Path of Construction

Laying the Foundation for Success

Agenda

Item	Topic	Presenter/Facilitator	Timing (min)
1	Safety Moment	Linda Clary	3
2	Introduction	Linda Clary	5
3	Session & Path of Construction Objectives	Linda Clary	2
4	Path of Construction Process	Darrell Coughlin, Geoff Ryan, Linda Clary	20
5	Interactive Session	Darrell Coughlin, Geoff Ryan, Linda Clary	30

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Introduction

- WorkFace Planning Lesson Learned
  - Construction needs to be “involved” in the Front End?
- CII identified barriers to Front End Planning
  - Silo based project organizations are a barrier to collaboration
  - Contract models institutionalize non-collaborative approaches
  - Decision aids do not exist that allow project managers to prioritize activities that require and benefit from construction input

Session Objectives

- Understand the COAA “Path of Construction” Process
- Buy In to the Importance and Timing of the Development of the Path of Construction
- Acknowledgement that a FORMAL Process is Required
- Interactive Real Time Feedback on Path of Construction Concept

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Path of Construction Objective

- Alignment of key players on the optimum building sequence
- Use the path of construction outputs to develop an integrated schedule
- Formalize the path of construction process so it becomes a project deliverable
- Ensure WorkFace Planning success in the field through rigorous Front End Planning

Path of Construction

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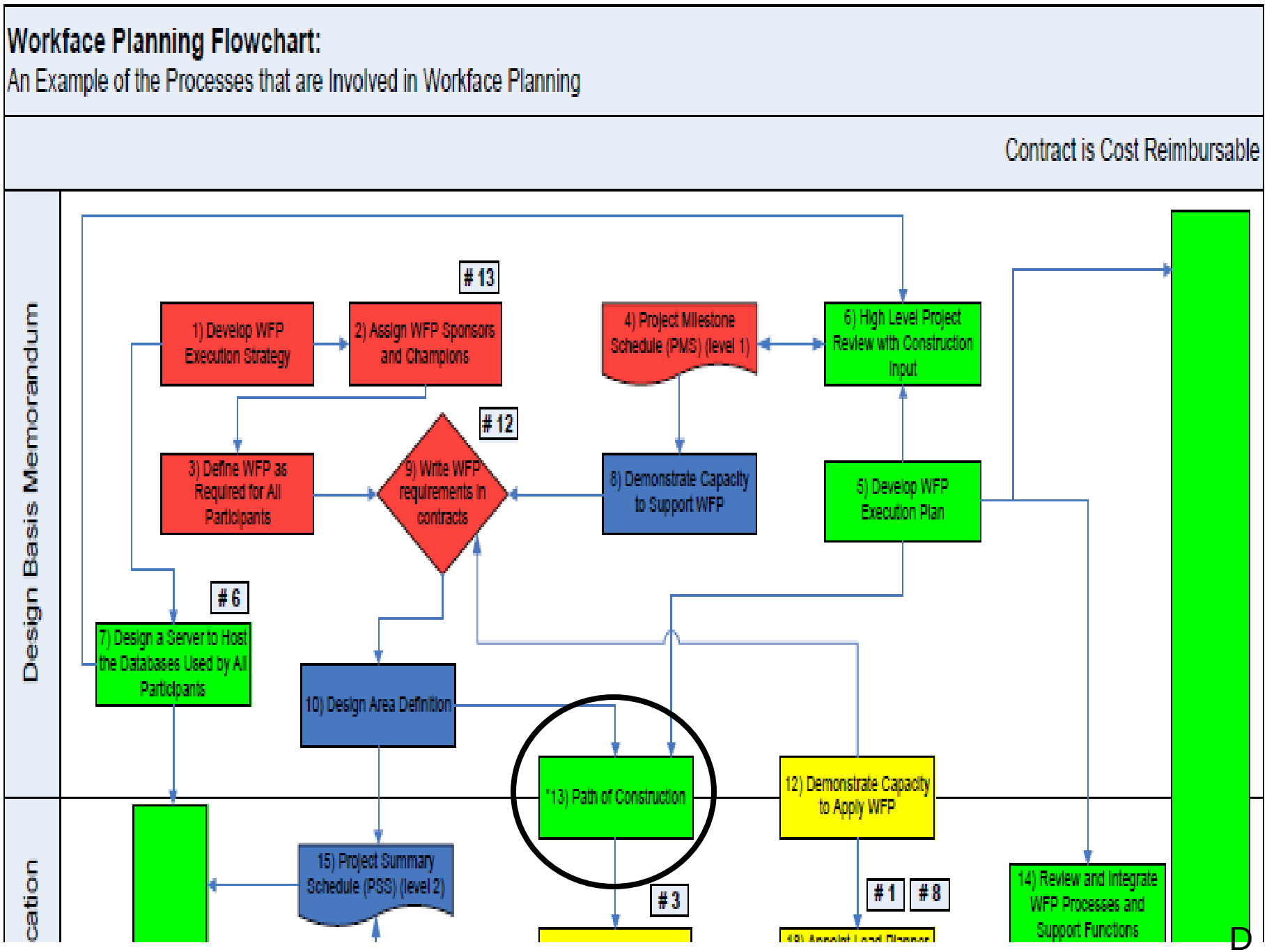
Path of Construction Working Definition

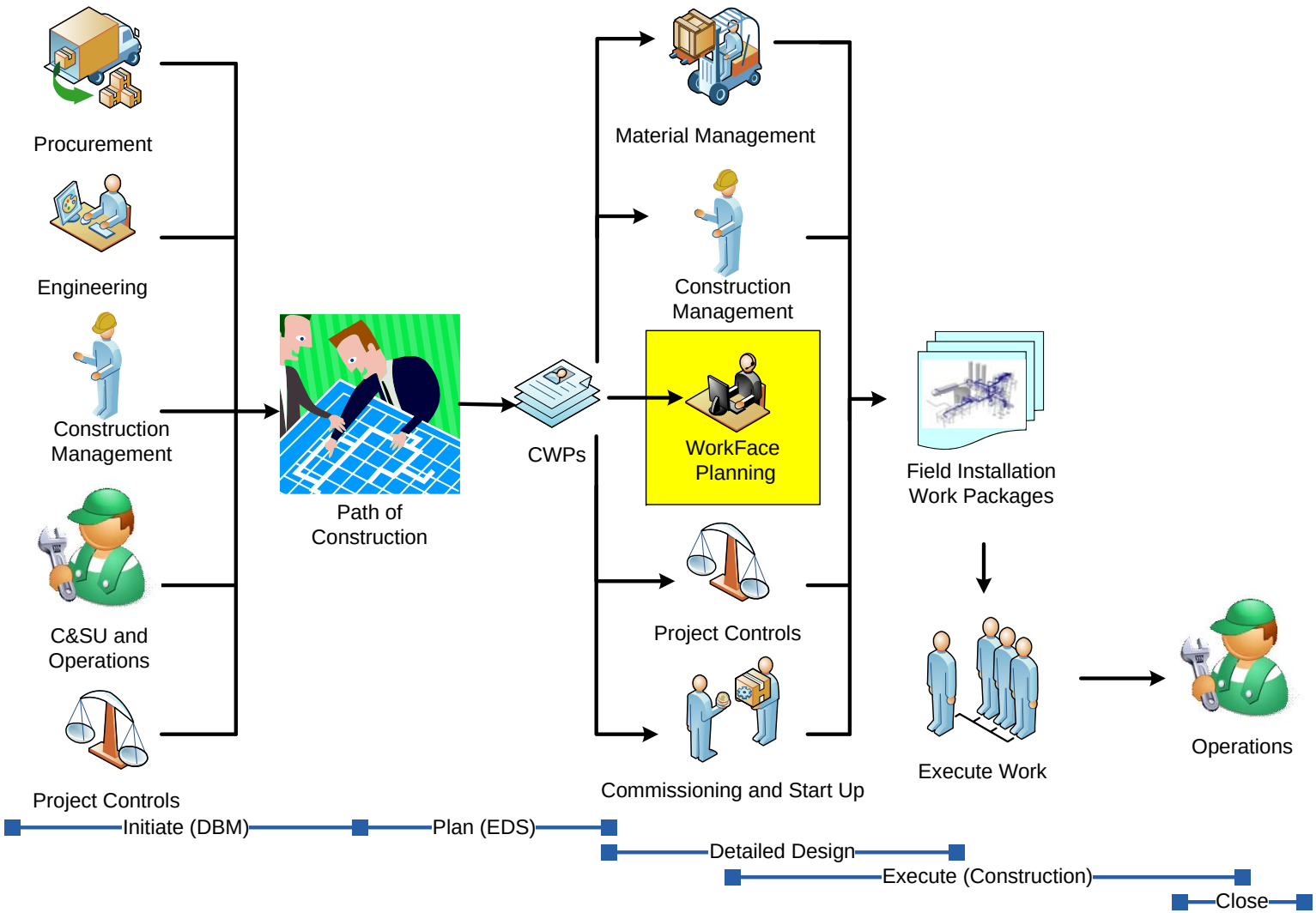
- Path of Construction is the articulation of the optimum building (installation, erection) sequence of the physical components of the facility.

Workface Planning Flowchart:

An Example of the Processes that are Involved in Workface Planning



Influence Diagram



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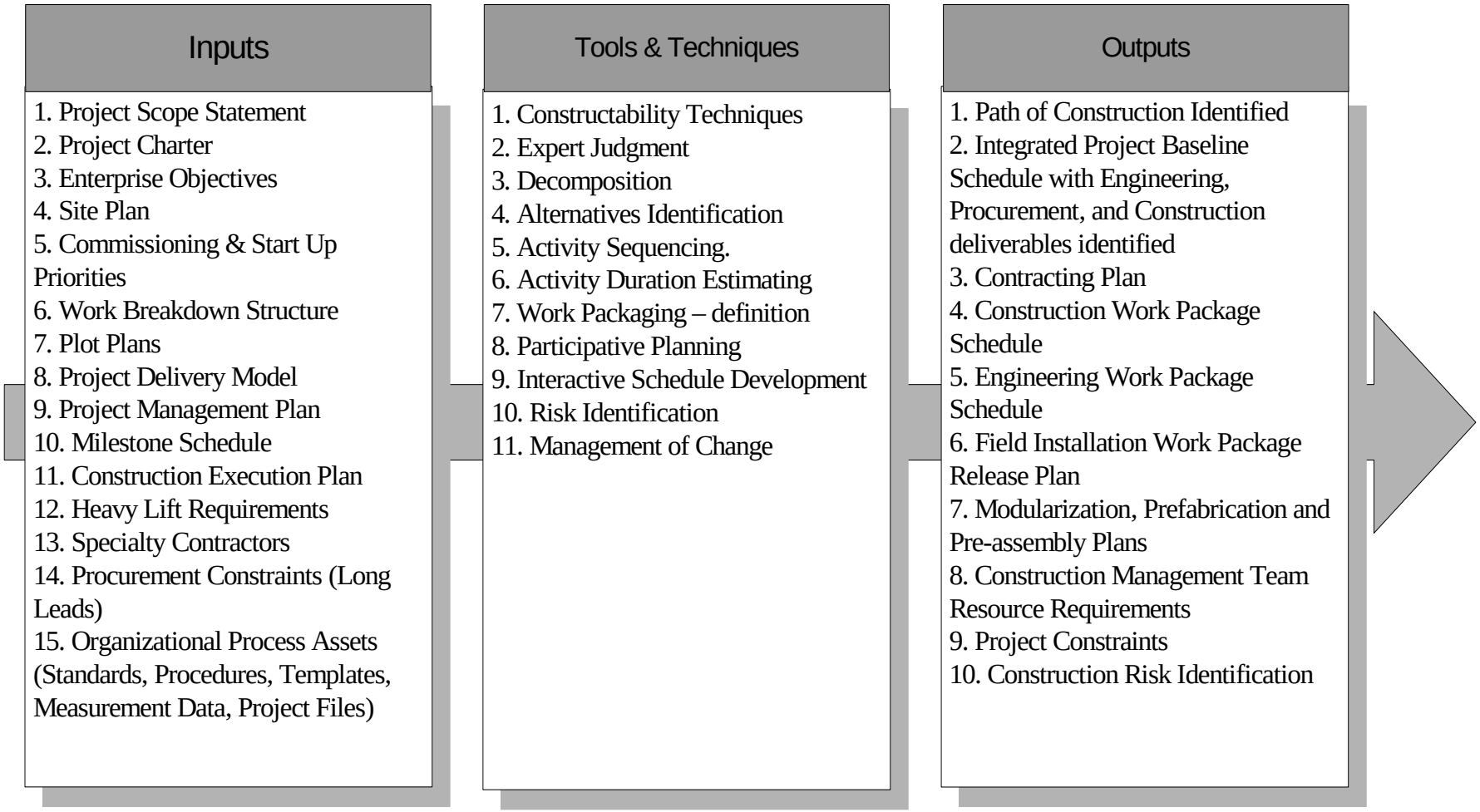
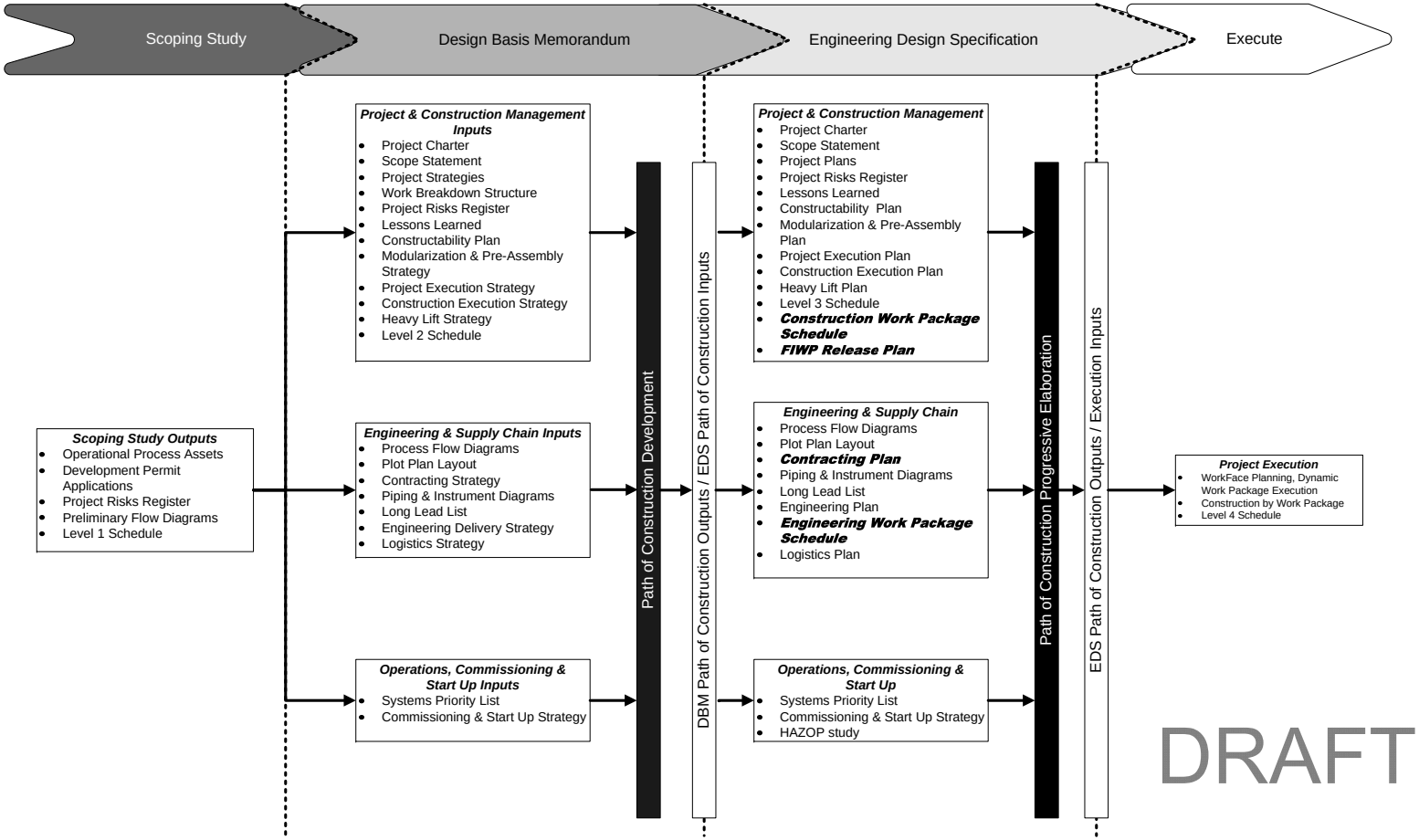
Inputs, Tools & Techniques, Outputs



Block Diagram



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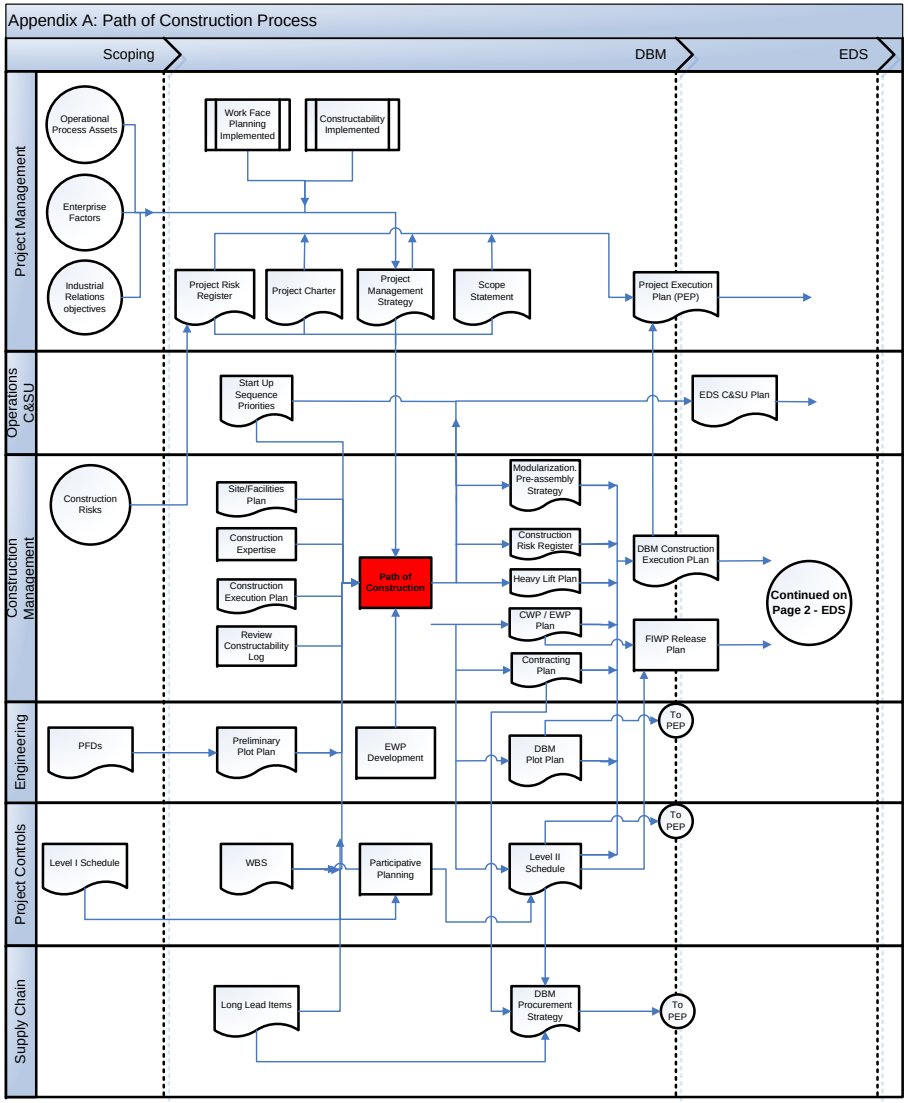
Procedure

- Procedure – documentation of the established method of performing work. It explains WHO does WHAT by WHEN. Procedures present a step-by-step sequenced way to do a task consistently and with maximum efficiency

- Link to Procedure

Flow Diagram



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Input Checklist and Tracking Log

Funtional Area	Input	Type	Due Date (D/M/Y)	Check ✓	Input Owner (specific person)
Project Management	Project Charter	Doc			
	Scope Statement	Doc			
	Project Plans	Doc			
	Project Risks Register	Doc			
	Lessons Learned	Doc			
	Project Execution Plan	Doc			
	Level 3 Schedule	Schedule			
Construction Management	Constructability Plan	Doc			
	Modularization & Pre-Assembly Pla				
	Construction Execution Plan				
	Heavy Lift Plan				
	Construction Wor d le				
	FIV				
Engineerin	Pr g				
	Pl g				
	Pip g				
	En				
	En dule	Schedule			
Supply Cha	Co	Doc			
	Lo	Doc			
	Logistics Plan	Doc			
Operations and	Systems Priority List	Doc			
	Commissioning & Start Up Strategy	Doc			
	HAZOP study	Doc			

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Path of Construction

- The Flow Diagram is a roadmap for the development of the Path of Construction
  - a plot plan and drawings are not enough
- The procedure, checklist, tracking log, etc. are like a compass, providing direction for who does what, when
  - “informal” planning and tracking will get you inconsistent, inexperienced, ill-timed results
- The schedule should be integrated and reflect the path of construction
  - not a bias schedule for just engineering, procurement or construction

Suncor MNU Project
ISBL

Presentation to:
Suncor
14 January 2008

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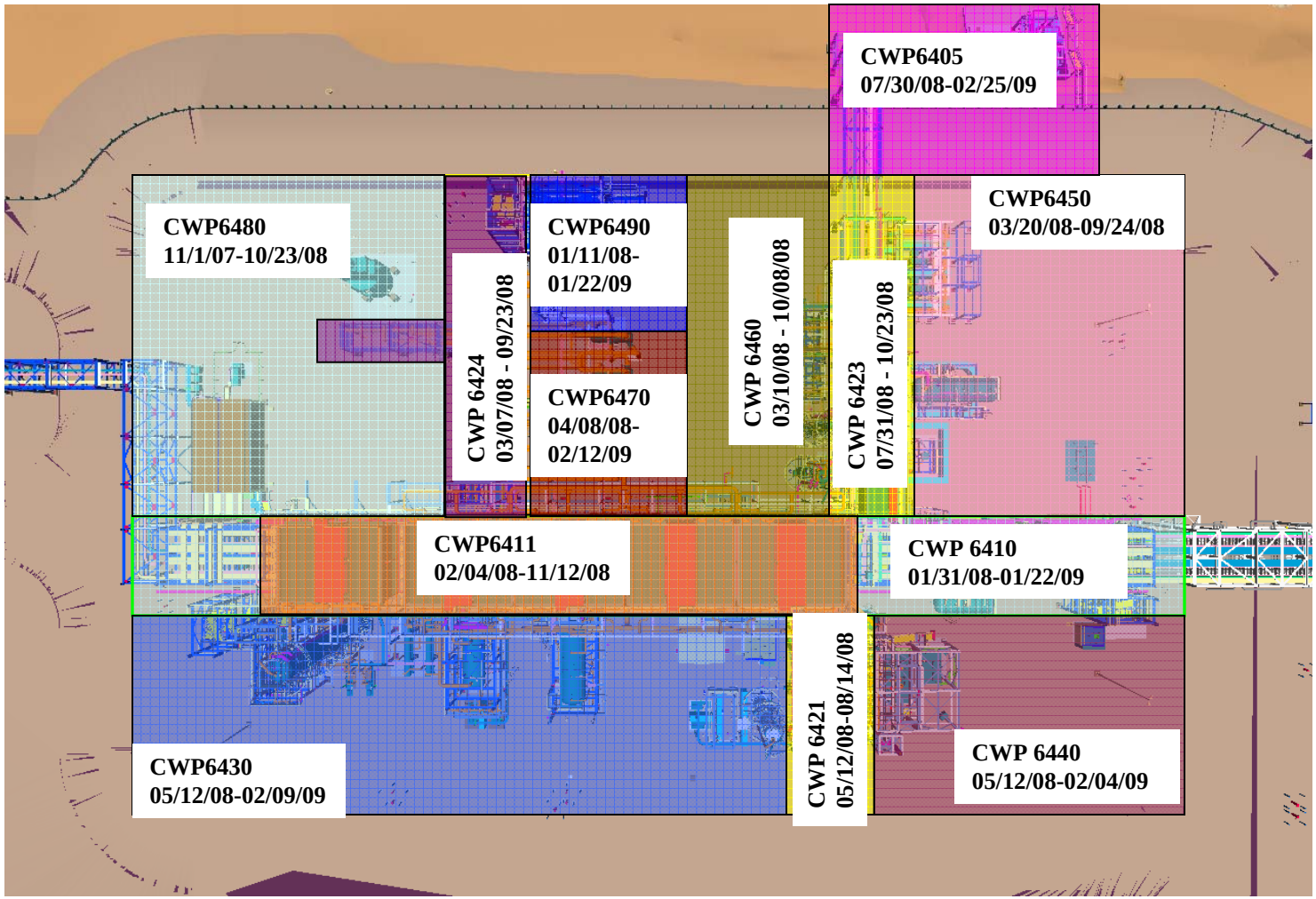
Path of Construction - ISBL



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Edmonton Module Yard Schedule

Scope	CWA	Module ID	Finished Dates
ISBL	CWA 64-05	64-PRM-1201	7-Apr-08
	CWA 64-10	64-PRM-100A	13-Dec-07
		64-PRM-101A	10-Jul-07
		64-PRM-100B	21-Jan-08
		64-PRM-101B	11-Dec-07
		64-PRM-100C	11-Feb-08
		64-PRM-101C	14-Dec-07
		64-PRM-100D	14-Feb-08
		64-PRM-101D	31-Oct-07
		64-PRM-100E	17-Jan-09
		64-PRM-101E	31-Oct-07
	CWA 64-21	64-PRM-100H	31-Mar-08
	CWA 64-23	64-PRM-100F	20-Feb-08
		64-PRM-101F	7-Mar-08
		64-PRM-100G	14-Mar-08
	CWA 64-24	64-PRM-100J	28-Mar-08
		64-PRM-100K	13-Mar-08
	CWA 64-30	64-PM-204	26-Mar-08
	CWA 64-60	64-PM-202	14-Mar-08
		64-PM-203	19-Mar-08

Scope	CWA	Module ID	Finished Dates
OSBL	CWA 56-40	56-PRM-0040M	31-Jul-07
		56-PRM-0040N	31-Jul-07
		56-PRM-0040P	31-Jul-07
		56-PRM-0040Q	1-Aug-07
		56-PRM-0040R	2-Aug-07
	CWA 56-50	56-PRM-0080A	23-Nov-07
		56-PRM-0080B	16-Nov-07
		56-PRM-0080C	14-Nov-07
		56-PRM-0080D	29-Jan-08
		56-PRM-0080E	30-Jan-08
		56-PRM-0080F	31-Jan-08
		56-PRM-0080G	14-Nov-07
		56-PRM-0080H	31-Jan-08
		56-PRM-0080J	7-Aug-07
		56-PRM-0080K	6-Sep-07
		56-PRM-0080L	19-Sep-07
		56-PRM-0080M	3-Oct-07
		56-PRM-0080N	28-Aug-07
	CWA 56-52	56-PRM-C100	28-Feb-08
		56-PRM-C101	18-Apr-08
		56-PRM-C102	3-Mar-08
		56-PRM-C103	21-Apr-08
Hydrogen		East PR Module	30-Apr-08
		West PR Module	30-Apr-08
		East Cable Tray Modle	2-Apr-08
		West Cable Tray Modle	5-Mar-08
		Process Module 1	Technip
		Process Module 2	Technip

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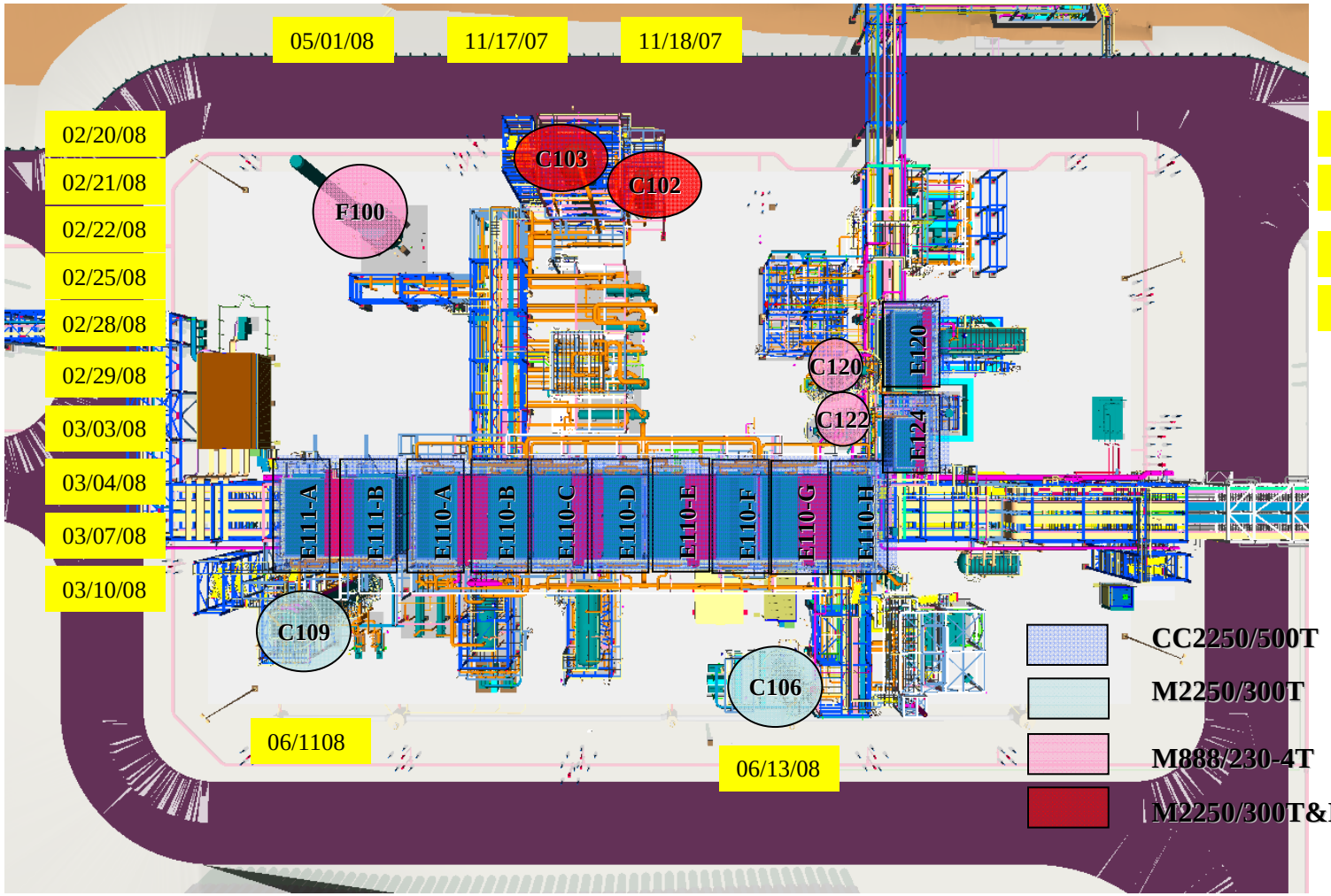
Construction Execution Plan – ISBL (Heavy Lift Equipments Setting)



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Path of Construction

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Interactive Session

- Goal
  - Get Your Feedback on this DRAFT Path of Construction Process
  - Harness Your Experience
  - We need Your HELP!

Interactive Session

- Rules of Engagement
  - Cell phones off
  - When you have a comment or question raise your hand and wait to be called on
  - Respect other speakers, wait your turn

Interactive Session Agenda

Item	Topic	Timing
1	Conceptually Sound	2
2	Players	5
3	Timing	3
4	Deliverables	15
5	Q&A and VOTE	5

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	Choose One
	Execution Sequence
	Path of Construction
	Construction Sequence
	Project Sequence
	Path of Construction Sequence
	Participative Planning
	Project Sequence Planning
	Other:

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INDUSTRY EXPERT PANEL SESSION

DURING THIS SESSION THE PANEL WILL DISCUSS THE BENEFITS OF WORKFACE PLANNING, THEIR THOUGHTS ON HOW WORKFACE PLANNING SHOULD BE APPLIED, AND HOW THE MODEL SHOULD BE DEVELOPED IN THE FUTURE.

Speakers:

- Al Wahlstrom, Suncor – Chair of the WorkFace Planning Committee
  - Major Projects at Suncor since early 80's
  - Worldwide experience

- Mike Eichhorn - Manager General Projects, Nexen
  - Major Projects at Nexen since early 80's
  - Worldwide experience

- Bill Elkington - Director, JV Driver
  - Introduced innovative technologies in fabrication shop for implementing construction
  - Well respected

Moderator:

- Lloyd Rankin - President, Ascension Systems Inc.

Questions to the Panel:

1. What are the benefits you have experienced in the use of WorkFace Planning?

   - Al Wahlstrom – Suncor is able to take a long term look & organize activities from an early part of the project to the end. We understand contracting strategy which forces us to look at the scheduling components.
   - Bill Elkington – JV Driver started using WFP as a shutdown tool, developing the tool in conjunction with the COAA model which resulted in better safety, more repetitive work in

production (materials, information, up front work) and 11 – 38% productivity improvement.

- Mike Eichhorn:
    i. Construction Management have a better understanding of project scope and are able to recognize engineering problems in order to remove constraints.
    ii. From the contractor's side, there is a better understanding of the scope of packages; therefore, time is freed up so the foreman can mentor to less experienced trade people. There is also a better safety environment.

2. Is the application of WorkFace Planning the same in the Front End, the Field, and in Fabrication Facilities? If not, how does it differ?

- Al Wahlstrom – The COAA Model definition effectively covers the Back End in the field; however, the current activities of the COAA WFP Committee & Suncor is to push into Front End Planning. We need to get involved as early as possible; there is not enough rigor or definition around front end planning to involve construction in planning process early. The primary purpose of the Path of Construction is to utilize planning experience from all interested stakeholders. The planning process needs to direct activities for on time delivery and to fit these deliverables to the construction activities. Input should come from many parties – project management, engineering, & critically, construction. There needs to be a smooth transition from planning to construction to develop the deliverables from the front end to the field – Suncor will own this process.
- Bill Elkington:
    i. Front end is working with engineering & procurement teams to define packages that are construction driven – certain construction strategies may vary the entry point.
    ii. Field installation work packages – We have used the shutdown model to get all information & all materials together – in the field, the men go to the work and the fabrication output flows into the field crew. Alternately, fabrication work come to the men in the shops then goes to the field & material flows.

iii. Each component handled differently depending whether in the shop or field to get best flow.

- Mike Eichhorn:
  i. There is not enough information at FEED. Phase 2 Long Lake was taken down to CWP level in FEED. Nexen's CEP & module strategy means at field schedule is at level 4 by workface package within CWP. In detail design, it is too early to start packaging at 30% engineering and it is our plan to package at 60%. We start with virtual packages (2000 hours/package) & schedule into integrated schedule. Quantities & labour hour estimates will be matched up then. There needs to be a move to a manufacturing process on construction site to improve labour efficiency.
  ii. 3 months before mobilization we bring in a GF to finalize & break down WP to 1000 hour units. Individual contractor CWP embedded in packages.
  iii. In process verification – The pre-hydro punch lists were short & matched to workface package level
  iv. Engineering errors, missing material handled by switching work packages. Progress packages only when work is done.

