We Simplify Shipbuilding

Enhancing Planning Fidelity with Production Simulation

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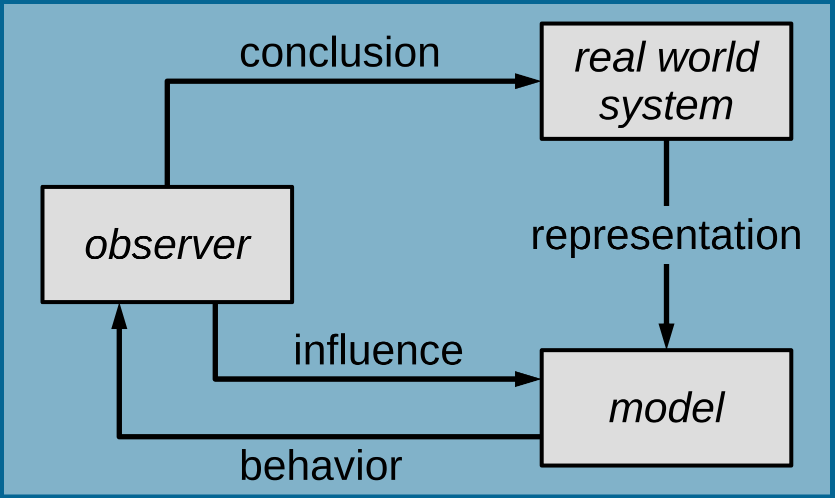
Presentation Goals

- Define what we mean by Production Simulation
- Brief Industry on A-es SBIR and NSRP Simulation Projects
- Differentiate the A-es Topgallant® Shipyard Solution
- Debunk the myth of DES start-up complexity
- Illustrate a DES project start-up

How Do We Define Simulation?

Discrete Event Simulation (DES):

Modeling dynamic processes in real systems to predict a real system's behavior by tracing a system's changes of state over time starting from some initial state



Source: Page and Kreutzer 9

Navy SBIR N06-173 *Automating Assembly Planning and Simulation*

Funding Status:

- Phase II completed 12/2010
- Two Phase III NSRP projects for GD NASSCO. Second ends 12/2011

Technical Status:

- Shipyard Modeling Tools – TRL 7
- Simulation Modeling Tools – TRL 5

Commercialization Status:

- Installed at GD NASSCO – Purchase pending
- Marketing to other US shipyards with GD NASSCO reference support
- Planning for other manufacturing markets

Commercialization

Business Models:

1. Software License Model: A-es licenses to industry, provides on-site implementation assistance, technical support, and software maintenance contracts.

2. Outsourcing Model: A-es manages complete simulation project, including developing and maintaining facility and production models. Simulations can be run by A-es or client.

