NAVSEA
NAVAL SEA SYSTEMS COMMAND

ICAS
(Enterprise Remote Monitoring)

DoD Maintenance Symposium

13 Nov 2007

Statement A: Approved for Public Release; Distribution is unlimited.

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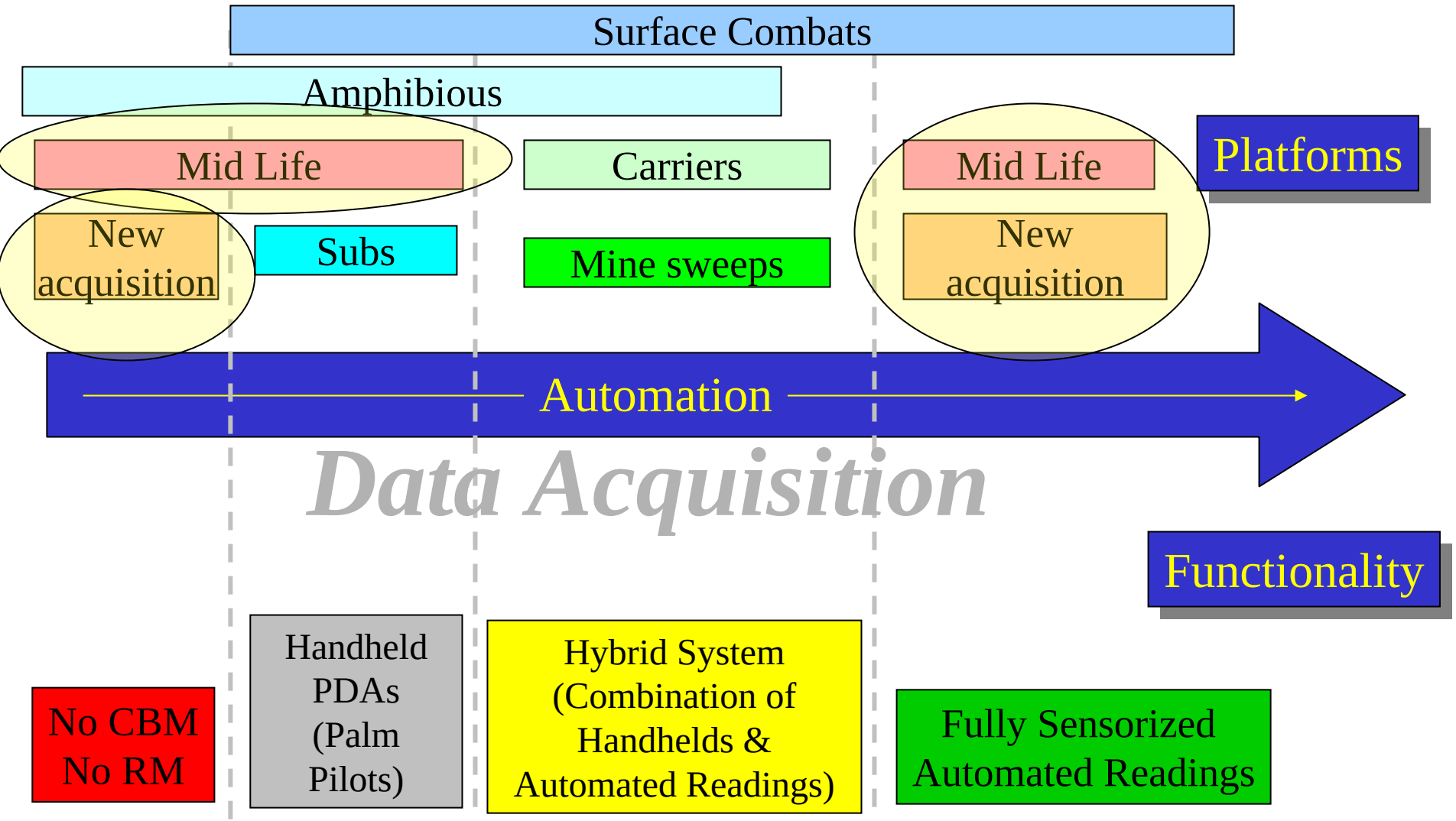
Navy's CBM / RM Challenge



Commercial Industry using Remote Diagnostics

OnStar Vehicle Diagnostics

Subscribers receive monthly e-mail updates on the condition of the vehicle's key operating systems.

Condition and time-based maintenance recommendations are included.

Approximately every 30 days, the vehicle automatically transmits diagnostic data on the following systems:

- Emissions Systems
- Air Induction System
- Fuel Management System
- Engine Cooling System
- Throttle Control System
- Variable Valve Timing System
- Ignition System including Misfire Detection
- Active Fuel Management™/Displacement on Demand
- Engine Electrical System
- Transmission Control System
- Antilock Braking System
- Traction Control System and StabiliTrak® (where applicable)
- Supplemental Restraint System including Airbag Deployment Mechanisms and related sensors
- OnStar System

Color-coded icons let you check results at a glance.

Reports feature automatic checks of several key systems. Click the links for details.

Check your OnStar subscription status, and use the link to renew your service.

