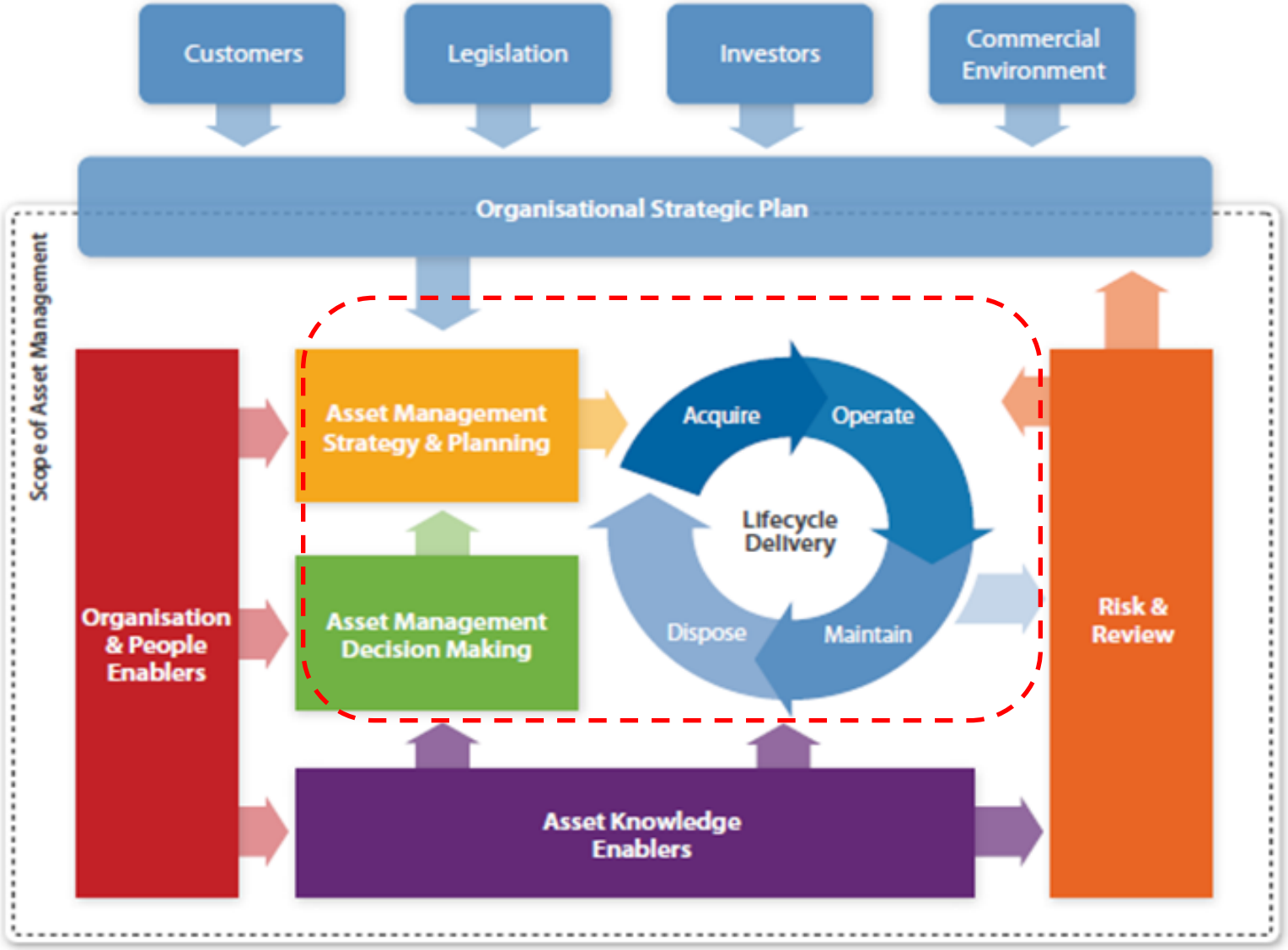
- Educating the Next Generation of Engineers – Challenges with 'Traditional' University Engineering Curriculums
- Conventional Training Methods are not totally effective in Ensuring workers are Adequately Trained
- It is Impractical to Conduct 'On-the-Job' Training for Abnormal Situations & Safety Critical 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

