NAVSEA
WARFARE CENTERS
NEWPORT

Sensors & SONAR Systems DEPARTMENT

Development of Systems Engineers in the Sensors & SONAR Systems Department

Presented To:

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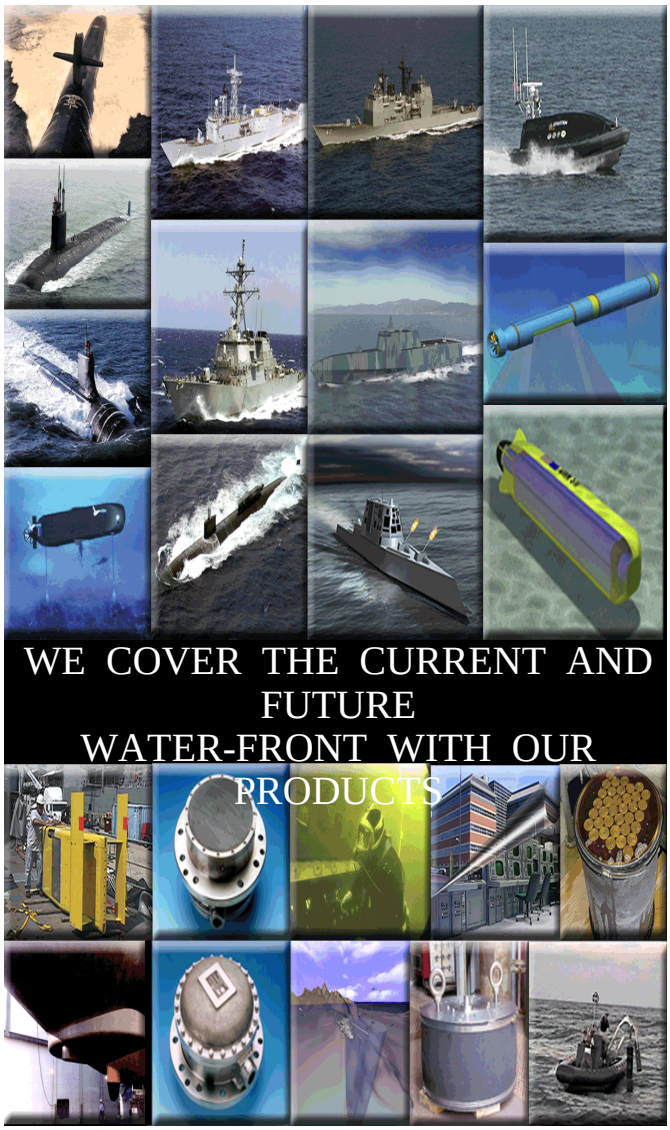
Sensors & SONAR Systems Department

NAVSEA WARFARE CENTERS NEWPORT

Our Main Thing is working with Industry, Academia, and Navy Labs to deliver solutions to the Warfighter where and when they are needed.