Keep up to date on how many Hands-Free Calling minutes you have in your vehicle.

As added convenience, we'll also include your XM Satellite Radio subscription status.

You'll also get reminders when your vehicle is due for scheduled maintenance.

Refer to your selling dealer information if needed for service appointments.

http://www.onstar.com/us_english/jsp/ovd/index.jsp

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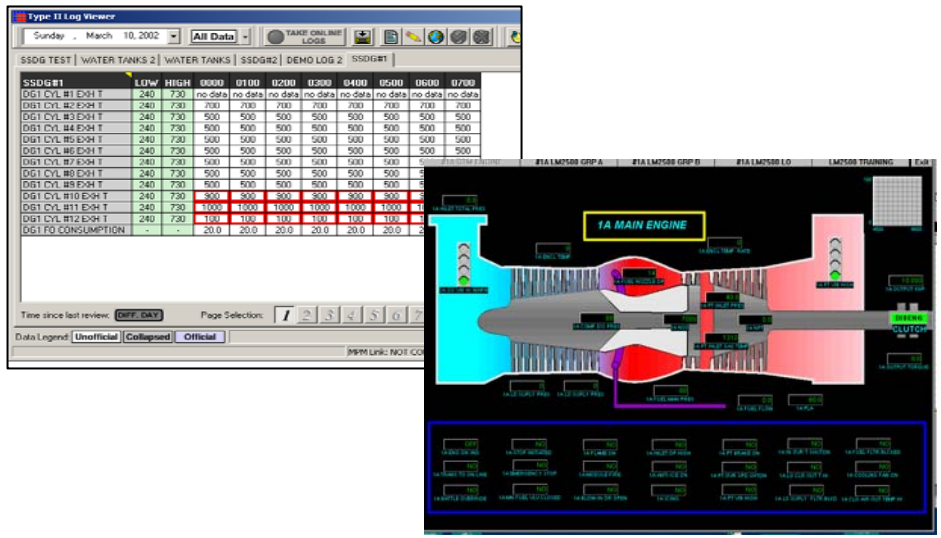
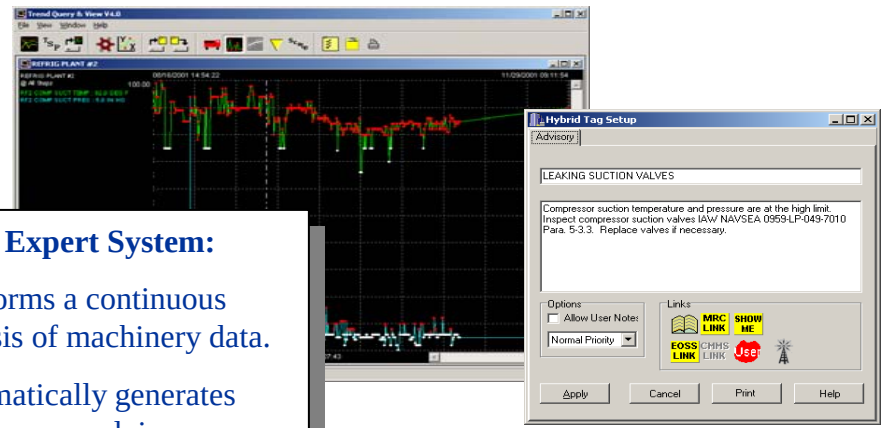
ICAS Capabilities - Afloat

- CBM implementation tool
  - Machinery Data Trending
  - Rules based expert system
  - Vibration Analysis
- Troubleshooting Aid
  - Rules based expert system
  - Event capture
- Operational Assessment
  - Material Assessment
  - Plant Situational Awareness
  - Assessment Visit Support (Availability Planning)
- A tool to enable reduced manning
- ILS
  - Access and linkage to PMS, EOSS and IETMs
- Electronic Logsheets

Data Logging / Situational Awareness



Continuous Analysis



ICAS Expert System:

- performs a continuous analysis of machinery data.
- automatically generates maintenance advisory

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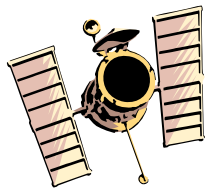
Remote Monitoring - Ashore

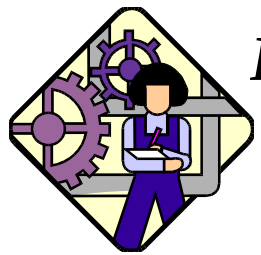
Distance Support
Data Seamless Offloaded



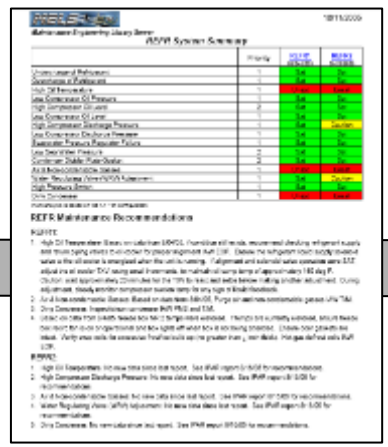
Brings ISEA Knowledge Base to Maintenance Team Cell

