



# Project Update

## Process Oriented Visual Planning

by

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NSRP Joint Panel Meeting

New Orleans, LA

December 8, 2010





# Introduction

- Process Oriented Visual Planner (POV Planner™) has been developed under an NSRP funded project
- Project primary goal is to develop tools and processes that will allow production planners and supervisors to exploit product model data to generate visual production aids, create work plans using resource constrained simulations and easily update short range plans based on current resource states
- Project Participants
  - Todd Pacific Shipyards – Project and Shipyard Lead
  - Knowledge Based Systems, Inc. (KBSI) – Technology Lead
  - Autodesk, Inc. – Software Support
  - Praeses, Inc – Technology Support
  - First Marine International – Production Planning Support
  - Bollinger Shipyards, Inc. – Advisory Support
  - Northrop Grumman Ship Systems – Advisory Support



# POV Planner™ Concept



- Exploit existing functionality of two COTS software tools; Navisworks® by Autodesk® and WorkSim® by KBSI
- Navisworks® is a multi-CAD visualization tool that provides access to product model graphics and data without requiring product modeling software on the users terminal
  - User can change and manipulate views and model configuration without impacting the engineering design
  - Product attribute data can be accessed without interfacing with the product model database
  - CAD design skills are not required to run the tool
- WorkSim® is a resource constrained simulation based planning tool
  - Process models used to drive simulations are based on the graphic representations developed and saved in Navisworks®
  - Planning tool allows user to regenerate plans and schedules based on real world variances in planned resources (manpower and equipment)



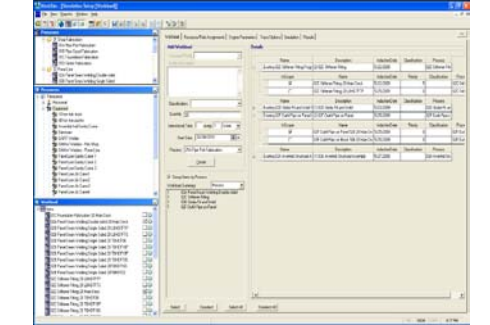
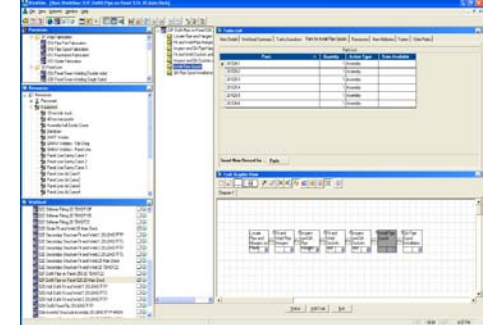
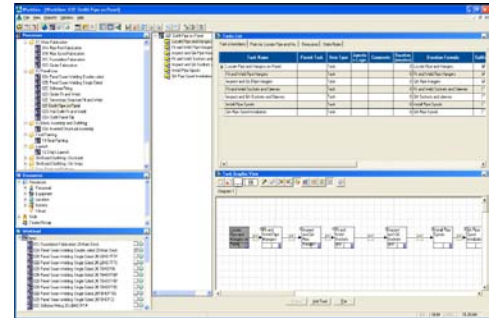
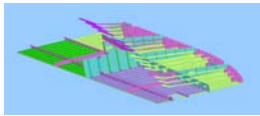
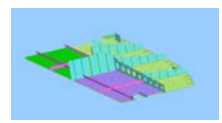
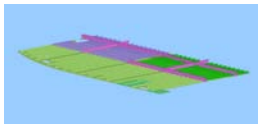
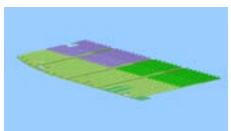
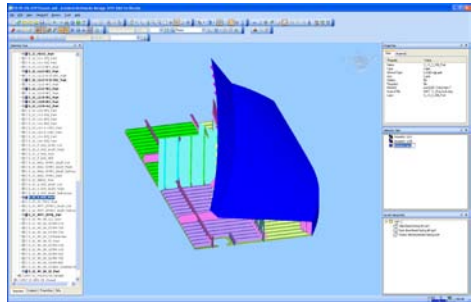
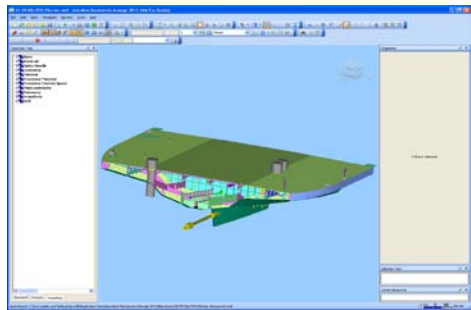
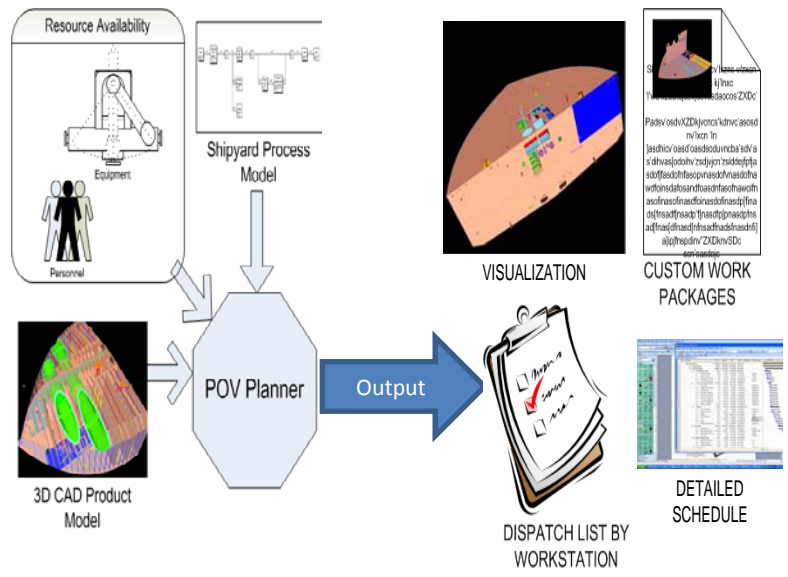
# POV Planner™ Work Flow and COTS Tool Interfaces



