RT319
Validating Advanced Work Packaging as a Best Practice – A Game Changer

Michael Bankes, Fluor
Joel Gray, Coreworx
William O’Brien, University of Texas at Austin
Jim Rammell, Wood Group Mustang, Inc.
Stan Stasek, DTE Energy
Agenda

- AWP Concepts
- Triangulation of Evidence
- Results
- Resources
- Implementation Panel
A Long Research Journey!

**RT272 Phase I (09-11)**
*Process*

**RT272 Phase II (11-13)**
*Implementation*

**RT319 (14-15)**
*Validation*

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Steve Autry, ConocoPhillips
Michael Bankes, Fluor
Jim Blevins, Pathfinder
Roy Burnette, CH2M HILL
Keith Critzer, ExxonMobil
Robin Michaelsson, Bentley Systems
Olfa Hamdi, The University of Texas at Austin
Ken Kohl, GE Power & Water
Fernanda Leite, The University of Texas at Austin
Brendan Lynam, Kvaerner
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Sean Pellegrino, Wood Group Mustang
Mark Stasek, DTE Energy
Jim Rammell, Wood Group Mustang
Bill O’Brien, The University of Texas at Austin
Sean Pellegrino, Wood Group Mustang

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Yogesh Srivastava, North West Redwater Partnership
Sean Pellegrino, Chevron
Stan Stasek, DTE Energy
Jim Rammell, Mustang
Jim Vicknair, WorleyParsons
Jim Vicknair, WorleyParsons
Glen Warren, COAA
Agenda

AWP Concepts

Triangulation of Evidence

Results

Resources

Implementation Panel
Background
AWP Work Package Relationships

Path of Construction
Research Objective

RT 272 Deliverables

Contracts
- Requirements
- Deliverables

Model
- Flowcharts
- Job Descript.

Tools
- Assessments
- Templates

Examples
- Support
- Preliminary Evidence

Is AWP leading to Performance Improvement?
Prove it!

RT 319 Objective

1. Validate the Benefits
2. Document Implementation Challenges & Lesson Learned
Agenda

- AWP Concepts
- Triangulation of Evidence
- Results
- Resources
- Implementation Panel
Triangulation of Evidence

Case Studies
- Methods of AWP Implementation
- Benefits / Challenges / Lessons Learned
- 17 Case Studies

Survey
- Statistical Validation
- AWP and Project Predictability
- 92 Surveyed Managers

Expert Interviews
- Specific AWP Processes
- Feedback on Research Findings
- 22 Direct Interviews

Cross-Validated Results!
Agenda

AWP Concepts

Triangulation of Evidence

Results

Resources

Implementation Panel
Case Studies

In-depth Results on AWP Benefits!

- 17 Case Studies and 46 Interviewees
- Different industrial sectors and project sizes
- Documented AWP benefits, challenges, and lessons learned

Sector
- Power, 5
- Chemical, 2
- Infrastructu re, 2
- Oil&Gas, 8

Size*
- Small, 5
- Medium, 2
- Big, 5
- Mega, 5

Location
- Canada, 7
- US, 10
- Medium, btw. 5 and 50
- Big, btw. 50 and 500
- Mega, > 500

Size (million USD):
- Small: < 5
- Medium: btw. 5 and 50
- Big: btw. 50 and 500
- Mega: > 500
Maturity Model

Three AWP Maturity Stages conceptualized within CII IR272 – Volume II

Objectives:

1. Provide empirical evidence of the 3 stages
2. Investigate the relationship between AWP Maturity and Project Performance
3. Deliver practical recommendations to obtain higher levels of AWP maturity
Maturity Model – Case Study Evaluations

Results:
- 60 Ratings on 15 Different Projects.
- Independent Ratings (CII Experts).
- 2 Dimensions of Analysis:

AWP Maturity
A. Process Adherence
B. Organizational Alignment
C. Contract Integration

Project Performance
A. Productivity
B. Cost
C. Safety
D. Schedule
E. Quality
F. Predictability

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Project Performance
A. Productivity
B. Cost
C. Safety
D. Schedule
E. Quality
F. Predictability
Maturity Model

AWP Early Stages

- Set small project goals
- Allocate adequate budgets
- Identify key roles to drive AWP implementation
- Perform intensive training
## (1) AWP Early Stages