3. What should we be doing right now to get alignment between the owners, construction contractors, and engineering firms? (Optional question based on available time) – Lack of trust between players in construction industry.
   - Al Wahlstrom – We need to bring people together and get them involved. That is the intent of the COAA WFP Committee activities. If a standard system can be put in place as a guideline (baseline), our own principles can be established around them. Activities initiated by Suncor & COAA should receive input from diverse representation in industry so a consistent approach to planning exercise on projects will result in owners developing more confidence & trust in the project environment and contractors will become more confident and knowledgeable.
   - Bill Elkington – Training is important – Safety has become more consistent with the use and rigor of consistent technology,

systems & training. Up front planning & working together needs leadership & participation.

- Mike Eichhorn – Training – continually reminding designers to tailor drawings to people in the field. It is important to have some understanding on both sides of the planning – construction vs engineering. We appreciate that we cannot grind on indirect costs.

4. What do you see as the future direction of WorkFace Planning?
   - Al Wahlstrom – The model & processes on the field side are in place for a baseline. We need to move upstream and get construction planning as early as possible into the project planning process. Suncor is taking ownership of the project planning process – conceptual to end - in order to add continuity. Involvement of construction can be in the planning but we need rigor in the defining of the processes.
   - Bill Elkington – The education level of participants is up. We need to be working with vendors and tracking materials for correct materials. We need to be looking for technology that can physically progress in the 3D model to monitor projects as they develop. Material process handling needs to be developed. Owners must be committed to align engineers with construction.
   - Mike Eichhorn – Building a deck means 100 trips to the hardware store, akin to how the oil and gas industry is handling projects and this must be changed.

Audience Questions:

1. **Donald Mousseau - Husky Energy** - Currently industry tracks schedule progress by paper being produced – weight of paper = equipment being constructed. Too much documentation. With automation techniques being developed, what is going to happen to upstream delivery of the paper to reduce amount of paper waste?
   - Bill Elkington– QC/QA is streamline. In fabrication facility, drop from the model detailing – mark out & scribe marks on structural and laid out for fabrication electronically. Pipe shop uses screen instead of spool sheets – 2D ISO and rotate

3D piece in the model. Orientations reduce errors. Not to the point in field to have tablets to view drawings in the field. Interested in how the screens in the fabrication facilities can be applied to the field. RFID finds materials quickly & efficiently & increases tool times. Manage materials with paper but should become digital. Using model for workface planning & using model cuts to make packages in the front end and improves CWP planning.

- Al Wahlstrom – Some of the software solutions will also help get away from huge FIWP that is carried around in the field; capability of keeping as much info as possible electronic.

2. **Cam Sonnenberg - Graham Industrial** - Are owners willing to wait until WFP is done at a contractor level to complete project organized at front?
   - Mike Eichhorn – We control movements of our mobilization until there is 3 months of FIWP backlog.
   - Al Wahlstrom - Suncor uses RFFC (Ready For Fabrication & Construction) Rule – 14 weeks in between completion of IFC package to mobilization and implementation of work in that package.
   - Bill Elkington – Keeping a number of FIWPs at ready. When engineering is complete is the big question for getting materials and preparing packages?

3. **Farshid Gholami - University of Calgary** - To what extent does WFP address engineering problems?
   - Al Wahlstrom – WFP may not have all the answers. Education in the overall planning process will help. Engineers historically have refused to let construction personnel tell them how they should execute their work. Suncor acknowledges importance of all players, but the sequence of construction must be set up by the Project Management Team. Supply Chain, Construction, &Engineering need to negotiate to come up with a plan.
   - Bill Elkington – Constructor in the engineering house will seek deficiencies in engineering when building FIWP. 80/100 needs to be 80% of physical engineering; quantity differential is significant at this point in sequencing work –

waiting to the field is too late. The right person is needed as the constructor – good rapport must be between the constructor & engineer. Accountability & responsibility is necessary to give players a chance to communicate and exchange ideas to solve deficiency issues before they get to the field.

- Mike Eichhorn – Rapport is important. Culture in EP organization is completely different than the culture in construction organization.
- Wayne Cusitar - Independent Consultant - The skill set from Project Management, Engineering, Construction is very different and I believe that we suffer from constraints of the capacity of contractors available to work for us. We may sacrifice the bidding processes because we need people with construction knowledge & experience to provide the services needed at this point.

4. **Dr. Janaka Ruwanpara - University of Calgary** - What is difference of WFP to Detail Construction Plan? How much tool time is increased if implemented properly?
   - Bill Elkington – WFP & good construction planning is the same thing. Plan your work right – all the information, all materials and the workface scoped out means that work flows smoothly. Try to train people in the industry consistently & improve across the whole industry.
   - Mike Eichhorn – We need an organization committed to executing according to the plan and we need accountability & responsibilities defined.
   - Al Wahlstrom – Project Management effectively drives the plan and needs to be part of the planning.
   - Bill Elkington– Productivity in field is improved 11 – 38% by planning to pipe and to boilers. Discipline is what is required.

5. **Andrew Hunter - AMC Consulting** - Do you see value in lean construction?
   - Al Wahlstrom – Trust is a big issue in industry. Internationally, my experience has been that trust is not a problem. From the owner's point of view, a lean approach will not hurt as long as we are doing the right things. It is

not the whole answer and we need to clarify scopes of work and the language needs to be clear; these things will help relationships.

6. EPC in a Lump Sum Contract - is it valid to plan to level of FIWP?
   - Al Wahlstrom – Proper execution will include the planning piece. This is necessary from the owner's & the contractor 'sside. Reimbursable or firm pricing would be driven the same way. With regard to FIWP preparation, Suncor sees that 80% of FIWPs can be prepared, then taken to site and the last 20% can be added at site by the contractor. 1000 man hours is a better size related to crew sizes. Owners drive the CWP, but not necessarily FIWPs. We should push as much to the contractor as possible but maintain ownership of the planning process. Completion of FIWPs is part of the payment process.
   - Bill Elkington – Lump sum means: No execution, No money. No planning, no execution. The biggest bang for the contractor is lump sum because lump sum projects with minimal changes are a bigger pay off for everyone. An EPC company doing FIWPs would not be recommended as this is too far down the sequencing line. Type B personalities are more prevalent in contractor organizations.

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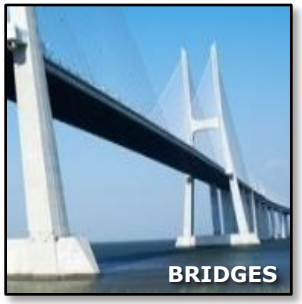
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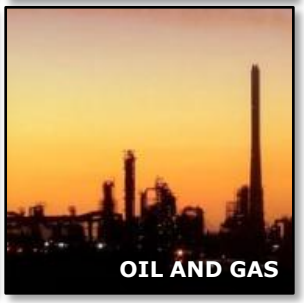
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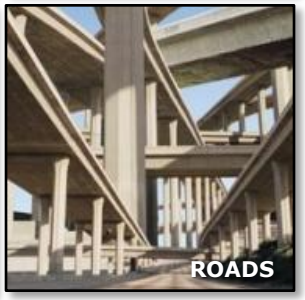
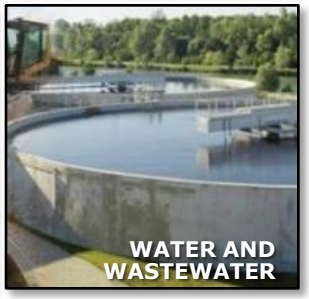
POWER GENERATION


RAIL AND TRANSIT


ROADS


WATER AND WASTEWATER

Introducing ConstructSim

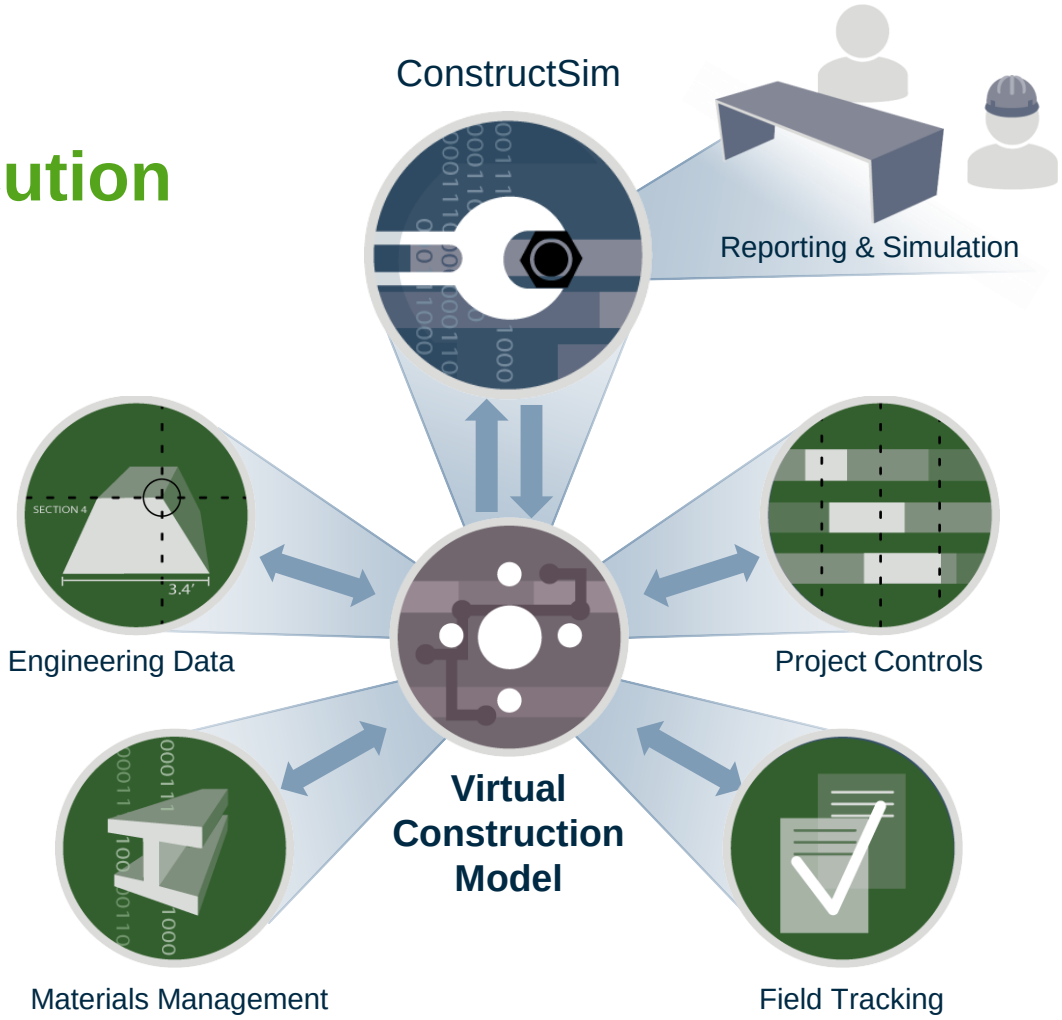
Solves complex planning and execution problems for

For Who?

- Owners
- Construction Managers
- Direct Hire

When?

- Early Planning
- Field Installation
- Turnover / Commissioning



Addresses These Main Issues

Visibility into the planned and current project status

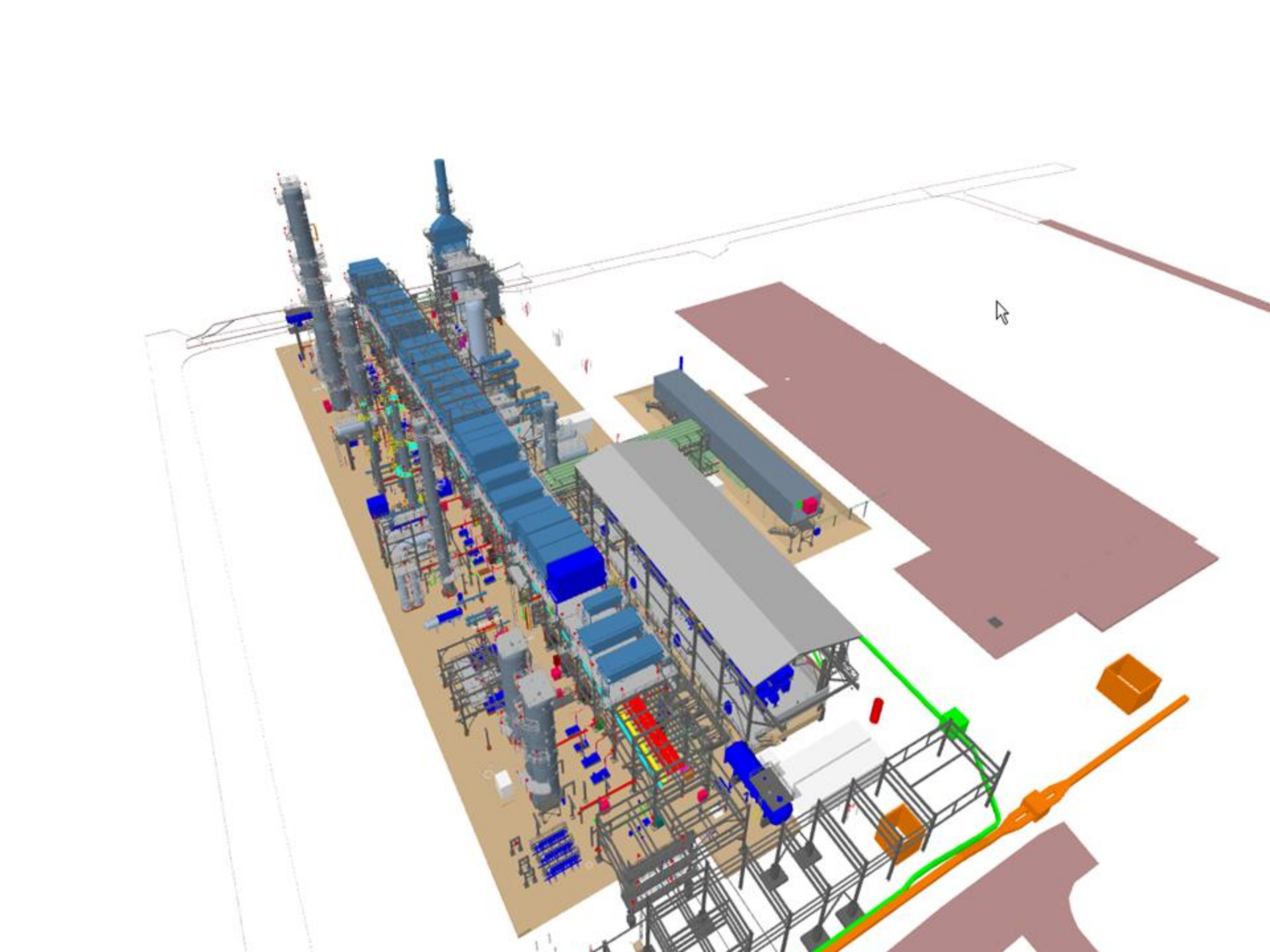
Material availability / engineering drawing production

Cost to complete

Information management / Aggregation

Reactive construction management

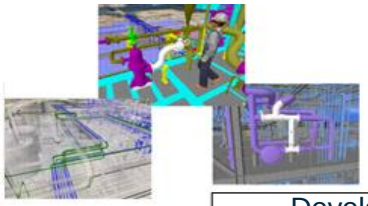
Productivity of field labor



Main Functionality

- Virtual Construction Model – dynamic updated daily with data from engineering and construction
- Auto re-organize engr 3D data for construction tracking
  - **Spools (SpoolGen / IsoGen); Steel Piecemarks, etc …**
- Provide construction views – area & systems (others)
- Work steps that relates to all small pieces (every pipe spool, steel beam) – automatic
- Video game environment to build work packs (detailed planning
  - **Click, click, click -> print reports (spool list, field materials, checklist – aka scorecard – for progressing … i.e. get paid)**
- Status visualization …. See progress in 3D
  - **engineering production / Material availability / installation / testing**
- Integration with schedule
  - **Visually produce schedule early in project**
  - **During project … update schedule weekly with progress (summary reports % complete per schedule)**
  -

Agile Construction Methodology



Develop Construction Plan

Create Crew Level Work Packages

Streamline Materials

Bag & Tag

Review & Sequence Work

The Quality Gate

Execute Work

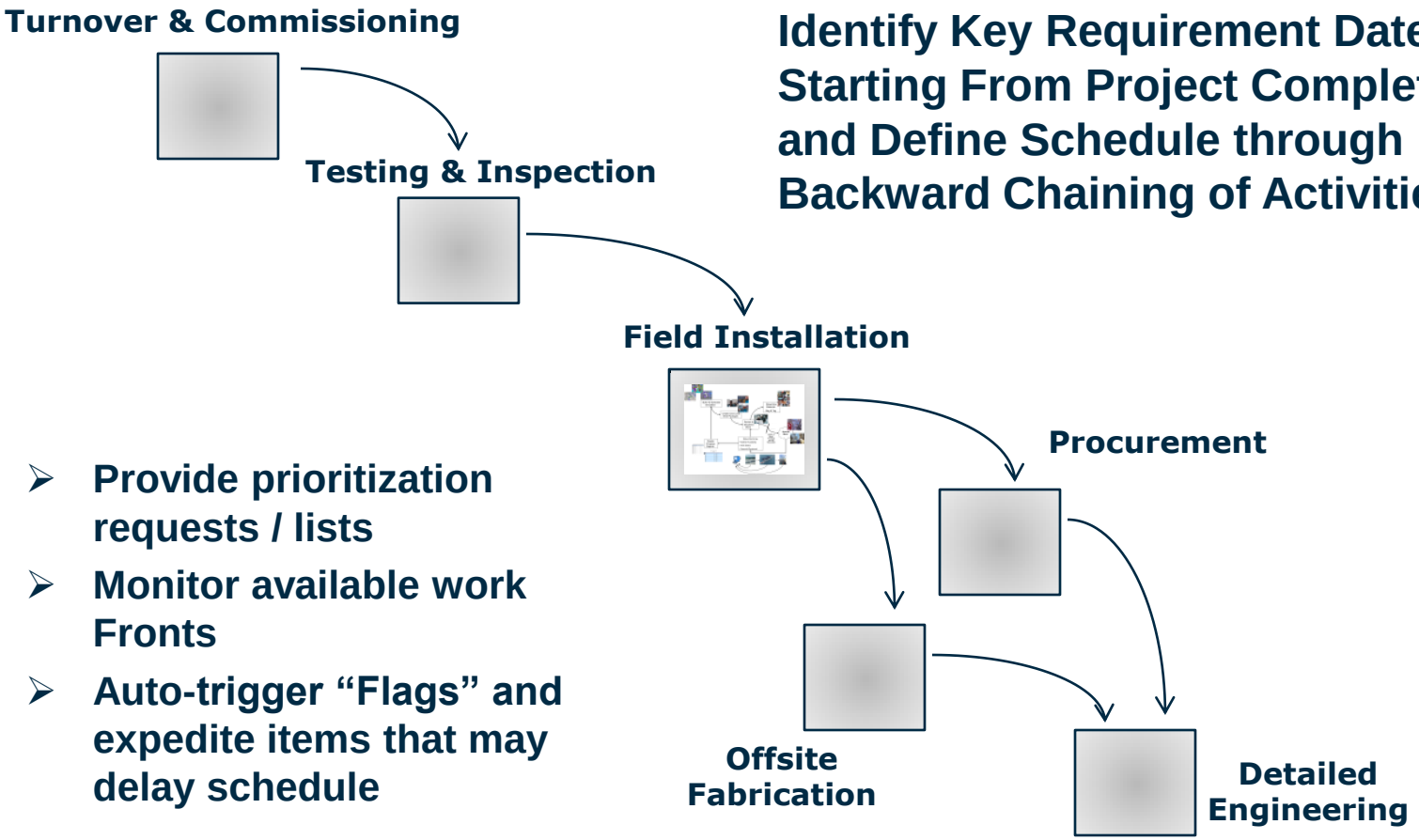
Buffer of Work Packages that are Executable

Status Monitoring

- Material Availability
- Work Status
- Supports/Equipment

Weekly Progress Reports

Agile Construction Methodology



Identify Key Requirement Dates, Starting From Project Completion and Define Schedule through Backward Chaining of Activities

- Provide prioritization requests / lists
- Monitor available work Fronts
- Auto-trigger “Flags” and expedite items that may delay schedule

Case Study – Off Shore Platform

Project Background

- Deepwater Offshore Platform - $150M
- Time and materials contract with Fab Yard
- ConstructSim Pipe purchased by Owner and utilized by module Fab Yard contractor

Project Use-Case

- ConstructSim used to re-baseline schedule, prioritize by TO Systems
  - **Finish project on-time, under budget**
- At “sail away”, only 7 Punch List items (compared to 1000’s)
- Development of crew-level work face plans with ConstructSim

Project Return-On-Investment

Investment	
Software and Services	$1M
Savings	
Reduced project cost from labour efficiency	$17M
Project completes ahead of schedule	3 mo.

Case Study – Diesel Refinery Unit

Project Background

- New Refinery Unit - TIC $320M.
- Lump Sum Contract with Mechanical Sub
- ConstructSim Pipe purchased by Owner and utilized by Construction Management firm

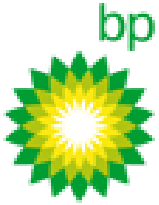
Project Use-Case

- Actual progress not in alignment with progress reported in field ... Switch to progressing through ConstructSim
  - **Project recovers schedule losses to complete on time**
- Excessive change order submitted by Mechanical Sub
  - ConstructSim used to analyze change order and provide visibility to impact on work

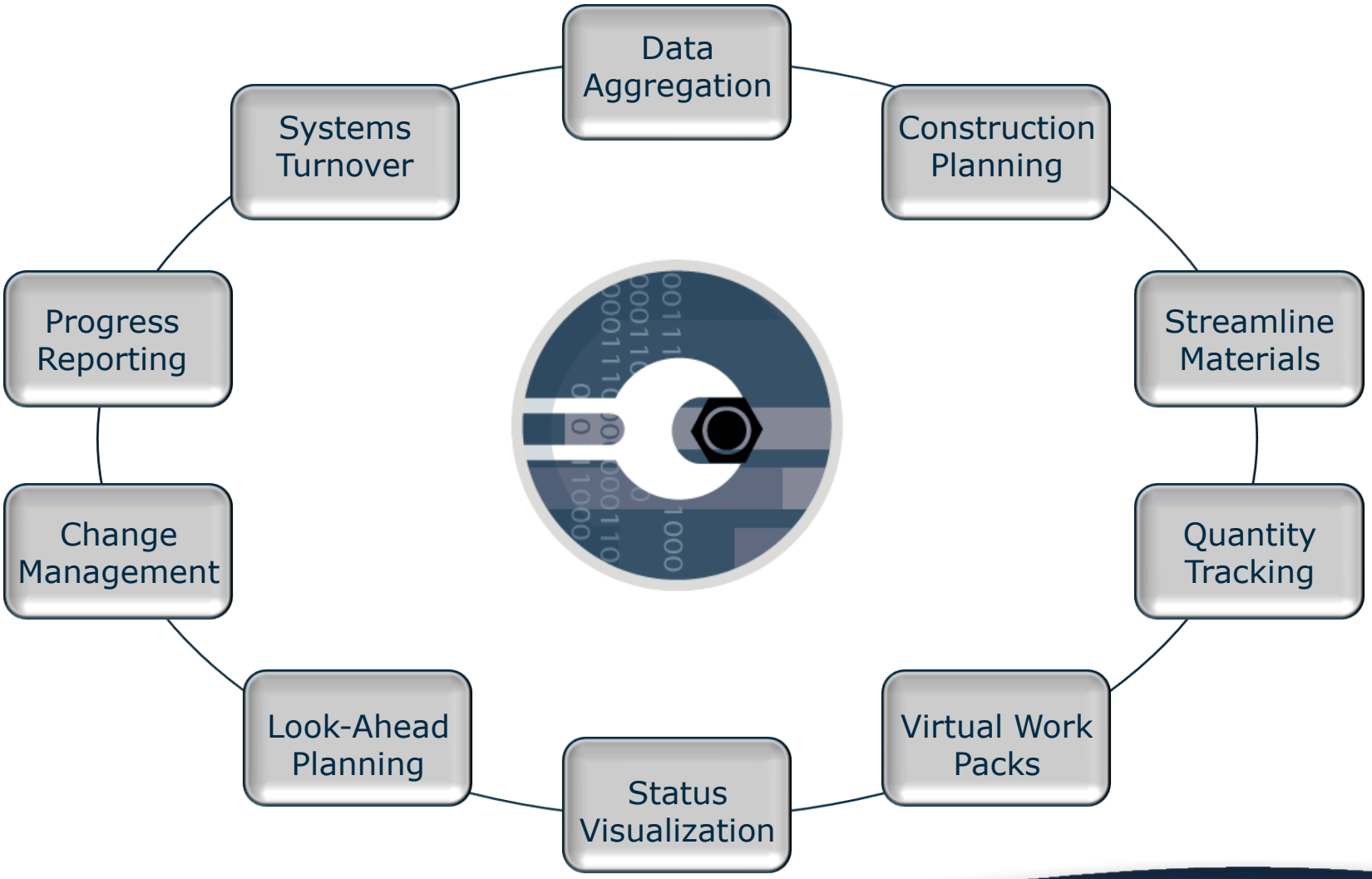
Project Benefits / Savings

Change order reduced from 2.5M to 500K	$2M
Project recovered and completed on-time	

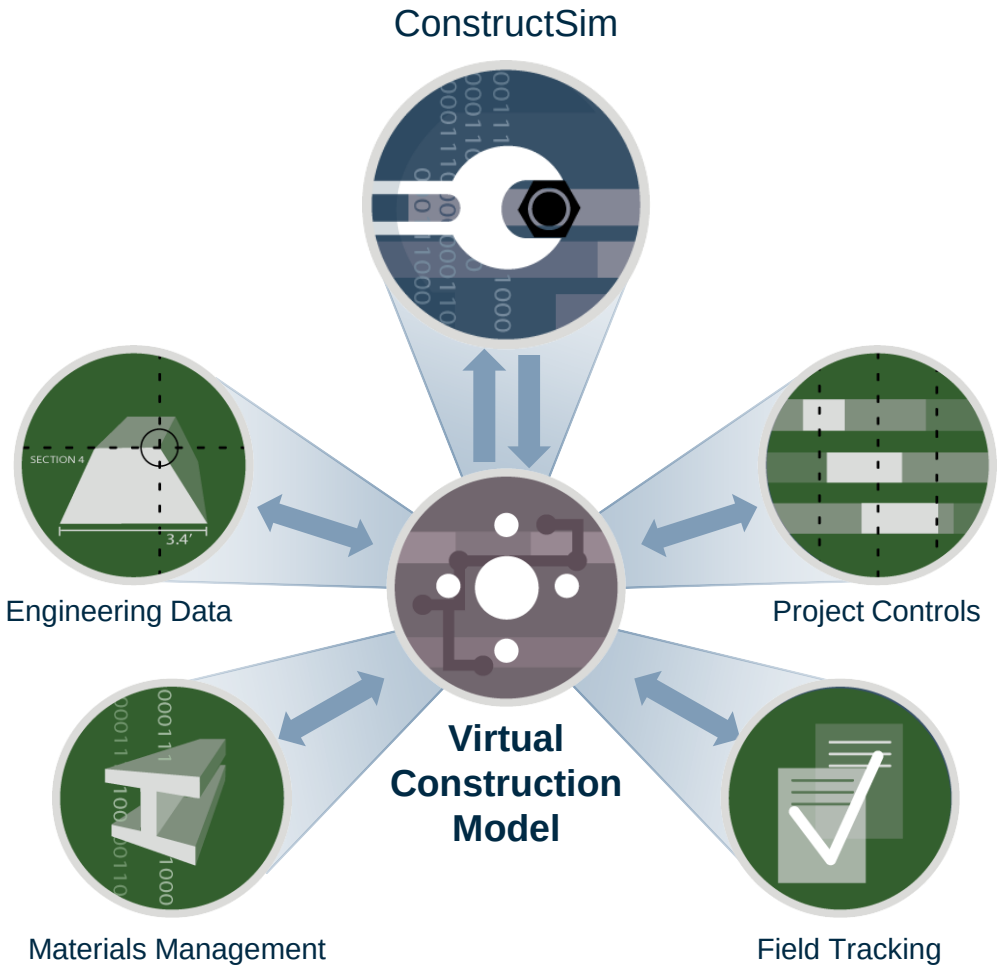
ConstructSim Users



ConstructSim Functionality

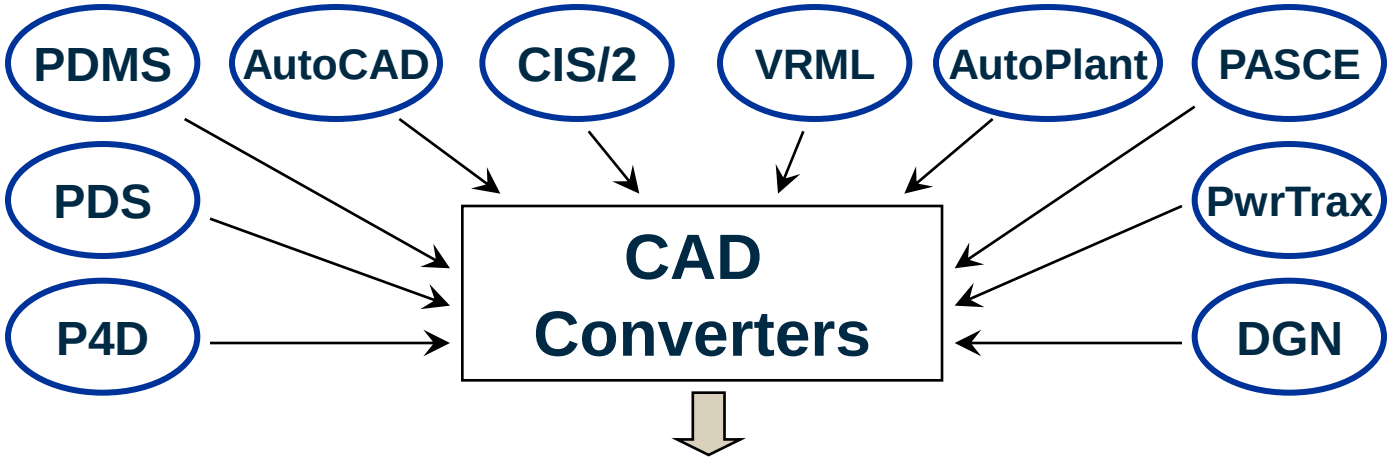


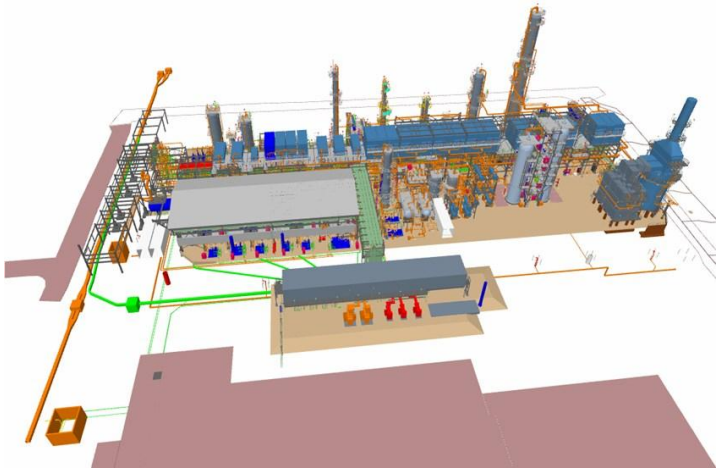
Data Aggregation



Back

Data Aggregation – CAD Adaptors





Data Aggregation – Digital ISO Input

ConstructSim reads digital ISO files and correlates them with the 3D CAD model…

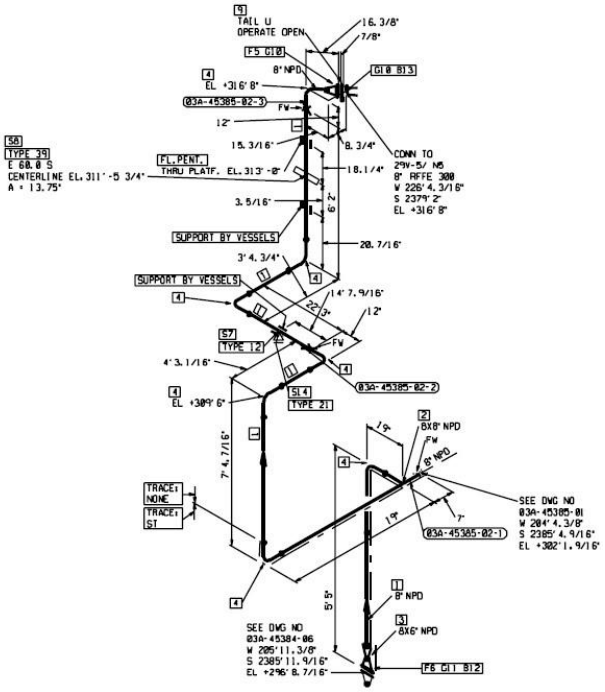
PT NO	DESCRIPTION	DIA (NPD)	CMDTY CODE	QTY
1	PIPE, DE SMLS, S-STD, ASTM A335-P22	8	DT10025	38.8'
	[illegible] A234-WP22 CL1, SMLS	8X8	DT30245	1
	[illegible] BE, S-STD ASTM A234-WP22 CL1, SMLS	8X6	DT302658	1
4	90 DEG ELBOW, BE, S-STD, ASTM A234-WP22 CL1, SMLS	8	DT30215	7
5	FLANGE, WN, ANSI-B16.5 CL300, RFFE, S-STD BORE, ASTM A182-F22 CL3, STD FIN	8	DT20175	1
6	FLANGE, WN, ANSI-B16.5 CL1500, RFFE, S-80 BORE, ASTM A182-F22 CL3, 125-250 RA FIN	6	DT20398	1
	PIPE SUPPORTS			
7	PIPE SUPPORT TYPE 12	8	TYPE12	1
8	PIPE SUPPORT TYPE 39	8	TYPE39	1

FIELD MATERIALS

PT NO	DESCRIPTION	DIA (NPD)	CMDTY CODE	QTY
9	FIG.8 FLG, CL300 RF, ASTM A387 GR 22 CL. 2, B16.48, STD FIN	8	DT8203	1
10	GASKET, RF, CL300, SPIRAL WOUND 304SS W/FLEXIBLE GRAPHITE FILLER, 1/8" THK, 2 1/4CR CR, FLEXITALLIC CG	8	RG125-3	2
11	GASKET, CL1500, RF, SPW 304SS W/FLEXIBLE GRAPHITE FLR, 1/8" THK 2-1/4CR CR & IR, FLEX CGI	6	RGA53-7	1
12	STUD BOLT, FULL THRD, ASTM A193-B7 W/A194-2H HVY HEX NTS, 10.25" BOLT LENGTH	1.3/8	CB7001	12
13	STUD BOLT, FULL THRD, ASTM A193-B7 W/A194-2H HVY HEX NTS, 6.75" BOLT LENGTH	7/8	CB7001	12
	PIPE SUPPORTS			
14	PIPE SUPPORT TYPE 21	8	TYPE21	1