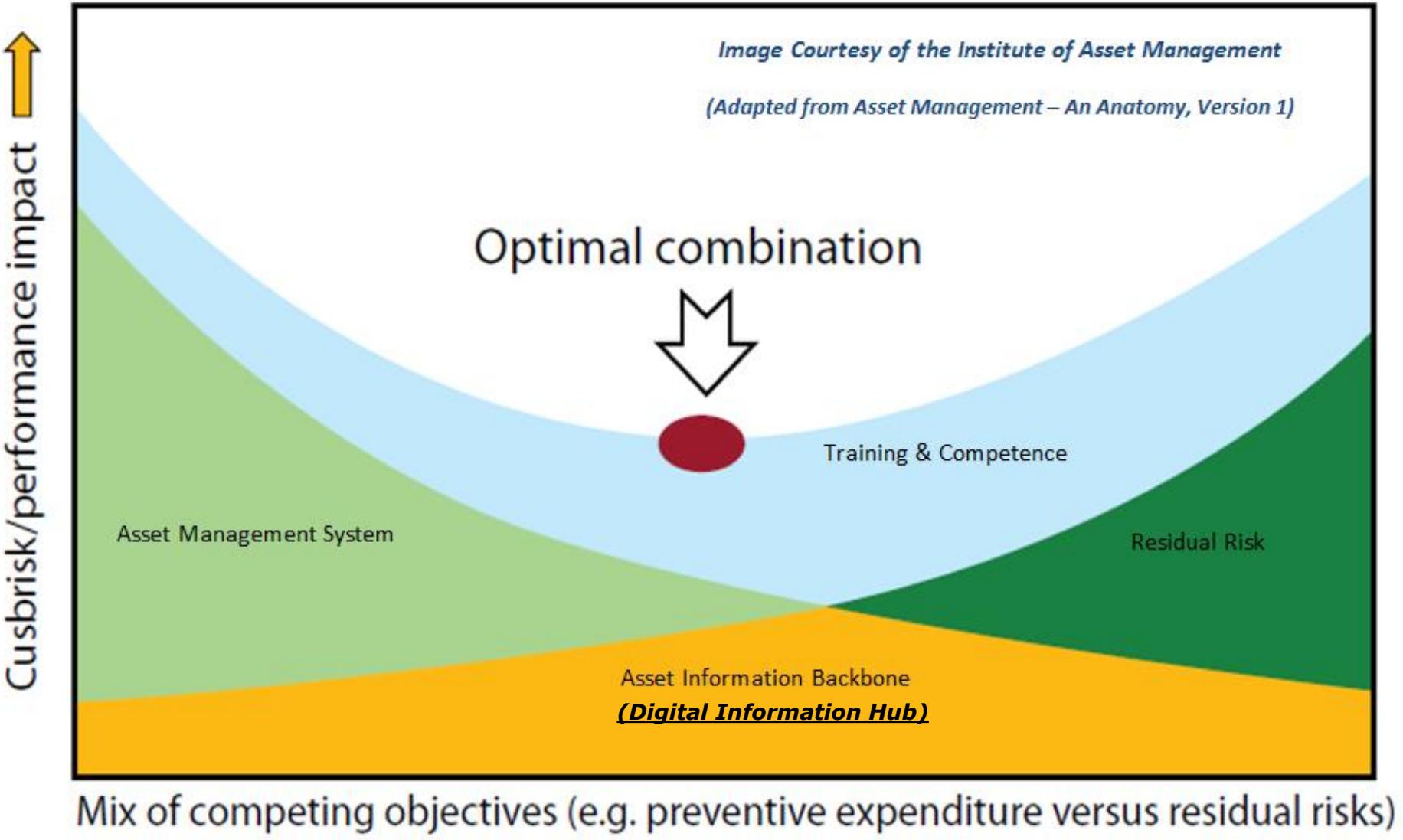
- Contract & Supplier Management
- Asset Management Governance
- Organizational Structure & Culture
- Competence & Behavior