## NAVISWORKS®

## WORKSIM®

### POV PLANNER INPUTS & OUTPUTS



Ship graphics by GPA

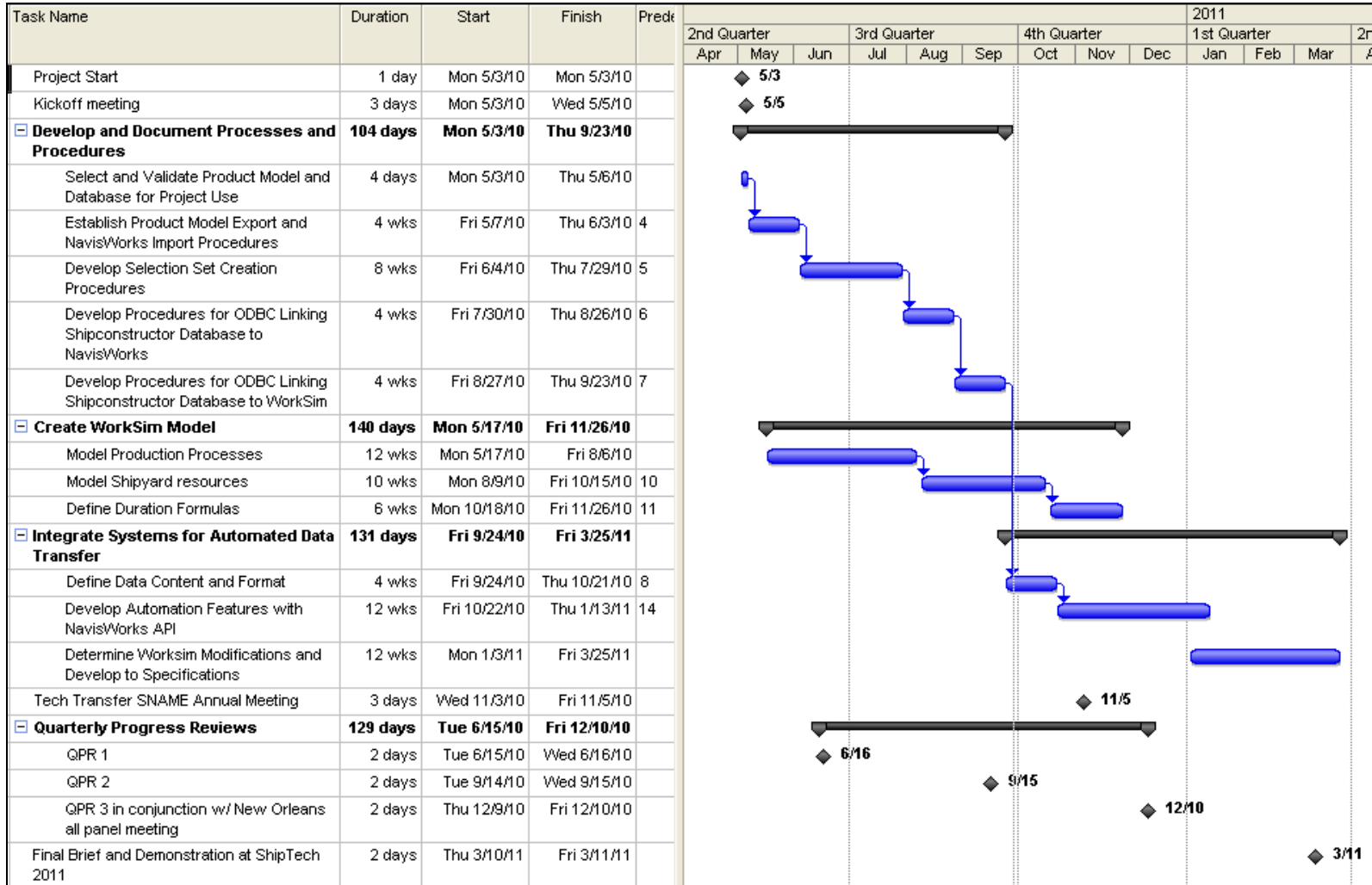


# Major Project Tasks

- Develop and document processes and procedures for loading a product model database and graphics into NavisWorks<sup>®</sup>, generating selection sets for planning use, and setting up user configured model views.
- Create a complete WorkSim<sup>®</sup> model of Todd Pacific Shipyards' processes and resources.
- Integrate product model database, NavisWorks<sup>®</sup> and the WorkSim<sup>®</sup> tool for automated data transfer and table population.



# Project Schedule



# Completed Sub-Tasks



- Developed and documented comprehensive, shipbuilding specific procedures for structuring design data and exporting to NavisWorks® for use in planning applications.
- Developed and documented comprehensive, shipbuilding specific procedures for creating and using search sets, selection sets and viewpoints in NavisWorks® for use in planning applications.
- Defined and created a comprehensive set of shipbuilding standard production process templates using IDEF3 process modeling tools and WorkSim®.