Simulation System Status

Shipyard and Product Modeling Tools – TRL 7

- *Facility Modeler, Assembly Production, SAAT, VSG, CAD Adapter*

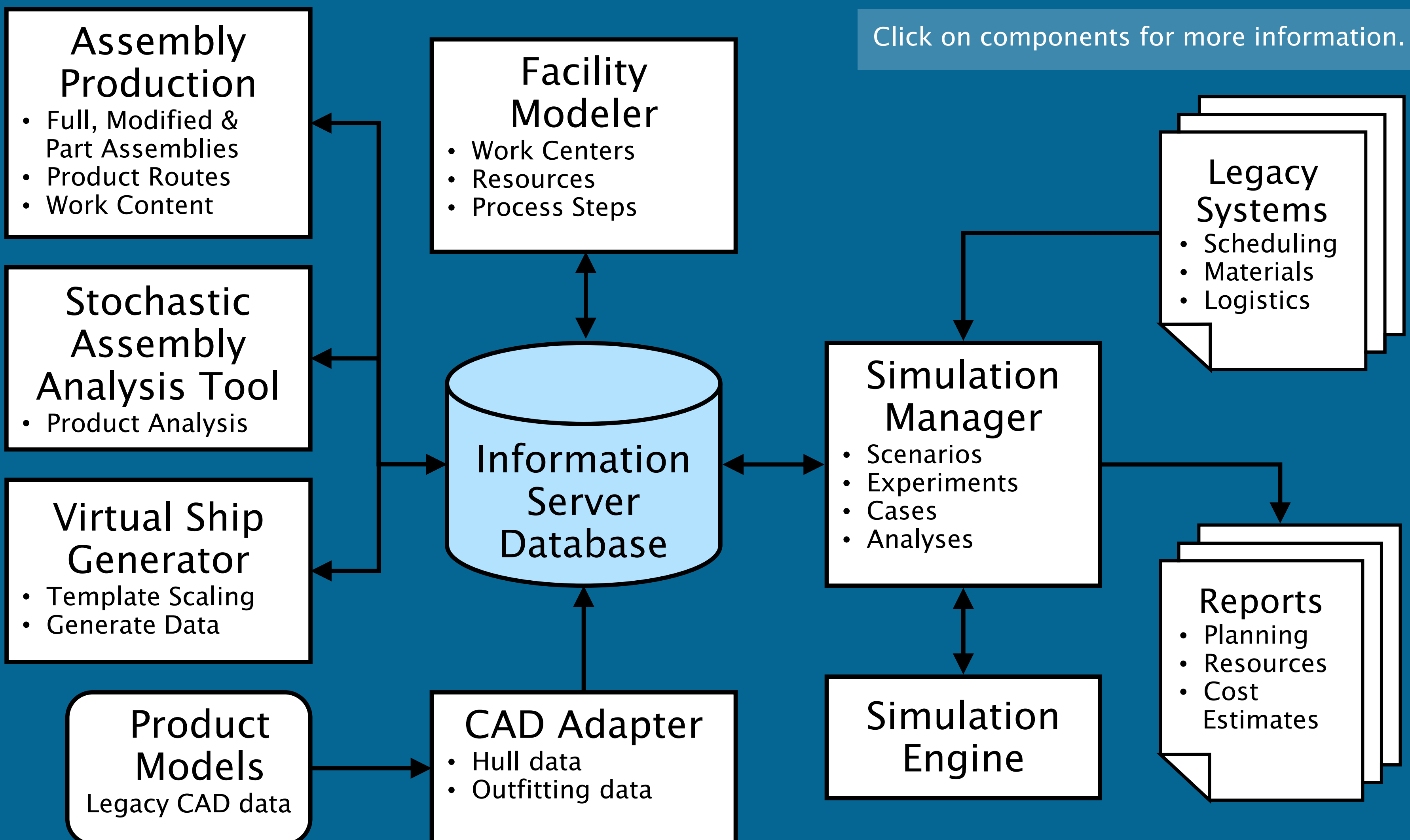
Simulation Management Tools – TRL 5

- Prototype complete: creates and manages scenarios, runs simulations
- Additional development planned to integrate controllers and new modeling features, support added scenario constraints, animation, and customized reporting

Technology Readiness Levels (TRLs)

TRL	Definition	Description	Supporting Information
5	Component and/or breadboard validation in a relevant environment.	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so they can be tested in a simulated environment. Examples include "high-fidelity" laboratory integration of components.	Results from testing laboratory breadboard system are integrated with other supporting elements in a simulated operational environment. How does the "relevant environment" differ from the expected operational environment? How do the test results compare with expectations? What problems, if any, were encountered? Was the breadboard system refined to more nearly match the expected system goals?
6	System/subsystem model or prototype demonstration in a relevant environment.	Representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in a simulated environment.	Results from laboratory testing of a prototype system that is near the desired configuration in terms of performance, weight, and volume. How did the test environment differ from the operational environment? Who performed the tests? How did the test compare with expectations? What problems, if any, were encountered? What are/were the plans, options, or actions to resolve problems before moving to the next level?
7	System prototype demonstration in an operational environment.	Prototype near or at planned operational system. Represents a major step up from TRL 6 by requiring demonstration of an actual system prototype in an operational environment (e.g., in an aircraft, in a vehicle, or in space).	Results from testing a prototype system in an operational environment. Who performed the tests? How did the test compare with expectations? What problems, if any, were encountered? What are/were the plans, options, or actions to resolve problems before moving to the next level?

