Developing Awareness of Non Traditional Engineering Disciplines at NNS

Teacher Enrichment Program
Bite of Science
Air and Space Museum
Hampton, Virginia

Michael Wallace, NNS
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Overview

Bite of Science provides an opportunity to:

• Share information about NNS and the NNS Career Pathways

• Tell my story as it relates to STEM

• Relate STEM to NNS engineering activities

• Introduce the field of Test Engineering

• Introduce the specialized field of computer based data display and acquisition

• Discuss a specific application at NNS
Michael Wallace is an Engineering Supervisor in the Test Division at Newport News Shipbuilding in Newport News, Virginia. His work experiences include design engineering tasks on a variety of platforms including Submarines and Aircraft Carriers. His areas of expertise include machinery design, submarine acoustics, and data acquisition. His current charter is to lead a team of data acquisition specialists in providing automated data acquisition and instrumentation services in support of shipboard testing, construction processes and shipyard facilities. Mr. Wallace received his BSME from Virginia Polytechnic Institute and State University.
Huntington Ingalls Facts

- Annual revenues of approximately $6.6 billion and current backlog of approximately $20.7 billion

- Employees: about 37,000; largest industrial employer in Virginia, largest private employer in Mississippi and Louisiana

- Key Locations:
  - NEWPORT NEWS SHIPBUILDING
    - Newport News, VA (Nuclear Aircraft Carriers, Submarines, Overhaul)
  - INGALLS SHIPBUILDING
    - Pascagoula, MS (Surface Combatants, Amphibs, CG large cutters)
    - New Orleans, LA (Amphibs, Auxiliaries)
    - Virginia Beach, VA (AMSEC, Fleet Support)
    - San Diego, CA (Continental Maritime, Fleet Repair & Support)
    - Gulfport, MS (Composite R&D, Composite Components)

The Nation’s Leading Military Shipbuilder
Newport News Shipbuilding

- Sole Supplier of U.S. Navy Aircraft Carriers
- One of Two Builders Constructing Virginia Class Nuclear Submarines
- Exclusive Provider of Refueling Services for Nuclear-Powered Aircraft Carriers
- Largest Non-Governmental Provider of Fleet Maintenance Services to the Navy
- Largest Industrial Employer in Virginia – More Than 22,000 Employees
- Home of one of the Western Hemisphere’s Largest Dry Docks and Cranes
People

- About 37,000 employees
- Third-, fourth- and fifth-generation shipbuilding employees
  - More than 5,100 engineers and designers
  - More than 1,600 employees with advanced degrees
  - More than 19 different crafts & trades employed
  - Nearly 5,500 veterans

- Over 1,000 Master Shipbuilders (40 years or more)

"Integrity is at the heart of who we are and what we do. We are each personally accountable for the highest standards of ethics and integrity. We will fulfill our commitments as responsible citizens and employees. We will consistently treat customers and company resources with the respect they deserve."

The True Key to our Success
Students who see the relevance of the study they do in class and have a vision of what they want to become, perform better at school and are better prepared for the world of work.
Career Pathways History

• Partnered with Newport News Public Schools (NNPS) in 2009

• Pilot program ran between 2009-2010

• NNS Career Pathways Department officially established in February 2011

• Expanded to Hampton and Virginia Beach Public Schools for 2011-2012 school year
Why Career Pathways

- To introduce students to the opportunities and benefits of working at Newport News Shipbuilding
- To influence students to focus on Science, Technology, Engineering and Mathematics (STEM)
- To conduct activities that focus on STEM ideas and applications
- To help improve the public image and correct misinformation about Newport News Shipbuilding
- To assist public school students to become college, career and citizenship ready

Exposing students early to NNS will encourage them to pursue a career in a STEM field and help replace our retiring workforce.
Career Readiness Skills

- Speaking & Listening
- Problem Solving
- Work Ethic
- Positive Attitude
- Application (STEM)
- Independence & Initiative
- Self – Presentation
- Attendance
- Teamwork
- Skills Training

Career Readiness Skills are highlighted at all Career Pathways events
Career Pathways Initiatives – HOW?

**INTERNSHIPS**

**JOB SHADOWING**

**WORK-SITE OPPORTUNITY**

**CAREER FAIR/ SPEAKERS BUREAU**

**MIDDLE SCHOOL PARTNERSHIP**

**CLUBS & ACTIVITIES**

- Through job shadowing, students and/or educators learn by walking through the work day as a "shadow" to a skilled worker. Job shadowing is a temporary unpaid exposure to the workplace in the student's Career Pathway of interest.
- Speakers Bureau members are informed professionals who give engaging presentations at schools to increase students and educators understanding of careers. When schools hold Career Fairs, students may contact professionals in the community for information or resources.
- Internships allow students and/or educators to apply their career specific knowledge through placement in an organization for a predetermined period of time. Internships may be paid or unpaid.
- Work-site opportunities are broadly defined as experiences that expose students and/or educators to the world of work in a particular Career Pathway. Examples include field trip participation, observing and volunteering.
- A middle school and a business formally agree to work together on projects and activities that enhance the quality of education, while developing essential Career Readiness Skills.
- Clubs & Activities meet with students on a regular basis to provide exposure to a particular Career Pathway or to develop career skills. Examples include a Medical Professionals Club or a Financial Literacy Course.
Major Events 2012-2013 School Year