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



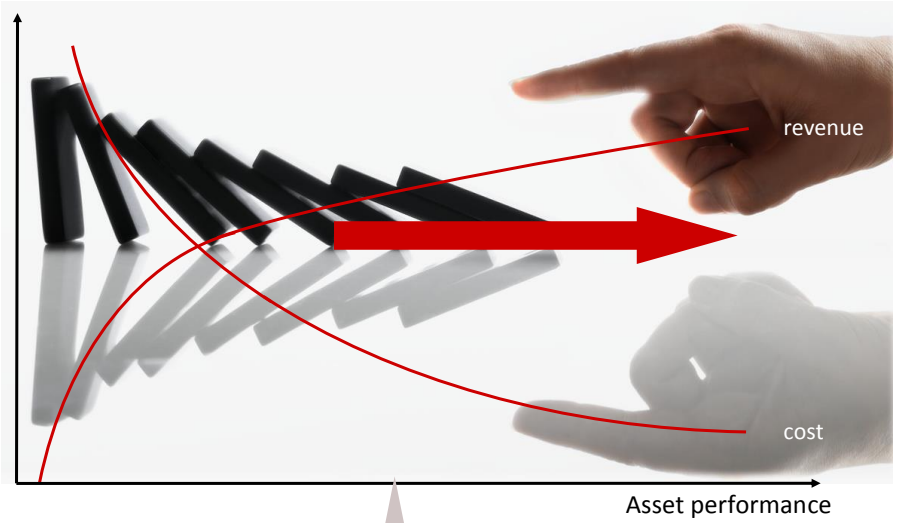
Solution Framework for Success

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

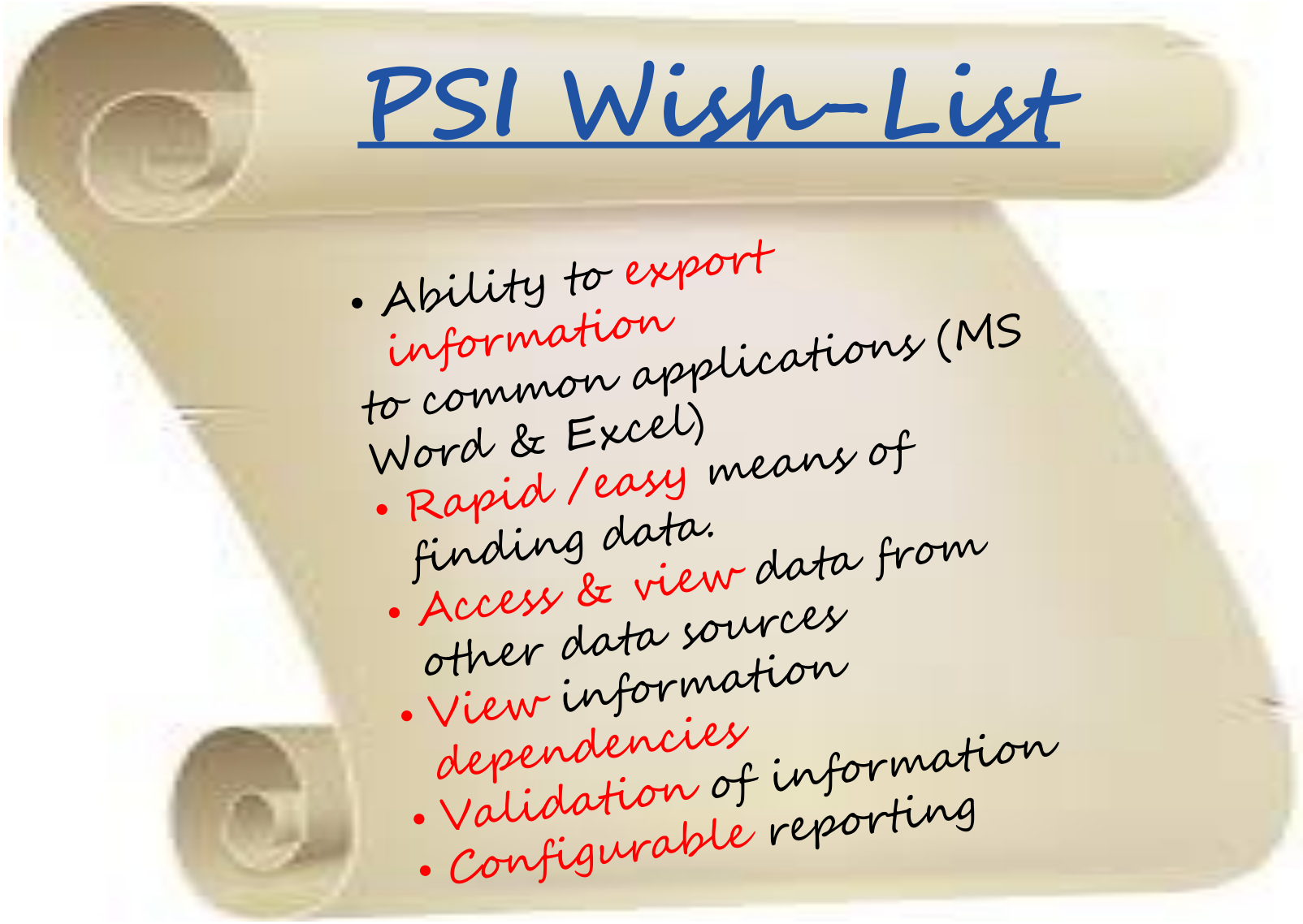


