Technical Expertise and Support
Leverage Globally, Act Regionally, Execute Locally – Faster and Smarter

Project Execution Excellence
Digital Project Execution (DPEx)
Approach Overview – MIMOSA and the Open Industrial Interoperability Ecosystem (OIIE)
The Chemicals business…

• Our competitive advantage is in the combination of equipment we put together and in the mixture of chemicals we put in it.

• Our core business is making chemicals. One of “side” businesses is designing, modifying and building new chemical plants.

• We do a lot of projects 3-5,000 in a year that range in size from $30,000 to Billions of dollars.

• Each project has a unique combination of equipment with a unique arrangement.

• The efficiency or productivity of each project depends on the data or information (Knowledge) flow the project is able to achieve.
Presentation Objectives

• Share Dow’s digitalization journey in the capital project space
• Discuss long term goals and short term tactics for achievement
• Share why we have chosen to participate in MIMOSA and Open Industrial Interoperability Ecosystem (OIIE) work
Implementation Success Relies on adoption by Suppliers, Owners and EPC’s

Recommendation:

1. Start by Listening
   Every Supplier, Owner and EPC is in a different place with different goals and different capabilities
   + Digitization is becoming a common goal
   – there is no common definition of success
   We gather together in groups when there are common goals

2. Transfer the context and the knowledge that is needed to start engagement at each organization’s pain point
DEPx VALUE – 2014

1. Set End to End Work Process – Value Chain Basis

<table>
<thead>
<tr>
<th>Engineering and Management (20%)</th>
<th>Procurement and Materials (40%)</th>
<th>Construction (35%)</th>
<th>Commissioning, Start-Up And Handover (5%)</th>
<th>Turnaround Management (TBD)</th>
</tr>
</thead>
</table>

2. Set Reasonable Productivity Improvement Target By 2020 – For every Billion $ of spend...

<table>
<thead>
<tr>
<th>Engineering and Management (20%)</th>
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<tbody>
<tr>
<td>$200,000,000</td>
<td>$400,000,000</td>
<td>$350,000,000</td>
<td>$50,000,000</td>
<td>?</td>
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<thead>
<tr>
<th>X% Productivity Improvement</th>
<th>Y% Improvement</th>
<th>Z% Productivity Improvement</th>
<th>A% Productivity Improvement</th>
<th>?</th>
</tr>
</thead>
</table>

| $C0,000,000,000 per year per B$ | $D0,000,000,000 per year per B$ | $EO,000,000,000 per year per $B | $F,000,000,000 per year per $B | ? |

3. Socialized Target – everyone agreed potential value was larger but...
Full Asset Life-cycle Management

DPEx Focus

Product Design
Product MFG
Process Engineer Simulate
Engineer Design
Procure
Construct

Operate & Maintain (O&M)

Completion, Commission and Startup

Continuous Improvement Feedback Loops

End of Life

Device/Equip Manufacturing
Platform Integrator Capital Project

Owner/Operators

Longer Term Value Delivery

Product Model/Product=Component/Systems(Packages)/System of Systems/Plant/Facility/Platform Life-Cycles

Derived from ISO TC 184
Manufacturing Asset Management Integration Task Force Final Report

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Once improvement target is set...

The Challenge from an Owner’s perspective:

Put together the work process, technology and people pieces to streamline the work and remove 7.75% of the execution costs from an investment while all my partners win.

4. Get a multifunctional team of subject matter experts and practitioners who “get it” and are passionate about improvement.

- IT folks who understand the execution work processes
- Execution folks who can understand/speak “IT”
Identify the Opportunity Areas

5. Develop an end to end understanding of the opportunity spaces:

For example- Dow’s capital project work process has 220 steps ... but they are very “big” steps e.g. Define the Project Execution Plan

It takes thousands of documents to just describe what work each of 26 functions and disciplines need to do at each step to get the job done.

6. Set a “simple” Vision
The Digital Project Execution (DPEx) Vision

Across the Project Life Cycle* we have….

- Single Data entry point
- Clear data definition and ownership
  - Aligned Data Definition and ownership across the facility life cycle
- No Manual Data Re-entry
- Strong data management practices with clear roles
- Data simplification
  (If no-one downstream uses that data and you don’t need it – Don’t generate it)
- Optimized data, document and image “packaging” to drive increased productivity of all Disciplines and Functions
- System simplification and value added integration
- Progress monitoring/ exception reporting occurs without “extra work”
- This vision is true for all Dow execution models.