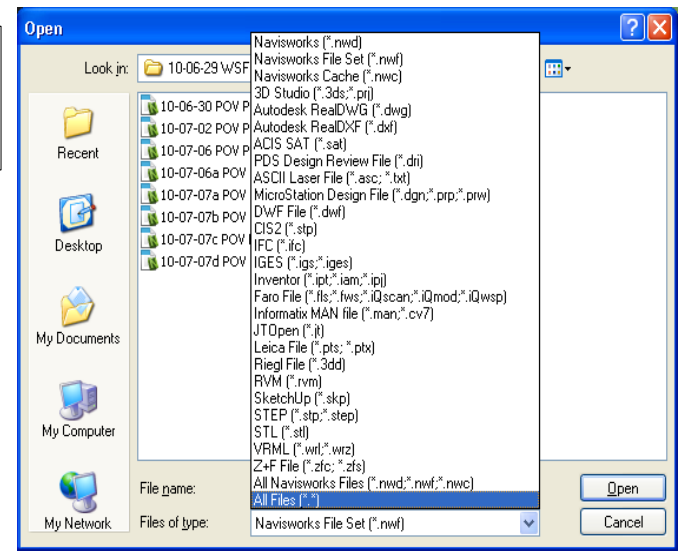
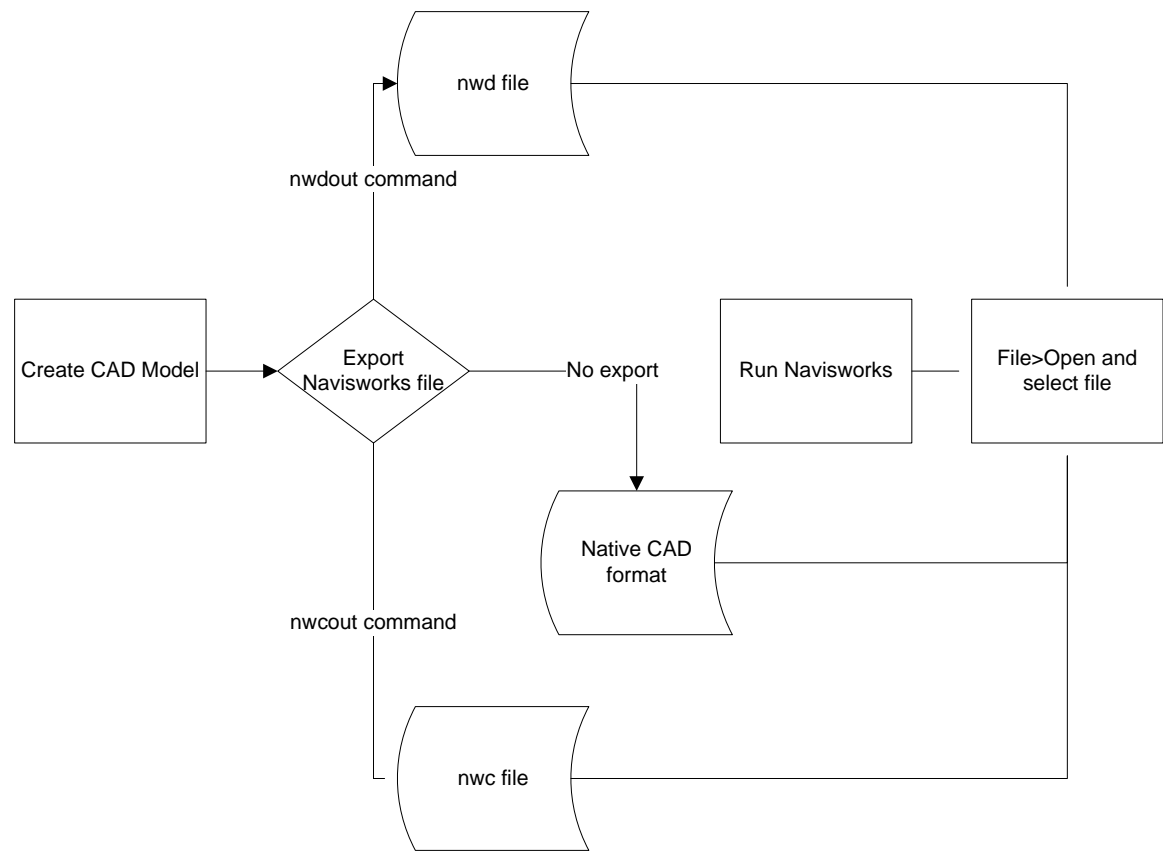
# Partially Completed Sub-Tasks



- Define production process duration formulas.
- Identify accessibility of attribute data required by process formulas.
- Input resource definitions for shipyard WorkSim<sup>®</sup> models.
- Determine and develop Application Programmer Interfaces between NavisWorks<sup>®</sup> and WorkSim<sup>®</sup>.
- Training sessions at Todd (scheduled for next week) and Bollinger (completed).