- Egg Drop activity at all NNPS High Schools and Middle Schools & two Hampton Schools
- Egg Drop Competition held at NNS between all NNPS High and Middle School winning teams
- Duct tape boat building activity – High Schools and Career Fair
- NASA/NNS/PEC Engineering Career Day
- Youth Career Expo –Major Sponsor
- High School Job Shadowing/Spring Break Make It Work Program
- Summer teacher internship
Students Reached During 2012-2013 School Year

Hampton: 2,239
Norfolk: 480
Virginia Beach: 14,167

Peninsula & Middle Peninsula Area Schools Combined Events: 3,043

Newport News: 3,396
Portsmouth: 500

Southside Area Schools Combined Events: 408

Smithfield/Isle of Wight: 1,080
Yorktown/Williamsburg: 1,080
Newport News: 3,396

Smithfield/Isle of Wight: 301
Southampton: 100

Suffolk: 80
Chesapeake: 180

Total Students: 26,021
Teachers/Adults: 680
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www.huntingtoningalls.com/careers
Presentation Goals

- To provide information to help influence students to focus on Science, Technology, Engineering and Mathematics (STEM)
- Expose teachers / students to the types of interesting work that people can become involved with through their focus on STEM education
- Communicating what engineers REALLY do in their jobs
- Change science and technology stereotypes perpetuated by the media (Big Bang Theory vs. Apollo 13)
Engineering Path

- Educational emphasis on math and science
- Opportunities for shadowing / internships
- Involvement with science and technology clubs in high school and college (smart highway, human powered submarine, Baja buggy)
- Exploit all opportunities to develop leadership and communication skills
- Get as broad base an education as possible (multidiscipline needs)
- An engineering education teaches you concepts and the language, but most importantly it trains you to think analytically and be a problem solver (engineers can’t help themselves)
NNS Engineering

Three Major Disciplines

• Facilities Engineering

• Design Engineering

• Test Engineering
Facility Engineering

- Develop and maintain the unique facilities and equipment necessary to build ships

- Multiple Science and Engineering Disciplines – civil, mechanical, electrical, metrology, environmental,
Facilities Infrastructure / Engineering
Facilities Infrastructure / Engineering
Design Engineering

Develop products necessary to build ships
• 3-D Product Models
• Traditional Drawings
• Bills of Material
• System Models and Simulations
• Waterfront Support
• Maintaining Design
3D Visualization

3d_modeling.mpeg
Discipline of Test Engineering

- Test Engineering is often overlooked when considering a “traditional” engineering career
- Test Engineering is a vital requirement for every product
- Test Engineering crosses many science and engineering disciplines
- Test Engineering is a very technical – hands on engineering discipline
- The result of your work is tangible – you see the ship come to life
Test Engineering Challenges

• Determining how to safely test systems (personnel and system)
• Determining how to test without influencing system under test
• Developing test plans
• Determining subsystem vs. integration test boundaries
• Determining how to thoroughly test complex equipment
• Determining adequacy of testing for critical systems (combat / safety)
• Selection of measuring device and understanding its use / limitations
Example Systems

- Propulsion Systems
- Ship Control – Steering and Diving
- Combat Systems
- Weapons Handling Systems
- Damage Control
- Hotel Services – water, lights, galley
Tools of Test Engineering

Test Engineering Tools

• Commercially Available - general use tools are used to measure many different parameters to validate proper equipment operation.

• NNS develops and manufactures unique measurement tools to support our products
Sound Level Meter
Accelerometer
Displacement Transducers
Decade Resistor Box
Precision Meters
Current Meters
Digital Thermometer, RTD & Milliamp Calibrator
Voltage Meters
Strobe Tachometer, Stopwatch & Dial Indicator
Ultrasonic Flow Meter and Transducers
Digital Recorder
Sea Trials

The result of many years of hard work and many years of test activity:

USS Minnesota Trials.mpeg
Specialty of Computer Based Data Acquisition

Specialized computer hardware and software to communicate with sensors for the purpose of:

- Data Collection
- Data Display
- Data Reduction and Analysis
A Data Acquisition System (DAS) is simply a system which collects data about some physical event and makes this information available for use in monitoring and control systems.

A basic DAS consists of:

- One or more Sensor/Transducers, which convert information about the event (temperature, pressure, etc.) into an electrical signal.
- Signal conditioning equipment, which modifies the signal for use with the system.
- A Multiplexer/Analog to Digital Converter (ADC) (when required), which takes one or more analog signals from Sensor/Transducers and converts them to a single digital output for use in the processor.
- A processor, specialized software application, and display, which receives, parses and manipulates the digital data and uses it for system monitoring, control and display.
Sensors and Signal Conditioning

- Sensor/Transducers are devices which respond in predictable ways to changes in a given parameter. For example, a thermocouple is a junction between two different metals that produces a voltage related to a temperature difference. This voltage can be measured and related directly to temperature.