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### Performance Break-Out

- **Productivity**: Around 10% improvement
- **Cost**: Project on budget
- **Safety**: 0 lost-time accident (TRIR below company average)
- **Schedule**: Project experienced minor delays
- **Predictability**: Not very satisfying (major changes to estimates)
- **Quality**: In line with previous quality performance
Maturity Model

AWP Effectiveness

- Set ambitious project goals
- Prioritize incremental improvement projects
- Watch out for complacency
- Attain to AWP guidelines
### (2) AWP Effectiveness

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#### Performance Break-Out

- **Productivity**
- **Quality**
- **Cost**
- **Predictability**
- **Schedule**
- **Safety**
AWP Business Transformation

- Continue investing in AWP implementation
- Increase the flexibility of Project Managers to evolve/adapt AWP processes
- Export the project as “world-class” benchmark
## (3) AWP Business Transformation

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**Performance Break-Out**

![Performance Break-Out Diagram](image)

- **Productivity**: Around 25% improvement
- **Cost**: Around 10% below TIC
- **Safety**: 0 lost-time accident (sporadic first-aids and near misses)
- **Schedule**: Project slightly ahead of schedule during both planning and execution
- **Predictability**: Completely positive (full alignment to estimates)
- **Quality**: Reworks and RFIs substantially below company’s average (negligible impact on IWP execution)
Managerial Implications

AWP MATURITY

- Set ambitious project goals
- Prioritize incremental improvement projects
- Watch out for complacency
- Attain to AWP guidelines

AWP Business Transformation

- Continue investing in AWP implementation
- Increase the flexibility of Project Managers to evolve/adapt AWP processes
- Export the project as “world-class” benchmark

AWP Early Stages

- Set achievable project goals
- Allocate adequate budget during planning
- Identify key roles to drive AWP implementation
- Perform intensive training for all key participants

AWP Effectiveness

PROJECT PERFORMANCE
Agenda

AWP Concepts
Triangulation of Evidence
Results
Resources
Implementation Panel
AWP World-Wide Adoption

RT 319 – Edmonton, 13May2015
Resources

CII Volumes
RT 272 + RT 319

CII Community of Practice
Virtual Meetings

Education
Conferences and Training
Agenda

- AWP Concepts
- Triangulation of Evidence
- Results
- Resources
- Implementation Panel
IMPLEMENTATION PANEL

MODERATOR: JOEL GRAY, COREWORX

AWP RESEARCH OVERVIEW: WILLIAM O’BRIEN, UNIVERSITY OF TEXAS AT AUSTIN

CONTRACTOR STORY: MICHAEL BANKES, FLUOR

OWNER STORY: STAN STASEK, DTE ENERGY

OWNER STORY: TREVOR POSYLUZNY, SHELL

RESOURCES: JOEL GRAY, COREWORX
Agenda

- AWP Concepts
- Research Validation Review
- Story: AWP Transformation
- Story: AWP Early Stages
- Resources
What is Advanced Work Packaging?

Work planning that emphasizes construction requirements
Sample CWP and EWPs

CWA – Construction Work Area  EWP - Engineering Work Packages
CWP - Construction Work Packages  IWP - Installation Work Packages
<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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<tbody>
<tr>
<td>Determine Path of Construction</td>
<td>Defined early in Stage 1 to allow for integrated planning during the development of the CWP &amp; EWP plans</td>
</tr>
<tr>
<td>Develop CWA Plan</td>
<td>In accordance with the Path of Construction and the Integrated Planning Sessions</td>
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<tr>
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<tr>
<td>Develop EWP Plan</td>
<td>To support the Path of Construction and CWP Release Dates</td>
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<tr>
<td>Complete EWP’s</td>
<td>Per Integrated Schedule</td>
</tr>
<tr>
<td>Build CWPs</td>
<td>Several factors will determine the actual content</td>
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<tr>
<td>Create IWP’s</td>
<td>The Workface Planner will develop IWP’s and installations schedule in accordance with Path of Construction and Integrated Plan</td>
</tr>
<tr>
<td>Construction</td>
<td>Once a backlog of IWP’s are available without constraints, Construction (field crews) mobilizes and begins site work</td>
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Inside the CWP Plan

• A CWP Plan considers:
  – Construction constraints
  – Trades being used
  – Contracting plan
  – Modules – separate CWPs for fabrication and installation
  – Minimize interfaces to other CWPs
  – Minimize schedule duration
Inside the CWP

