The Question is – How Can Virtual Technology Contribute to “Outage Excellence”?
Topics

The Business Value of Virtual Reality

- **Introduction**
  - Dassault Systemes
  - The Energy Lifecycle
  - Industry Challenges
- **Virtual Planning for Operations & Maintenance**
- **Virtual Training for Operations & Maintenance Learning**
- **How to Experience the Immersive Environment**
- **Customer References**
- **Customer Project Recommendations**
- **Capital Project Management Overview**
- **3D Collaboration**
- **ROI Project Calculator**
- **Summary/Q&A**
Dassault Systèmes Update

2009
- $2 Billion Revenue
- 23% R&D
- Operating Margin 25%
- 8,200 Employees
- 27 Countries
- 100,000 Customers
- 2,000,000 Users

IBM PLM Acquisition
- Acquisition took effect on April 1st, 2010,
  Largest Acquisition in DS History for approx $600 million, 700 people globally
- DS to be IBM Global Alliance Partner
ENERGY Industry Segmentation

**Oil & Gas**
- Petrochemical
- Downstream Oil refinery plants
- Oil & Gas Offshore
- FPSO’s, Drilling Rigs, Jackets

**Process**
- Chemical Plants
- Cement, Mining, Water treatment
- Mining process plant,
- Cement plants

**Energy & Utilities**
- Thermal plants
- Nuclear Plants
- Hydro dams & Offshore farms
- Wind & Solar farms

Owner/Operators:
- bp
- Xcel Energy
- Petrobras
- DSM
- Hydro Quebec
- EDF
- Exelon
- STORK

EPC & Services:
- Halliburton
- Schlumberger
- Foster Wheeler
- AREVA
- Oceaneering

Major Equipment Vendors:
- Alstom
- Areva
- Voith Siemens
- Bi
- Gamesa

© Dassault Systemes
Energy Project – Lifecycle Perspective

Project Information Management
Asset Creation – O/O, EPC, Suppliers

Finance / Analyses
FEED / Conceptual Design
Functional & Detail Design
Construction & Fabrication

Operation, Maintenance & Services
Life Extension and Refurbishment
Projects starting a new Phase
Decommission

Project Phase
0.5 – 10 years

Operation & Maintenance Phase
20 – 40 – 60 years

Operation Management
Asset Lifecycle – O/O

Project Handover
Start-up and Testing Phase - First Fuel Loading or First Oil
I hear and I forget.
I see and I remember.
I do and I understand.

Confucius
Chinese philosopher & reformer (551 BC - 479 BC)
Common Challenges the Energy Industry Face

- **Operator and Team Safety**
  - What if you could virtually simulate your key processes against your *schedule* to train your project teams?
  - What if you could improve operator training (Murphy’s Alley)
  - Can you better prepare the 60-70% of contractors during an outage

- **Schedule Acceleration or Conformance**
  - What if you could virtually model your *schedule* to ensure compliance and optimization?
  - *What is 1 day worth?*

- **Hazardous Area Exposure Tracking**
  - What if you could simulate, calculate and report (ALARA) exposure based on people and tasks?

- **Aging Workforce & Turnover**
  - What if you can capture the knowledge

- **Unplanned Incidents**
  - What if you had a virtual environment to simulate a response to an incident before mobilizing resources in the plant?

- **Security**
  - What if you can virtualize *force on force* breach training

**All Challenges a Virtual Environment CAN ADDRESS!**
Recent Tragedies - Safety Focus More so Now Than Ever

Deepwater Horizon – 4/20/2010

West Virginia Coal Mine 4/5/2010
DS Energy Solutions

MechCAD and Plant Design

Virtual Training

Capital Project Management

Role Based - Consistent Information & Project Data Throughout Entire Project Lifecycle

Realistic Simulations

Virtual Planning

3D Live Web Navigation
Achieving Outage Excellence Through Virtual Optimization – Two distinct yet related topics

**Virtual Planning – optimize tasks**

- **Link 3D Data with schedule** and resource information
  - Review and optimize activities related to time and cost

- Perform kinematics analyses
  - Remove and place equipment (identify critical path)
  - Optimize Crane Operations
  - Robotics (other remote operated devices – ROV)

- Study human tasks against ergonomic requirements

- Capture routine task for future reuse (Knowledge and IP)

**Virtual Training – train workers**

- Add interactivity and behavior to 3D data

- Perform tasks in an interactive and immersive environment, as an individual or as a team
  - Plant Orientation
  - Crane operations
  - Perform a maintenance procedure etc.