PIECE MARKS

03A-45385-02-1 03A-45385-02-2 03A-45385-02-3



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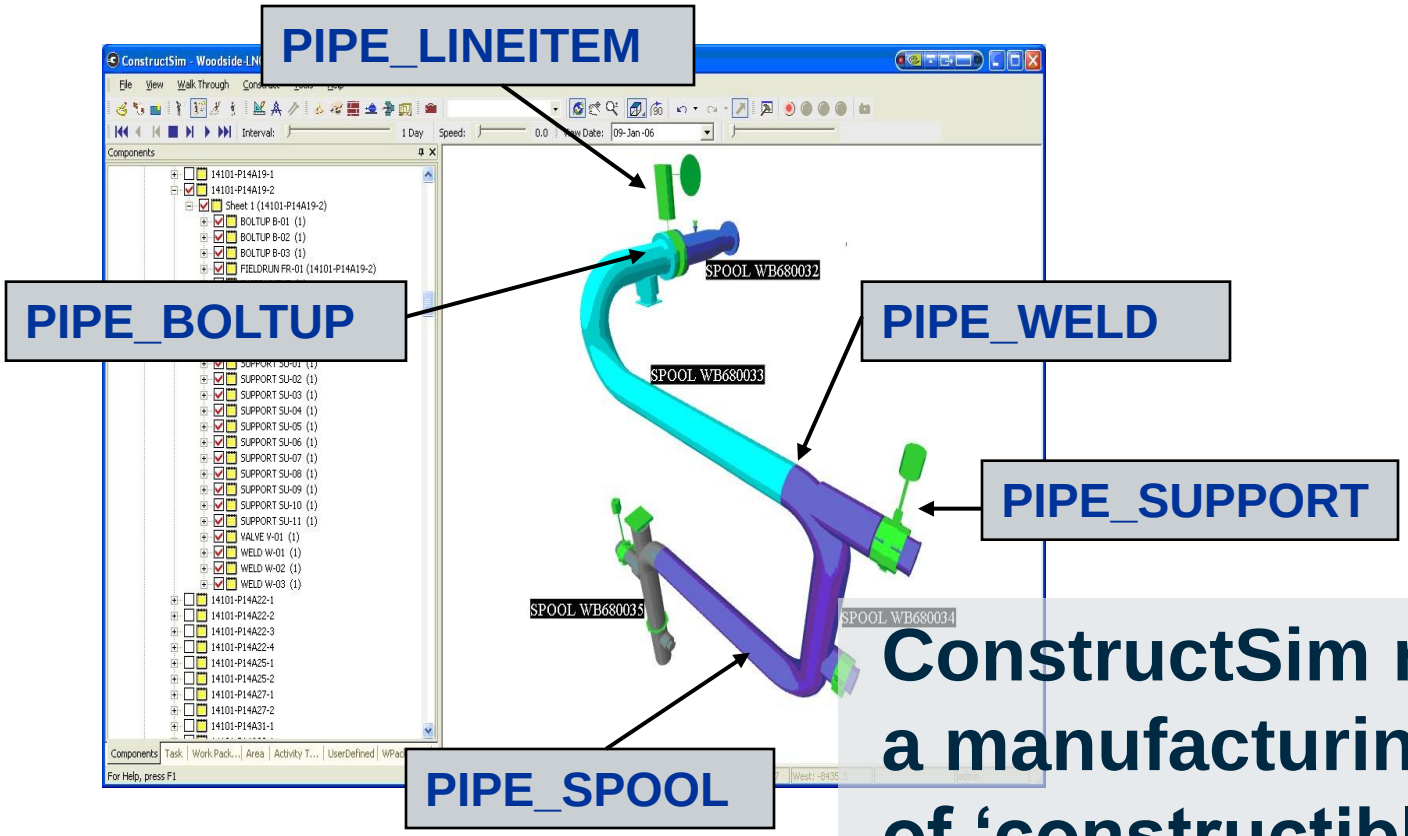
Data Aggregation – ISO Components

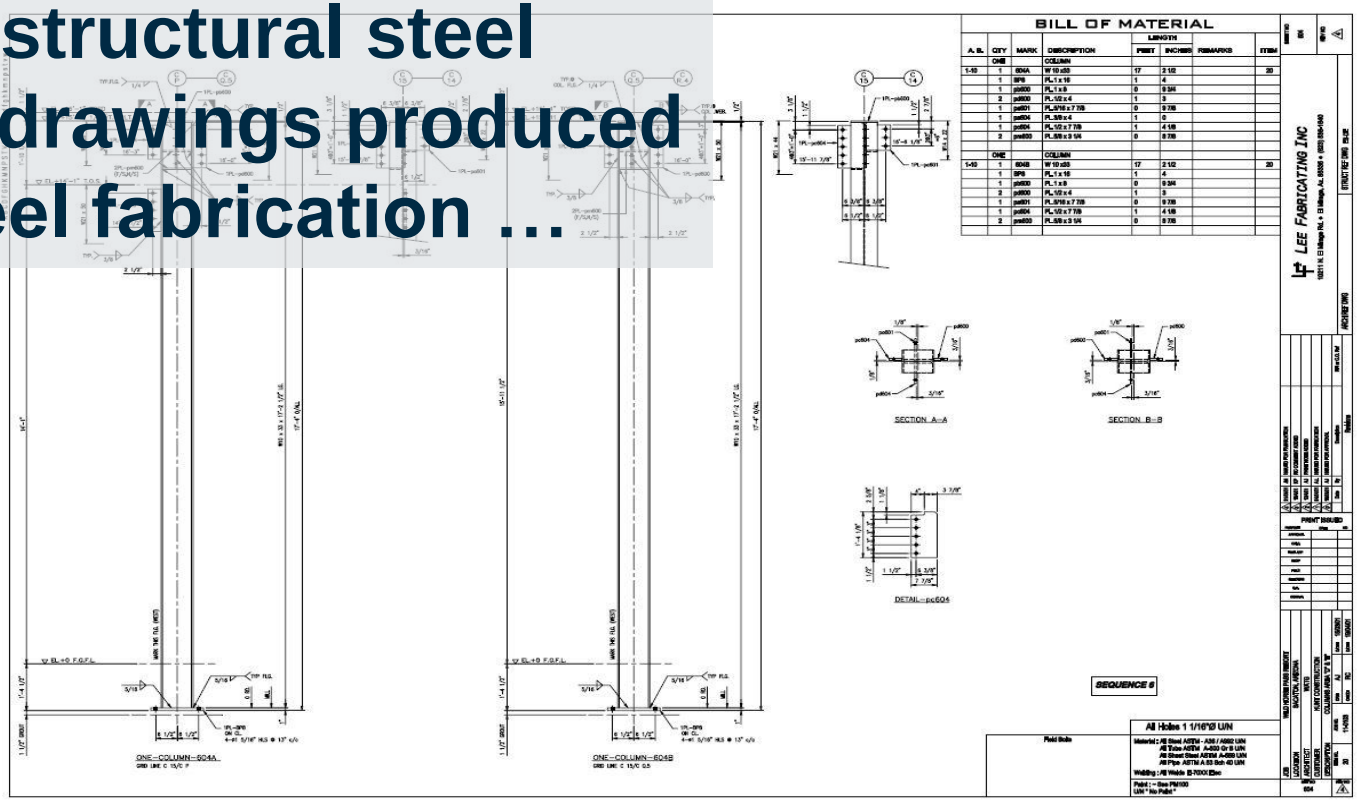


ConstructSim represents a manufacturing model of 'constructible' pipe elements.

Back

Data Aggregation – Structural Details

ConstructSim reads structural steel detail drawings produced for steel fabrication …



Back

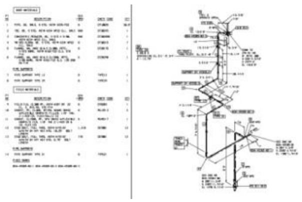
Data Aggregation – Attributes

Attributes in ConstructSim are derived from multiple sources

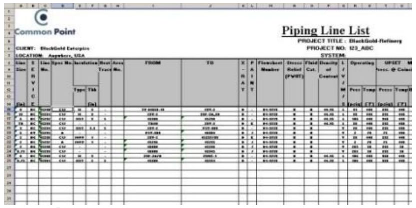
ConstructSim also collects attributes needed for automated task generation

3D CAD Model

Digital Isometrics



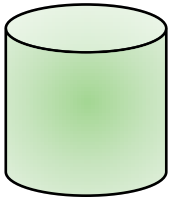
Line List



ConstructSim Take-Off

ConstructSim

Other Sources



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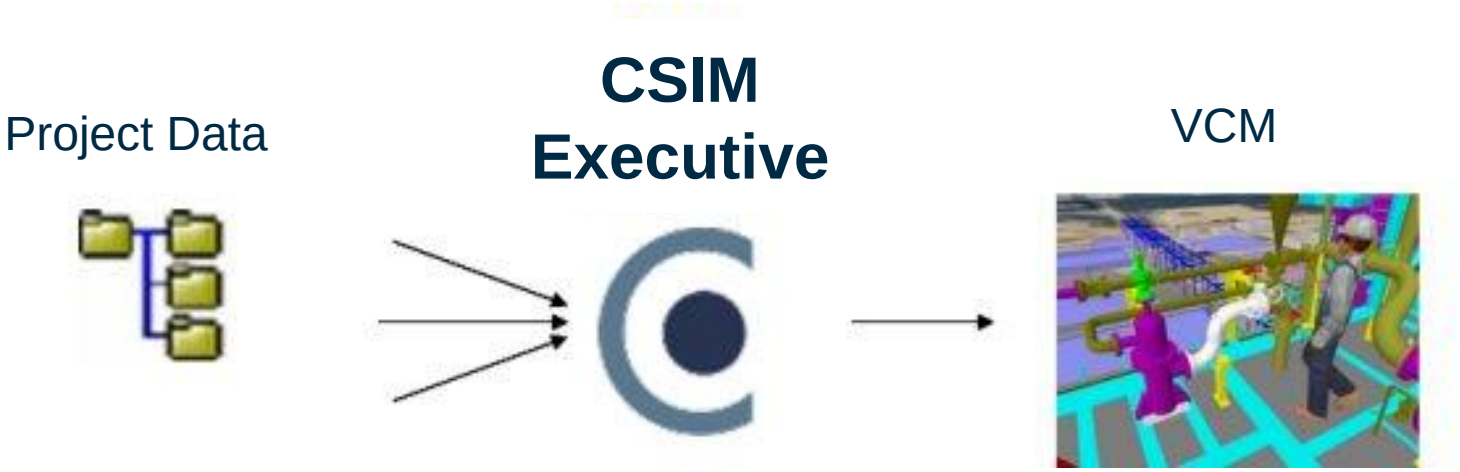
Data Aggregation – CSIM Executive

The *Virtual Construction Model (VCM)* is generated and updated by the ***CSIM Executive*** data processing engine. The ***Executive*** processes the *Project Data* as inputs and updates the *VCM* throughout the course of a construction project.



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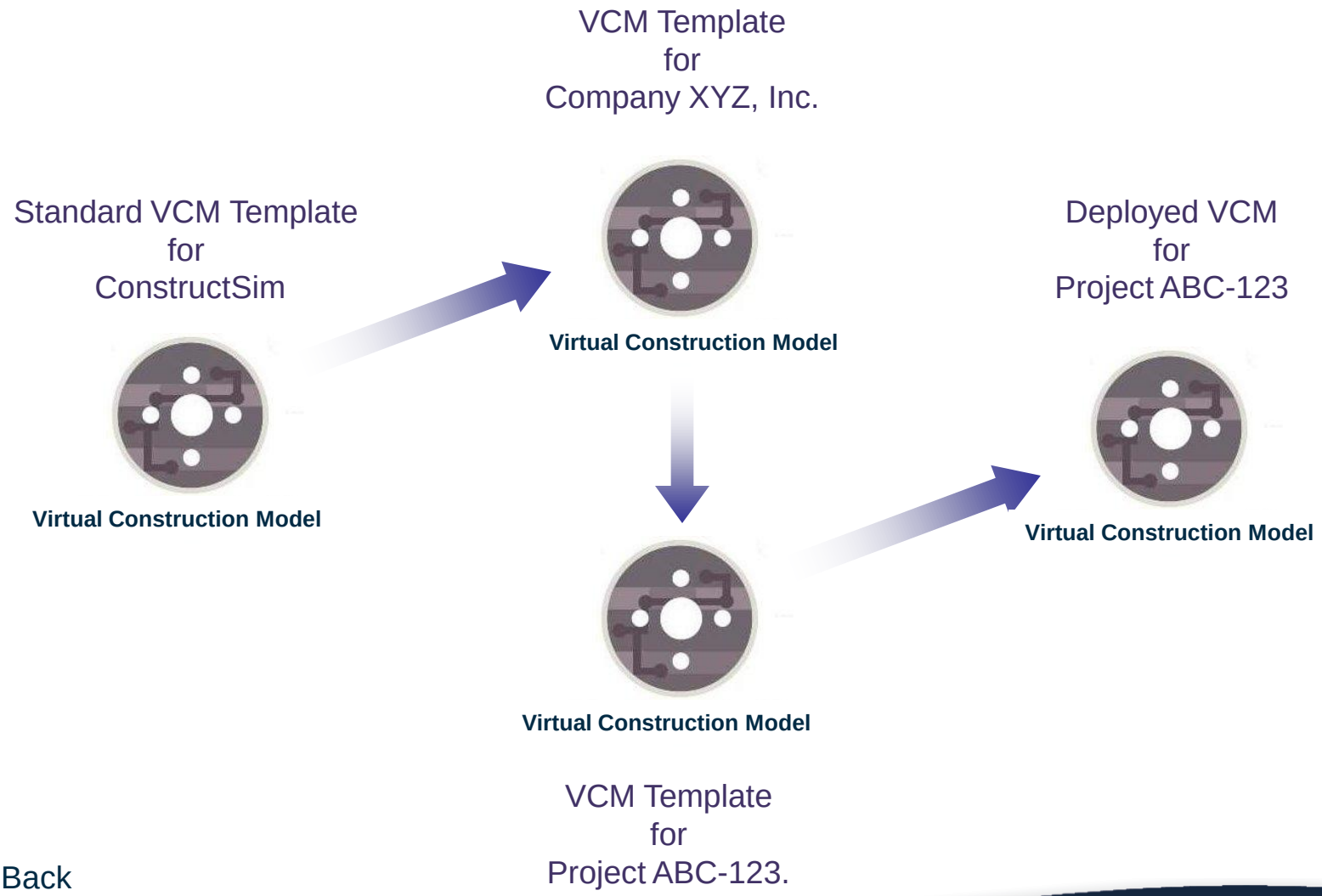
Data Aggregation – VCM Templates



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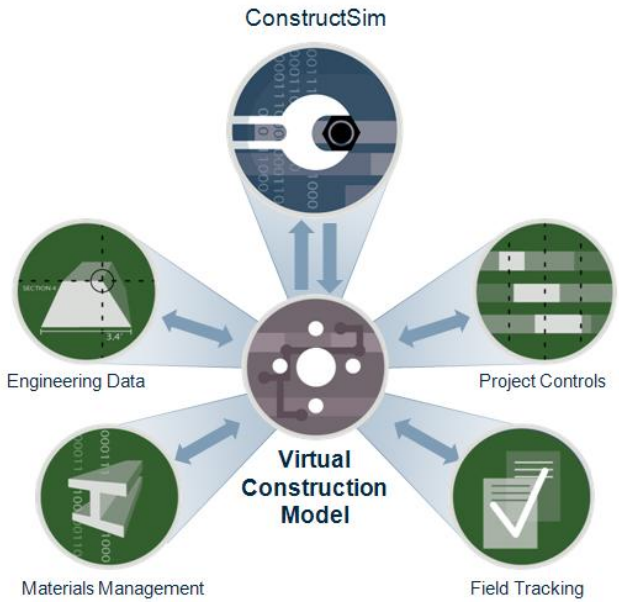
Data Aggregation – Project Data

Typical Project Data input to ConstructSim on a project includes:

- 3D CAD
- Pipe Isometrics
- Structural Detailing Data
- Line List / Equipment List
- Instrument Index / Electrical Lists
- L3 Project Schedule
- Unit Rates/ Rules of Progress
- Offsite Fabricator Status
- Material Availability
- Quantity Tracking (Progress)
- Weld Tracking / NDE
- TO Systems / Completions



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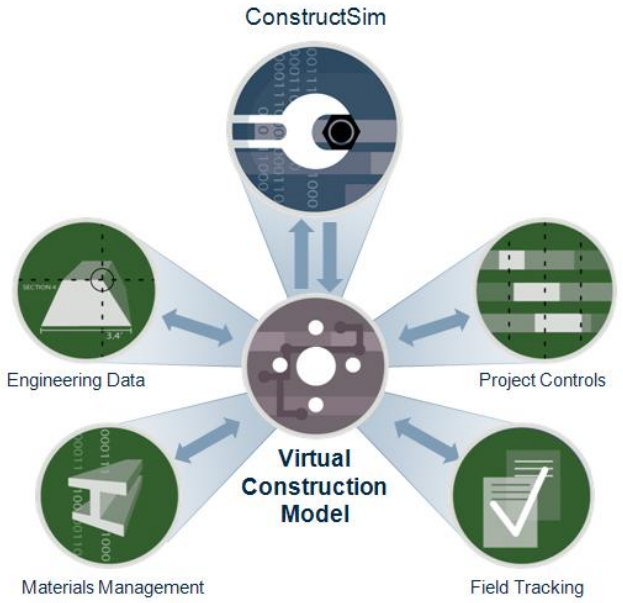
Data Aggregation – Project Data

Typical Progressing Options:

- Use ConstructSim reports and data entry forms to track progress
  - Pipe
    - Receive
    - Fabricate
    - Install
    - Test
  - Steel
    - Receive
    - Install
  - Equipment
    - Receive, Install, MC

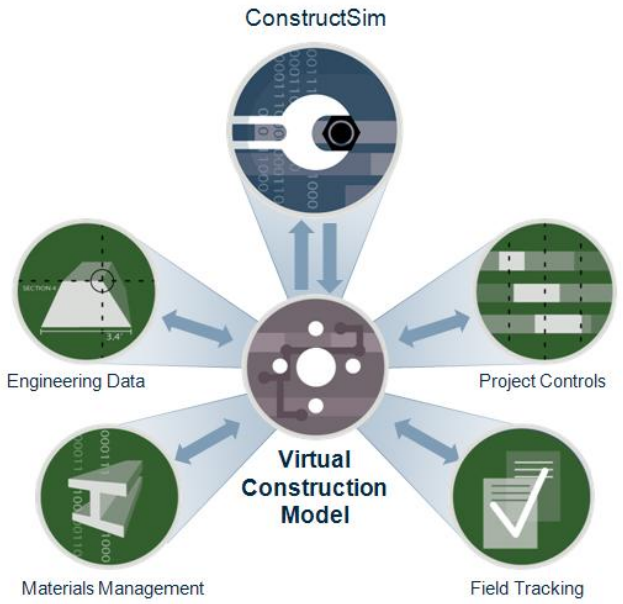


Back

Data Aggregation – Project Data

Typical Progressing Options:

- Interface with other electronic system
  - In-House / 3rd Party Commercial
    - Progressing – QTY Tracking
    - Material System
- Progressing XLS from sub-contractor
  - Validate list is correct
- Use ConstructSim to produce XLS sheet for sub-contractor, ask sub-contractor to submit progress in XLS format
  - Reduces in-acuracies



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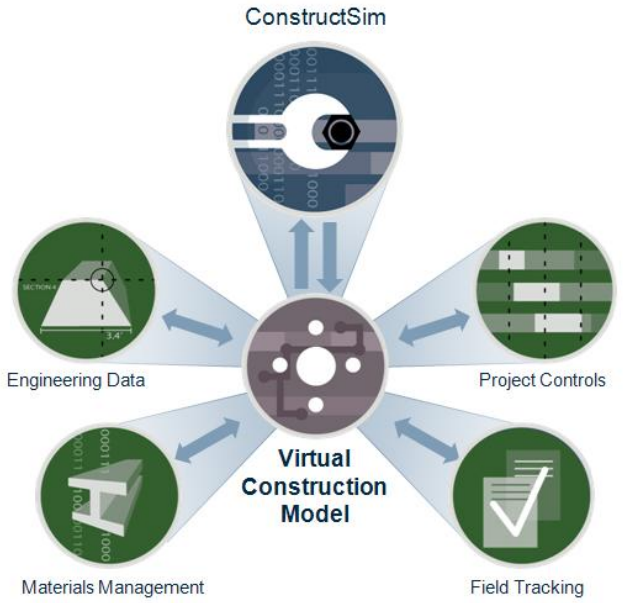
Data Aggregation – Project Data

Typical Progressing Options:

- FUTURE – State-of-the-art active RFID hardware

  - R&D Project
    - Waseda University

  - Partner - Intelliwave



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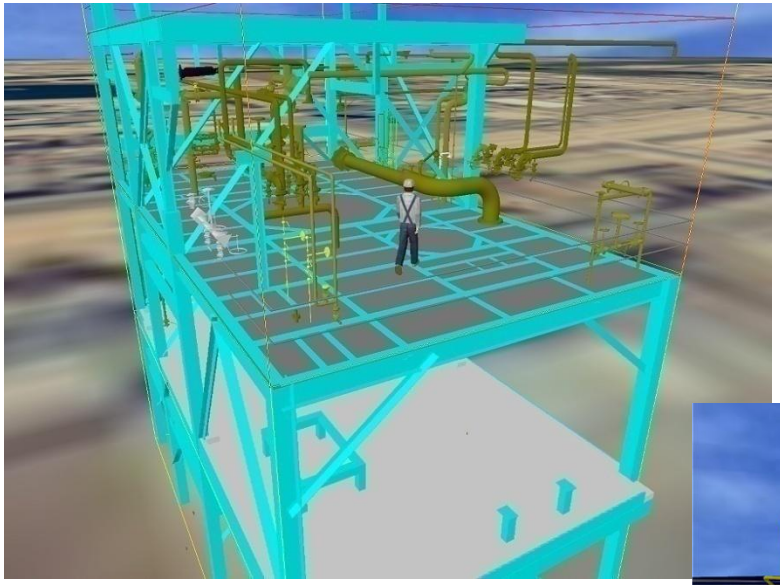
Construction Planning – UD Groups

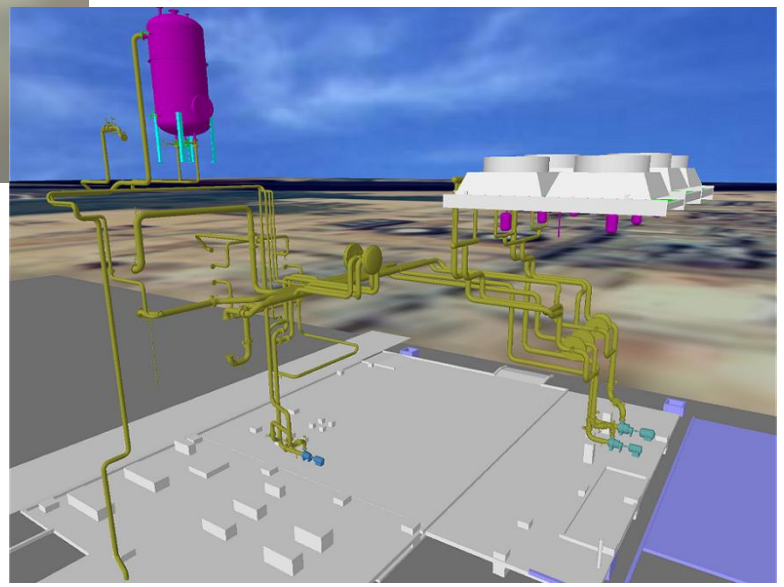


Construction Areas

Unit 1, Level 3

Large Bore, CS

Turnover Systems



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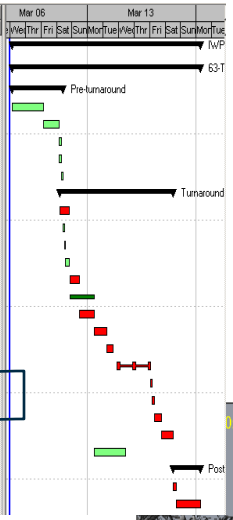
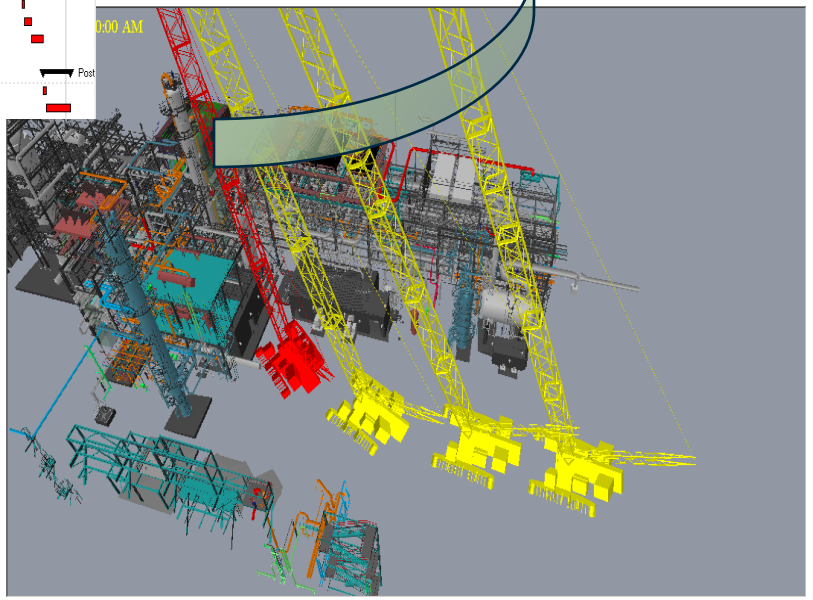
Construction Planning – 4D Playback

Activity Name	Planned Duration	Tie In Point	CSim Activity Type	Resource Instance	Work Space	Labour Force
IWP: 0010	243h					60.00
63-TP-1012	243h					60.00
Pre-turnaround	66h					14.00
Install Temporary Platform	40h	63-TP-1012	Scaffold.Build	Scaffold.01.0010		3.00
Remove Insulation & Install Temporary Cladding	20h	63-TP-1012	1.PreTA		63-TP-1012	4.00
Mark Tie-In Point Location and Confirm Dimensions	4h	63-TP-1012	1.PreTA		63-TP-1012	3.00
Conduct Positive Material Identification	4h	63-TP-1012	1.PreTA		63-TP-1012	2.00
Measure Wall Thickness	2h	63-TP-1012	1.PreTA		63-TP-1012	2.00
Turnaround	149h					39.00
Mobilize (Set Up) Crane	15h	63-TP-1012	Crane.Place	Crane.Crawler.0010		0.00
Gas Free & Safe	2h	63-TP-1012	2.TA.Demo		63-TP-1012	2.00
Lock Out/Tag & Obtain Permits	2h	63-TP-1012	2.TA.Demo		63-TP-1012	0.00
Prepare for Hot Works (Wind Screens & Fire Blankets)	6h	63-TP-1012	2.TA.Demo		63-TP-1012	6.00
Cold Cut and Prep for Welding	10h	63-TP-1012	2.TA.Demo		63-TP-1012	6.00
Crane Lifts	30h	63-TP-1012	Crane.Lift	Crane.Crawler.0010		0.00
Field Fit and Weld or Bolt-Up	20h	63-TP-1012	2.TA.Construct		63-TP-1012	6.00
Visual QA and Tag for X-ray	15h	63-TP-1012	2.TA.Inspect		63-TP-1012	3.00
Post Weld Heat Treatment	10h	63-TP-1012	2.TA.Construct		63-TP-1012	2.00
X-ray, Additional NDT if required	12h	63-TP-1012	2.TA.Construct		63-TP-1012	2.00
Hydro/Carber Test or Waiver/Service Test	2h	63-TP-1012	2.TA.Inspect		63-TP-1012	3.00
De-Blind/De-Tag and Reinstate	4h	63-TP-1012	2.TA.Construct		63-TP-1012	3.00
Final EPC QC Approval and Inspection	10h	63-TP-1012	2.TA.Inspect		63-TP-1012	2.00
Install Temporary Insulation	15h	63-TP-1012	2.TA.Construct		63-TP-1012	4.00
Demobilize Crane	40h	63-TP-1012	Crane.R	Crane.Crawler.0010		0.00
Post-turnaround	34h					7.00
Install Insulation	4h	63-TP-1012			63-TP-1012	4.00
Teardown Temporary Platform	30h	63-TP-1012	TearDown	Scaffold.01.0010		3.00





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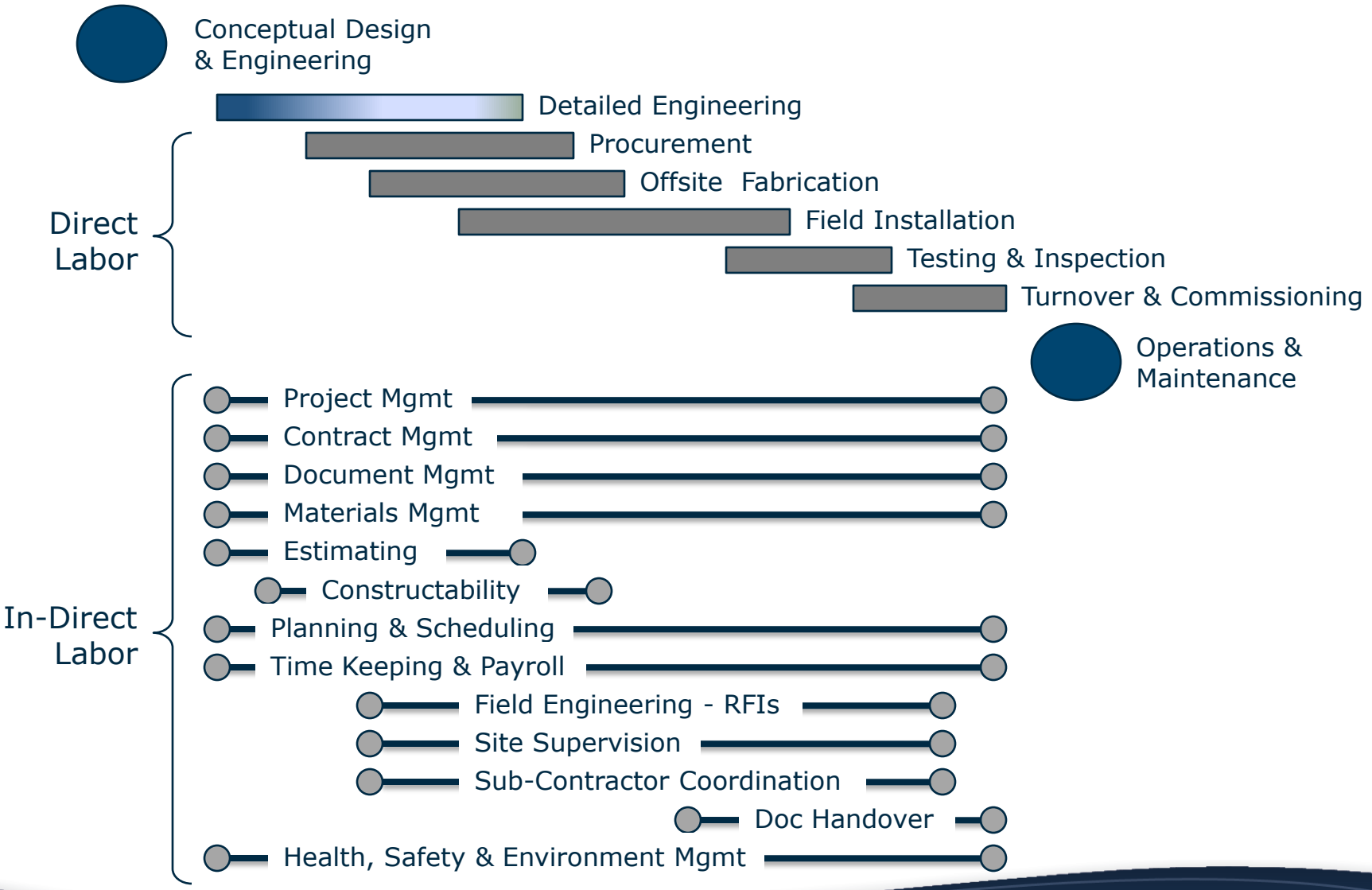
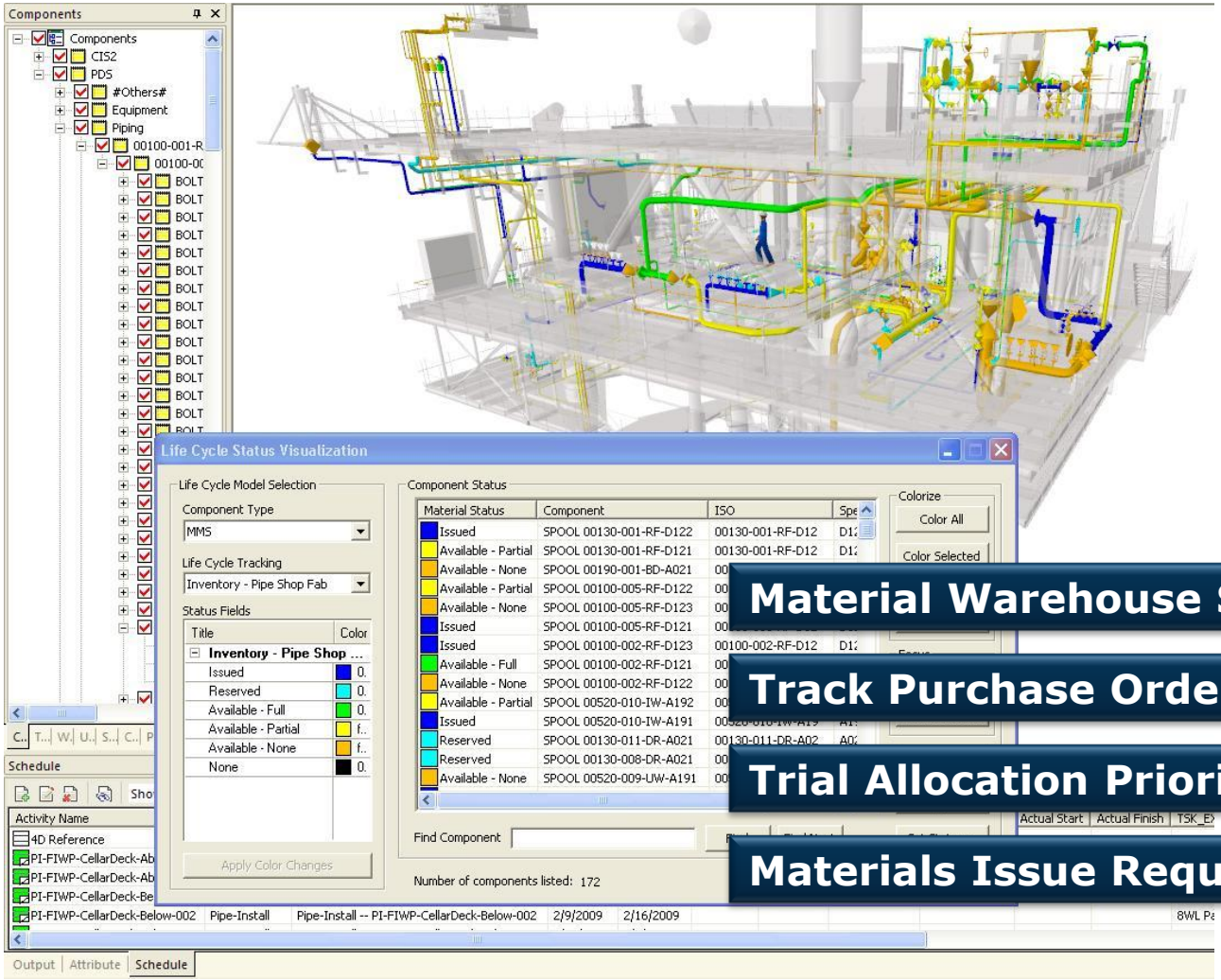
Construction Planning – Activities