- All information required by Construction Contractor
- Usually compiled by Construction Management (or the party responsible for managing subcontractors)
- Considers construction constraints, trades, contracting plan, module fabrication & installation, minimal interfaces with other CWPs, minimal duration
Inside the EWP Plan

• A EWP Plan considers:
  – Availability of engineers and drafters
  – Availability of design data
  – Dates when needed by construction
Inside the EWP

• All information required to be developed & transmitted from Engineering
  – Scope of work, drawings and specifications, vendor data, line lists and equipment lists

• Content will vary depending on Engineering's scope of work
  – Is the Engineering Contractor also procuring materials?
  – Is Engineering developing the specifications or are they being provided?
  – Full EPC contract?
Inside the IWP

- All unique requirements to install a portion of work
- Enough work for one “Shift”
- Includes
  - IWP Constraints
  - Scope of Work
  - Safety Requirements
  - QA/QC Requirements
  - Trade Coordination
  - Material Take Offs & Locations
  - Scaffold Requirements
  - Model Shots, Drawings and All Other Necessary Engineering Information
  - Any Other Information Required to Install the Work
AWP – the Ultimate Payoff

• Brings Construction planning into the early phases of the project
• Provides better visibility to the progress in a given portion of the project
  – Highlights areas that are falling behind plan and allows more efficient recovery planning
  – Allows flexibility in construction execution
• Provides a mechanism to maximize supervision time and tool time in the field
Agenda

AWP Concepts

Story: Research Validation Review

Story: AWP Transformation

Story: AWP Early Stages

Resources
Triangulation of Evidence

RT 319 Objective

1. Identify AWP Maturity Levels
2. Validate AWP Benefits

- Case Studies
  - Methods of AWP Implementation
  - AWP Benefits & Lessons Learned

- Expert Interviews
  - Support Case Study Analysis
  - Focus on Specific AWP Processes

- Survey
  - Statistical Validation
  - AWP and Project Predictability

Cross-Validated Results!
Case Studies

Objective:
In-depth Results on AWP Benefits

- 20 Case Studies and 52 Interviewees.
- Different industrial sectors and project sizes.
- Documented AWP benefits, challenges, and lessons learned.

*Size (million USD):
- Small: < 5
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Sector
- Power, 5
- Chemical, 3
- Infrastructure, 2
- Oil&Gas, 10

Size*
- Small, 5
- Mega, 6
- Medium, 2
- Big, 7

Location
- Canada, 8
- US, 12
AWP Maturity Model

S-Curve pattern:

- High Correlation between AWP Maturity and Project Performance (Spearman rho = 0.959, significant at 99% confidence level)

- AWP Maturity level can be used to set Project Performance expectations ($R^2 = 0.923$, significant at 99% confidence level)
Objectives:

1. Provide empirical evidence of the 3 stages
2. Investigate the relationship between AWP Maturity and Project Performance
3. Deliver practical recommendations to obtain higher levels of AWP maturity
### (1) AWP Early Stages

![AWP Early Stages Diagram](image)

#### Performance Breakout

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Objective:
Achieve Generalizable Results on AWP Benefits
• 92 Responses (Houston + Alberta Data)
• Unit of Analysis = Project
• Strong Statistical Robustness

AWP Implementation

Engineering Deliverable

AWP explains 25% of Timely and Complete Eng. Deliverables

Project Predictability

AWP explains 30% of Project Predictability (time, schedule, and rework)

AWP is a large contributor to Project Predictability (range of performance improvement from case study analysis)
Expert Interviews

Objective:
Provide Confirmatory Results to Case Study Analysis
• 22 Expert Interviews
• Explore AWP in different sectors (e.g. building)
• Focus on specific implementation areas

Specific AWP Processes
- Contract
- Change Management
- FEED Integration

Multi-Project Perspective
- Roles and Responsibilities
- Communication and Control
- Supply Chain Management

Feedback
- Clarity
- Practicality

Role
- Owner, 11
- EPC, 9
- Consulting, 2

Sector
- Oil&Gas, 16
- Power, 4
- Technology, 2

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Agenda

- AWP Concepts
- Story: Research Validation Review
- Story: AWP Transformation
- Story: AWP Early Stages
- Resources
AWP Business Transformation

- Continue investing in AWP implementation
- Increase the flexibility of Project Managers to evolve/adapt AWP processes
- Export the project as “world-class” benchmark