MELS
IPARs
Formats & Presents Reports

RMC



Evaluate IPAR Information



emailed

ICAS
Collects & Process Data

"ICAS has the information that Distance Support needs."
– VADM Sullivan, NAVSEA 00

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Integrated Performance Analysis Report

"Ship / System Level"

Electronics & Database

- ICAS
- MELS
- RMU

Subject Matter Experts

- RMC
- ISEA

Final Product

- IPAR

MELS

Maintenance Engineering Library Server

9/13/2005

AC System Summary

	Priority	AC1 09/02/2005	AC2 08/26/2005	AC3 09/02/2005	AC4 09/02/2005
Refrigerant Superheat High	1	Unsat	Unsat	Unsat	Unsat
Refr. Low Suction Temp.	1	Sat	Sat	Sat	Sat
Refrigerant Charge	1	Caution	Caution	Caution	Caution
Air & Non-condensible gases	1	Sat	Sat	Caution	Sat
Leaking Condenser Divider Plate	2	Sat	Sat	Sat	Sat
Chill Water Outlet Temp.	1	Unsat	Sat	Sat	Unsat
SW Pump Operation Check	1	Sat	Sat	Sat	Sat
Dirty Condenser	1	Sat	Sat	Sat	Sat
Insufficient SW Flow	1	Unsat	Unsat	Sat	Sat
Excessive SW Flow	2	Sat	Sat	Sat	Sat
Chill Water Low Temperature	1	Sat	Sat	Sat	Sat
Oil Level	2	Unsat	Sat	Unsat	Unsat
Oil Temperature	2	Unsat	Unsat	Unsat	Unsat
Oil Thermostat	2	Unsat	Unsat	Unsat	Unsat
High/Low Oil Pressure	1	Sat	Sat	Sat	Sat
Oil Pressure D/P Switch	1	Sat	Sat	Sat	Sat
Bearing Oil Temperature	1	Caution	Sat	Unsat	Unsat
Compressor High Disch. Temp.	2	Sat	Sat	Sat	Sat

IPAR analysis is based on the York 200 Ton R114 configuration

AC Maintenance Recommendations

AC1:

1. Refrigerant Superheat High: REFER TO COMMENT ON REFRIGERANT CHARGE
2. Refrigerant Charge: VERIFY REFRIGERANT CHARGE BY STOPPING UNIT, COMPLETELY SECURE ALL CHILLED WATER AND SEAWATER FLOW TO THE PLANT, WAIT APPROX 15 MINS FOR REFRIGERANT SYSTEM TO EQUALIZE, THEN CHECK CHILLER'S MIDDLE SIGHTGLASS FOR REFRIGERANT LIQUID LEVEL. LEVEL SHOULD BE BTWN 1/2 - 3/4 OF THE SIGHTGLASS. ADD /TRIM REFRIGERANT CHARGE IAW T/M.

"The right maintenance, at the right time, at the right cost."