Topgallant® DES System Overview



Atlantec DES Market Segments

- Shipbuilding
- SME Advanced Manufacturing
- Offshore Wind Power

Source: Wright

Source: Stuart

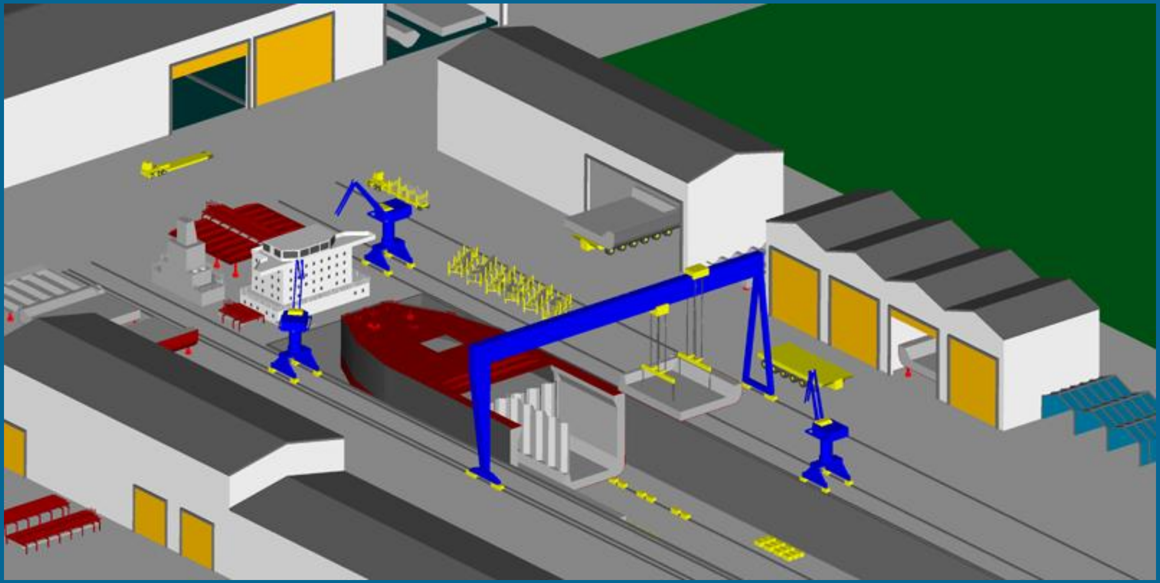
Source: Revall

Topgallant® Solution

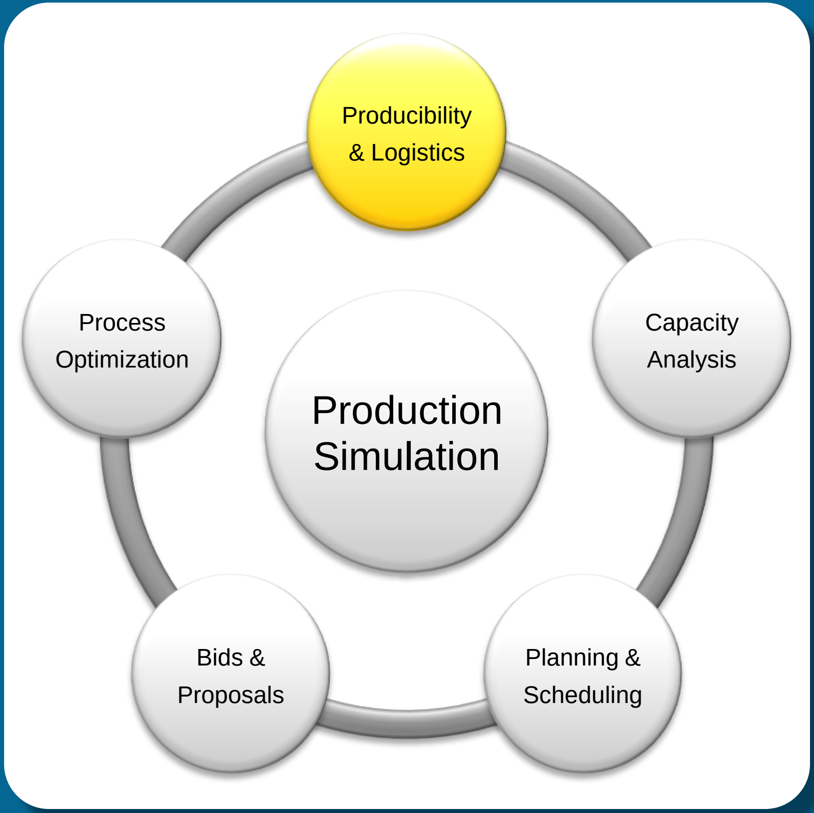
- Provides a nearly turnkey system for shipbuilding
  - Installation in US and EU research programs
  - Implement with limited expertise
  - Develop models quickly
  - Apply progressively
  - Validate simulation results easily
  - Document vital enterprise manufacturing information

Different from Other DES Approaches

- Reduces modeling time
- Improves analysis fidelity
- Easy to make changes
- Includes advanced modeling components