Asset Information

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

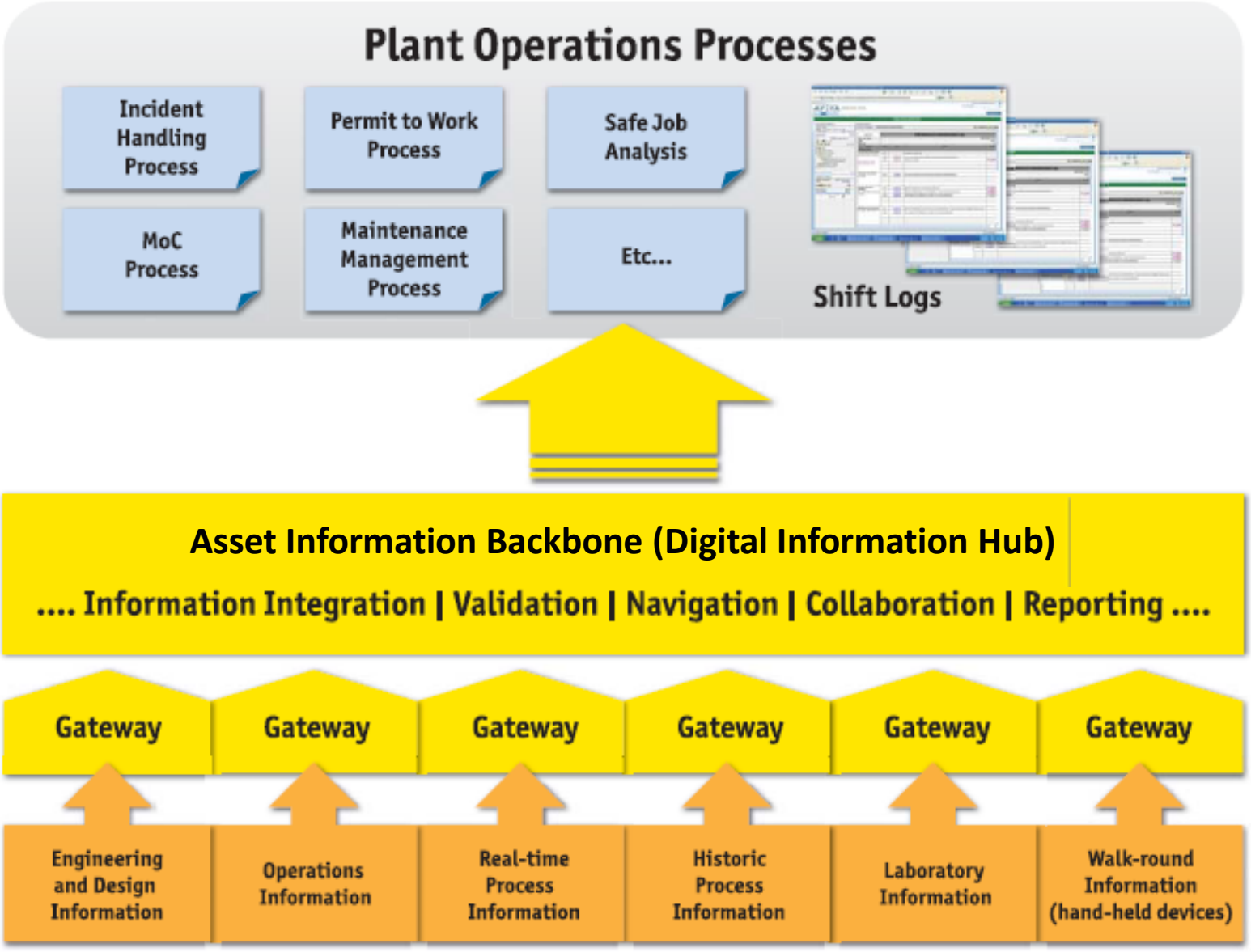
Solution Framework for Success

PSI Solution Wish-list

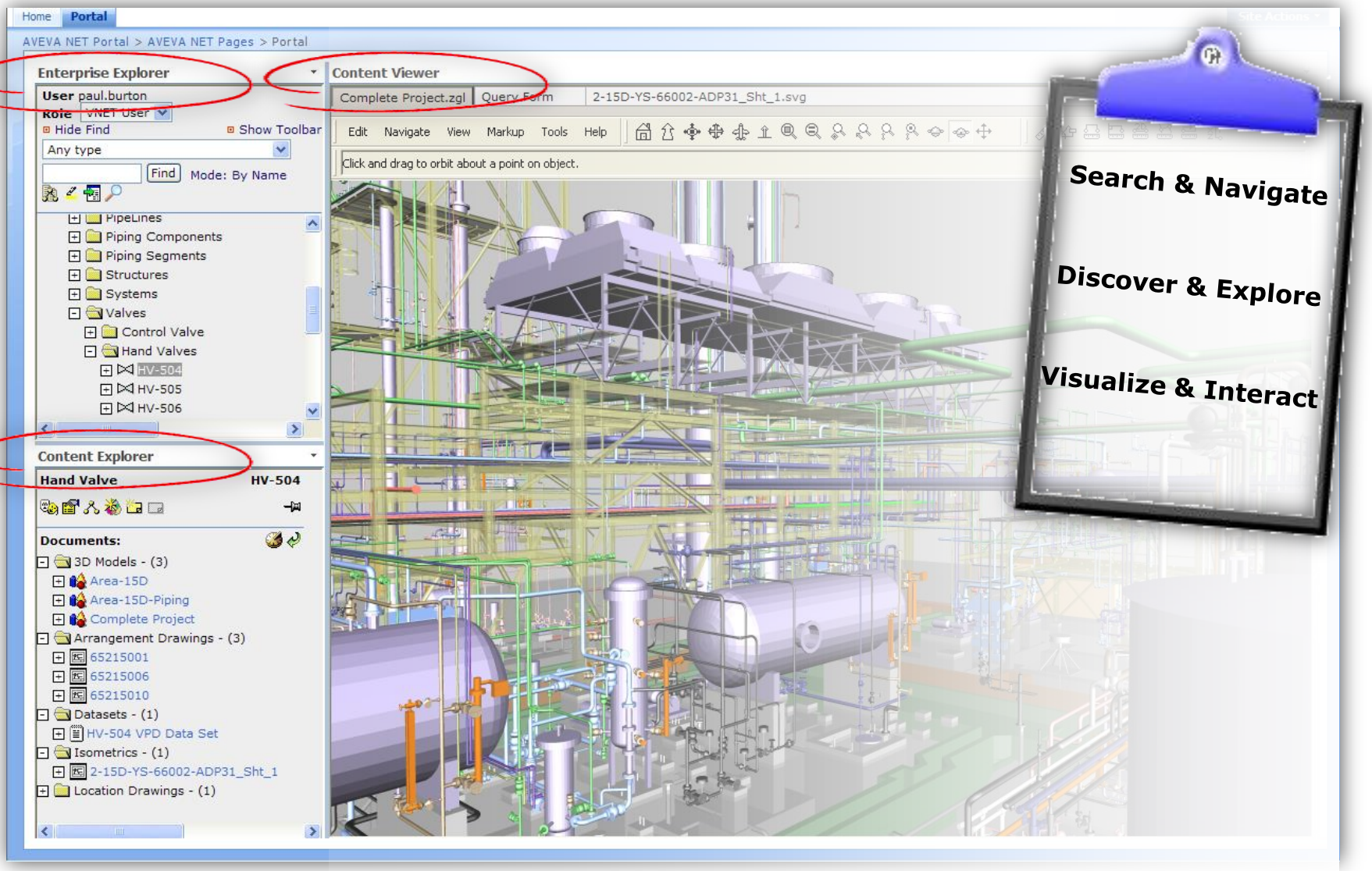


Solution Framework for Success