# Import/Export Procedures

- NavisWorks® File Creation Process

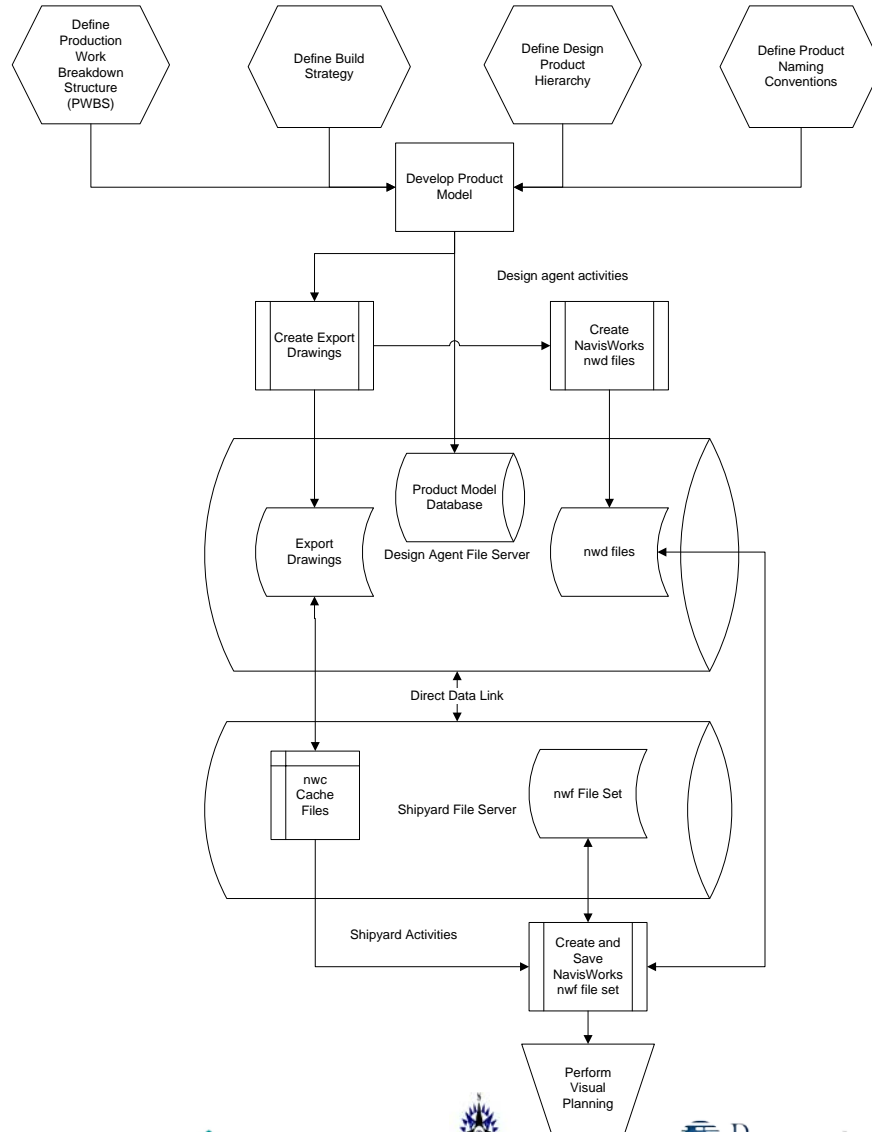




# Import/Export Procedures



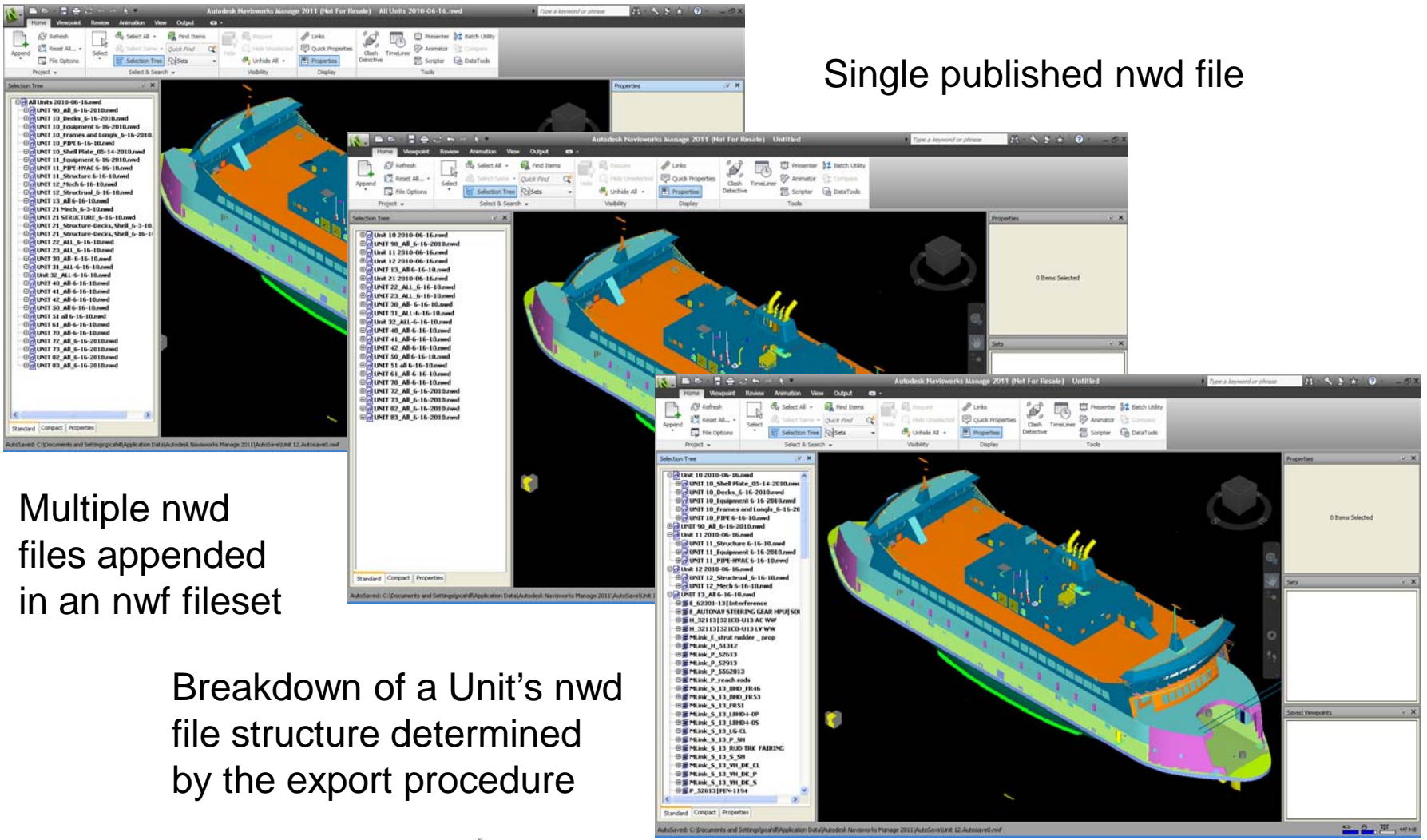
Activities performed jointly between shipyard and design agent



NavisWorks® file creation process when a shipyard uses a design agent

# Import/Export Procedures

Single published nwd file



Multiple nwd files appended in an nwf fileset

Breakdown of a Unit's nwd file structure determined by the export procedure



# Export Procedures and Build Strategy



- Build Strategy – What is it?
- Production Build Strategy – Unit/assembly breakdown for structure, outfitting strategy for systems
- Design Build Strategy – Unit/assembly breakdown, systems definition and hierarchical product structure
- Planning Build Strategy – Merging of production preferences and restrictions with design output to produce a plan and schedule to build the vessel
  - POV Planner will provide a way to qualitatively review and quantitatively assess a planning build strategy prior to implementation



# Production Build Strategy



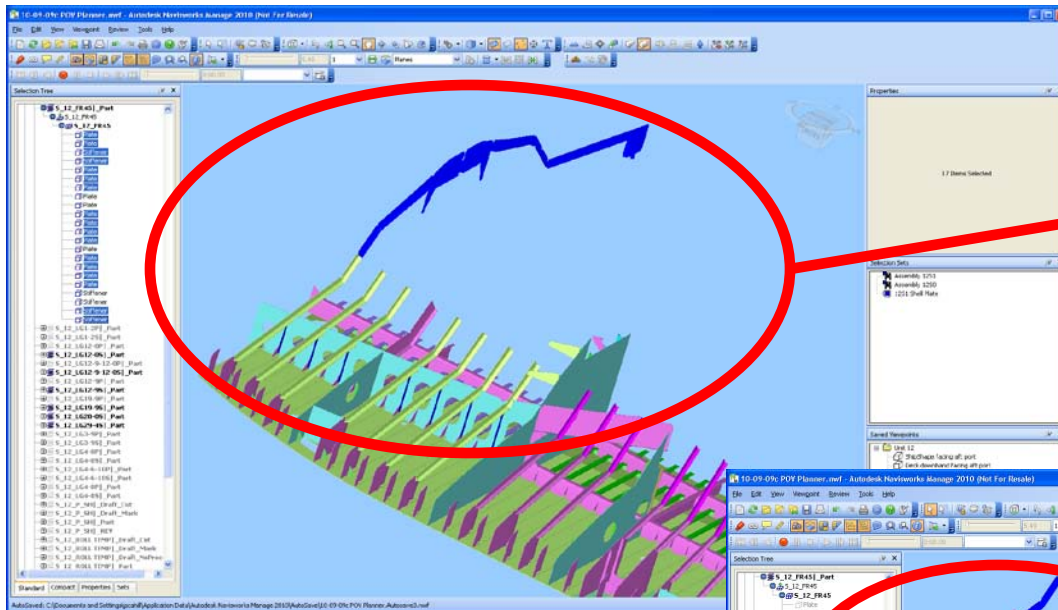
The screenshot displays the Autodesk Navisworks Manage 2010 interface. The main window shows a 3D model of a ferry, color-coded by system components. The left-hand 'Selection Tree' pane is circled in red and contains the following list of units:

- All Units 2010-06-16.nwd
- UNIT 90\_All\_6-16-2010.nwd
- UNIT 10\_Decks\_6-16-2010.nwd
- UNIT 10\_Equipment\_6-16-2010.nwd
- UNIT 10\_Frames and Longls\_6-16-2010.nwd
- UNIT 10\_PIPE\_6-16-10.nwd
- UNIT 10\_Shell Plate\_05-14-2010.nwd
- UNIT 11\_Equipment\_6-16-2010.nwd
- UNIT 11\_PIPE-HVAC\_6-16-10.nwd
- UNIT 11\_Structure\_6-16-10.nwd
- UNIT 12\_Mech\_6-16-10.nwd
- UNIT 12\_Structural\_6-16-10.nwd
- UNIT 13\_All\_6-16-10.nwd
- UNIT 21\_Mech\_6-3-10.nwd
- UNIT 21 STRUCTURE\_6-16-10.nwd
- UNIT 21\_Structure-Decks, Shell\_6-3-10.nwd
- UNIT 21\_Structure-Decks, Shell\_6-16-10.nwd
- UNIT 22\_All\_6-16-10.nwd
- UNIT 23\_All\_6-16-10.nwd
- UNIT 30\_All\_6-16-10.nwd
- UNIT 31\_All\_6-16-10.nwd
- Unit 32\_All\_6-16-10.nwd
- UNIT 40\_All\_6-16-10.nwd
- UNIT 41\_All\_6-16-10.nwd
- UNIT 42\_All\_6-16-10.nwd
- UNIT 50\_All\_6-16-10.nwd
- UNIT 51 all 6-16-10.nwd
- UNIT 61\_All\_6-16-10.nwd
- UNIT 70\_All\_6-16-10.nwd
- UNIT 72\_All\_6-16-2010.nwd
- UNIT 73\_All\_6-16-2010.nwd
- UNIT 82\_All\_6-16-2010.nwd
- UNIT 83\_All\_6-16-2010.nwd

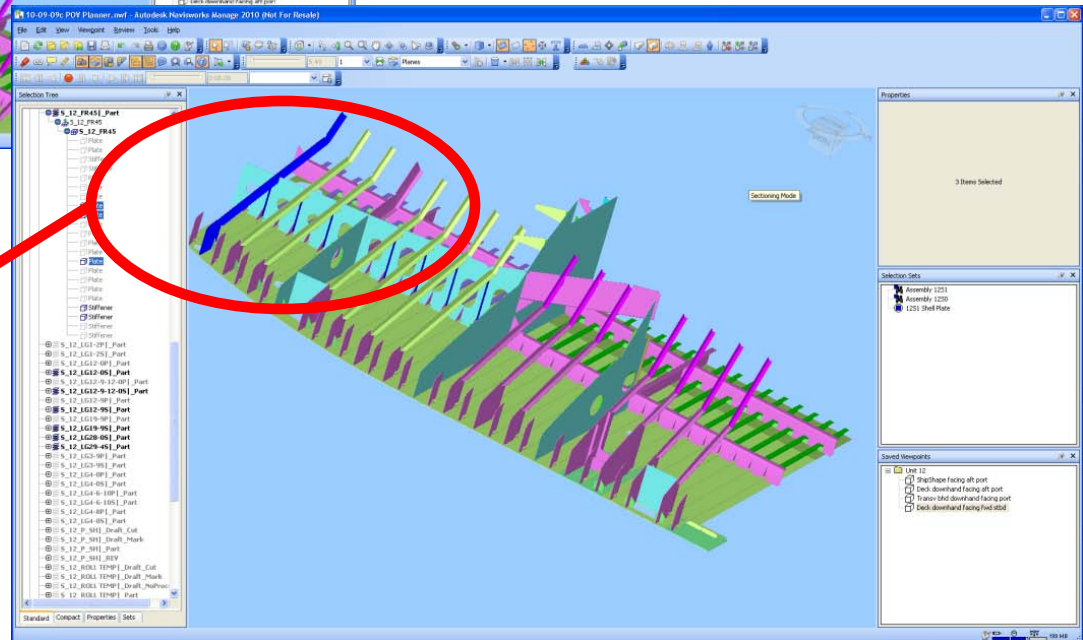
The 3D model shows the ferry's hull, decks, and superstructure. A small 3D coordinate system icon with 'FRONT', 'RIGHT', and 'UP' labels is visible in the upper right corner of the model view.

Product work breakdown structure  
In Navisworks® selection tree

# Design Build Strategy



Design view of a frame – based on planar group

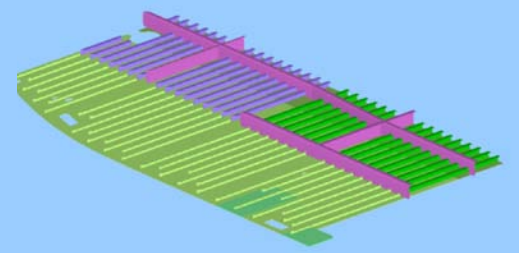
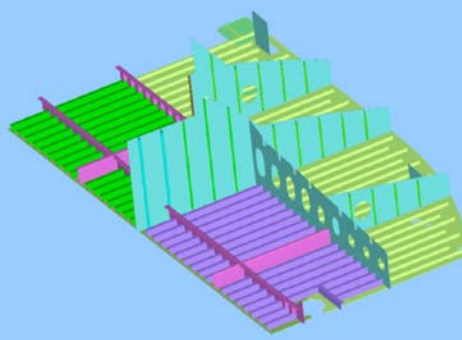
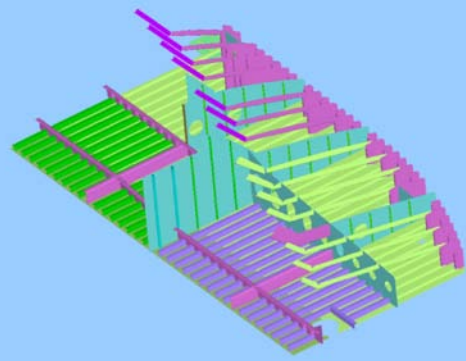
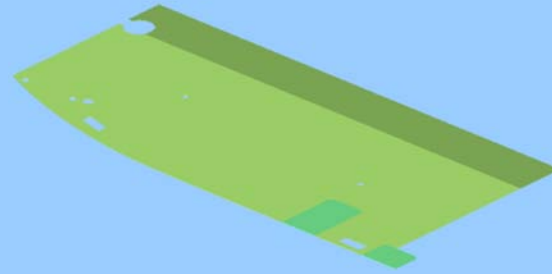
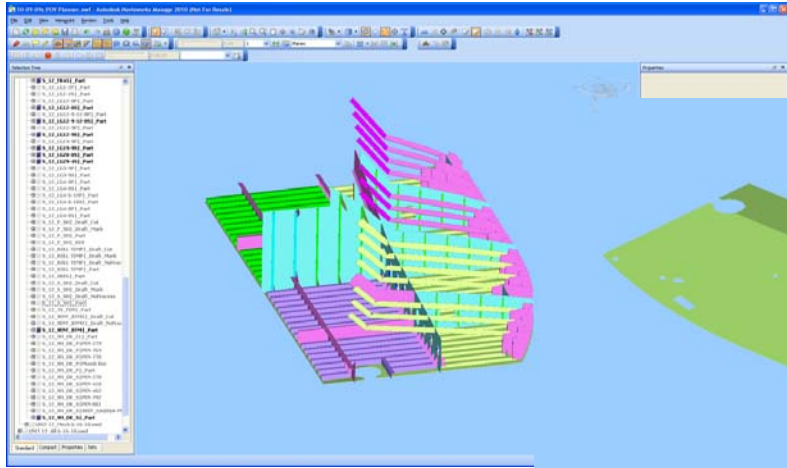