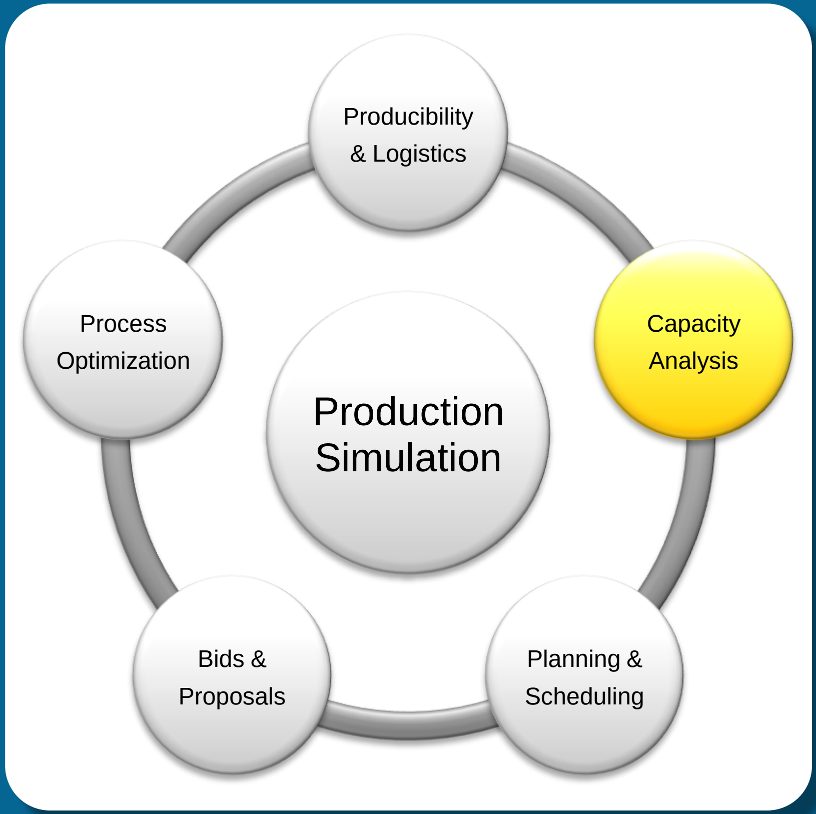


How DES Can Be Used in Shipbuilding



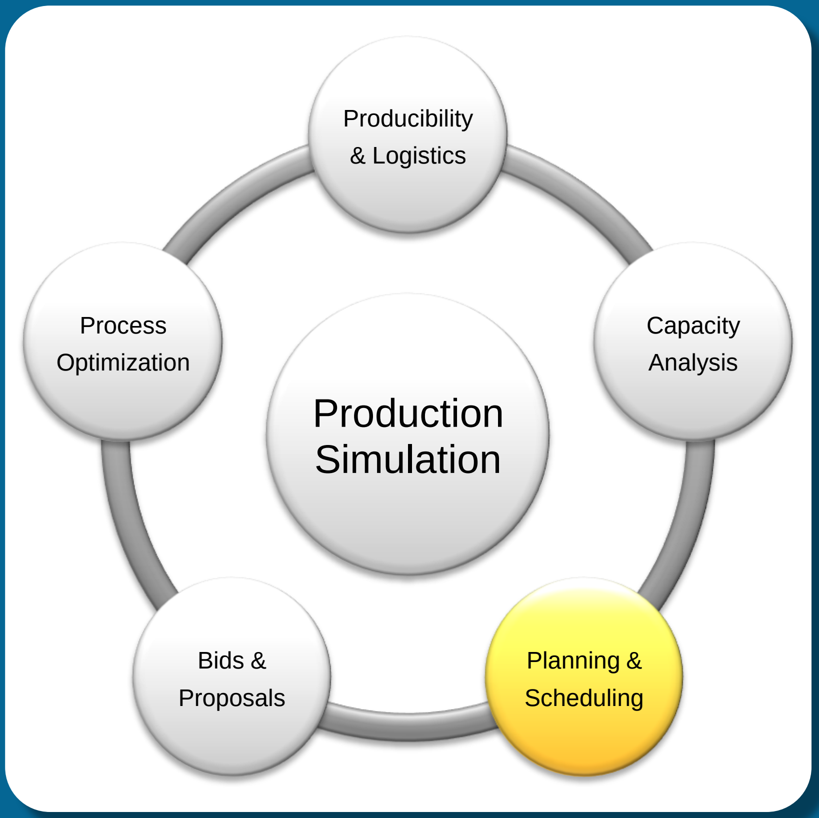
- Producibliy & Logistics
  - Validate task sequences for manufacturing, ordering and delivery
  - Evaluate material or cargo flows
  - Understand impacts on transportation networks
  - Create visualizations and animations

How DES Can Be Used in Shipbuilding



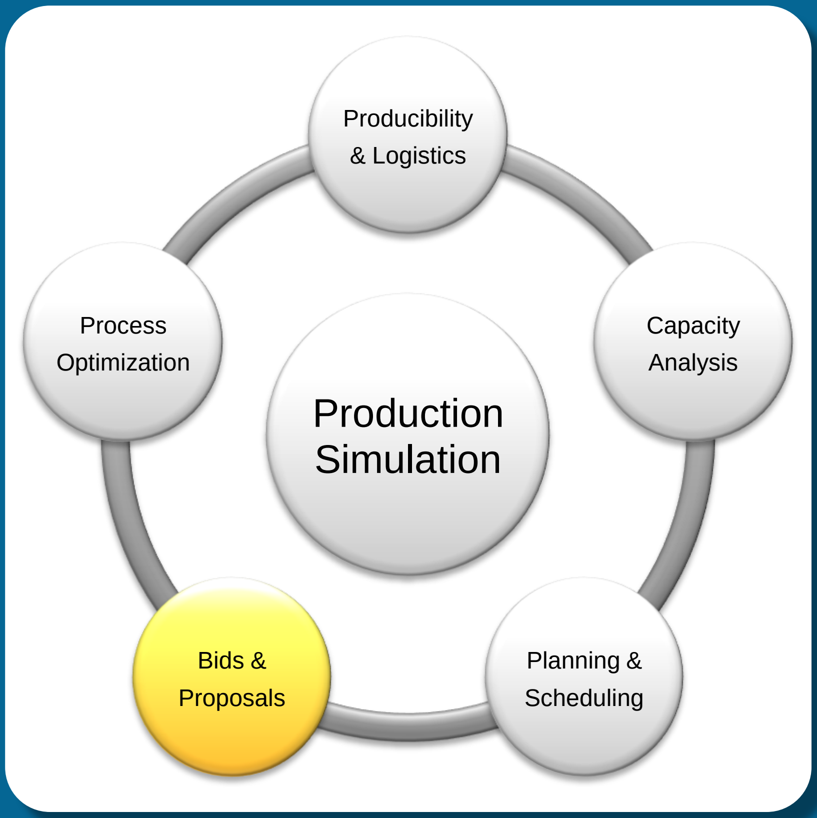
- Capacity Analysis
  - Analyze facility and resource utilization
  - Evaluate proposed changes for facility and process improvements, build strategies, and product routings
  - Determine manning, transportation and storage requirements
  - Identify bottlenecks and production flow characteristics