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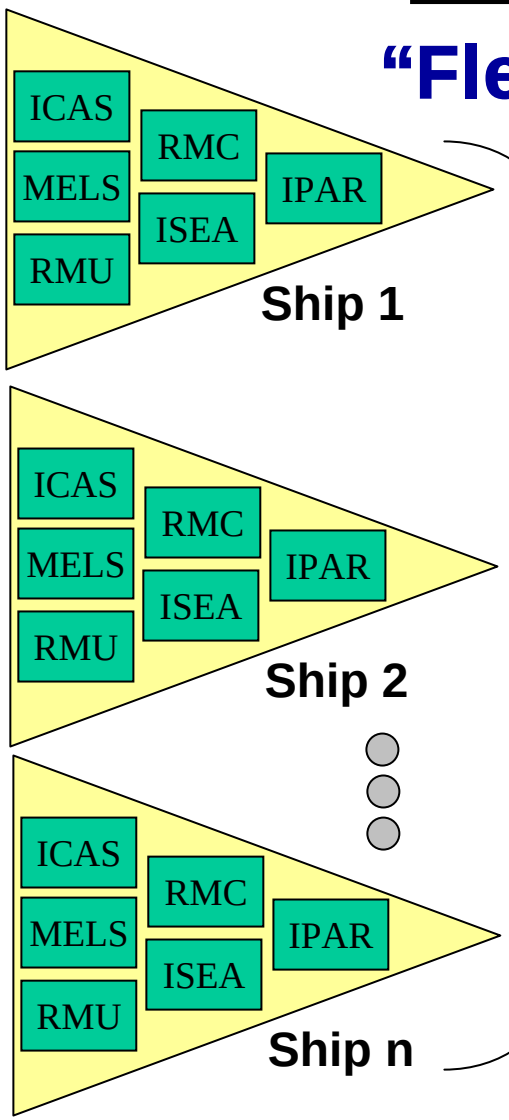
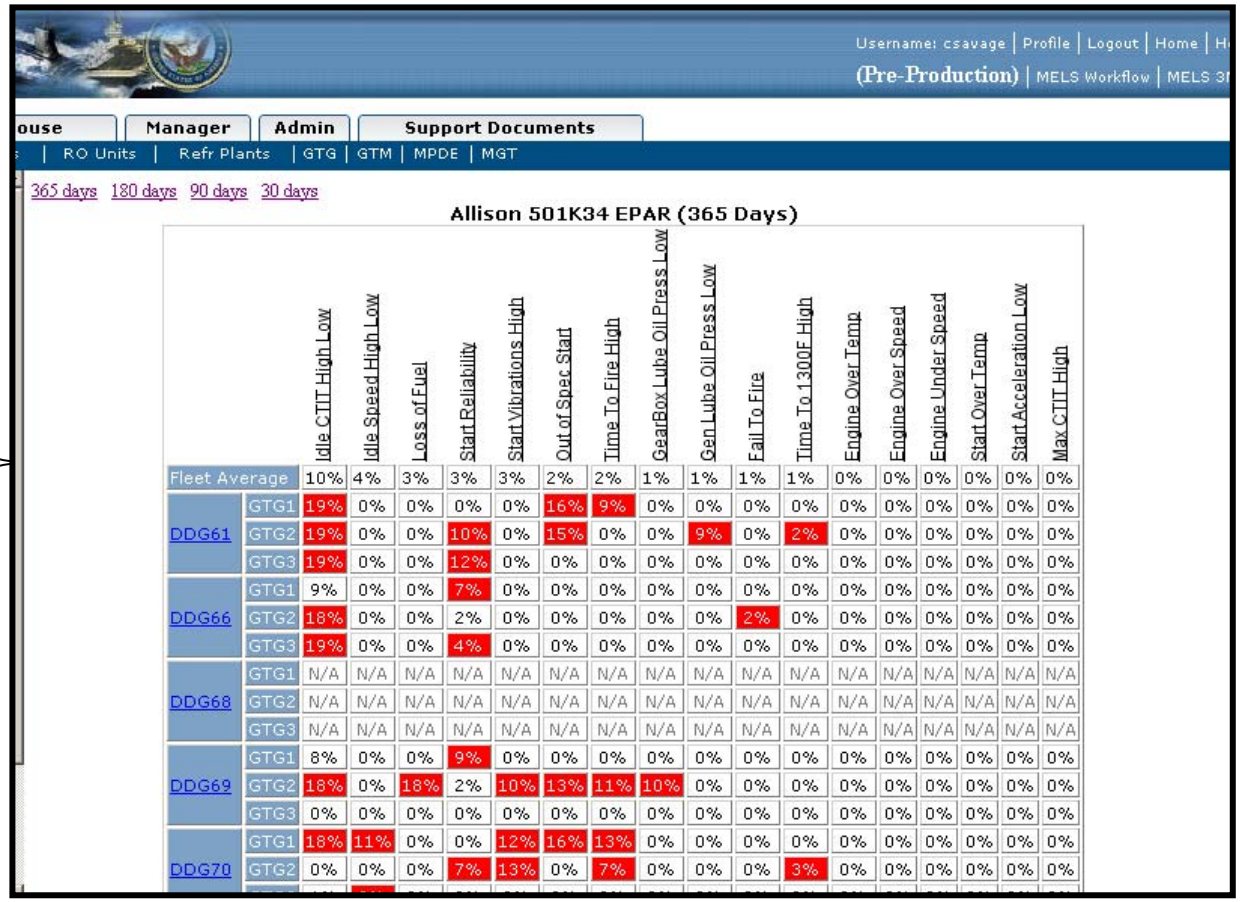
Enterprise Performance Analysis Report

"Fleet wide view of a system"





		Idle CTIT High Low	Idle Speed High Low	Loss of Fuel	Start Reliability	Start Vibrations High	Out of Spec Start	Time To Fire High	GearBox Lube Oil Press Low	Gen Lube Oil Press Low	Fail To Fire	Time To 1300F High	Engine Over Temp	Engine Over Speed	Engine Under Speed	Start Over Temp	Start Acceleration Low	Max CTIT High
Fleet Average		10%	4%	3%	3%	3%	2%	2%	1%	1%	1%	1%	0%	0%	0%	0%	0%	0%
DDG61	GTG1	19%	0%	0%	0%	0%	16%	9%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GTG2	19%	0%	0%	10%	0%	15%	0%	0%	9%	0%	2%	0%	0%	0%	0%	0%	0%
	GTG3	19%	0%	0%	12%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
DDG66	GTG1	9%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GTG2	18%	0%	0%	2%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%
	GTG3	19%	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
DDG68	GTG1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	GTG2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	GTG3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DDG69	GTG1	8%	0%	0%	9%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GTG2	18%	0%	18%	2%	10%	13%	11%	10%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GTG3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
DDG70	GTG1	18%	11%	0%	0%	12%	16%	13%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GTG2	0%	0%	0%	7%	13%	0%	7%	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%