Streamline Materials



Material Warehouse Status

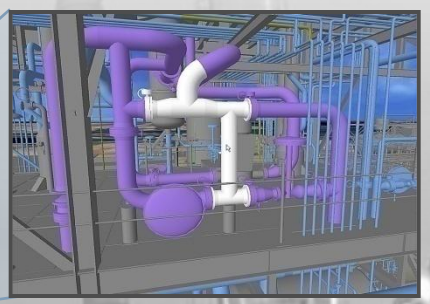
Track Purchase Orders / ETAs

Trial Allocation Priorities

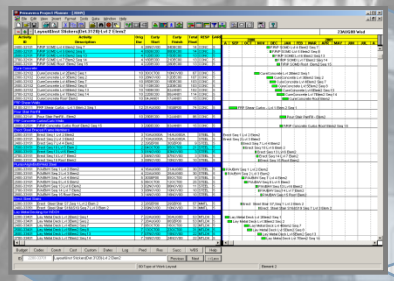
Materials Issue Request

Back

Quantity Tracking

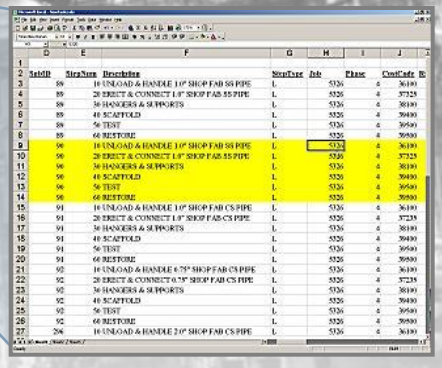


MTO
From CAD +
Isometric Documents



Schedule

ConstructSim



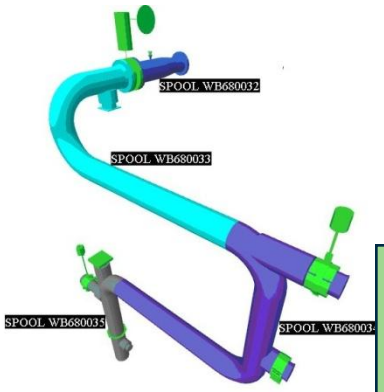
Labor Rates &
Rules of Progress

Work Steps

Back

Quantity / Labor Tracking – Tasks

Tasks grouped by “activity type” and “component type”



PIPE_SPOOL

Procure → Fabricate → Install → Test → Turn-over

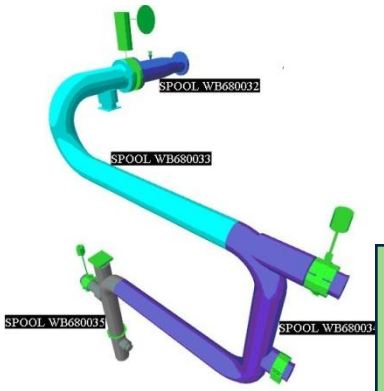
Fabricate Work Steps

Cut → Fit-Up → Weld → PWHT → NDE → Paint

Back

Quantity / Labor Tracking – Tasks

Tasks grouped by “activity type” and “component type”



PIPE_SPOOL

Procure → **Fabricate** → **Install** → **Test** → **Turn-over**

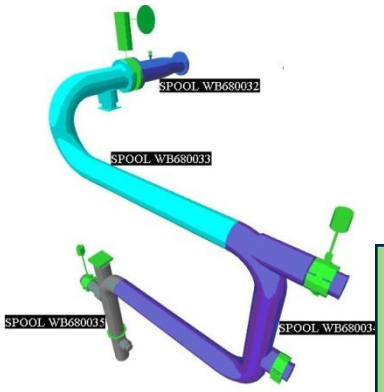
Install Work Steps

Stage → **Erect** → **Connect**

Back

Quantity / Labor Tracking – Tasks

Tasks grouped by “activity type” and “component type”



PIPE_WELD

Procure → **Fabricate** → **Install** → **Test** → **Turn-over**

Install Work Steps

Tack → **Complete**

Back

Levels of Planning & Scheduling

L3 - Schedule Activity

Example – A/G Piping Field Installation – Area 3A

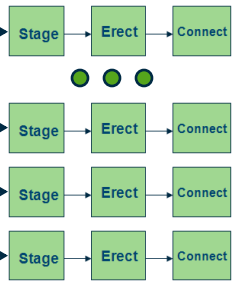
ConstructSim "**Auto-links**" Model Components to L3 Activities By Attribute Matching Rules

L4 – Crew Work Packs

Example – One "shift" of work (~1-2 weeks), includes scope identified with associated L5 tasks

Work face planner **"Builds"** optimal path of construction using ConstructSim

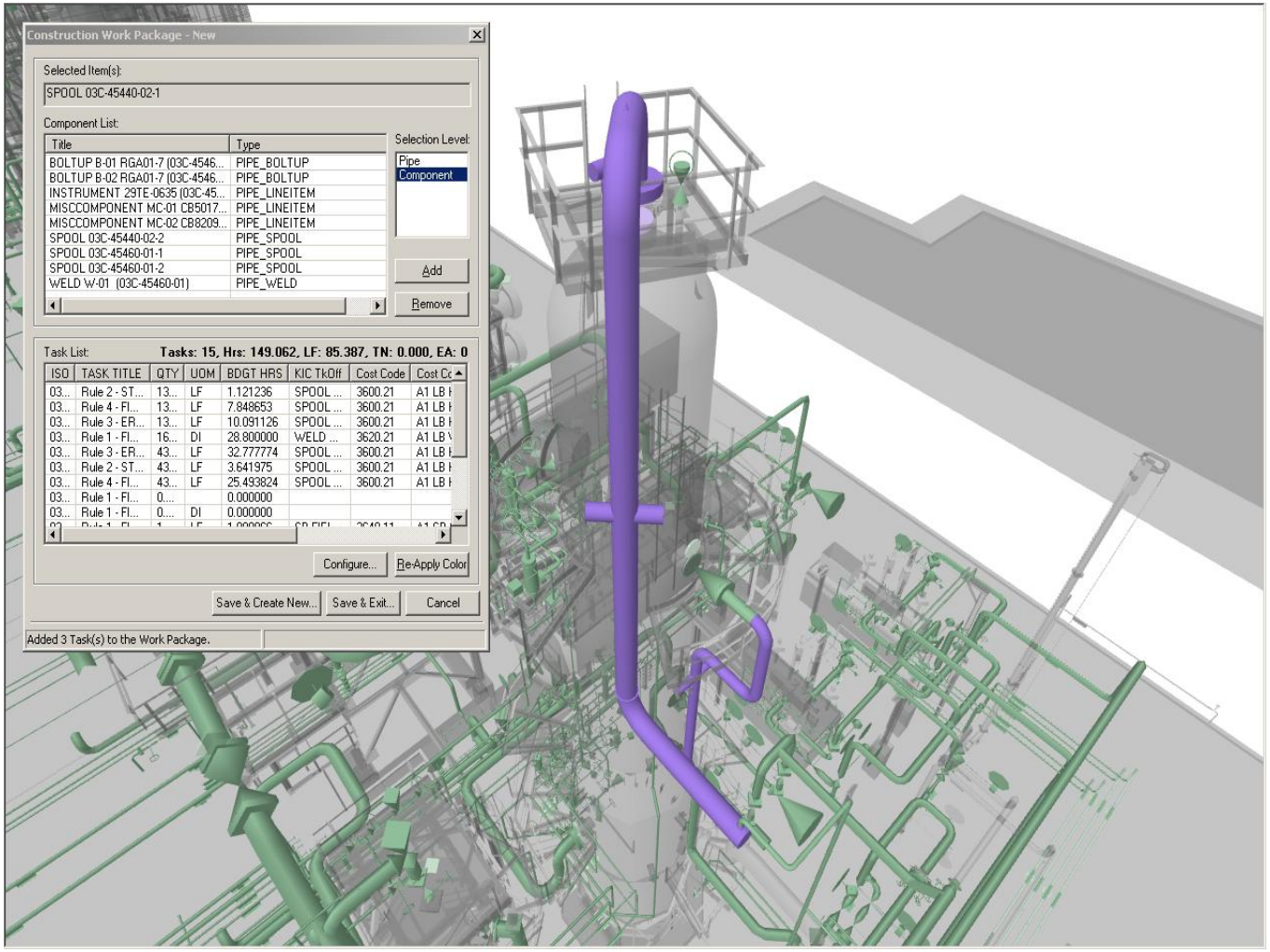
L5 - Tasks



Example – Spool 101-A Erect, Fit-Up, Connect

ConstructSim "**Auto-Generates**" L5 Tasks from Template "Rules of Progress"

Virtual Work Packs



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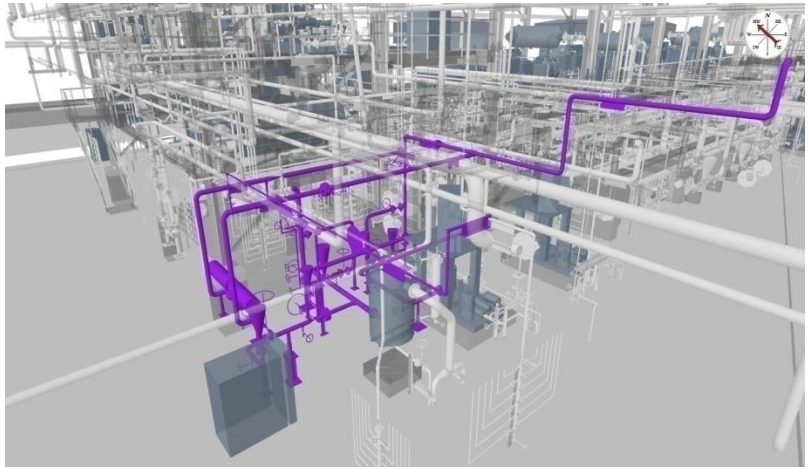
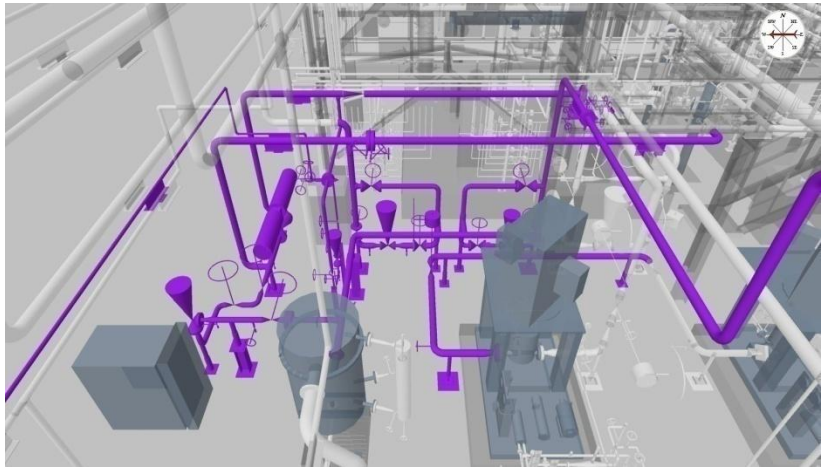
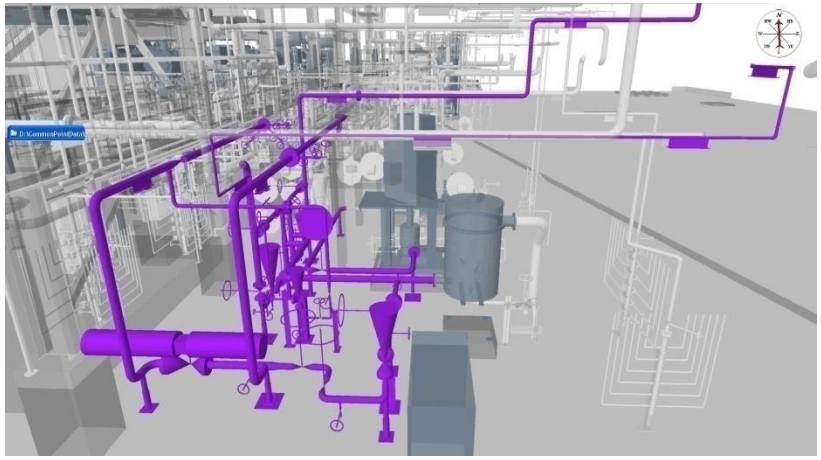
Virtual Work Packs – 4 Views







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Virtual Work Packs - Reports

ConstructSim - Work Package Execution Reports

Set Work Pack Type: Pipe::Install

Work Package: PI-FIWP-CellarDeck-Above-004

Document Type

Reports To Print

4/8/2009

Filter Work Pack List:

Set Report Type: Field Materials

- PI-FIWP-CellarDeck-Above-001
- PI-FIWP-CellarDeck-Above-002
- PI-FIWP-CellarDeck-Above-004
- PI-FIWP-CellarDeck-Above-005
- PI-FIWP-CellarDeck-Below-001
- PI-FIWP-CellarDeck-Below-002
- PI-FIWP-CellarDeck-Below-003
- PI-FIWP-MainDeck-Below-001
- PI-FIWP-MainDeck-Below-002
- PI-FIWP-Wellhead-001
- PI-FIWP-Wellhead-002
- PI-FIWP-Wellhead-003
- PI-FIWP-Wellhead-004
- PI-FIWP-Wellhead-005
- PI-FIWP-Wellhead-006
- PI-FIWP-Wellhead-007
- PI-FIWP-Wellhead-008

ISO	Mat'l Code	Material Description	Bore	Mat'l	Qty
00120-031-GY-A19	I4023191	STUD BOLTS & 2 HEAVY HEX. NUTS ASME B18.2.1 / ASME B18.2.2, 95.0MM BOLT LENGT	4	LTCS	8
00120-031-GY-A19	I2575937	CAP ASME B16.11 FTE	0.75	LTCS	0.04
00120-031-GY-A19	I3155766	SPIRAL WOUND GASKET ASME B16.20 RFTBE	4	LTCS	1
00120-031-GY-A19	BUG SCREEN FL	PIPING SPECIALTY	4	LTCS	1
00540-002-DR-A02	I2242408	STUD BOLTS & 2 HEAVY HEX. NUTS ASME B18.2.1 / ASME B18.2.2, 85.0MM BOLT LENGT	2	CS	16
00540-002-DR-A02	I3155567	SPIRAL WOUND GASKET ASME B16.20 RFTBE	2	CS	4
00540-002-DR-A02	00540-LT-110	PIPING SPECIALTY	2	CS	1
00550-016-DR-A02	I2242408	STUD BOLTS & 2 HEAVY HEX. NUTS ASME B18.2.1 / ASME B18.2.2, 85.0MM BOLT LENGT	2	CS	16
00550-016-DR-A02	I3155567	SPIRAL WOUND GASKET ASME B16.20 RFTBE	2	CS	4
00550-016-DR-A02	00550-LT-110	PIPING SPECIALTY	2	CS	1
00550-016-DR-A02	I3155590	VALVE BALL FLANGED ENDS LONG PATTERN API 6D SPLIT BODY / REDUCED BORE / FI	2	CS	1
00550-017-DR-A02	I2242408	STUD BOLTS & 2 HEAVY HEX. NUTS ASME B18.2.1 / ASME B18.2.2, 85.0MM BOLT LENGT	2	CS	16
00550-017-DR-A02	I3155567	SPIRAL WOUND GASKET ASME B16.20 RFTBE	2	CS	4
00550-017-DR-A02	00550-LT-120	PIPING SPECIALTY	2	CS	1
00550-017-DR-A02	I3155590	VALVE BALL FLANGED ENDS LONG PATTERN API 6D SPLIT BODY / REDUCED BORE / FI	2	CS	1

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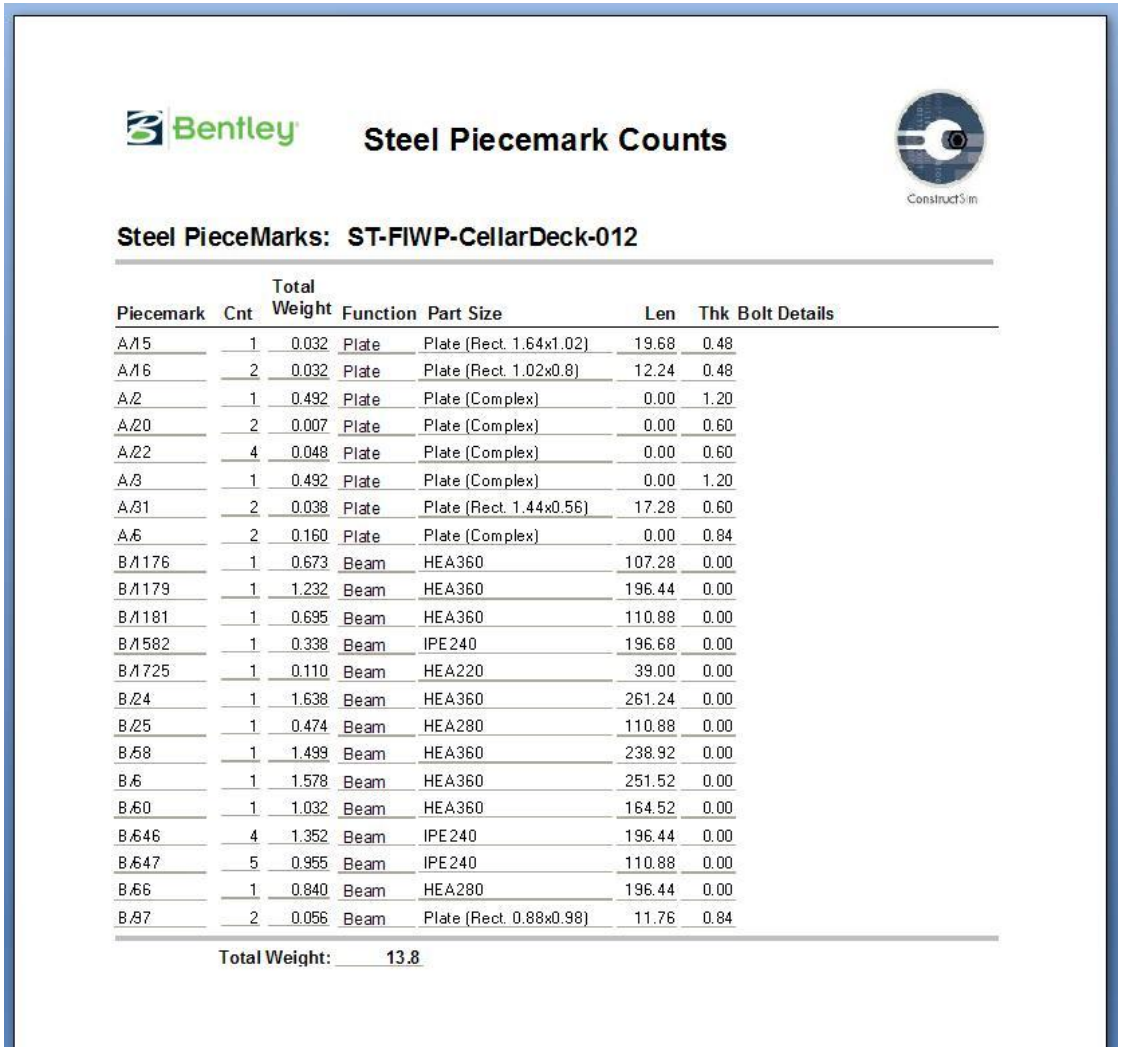
Virtual Work Packs - Reports



Bentley

Steel Piecemark Counts

ConstructSim

Steel PieceMarks: ST-FIWP-CellarDeck-012

Piecemark	Cnt	Total Weight	Function	Part Size	Len	Thk	Bolt Details
A/15	1	0.032	Plate	Plate (Rect. 1.64x1.02)	19.68	0.48	
A/16	2	0.032	Plate	Plate (Rect. 1.02x0.8)	12.24	0.48	
A/2	1	0.492	Plate	Plate (Complex)	0.00	1.20	
A/20	2	0.007	Plate	Plate (Complex)	0.00	0.60	
A/22	4	0.048	Plate	Plate (Complex)	0.00	0.60	
A/3	1	0.492	Plate	Plate (Complex)	0.00	1.20	
A/31	2	0.038	Plate	Plate (Rect. 1.44x0.56)	17.28	0.60	
A/6	2	0.160	Plate	Plate (Complex)	0.00	0.84	
B/1176	1	0.673	Beam	HEA360	107.28	0.00	
B/1179	1	1.232	Beam	HEA360	196.44	0.00	
B/1181	1	0.695	Beam	HEA360	110.88	0.00	
B/1582	1	0.338	Beam	IPE240	196.68	0.00	
B/1725	1	0.110	Beam	HEA220	39.00	0.00	
B/24	1	1.638	Beam	HEA360	261.24	0.00	
B/25	1	0.474	Beam	HEA280	110.88	0.00	
B/58	1	1.499	Beam	HEA360	238.92	0.00	
B/6	1	1.578	Beam	HEA360	251.52	0.00	
B/60	1	1.032	Beam	HEA360	164.52	0.00	
B/646	4	1.352	Beam	IPE240	196.44	0.00	
B/647	5	0.955	Beam	IPE240	110.88	0.00	
B/66	1	0.840	Beam	HEA280	196.44	0.00	
B/87	2	0.056	Beam	Plate (Rect. 0.88x0.98)	11.76	0.84	

Total Weight: 13.8

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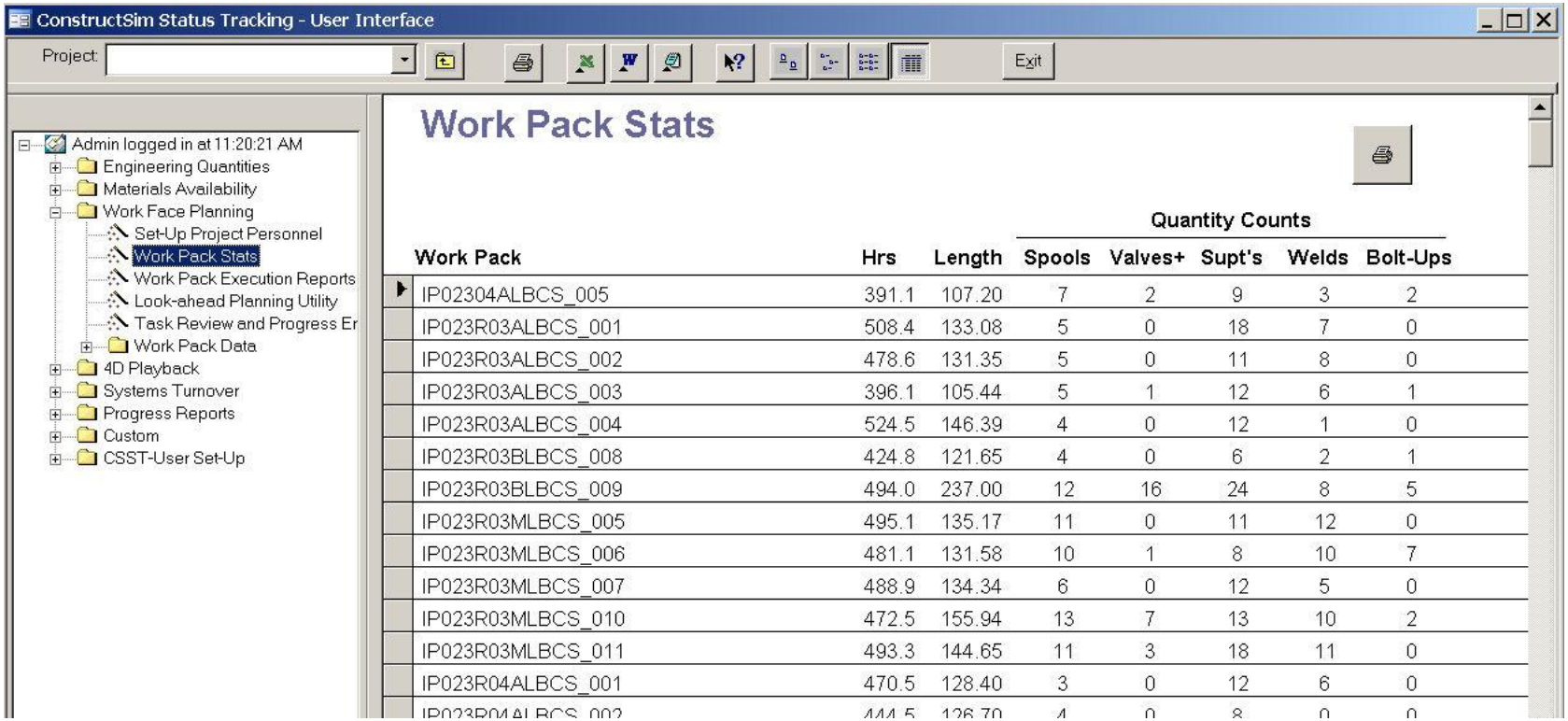
Virtual Work Packs - Reports

Work Pack Stats displays a list of all the work packages, with quantities and associated hours.



Work Pack Stats

Work Pack	Hrs	Length	Quantity Counts				
			Spools	Valves+	Supt's	Welds	Bolt-Ups
IP02304ALBCS_005	391.1	107.20	7	2	9	3	2
IP023R03ALBCS_001	508.4	133.08	5	0	18	7	0
IP023R03ALBCS_002	478.6	131.35	5	0	11	8	0
IP023R03ALBCS_003	396.1	105.44	5	1	12	6	1
IP023R03ALBCS_004	524.5	146.39	4	0	12	1	0
IP023R03BLBCS_008	424.8	121.65	4	0	6	2	1
IP023R03BLBCS_009	494.0	237.00	12	16	24	8	5
IP023R03MLBCS_005	495.1	135.17	11	0	11	12	0
IP023R03MLBCS_006	481.1	131.58	10	1	8	10	7
IP023R03MLBCS_007	488.9	134.34	6	0	12	5	0
IP023R03MLBCS_010	472.5	155.94	13	7	13	10	2
IP023R03MLBCS_011	493.3	144.65	11	3	18	11	0
IP023R04ALBCS_001	470.5	128.40	3	0	12	6	0
IP023R04ALBCS_002	444.5	126.70	4	0	8	0	0

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Status Visualization

Status information from task progress or from external data sources

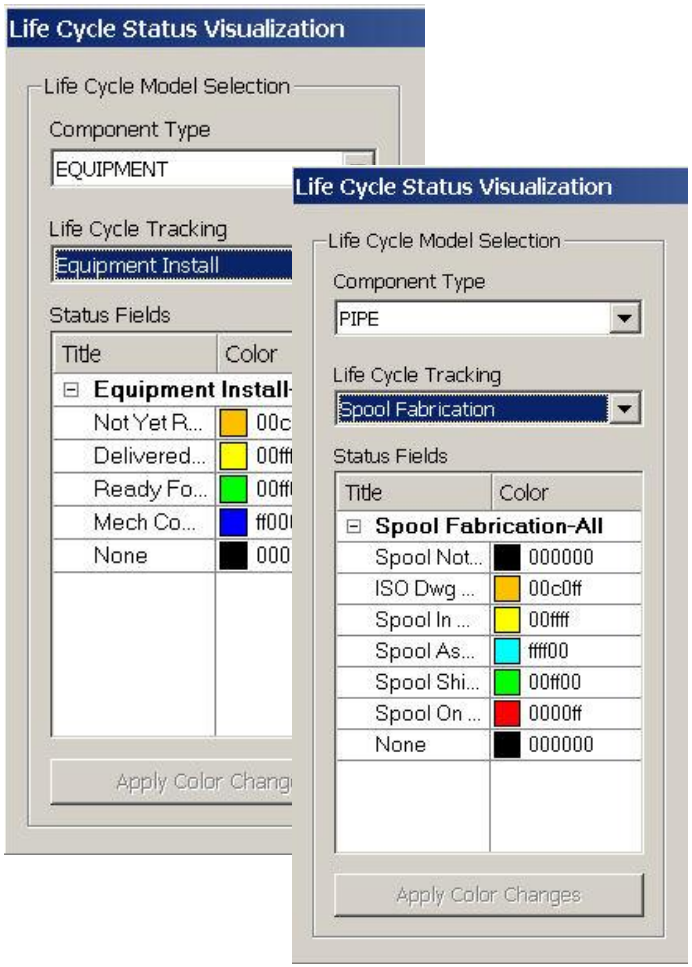
No Progress	
Received	
Staged	
Erected	
Final Complete	
Punch Complete	

Back

Status Visualization – Standard Modes

- Spool fabrication
- Equipment installation
- ISO release status
- Pipe material availability
- Advance revision notices
- Work step tracking
- Test pack status
- QA/QC status
- Work package constraints

Project / user specific status modes can also be created.



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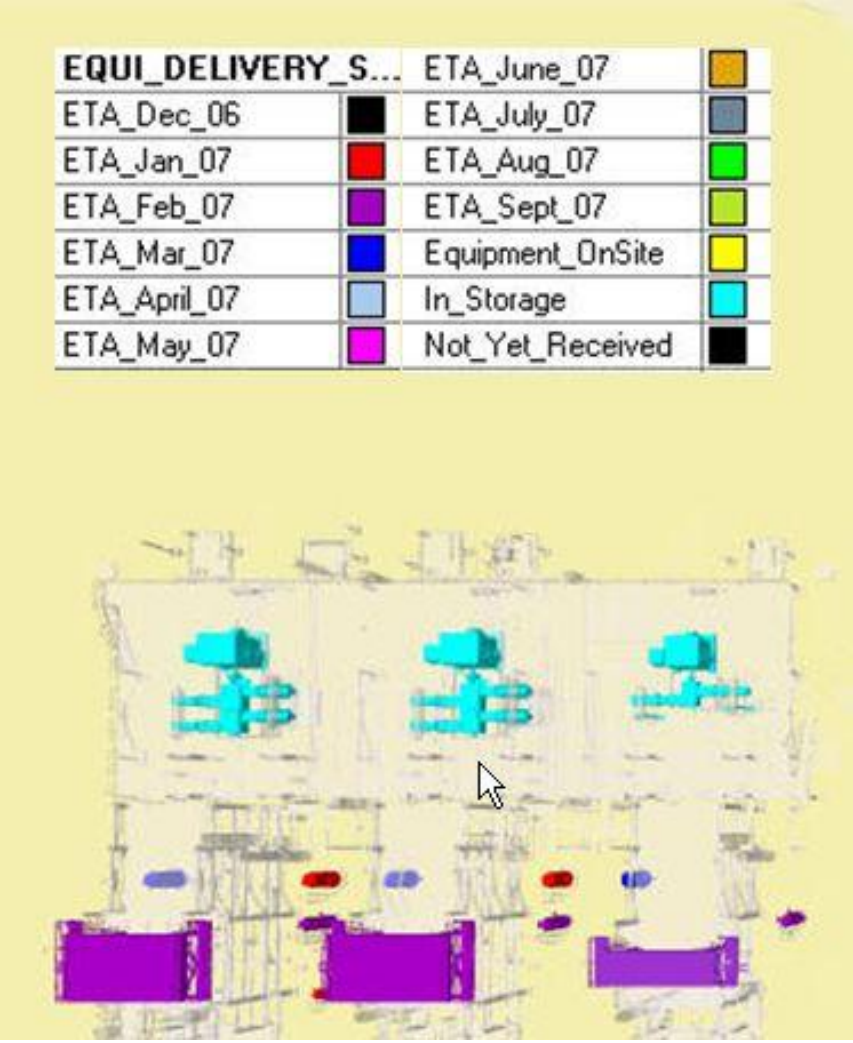
Bentley Sustaining Infrastructure

Status Visualization – Equip Delivery



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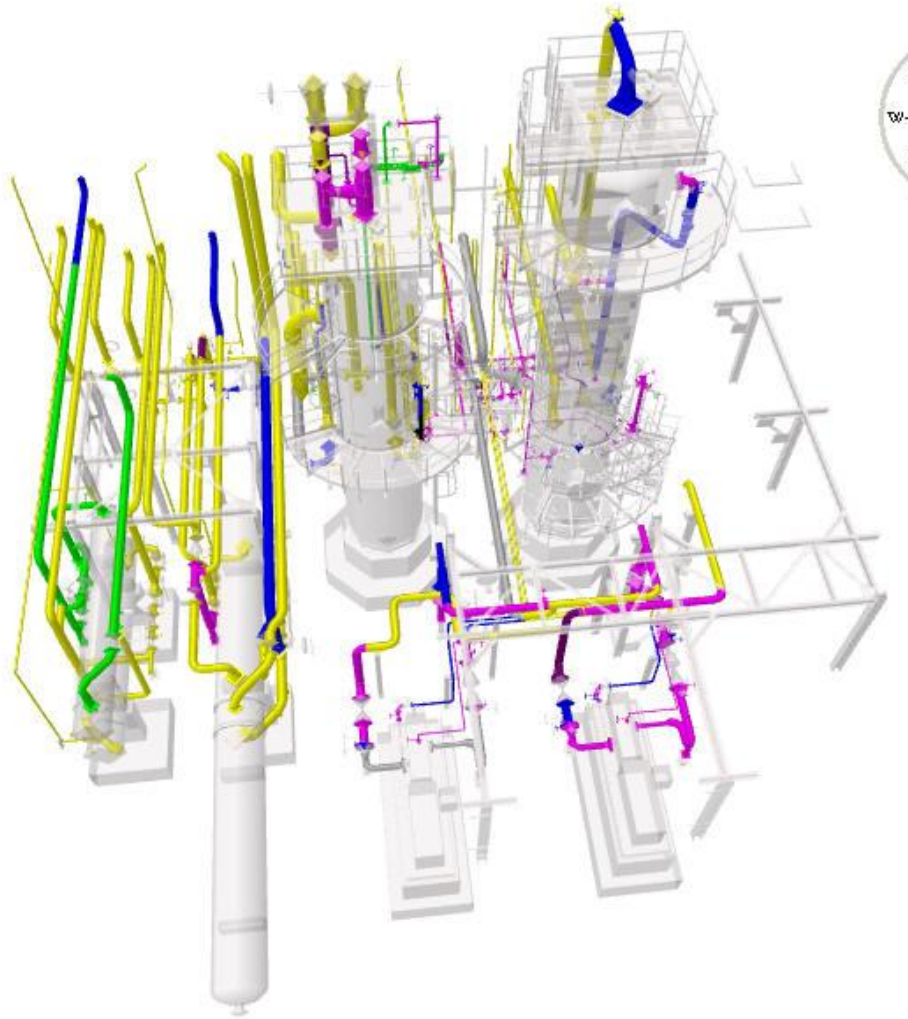
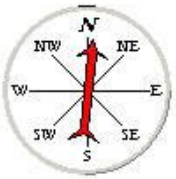
Status Visualization – Pipe Fab





Area 15

SPOOL_Delivery_St...	
ETA_3+WEEKS	
ETA_2WEEKS	
DUE	
PASS_DUE_2WEE...	
PASS_DUE_3+WE...	
SHIPPED	
ONSITE	
ON_HOLD	
NO_DATE	