- Experience practical maintenance and operations scenarios in VR - Virtual Reality

- Deploy online, offline, HMD, 3D screens, Cave, 360° Theater
Virtual Training and Planning in Operations & Maintenance

Usual “As Is” process

- Paper, video based instruction guides or static training centers.
- Finalized by learning on actual plant site.

- Workers arriving on remote site need time to explore and understand site configuration
  - Critical time spent to get familiar with the site and unique equipment, 50-70% of contractors have never set foot on the site.

- Site access restrictions when in operation
  - Practice requires disruption of ongoing operations and production losses
Virtual Planning
MAINTENANCE & REFURBISHMENT Solutions for Energy

Plan, Simulate and Validate Outage Schedules in 4D

Even “planned” outages are difficult to execute. DELMIA’s Virtual Maintenance solution revolutionizes the planning of your capital projects, reducing overall project risk while improving the quality of planning and validation processes.

DELMIA’s Virtual Maintenance solution enables 4D planning, simulation and validation of outage schedules for capital projects. The outage could be for maintenance, major refurbishment – or even new construction. Using DELMIA, companies plan scheduled activities in detail and avoid unforeseen problems that result in rework and delays. In addition, human, mechanical equipment and robotic simulations can be performed to reduce the risk of work-related injuries, ensure the health and safety of workers, and evaluate equipment. Work efficiency is also increased by providing upfront training.

It is essential for companies in the energy industry to minimize expensive delays in projects which can often cost more than $1 million per day. With so much at stake, organizations need a surefire way to execute maintenance and outage projects with greater efficiency, minimal downtime and reduced risk.
Virtual Planning for Operations & Maintenance

Industry Challenges

- How to validate complex Maintenance and Refurbishment project activities?
- How to improve Maintenance quality, safety and efficiency, and easily explain and share information?

1. Validating complex project activities
2. Capitalizing knowledge
3. Training workers prior to outage

Using 3-D Modeling to Improve Asset Lifecycle Management in Upstream E&P

- Perform effective Human Posture analysis, Accessibility and Operations studies
- To identify equipment installation and removal path without clashes and enough clearance
- Plan and simulate viable Mechanical and Equipment Kinematics
3D Virtual Planning

What is it?

Plan virtual maintenance activities based on 3D plant model to validate and capitalize complex project scenarios.

Capture physical asset and plant information and create an as-maintained/as-is 3D model.

Link time, activities and resources (human, tools, equipment etc.) information to the 3D Model WBS (Work Breakdown Structure).

Easily replay, validate and rehearse scenarios prior to performing critical work during an actual maintenance project.
3D Virtual Planning

Industry Use Case: Create Human task simulations

- **Create Human task simulations and validate against ergonomic requirements**
  - Comply with Regulations, such as OSHA (Occupational Safety and Health Administration)
  - Analyze and understand QHSE requirements

**Solution Description:**
- Perform various virtual ergonomics activities:
  - Measurements, Posture Analysis, Activity Analysis, Task Simulation and Human Catalogs
- Build catalog of predefined manikin in plant context
- Perform human clashes & biomechanics analysis
- Create digital work instructions

**Risk Reduction:** Improve work conditions through ergonomic studies
**Schedule Optimization:** Reduce NPT
**Productivity:** Avoid physical mockups
3D Virtual Planning