Performance Breakout

- Productivity
- Quality
- Cost
- Predictability
- Safety
- Schedule

AWP Maturity Model

AWP Early Stages
AWP Effectiveness
AWP Business Transformation

PROJECT PERFORMANCE

AWP MATURITY

RT 319 – Edmonton, 13May2015
AWP Business Transformation

• Project Setup and Execution
  – Written Practices and Procedures
  – WBS/CBS
  – Engineering and Construction Work Package Plans
  – Scheduling and Progress Measurement by Work Package
  – Change Management Systems

• Construction Focused
  – Effective Construction input early in FEED
  – Well thought out Path of Construction and CWP Plan
  – Material delivery dates integrated into schedule
  – Dedicated and Experienced WorkFace Planners
AWP Business Transformation

Influence of WBS on AWP
AWP Business Transformation

Influence of WBS on AWP

Sample Numbering Schemes

CWP-29-02-01
EWP-29-02-01-01
Mark-29-02-01-03-05-10202
Key Points to Maximize Full Potential

DEVELOP DURING FEED

CONSTRUCTION INPUT

COORDINATION BETWEEN CONSTRUCTION AND ENGINEERING
AWP Business Transformation

Alternate WBS Structure

CONSTRUCTION INPUT

COORDINATION BETWEEN CONSTRUCTION AND ENGINEERING

ONE TO ONE RELATIONSHIP
AWP Business Transformation

• Integrated Data Systems
  – Statusing individual EWP’s, CWP’s and IWP’s
  – Automated constraint analysis
  – Automated IWP creation
  – Effective checkout and start up
Agenda

AWP Concepts

Story: Research Validation Review

Story: AWP Transformation

Story: AWP Early Stages

Resources
One Owner’s Story – DTE Energy

• **DTE Energy** is a Detroit based diversified energy provider involved in the development and management of energy related businesses and services nationwide.
DTE Energy – Major Enterprise Projects

• **Major Enterprise Projects** is responsible for managing large capital and strategic projects for DTE Energy

• Portfolio is large and very diverse
Case for Change – Why Advanced Work Packaging?

• MEP exists to deliver enterprise projects in a **predictable** and **repeatable** manner

• Client expectations focus on **safety, schedule, cost, quality**
  – Sounds like AWP might help achieve

• MEP has experienced variability in **productivity, constructability, and rework rates**

• Significant contractor variability in using work packaging
  – From zero use of work packages to full use of AWP

• MEP has focus on **process orientation** for all project activities
Approach - Embedding AWP Into MEP Work

- Establish a core team (including an AWP implementation lead with prior experience)
- Benchmark AWP techniques/insights/lessons learned (RT272)
- Plan and execute WP/AWP on targeted pilot projects (large repeating project, small repeating project)
- Conduct After Action Reviews
- Apply lessons learned and “finalize” governance procedure controls
- Roll out to all “new” MEP projects
- Check and adjust, coach and mentor (ongoing)
Benefits Realized So Far

• Early wins
  – Productivity improvements (less crew downtime)
  – Improved tracking of work progress
  – Improved communication between contractor(s) and owner
  – Worker feedback used to improve downstream work
  – Increased contractor ownership of issues and their resolution
  – Better constructability planning embedded into design phase
Challenges

• Early learnings
  – Contract language needs to clearly define AWP expectations upfront
  – Some contractors were new to AWP – wanting to add AWP costs as contingency risk to bids (felt it was potentially added work)
  – Need to educate project stakeholders on AWP (owner’s staff, contractors, client representatives)
  – Very difficult to initially implement AWP on in-flight projects
One Owner’s Conclusions

DTE Energy has concluded that:

• AWP improved project productivity and predictability

• AWP can be scalable, adjusted and applied to smaller projects as well as larger projects

• Contractors will embrace AWP once they gain experience in its use

• The Owner needs to drive use of AWP in the early stages

• Early Stages of AWP can see a payback even if their maturity level is low

• Need only use technology/software necessary to do the job
Initial Misperceptions of AWP

• True or False?