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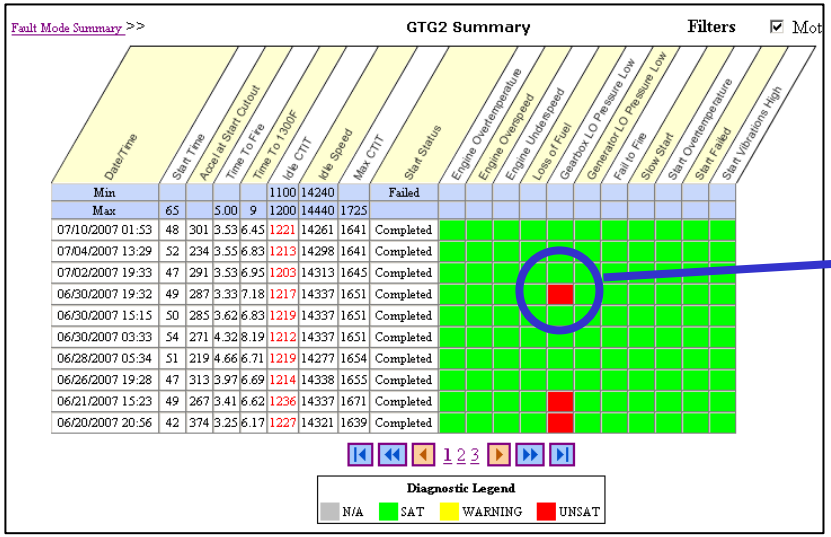
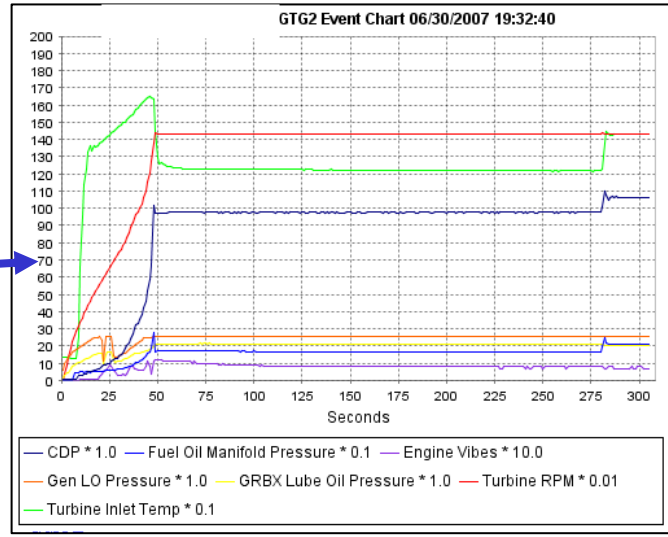
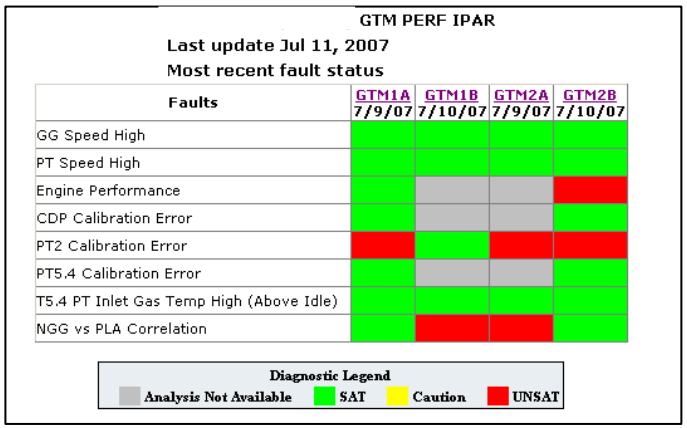
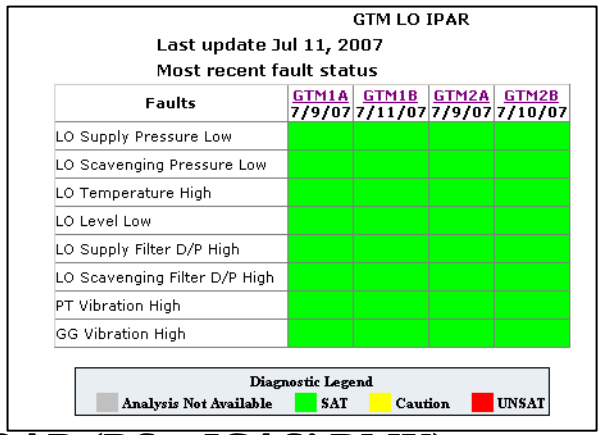
DDG 51 Class Destroyer

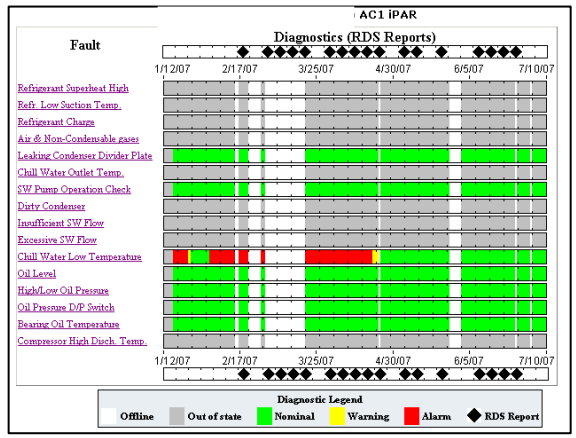




Parameter	Value	Low Limit	High Limit
Start Time	49		65
Accel at Start Cutout	287		
Time To Fire	3.33		5.00
Time To 1300F	7.18		9
Idle CTIT	1217	1100	1200
Idle Speed	14337	14240	14440
Max CTIT	1651		1725
Start Status	Completed	Failed	