Solution Description:
- Capture the plant and equipment in a virtual 3D model
- Simulate the dismantling, moving and reassembly of equipment inside the powerhouse of the Manic-3 hydro power generation station
- Using CATIA to create the 3D model and DELMIA to perform simulations

Business Benefits:
- Shorten refurbishing schedule by more than three years
- Save CAN$50M
- Export optimized and validated schedule back to Scheduling system
- Simulate each movement with a precision of a few centimeters

Hydro Quebec
Business:
- Energy provider to over 3.5 million customers in Quebec, Canada
- 2008 Revenues: CAD12,717 ($ M)
- 2008 Employees: 23,345
- Number of hydroelectric generating stations: 59
- Total installed capacity: 36,429 MW
3D virtual maintenance of plant assets

Use Case Overview

1. Import 3D data, laser scan, xCAD and 2D.
2. Import and Link Schedule and Resource information to 3D WBS.
3. Create detailed planning activities and prepare simulation.
4a. Create Simulations for activities with clash detection.
4b. Simulate mechanical kinematic equipment removal and placement.
5. Create Human task simulations and validate against ergonomic requirements (e.g. OSHA). Create work instructions.
6a. Study alternative sequences and optimize schedule.
6b. Update Master Schedule with optimized Project Plan. Save history and capture knowledge.
Virtual Construction & Maintenance Planning

Visualize, Analyze and Simulate Scheduled Outages and New Construction Projects
Solutions Highlights:
- Cost Control
- Schedule Compliance
- Risk Reduction
- Human and Robotics Simulation
- Process Validation
- Radiation tracking

Virtual Construction and O&M Planning
- Fabrication Planning
- Plant & Resources Eng.
- Program & Control Eng.
- Maintenance Planning
Solution Areas - HSE - Safety Planning, Bio-Mechanics

Manikin Simulation

Hazardous Area Tracking
Virtual Training
Virtual Training

Virtual Training for Operations & Maintenance Learning

Train workers in an interactive and immersive learning environment performing ‘realistic’ operations and maintenance scenarios.

- Capture physical assets and create 3D Models
- Add interactivity and behavior
- Deploy to trainees: Online, Offline, VR, Multi-User

- Perform tasks (Plant Orientation, Crane operations etc.) in an interactive and immersive environment
- Experience practical maintenance and operations scenarios in VR - Virtual Reality
- Work in a Multi-User environment experiencing virtual teamwork
Human Performance Training – “Murphy’s Alley”
Virtual Training for Operations & Maintenance Learning

How does it work?

Capture data → Data conversion and preparation → Apply Behaviors and Scenarios → Publish

- Laser scanning
- ISO 15926
- 2D Drawing to 3D
- 3D Models
- Pictures

3D Master Model → Equipment Behaviors

QHSE scenarios → Orientation Aids → Behaviors/ Avatars

Virtual Training

- 24/7/365 via Internet and Intranet
- Multi-User environment
- Immersive Platform Cave, HMD, Screens
- Offline
Electricity de France, EDF is one of the European leaders in the energy field and operates the largest electricity generation capacity.

Solution Description

- Power plant polar crane manipulation
- Multiuser (8 characters) and collaborative application. 3D Avatar as Operations Manager animated with 40 gestures specific to equipment handling
- Realistic rendering

Key Benefits:

- Powerful tool for managing significant amounts of data and behaviors in real time
- Powerful and effective applications for increased productivity
Virtual Training for Operations & Maintenance Learning

How does it work?

- Flat shape
- Curved shape
- Cube shape
- Dome shape

Collaboration Immersive feeling Full Immersion

CADWall Reality Center I-Space HoloSpace Digital planetarium

Powered by the HP Z800
Visualization Display System Examples
Customer References
Mark 1 BWR - Torus Recoat

V5 PLM - Peach Bottom simulation of Torus recoat process using telerobotics to minimize dosage & maximize safety.

Dose Reduction Projections 77% – 200 down to 30 Man REMS
Developing Fusion Power: Using PLM Collaborative Capabilities to Centrally Control Engineering Content

Eric Martin, Head of Design Office
ITER International Fusion Energy Research Project
ITER
Fly through
## What our Customers Are Saying...