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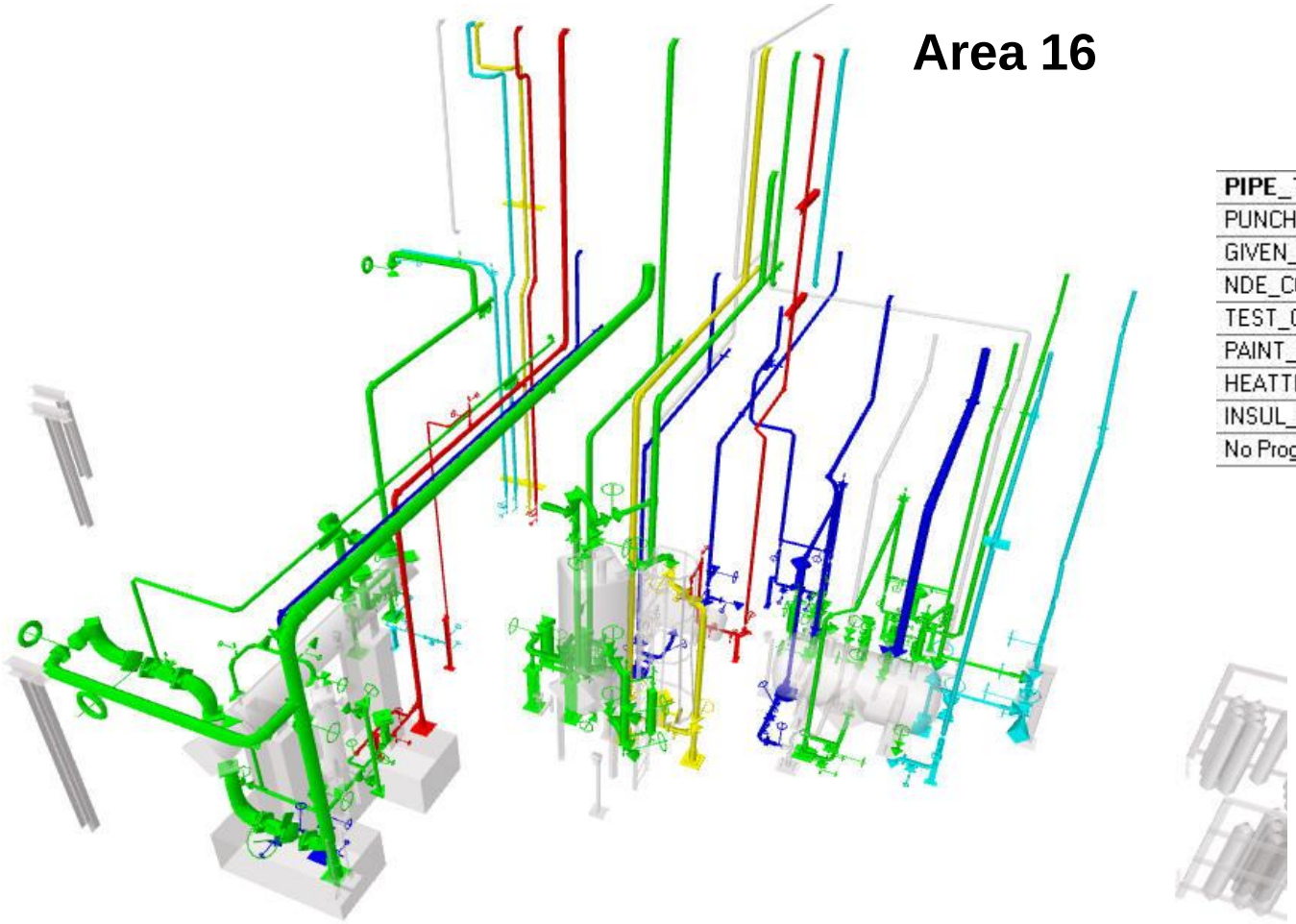
Status Visualization – Test Status



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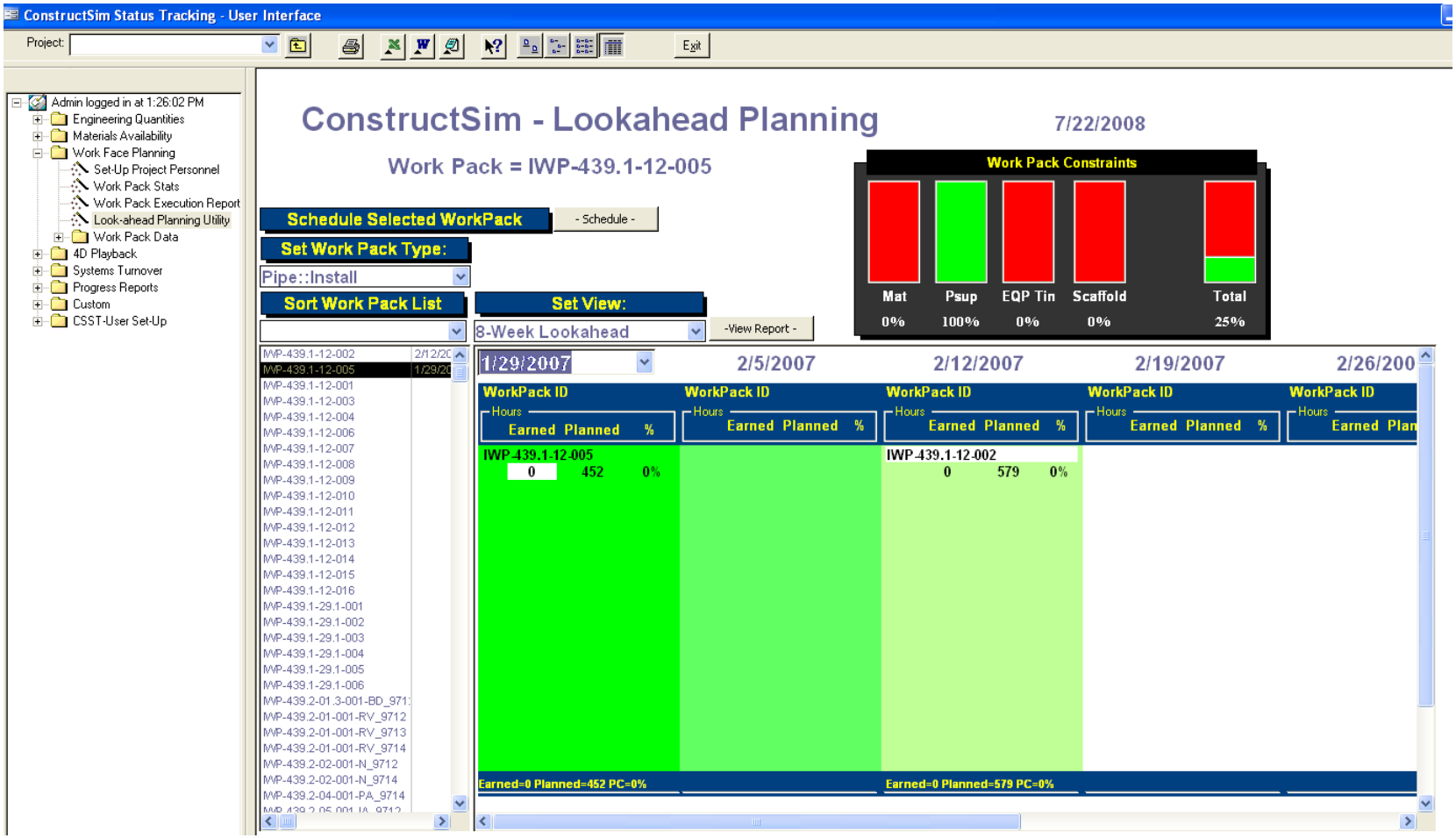
Look-Ahead Planning



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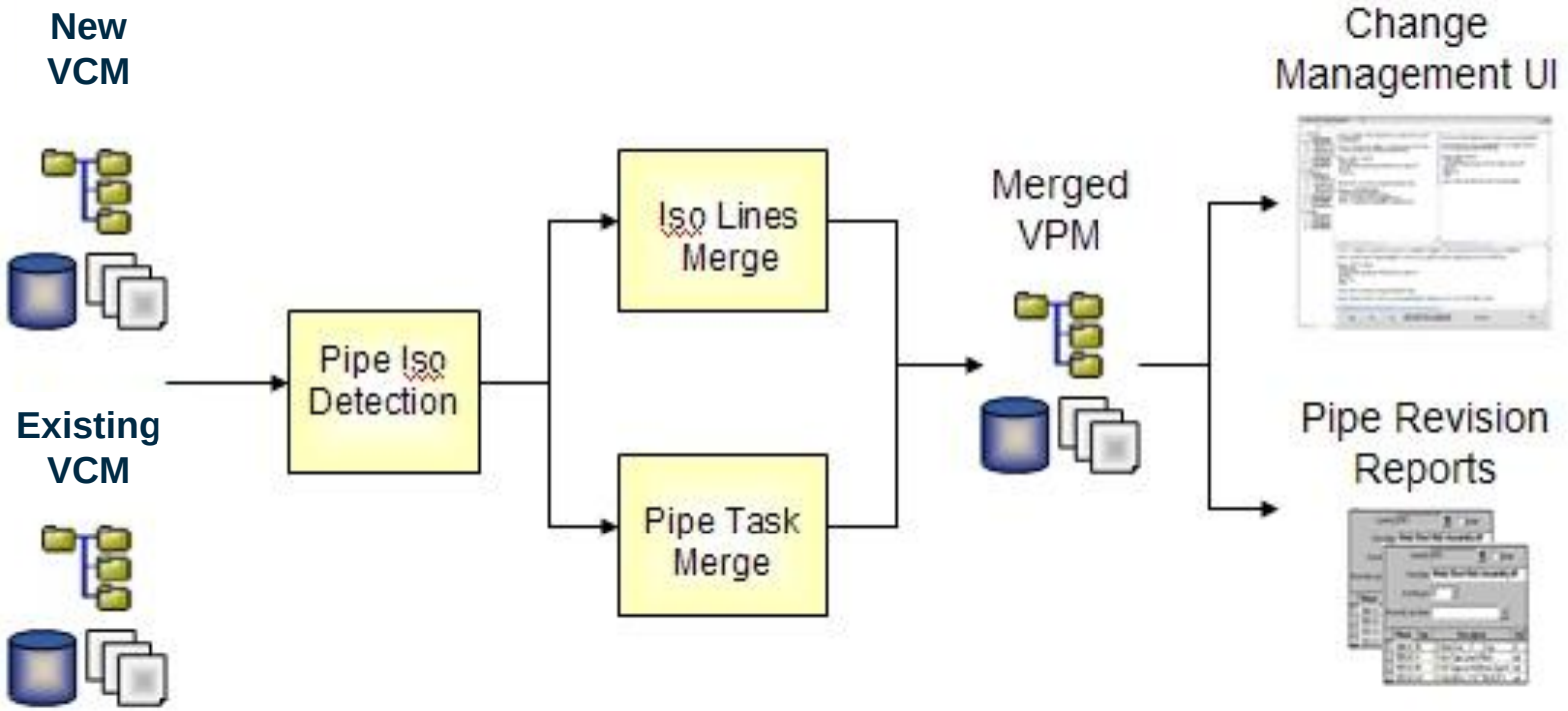
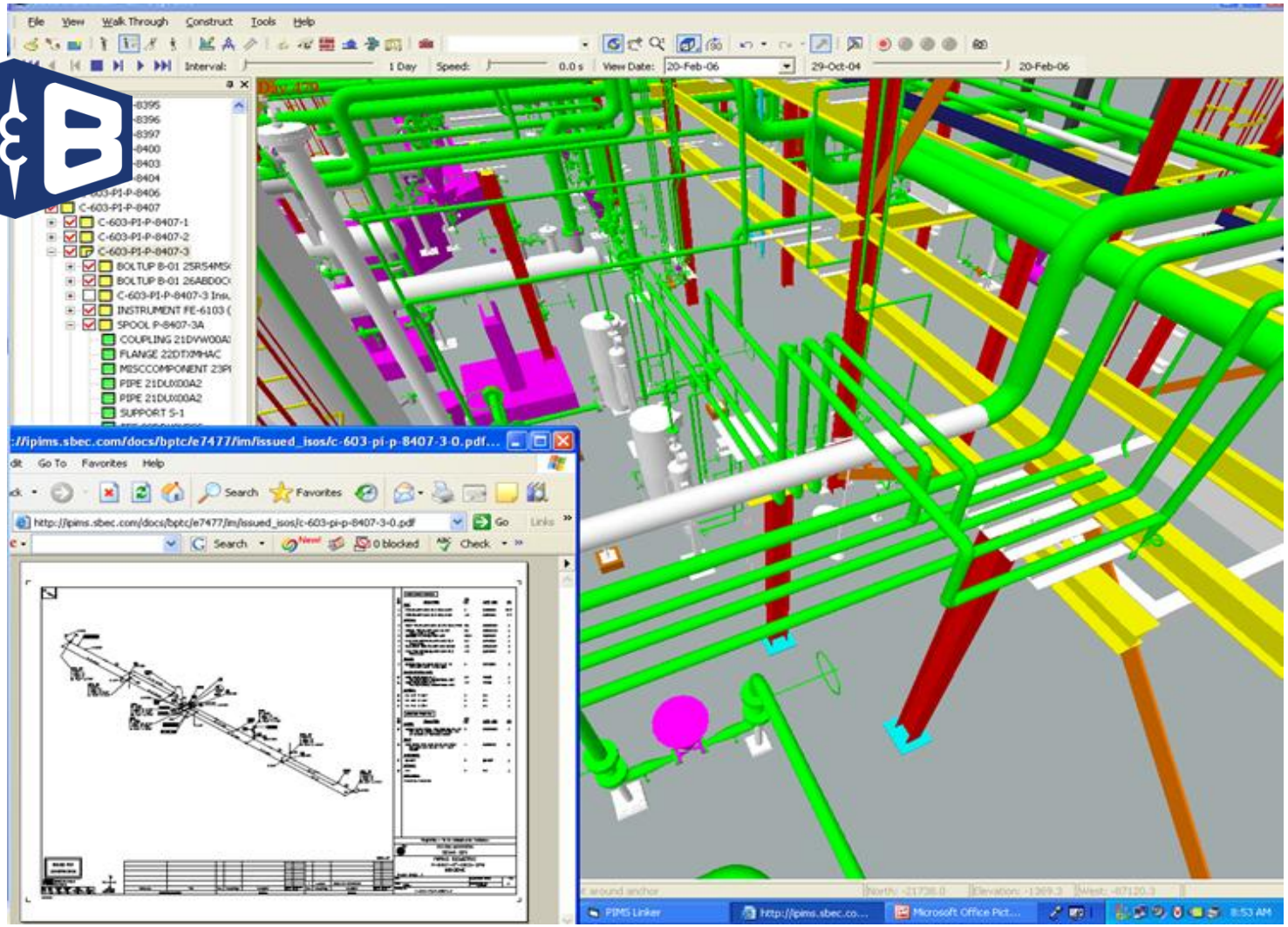
Bentley Sustaining Infrastructure

Change Management

ConstructSim keeps track of the changes in pipe isometrics and propagates the changes throughout the Virtual Construction Model



Document Linker



Bentley Sustaining Infrastructure

Progress Reports

Pipe Progress Tracking By Area

ConstructSim - Pipe Progress By Area

1/17/2006

ConstructSim

Drop Filter Fields Here

Drop Column Fields Here

AREA	Matl	Size	LF-Bdgt	LF-Earn	Welds-Bdgt	Welds-Earn	BoltUp-Bdgt	BoltUp-Earn	Supp-Bdgt	Supp-Earn	Valve-Bdgt	Valve-Earn	SpItem-Bdgt	SpItem-Earn	Instr-Bdgt	Instr-Earn	Bdgt-Hrs	Earn-Hrs
⊟01A	⊞(Blank)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
	⊞CS		4,672.00	3,869.51	516.00	457.40	563.00	442.70	227.00	198.03	24.00	21.90	0.00	0.00	13.00	11.80	7835.18	6,706.25
	⊞SS		549.00	490.90	256.00	230.40	47.00	39.60	42.00	24.30	0.00	0.00	0.00	0.00	0.00	0.00	1594.568	1,361.60
	Total		*5,221.00*	*4,360.41*	*772.00*	*687.80*	*610.00*	*482.30*	*269.00*	*222.33*	*24.00*	*21.90*	*0.00*	*0.00*	*13.00*	*11.80*	*9429.748*	*8,067.86*
⊞02A			3,248.00	974.60	675.00	252.10	407.00	39.60	137.00	9.90	14.00	0.00	1.00	0.00	32.00	6.30	5859.222	1,443.06
⊞02B			2,071.00	1,451.80	1,124.00	831.60	592.00	335.30	136.00	67.70	34.00	20.70	0.00	0.00	11.00	8.10	6175.871	4,417.29
⊞03A			1,923.00	1,043.80	797.00	232.20	339.00	157.80	111.00	42.60	19.00	2.70	0.00	0.00	5.00	2.80	5170.759	2,106.60
⊞03B			2,703.00	1,304.31	750.00	192.00	393.00	135.30	88.00	44.10	31.00	10.10	0.00	0.00	12.00	5.60	4844.726	2,217.65
⊞03C			3,914.00	1,704.60	918.00	373.50	420.00	183.60	161.00	70.20	43.00	17.10	1.00	0.00	13.00	4.50	7018.475	3,286.24
⊞04A			6,163.00	4,462.30	588.00	514.80	1,056.00	662.40	237.00	187.20	46.00	36.90	19.00	10.80	12.00	6.30	10188.762	7,929.86
⊞04B			2,574.00	1,683.90	196.00	164.70	406.00	354.60	143.00	99.00	24.00	21.60	7.00	6.30	3.00	1.80	4372.483	3,015.67
⊞04C			2,783.00	1,564.90	222.00	151.20	452.00	297.00	144.00	68.40	24.00	13.50	7.00	4.50	3.00	1.80	4654.137	2,622.26
⊞04D			2,804.00	1,605.30	200.00	123.30	342.00	162.00	136.00	59.40	20.00	8.10	5.00	0.90	3.00	0.00	4537.145	2,484.25
⊞04E			753.00	621.70	146.00	131.40	49.00	44.10	52.00	46.80	18.00	16.20	0.00	0.00	3.00	0.90	1391.979	1,244.36
⊞04F			5,218.00	4,129.60	929.00	823.90	373.00	285.00	417.00	217.20	20.00	18.30	6.00	5.40	7.00	4.50	10089.007	7,884.35
⊞04G			1,388.00	1,170.80	118.00	106.20	264.00	237.60	30.00	25.20	11.00	9.90	4.00	3.60	1.00	0.90	2103.347	1,818.14
⊞05A			16,932.00	13,800.70	3,900.00	2,939.50	1,433.00	1,108.00	1,160.00	832.40	70.00	57.00	0.00	0.00	7.00	6.30	35992.431	28,187.92
⊞06A			3,030.00	2,448.40	295.00	252.40	518.00	503.00	127.00	113.20	40.00	38.90	2.00	2.00	10.00	8.90	4748.588	4,330.17
⊞06B			1,298.00	1,129.70	199.00	181.50	364.00	324.60	68.00	51.60	22.00	19.80	2.00	0.00	5.00	4.50	2501.447	2,173.56
⊞07A			3,920.00	2,288.60	1,116.00	779.70	956.00	700.50	173.00	117.70	31.00	21.80	5.00	2.00	11.00	8.30	7858.459	5,009.40
⊞07B			1,961.00	1,288.00	412.00	226.20	245.00	166.60	61.00	35.10	14.00	12.40	3.00	2.00	3.00	0.90	3417.825	2,271.66
⊞07C			2,840.00	2,462.80	314.00	286.40	489.00	451.70	118.00	103.90	30.00	27.90	7.00	6.30	8.00	6.60	4970.018	4,370.65
⊞08A			2,287.00	2,133.80	131.00	122.90	250.00	244.60	115.00	109.60	23.00	22.40	2.00	2.00	5.00	4.80	3845.625	3,613.22
⊞08B			1,739.00	1,668.20	192.00	187.50	282.00	276.60	77.00	74.90	21.00	20.50	1.00	0.90	7.00	6.90	3033.407	2,926.49
⊞08C			3,694.00	3,499.10	582.00	555.60	654.00	636.80	148.00	140.20	38.00	37.10	9.00	8.70	11.00	10.60	6602.699	6,275.63
⊞09A			3,231.00	2,838.50	462.00	394.80	883.00	809.70	174.00	158.10	55.00	50.00	4.00	3.70	20.00	18.10	5934.656	5,512.81
⊞09B			2,975.00	2,453.90	457.00	412.50	333.00	304.20	82.00	72.60	28.00	26.00	0.00	0.00	11.00	9.90	4767.925	4,311.47
⊞10A			4,335.00	3,014.90	393.00	329.20	603.00	523.20	157.00	118.40	31.00	27.60	3.00	2.90	13.00	10.80	6239.189	5,078.62
⊞11A			703.00	633.30	102.00	91.80	0.00	0.00	55.00	49.50	0.00	0.00	0.00	0.00	0.00	0.00	1298.68	1,169.62
Grand Total																		

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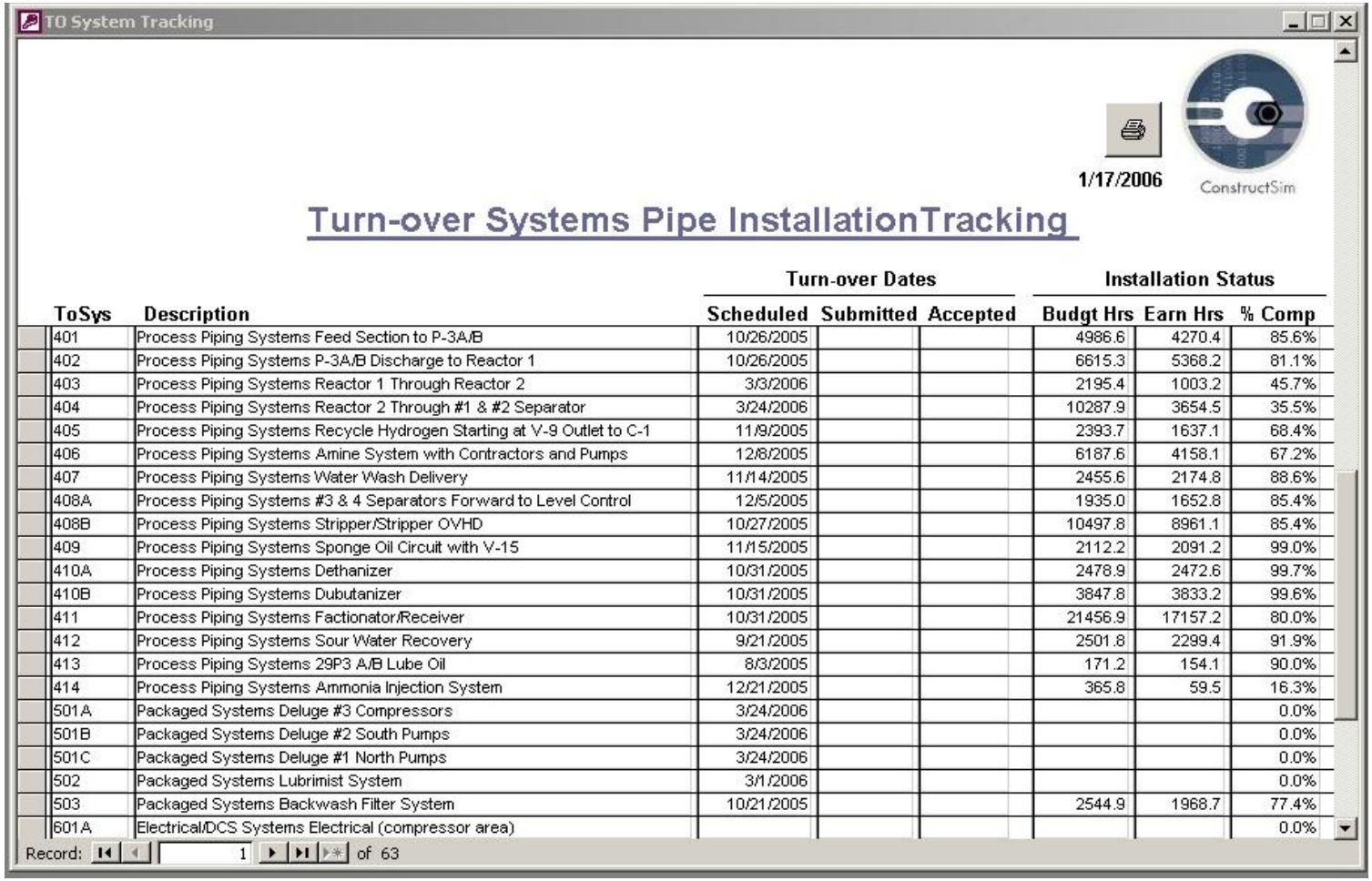
Bentley Sustaining Infrastructure

Progress Reports



Turn-over Systems Pipe InstallationTracking

			Turn-over Dates			Installation Status		
	ToSys	Description	Scheduled	Submitted	Accepted	Budgt Hrs	Earn Hrs	% Comp
	401	Process Piping Systems Feed Section to P-3A/B	10/26/2005			4986.6	4270.4	85.6%
	402	Process Piping Systems P-3A/B Discharge to Reactor 1	10/26/2005			6615.3	5368.2	81.1%
	403	Process Piping Systems Reactor 1 Through Reactor 2	3/3/2006			2195.4	1003.2	45.7%
	404	Process Piping Systems Reactor 2 Through #1 & #2 Separator	3/24/2006			10287.9	3654.5	35.5%
	405	Process Piping Systems Recycle Hydrogen Starting at V-9 Outlet to C-1	11/9/2005			2393.7	1637.1	68.4%
	406	Process Piping Systems Amine System with Contractors and Pumps	12/8/2005			6187.6	4158.1	67.2%
	407	Process Piping Systems Water Wash Delivery	11/14/2005			2455.6	2174.8	88.6%
	408A	Process Piping Systems #3 & 4 Separators Forward to Level Control	12/5/2005			1935.0	1652.8	85.4%
	408B	Process Piping Systems Stripper/Stripper OVHD	10/27/2005			10497.8	8961.1	85.4%
	409	Process Piping Systems Sponge Oil Circuit with V-15	11/15/2005			2112.2	2091.2	99.0%
	410A	Process Piping Systems Dethanizer	10/31/2005			2478.9	2472.6	99.7%
	410B	Process Piping Systems Dubutanizer	10/31/2005			3847.8	3833.2	99.6%
	411	Process Piping Systems Factionator/Receiver	10/31/2005			21456.9	17157.2	80.0%
	412	Process Piping Systems Sour Water Recovery	9/21/2005			2501.8	2299.4	91.9%
	413	Process Piping Systems 29P3 A/B Lube Oil	8/3/2005			171.2	154.1	90.0%
	414	Process Piping Systems Ammonia Injection System	12/21/2005			365.8	59.5	16.3%
	501A	Packaged Systems Deluge #3 Compressors	3/24/2006					0.0%
	501B	Packaged Systems Deluge #2 South Pumps	3/24/2006					0.0%
	501C	Packaged Systems Deluge #1 North Pumps	3/24/2006					0.0%
	502	Packaged Systems Lubrimist System	3/1/2006					0.0%
	503	Packaged Systems Backwash Filter System	10/21/2005			2544.9	1968.7	77.4%
	601A	Electrical/DCS Systems Electrical (compressor area)						0.0%

Record: 1 of 63

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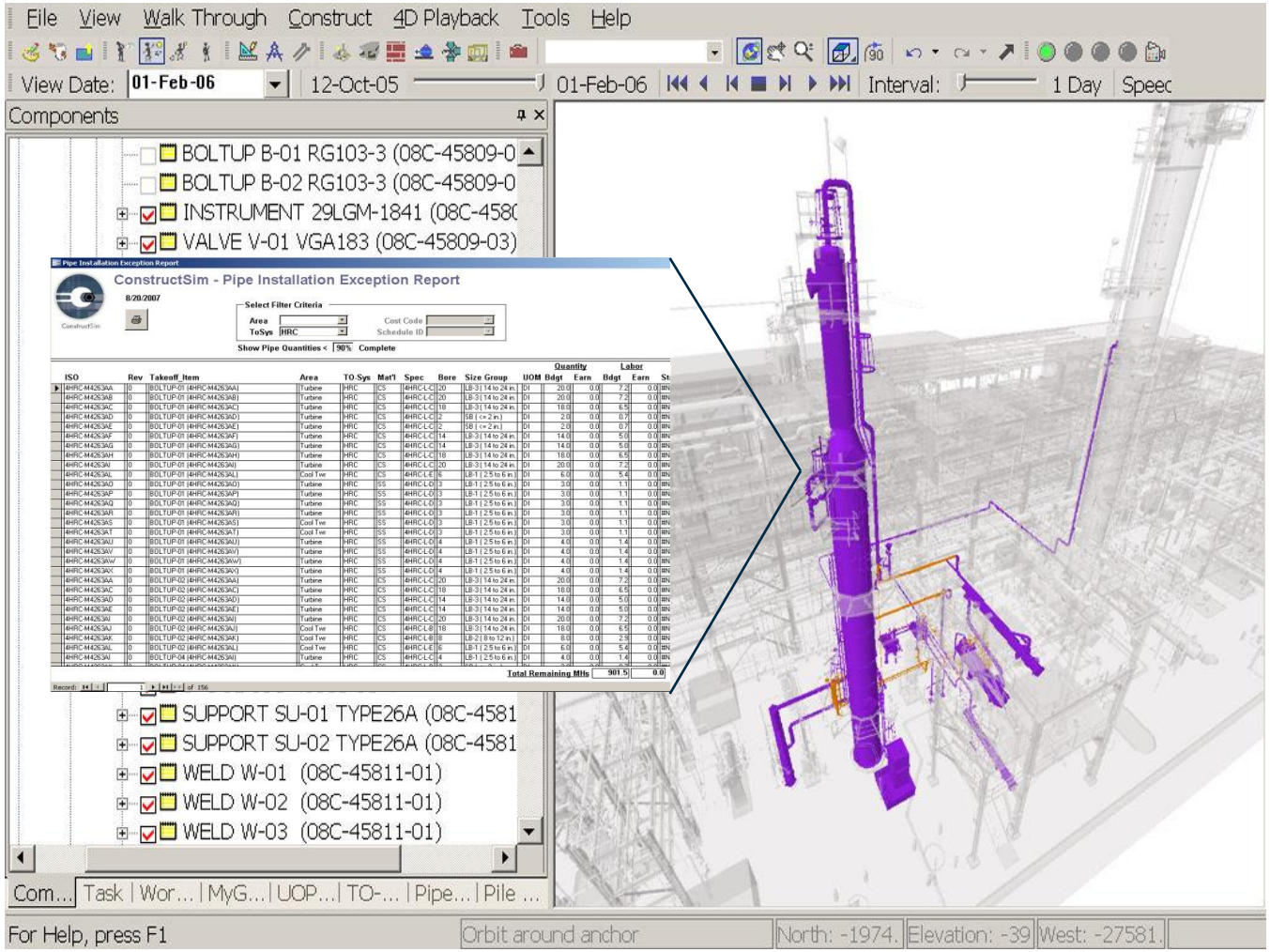
Systems Turnover



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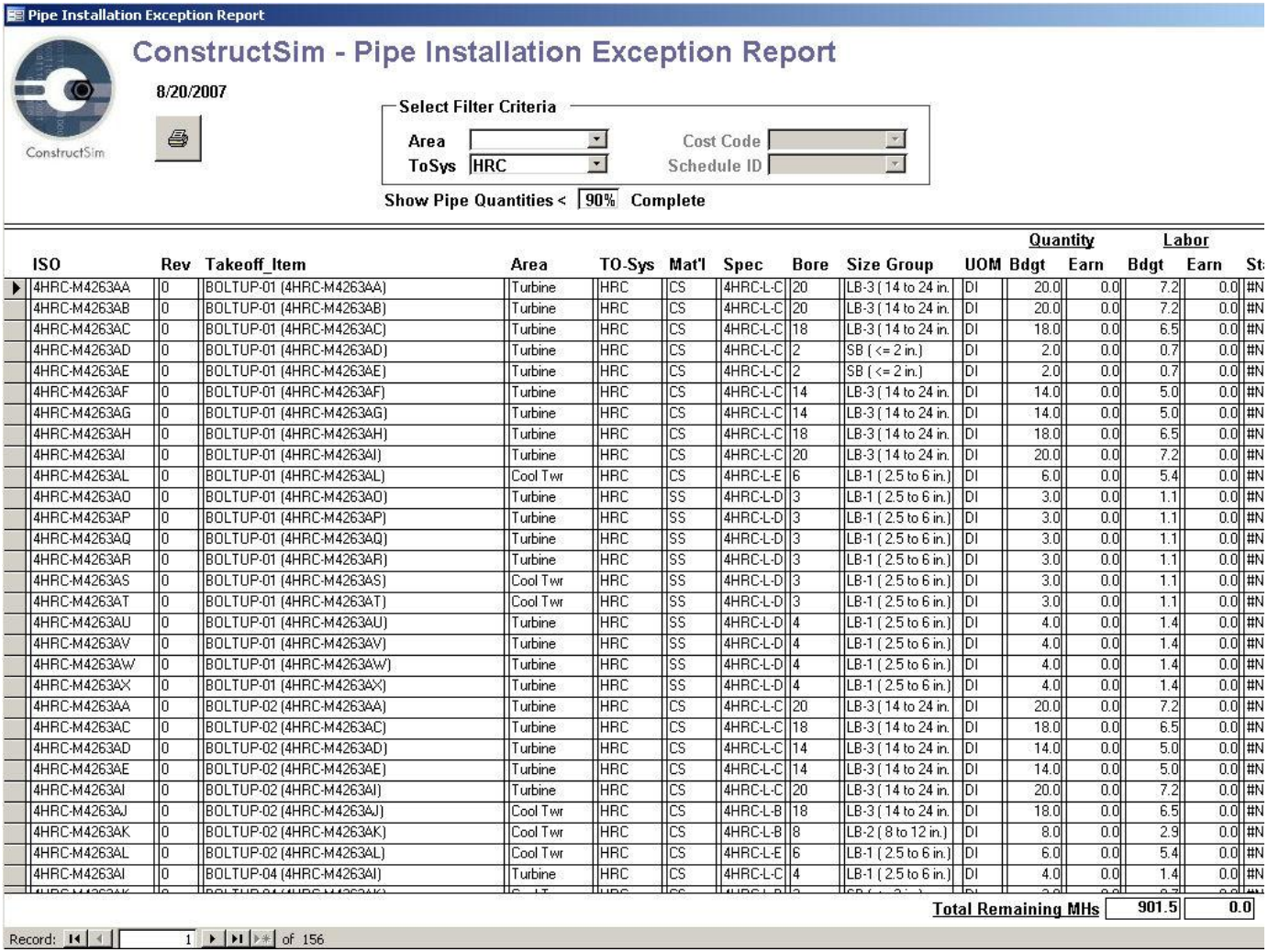
Systems Turnover – Incomplete Work



Pipe Installation Exception Report

ConstructSim - Pipe Installation Exception Report

8/20/2007

Select Filter Criteria

Area: | Cost Code:
ToSys: HRC | Schedule ID:

