Solutions

BRIDGES
BUILDINGS
CADASTRE AND LAND DEVELOPMENT
CAMPUSES
COMMUNICATIONS
ELECTRIC AND GAS UTILITIES
FACTORIES
METALS AND MINING
OIL AND GAS
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

1. Visibility into the planned and current project status
2. Material availability / engineering drawing production
3. Cost to complete
4. Information management / Aggregation
5. Reactive construction management
6. 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

1. Develop Construction Plan
2. Create Crew Level Work Packages
3. Review & Sequence Work
4. Status Monitoring:
   - Material Availability
   - Work Status
   - Supports/Equipment
5. Streamline Materials
6. Bag & Tag
7. The Quality Gate
8. Execute Work
9. Weekly Progress Reports
10. Buffer of Work Packages that are Executable
Agile Construction Methodology

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

- Turnover & Commissioning
  - Testing & Inspection
  - Field Installation
  - Procurement
  - Offsite Fabrication
  - Detailed Engineering

- 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

ROHM and HAAS
ZACHRY
BP
J.RAY McDERMOTT
Shell
PETRO-CANADA
Flint Hills Resources
Nexen
Shaw
ExxonMobil
CIANBRO
ConocoPhillips
Baker
Chevron
S&B
CBI
Bentley
ConstructSim Functionality

- Systems Turnover
- Data Aggregation
- Construction Planning
- Progress Reporting
- Change Management
- Look-Ahead Planning
- Status Visualization
- Streamline Materials
- Quantity Tracking
- Virtual Work Packs
Data Aggregation

ConstructSim

Virtual Construction Model

Engineering Data

Project Controls

Materials Management

Field Tracking

Back
Data Aggregation – CAD Adaptors

PDMS  AutoCAD  CIS/2  VRML  AutoPlant  PASCE

PDS

P4D

CAD Converters

PwrTrax

DGN
Data Aggregation – Digital ISO Input

ConstructSim reads digital ISO files and correlates them with the 3D CAD model.
ConstructSim represents a manufacturing model of ‘constructible’ pipe elements.

Data Aggregation – ISO Components
Data Aggregation – Structural Details

ConstructSim reads structural steel detail drawings produced for steel fabrication …
Data Aggregation – Attributes

3D CAD Model

Digital Isometrics

Line List

ConstructSim

Take-Off

ConstructSim attributes are derived from multiple sources and other sources.

Other Sources

Automated task generation
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.
Data Aggregation – VCM Templates

Standard VCM Template for ConstructSim

Virtual Construction Model

VCM Template for Company XYZ, Inc.

Deployed VCM for Project ABC-123

Virtual Construction Model

VCM Template for Project ABC-123.
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
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
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
Data Aggregation – Project Data

Typical Progressing Options:

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

• R&D Project
  • Waseda University

• Partner - Intelliwave
Construction Planning – UD Groups

Construction Areas
Unit 1, Level 3
Large Bore, CS

Turnover Systems
Construction Planning – 4D Playback
Streamline Materials

Material Warehouse Status

Track Purchase Orders / ETAs

Trial Allocation Priorities

Materials Issue Request
Quantity Tracking

MTO
From CAD + Isometric Documents

Schedule

ConstructSim

Work Steps

Labor Rates & Rules of Progress
Tasks grouped by “activity type” and “component type”
Quantity / Labor Tracking – Tasks

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

Install Work Steps

- Stage
- Erect
- Connect

PIPE_SPOOL

- Procure → Fabricate → Install → Test → Turn-over
Quantity / Labor Tracking – Tasks

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

Procure → Fabricate → Install → Test → Turn-over

PIPE_WELD

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
Virtual Work Packs – 4 Views
## Virtual Work Packs - Reports

### ConstructSim - Work Package Execution Reports

**Set Work Pack Type:**
- Pipe

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

**Filter Work Pack List:**
- PI-FIWP-CellarDeck-Above-001
- PI-FIWP-CellarDeck-Above-002
- PI-FIWP-CellarDeck-Above-003
- PI-FIWP-CellarDeck-Above-004
- 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-Welthead-001
- PI-FIWP-Welthead-002
- PI-FIWP-Welthead-003
- PI-FIWP-Welthead-004
- PI-FIWP-Welthead-005
- PI-FIWP-Welthead-006
- PI-FIWP-Welthead-007
- PI-FIWP-Welthead-008

### Field Materials

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## Steel Piecemark Counts

**Steel Piecemarks:** ST-FWP-CellarDeck-012

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**Total Weight:** 13.8
Virtual Work Packs - Reports

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

Status information from task progress or from external data sources

- No Progress
- Received
- Staged
- Erected
- Final Complete
- Punch Complete
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.
Status Visualization – Equip Delivery

<table>
<thead>
<tr>
<th>EQUI_DELIVERY_S</th>
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<tbody>
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<td>ETA_Dec_06</td>
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<td>ETA_May_07</td>
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Status Visualization – Pipe Fab

Area 15
Status Visualization – Test Status

Area 16

PIPE_TEST_PROGRESS
PUNCHLIST_GENERATION
GIVEN_TO_CLIENT
NDE_COMPLETE
TEST_COMPLETE
PAINT_COMPLETE
HEATTRACE_COMPLETE
INSUL_COMPLETE
No Progress
Look-Ahead Planning

ConstructSim - Lookahead Planning

Work Pack = IWP-439.1-12-005

7/22/2008

Work Pack Constraints

7/22/2008

ConstructSim Status Tracking - User Interface

Admin logged in at 1:08:02 PM

Engineering Questions

Materials Availability

Schedule Project Personnel

Work Plan Stats

Work Plan Execution Report

Lookahead Planning Utility

Work Plan Data

3D Playback

Scheduling Overview

Progress Reports

Custom

CSS: Task Set Up

Project

Schedule Selected Work Pack

Set Work Pack Type:

Pipe: Install

Sort Work Pack List

Set View:

8-Week Lookahead

Earned Planned %

Work Pack ID

IWP-439.1.12-005

Earned Planned %

IWP-439.1.12-005

Earned Planned %

Earned Planned-867 PC-6%

Earned Planned-579 PC-6%

Back
Change Management

ConstructSim keeps track of the changes in pipe isometrics and propagates the changes throughout the Virtual Construction Model.
### Progress Reports

#### Turn-over Systems Pipe Installation Tracking

<table>
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<tr>
<th>ToSys</th>
<th>Description</th>
<th>Turn-over Dates</th>
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<td></td>
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<td>H401</td>
<td>Process Piping Systems Feed Section to P-3A/B</td>
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<td>H403</td>
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**Back**
Systems Turnover
## Systems Turnover - Incomplete Work

### ConstructSim - Pipe Installation Exception Report

**8/20/2007**

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**Total Remaining MHs**: 361.5, 0.0
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
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
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.