How DES Can Be Used in Shipbuilding



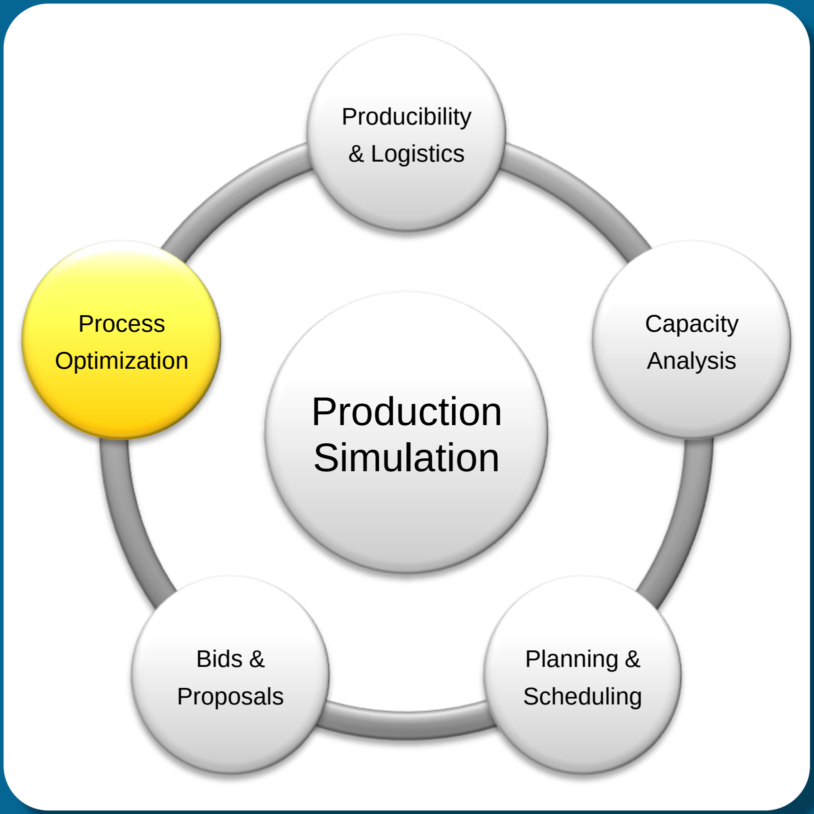
- Planning & Scheduling
  - Validate proposed schedules and changes
  - Determine requirements for schedule adherence
  - Support precise, short-term planning and long-term forecasting tasks
  - Identify periods for changing resources to level load facilities

How DES Can Be Used in Shipbuilding



- Bids & Proposals
  - Validate and refine work-content and resource requirements
  - Evaluate configuration to minimize impacts of new work on current programs
  - Compare proposed scenarios for cost-benefit analysis
  - Examine production aspects of design alternatives

How DES Can Be Used in Shipbuilding



- Process Optimization
  - Compare merits of different scenarios to find best case configuration
  - Increase utilization levels, level load facilities and maintain schedule adherence
  - Determine efficient building sequences

Myths of Start-up Complexities

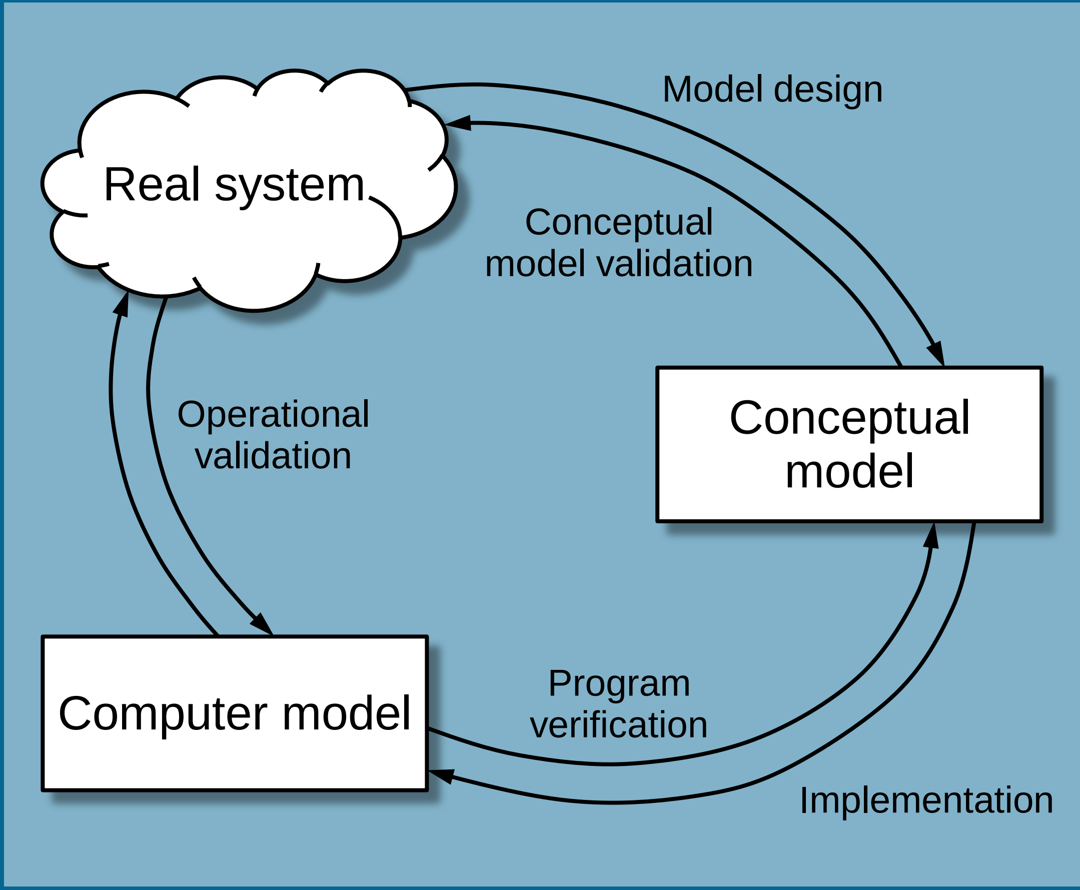
- Mature data and validation requirements can be met without great efforts
  - Knowledge-based products capture vital enterprise information
  - Equipment operating data is available
  - Production planners and team leaders have vital information
- Modeling the entire yard may not be necessary
  - Start with areas of concern
  - Build on previous models
  - Use basic duration-based processes
  - Day-to-day scheduling requires very detailed information