– Costs of AWP implementation outweigh the benefits (FALSE)

– In the Early Stages, expensive new technology and software are required to implement AWP (FALSE)

– AWP can only be used on large complex projects (FALSE)

– AWP requires large additional staffs to implement (FALSE)
AWP IMPLEMENTATION IN SHELL

Owners Story

Trevor Posyluzny
Global AWP/WFP Subject Matter Expert
OPTIMAL PATH OF CONSTRUCTION

- Established in Select (very early) and finalized in Define (Pre-execution).
- Utilizes Construction Work Areas (CWAs) as its primary elements
- **Drives** the **sequence** and prioritization of the Engineering and Procurement deliverables
- Facility **commissioning complexity, start-up sequence** and **long lead items** must be considered and incorporated
Both Shell and its contractors develop Engineering and Procurement packages that are broken down into discrete work packages that align with **optimal construction sequencing.**

This guide provides the **framework** to implement a **systematic** process to **organize** and deliver all the elements necessary, to enable craft persons to perform quality work in a safe, effective, and efficient manner.
WORK BREAKDOWN STRUCTURES AND REPORTING
GLOBAL IMPLEMENTATION

- Projects >$100M have been identified in all regions and all Business Super Buckets.
- KPIs and Reporting Processes include Site reporting and extend up to Regional VP score cards.
- AWP is an expectation for all projects – It will be one of our major levers to become predictable and efficient in Project delivery.
PERFORMANCE INDICATORS

**Leading Indicators**

- IWPs approved by HSSE, QA and Construction Engineering, and ready for issuance to field
  - vs plan vs total forecast of IWPs; ~ Go/No-Go Status; by discipline and area,
- IWPs completed and closed out vs plan vs total forecast of IWPs; by discipline and area,
- IWPs issued to field and in progress vs plan; by discipline and area,
- 90 day look-ahead of IWPs ready for release to field for execution (Unit and/or area) vs plan; status of engineering and procurement deliverable constraints

**Lagging Indicators**

- IWPs returned incomplete (due to constraints), for week and in total; trend analysis of constraints; by discipline and area,
- % Time on Tools - # hours on tools working constraint free / duration of work shift, plus list of typical constraints w/ trending analysis,
- Productivity factor – based on earned labor man-hours/budgeted labor man-hours, by discipline, by CTR, by IWP or total, 3 week trending,
- Average trend of Cost Performance Index of IWP – actual costs/budget,
- Average trend of Schedule Performance Index of IWP – actual duration/approved duration,
COLLABORATION WITH OUR CONTRACTORS

- Project **strategy** is shared among key project participants to **obtain commitment** towards a shared vision.
- **AWP Language** and expectations have been **included within the contracts**.
- The procedures are prepared by the EPC and then **reviewed and approved by the owner**.
- Contracts included the specification of major project **milestones** and serve as a basis for the audits throughout the various project phases.

**AWP IS A TEAM SPORT!**
AWP AND MODULARIZATION

- Aligning the **delivery sequence** of modules with the construction sequence is critical because of the **different optimization logics** between the mod-yard and the construction site.

- Identify **Module Work Scope** and **Site executed** early in project detailed Planning.
RESULTS – CASE STUDY 2.8M MAN HOURS

**Improved safety:** significantly better safety statistics (Zero LTIs)

- **Under Budget!** >$20M

- **On time:** Delivered 3 months ahead of schedule!

- **Superior Quality:** Rework from construction activities was below 1% in comparison to a target of 3% or less rework.

- Not all areas of this project used AWP, those areas used a disproportionate amount of contingency.

- **Predictable:** minimal change orders (influenced by both the completeness of construction specifications and by the higher level of engineering completion before field mobilization).
LESSONS LEARNED

- A global database has been developed with over **120 lessons** currently captured – they are **shared with all projects implementing AWP/WFP strategies**.

- Top 3 lessons:
  - Start AWP planning/execution early
  - All home office work must support the optimal Path of construction
  - Include support crafts in the design stages - early involvement of CM and construction contractors pays dividends.
Agenda

AWP Concepts

Story: Research Validation Review

Story: AWP Transformation

Story: AWP Early Stages

Resources
RT 272 Publication – IR272-2 rev. 3

Volume I:
Recommended Process

Volume II:
Implementation Guidance

Volume III:
Case Studies and Expert Interviews
Narrative & Templates

- Narrative description of the overall AWP Process
- CWP, EWP, IWP templates
- Contract considerations
- Functional Roles & Job Descriptions
- Vendor prequalification
- Maturity model
- Audit & assessment tools
Detailed Project Example

Example: Construction Work Area (CWA)

Example: Overall Project (ISBL)

Example: Engineering Work Package (EWP)

Example: Installation Work Package (IWP)
Questions & Answers