Planning view of a frame – based on sub-assembly grouping

# Planning Build Strategy



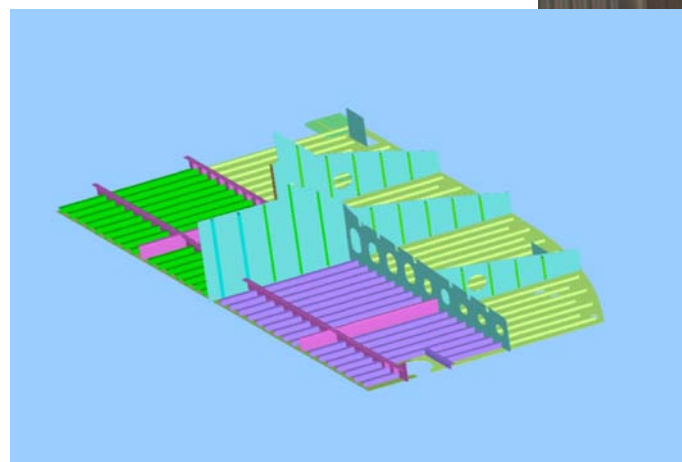
Incremental “virtual” build of an assembly using Navisworks® selection sets and views



# Planning Build Strategy



“Virtual” build matches real world work content



# Process Modeling



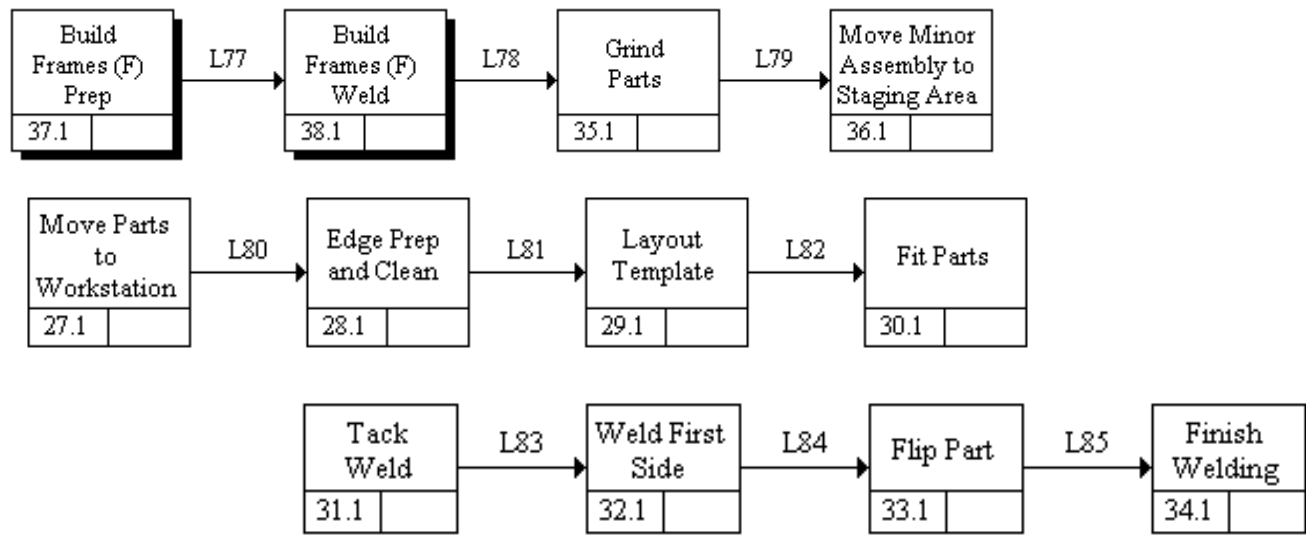
- IDEF3 (Integration Definition Language 3), an established process modeling language, is the backbone of WorkSim®.
- IDEF3 combines activities with sequencing and time dependence. Resource requirements are defined.
- Detailed process modeling forces you to think about the real steps involved in an activity. It exposes the inherent flaws in weight based estimating and many other estimating methodologies.