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❖ Project Life Cycle starts with FEL and goes through Hand-off to Operations and Maintenance and includes Facility Data Maintenance agreements to support “next” project
Develop an Approach

5. Brainstorm the Business Use Cases – where is the inefficiency? Where are the major manual data flows?

7. Start at the Back-End and Move Forward

8. Stay aligned with Strategic Plans and Corporate Initiatives
   - 2016 - Productivity Improvement Goals
   - 2017 – Manufacturing 4.0
   - 2018 – Digital Twin \( \rightarrow \) DPEx is defining the front end of the Digital Thread
   - 2019 - Digitalize
TES Strategic Vision

Technical Expertise & Support

- Safety
- Reliability
- Project Execution Excellence 10/10/10

Technology

Cost Advantaged 20/20

Maintenance

Delivery of TES Innovation

Manufacturing 4.0

Breakthrough Changes in How We Work

ONE TEAM

PEOPLE

CAREERS

TECHNICAL EXPERTISE

Dow

DOW RESTRICTED
Digital Project Execution Program Overview

<table>
<thead>
<tr>
<th>FEL (FRONT END LOADING)</th>
<th>PROJECT EXECUTION</th>
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<tbody>
<tr>
<td>FEASIBILITY STUDIES</td>
<td>BASIC ENGINEERING</td>
</tr>
<tr>
<td>DOW STAGE I</td>
<td>DOW STAGE II</td>
</tr>
<tr>
<td>PROJECT IDENTIFICATION</td>
<td>PROJECT DEFINITION</td>
</tr>
<tr>
<td></td>
<td>(Initial/Preliminary Funding)</td>
</tr>
<tr>
<td>DOW STAGE III DESIGN &amp; CONSTRUCTION</td>
<td>DOW STAGE IV COMMISSIONING &amp; START-UP</td>
</tr>
</tbody>
</table>

- Engineering Tools Integration
- Integrated Materials Management
- Advanced Work Packaging
- Commissioning & Start-up
- Facility Data Transfer to O/M
- Turnarounds

Enablers: Project Management, Data Management, Document Management, Metrics, Demand Portfolio and Resource Management

Operations and Maintenance

- ✓ X MM$/yr delivered in 2016
- ✓ Y MM$/yr target in 2017
- ✓ Z MM$/yr target in 2018
- ❑ A MM$/yr target in 2019
- ❑ B MM$/yr target in 2020
Digital Project Execution (DPEx):
Weaving the Digital Threads Together to Deliver the Data Asset

Enablers: Project Management, Data Management, Document Management, Metrics, Demand Portfolio and Resource Management

Making Knowledge Flow
OIIE/OGI Standardized Use Case Architecture

Standardized Methodology to Define and Re-use OIIE Components

**User Stories**
- High-level
- Pictographic
- Depict 1 or more Use Cases, Scenarios, and/or Events
- Actors, Systems, Exchanges, Data

**Scenarios**
- Background
- Scope
- Preconditions
- Successful End Condition
- Actors
- Triggers
- Process Workflows
- Events
- (OIIE) Events

**Events**
- Individual Message Exchange
- Specific Data Content
- Required data processing
- Expected Response Event
- Implemented by CCOM BODS and possibly others

*Where Owner's Can help*
Chemical Industry Ecosystem

EPC Firms

Engineering and Construction Systems

IT Networks

(OEM)

Equipment & Device Manufacturers

Enterprise Business Systems

Features
- Multiple Platforms and Networks
- Digital Business Ecosystems
- Supplier-neutral Framework

Plant/Facility Operators

Enterprise Business Systems

IT Networks

Automation and Control Systems

Manufactured Asset

(Make/Model Information, Serial#)

(Monitoring, Diagnostics, Prognostics)
Transforming the Petrochemicals Industry Using the OIIE
A Pragmatic Solution for Industrial Digitalization

Custom Integration

Open Industrial Digital Ecosystem

Custom development
Specific data adapters
Owner/operator responsible for sustainment

Configuration rather than development
Based on well defined standards
Suppliers responsible for sustainment

Open Industrial Digital Ecosystem (OIIE)
ISO 18101

Industry Standard Digital Ecosystem
- Supplier neutral – open source and COTS
- Standard set of included standards
- Standard use case architecture
- Standard use cases, scenarios & events
- Standard APIs and services definitions
- Standard information payloads
- Standard adaptors
- Standard reference data - ISDDs
- Standard ecosystem administration
- Standard piloting testbed

Dow, BP and other industry participants can share cost and risks in the OIIE OGI Pilot, then implement at lower risk and costs.
Why is Dow active in MIMOSA?

• The approach makes practical sense
• ISDD Datasets are already defined and are being used every day in the industry; terms are defined and consistently understood
• Will handle ~ 20% (?) of my dataflow challenges – my engineering tools are already set up to deliver specifications in a datasheet structure
• Once demonstrated - the approach can be expanded to other datasets
Industry Challenges

• Vocabulary and Communication – We are still not talking the Value Cases
  – Recommendation: Add the current steps and effort it takes to deliver the use case
    without the data exchange standard – dollarize the difference and state the value to
    be delivered by automating dataflows
  – Example: Dow’s cost to load instrument data into SAP

• Multi-level / adjustable knowledge packaging of needed

<table>
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<tr>
<th>Partner (My) Context</th>
<th>Work Process Context</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Standards Context</td>
</tr>
<tr>
<td></td>
<td>Technical Context</td>
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Industry Challenges

• Understanding of the EPC and Owner’s ability to execute – who should you be partnering with inside the organization – it’s not only the IT arm - can they speak project execution and bring the execution/ work process owners with them to the table and talk to them so knowledge is transferred and decisions can be made

  Are you assuming that if you build it- I’ll be able to implement it?

• Understand the Partners willingness to participate- where and how do they win?

• Can we change the industry design resourcing model? What could we accomplish with the “right” 30 people in a room for 20 days? Do we have the skills to plan and execute that workshop? Do we have enough credibility to have the right people come?
Questions?