<table>
<thead>
<tr>
<th>Dassault Systèmes ENOVIA...</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accelerated Access Time to CAD Drawings</td>
<td>2 days</td>
<td>5 mins</td>
</tr>
<tr>
<td>Increased Engineering Record Throughput handling</td>
<td>15 / per day</td>
<td>100+ per day</td>
</tr>
<tr>
<td>Reduced BOM Data Transfer Process</td>
<td>Several days</td>
<td>Real Time</td>
</tr>
<tr>
<td>Reduced Procurement Package Creation</td>
<td>1 Week</td>
<td>1 Day</td>
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ENOVIA Engineering Central was a Major Contributor to a Successful Readiness Review by the DoE
Customer Recommended Projects for Virtual 3-D Simulation

Specific projects (actual, planned or suggested):

- Steam Generator Replacement – SONGS/W3 (actual)
- Incore Instrumentation Modification and Repair – SONGS/W3 (actual)
- RPV Head Replacement – Palo Verde (actual)
- EPU-Feedwater Heater Replacement
- Containment Sump Modifications – TVA (suggested)
- Alloy 600 Weld Overlays – STP (planned)
- Steam Generator Chemical Cleaning – SNC (suggested)
- BWR Torus Refurbishment – Peach Bottom (planned)
- Turbine Generator Upgrades/Main Condenser Modifications – (6 units) Exelon (planned)
- BWR Core Shroud Repair – Exelon (suggested)
- Pressurizer Replacement – Farley (suggested)
- Refueling Car Repair and Replacement – Farley (suggested)
- NFPA 805 Risk Informed FP Program Fire Scenarios - W3 (planned)
- Large Transformer Replacements – SNC, TVA (suggested)
- Design/Build new nuclear power plants- SNC, STP, Exelon (suggested)
- Outage organizational meetings & planning scenarios - Xcel Energy (suggested)
  - More engaged team members
  - Better decision making
  - Better coordination of area activities
  - Allows running “what if” scenarios and contingency plans
- Security scenarios – Entergy (suggested)
- RCP Pump/Motor Replacement – TVA (suggested)
- ISI 10 year Reactor Vessel Inspection – Exelon (suggested)
- Refueling operation template improvement – Exelon (suggested)
- Project cost estimating and validating for utility/contractor activities – Exelon (planned)
- ALARA radiation dose management – SNC, Exelon (planned)
- Knowledge captured for future planning, task improvement, and worker training – All (suggested)
- Utilize state-of-the-art planning tools for extended plant life cycle management by the new generation of computer trained engineers – All (suggested)
Capital Project Management
- Manage all aspects of a project or program execution: deliverables, schedules, resources, work requests/orders/permits, risks, issues in one single system.

Collaborative Innovation

Role Based - Consistent Information & Project data throughout entire Project Lifecycle

Risk Management
Bidding Management
Deliverable Management
Work Package Management
Milestone Management
Issues and Change Management

Bringing it all together

Engineering
Project Management
Collaboration (O/O, EC, Suppliers, Vendors)
Procurement
Construction
Scheduling
Work Package (WBS) Management - RFQ
How can Virtual Planning and Training IMPACT your business?

IN SUMMARY
Virtual Planning and Training enables you to...

- minimize PROJECT RISK
  ... by having all stakeholders share the same view of the operations and maintenance process to reduce risk during operations and downtime

- ensure HEALTH and SAFETY
  ... for workers in a hazardous environment to minimize risk of work related injuries performing daily routines or during critical refurbishment projects

- retain KNOWLEDGE
  ... by capturing company know-how and best practices of key operations and procedures to reuse for future projects and train new workers
License Renewal Projects of Today & Next Generation Plants of Tomorrow Need to Embrace Next Generation Leading Edge Technology Now

We Bring Data to LIFE!
We Bring 3D to ALL
thank you
danke schön
merci
gracias

Q&A
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