MSC Software Technology For Shipbuilders

tony.abbey@mscssoftware.com
MSC Software Technology For Shipbuilders

Paper Overview

MSC Software tradition in shipbuilding

What is the MSC Software Solution Today

A solution to the **simulation process** – not just the *event*!

The paper will describe the key process simulation tool available SimManager

Then we will highlight some detailed technologies for ship building productivity through PATRAN, MD NASTRAN and SimXpert
Shipbuilding

Strength and Fatigue Assessment System For Large Ship Structures

- Class rule based Sections Scantlings tool for hull girder strength
- FSI for sloshing, “bottom slamming”, Ship Shock “green water” analyses

Ship hull modeling system automation

Ship Shock, Collision & Grounding

MSC Software Technology For Shipbuilders
MSC Software Technology Tradition in Shipbuilding

Germanischer Lloyd

GL/ShipModel

Summary:
The German classification society Germanischer Lloyd is using MSC.Patran as the foundation for their industry-specific solution GL/ShipModel. Through customization based on the MSC.Patran pre-processor, GL/ShipModel enables pattern-based semi-automatic modeling of ship structures while taking into account specific shipbuilding modeling needs. Tailored to the shipbuilding engineering process flow, the program’s functionality is saving time up to 30% and cost, and increasing quality. VPD tools from MSC Software are helping Germanischer Lloyd meet safety requirements, and tight schedules while maintaining acceptable profit margins.

“The ability to model in parallel to the engineering process by splitting the geometry and property input is a clear improvement.”

“Tailored to the shipbuilding engineering process flow, the program’s functionality is saving time – up to 30% – and cost, and increasing quality.”
MSC Software Technology Tradition in Shipbuilding
MSC Software Technology Tradition in Shipbuilding

Sesam Patran-Pre from DNV is developed by MSC UK and sold by DNV

Tribon Access is a toolkit in Patran as an interface with AVEVA’s Tribon CAD system. It is developed and sold by MSC UK.

NAPA (Finnish ship design software) is providing an interface with Patran/Nastran based on Patran PCL.

Lloyds Register was a pioneer with MSC Nastran and more recently MSC UK developed a panel buckling toolkit in Patran for them.
The Simulation Process - How often do we …

- Try to find a model or analysis from a program we worked on a couple years ago?
  - Takes too long to find it
  - Can find results but not the model or assumptions
  - Can’t find it at all
  - The person left the company or moved to another program

- Give someone the wrong model to start their analysis?

- Want to pass on the experience and best practices of senior analysts to younger engineers?
Ship System Scenario

• AEGIS Missile Guidance Program has a request for re-work on the Digital Processing Board (DPU) tied to the MK 99 Fire Control System RFA Driver Box.

• Customer requested that work needs to be completed in a very short time (less than 1 week).
As a Manager – Where do you Go?

- AEGIS Program started by NAVSEA in 1977 32 years ago.
- Started at Raytheon 30 years ago.
  - Lot’s of employees, contractors, & subcontractors involved
- Where do you start?
  - Can we use an older analysis?
  - Where is the analysis?
  - Who did the analysis?
  - What process was used?
  - Was analysis is needed to be repeated?
  - What assumptions were used?
Intellectual Capital
Creation of the Experienced Engineer

The experience gained from trial based learning

MSC Software Technology For Shipbuilders
Traditional Analytical Information Life Cycle

Disconnected Information Islands

PROJECT

MSC Software Technology For Shipbuilders
But what happened to all of the engineering content in between that describes risk reduction and performance characteristics of the product?
Simulation Process And Data Pedigree

Automatically Captured, Always Available

Design/Analysis Pedigree Audit
- What FEM components
- What FEM Assy method
- What root CAD models
- What Program Milestone / Design Configuration

Simulation DATA Pedigree Audit
- What data are we operating on?
- What loads used
- What FEM model used
- What Results created
- What Report created

Simulation Process Pedigree Audit
- What method used to create it?
- What tool used to solve (and version)
- Parameter setting
- IT/Computation metrics/settings

MSC Software Technology For Shipbuilders
SimManager – Finding Information
Enterprise Customer Examples

CAE Work Bench
Increase Simulation - Correlate Test
35% Increased Throughput in Simulation Departments
• 200 – 10,000 analyses growth
• Predictive power in early design
• Make Physical Test more valuable, e.g. Comparison
• Enables earlier and faster Performance Analysis of the Product

BCA Propulsion Portal (IPAP)
Significantly Reduce Process Time
• Integrates entire Propulsion Loads and Analysis process
  • Static & Dynamic Loads
  • Fan Blade Out and related transient events
  • Primarily Based on MSC.Patran and MSC.Nastran
• Core Analysis performed by Internal Analysts

Hydraulic Cylinder Design Portal
Analysis Driven Design
• Automated Product Specification
• Rules Based Simulation Design
• Managed process and data
• 6 Sigma Certified Design Process
• 100% of Product Validated Virtually
• Dramatic Productivity Improvements
• Significant Design Improvements

MSC Software Technology For Shipbuilders
Roadmap to Phased SimManager Implementation

1. Foundational System
   - Content Management and Traceability
   - Work Status Tracking
   - Select Integrated Clients

2. Tool Integration
   - Integrated Clients
   - Tool Launches
   - Job Submits

3. Post-Processing
   - Libraries of Result Extraction Automations
   - Standard Result Extraction Sets per Solution Type
   - Templated Comparison Reports

4. Pre-Processing
   - Managed Model Assembly
   - Automated Load Case Application
   - Libraries of Standard Loads & Materials

5. PDM Integration
   - Test DB Integration

**Enterprise Integration**

**Automation Of Process**

**Initial Focus:** Managing Engineering Content Tied to Work Request To Capture Best Practices
SimManager Adoption Accelerating
Major customer deployments

[Images of various companies and organizations]

MSC Software Technology For Shipbuilders
MSC Software Technology For Shipbuilders

Some of many Highlights!