MISSION

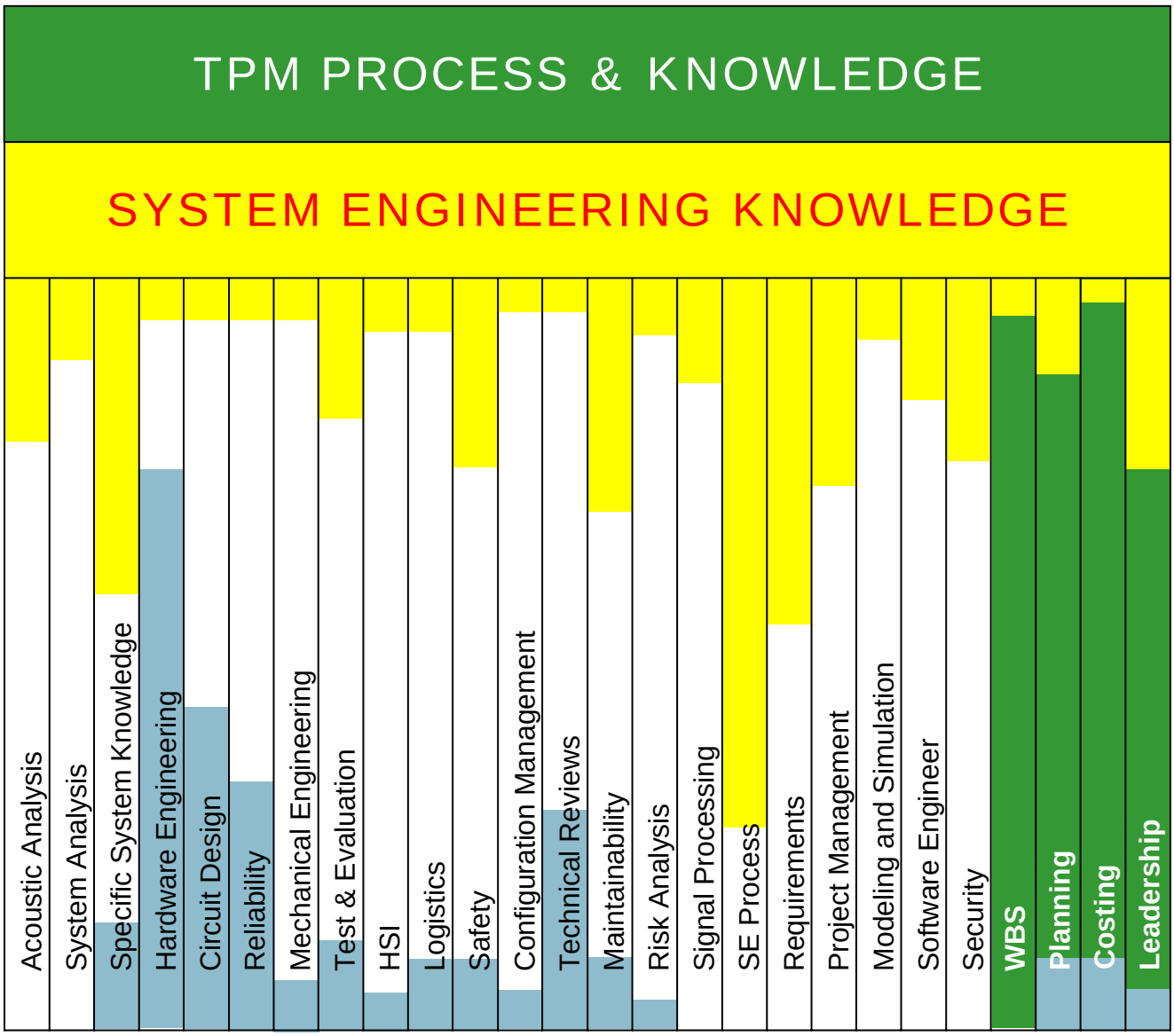
Conducts a full spectrum program of research, development, engineering, and test & evaluation directed toward underwater sensors and sonar systems applicable to all platforms as well as off-board distributed and unmanned systems, with equal emphasis on technology base, advanced development, full-scale development, and in-service engineering, supportability and life-cycle hardware and software support. Focuses on analysis, definition, development, system engineering, integration and testing. The mission focus is on all aspects of Undersea Warfare (USW) and associated areas of the Global War on Terrorism (GWOT).

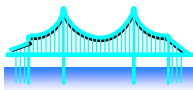


Products and Capabilities

- ✓ Active and Passive Acoustic Systems
- ✓ Environmental Acoustic Technology and Systems
- ✓ Hull-mounted, Fixed, and Towed Sonar Systems
- ✓ Offboard Sensors and SONAR Systems, Including Distributed Systems
- ✓ Human Systems Integration for Manned & Unmanned Systems
- ✓ Sonar Trainer Systems
- ✓ Transducers, Materials, Measurements, and Standards
- ✓ Underwater Acoustic Communications Systems
- ✓ Underwater Off-Board Sensors and SONAR Systems
- ✓ Underwater Non-Acoustic and Environmental Sensors
- ✓ Unmanned Vehicle Sensors and SONAR Systems

Systems Engineers Need A Depth of Knowledge





Good Systems Engineers Demonstrate

- Technical Expertise and Competence
- Solid Engineering Design Skills
- Willingness to Take on Leadership and Responsibility Roles
- Effectiveness Working in Dynamic Team and Interdisciplinary Environments
- Excellent Communications Skills

Not all engineers display the desire and aptitude
to be a Systems Engineer.