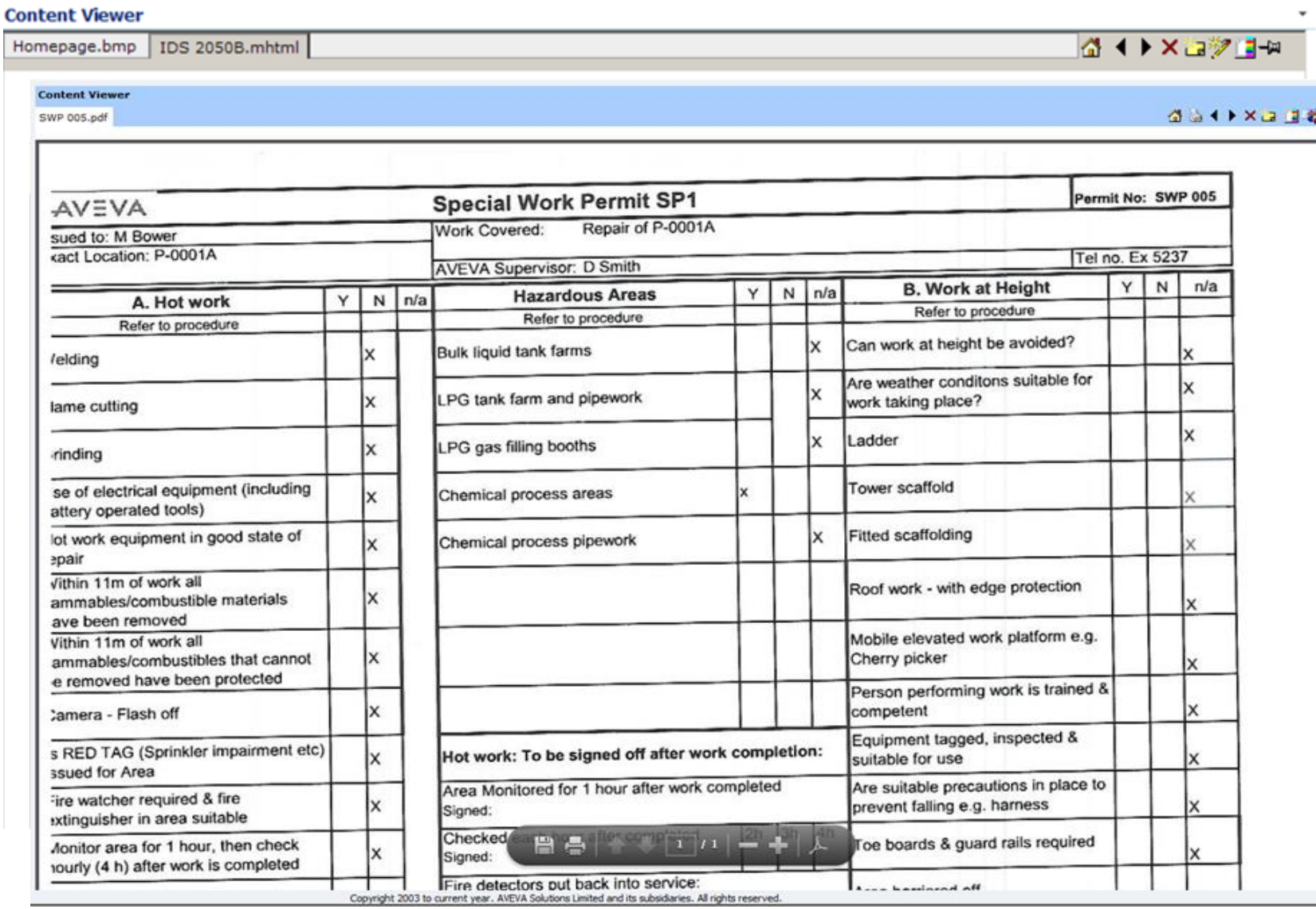
Process Safety & Asset Information Solution Needs - Making it a Reality



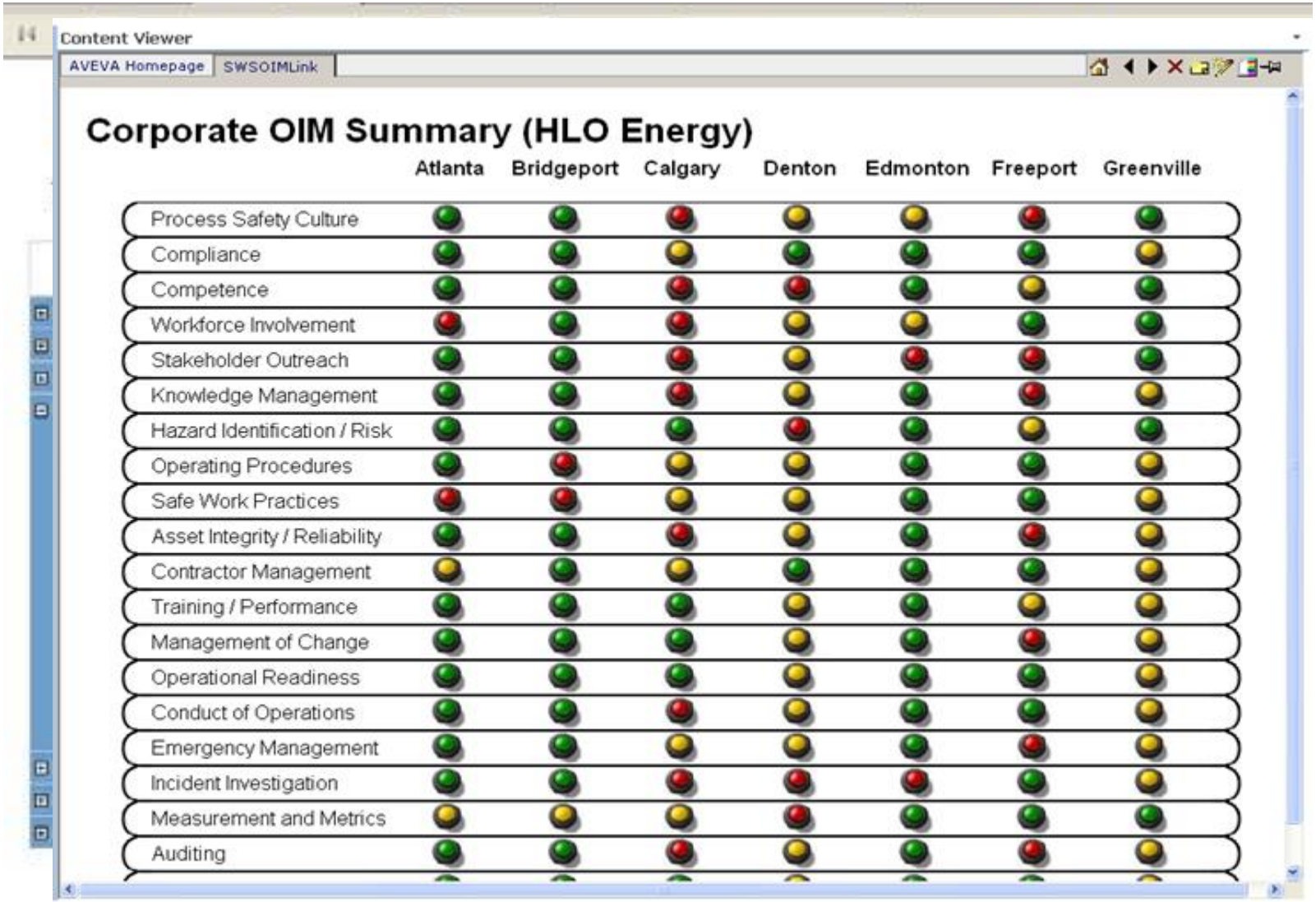
End User Information Access– Information Visualization