AUTOMATED SHIP OFFLOAD (DS + ICAS' RMU)

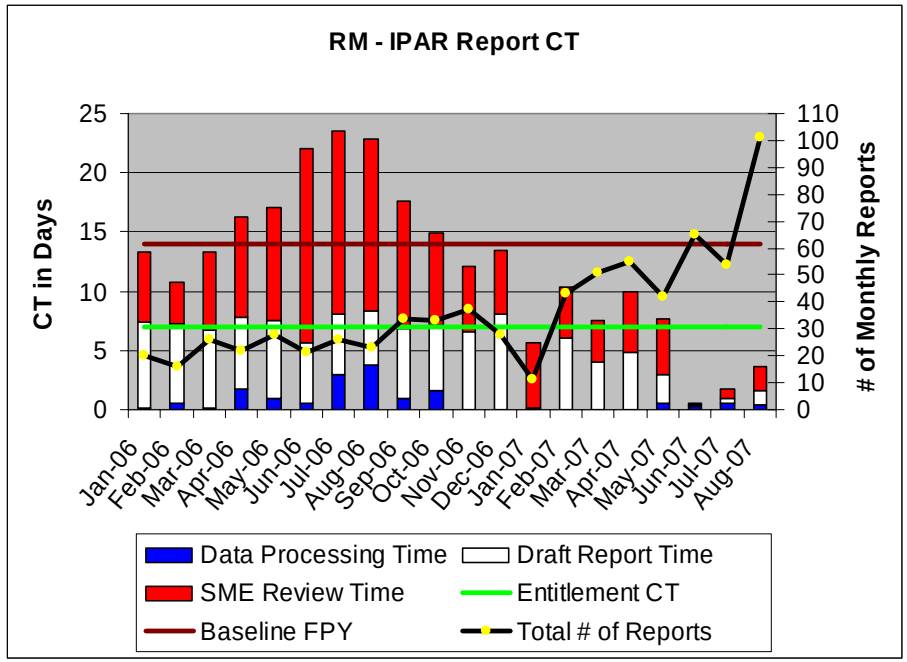
SHIPS Configured for DS	HULL	NIAPS Version	15-Jul-07	8-Jul-07	1-Jul-07	24-Jun-07	17-Jun-07	10-Jun-07	3-Jun-07	27-May-07
DDG 51 Class Destroyer	DDG51 Class	1x	3	6	4	7	1	4	3	4

SWE Remote Monitoring

- *IPAR Summary*
  Sep 06 – Aug 07
  - *12 System IPARs complete*
    - *MPDE, GTM, GTG, AC, HPAC, LPAC, EVAP, RO, Refer, etc*
  - *2871 Ship data submittals*
    - *High Month: Aug 07: 361*
  - *81 Separate Ships*
    - *91% ICAS Surf Ships*
    - *High Month: Jun 07: 45*
  - *554 IPARs were released*
    - *High Month: Aug 07 : 101*

- *Business Rules*
  - *Currently optimizing process via SWE*
  - *Process Metrics presented to SWE BOD*

SWE Bridge Plot



Remote Monitoring is an Integral Part of the Surface Warfare Enterprise

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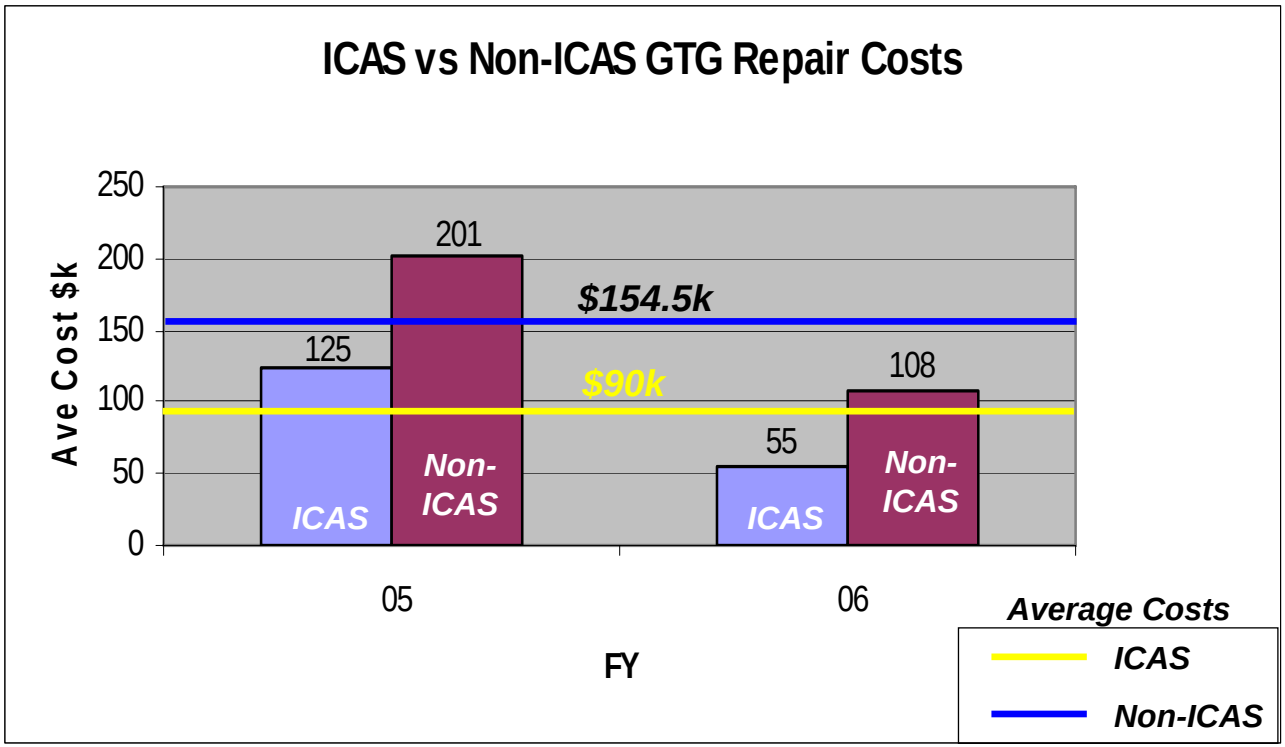
CNSF GTG Metric Study