# Production Process Models



## Minor Sub Assembly Built Frames (F) IDEF3 Process Example

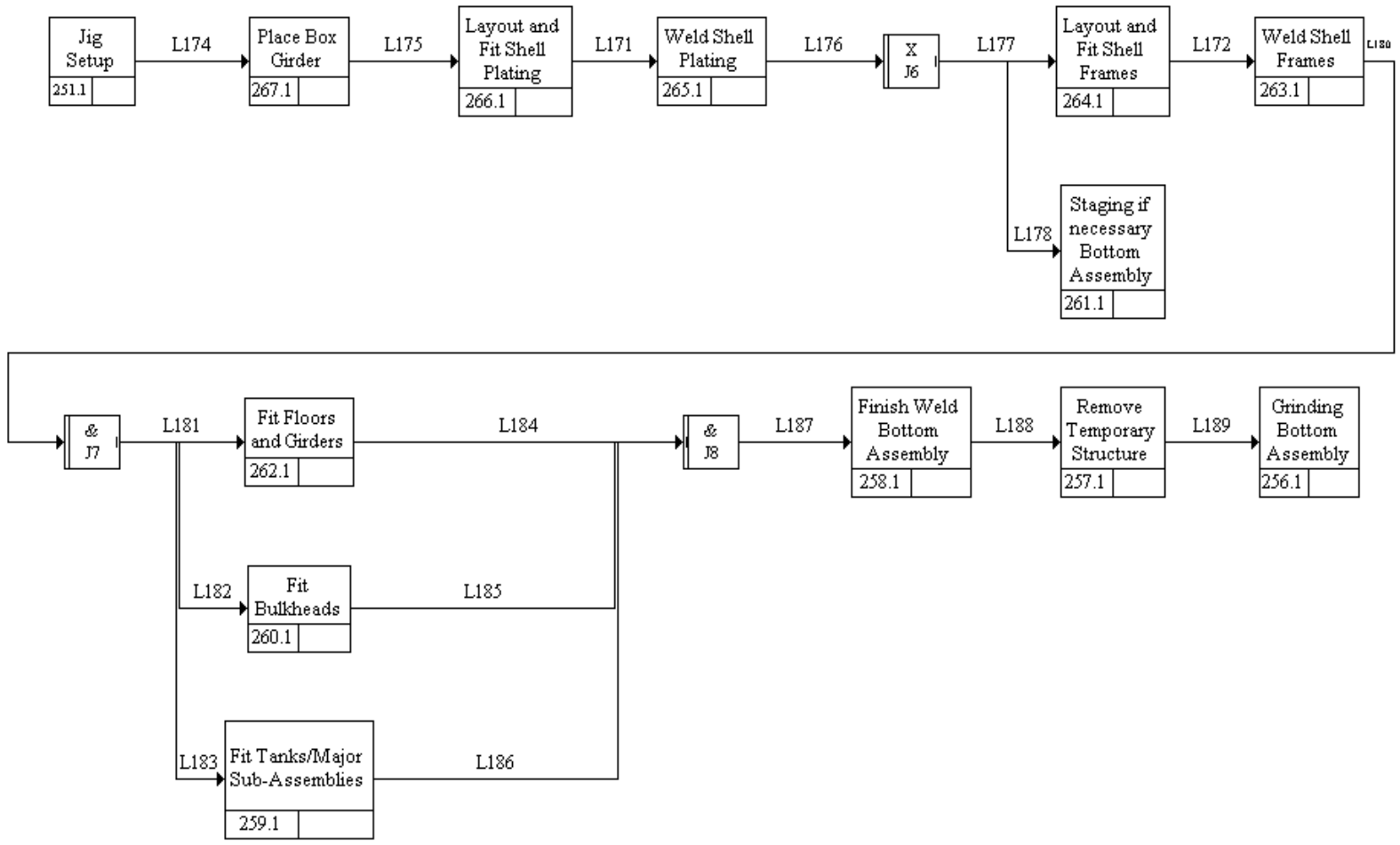
Built Frames (F)	
26.1	



# Production Process Models



## Bottom Assembly IDEF3 Process Model Example



# WorkSim® Basics



- Standard processes are defined in IDEF3
  - Processes are tied to skills and physical resources required to perform the process
- Resources are defined and documented
  - Resource availability calendars are established
  - Resource skills are defined
- Processes are instantiated as work content
- Work content is loaded into the simulation engine
- Simulation is run against a defined time horizon
- Schedules and work dispatches are generated



# WorkSim Setup



WorkSim - [Workflow: Center Assembly - C]

File View Reports Window Help

**Processes**

- Struct Assembly
  - Center Assembly - C
    - Mezzanine Assembly - H1
    - Mezzanine Assembly - H2
    - Side Assembly - S
  - Minor Sub Assembly
  - Outfit on Assembly
  - Panel\_Fab
  - Pre\_Outfit\_on\_Panel

**Resources**

- Personnel
- Equipment
- Location
  - Generic
  - Virtual
- Skills
- Teams/Group
- Queues

**Workload**

- Items
  - 10C0 Center Assembly - C
  - 11C0 Center Assembly - C
  - 12C0 Center Assembly - C
  - 21C0 Center Assembly - C
  - 22C0 Center Assembly - C

**Tasks List**

Task Name	Parent Task	Item Type	Junction Logic	Comments	Duration (minutes)	Duration Formula	Splittable	Status	User Reference
Center Assembly - C		Task			0		<input type="checkbox"/>	Unknown	
Jig Set-up	Center Assembly - C	Task			0		<input type="checkbox"/>	Unknown	
Place Deck Panel	Center Assembly - C	Task			0		<input type="checkbox"/>	Unknown	
Fit Girders	Center Assembly - C	Task			0		<input type="checkbox"/>	Unknown	
New Jn	Center Assembly - C	Fan-OUT Junc	Probabilist		0		<input type="checkbox"/>	Unknown	
Staging if necessary	Center Assembly - C	Task			0		<input type="checkbox"/>	Unknown	
Fit Structures_J	Center Assembly - C	Fan-IN Junc			0		<input type="checkbox"/>	Unknown	
Fit Bulkheads	Center Assembly - C	Task			0		<input type="checkbox"/>	Unknown	
Weld out	Center Assembly - C	Task			0		<input type="checkbox"/>	Unknown	
Remove Temporary Structure	Center Assembly - C	Task			0		<input type="checkbox"/>	Unknown	
Grinding	Center Assembly - C	Task			0		<input type="checkbox"/>	Unknown	
Fit and Weld Lifting Lugs	Center Assembly - C	Task			0		<input type="checkbox"/>	Unknown	
Inspect/QA	Center Assembly - C	Task			0		<input type="checkbox"/>	Unknown	

**Task Graphic View**

Center Assembly

```
graph LR; JigSetUp[Jig Set-up] -- FS --> PlaceDeckPanel[Place Deck Panel]; PlaceDeckPanel -- FS --> FitGirders[Fit Girders]; FitGirders -- FS --> NewJn[New Jn]; NewJn -- FS --> Staging[Staging if necessary]; NewJn -- FS --> FitStructuresJ[Fit Structures_J]; FitStructuresJ -- FS --> WeldOut[Weld out]; FitBulkheads[Fit Bulkheads] -- FS --> RemoveTemp[Remove Temporary Structure]; WeldOut -- FS --> Grinding[Grinding]; RemoveTemp -- FS --> FitWeldLugs[Fit and Weld Lifting Lugs];
```