• MD Nastran MDACMS
• MD Nastran Glued Contact
• MD Nastran Touching Contact
• MD Nastran Explicit and FSI
• Patran – new productivity
• MD Nastran - Marc technology – welding process
• SimXpert – linking MD Adams with MD Nastran
MD Nastran MDACMS

- Details
  - Matrix Domain Automated Component Modal Synthesis
  - Faster solution Time using MDACMS for very Large Models

- Why using MDACMS?
  - Significant Improvement on I/O and Solve Time
    - Improving release after release
  - Automatic Partitioning
    - Solving hundreds of small problems, more efficient and better suited for CPU architecture and multi-processing (SMP,DMP)
  - Works in a Broad Set of Solutions
    - Statics, Dynamics, Non-Linear and Optimization
    - Can be used in ADAMs Flex Body Reductions
    - Supports External Superelements
  - Intelligent use of Scratch Memory (SMEM)

- Application
  - Large FEM and Complex FEM Assemblies
    - Aircrafts, Cars, Ships, Trains
MD Nastran Glued Contact

• Details
  • Glued Contact Between Bodies

• Traditional FEM Techniques
  • Create Separate Detailed Models, Mesh Transitions, Making Nodes Coincident…
  • Apply Load/Displacement via Fields to Local Refined Model
  • Solving Local Detailed Model

• Why is it better?
  • Fast and Easy Setup for Glued Contact
  • Accurate Stiffness & Loads Transfer

• Application
  • Expedite Creation of Large FEM Assemblies
    • Aircrafts, Cars, Ships, Trains
  • Detailed Components & Other Assemblies
    • Beams to Plates, Plates to Solids, Beams to Solids
  • Perform Global/Local fully integrated Studies

Expedithe Assembly & Local Meshing

Integrated Global Local Analysis

MSC Software Technology For Shipbuilders
MD Nastran Linear Touching Contact

- **Details**
  - Touching Contact Between Bodies

- **If you ignore Touching Contact**
  - Assumptions on Design using Rigid Connections
    - Over-conservative stiffness
  - Conservative bolted joint Assemblies
    - All Loads going through fasteners

- **Why is it better?**
  - Fast and Easy Contact Detection Setup
  - Accurate Stiffness & Loads Transfer
    - Avoid *going-through* situations in linear statics
    - Analytic smoothing
    - Representative heel-and-toe simulation
  - Enables preload and interference fit in linear statics

Predicts Realistic Contact & Stiffening Effects

Enables Bolt Preloading and Interference Fit
Patran 64-bit Platform Support

- **Description**
  - Patran 2010 now supports 64-bit Windows
  - Linux 64-bit pre-release can be used for testing
  - 32-bit production version also available for both 64 and 32-bit Windows and Linux as well as all other supported platforms.
  - Take advantage of the full computing power of your PC

- **Benefit**
  - Better efficiency, stability, productivity, and performance
  - Average 15% performance improvement compared to 32-bit version, up to 32-bit memory limits
  - 64-bit Model size only limited by available memory
  - Tested on model sizes > 50M elements
Patran Ribbons – exposing functionality in a modern, intuitive way

No need to remember the old menu structure

Patran RMB – constrain your mouse!

Quick Access Bar (QAB) – roll your own!

Much more coming!
MD Nastran Explicit and OpenFSI

Explicit Lagrangian

Explicit Eulerian

OpenFSI
ADAMS Motion with MD Nastran in SimXpert

Applications in Lifting and Handling

Issues

• Strength of Rig
• Clashing of Rig
• Permanent set and strength of Component

Options

• Positioning Path of Rig
• Attachment point positions
• Support Bracing
ADAMS Motion with MD Nastran in SimXpert

Structures (flex body)

Kinematics - Motion

Two technologies in a single product – and more if you want it..

MSC Software Technology For Shipbuilders
ADAMS Motion with MD Nastran in SimXpert

Kinematics Drive Crane and Rig positions

Component Model fidelity can be varied
Attachment positions can be varied

Rig can be rigid with joints
Or have flexible body information built in

Multiple Load states on Component for Nonlinear permanent deformation analysis
Or continuous transient dynamic analysis
ADAMS Motion with MD Nastran in SimXpert

Construction kit type of approach to what if in the rig

Force, displacement, velocity etc.

Swap in, swap out of flex bodies dependent on design maturity
ADAMS Motion with MD Nastran in SimXpert

Cargo unloading demonstrated

- Applications to refueling
- Cross deck supply
- Cargo or equipment motion in sea state
Phased analysis and test correlation study

Phase 1: Modeling thermal loading and material phase changes due to welding process on a bare plate

• Captures resultant weld state and residual stresses
• Extending to multi passes
• Correlation against test

Phase 2: Modeling thermal loading and material phase changes due to welding process on typical 3D joints

• Tacking process
• Multi passes in a 3D structure
MSC Software Weld Technology

Marc technology embedded in MD Nastran

- Moving thermal ‘bubble’ defined by
- Material phase changes

Filler Material
Predicted Fusion Boundary

Sections Along Weld Bead
(Temperatures above fusion temperature of 1400 Deg. C shown in red)
Predicted Fusion Boundary Versus Measured

Transverse Section View - Mid length
(Temperatures above fusion temperature of 1400 Deg. C shown in red)

Looking for NSRP interest via Shipyard sponsor as we move to phase 2
Thank You

Questions / Answers…

tony.abbey@mscsoftware.com

david.wert@mscsoftware.com