Myths of Start-up Complexities

- Immediate access to product data is not required
  - Areas of analysis may not require detailed product structure
  - Start with similar production levels
  - Develop product data using templates and *VSG*

Simulation Project Cycle

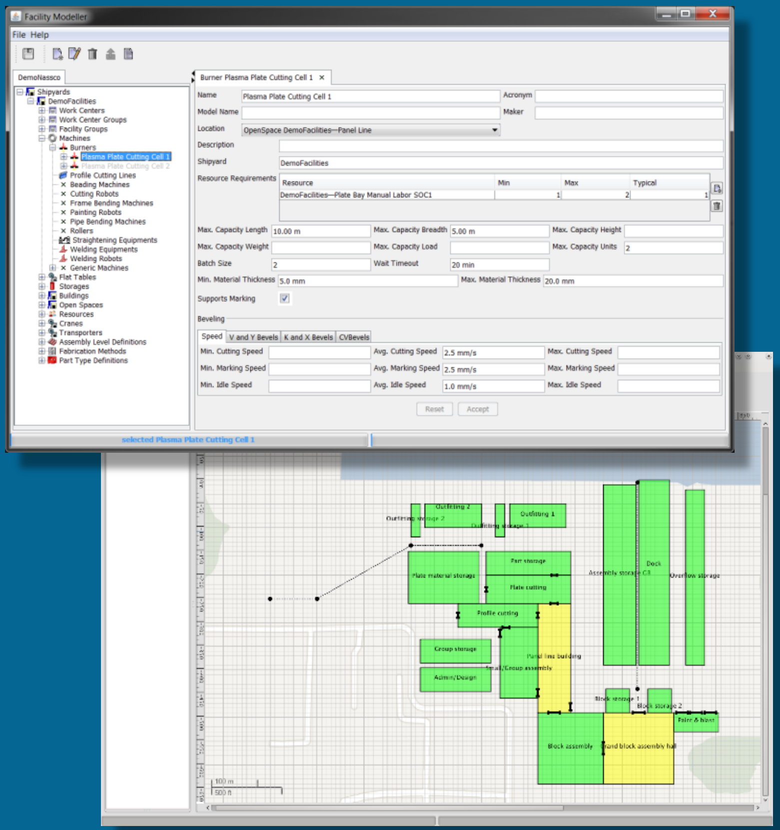
- Problem definition and system identification
- Model design
- Data collection
- Model implementation
- Experimentation
- Analysis of results
- Presentation and documentation
- Putting recommendations into practice