Status Add Task Exit

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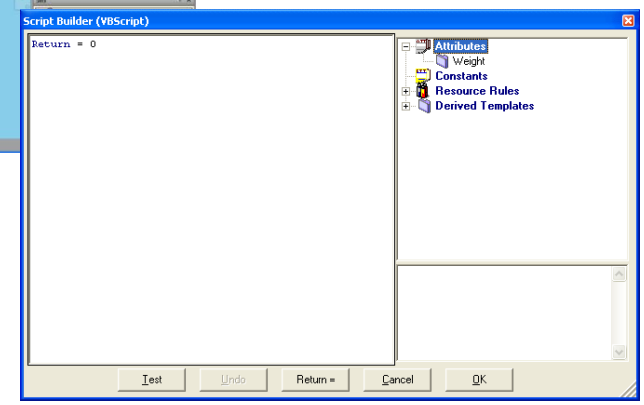
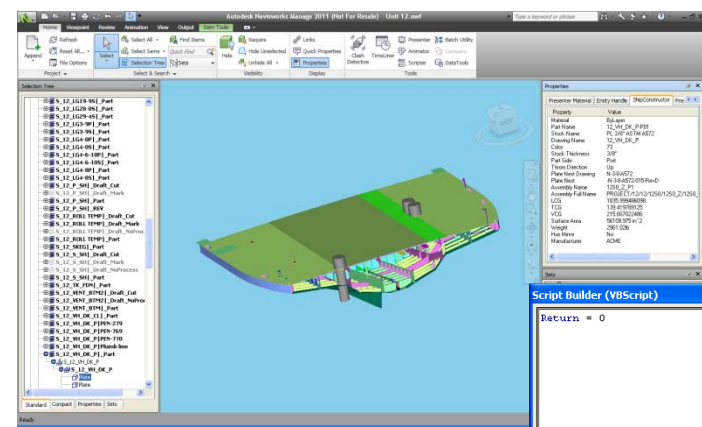


# Calculating Process Durations



- Process step duration formulas based on product geometry attributes
- Product attributes available in Navisworks® as downloaded from design software

Material:ByLayer  
 Part Name:12\_VH\_DK\_P-P01  
 Stock Name:PL 3/8" ASTM A572  
 Drawing Name:12\_VH\_DK\_P  
 Color:73  
 Stock Thickness:3/8"  
 Part Side:Port  
 Throw Direction:Up  
 Plate Nest Drawing:N-3-8-A572  
 Plate Nest:-N-3-8-A572-015-RevD  
 Assembly Name:12S0\_Z\_P1  
 Assembly Full  
 Name:PROJECT/12/12/12S0/12S0\_Z/12S0\_0\_P1/12S0\_Z\_P1  
 LCG:1035.999486098  
 TCG:139.419789125  
 VCG:215.667022486  
 Surface Area:56109.975 in^2  
 Weight:2961.02lb  
 Has Mirror:No  
 Manufacturer:ACME





# WorkSim Process Simulation



WorkSim - [Simulation Setup [Workload]]

File View Reports Window Help

Workload | Resource/Role Assignments | Engine Parameters | Trace Options | Simulation | Results

**Processes**

- Struct Assembly
  - Center Assembly - C
    - Mezzanine Assembly - H1
    - Mezzanine Assembly - H2
    - Side Assembly - S
      - Minor Sub Assembly
      - Outfit on Assembly
      - Panel\_Fab
      - Pre\_Outfit\_on\_Panel

**Resources**

- Personnel
- Equipment
- Location
- Generic

**Workload**

Items

- Center Assembly - 10C0
- Center Assembly - 11C0
- Center Assembly - 12C0
- Center Assembly - 21C0
- Center Assembly - 22C0
- Side Assembly - 12S0
- Side Assembly - 21S1
- Side Assembly - 21S0
- Side Assembly - 22S0
- Side Assembly - 22S1
- Side Assembly - 10S0
- Side Assembly - 10S1
- Side Assembly - 11S0
- Side Assembly - 11S1
- Side Assembly - 12S1

**Add Workload**

Workload Profile:

Profile Description:

Classification:

Quantity:

Inter-Arrival Time:  every

Start Date:

Process:

Group Items by Process

Workload Summary:

**Details**

Name	Description	InductionDate	Classification	Process	
[ all process types ]					
InScope	Name	InductionDate	Priority	Classification	Process
<input checked="" type="checkbox"/>	Center Assembly - 10C0	12/8/2010 12:33	0		
<input checked="" type="checkbox"/>	Center Assembly - 11C0	12/8/2010 12:34	0		
<input checked="" type="checkbox"/>	Center Assembly - 12C0	12/8/2010 12:37	0		
<input checked="" type="checkbox"/>	Center Assembly - 22C0	12/8/2010 12:37	0		
<input checked="" type="checkbox"/>	Center Assembly - 21C0	12/8/2010 12:37	0		
<input checked="" type="checkbox"/>	Side Assembly - 12S1	12/8/2010 12:46	0		
<input checked="" type="checkbox"/>	Side Assembly - 10S1	12/8/2010 12:46	0		
<input checked="" type="checkbox"/>	Side Assembly - 10S0	12/8/2010 12:46	0		
<input checked="" type="checkbox"/>	Side Assembly - 11S1	12/8/2010 12:46	0		
<input checked="" type="checkbox"/>	Side Assembly - 11S0	12/8/2010 12:46	0		
<input checked="" type="checkbox"/>	Side Assembly - 22S1	12/8/2010 12:47	0		
<input checked="" type="checkbox"/>	Side Assembly - 12S0	12/8/2010 12:47	0		
<input checked="" type="checkbox"/>	Side Assembly - 21S1	12/8/2010 12:48	0		
<input checked="" type="checkbox"/>	Side Assembly - 21S0	12/8/2010 12:48	0		
<input checked="" type="checkbox"/>	Side Assembly - 22S0	12/8/2010 12:48	0		

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# Next Steps

- Finalize process step duration formulas
- Complete API work for product attribute extraction
- Complete WorkSim modifications
- Load WorkSim examples and test
- Validate against actuals
- Implement
- Workshop and Final Brief at ShipTech



# Acknowledgements



National Shipbuilding Research Program and NAVSEA for project funding

Guido Perla and Associates for ferry product model design graphics

Project participants for their support and contributions





# Conclusion

## Questions or Additional Information

Including registration for POV Planner Workshop following ShipTech  
2011 on March 17, 2011 in Biloxi, MS

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