Show Pipe Quantities < 90% Complete

										Quantity		Labor		
ISO	Rev	Takeoff_Item	Area	TO-Sys	Mat'l	Spec	Bore	Size Group	UOM	Bdgt	Earn	Bdgt	Earn	St
4HRC-M4263AA	0	BOLTUP-01 (4HRC-M4263AA)	Turbine	HRC	CS	4HRC-L-C	20	LB-3 (14 to 24 in.	DI	20.0	0.0	7.2	0.0	#N
4HRC-M4263AB	0	BOLTUP-01 (4HRC-M4263AB)	Turbine	HRC	CS	4HRC-L-C	20	LB-3 (14 to 24 in.	DI	20.0	0.0	7.2	0.0	#N
4HRC-M4263AC	0	BOLTUP-01 (4HRC-M4263AC)	Turbine	HRC	CS	4HRC-L-C	18	LB-3 (14 to 24 in.	DI	18.0	0.0	6.5	0.0	#N
4HRC-M4263AD	0	BOLTUP-01 (4HRC-M4263AD)	Turbine	HRC	CS	4HRC-L-C	2	SB (<= 2 in.)	DI	2.0	0.0	0.7	0.0	#N
4HRC-M4263AE	0	BOLTUP-01 (4HRC-M4263AE)	Turbine	HRC	CS	4HRC-L-C	2	SB (<= 2 in.)	DI	2.0	0.0	0.7	0.0	#N
4HRC-M4263AF	0	BOLTUP-01 (4HRC-M4263AF)	Turbine	HRC	CS	4HRC-L-C	14	LB-3 (14 to 24 in.	DI	14.0	0.0	5.0	0.0	#N
4HRC-M4263AG	0	BOLTUP-01 (4HRC-M4263AG)	Turbine	HRC	CS	4HRC-L-C	14	LB-3 (14 to 24 in.	DI	14.0	0.0	5.0	0.0	#N
4HRC-M4263AH	0	BOLTUP-01 (4HRC-M4263AH)	Turbine	HRC	CS	4HRC-L-C	18	LB-3 (14 to 24 in.	DI	18.0	0.0	6.5	0.0	#N
4HRC-M4263AI	0	BOLTUP-01 (4HRC-M4263AI)	Turbine	HRC	CS	4HRC-L-C	20	LB-3 (14 to 24 in.	DI	20.0	0.0	7.2	0.0	#N
4HRC-M4263AL	0	BOLTUP-01 (4HRC-M4263AL)	Cool Twr	HRC	CS	4HRC-L-E	6	LB-1 (2.5 to 6 in.)	DI	6.0	0.0	5.4	0.0	#N
4HRC-M4263AO	0	BOLTUP-01 (4HRC-M4263AO)	Turbine	HRC	SS	4HRC-L-D	3	LB-1 (2.5 to 6 in.)	DI	3.0	0.0	1.1	0.0	#N
4HRC-M4263AP	0	BOLTUP-01 (4HRC-M4263AP)	Turbine	HRC	SS	4HRC-L-D	3	LB-1 (2.5 to 6 in.)	DI	3.0	0.0	1.1	0.0	#N
4HRC-M4263AQ	0	BOLTUP-01 (4HRC-M4263AQ)	Turbine	HRC	SS	4HRC-L-D	3	LB-1 (2.5 to 6 in.)	DI	3.0	0.0	1.1	0.0	#N
4HRC-M4263AR	0	BOLTUP-01 (4HRC-M4263AR)	Turbine	HRC	SS	4HRC-L-D	3	LB-1 (2.5 to 6 in.)	DI	3.0	0.0	1.1	0.0	#N
4HRC-M4263AS	0	BOLTUP-01 (4HRC-M4263AS)	Cool Twr	HRC	SS	4HRC-L-D	3	LB-1 (2.5 to 6 in.)	DI	3.0	0.0	1.1	0.0	#N
4HRC-M4263AT	0	BOLTUP-01 (4HRC-M4263AT)	Cool Twr	HRC	SS	4HRC-L-D	3	LB-1 (2.5 to 6 in.)	DI	3.0	0.0	1.1	0.0	#N
4HRC-M4263AU	0	BOLTUP-01 (4HRC-M4263AU)	Turbine	HRC	SS	4HRC-L-D	4	LB-1 (2.5 to 6 in.)	DI	4.0	0.0	1.4	0.0	#N
4HRC-M4263AV	0	BOLTUP-01 (4HRC-M4263AV)	Turbine	HRC	SS	4HRC-L-D	4	LB-1 (2.5 to 6 in.)	DI	4.0	0.0	1.4	0.0	#N
4HRC-M4263AW	0	BOLTUP-01 (4HRC-M4263AW)	Turbine	HRC	SS	4HRC-L-D	4	LB-1 (2.5 to 6 in.)	DI	4.0	0.0	1.4	0.0	#N
4HRC-M4263AX	0	BOLTUP-01 (4HRC-M4263AX)	Turbine	HRC	SS	4HRC-L-D	4	LB-1 (2.5 to 6 in.)	DI	4.0	0.0	1.4	0.0	#N
4HRC-M4263AA	0	BOLTUP-02 (4HRC-M4263AA)	Turbine	HRC	CS	4HRC-L-C	20	LB-3 (14 to 24 in.	DI	20.0	0.0	7.2	0.0	#N
4HRC-M4263AC	0	BOLTUP-02 (4HRC-M4263AC)	Turbine	HRC	CS	4HRC-L-C	18	LB-3 (14 to 24 in.	DI	18.0	0.0	6.5	0.0	#N
4HRC-M4263AD	0	BOLTUP-02 (4HRC-M4263AD)	Turbine	HRC	CS	4HRC-L-C	14	LB-3 (14 to 24 in.	DI	14.0	0.0	5.0	0.0	#N
4HRC-M4263AE	0	BOLTUP-02 (4HRC-M4263AE)	Turbine	HRC	CS	4HRC-L-C	14	LB-3 (14 to 24 in.	DI	14.0	0.0	5.0	0.0	#N
4HRC-M4263AI	0	BOLTUP-02 (4HRC-M4263AI)	Turbine	HRC	CS	4HRC-L-C	20	LB-3 (14 to 24 in.	DI	20.0	0.0	7.2	0.0	#N
4HRC-M4263AJ	0	BOLTUP-02 (4HRC-M4263AJ)	Cool Twr	HRC	CS	4HRC-L-B	18	LB-3 (14 to 24 in.	DI	18.0	0.0	6.5	0.0	#N
4HRC-M4263AK	0	BOLTUP-02 (4HRC-M4263AK)	Cool Twr	HRC	CS	4HRC-L-B	8	LB-2 (8 to 12 in.)	DI	8.0	0.0	2.9	0.0	#N
4HRC-M4263AL	0	BOLTUP-02 (4HRC-M4263AL)	Cool Twr	HRC	CS	4HRC-L-E	6	LB-1 (2.5 to 6 in.)	DI	6.0	0.0	5.4	0.0	#N
4HRC-M4263AI	0	BOLTUP-04 (4HRC-M4263AI)	Turbine	HRC	CS	4HRC-L-C	4	LB-1 (2.5 to 6 in.)	DI	4.0	0.0	1.4	0.0	#N

Total Remaining MHs: 901.5 | 0.0

Record: 1 of 156

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Bentley Sustaining Infrastructure

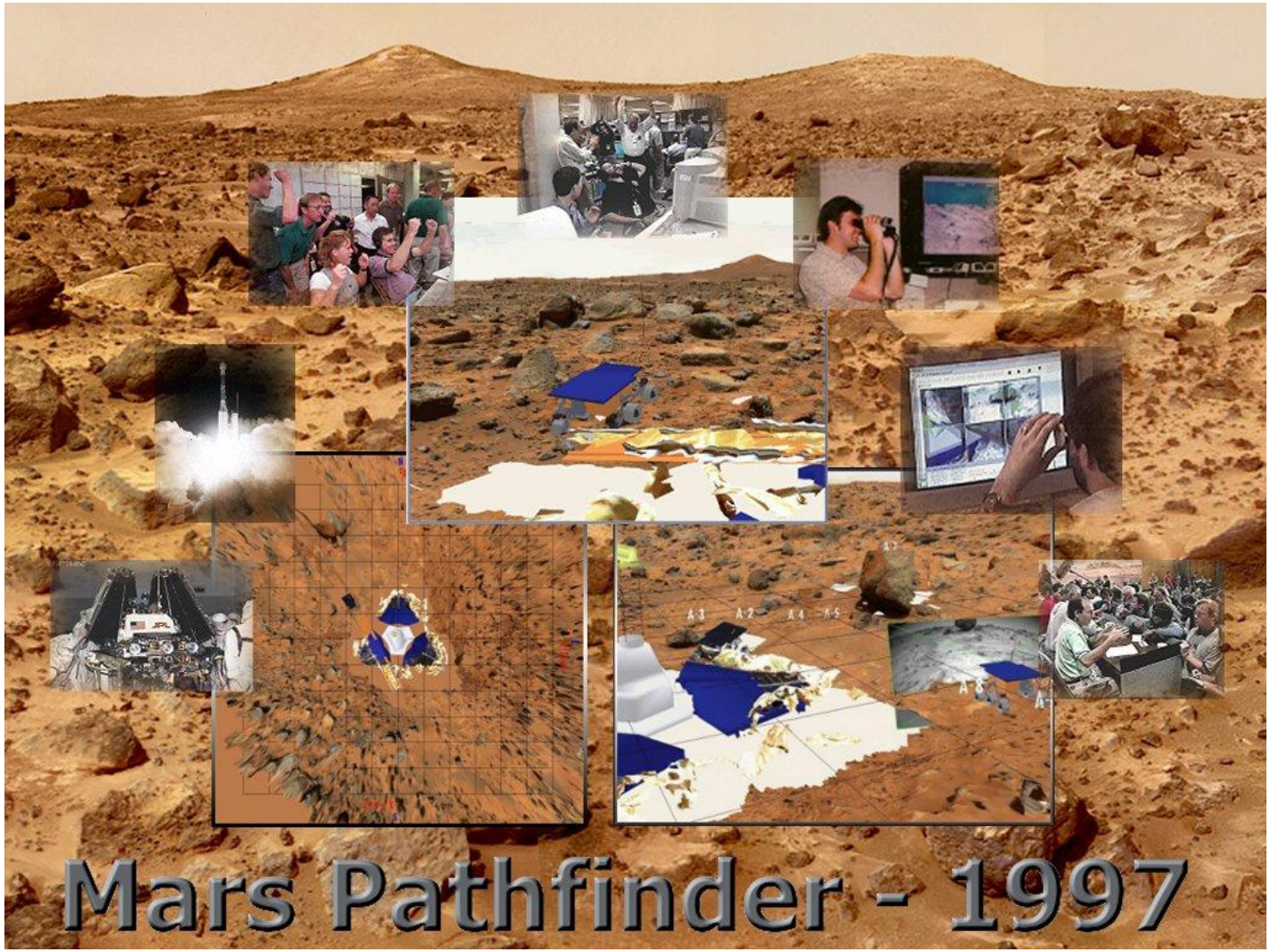
Work Process Topics

- Engineering Inputs
- Path of Construction
- Work Pack Development
- Sub-contractor coordination
- Lookahead Planning
- Equipment Planning & Tracking
- Shop Fabrication – Modular Construction
- Streamline Materials
- Progressing & Reporting
- Revision Management
- Turnover Systems
- Revision Analysis

Construction Driven Engineering

- **Pull Driven Scheduling**
  - Prioritization / monitoring of engineering & fabrication
- **Defining data requirements**
  - Engineering to construction handovers
  - Specifications
  - Contractual Terms
- **Technology Approach**
  - Federated Information Workflows

NASA Heritage



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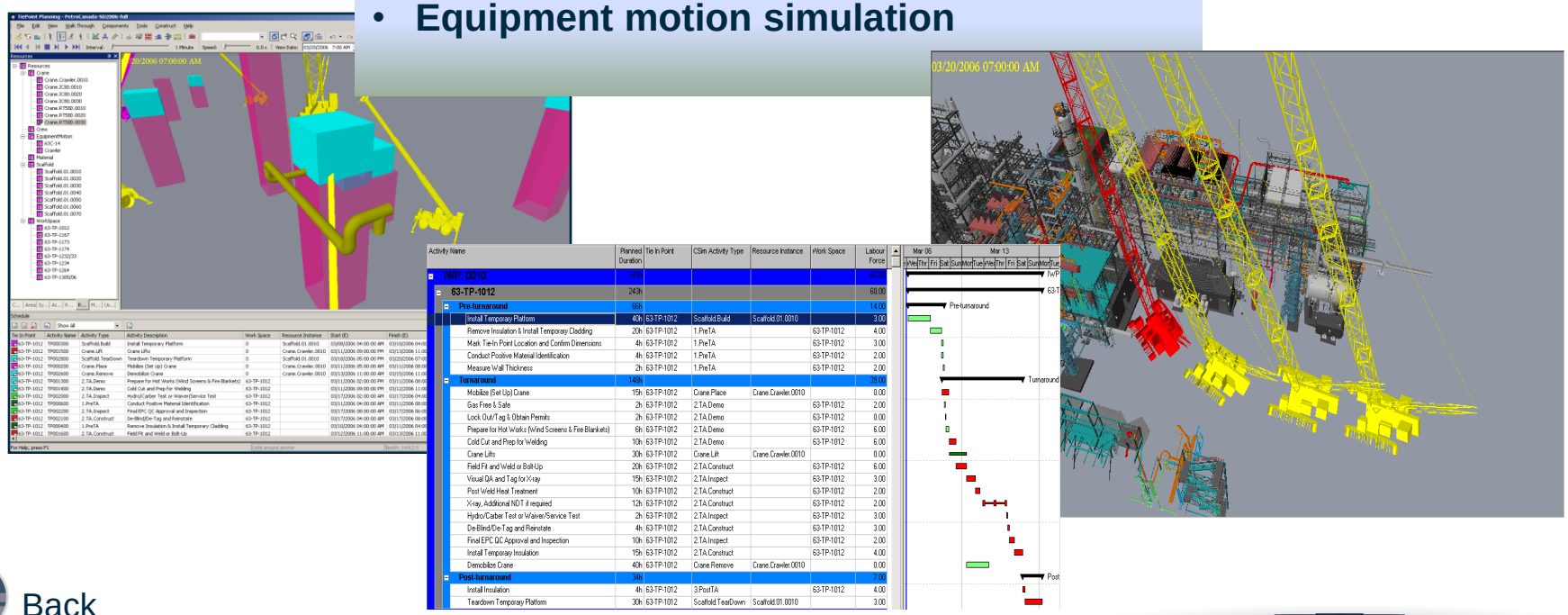
Beta - Scaffold / Crane Resource Module

- Dynamic link to P3E
- Automated link to Tie-in List (XLS format)
- User specifies placement of
  - Cranes
  - Scaffold / Temp Work Platforms
  - Crew workspaces
- Crew Density Analysis
- Equipment motion simulation



Activity Name	Planned Duration	Tie In Point	CSim Activity Type	Resource Instance	Work Space	Labour Force
IWP: 0010	240h					60.00
63-TP-1012	240h					60.00
Pre-turnaround	60h					14.00
Install Temporary Platform	40h	63-TP-1012	Scaffold Build	Scaffold.01.0010		3.00
Remove Insulation & Install Temporary Cladding	20h	63-TP-1012	1.PreTA		63-TP-1012	4.00
Mark Tie-In Point Location and Confirm Dimensions	4h	63-TP-1012	1.PreTA		63-TP-1012	3.00
Conduct Positive Material Identification	4h	63-TP-1012	1.PreTA		63-TP-1012	2.00
Measure Wall Thickness	2h	63-TP-1012	1.PreTA		63-TP-1012	2.00
Turnaround	140h					39.00
Mobilize (Set Up) Crane	15h	63-TP-1012	Crane Place	Crane.Crawler.0010		0.00
Gas Free & Safe	2h	63-TP-1012	2.TA Demo		63-TP-1012	2.00
Lock Out/Tag & Obtain Permits	2h	63-TP-1012	2.TA Demo		63-TP-1012	0.00
Prepare for Hot Works (Wind Screens & Fire Blankets)	6h	63-TP-1012	2.TA Demo		63-TP-1012	6.00
Cold Cut and Prep for Welding	10h	63-TP-1012	2.TA Demo		63-TP-1012	6.00
Crane Lifts	30h	63-TP-1012	Crane Lift	Crane.Crawler.0010		0.00
Field Fit and Weld or Bolt-Up	20h	63-TP-1012	2.TA Construct		63-TP-1012	6.00
Visual QA and Tag for X-ray	15h	63-TP-1012	2.TA Inspect		63-TP-1012	3.00
Post Weld Heat Treatment	10h	63-TP-1012	2.TA Construct		63-TP-1012	2.00
X-ray, Additional NDT if required	12h	63-TP-1012	2.TA Construct		63-TP-1012	2.00
Hydro/Caiber Test or Waiver/Service Test	2h	63-TP-1012	2.TA Inspect		63-TP-1012	3.00
De-Blind/De-Tag and Reinstate	4h	63-TP-1012	2.TA Construct		63-TP-1012	3.00
Final EPC QC Approval and Inspection	10h	63-TP-1012	2.TA Inspect		63-TP-1012	2.00
Install Temporary Insulation	15h	63-TP-1012	2.TA Construct		63-TP-1012	4.00
Demobilize Crane	40h	63-TP-1012	Crane Remove	Crane.Crawler.0010		0.00
Post-turnaround	34h					7.00
Install Insulation	4h	63-TP-1012	3.PostTA		63-TP-1012	4.00
Teardown Temporary Platform	30h	63-TP-1012	Scaffold.TeaDown	Scaffold.01.0010		3.00

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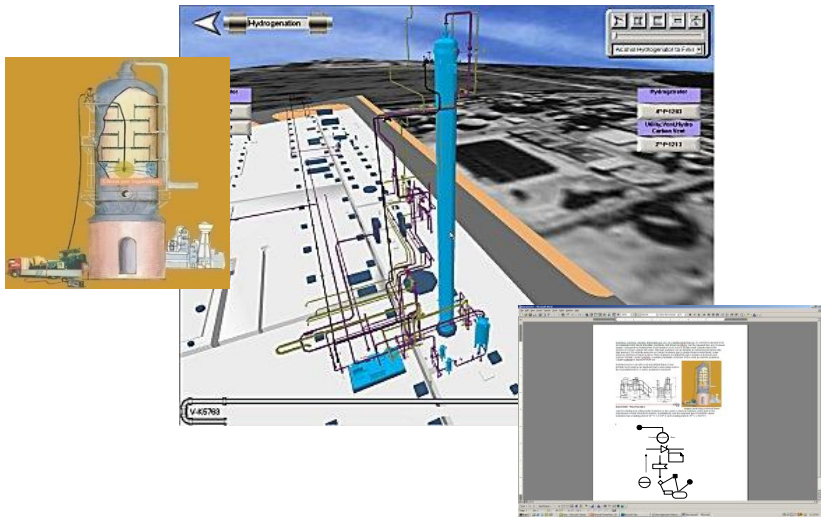
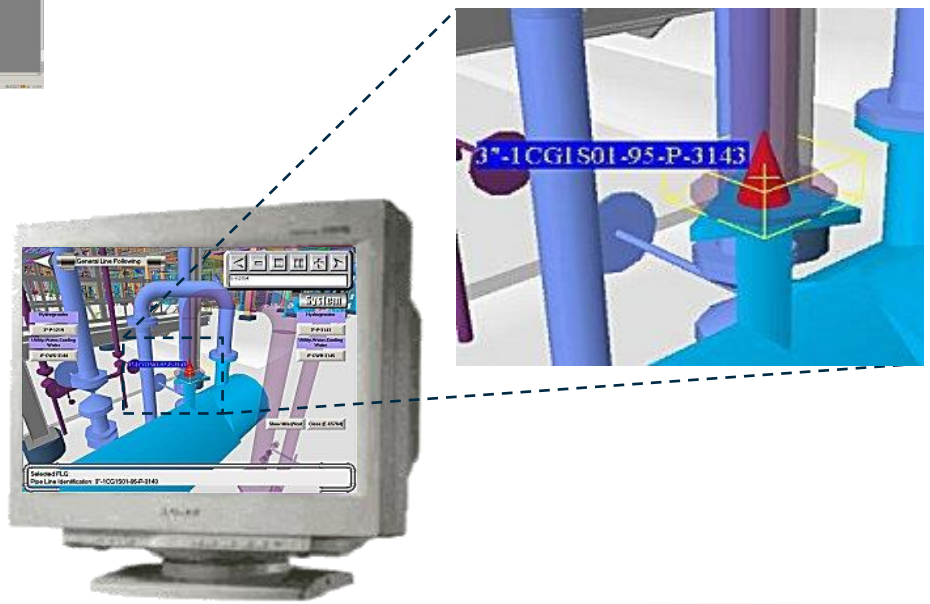
OpSim Insight



- Perform systems analysis and training in a virtual model
- Drive the Virtual Model from PowerPoint training slides
- Capture operator knowledge and experience digitally in the virtual model

Enable a better trained workforce in a safer work environment.



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CONSTRUCTION OWNERS ASSOCIATION of ALBERTA

WORKFACE PLANNING CONFERENCE
WFP IS MAKING IT HAPPEN

Glenmore Inn Hotel and Convention Centre
Calgary, Alberta - November 17-18, 2009

PROJECT PLANNING – A CASE STUDY

Wayne Cusitar, P.Eng., MBA

INTRODUCTION

- **This presentation is generic and at a high level, in order to present *"Project Planning"* as a topic and to introduce fresh perspectives.**

- **The opinions expressed are those of the Author:**
  - ***Reflecting > 40 years of personal project execution experience;***
  - ***Spanning industrial settings including Oil Sands, Oil & Gas, Production of Fertilizers, Mining & Mining Plants and Business Ownership;***
  - ***Arising from projects both small and large, including recent Alberta Oil Sands Mega-Projects;***
  - ***Arising from projects using and not using "COAA WFP Best Practice"***
  - ***The Author's insights were formed largely within the environment of Calgary's EPC(M) community.***

- **This Case Study presumes a (hypothetical) Alberta Oil Sands "Mining" mega-project.**

AUTHORITIES

The following authorities are acknowledged for "BEST PRACTICES" for construction project management:

1. ***Construction Industry Institute (CII): "Constructability Best Practice"***

2. ***Independent Project Analysis Inc. (IPA): "Unique competencies in quantitative timing of practices to business results".***

3. ***Construction Owners Association of Alberta (COAA): Best Practices.***

The Author also acknowledges the contributions of many mentors, associates and nurturing team environments for contributing to the insights presented herein.

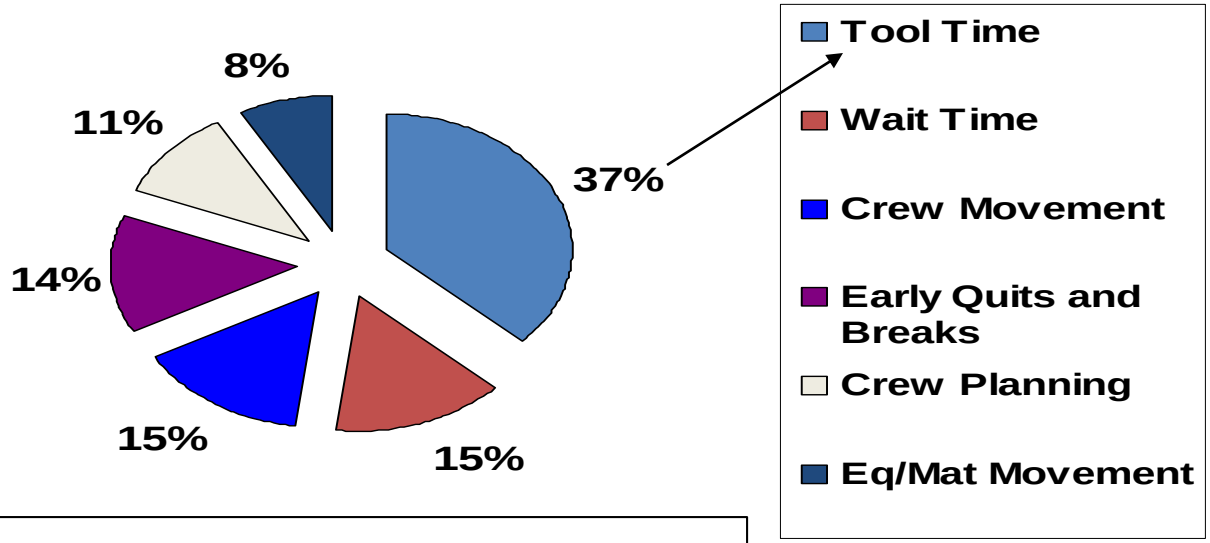
WE COULD DEFINE *"PROJECT PLANNING"* AS

The process of anticipating the sequential, time-sensitive needs of project stakeholders, to enable optimal allocations of inherently limited project resources, so as to satisfy stakeholder's needs in a timely and cost effective manner.

WHY IS A "PROJECT PLANNING" PERSPECTIVE NEEDED ?

(ref. COAA)

On a typical oil sands construction project, ~ 40% of the total cost is for direct craft labour. A COAA study has observed that on average only 37% of a normal working day is spent on productive work.



Productivity improvement will be a primary objective of "Project Planning".

WHAT BENEFITS CAN *"PROJECT PLANNING"* ACHIEVE ?

- **COAA** has researched the productivity losses due to "wait time" and other delays and estimated that up to 25% productivity gain could be achieved through more detailed execution planning i.e. 37% "Tool Time" could become ~ 43%;

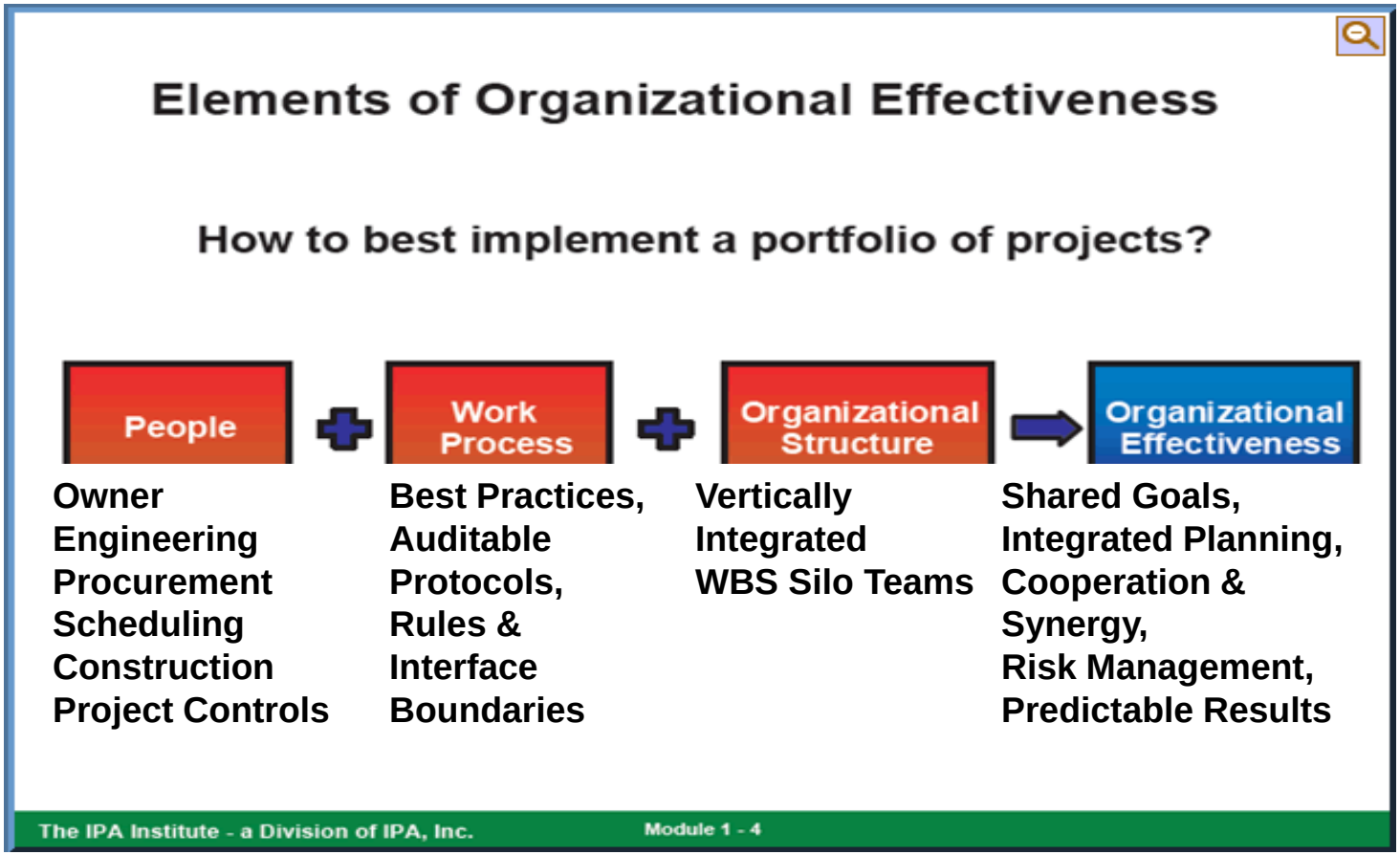
- By a corollary calculation, **COAA** estimated that a net 9% reduction in project "Total Installed Cost" (TIC) could accompany this improvement in "Tool Time";

- On a $5 billion project, the ***"net benefit would be $450 million".***

Also, better organization and planning leads to a SAFER working environment.

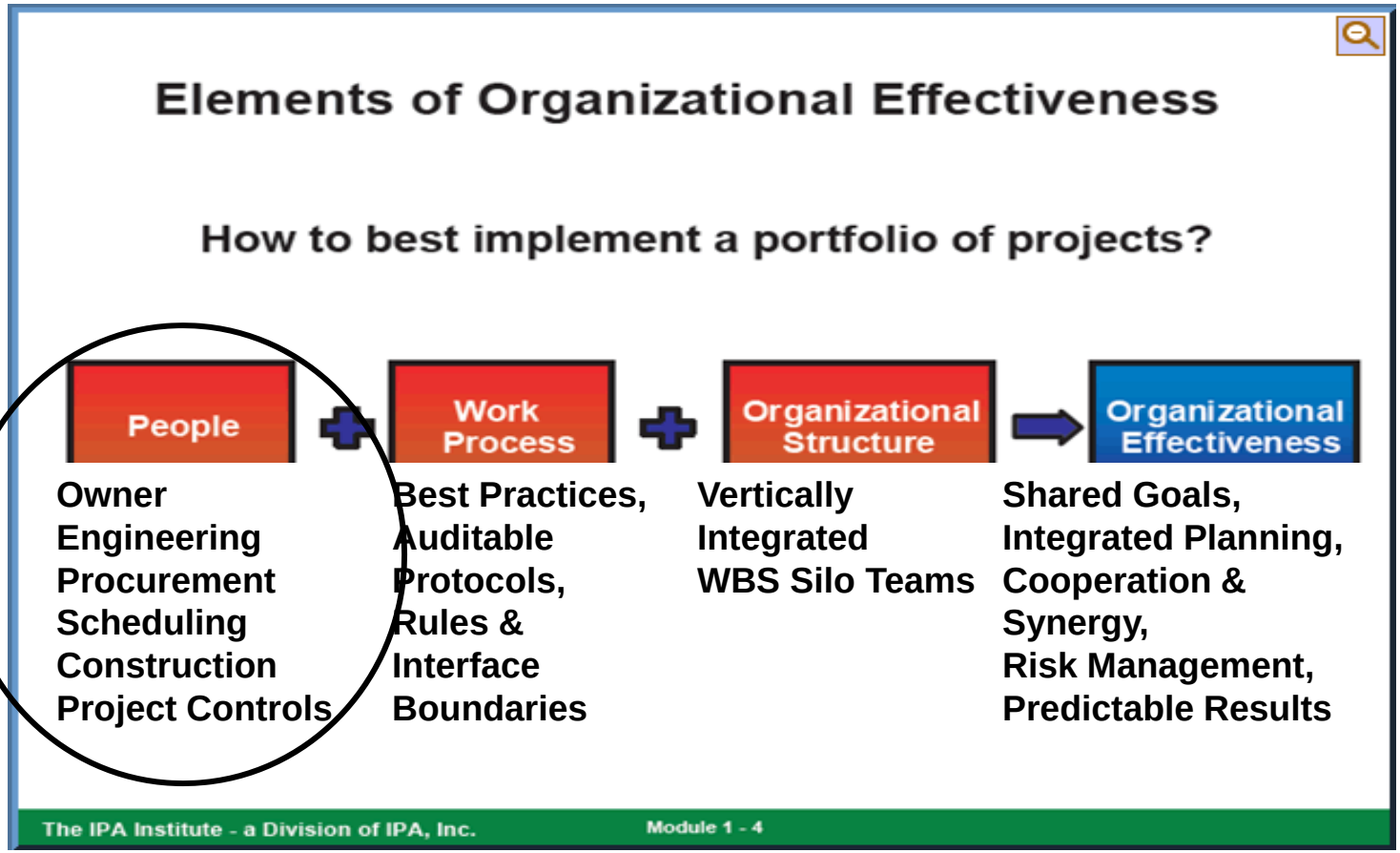
MODEL: EFFECTIVE ORGANIZATIONAL STRUCTURES (by IPA)

A MODEL FOR EFFECTIVE *"PROJECT PLANNING"* COULD BE ADAPTED AS SHOWN:



MODEL: EFFECTIVE ORGANIZATIONAL STRUCTURES (by IPA)

LET'S CONSIDER THE *"PEOPLE"* AND THEIR ROLES, FIRST.



-

PROJECT PLANNING **recognizes the interests, responsibilities and accountabilities of all *STAKEHOLDERS*:**

- **OWNER's Role**
  - CORPORATE / GOVERNMENT / POLICIES & STANDARDS / OIL SANDS MINE
  - CONTRACTING STRATEGY & THE ``GOLDEN PEN``
  - COMMUNITIES & PUBLIC RELATIONS
- **EPC(M) ENGINEER's Role**
  - ENGINEERING / PROJECT CONTROLS / SCHEDULES / CONSTRUCTION SUPPORT
- **PROCUREMENT's Role**
  - BID REQUESTS, P.O.s FOR MATERIALS & EQUIPMENT / CONTRACT ADMIN
  - QA / EXPEDITING, MTLS MGMNT
- **CONSTRUCTION's Role**
  - CONSTRUCTABILITY & EXECUTION PLANNING
  - CONSTRUCTION EXECUTION
  - PROGRESS & COST REPORTING

QUESTION: whose role is *"PROJECT PLANNING"* - in view of the need for Coordination / Integration / Conflict Resolution ?

- **Mine vs. Plant**
- **Owner vs. Engineer**
- **Owner vs. Constructors**
- **Engineer vs. Vendors**
- **Engineer vs. Constructors**
- **Constructor vs. Constructor**

PROJECT PLANNING** is a role of the **LEADERSHIP TEAM** and is a shared responsibility among all **STAKEHOLDERS.