- Other Sensor/Transducers used include: pressure transducers which measure system or environmental pressure, flow meters which measure fluid flow, load cells which measure strain/stress, etc.

- Signal Conditioning is the process by which the reaction of the sensor (change in resistance, voltage, movement, etc.) is processed to be a value which can be used by the DAS.

- The sensors may be influenced by environmental conditions, so the signal is often conditioned and amplified locally and transmitted to the DAS through conventional means (fiber-optic or Ethernet cable). The Omega TX64 is used with many DAS systems for signal conditioning and amplification.
Sea Trial Display
Sea Trial Display
Tying it all Together

Bulkhead Project ties many elements together:

• Facilities Engineering

• Test Engineering

• Instrumentation

• Computer based data acquisition / display / data analysis
Proactive Engineering Management of Ship Construction Through Technology

- Description of manufacturing process
- Description of original approach to managing the manufacturing process
- Description of new philosophy
- Applying technology to support new philosophy
- Benefits of new management approach
- Summary
- Questions and Answers
Bulkhead Final Assembly Fixture

- Load Cell
- Jack 20,000 LB CAP
- Removable Plate Clamp Assembly
- Exterior Beam or Support Leg
- Camber Block
- Clamp Assembly
Pull Cylinders’ Load Cell

- Four pull cylinders
- Capacity of 120,000 lbs
- Pull down corners of plate

Shackle Load Cell
• Jack loads are important to monitor because the support structure has a finite load capacity.

• Jack loads change when welding preheat is applied to the bulkhead.

• Jack loads have “RED LINE” Limits.

• RED LINES are for personnel safety and protection of equipment.

• Work stops when RED LINES are exceeded.

• Final shape of the plate is critical

• Fixtures occupy valuable production real estate

• Production is 24 / 7
Initial Management of Construction Process

- Personnel had to periodically check load status at each fixture to:
  - Ensure personnel safety
  - Prevent material / equipment damage
  - Manage the shape of the plate

- When RED LINE Limits were reached:
  - All production work stopped
  - Engineering was contacted
  - Engineering determined a resolution
  - Resolution was implemented
  - Production work recommenced
Frequent construction interruptions and time demands associated with non-automated monitoring necessitated a new philosophy:

The continually changing loads associated with the manufacturing process need to be monitored automatically and managed proactively.
Implementing the new philosophy required:

• A means for construction activities and engineering activities to be more closely coupled
• A means for engineering to be aware of the current conditions
• A means by which engineering can analyze real time data
• A means for engineering to remotely adjust load limits
Using specialized software and computer resources changes were implemented

- **Local**
  - Local data acquisition, monitoring, and recording
  - Supervisory view of all bulkheads (enhanced spatial awareness)
  - Audible and visual alarming

- **Remote Capabilities**
  - Data viewing via any Company computer
  - Remote, real-time analysis tools
  - Ability to change red lines
  - Automated text messaging / pop ups / emailing for alarms
  - Remote network access for proactive Engineering support, including after-hours Engineering oversight
  - Configurable warnings: yellow lines & rate of change alerts
  - Designated “duty” notebook computer and “duty” cell phone for engineering
Data Acquisition, Display and Recording Equipment

Cabinet at Each Build Site
Data Acquisition, Display and Recording Equipment - Details

Cabinet at Each Build Site
Visual and Audible Alarm

Automated Audible and Visual Alarm at Each Build Site
Revised System

At Each Build Site

External Users

NNS LAN Users

FIBER OPTIC ETHERNET SWITCH

DATA ACQUISITION EQUIPMENT

LOAD CELLS

120 V POWER CONTROLLER

VISUAL ALARM

AUDIBLE ALARM

LOCAL FIBER/CAT5 ETHERNET SWITCHES

BUILD SITE COMPUTERS

TEXT MESSAGES TO SUPPORT PERSONNEL
LCIS System Supervisory Overview
Build Site Status

Black – offline
Green – normal
Yellow – yellow line exceeded
Red – Alarm Condition
Real Time Load Conditions

Load Cell Data and Limits

Tabular Display With Min and Max
Real Time Select Data Review Capability
Ability to Review Data History

Please Select The Desired Start Time, Stop Time And Sample Interval

**Start Timestamp**
3:10:29 PM
6/12/2007

**Sample Interval**
(HH:MM:SS)
00:00:01

**Stop Timestamp**
3:10:30 PM
6/12/2007

Number of Current Records Based on Time Selections
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[OK] [Cancel]
Ability to Remotely Adjust Load Limits

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Summary

At yellow line, notification occurs via pop up messages on desktops and text message to cell phones.

Upon notification engineering remotely accesses data and performs the necessary analyses.

Production work continues uninterrupted!
• Science and technology education in the high school and college classrooms develops the knowledge baseline required

• More importantly the classroom and laboratory work teach students how to think analytically and solve problems. You are taught how to think.

• The importance of developing communication skills cannot be understated
  – People in engineering who can effectively communicate complex, technical issues at a variety of levels and in a variety of formats are those that succeed
    • Communicate to upper management
    • Communicate to customers
    • Communicate to trades

• NNS has a wide diversity of traditional and non traditional engineering work
Questions and Answers