Web-Based Access to ANY type of Information



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



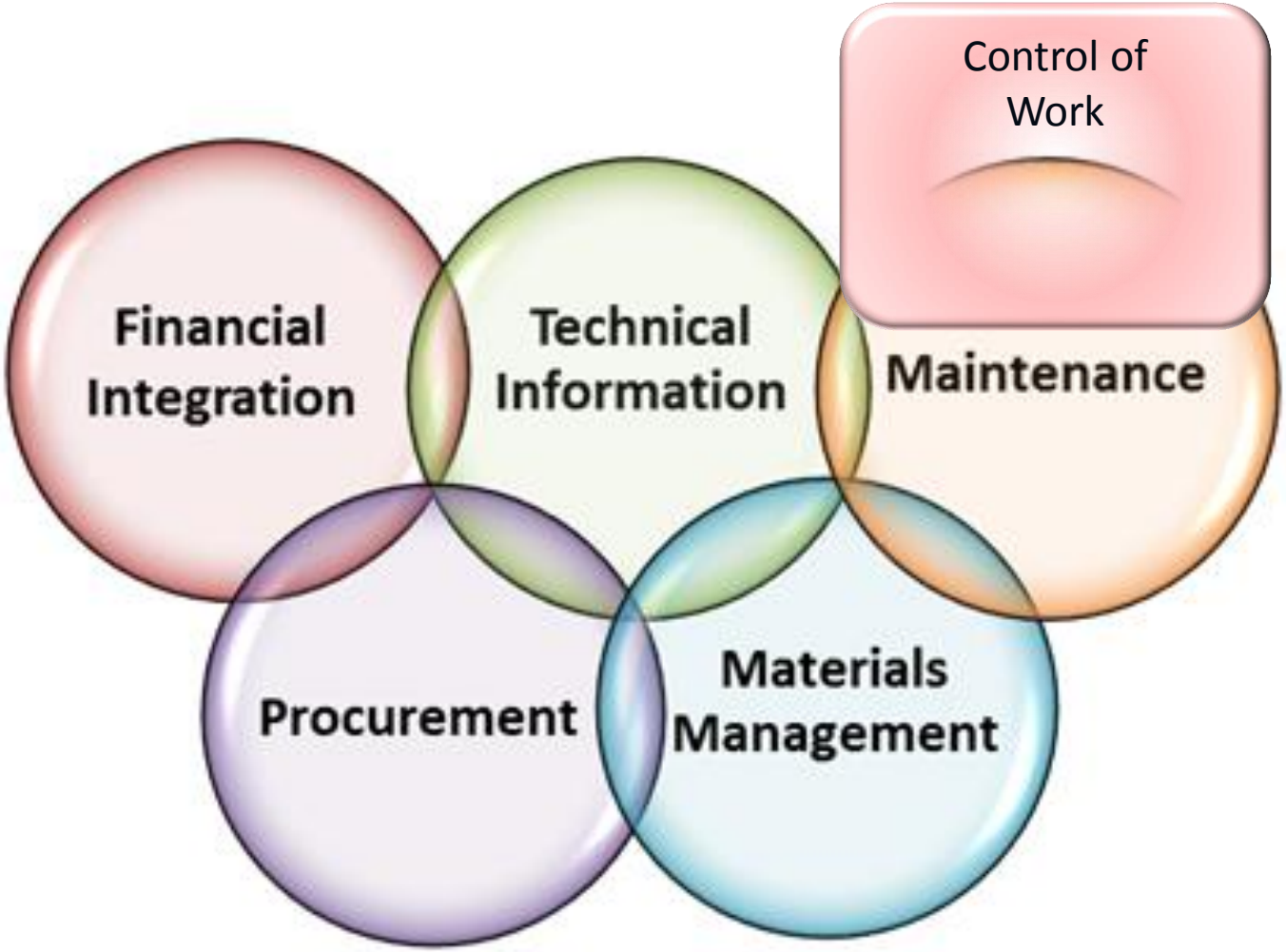
Summary of Key Capabilities Provided by The Asset Information Backbone

- **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.