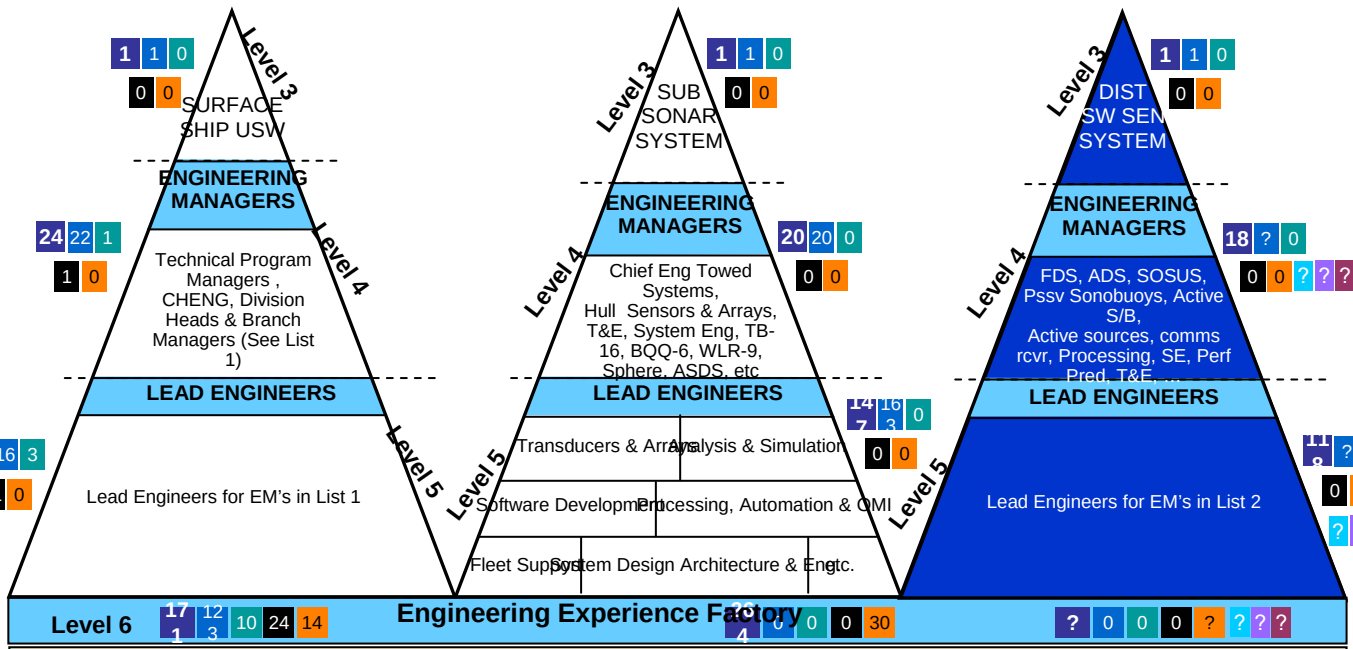
They are not merely “made’... innate qualities and
interest are necessary.

Typical System Engineering Career Development Timeline

Career Stage	Elapsed Time	Concurrent Age
New Hire	-	23
Develop Technical Experience in Engineering Discipline	5 - 8 years	28
T&E At-Sea Experience/System Installation/System Delivery	1 - 2 years	29
Rotational Assignments: • *Other Engineering Specialties* • *Operational Experience* • *On-Site Assignments (I.e. Field Team)* • *International Experience*	1 - 2 years	30
Technical Program Manager/Task Leader	2 years	32
System Engineer	2 years	34
TOTAL	11 - 16 years	34 -39

Combined Surface Ship USW, Submarine Sonar and Distributed USW Sensor Systems Tech Warrant Pyramid With At Risk Positions

TOTAL	NUWC/NPT	NUWC/KPT	NSWC DD	NAWC/PAX	SSC/SD	SSC/NF	CONT



Analysis
- ☐ Acoustic Analysis
- ☐ Sonar Performance Analysis
- ☐ Environmental Modeling & Assessment
- ☐ Hydrodynamic Data Analysis
- ☐ Mission Effectiveness Analysis
- ☐ Signature Analysis
- ☐ Sonar/Platform/Battle-group Engineering Assessments

Calibration & Measurement Facilities
- ☐ Array & Sensor Calibration

ILS
- ☐ CM
- ☐ COTS Supportability Analysis
- ☐ Fleet Technical Publications Support
- ☐ Logistics System Support
- ☐ Operational Guidelines & Employment
- ☐ Training
- ☐ Trainers

In Service Engineering
- ☐ Array Maintenance & Repair
- ☐ Fleet Introduction
- ☐ Fleet Liaison
- ☐ Fleet Support
- ☐ Production Engineering
- ☐ Restoration Engineering
- ☐ Systems Supportability

Installation
- ☐ OPALTS
- ☐ SHIPALTS
- ☐ TEMPALTS

Modeling and Simulation
- ☐ Finite Element Modeling & Assessment
- ☐ Model Development & Verification
- ☐ Modeling, Testing & Qualification
- ☐ Sonar SIM/STIM
- ☐ Structural Acoustics
- ☐ Target Physics Modeling & Research
- ☐ Towed Body/HD Models