Two-Year 1B4B Cost Averages

- ICAS Average Per-Ship Cost = $90k per year
- Non-ICAS Average Per-Ship Cost = $154.5k per year

Maintenance Savings Can Be Realized Using The ICAS System

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COMMONALITY

- The Integrated Condition Assessment System (ICAS) is the poster child for Fleet Commonality
  - Surface Combatants (60/100)
  - Amphib & Minesweeps (24/34)
  - Carriers (6/11)

- The same ICAS software is utilized on all installations
  - Enterprise class based system training
  - Shared logistics costs
  - Shared system support costs
  - Shared implementation costs

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A Cross Platform, Common Solution

Various Sources of Requirements

Legacy Fleet
- ✓Log Sheets
- ✓Trends
- ✓Events.

DDG Mod
- ✓Client Sever
- ✓Thin Client

SEA 08
- ✓Relational Database
- ✓10,000 Sensors

DDG 1000
- ✓TSCEI
- ✓Diagnostics

LCS
- ✓Data Qualification
- ✓Remote Monitoring

Enterprise Remote Monitoring (eRM)
- ✓Commonality
- ✓Reduced Life Cycle Costs
- ✓Shared/Reduced Development Costs
- ✓Reduced Installation Costs
- ✓Reduced In Service Costs

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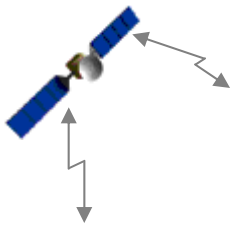
Enterprise Remote Monitoring
"The Path to the Vision"



MAINTENANCE FACILITIES

Fully Autonomous Enterprise Remote Monitoring

- Shipboard Generated IPAR's (w/ rec's)
- IPAR Virtual Subject Matter Expert
- 2 Hour IPAR Turn Around
- Tiered Remote Monitoring Team (Upside Down Pyramid of Support)
- IPAR Case Based Reasoning
- Dedicated eRM Response Center
- PMS Identified & Scheduled Remotely
- Remote Real-Time Tech Assist
- IPAR Standard Statements
- Machinery Control System LAN Secure Interface
- Remote Monitored 2 Kilos Generated Shore Side uploaded Shipboard
- High Security Firewall – Multi Level Network Card
- IPARs Delivered to Ship via Web Service
- Shipboard Generated IPAR's (w/o SME rec's)
- Electronic Data Submittals
- Interface with ISNS LAN
- Integrated Performance Analysis Reports (IPARs)
- Manual Data Submittals
- Shipboard Automated Diagnostics
- Shipboard data qualification (trends, events, transient analysis, alarms)
- Shipboard Data Storage
- Shipboard Monitoring & Alarming