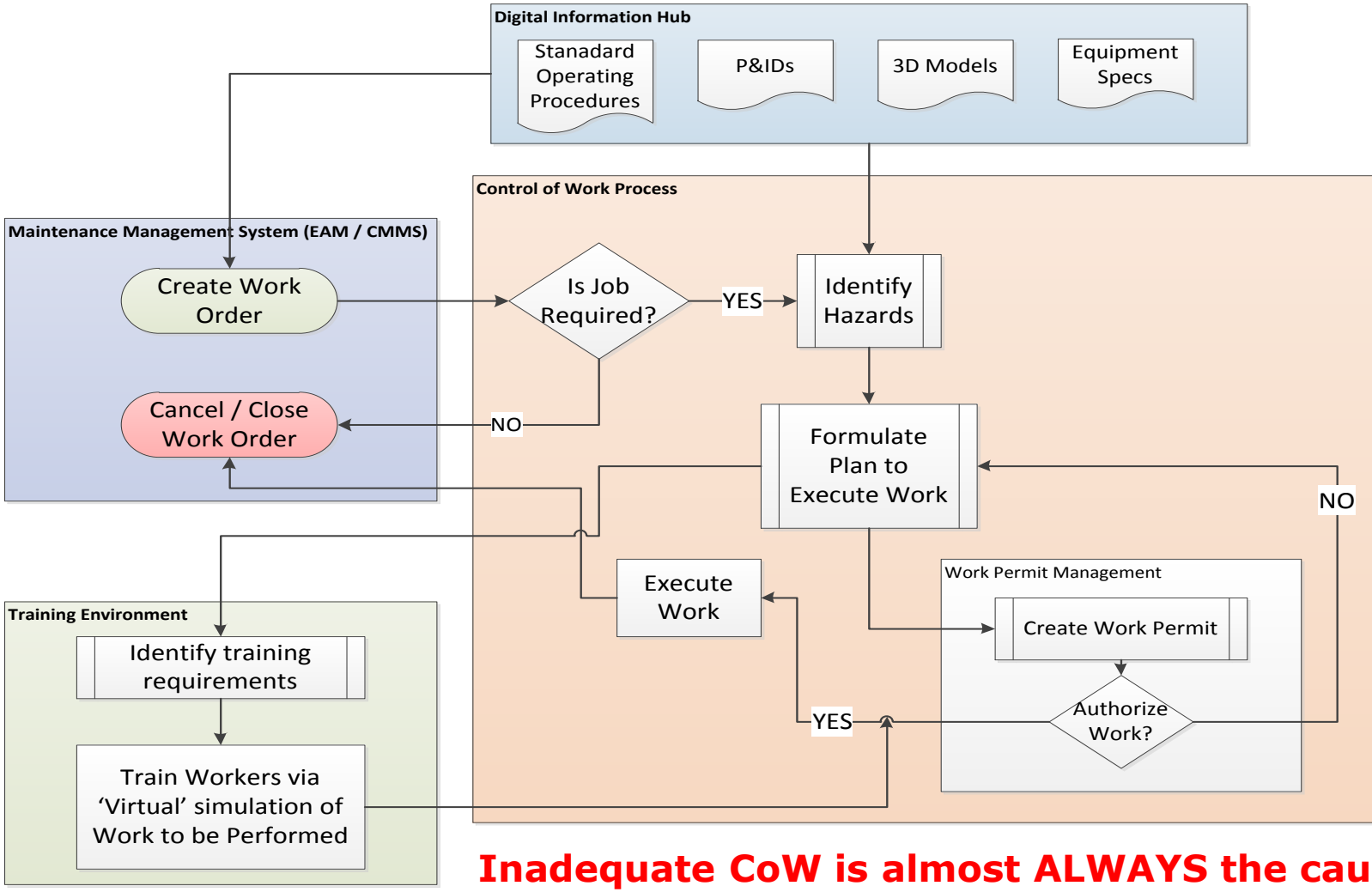
Solution Framework for Success

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



Solution Framework for Success

'Control of Work (CoW) 101'

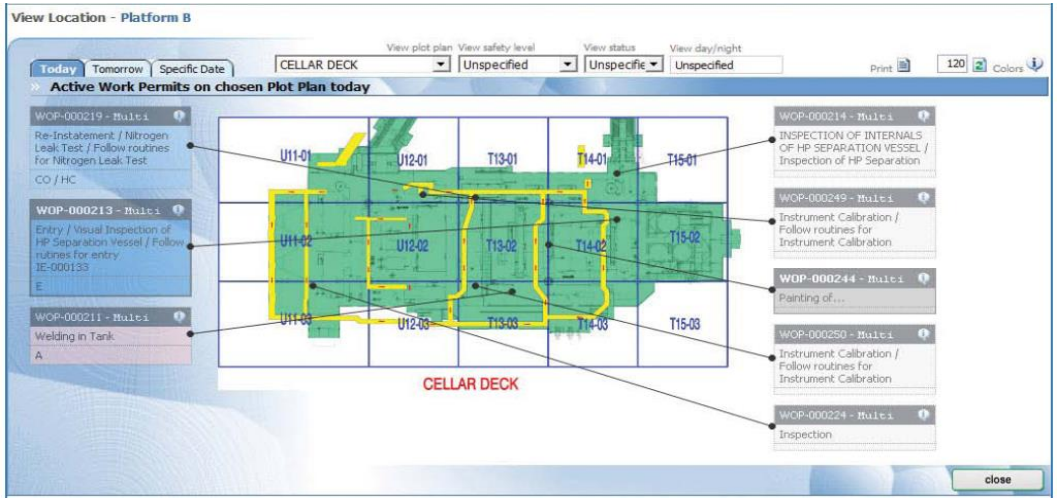


Inadequate CoW is almost ALWAYS the cause of Personal Injury & Major Incidents!!!

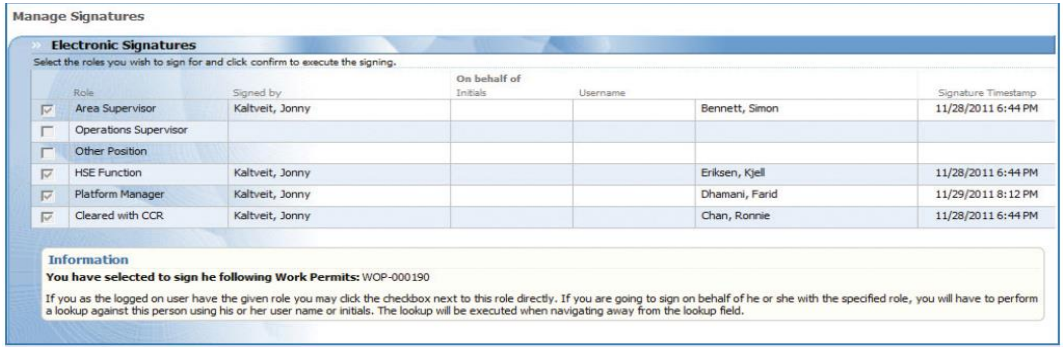
Solution Framework for Success

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**
- **<u>Benefit</u> = Improved regulatory compliance and safety**