Source: Page and Kreutzer 13

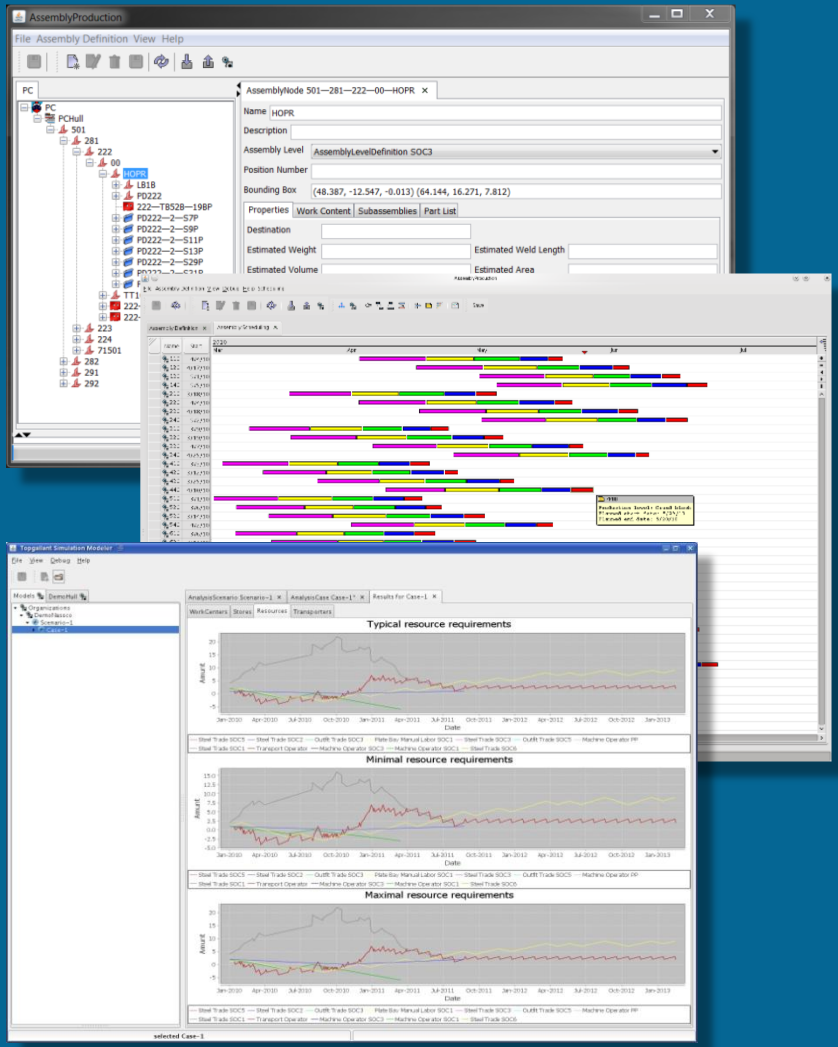
Initiating a Simulation Project

- Identify goal of simulation
  - Capacity analysis
  - Schedule adherence
  - Resource management
- Model facilities or part of facilities
  - Start with production areas, use durations when needed
  - Add machines and processing rates
  - Define resources
  - Additional details as needed



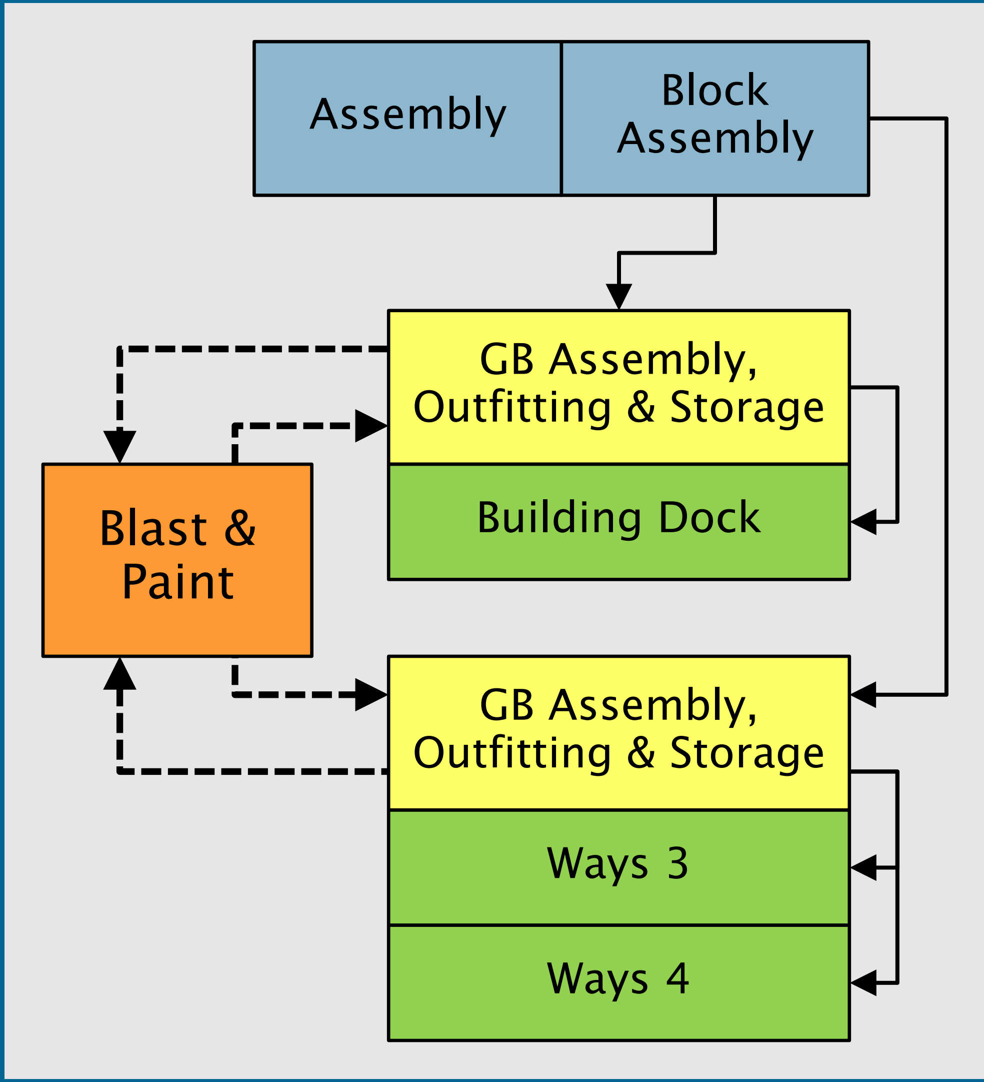
Initiating a Simulation Project

- Manage product data
  - Assign production routes
  - Create schedule
  - Create virtual product data if needed
- Run simulation & analyze results
  - Assembly delivery dates
  - Resource consumption
  - Area utilization