Status

Further Planning Required

Planned & Estimated

Under Development

Development Complete, Deployment Underway

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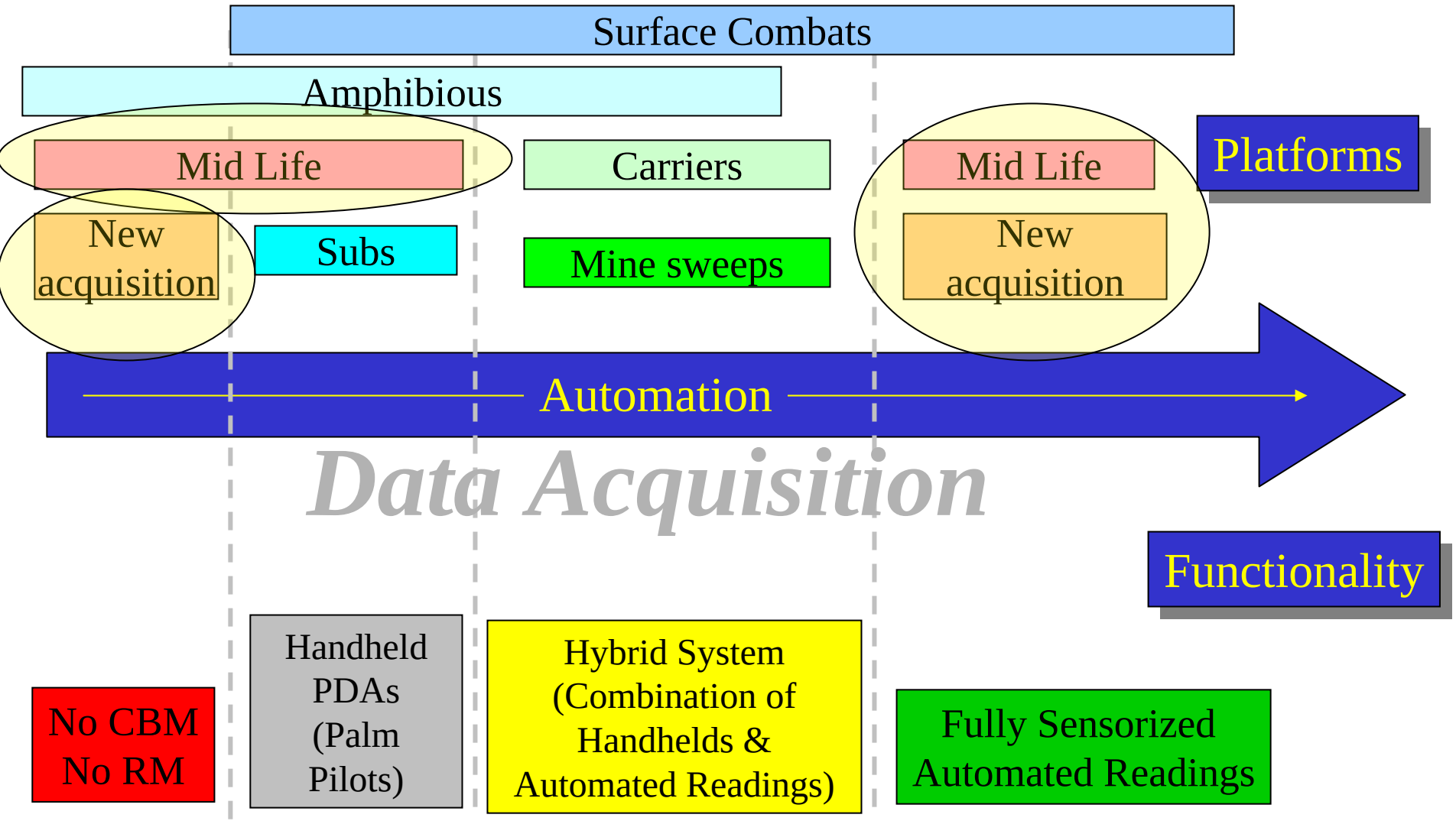
Navy's CBM / RM Challenge



Backup Slides

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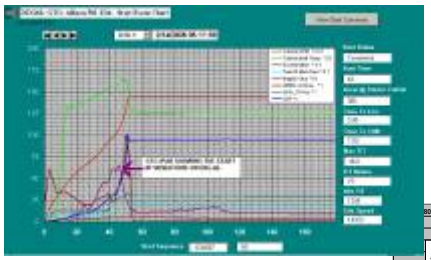
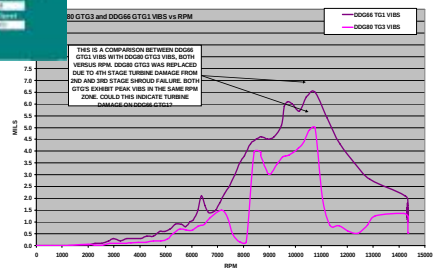
DDG 66 GTG High Startup Vibrations

Reverse Distance Support Timeline





MARMC Change out request

+

- First ICAS data offload received
- First RDS Event for Ship

Ship contacted and begins troubleshooting

(waterwash, transducer inspection, etc)

MARMC SME performed borescope inspection. Damage found on 4th stage blade

SME Performance review complete

Data Verified by SME and compared to failure library

Recommendations documented in pdf

ICAS Install

Feb 5, 2005 | March 4, 2005 | Time: + 1 day | Time: + 3 days | Time: + 11 days | Time: +11days

Problem Description

- High Startup Vibes on GTG#1
- Identified During RDS event 4 March 2005
- This is the first data offload and first RDS event for ship

Analysis performed

- High vibes compared to DDG80 GTG high vibe problem that resulted in engine replacement due to 4th Stage turbine blade damage
- Vibe signature matched and suspected 4th stage turbine damage on GTG#1

Action Taken

- Ship notified (in POM period) and begins troubleshooting
- MARMC visits ship after water wash and troubleshooting complete
- MARMC performs borescope inspection during connection of independent vibration gear

Results\Benefits

- Borescope revealed, (as suspected), 4th stage turbine blade damage
- MARMC recommended engine replacement based on damage and ship schedule