Signal Processing
- ☐ Active Signal Processing
- ☐ Passive Signal Processing

Software Engineering
- ☐ Database Development
- ☐ Information Assurance
- ☐ Software CM
- ☐ Software Development
- ☐ Software Integration and Unit test
- ☐ Software Process
- ☐ Software Requirements (development, allocation & management)
- ☐ System Software Architecture

Sonar Array Technology
- ☐ Acoustic Measurement
- ☐ Acoustic Modeling & Research
- ☐ Acoustic Transducer Metrology and Standards
- ☐ Acoustic Windows
- ☐ Active Source Performance
- ☐ Advanced Arrays
- ☐ Array Structures
- ☐ Developmental Arrays
- ☐ Hull, Deployed, & Towed Sensor Engineering
- ☐ Sonar Projectors
- ☐ Sonar Self-Noise Performance
- ☐ Transducer & Array Materials
- ☐ Transducer Design
- ☐ Telemetry Technology
- ☐ Towed Sensors
- ☐ Sphere, Large Aperture/Conformal & Towed Arrays
- ☐ Fiber Optic Sensor

Sonar Engineering
- ☐ Acoustic Communication
- ☐ Advanced Processing
- ☐ Advanced Processing Builds
- ☐ Advanced Systems Prototyping & Eva
- ☐ Algorithm Development
- ☐ Array Handling Technology
- ☐ Automation
- ☐ Data Fusion/Contact Management
- ☐ Detection, Classification
- ☐ Display Engineering
- ☐ HF Imaging & ASW
- ☐ Mine Detection & Avoidance Sonar
- ☐ Multistatics
- ☐ Oceanographic Engineering
- ☐ Optical Application to Sensors
- ☐ Prototyping
- ☐ Rapid COTS Insertion
- ☐ Real Time COTS Processing
- ☐ Recon Docking & Side Scan Sonars
- ☐ Signal Conditioning Micro-Electronics Prototyping
- ☐ Sonar Systems Engineering
- ☐ Technology Insertion
- ☐ Tracking & Localization
- ☐ Platform Engineering

System Engineering
- ☐ Anti-Tamper Engineering
- ☐ COTS Engineering
- ☐ Sonar Power Amplifier Engineering
- ☐ Engineering Change Process
- ☐ FCA/PCA
- ☐ HSI Engineering
- ☐ Interface Engineering
- ☐ Legacy System Engineering
- ☐ Open System Architecture Engineering
- ☐ Reliability Engineering
- ☐ Requirements Allocation
- ☐ Risk Management
- ☐ Sensor Requirements
- ☐ Specifications
- ☐ SUBSAFE
- ☐ System Requirements
- ☐ System Safety
- ☐ TDA Support Technical Failure Analysis
- ☐ Technology Transition
- ☐ USW System Conceptual Development
- ☐ USW System Functional Decomposition
- ☐ USW System Integration
- ☐ Testing, Evaluation & Certification
- ☐ At-Sea T&E

System Engineering (Cont'd)
- ☐ Augmentation
- ☐ Data Acquisition & Analysis
- ☐ Environmental Sensors
- ☐ Test Planning
- ☐ Shock Qualification
- ☐ System Assessment Testing (in

Energy Generation

RF Communication

Floating Sensors

Bottom Sensors

Self Propelled Sensors

Airborne Deployment

Shipboard Deployment

Launchers

Surface Personnel 23 6 | 152 | 14 | 36 | 14

Submarine Personnel 45 8 | 428 | 0 | 0 | 30

Dist USW Sys Personnel ? | ? | 0 | 0 | ? | ? | ? | ?

Total Positions With Shared Experience Factory = 570+

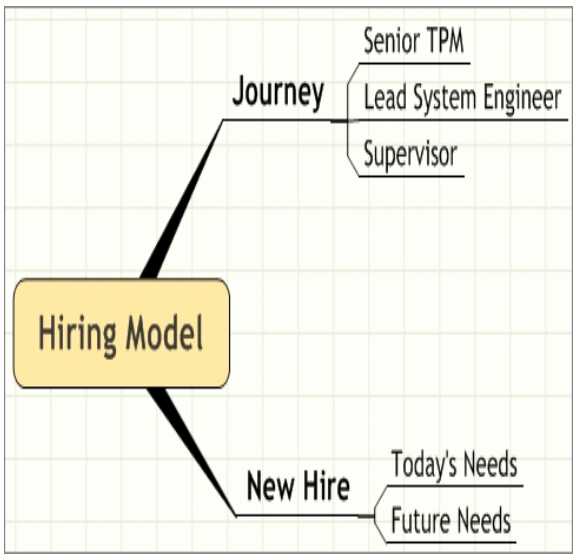
Currently At Risk
Projected At Risk
Capacity At Risk