WHOSE ROLE IS "*CONSTRUCTION PLANNING" ?*

- **Given the typical project phases and project timeline, it is difficult to obtain any direct constructability input before the Sanction Date:**

PROJECT TIMELINE

EPC PATH OF ENGINEERING
• CONCEPTUAL / DBM / EDS / DETAILED ENGINEERING & CONSTRUCTION SUPPORT…

PATH OF PROCUREMENT
* RFP… * RFQ * P.O.s & CONTRACTS / EXPEDITING / CHANGE ORDERS

PROJECT SANCTION DATE

CONSTRUCTION MANAGEMENT TEAM (CMT)
• DIRECT SUPERVISION / QUALITY ASSURANCE / CHANGE MANAGEMENT / MANAGE THE WFP PROCESS

GWC PATH OF CONSTRUCTION
• EARLY WORKS (PRE-SANCTION)
  • CONFIRM CONSTRUCTABILITY & CWP MAP
  • MOBILIZE MODULE YARD FABRICATION
  • MOBILIZE EQUIPMENT / TOOLS / TRADES / SITE ACCESS & LAYDOWN, SECURITY
  • CREATE & EXECUTE FIWPS

Suggest adding a *"CONSTRUCTION PLANNING TEAM (CPT)"* as a formal discipline within Engineering:

PROJECT TIMELINE

EPC PATH OF ENGINEERING & PROCUREMENT
- CONCEPTUAL / DBM / EDS / DETAILED ENGINEERING & CONSTRUCTION SUPPORT…
  - RFP… * RFQ… * P.O.s & CONTRACTS / EXPEDITING / CHANGE ORDERS

CONTRUCTION PLANNING TEAM (CPT)
- *CONSTRUCTABILITY PLANNING / MODULE PLAN / COST & SCHEDULE ESTIMATES / CWP IDENTIFICATION & RELEASE PLAN*

PROJECT SANCTION DATE

CONSTRUCTION MANAGEMENT TEAM (CMT)
- DIRECT SUPERVISION / QUALITY ASSURANCE / CHANGE MANAGEMENT / MANAGE THE WFP PROCESS

GWC PATH OF CONSTRUCTION
- EARLY WORKS (PRE-SANCTION)
  - CONFIRM CONSTRUCTABILITY & CWP MAP
  - MOBILIZE MODULE YARD FABRICATION
  - MOBILIZE EQUIPMENT / TOOLS / TRADES / SITE ACCESS & LAYDOWN, SECURITY
  - CREATE & EXECUTE FIWPS

THE CONSTRUCTION PLANNING FUNCTION

Effective Constructability & WFP Planning needs to begin much earlier than the "Project Sanction Date", but Owners are constrained:

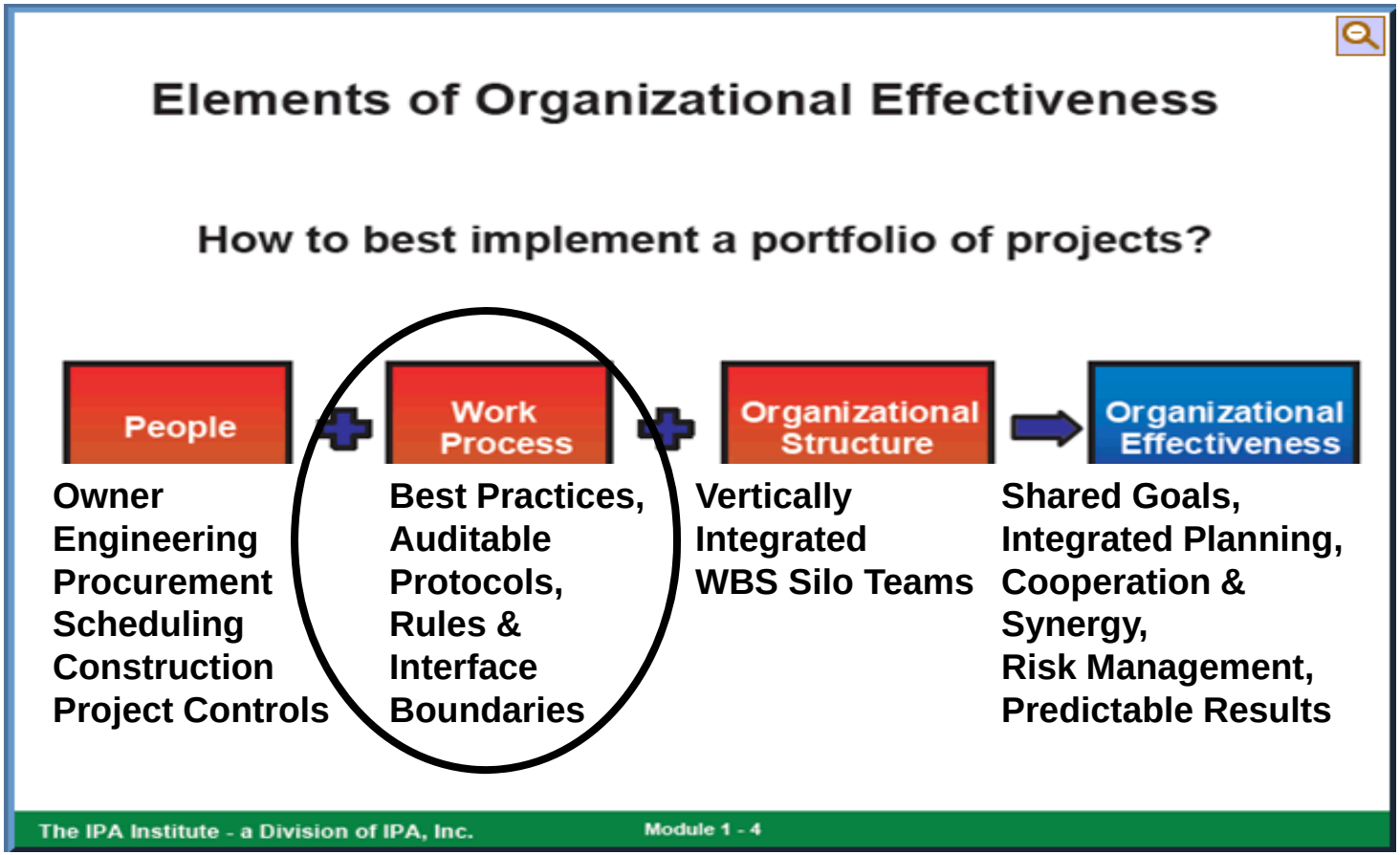
1. **Add a *"CONSTRUCTION PLANNING TEAM (CPT)" discipline within Engineering***

2. **Scope of Work for the CPT includes:**
   - **Constructability inputs to Design, including the optimal *"PATH OF CONSTRUCTION"***
   - **Contribute to Cost Estimates & integrated Schedule development**
   - **Develop *"CWP RELEASE PLAN"* for each WBS Silo**
   - **Develop contract language to implement WFP for subcontractor bid documents**
   - **Identify / Develop *"WFP PROJECT PROCEDURES & FORMS"***
   - **Assess WFP Training needs for subcontractors**

3. **The CPT transitions into the *"CONSTRUCTION MANAGEMENT TEAM (CMT)" following the Project Sanction Date*.**

MODEL: EFFECTIVE ORGANIZATIONAL STRUCTURES (by IPA)

In the MODEL let's consider examples of *"WORK PROCESS"*, next:



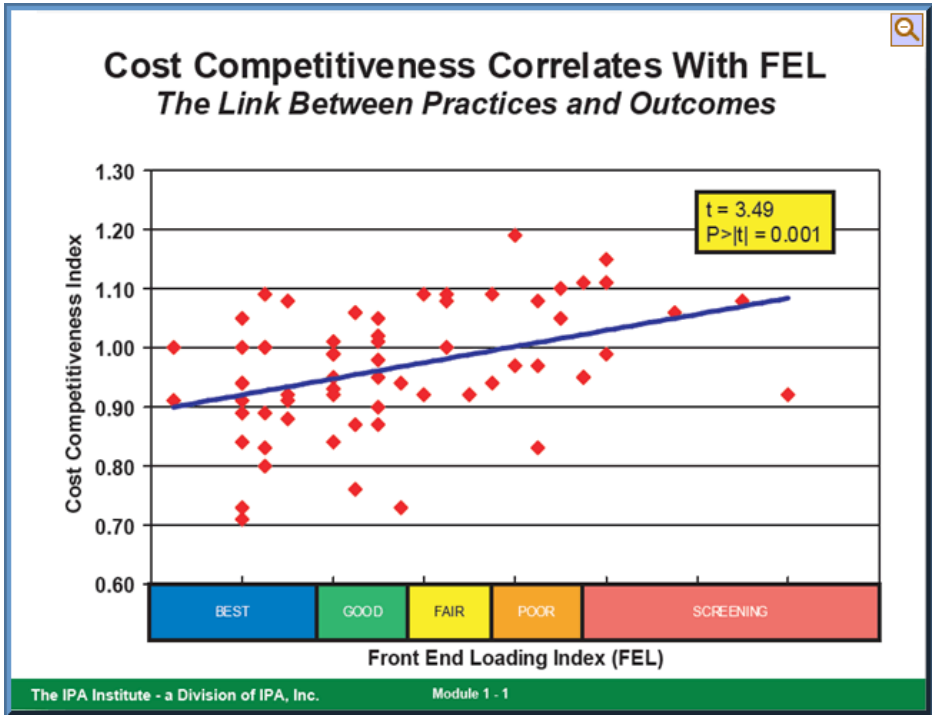
EXAMPLE 1: FRONT END LOADING & BEST PRACTICES (by IPA)

IPA case studies show that increasing from “poor” to “best” in the early use of ‘best practices’ achieved an associated 8% reduction in Total Installed Cost (TIC).

Typical “FEL” & “Best Practices”

All early studies e.g.

- Modularization
- Process Pilot
- Process Technical Risk
- HAZID, HAZOP, EIA, etc.
- Value Engineering
- Constructability
- CWP Map
- 3-D Model Reviews
- Readiness Reviews

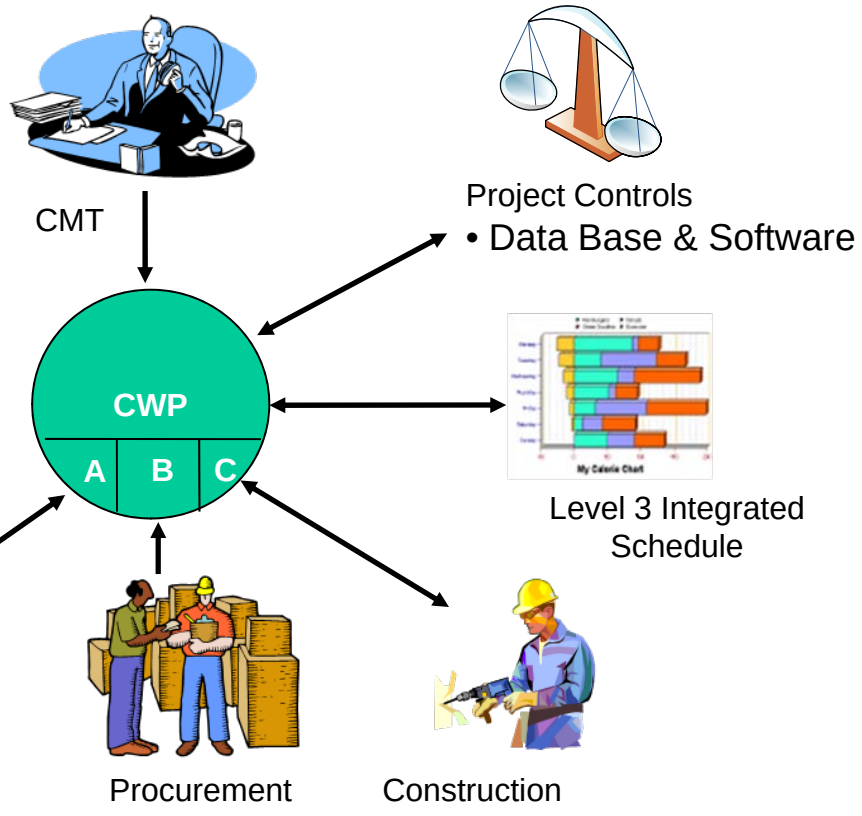


EXAMPLE 2: WORKFACE PLANNING (ref. COAA)

WFP is a key construction management initiative by COAA. The CWP will form the central hub of all planning for site labour resources, construction tools, equipment, materials, engineering documents & Safety

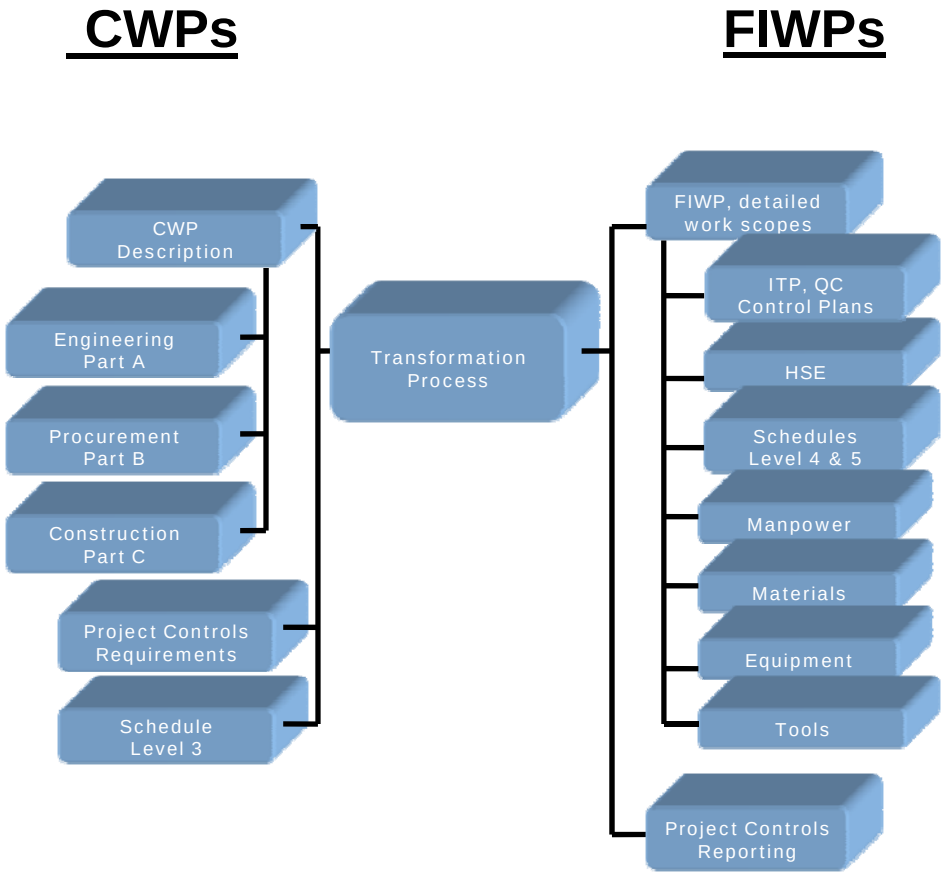
Construction Work Package(s)

- **Single Discipline**
- **5,000 to 15,000 mhrs**
- **Project may have 1,500 to 2,000 CWPs**
- **Budget Control Point aligned with WBS**



Example 3: WFP Work Processes

- CWPs will be developed jointly among the CPT, Engineering & Constructors
- FIWPs are created by the Constructors under QA oversight of the CPT & Project Controls



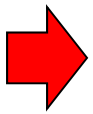
Example 4: CWP Protocols, Rules & Interface Boundaries

1. CWP Templates to ensure consistency
2. CWP Constraints – small packages, single discipline
3. Coordinated CWP assembly (Engineering, CPT & Constructors)
4. CWP preparation milestones on Level 3 schedule
5. CWP inputs 100% complete before IFC
6. Uniform rules for Progress & Cost accounting via CWP coding structure
7. Clear Accountabilities – Engineering, Procurement, Construction inputs populating CWP
8. Etc…

Example 5: WFP Deliverables in Timeframe (ref. COAA - WFP model)

PROJECT PHASE	DBM	EDS	DETAILED ENGINEER'G & CONSTRUCT'N
Deliverable	CWP Templates - created by CPT	CWP Identification & Release Plan – created by CPT	1. IFC – CWP inputs by Engrg, Procrmt & Const'n 2. IFC – FIWPs by GWC Contractors
Details	CWP task descriptions for all const'n disciplines & modules	Update & align CWPs with Level 3 Project Schedule	1. IFC - CWPs completed; 2. FIWPs created and used to execute all construction activ's
Timing	Late DBM	Late EDS	Continuous creation, approvals & execution

Project Sanction Date



EXAMPLE 6: INTEGRATED PROJECT SCHEDULE (ref. COAA)

The inputs from Engineering, Procurement and Construction will be linked to each CWP on the Level 3 Project Schedule, providing the PMT with visible tracking of progress and / or early warning of slippage:

-120 days CWP Part A IFC
- Parts A & B checklists for IFC status
- Develop detailed CWP descriptions

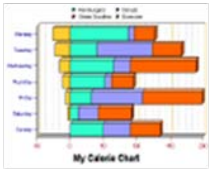
-90 days CWP Part A&B IFC
- CWP Checklist
- Purchase field material
- Order tools and equipment
- Confirm materials ROS dates are on schedule
- Subcontractor requirements

-60 days Begin FIWP development
- Begin populating FIWPs
- Confirm material, tool & equipment availability
- Plan resources
- Develop Back Log or "Plan B" FIWPs

-30 days FIWP ready for release
- FIWP readiness checklist
- Integrate plans with other disciplines
- Add to 3 Week Look-ahead
- Confirm material and equipment received
- Get sign off

0 days Release FIWP
- Print 'hard copy' of FIWPs that are 100% ready
- Begin to execute FIWPs

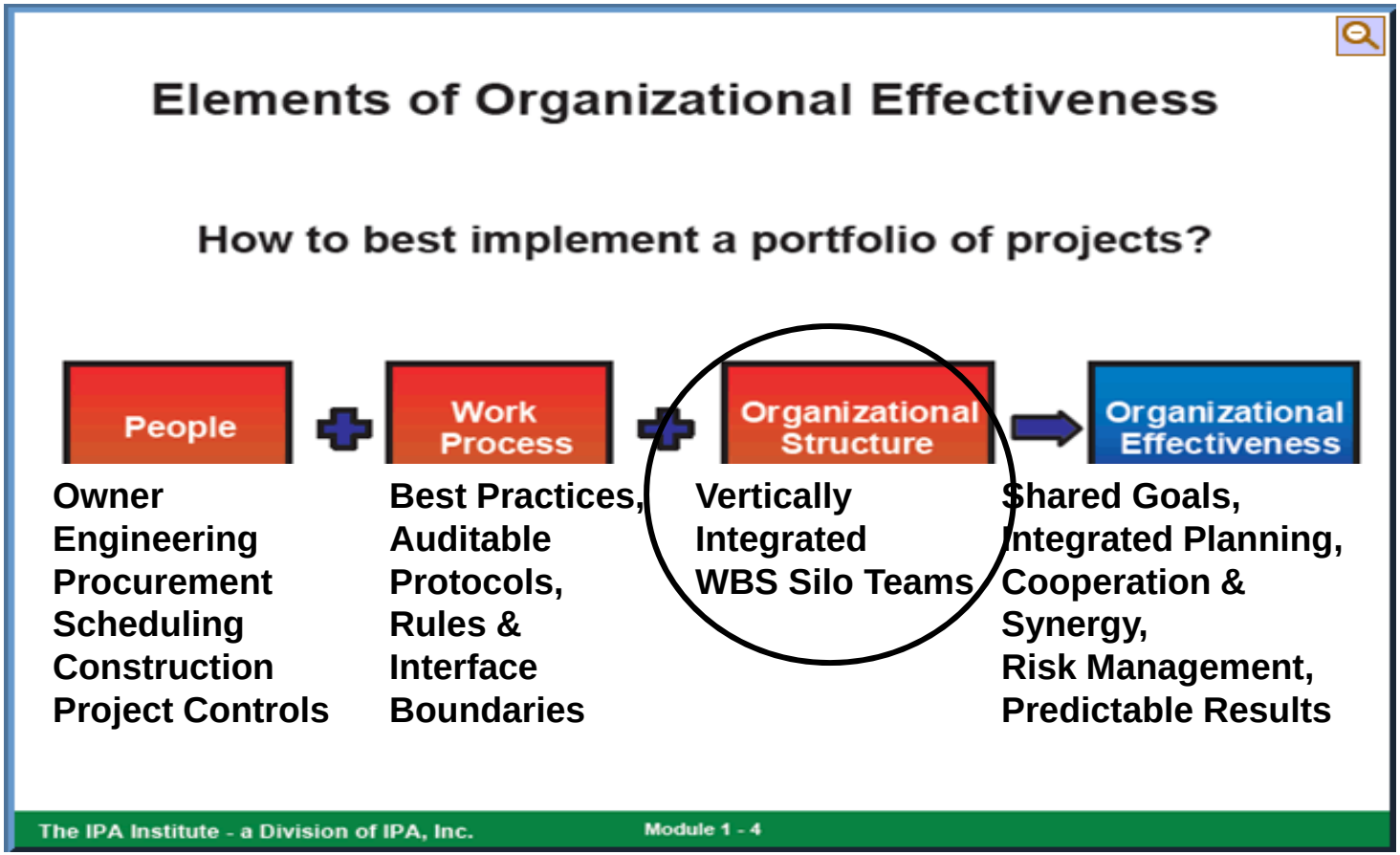
Where: **CWP Part A = Engineering Input**
CWP Part B = Procurement Input
CWP Part C = Construction Input



Level 3 Integrated Schedule

MODEL: EFFECTIVE ORGANIZATIONAL STRUCTURE (by IPA)

IN THE MODEL LET'S CONSIDER *"ORGANIZATIONAL STRUCTURE"*, NEXT:



EPC(M) ORGANIZATIONAL STRUCTURE

- ASSUMING A TYPICAL ALBERTA OIL-SANDS “MINING” PROJECT:

	AREA 1 ORE PREPAR-ATION	AREA 2 TAILINGS	AREA 3 EXTRAC-TION	AREA 4 FROTH TREAT / RECOV’RY	AREA 5 UTILITIES	AREA 6 OFF-SITES
WBS “SILOS”						
ENGINEERING (typical matrix organization structures)	EPC #1 Area 1 Team -Engrg discipl -Procurmt -Scheduling -Proj Controls	EPC #1 Area 2 Team -Engrg discipl -Procurmt -Scheduling -Proj Controls	EPC #2 Area 3 Team -Engrg discipl -Procurmt -Scheduling -Proj Controls	EPC #2 Area 4 Team -Engrg discipl -Procurmt -Scheduling -Proj Controls	EPC #3 Area 5 Team -Engrg discipl -Procurmt -Scheduling -Proj Controls	EPC #4 Area 6 Team -Engrg discipl -Procurmt -Scheduling -Proj Controls
CONSTRUCTION (multiple GWCs)	GWC #1 Area 1 Team -Supers -Planners -Proj Controls -Trades	GWC #2 Area 2 Team -Supers -Planners -Proj Controls -Trades	GWC #3 Area 3 Team -Supers -Planners -Proj Controls -Trades	GWC #3 Area 4 Team -Supers -Planners -Proj Controls -Trades	GWC #4 Area 5 Team -Supers -Planners -Proj Controls -Trades	GWC #4 Area 6 Team -Supers -Planners -Proj Controls -Trades

- The WBS Silos reflect logical, "RIGHT SIZE" divisions of the “SCOPE OF WORK”
- Subcontractor organization charts, reporting, responsibilities & accountability are vertically aligned with the WBS

ORGANIZATIONAL EFFECTIVENESS cont'd:

- Features of the Team Relationships

FOR THE OWNER

1. Assign OWNER REPs to each WBS Silo Team
2. Assign LEGAL / CONTRACT COUNSEL to the project
3. Facilitate an efficient P.O. / CONTRACT / TRENDs REVIEW & APPROVAL PROCESS

FOR THE ENGINEER

1. Each WBS Silo Team should be self-sufficient
2. Engineering Silo Teams to be organized by WBS, not by commodity specialist
2. Procurement Silo Teams to be organized by WBS, not by commodity specialist
3. Identify and manage all interfaces at Battery Limits – horizontal integration.

FOR THE CONSTRUCTOR

1. Constructor Silo Teams maintain 1-to-1 Relationship with Engineer Silo Teams
2. INFRASTRUCTURE & UTILITIES require construction access across battery limits

THESE CONDITIONS PRECEDENT ARE ESSENTIAL TO ENABLE CONTROL & ACCOUNTABILITY BY THE WBS SILO AREA MANAGERS.

SUMMARY

Given the definition and concepts of "Project Planning" as presented:

- **Is the "Project Planning Model" valid for mega-projects …... Yes/No**
- **Is "Project Planning" a "Leadership responsibility" ……. Yes/No**
- **Is the CPT's role truly a missing Engineering discipline …….Yes/No**
- **Is vertical integration of Engrg & GWC silo teams optimal … Yes/No**
- **Does "Project Planning" complement the use of WFP ……. Yes/No**
- **Are the Safety & Financial benefits of P.P. attractive ……... Yes/No**
- **Is "Project Planning" a potential "Best Practice"…….. Yes/No**
- **Will you use (P.P.) concepts on *your* next project ! ……Yes/No**

It has been my pleasure speaking to you today !

FRONT-END TRACK

WHAT ARE THE EXPECTATIONS FOR CONSTRUCTION CONTRACTORS AND ENGINEERING FIRMS REGARDING FRONT-END WFP?

- What do owners want from their contractors and engineers and what will they be looking for when qualifying contractors?

Speakers:

- Al Wahlstrom – Director of Central Construction, Suncor Energy
- Mike Eichhorn – General Manager Major Projects, Nexen

Moderator:

- Lloyd Rankin – President, Ascension Systems Inc.

Questions to Panel:

1. What evidence would the Construction Contractor or Engineering Firm be expected to provide to show proof of their understanding of and competence in WorkFace Planning in the Front End portion of the project?
   - Al Wahlstrom – Suncor plans to own the planning process and any other parties need to show ability to work within their framework. Why or How? We have chosen to take ownership because in the front-end we don't see ability to bring contractors in without compromising the contract process. In the front-end planning of large projects, Suncor recognizes that there will be multiple contractors on site – horizontal contract services – Suncor will know the most about these programs and have the best ability to integrate these programs. Engineering & construction contractors must work within their framework or systems. Suncor is open to new ideas in the bidding phase, but these 'better' ideas must fit into the larger picture.
   - Mike Eichhorn– Engineering contractor & construction contractor in front-end has to show willingness to work to our planning execution ideas, how we want to package work & material to support work in the field. We want to own the planning part of the project and they have to recognize & respect that.

2. What information should the Owner provide to the Construction Contractor and Engineering Firm to prepare for bidding on the project?
    - Mike Eichhorn – Dependent on the type of contract – lump sum or reimbursable. We will define what the owner will be accountable for in WFP & execution process. Will we bag & tag material or pass this on to the contractor? We will also show what our WFP organization will look like and how execution has gone on in the past regarding delivery of modules & equipment.
    - Al Wahlstom – We use a gating process to develop projects. In FEED, work is conceptual with scoping study to get ready for detail design. We don't see a construction contractor being involved at this point. Suncor will give information to the contractor that details our planning processes and we expect that the execution plan & level 3 schedule will go into hand of contractor who will do the detail. They will have to use our standards and rules that are built into our execution planning. That is put in during the contract bidding process.

3. What lead you to become more involved in the planning process? Is this a trend with other owners?
    - Mike Eichhorn - About 5 – 6 years ago, Nexen embarked on Long Lake Project Phase I. This was the biggest project they had done to date. The execution plan was to set up a quasi alliance with 2 construction contractors & and engineering company. A shadow organization was not hired and the results for many reasons were not good. On a go forward basis, Nexen needs to be more involved in project management, material management and have more influence. When we execute the 2nd phase, we will have more staffing requirements to meet this expectation. It depends on the sophistication of companies and their management team – Junior players may need to rely on industry expertise.
    - Al Wahlstrom – Suncor's merger has added resources to the company. We are mostly based in oil sands and capital project development and need to maintain certain levels of expertise in project work. Experience around the Millenium project in 90's saw Suncor use an owner engineering team, construction advisory counsel and the results were not good. In 2002, Suncor formed Major Projects Group that is owner focused to have a more effective Project Management team to better manage our responsibilities in this environment. The planning side is newer

within Suncor and utilizes engineering & technological advisory resources, but planning was previously done by the contractors. Suncor feels that we have the best line of sight position over the whole project. Imperial Oil is looking more closely at long term relationships with planning groups, a different approach that works for them. Suncor has chosen their own way that may not necessarily be a trend. Each company will meet their own need in their own way.

4. Would your expectations be different if the work was lump sum verses cost reimbursable?
    - Mike Eichhorn – This is a matter of risk and who is taking it? Lump sum moves risk to the contracting party and they must be in control of the work. We need to specify inputs by owner being brought to the job and let the contractor execute as they know how.
    - Al Wahlstrom – We have a major responsibility to integrate activities across a site. We can transfer of risk to contract, but must integrate their deliverables with the rest of the planning – Suncor will not shadow but have contractors develop & present their plan of execution so that it fits our larger plan – shared responsibility. On Reimbursable projects, we expect the project team to operate the same as in Lump sum. In a firm price contract, the contractor drives decisions & pays. Otherwise, the owner drives the decisions in a reimbursable situation.

5. What is the difference between evidence for vendor prequalification and vendor bid purposes?
    - Mike Eichhorn– There is general information in a prequalification document. At bid time, we want to see an execution plan & organizational chart.
    - Al Wahlstrom – There is a different experience in Western Canada compared to international control on contracts with prequalification packages having contractors commit. In prequalification, Suncor requires that they show what they CAN do, and in the bid process what they WILL do.

Audience questions:

1. In greater planning responsibility by owners, how do you strike a balance for getting contractor info without affecting big process?
    - Mike Eichhorn– Nexen gets contractor input 3 months before mobilization and defines scope & details work packages then. We rely on internal staff to define these areas. We do not hire silo construction managers but subcontract the work ourselves.
    - Al Wahlstrom– Like Nexen, we believe that we have competent construction planning capabilities within our project management group. No doubt, different contractors can execute more efficiently in different ways. The silo must interface and these issues need to be sorted out; then bring their process in and look at their work packaging so they can build and have other plans for components of the project to tie in with. They are a silo but not independent. Using peel back or layering issue and combine various activities so at end of day Suncor drives planning process.

2. Can we develop into WFP a handoff process to get a buy in from all of the stakeholders to get maximum benefit from the WFP concept? How do we get a clear hand off to contractors if we are doing all of the planning?
    - Al Wahlstrom– During the bidding phase Suncor gives clear execution plans so that the contractor plan or execution plan will then be integrated with the contractor. If the contractor believes they have a better way, we would expect to get through that discussion during the bidding phase, not after the bid is complete. Within Alberta, the infrastructure is small enough that there is flexibility to make changes during the bidding process.
    - Mike Eichhorn – Handoff would work if we were throwing over the fence, but in our model we will be more involved with contractor in setting up the work packages. There will be a full slate of WP (2000 hrs) virtually prepared prior to contractor coming in and learning the scope. At that point, scale WP down to 1000 hours.
    - Lloyd Rankin– Research done by WFP Committee that generally owners want control down to Level 3 schedule – CWP, Budget & Schedule to manage to. Degrees below the CWP will be up to the contractors to figure out or the owner could decide to get involved. Static packages can be strongly influenced by owner but they want

contractors to manage dynamic packages once the work gets to the field.

- Mike Eichhorn– It is important to coordinate all the activities of all contractors on site. Nexen will manage the materials and need to be intimately aware of how the contractor is going to construct and become much more integrated.

3. Wayne Cusitar– Owners will control procurement & warehouse function? Does that mean engineering does mechanical & civil but procurement is a different function? How do you handle taking over materials?
    - Mike Eichhorn - Manage piping bulks and fabricate spools etc as we know when they need to be at site.
    - Lloyd – Suncor & Nexen have been in the game longer that most heavy oil producers and their plan of action may be different than some of the new players. Newer players may not have the construction expertise.

Owners, Engineers, Contractorss are still evolving the COAA Best Practices Model and the WFP Committee is gathering information from stakeholders to continue developing & evolving the model. As a volunteer organization, we need to prioritize what the next steps should be. We need feedback for how to move forward.

- Mike Eichhorn– My personal hope is not to water down WFP by bringing it into the front-end. The true value is in the fact that the tradesman has the drawings & tools to get the work done.
- Al Wahlstrom– In gathering statistics, JV Driver & Flint have proven that getting the material to the site for the craftsmen will show a significant change in productivity and we do not want to lose this factor. Involvement with COAA means that more standardized work processes will bring more success. We believe front-end planning will double productivity gain and will add to what has already been developed. The barrier is related to siloing of engineering & supply chains groups – the need to integrate their activities for a better overall construction plan. The Project Management Team has to drive the best possible execution plan for the whole project.

Who makes an ideal WorkFace Planner?

Introduction

During this session the panel will discuss the education, and experience necessary to be a successful WorkFace Planner, as we as how they should be developed, and other related issues.

The Panel

- Jacob's Vice President Niels Frederiksen
- Aluma Systems Director and General Manager Mick Herke
- Kiewit Energy Canada Corp's Project Manager Sky Mitchell
- And your moderator Lloyd Rankin

Question 1 What background and experience do you require of your WorkFace Planners?

The entire panel agreed they required either Journeymen with 5 years experience and supervision experience at least the foremen's level or a technical background (possibly as a field engineer with at least 5 years related experience.

Question 2 How do you develop your WorkFace Planners?

The entire panel indicated that mentoring, education and giving the planners a variety of work experience was the way they developed their planners.

Question 3 What background and experience would you look for in a WorkFace Planning Lead?

The panel agreed they would be looking for an individual with previous experience as a WorkFace Planner, an understanding of multiple trades and a background similar to a superintendant. Typically these individuals would have 10 or more years of experience.

Question 4 How does WorkFace Planning fit in as a career path?

Each of the panel commented on how WorkFace Planning combined with other related construction experience could lead to a position as a WorkFace Planning Lead, Construction Superintendant or a position in Project Management.

Question 5 How important is being able to work with a variety of levels in an organization?

This is seen as a critical skill as WorkFace Planners need to communicate effectively with foremen, general foremen, superintendants and a variety of job functions in other departments.

Question 6 What is the product that WorkFace Planners are delivering?

FIWP, executable work in 1,000 to 2,000 hour packages that have all necessary information included and all constraints satisfied.

Question 7 Do you need WorkFace Planners in a lump sum environment?

Yes, it is even more important because any costs due to planning related inefficiencies are the contractor's responsibility.

FRONT-END TRACK

INTEGRATING INFORMATION ON A MEGA PROJECT

- Discussion of common problems relaTed Blackmon to integrating project information and possible solutions to addressing these problems. This will be a highly interactive session and the audience will be asked to share their issues and experience.

Speakers:

- Ted Blackmon Blackmon – Director of Construction Solutions, Bentley Systems
- Ewan Botterill – Technical Director, Intergraph Corporation
- Darryl Coughlin – Workface Planning Manager, Flint Energy Services
- Scott McMorran McMorran – Vice President, JV Driver

Moderator:

- Ric Jackson Jackson – Director, FIATECH

Questions to Panel:

1. Given the economic climate where we are all faced with reshuffling of priorities, has integration and interoperability remained a top priority for your companies and why?
    - Darryl Coughlin – Yes, this is a priority to remain effective. More than ever we need to reduce the overlap in redundancy to contribute to the bottom line. This is a key part of Workface Planning.
    - Scott McMorran – Team of programmers that will tie together our software systems.
    - Ewan Botterill – We need to change the terminology from exchange information to sharing information. We need to handover big items between engineering & operations. We need to sharing information rather than exchanging information. This changes the thinking for contracting strategies. Our main barrier in contract strategy is what is going to be exchanged or should it be shared? We need transitioning from one phase to another. What technologies need to be put in place to make that happen? Am I

getting the specific information that I need – than work back. 10 – 20% technology change & 80 – 90% cultural change. What content is needed and how do we put it into place?

- Ted Blackmon – Data standards like ISO 15926 – what is the key driver of this standard? We need to define the data requirements of what needs to be handed over. We can drive out of each discipline what needs to be driven into FIWP. The lack of purpose is missing. We need the common data and then the order of the data is defined by the WFP process. We need to know what is needed by FIWP development and develop that. Engineering data, scheduling systems, material management systems, quantity tracking systems, RFID information are several types of information that needs to be purposed around WFP. Specifically, data requirements should become standard in contracts. We need to drive this into the contractual process.
- Darryl Coughlin – COAA WFP Committee has discussed the possibility of putting language regarding WFP into contract language. We need to leverage off of the work that has already been done and access information that is already out there.

2. What do you see as the biggest challenge in attaining full interoperability and what specifically needs to be done to achieve it?
    - Scott McMorran – Cost is a challenge to sharing information.

3. What specifically can the owners in this room do to support this work and achieve interoperability results for themselves?
    - Darryl Coughlin – The trust factor is important. Contractors & engineering houses are hired to deliver a product and they must be trusted to deliver.
    - Scott McMorran – COAA is the place to make a change in the culture. Consistency in workface planning is necessary through organizations and owners.
    - Ewan Botterill – It is easy to create a tool but if the information is not used in the tool – the tool is no longer useful. The problem is not that the information can't be shared, it just isn't. Where does proprietary enter the picture? If I release the information, do I lose control of it?