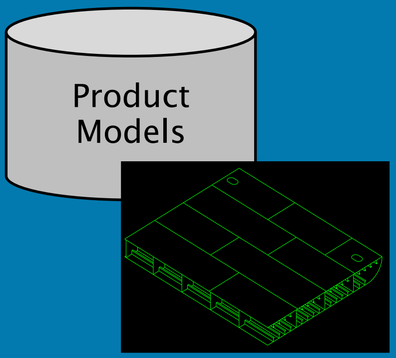


Practical Applications: GD NASSCO Bottleneck in Blast & Paint Shops

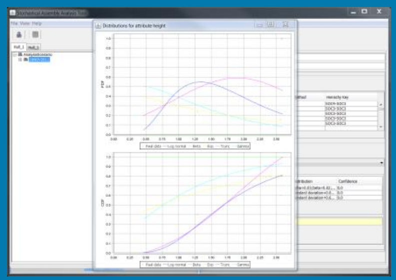
- Production schedule places high demand on blast & paint facilities
- Look at parent erection locations, storages and laydown dimensions
- Shift portion of work to GB Outfitting areas
- Simulate new product routes to level load facilities and still meet schedule



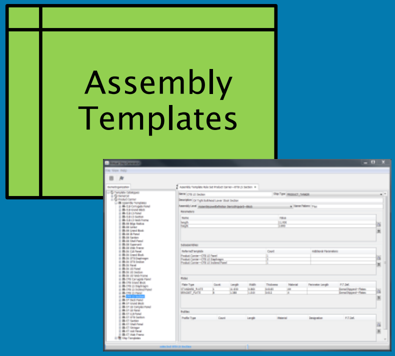
Practical Applications: GD NASSCO Long-term Scheduling for New Designs



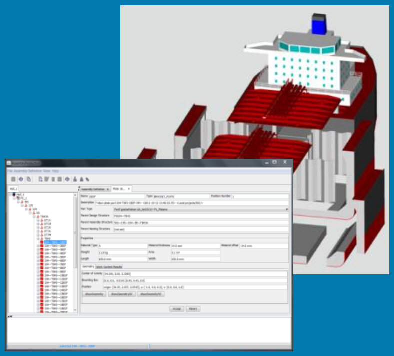
Extract past design data



Analyze products for template library

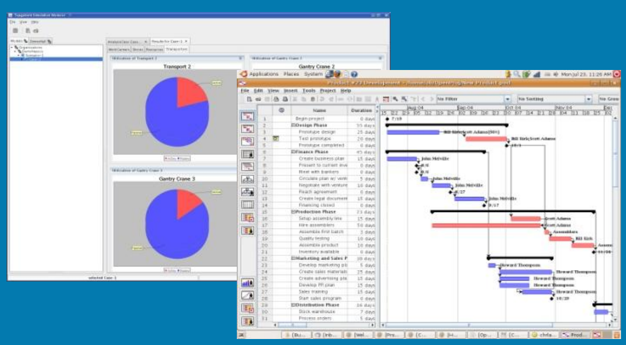


Select and scale desired templates



Generate virtual product data

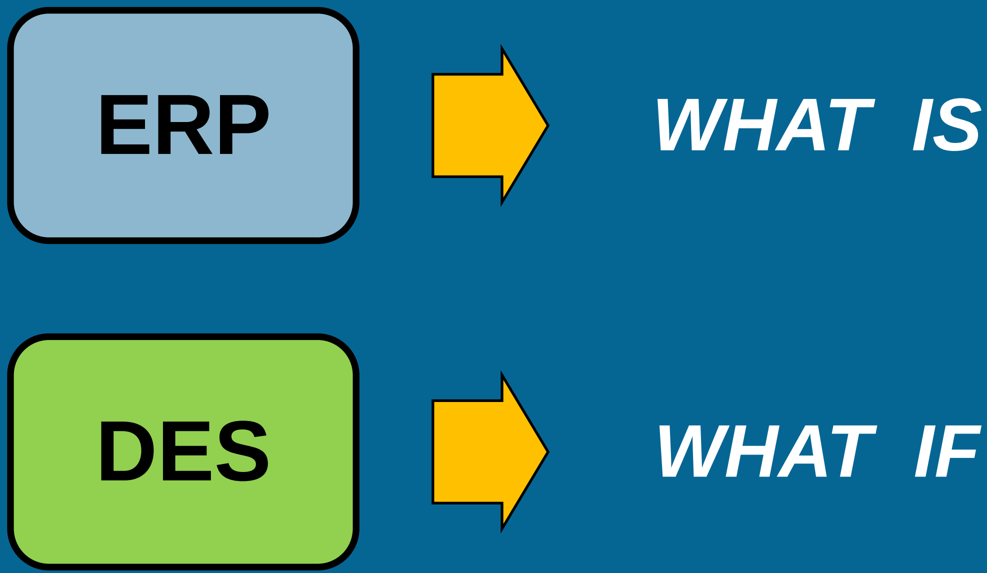
- Analysis of past designs to build library
- Select similar templates for new design
- Generate virtual product data from templates
- Dynamic simulation of production for accurate bids and proposals



Simulate virtual data for new ship design

DES and ERP Systems

- ERP: from business to engineering and production
- DES: from engineering and production to business



- DES provides a dynamic approach to decision making

Conclusions

- Shipyards can quickly document vital enterprise knowledge and reduce risks by implementing an automated production simulation system
- Like any other powerful methodology or technology it will take a long time to fully exploit its potential
- However companies will quickly benefit from its use by enhancing planning information fidelity, reducing schedule risks and cost overruns
- Production simulation should be considered a journey leading to continuous improvement and statistical quality control

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