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



Electronic authorization of work permits

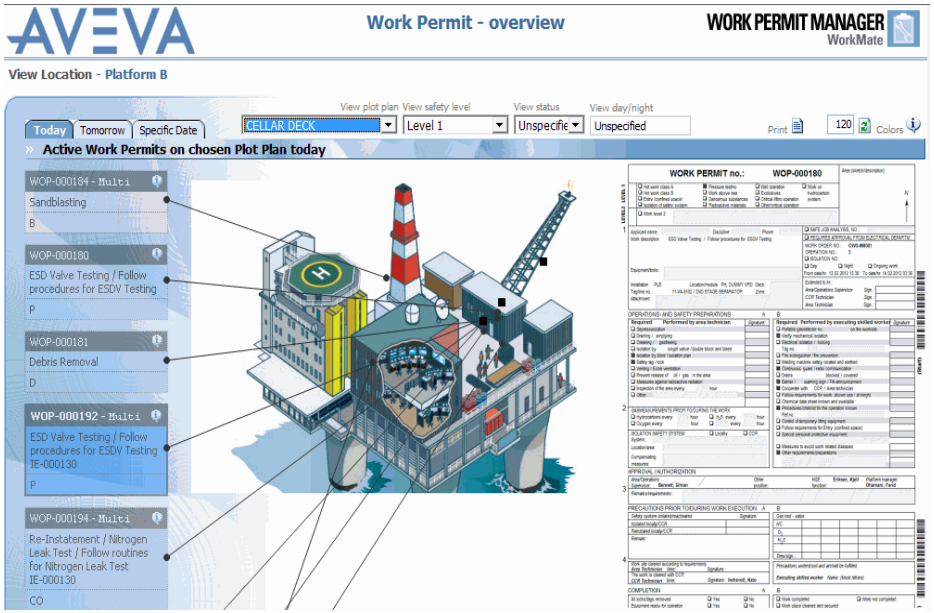
Solution Framework for Success

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…)



Solution Framework for Success

Competency Development – Training Solution Wish-list

Solution Framework for Success – *Training Solution & Activity Visulaization*

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

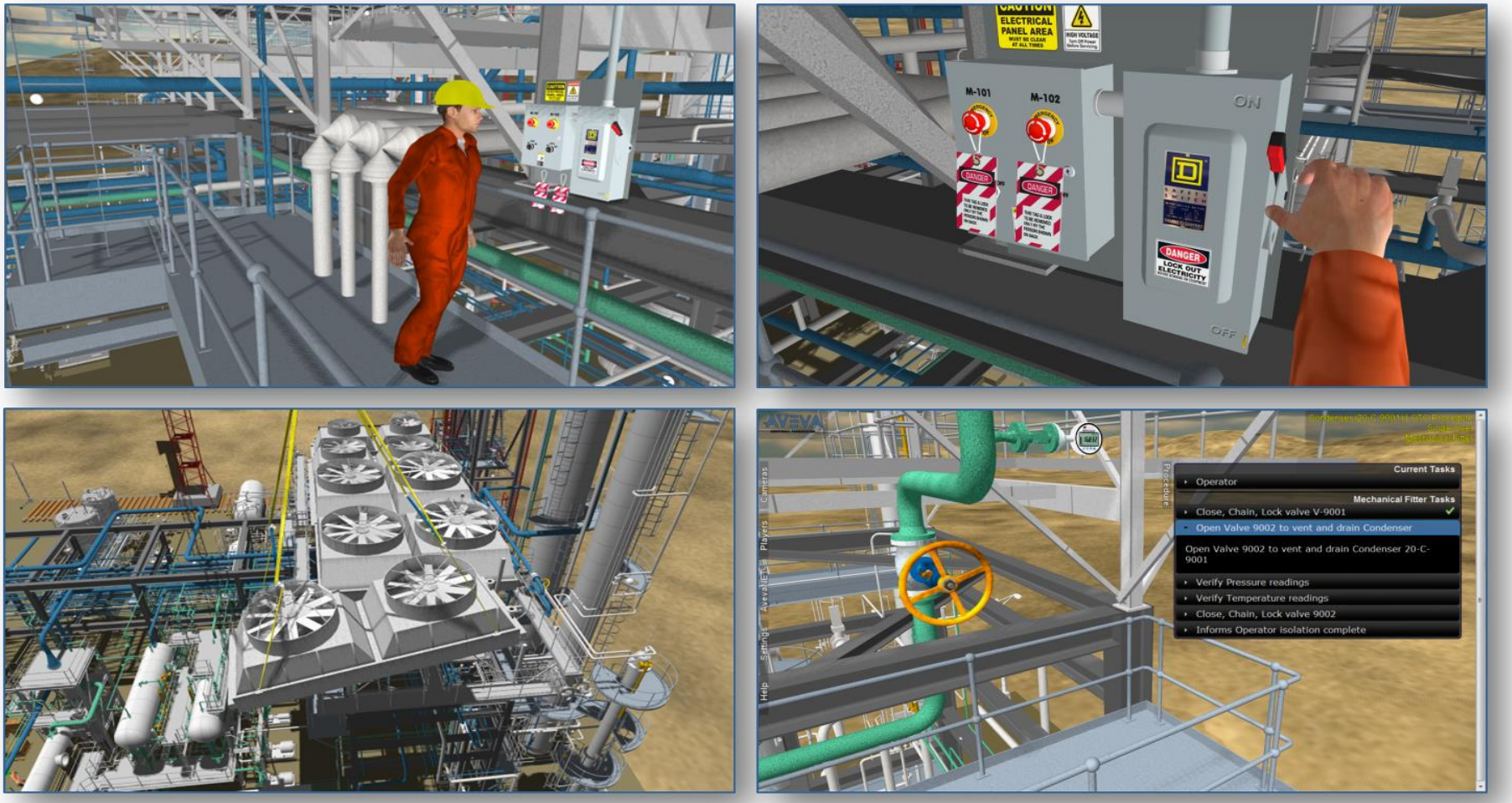
- Custom visualization tool for engineers, offering an immersive experience of a 3D-model-based environment, with embedded links to data & document management systems as real-time data feed sources.
- ***Benefits: Increased safety, enhanced remote asset surveillance & troubleshooting & improved collaboration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

Thank you

www.aveva.com