4. What is the role for the supplies community? How, and how well, are they contributing to this effort?

Audience questions:

1. Why isn't information from the project that provided for everyone in the project contained in one spot where the tool can be plugged in? Can the database not be managed with passwords, etc?
    - Ted Blackmon – a distribution framework has to be set up because companies don't want estimating rates shared with everyone. The contractual nature of how a project is set up and the work flow determines what information can & will be shared. A single database will exclude vendors. Project databases can drive the software, but data change control will make or break successful deployment of WFP. Having all software applications tie into one database will corrupt the data fundamentally. Contractual specifications are not determined for sharing & exchange of information. Fundamental exchange of a deliverable (data) must be contractual.
    - Scott McMorran – Accessing isogen files that are put into a spooling program is a problem. Having them released from the engineers would make life so much easier.
    - Ewan Botterill – Exchanging rather than sharing data brings in a liability as to changing the integrity of the information.

2. Whatever technology or contract changes are made, culturally the industry does not want to change. How do you change this?
    - Scott McMorran – We need a standard set of deliverables that are written into contracts.
    - COAA has been working on standard contract language that can be used by industry to start breaking down barriers.
    - Ewen Botterill – There could be participation in Fiatech Big Information Handover Guide. Repurposing information can generally be done during engineering design to use in other parts of the project lifecycle. Construction has not been included in the language as much as engineering & operations.

3. Submit to COAA Board a 2 page request of what kind of language is required in contracts to solve the data sharing problem.
    - There is a standard COAA contract template; however, most owners use their own templates.
    - Ric Jackson commented that it is one thing to say you are going to do something, but it is another thing to do it.

4. Can you get WFP into a project without using a contract?
    - Scott McMorran – This is more of a scope issue, not a contractual issue.
5. Project Managers dictate the business and lawyers write whatever language is necessary to get the business done. Do we really want to put this in the contract? Do we really know what needs to be in the contract?
    - Ted Blackmon – Transform from paper based document transfer to electronic data.

6. Why can't COAA go to an owner building a mega project & demonstrate the principles & ideas we are trying to get in place?
    - Ewan Botterill – If we agree that WFP is good idea, why can't we get past the contract issues, scope issues – why can't we do it? Is cost the issue? Is there not a budget? When does it become viable to be able to afford WFP? Until the last minute?
    - Ric Jackson – Someone has to take on the cost and do it. Clearly it can be done, but it is not being done. Stop pointing and start doing!
    - A non-understanding is part of the problem and the cost is an unknown.
    - Robyn Yaremchuk– Why not a Pilot Project?
    - During the last downturn of economic environment, probably 75% of owners needed to change their contracts by defining what our data & information deliverables were. This area is being explored with COAA defining the contract – what is missing is exactly what the information deliverables are. Technology exists today for bringing multiple disparate databases together without knowing the authoring tool to make key decisions. Technology is there to take unstructured data and put it into structured data.

Summary:

- We have heard from technology developers that the technology is there and they suggest that once they can get the database they can work it. For owners, access to information is critical to the success of the project from beginning to end and will save money. The will is there, the technology is there, commitment & understanding is there – need a tipping point. COAA can come together and speak for owners regarding contract language, etc – tools are there, the money or savings are there and there are some success stories in deploying this process. We could wait for success through evolution or we could start a revolution by doing a pilot project. Take the best owner, best EPC, best collection of software to create a Best Practice. There is an opportunity to take advantage of the wisdom available and go from Evolution to Revolution.

FRONT-END TRACK

WHAT HAVE WE LEARNED ON RECENT PROJECTS? HOW ARE WE PLANNING OUR PROJECTS? WHAT IS WORKING AND WHAT DO WE NEED TO CHANGE?

Speakers:

- Kelly Adams Adams – Vice President of Operations, Phoenix Industrial Management
- Gord N. Crawford N. Crawford – Engineering Manager, Rally Engineering
- Rick Gallant Gallant – Manager Operations Technical Surface Engineering, Imperial Oil Resources

Moderator:

- Lloyd Rankin – President, Ascension Systems Inc.

Questions to Panel:

1. What are we learning about how detailed planning on our projects should be and what activities are required to support the level of planning?
    - Gord N. Crawford – The outcome of the battle is determined before you hit the field. When do we get all players involved – different & competing. We need to integrate teams at outset of project to come up with a plan. There needs to be an early decision about using WFP needs to be made at the beginning of the project, then alignment of organization is next. Material arrival can affect success of a project and the agendas of each player have to be in line with the larger plan.
    - Kelly Adams – As the role for WFP is broadened, role of WFP has grown & changed. Now a methodology. We need a holistic approach for execution in the field. Also, we need to make sure that everyone is in place with a role that is effective in the workface planning role.
    - Rick Gallant – Planning depends on the complexity of the work. The more complete the planning, the better the safety performance, the better the cost & schedule performance. Detail of planning is a function of the complexity of project. There is a choice to spend time up front doing the detailed planning or spend the same time

on change management in the field waiting for work activities to begin. A good approach is to assemble who teams early with a clear understanding of objectives, agreement on P of C & work sequencing. It is really important to have a disciplined change management process that is rigorous with collaborative effort.

2. What are we learning about how to create collaboration & manage the alignment necessary to execute the plan?
    - Rick Gallant - We need to gauge contractors early – construction & engineering – through the design & construction process. Depending on the type of contract, it is important that involvement is early. Sometime we may need to pay for the consultation before putting contract out to bid. If you are able to work with ongoing contractual relationships in many projects – alliances can be valuable. Over time, alignment on expectations and planning process works more smoothly. When constructors participate in constructability reviews, there is a better product to take to the field.
    - Kelly Adams – Change Management from an internal perspective means making sure contractors know what the system looks like before going into the field. A culture shift within organizations to understand the priorities and why systems function a certain way is critical. There can be impact by changes in project priorities and systems need to adapt through understanding of the principles behind systems.
    - Gord N. Crawford – The Cradle to Grave concept for team approach means leadership management should be there to continue with the project, even if there is a change in players. Constructability reviews utilized at pre-DBM stage at higher level with larger blocks of work has produced positive outcomes in planning. Real, productive, paid work.

3. What are we learning about how the project should be managed?
    - Kelly Adams – More constructor/contractor involvement is beneficial to the life cycle of the asset and how it should be constructed. Shorter turnaround times need to deliver critical information to the field.
    - Rick Gallant – There has been a recent trend of owner involvement; although, nothing constant yet. Owner presence is critical. Owner involvement on the Project Management team is

imperative. All of the key positions are staffed by owner staff & hand picked by owners to maintain total care & custody for the project. Project Management is a core job and we need people skilled in doing that kind of work. The provincial experience level has declined and we need to draw on knowledge & experience where we can get it, but the responsibility must rest with owners.

- Gord N. Crawford – composition of the team with owner involvement is clear; however, it is created (embedded in home or 3rd party team). PMT can be in house staff positions or 3rd party EPC integration. Both are successful; however, 3rd party is still at arm's length (us & them concept) until final turnover that owner takes full ownership & accountability. Internal PMT shortfall is akin to working with family – commitment level is fluid and you are left turning over a project to yourself. Project priorities are not always clear.

4. How do you capture the Lessons Learned – in the contract, what other ways? How do we learn and put the lessons into practice?
    - Gord N. Crawford – The key factor is WHO owns the plant! Internal PMT then ownership of the plant is that company. EPC work means EPC owns the plant and must be involved at an early stage with a clearly defined plan.
    - Kelly Adams – Instruments involved in contracts revolve around default/failure. We need to set out general expectations at a contact level so alignment of all parties & expectations will put instruments in to protect from failure and guarantee success. Set up-front standards for everyone to adhere to, all working to the contract.
    - Rick Gallant – Longer term contractual relationships help but up-front expectations are paramount so there are no later surprises to derail the projects.
        i. Safety Standards – performance & how it is managed
        ii. Project Planning Methods – focusing on expected results
        iii. Execution Plan
        iv. Project Measurement
        v. Home Office visits to test that functions are in place
        vi. Stewardship in contracts related to contractors & subcontractors
        vii. Procurement Staff to oversee procurement activities.

Audience Questions:

1. Are Lessons Learned cycled into Standards & Procedures & filtered through organizations?
    - Gord N. Crawford – Some have become Best Practices and may be implemented on future projects- mostly what worked well. People turnover lessons are harder to implement.
    - Kelly Adams – We need post mortem discussions after construction that are seriously listened to and focused back into new projects.
    - Rick Gallant – We need to discipline the Lessons Learned process to capture across all organizations a continuous improvements process on our management development system to apply Lessons Learned. It is critical that lessons are learned the first time and not repeated.

2. Over $300 Million dollars, more problems experienced? How is this managed differently?
    - Gord N. Crawford - A management system is scaled with gate/checkpoint review with a certain amount of detail at each stage. Complexity or size means more review. There must be rigour in review of detail design and the construction process. Some organizations have scaleable PEP & some do not – so this can be an area of concern depending on the type of project. The key element of PEP, large or small, is the due diligence steps. Distill a large project down to smaller scale to exercise plan, then religiously follow it.
    - Kelly Adams – More progress auditing, safety audits, quality audits should be bigger and start almost immediately. No big bang effect, continual auditing.

3. How to manage scaffolding with regard to WFP, as part of CWP, FIWP, separately?
    - Kelly Adams – There must be breakdown of CWP in support of a work package. Include a scaffolding diagram related to scope of work for placing, timing, criteria, etc. , then roll into an overall scaffolding schedule.
    - Lloyd – Should we be looking at engineering scaffold prior to going to the field?

- Kelly Adams – Scaffold can become an operational part of plant after construction. Possibly platforms can replace scaffolds. Going through a platform design cycle and early discussion would reduce the permanent/temporary scaffold problem.
- Gord N. Crawford – The missing link is involving operations & maintenance in early design. Platforms are easy to cut out of budget but save a lot of money later.
- Rick Gallant – Slways have an operations representative in planning team. Conduct a scaleable, detailed human factor review of design to pick out access points that can be problematic.

4. Is there experience where a contract consultant does not end up being the contractor hired?
    - Rick Gallant – We've consulted with a contractor that built a previous plant and used their experience for planning of the second project but there has been not actual bidding yet.

5. Given turnover that can often happen in beginning of project how do you maintain the training & education process? Various stages of front-end has had a lot of change. Is there an ongoing training procedure to keep everyone in line?
    - Gord N. Crawford – This is dependent on project leadership with a clear mandate that is communicated clearly. Clear objectives & project culture should be communicated when a new person comes on and this is spelled out at the outset. If there isn't compliance, it is necessary to decide to keep or lose participant.
    - Kelly Adams – Change management is a program that starts early, before project charter. The team needs to know start, plan and end. Systems need to be established early on with structure, expectation & roles/responsibilities.
    - Rick Gallant – Project Management System with Exxon Mobil brings people in with overview of system & expectations for on-boarding process. Change Management Process deals with design & project personnel to cover issues of familiarity, project goals, etc.

6. When trying to get onto site, safety training is inconsistent. How do we make it possible for WFP to become a standard from project to project with consistent key element? Should we aspire to this?
    - Rick Gallant – We have an efficiency opportunity to reach critical mass of the number of people who adopt WFP to make a standard. Qualification standard is necessary. Currently SAIT has a training process, but it currently is not a standard and we should aspire to that.
    - Kelly Adams – Reduce adaptability from project to project. Standardization of interaction will be a benefit for alignment and critical handoffs. The variety of systems & software applications create a need for standards in exchanging information and using it.
    - Gord N. Crawford – Understanding!! Of what Workface Planning entails is the big challenge for the upcoming year. We need a better, widespread understanding in the industry.

IN-FIELD TRACK

WHAT ARE THE EXPECTATIONS FOR CONSTRUCTION CONTRACTORS & ENGINEERING FIRMS REGARDING INFIELD WFP?

Speakers:

- Mike Eichhorn – General Manager Major Projects, Nexen
- Al Wahlstrom – Director of Central Construction, Suncor Energy

Moderator:

- Lloyd Rankin – President, Ascension Systems Inc.

Questions to Panel:

1. How does the in-field portion differ from the front-end portion?
   - Al Wahlstrom – In terms of expectations in-field, Suncor is targeting getting to and keeping at workface to be productive; optimizing time. Front-end focus is on right deliverables to the field at the right time – engineering, materials & construction sequence, coming to the field when needed. The engineering group running into difficulty will shift resources to other work that may or may not be needed. Planning & delivering information to be delivered to field one workface at a time.

   - Mike Eichhorn – Executing plan in field. Counterproductive in field if there isn't work available to meet the expectations of the plan.

2. What evidence is needed from contractor or engineering firm that they understand WFP & are competent?
   - Al Wahlstrom – They must have experience & understand WFP; not necessarily exactly to COAA model but understand and expect that planning functions are critical to the contractor as well as owner. Integrate factors between all services with planning functions that arrive at solutions. Owners' expectations are that plans are followed. Expect engineer & contractor to understand that early planning will be done by owner. Have to show that they can work with that plan and they need to be able to rationalize any changes recommended.

   - Mike Eichhorn – Check the webpage for contractor and review their Mission Statement. Want to see that productivity is of a value to

company. Formal procedures & practices for WFP should already be in place & evidence that their people have been trained in WFP. See Organization Chart & importance of WFP in that chart & that they are auditing their procedures & making sure they are following them.

3. What would be your expectation regarding composition of FIWP? Do you feel type or location of work would change packages – disciplines, fabrication shops, work at site.
   - Al Wahlstrom – If we look at where COAA is work packages should be 1000 – 2000 man hours. Look at the crew size and make sure work packages are placed within one crew and complete within their particular shift eg. 10 & 4. The composition of WP is easy to file electronically and only the documentation that is necessary for use is physically put into packages to make manhandling the package easier. Eg, 1 drawing, 5 documents – only that which is needed at the workface. Everything else be electronically controlled. Suncor is trying to get the size of field teams into a more solid, reduced focus. To do that, to run quantity surveyors, unit rate process must be an extensive team in the field and progress through construction & FIWP packages – tailor monthly schedule around FIWP.

   - Mike Eichhorn – setting up packages. Make the packages how you want executed. Excavation, rebar, concrete are separate packages.

   - Al Wahlstrom – In the mod shops the workers go to the material. In the field, the materials go to the workface and the worker. A mod shop is easier to work off 100% electronic info because you can physically scroll through quickly. With workface planning or planning for construction, the information must be delivered to the mod shop in a timely fashion.

   - Mike Eichhorn – A fabrication shop is closer to a manufacturing process. Know how to move the materials – process or WFP?

4. How important are audits to support contractor & engineering claims?
   - Al Wahlstrom – Most people on projects don't appreciate audits; however, with a lot of information in one area, it is easier to look at the information and compare what happened from activity perspective. Work packaging allows pulling information to one area for governance.

- Mike Eichhorn – Internal audits are more important to stay efficient & flexible. That is the value of an audit.

5. Importance of education – what are you looking for to show organization is serious about education?
   - Al Wahlstrom – We like to see from contractors (engineering & construction) proof of people trained in programs along with experience. The long term goal is to drive toward consistency. The education in place already is driving in this direction.

   - Mike Eichhorn – Need to change the mindset of people. Break bad habits – break them with education

6. Importance of education for subcontractors & the expectations of them and for companies employing them?
   - Al Wahlstrom – Suncor holds the same position from training/planning perspective for a subcontractor as for a main contractor.
   - Mike Eichhorn – ditto

7. How are WFP expectations reflected in the various type of contracts?
   - Al Wahlstrom – We cannot direct a contractor within a contract to use WFP. This would be an attachment to the contract and geared around execution plans of project. Part of the bid or pre-qualification process would present WFP information, including execution plans and it would be up to the contractor to apply response to those specifics. Otherwise, the contract won't move to the next level if this expectation is not met.

   - Mike Eichhorn – In a reimbursable contract, Nexen is more prescriptive toward WFP but in a lump sum, just front-end planning.

8. WorkFace Planners – Engineering vs Construction
   - Al Wahlstrom – Key deliverables are FIWP & CWP. The Engineer delivers into the CWP; however, Suncor does not believe the engineer is the right person to prepare CWP and work out a CWP schedule. This requires a certain construction experience level. A joint effort will produce the best solution. Those components of WFP need to be provided by someone with construction experience.

- Mike Eichhorn – EWP feeds to CWP. Nexen does strategy on CWP, fill with engineering info and work packages follow.

Audience questions:

1. Highly repetitive work – pipeline across prairie – how would you break into 1000 hr packages?
   - Al Wahlstrom – In civil and piping packages with long sessions of repetitive work, the size can be adapted. You can use different criteria to separate work and package for crews.

2. John – Shell Scotford Upgrader – FIWP in place for contractor. Material missing. 1 per 380 packages had enough material. Undermined whole program and at the last months when material arrived became successful. When are owners going to get serious about material arriving in proper sequence?
   - Al Wahlstrom – Participants need to be in game together. Owners do not always have the most say, but the reality is that there are many players. We need to recognize that more than engineering deliverables are expected, supply chain as well. Whoever is supplying materials needs to be engaged. A key component is the material list.

   - Mike Eichhorn – There needs to be pre planning of which materials should be there first and this is a major failing of many projects across Alberta.

3. Could payment on work packages be tied to supply chain as well as engineering?
   - Al Wahlstrom – The focus is on construction activities and an extensive effort to develop front-end activities. We need to structure project organizations to get planning exercises into project development.

   - Dennis – There is too much focus on FIWP for trades person. We need to step back and be more observant that the package does not come together without all the other factors coming together and participate.

4. What do you think the challenges are to get engineers engaged?
   - Mike Eichhorn – Engineering is a different process from planning packages. Engineers are not who should be doing the workface planning.

   - Al Wahlstrom – The expectations of engineering are that they are expected to work in the environment of execution even if it is not optimum to them. This is an area that is a challenge right now. Project schedule is developed best for the project and not necessarily engineering. There a slowly changing attitude in this area. As we work through a broader acceptance of WFP in industry, engineers will eventually come in line. They do not like to engineer on a speculative basis but they have to follow the project plan.

   - Mike Eichhorn – Engineers take the path of least resistance and are not in tune with construction.

5. Process Integration – Who should take the role of planning process from beginning to end?
   - Al Wahlstrom – In the last 35 years of experience, the EPC model started out as simple and contractors could put processes in place and supply the complete package. Now, we have gating processes from conceptual DBM to FEED and contractors are not present in those stages; although, they should have the accountability to employ WFP for that phase of project development. The strategy based on large capital project work and major projects group's prime focus is to provide these processes. When contractors are brought into the picture, they have to be engaged into this process. Contractors have to be able to be open and discuss these plans with the owner. Fundamentally, contractors are not involved in early phases. A lot of projects are large and need multi-contractors on site that should be split by process units. There needs to be a larger entity to take control & owners are taking this role.

   - Mike Eichhorn – Lump sum work was not popular 5 – 6 years ago and contractors were not willing to take risks. Owners have had to come in and take control of overall projects. This is good because the owner is the go-between for engineering & construction.

6. Owners have been reluctant to pay extra costs for integration?
   - Mike Eichhorn – Owners should be looking long term when deciding on spending – spend now to prevent extra cost later.

   - Al Wahlstrom – When are owners going to smarten up on spending? This is happening now.

7. When is owner/engineering going to identify systems early on for planning with regard to electrical planning?
   - Mike Eichhorn – We need to define major systems first, then break them down into subsystems. Nexen couldn't turn over Long Lake Phase 1 because of this issue. We need to define electrical systems early on so we can track progress on system as well as CWP basis. This is a big labour saving.

   - Al Wahlstrom – Start with the end in mind. Look at the systems that need to be delivered first which is the critical execution plan. Develop the structure for CWP as early as possible and build from initial FIWP structure based around systems and move them into the CWP to form around contracting structures and physical layouts of plant. Then the FIWPs are broken out in line with this plan. We need to deal with the issue of getting systems operational in a timely fashion.

8. How WFP changes contracting strategy & timing of getting contractor in?
   - Mike Eichhorn – Constructors on staff need to have long time experience. There should be construction input at the start. In a reimbursable contract, we will bring the General Foreman in 3 months before mobilization to finalize CWP and tailor FIWP. In a lump sum contract, we need to make sure there is proper planning properly that is communicated to contractor before work starts.

   - Al Wahlstrom – We want to own planning. Early phases of planning are usually without contractors and take owner accountability/responsibility. If contractors struggle with execution plan, there must be flexibility to discuss issues.

9. Manpower based on schedule with no correlation to backlog of work. Is there alignment coming to where backlog will properly represent schedule?
   - Al Wahlstrom - Suncor will not go schedule critical on projects. Suncor has a process in place at a high level – RFFC - Ready for Fabrication & Construction with a 14 week period between IFC delivery and start of work. Packages goes into backlog during this 14 week period. The checks & finalization of materials occur during this 14 week period but this is still not a perfect process. Delivering a high rate of work into a project – contractor goes into field with all the work and the backlog is down. Owners are prepared to accept that contractors do not want to release men into the field if work is not available – a recurring problem.

   - Mike Eichhorn – Need a shift in thought by owners to keep backlog full and remove constraints.

10. In WFP, a schedule is a catalogue of detailed scope. When a schedule is integrated tightly with WFP, a backlog will naturally be generated. There will always be a list of activities that need to be addressed and assist with the labour curve.
    - Al Wahlstrom – A Planner is a scheduler, but scheduler is not necessarily a planner. Drive planning function first, then integrate into schedule.

IN-FIELD TRACK

WORKFACE PLANNING FROM A CONTRACTOR AND ENGINEERING PERSPECTIVE.

Speakers:

- Niels Frederiksen – Vice President, Jacobs
- Jose Herrero – Vice President, Fluor Canada
- Danny Daoust – President of Construction, CH2M Hill Energy Canada

Moderator

- Lloyd Rankin – President, Ascension Systems Inc.

Questions to the Panel:

1. With regard to front-end, what changes when you apply WorkFace Planning? (Note: - Based on our discussion the answer could include Path of Construction, when you bring on contractors, how you develop the EWP, CWP and FIWP the contract language, etc.)

    - Niels Frederiksen – Be cautionary as WFP is only one element of project delivery. If you don't have all of the other wheel cogs, the project will not be successful. The COAA WFP Committee was to use their past experience for constructors to work to a better plan. Turnaround for operating plant is at least a year ahead – scope of operations vs regulations. Once the scope is finished and procurement is done, packages are turned over to the planners who plan the work, front-end loaded so that when the plant is taken down, the down time is exact. Investment in success is at the front-end in turnaround. This is the element missing in the construction industry. FIWP process is not enough – need discipline with a gated program. 20 person team who travels (Construction Readiness Review) around country to establish scope – independent set of eyes to check the plan. Use color coding to show readiness. When work is planned, the components to execute plan are available on site.

- Danny Daoust – We need to use common sense. Start at commissioning, go to construction & engineering in DBM stage. EWP delivery may not suit CWP. Humans want to start building early because of the visual results but planning may not be done. Need heavy lift plan in place to accommodate lay down areas. When installing long pipe rack and EWP is by system, 80% may not be accurate because sequencing in not correct and it may not be possible to begin construction because material is not ready & available. Need a full vision early on and fit FIWP development into vision that is most economical for the project, not necessarily only engineering.
- Jose Herrero – The key is to optimize the plan. Influence engineering, construction & procurement such that the planning sequence that owner wants is in place. EPC process needs information fed into the Path of Construction from all to visualize plan. Construction needs in-house skill for construction sequencing to take lead and have meaningful conversations about how best approach for construction – modules, etc. WFP is the catalyst to force companies to follow normal steps but with more communication, solid execution plan & more integration between all parties involved. There needs to be practices, process & people to implement this execution – what is missing are the people who are trained consistently and there is a disconnect between processes & practices that needs refining. Avoid the path of least resistance and put in the effort.

2. With regard to project execution what changes when you apply WorkFace Planning? (Note: - Based on our discussion the answer could include using WorkFace Planners, how you deliver procurement and engineering, how you progress the project, the skill level of the workforce, etc)
    - Jose Herrero – Once you have developed P of C, engineering sequence must be established to meet overall objective. There must be communication with engineering that may not be a natural communication. Work Breakdown Images – breaking plot plan into small portions. Make connection between P of C and Work Breakdown Images to get a better sense of meeting final target. Must include ISOs & materials in discussion.
    - Danny Daoust – The biggest change in industry now is that supervision in the field is now at the workface with the people

doing the work rather than in the office planning. The pool of talent for supervision is still there but demand is greater. We are introducing new workforce that is relatively green and without adequate experience. WFP done right with FIWP correct including all information means we are able to execute the work under proper supervision because supervisor is not running around looking for missing items and following a correct process.

- Niels Frederiksen – 70% of foreman should be in the field with face to face contact with workers with a consistent approach to planning work that can transfer from site to site. Building a consistent approach will create a resource base to draw on. Interactive Plan in Jacobs brings all stakeholders in – procurement, warehousing – need to plan what is in the warehouse and how we will get it out. Need processes that work. Make people aware of the value to them that WFP will provide. Foremen initially feel threatened; however, change management process identifies behavior change to accept the WFP process. We need to explain the value to foremen of planners giving work packages and take feedback coming from foreman for future packages. The Constructability mandate is that a specialist must commit to go to site rather than sit in planning office.

3. With regard to the benefits and limitations of WorkFace Planning how can the application of WorkFace Planning benefit projects and are there any limitations to implementing WorkFace Planning that Owners, Construction Contractors, or Engineering Firms should be aware of? (Note: - The limitations could include issues relating to obtaining alignment, the fact that the model is still new and needs further development, that tools are just being developed to help with implementation, etc.)
    - Niels Frederiksen -
        i. Benefits – Software provides visualization which really impacts decision making & package implementation. Easier to plan scaffolding, commissioning (hydro test, etc)
        ii. Limitations – amount of trained/educated people available (power users). Software systems that need to be integrated with other systems. Engineers must agree to update model regularly if integration is not possible.

- Danny Daoust –
    i. Benefits – detailed plan that can be followed & executed – manage rather than react.
    ii. Limitations – need right people involved in process. Project Manager needs to be there from beginning to end. Change management is reduced by getting the right people in place for better planning & less reaction time.

- Jose Herrero –
    i. Benefits – Review Projects with different planning strategies to compare differences. When WFP is applied as it should be, the difference in productivity and budget was over 25% better. Globally recognized. Still a new process with limitations, but becoming recognized.
    ii. Limitations – There are good work processes & practices; however, new technologies are not used properly for integration of construction & engineering processes. Model concept – in the old days, used a plastic model. Visualization makes it easier for planning & change management, for constraint planning & sequencing; however, training is needed.

Audience questions:

1. FIWP – Do you use that for a tool to control productivity? How is superintendent or foreman involved in FIWP planning?
    - Danny Daoust – We need the right people involved to make a plan that makes sense. You want more than a plan that looks good, it must be useable. Tie the FIWP into the estimate and earned man hours by activity. The man hours allotted to the package should be correct. General Foreman or Superintendent would be involved. Measure on a shift basis the hours earned or earned value against control budget.
    - Niels Frederiksen – Rough basis for hours; can use work face packages and use quantity survey for that. Packages are signed off by Superintendent, Quality, Warehousing before hand-off so that there are no punch items in packages. The sequencing is more

concise. There are no punch list items. Monitor progress & productivity separately from the packages.

- Jose Herrero – Asking people to track by FIWP is not precise. We found that information is not consistent so we need to track by system or area.

2. How do you align estimating, engineering, scheduling, workface planning with relation to the Organization Chart of each company?
   - Jose Hererro - The function is important, not necessarily the name of the function. This is not a natural process. The Project Manager needs to promote alignment in these functions. Project Manager has to drive the planning process which is different than how projects have been planned before, independent of workface planning being used.
   - Danny Daoust – Without alignment, there is no delivery. Take two projects with different execution strategy.
     i. One owner took charge and used WFP – scheduling of EWP, contractor, materials management – everyone had authority and responsibility and the project was very successful.
     ii. Another owner bought WFP from consultant but were not engaged and the success level was reduced. Misalignment is usually with the owner – if they are not bought in, there will be no success.
   - Niels Frederiksen – If people responsible for incremental deliveries do not deliver on time with acceptance, there is where the breakdown occurs. There must be ownership of activities, deliverables & planning sequences. Requirements of each discipline must be understood. Independent team will come in and audit whether or not a project is ready for mobilization. Roles & Responsibilities are paramount.

3. What will be the best timing using WFP to get construction involved – definition of 80% engineered?
   - Niels Frederiksen – 80% means mechanically engineered by system, not necessarily completion of total project. There is value in getting WFP involved early to build a concept and educate procurement. Packages cannot be completed until engineering is 80% done. The sequencing is critical. There is not one model that

fits all but it is necessary to use common sense and logistical planning.

- Danny Daoust – Start up & commissioning team should be involved early, but not all the time and the same can be said of construction. It's helpful to plan undergrounds and super modules on site – discuss and align conceptual plans early, then define detail later.
- Jose Herrero – When using a model, there is more success because you can check completion accuracy. % can be misleading and visually you can see what the actual progress is. WFP should be brought in from the very beginning to link drawings/materials so that the people in the field have all available to use when they start working – at DBM from a concept level.

4. From scheduling point of view in lifecycle of project, where is the proof that WFP does not compromise schedule?
    - Jose Herrero - Planning is not an expense to the schedule and has not been detrimental
    - Danny Daoust - Physical construction may not start at the same date but will end on the same date and affect amount of indirect cost.
    - Niels Frederiksen - Backlog of packages and flexibility will provide ability to change sequence of work to accommodate unexpected constraints. There must be discipline and their must be sign offs, diligence in work area preparation, etc.

WORKFACE PLANNING ABSOLUTES

WHEN IT COMES TO WORKFACE PLANNING, ARE THERE ANY ABSOLUTES? IF THERE ARE, WHAT ARE THEY? DURING THE SESSION THE PANEL WILL ALSO DISCUSS THE BENEFITS OF WORKFACE PLANNING.

Speakers:

- Perry Mayer – Construction Planner, Nexen
- Geoff Ryan – Manager of Project Controls, Rally Engineering
- Ron Nalewajek – Vice President of Strategic Planning, Ledcor Group of Companies

Moderator:

- Ben Swan – Implementation Director, Element Industrial Solutions

Questions to Panel:

1. What are the WorkFace Planning Absolutes with regard to the Front End of a project?
    - Ron – The key to successful implementation of WFP is time. We need to bring engineering and material deliveries to a state where contractors can build effectively & safely. Contractors can be brought in early enough to prevent productivity loss. Many owners are taking ownership in the planning but must pass along to contractors in time.
    - Perry Mayer – The absolute is integrating construction workers back into the owner organization. Our firm has moved construction into the front-end to get engineering deliverables lined up with the technology we want to use to create FIWPs.
        i. Philosophy – what does it mean to the organization; what do we want to accomplish – into CEP & PEP
        ii. Strategy – Procedures that are written & signed off; work flows
        iii. Requirements to execute – strategies
    - Geoff Ryan – As engineering looks for direction, information needs to come from owners with procedures & expectations for everyone on the project. Engineering needs to plan to deliver on the schedule and their must be development of Path of

Construction to build CWP in line with EWP. Deliverables must meet the construction needs in line with schedule. Procurement must have a good definition of scope by understanding the CWP. Fabrication must be procured to serve the needs of the CWP eg. Modules – what to leave on & what to leave off.

2. What are the WorkFace Planning Absolutes with regard to the creation of the Field Installation Packages?
   - Ron Nalewajek –
     i. Size of FIWP is important to design to measure progress readily. Optimum size is a shift crew size – 21&7 or 10&4
     ii. Workflow staged so no delay in work delivery
     iii. Buy-in from stakeholders – owner/engineer teams and any other interface involved
   - Perry Mayer –
     i. Use CWP and work out lower level detailed, multi-discipline plan for Path of Execution. Sit with structural, piping, electrical, scaffold & insulating to define work areas & execution plan from which comes an FIWP Release Plan tailored to the same CWP. Interdependencies must be addressed before creation of the FIWP.
     ii. Creation of FIWP clearly needs constraint definition regarding material, men, tools, equipment, man hours. Need to be confident that an FIWP placed on a schedule matches the estimate. Listing man hours as a constraint against the package.
     iii. Consistency in developing work packages for the multi disciplines – scorecards, progressing, travel sheet, how to mark up isometric drawings, etc.
   - Geoff Ryan – Planners are key to the building FIWPs, for the planning of execution of work and removal of constraints. The schedule has to be the ruling document on the project. The plan to develop FIWP must be in line with the schedule to align engineering, procurement and all stakeholders. Constructors must make sure construction execution is perfectly aligned with the schedule – believable, achievable & must stick to it.

3. What are the WorkFace Planning Absolutes with regard to the Executing and Progress Tracking of the planned work?
    - Ron Nalewajek –
        i. Tracking should be at the FIWP level. There must be a continual backlog of fully completed FIWPs.
        ii. Have an Integration Planner to be part of the execution of FIWP.
        iii. Owner must take responsibility of the integration of other activities.
        iv. A sign off on FIWP would earn progress in the schedule.
    - Perry Mayer –
        i. Construction Owners (Foreman, GF) have to have the balls to say 'It ain't ready' if it's not. Shadow CMT need to be out removing constraints that will come up in the future – planning vs reacting
        ii. Tracking tools are in the FIWP – identify work that can be progressed and attach man hours that match the estimate. Track progress by earned hours on each activity – there has to be consistency in reporting so as not to bias against subcontractors.
        iii. In process verification – listing out tasks in FIWP & outline progressing tool – once progress comes in, engage owner quality assurance to inspect work completed. Misinterpretations, errors are corrected early on.
    - Geoff Ryan –
        i. If you track it, you manage it. Tracking must happen. There must be a process to remove constraints to complete work and put value on the package. The standard in the future will be software tools for tracking progress – how much and what has been done. 3D software will move from a Want to a Need once it starts to be used.

4. Why do you believe we need to use WorkFace Planning?
    - Ron Nalewajek – When you improve productivity, you can reduce the number of men on site, which impacts camp costs. Reduced rework and lower costs because FIWP is complete before it goes to the field. Mitigate safety issues.

- Perry Mayer – We need to increase the amount of time that men install equipment
    i. Get foreman away from fire fighting to mentoring men
    ii. Statistics show that the foreman is often the youngest, less experienced men because of the current chaos on projects. Need to put experienced people back into management positions.
    iii. Better scope definitions so FIWP are executable.
    iv. More consistent progress reporting.
    v. Cut down on the amount of punch items at turnover. Whatever is tracked can be managed & completed. The level of confidence rises with completion of tasks.
- Geoff Ryan – Development of an engineering model for WFP needs and awakening of understanding. Engineering deliverables needs to be a deliverable that can be constructed. WFP gives the model of the size of the chunks that need to be produced by engineering and this brings focus back to engineering to clearly define the project route & the finish line.

Audience questions:

1. Do you handle hydro test packages differently than FIWPs?
    - Geoff Ryan – different but the same. Using software, great way to transfer from bulk systems with Hydro Test packaging. Very good fit on projects and brings Work Face planners into the process.
    - Ron Nalewajek – Hydro Testing is part of a spool in putting modules together. Bring this in early enough and turnover is much smoother.

2. WorkFace Planning is bringing morale up on job sites because trades men are satisfied with a day's work. Safety, quality & morale is better.

3. Project outcome was that the Job Steward had no work to do because all of the issues were worked out before the work went out to the field.

4. Are there differences in how you package work between trades and how do you see collaboration in multi discipline packaging?

- Perry Mayer – FIWP is for a crew and still needs separate packages for different disciplines. There has to be a Path of Construction to tie these packages together.
- Ron Nalewajek – Different disciplines required different levels of accuracy & timing and WFP is the critical element of success.
- Geoff Ryan – Better model to put all discipline planners together to exchange collaborative information.