Workforce Shaping

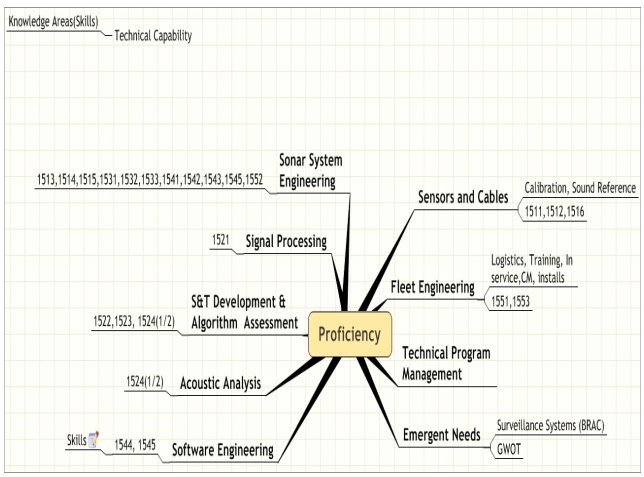
WORKFORCE SHAPING PLAN SUMMARY

- Workforce shaping changes the potentials and abilities of the workforce that can be applied to current Navy problems. Tools for changing the workforce include
  - *Hiring: Change the current mix of the workforce. Both external and internal acquisitions are used at both new and journey level persons.*
  - *Training: Increasing the education or skills of members of the organization through college training, specific skill training, or on the job experiences.*

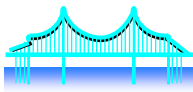
HIRING MODEL



PROFICIENCY NEEDS



Position	RISK FACTOR		
	Currently at Risk	Projected at Risk	Capacity at Risk
ANALYSIS			
Sonar Performance Analysis		X	
SIGNAL PROCESSING			
Active Signal Processing		X	
Passive Signal Processing		X	
SONAR ARRAY TECHNOLOGY			
Acoustic Transducer Metrology and Standards	X		
Fiber Optic Sensors		X	
SONAR ENGINEERING			
Sonar Systems Engineering		X	
SYSTEM ENGINEERING			
Sonar Power Amplifier Engineering	X		
Testing, Evaluation & Certification			X
At-Sea T&E			X
Mechanical Engineering			
Platform Installation Engineering		X	



Formal Training

- College Courses
  - Tuition for advanced degrees
  - Long term training
- Commercial Training – Short Courses
  - On-site courses
- Special Programs
  - SE and Program Mgmt degrees programs
- DAWIA
  - Most of our people fall under SPRDE
  - Required level III certification
  - Courses available

Tailored On-Site Training

5 October 2006 WORKING DRAFT V0.5

Sensors and Sonar Systems Department Systems Engineering Training Plan

Working With Industry, Academia, and Navy Labs to Deliver Solutions to the Warfighter Where and When They Are Needed

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Naval Undersea Warfare Center Division
Newport, Rhode Island

...Working Together to Deliver the Best Solutions Quickly

Prepared by, L. Lazar (1541) and G. Maris (1542)

Modules

Title	Status
Introduction to Sys Eng	Complete
DoD 5000 Summary Presentation	Complete
Navy Organization & Funding	Complete
T&E Fundamentals	Complete
Naval Organization & CWC Concept	Complete
Basic ASW	Complete
Sonar Fundamentals	Complete
Sonar Design Trade-offs	Complete
Acquisition Logistic Support	Outline
Human System Integration (HSI)	Outline
EQT	In Process

Title	Status
USW Systems Overview	Not Started
Requirements	Not Started
Development Models	Not Started
Modeling & Performance Prediction	Not Started
Sensors to Displays	Not Started
Program Management for SE	Not Started
Business Office	Not Started
Personal Development	Not Started
HSI	Not Started
Training	Not Started
SW Engineering	Not Started
Subsafe	Not Started
Sonar Automation	Not Started
	Not

Results

- 8 Sessions Conducted to Date
- Responses Generally Good
- Delays Due to Other Demands On Presenters/Organizers Time
- Some Variability In Quality
- Requests To Expand Program