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Successful First AESA Deployment through Application of Systems Engineering

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Outline

- Background
- Approach
- Systems Engineering Activities
- Results of Analyses
- Readiness Assessment
- What Happened
- Lessons Learned

Background

- Raytheon developed a new AESA radar for the F/A-18E/F aircraft under contract to Boeing for the US Navy
- After completion of OPEVAL and training, US Navy planned to deploy two full squadrons of 12 jets each with new AESA radars for a six month deployment in support of OIF/OEF.
  - One squadron on the USS Reagan deployed from San Diego, CA and one on the USS Roosevelt deployed from Norfolk, VA.
- US Navy/Boeing/Raytheon Team dedicated to deployment success!

Used a Systems Engineering Approach to Address All Aspects of First Deployments

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- Created a joint team of Navy, Boeing and Raytheon representing the various disciplines required for a successful deployment
  - Squadron Commanders, pilots, maintainers, engineers, software engineers, field support technicians, repair management, etc
- Determined Success Criteria
  - Stability of hardware
  - Tactical performance
  - Inputs from Commanders
  - Inputs from Navy Maintainers
  - Inputs from USN PMO/DAPML
- Visited each of the 2 squadrons on each coast to conduct pre-deployment readiness review/coordination sessions
- Assess all Logistics Elements
- Developed Action Plan
  - Developed a readiness checklist
  - Spares, repairs, retrofits, IETMs, etc
- Worked Plan
- Supported Deployment
- Prepared Lesson Learned

Using Systems Engineering Techniques Was Able to Assess the Hardware/Software Readiness of the New Radar

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- Hardware Readiness
  - Evaluate maturity of hardware to be deployed
  - Determined the minimal configuration of each radar LRU (WRA).
  - Identified hardware that needed to incorporate retrofits for radars to be deployed
- Evaluate Performance of Tactical Software
  - Analyzed OPEVAL and training data of various mission profiles
  - Analyzed data on various tactical software releases
  - Analyzed current problems/anomalies reported from fleet and pilots
  - Developed procedure to work-around critical anomalies
- Evaluate performance of BIT software
  - Ability to accurately Fault Detect
  - Ability to accurately Fault Isolate
  - False Alarm rate

Systems Engineering Assessment of All Logistics Elements

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- Maintenance Concept
- Supply Support
- Repairs
- Depot Status
- Tech Reps
- IETMS
- PHST
- Maintenance Training
- Reliability
- Support Equipment
- Tools

Results of Analyses

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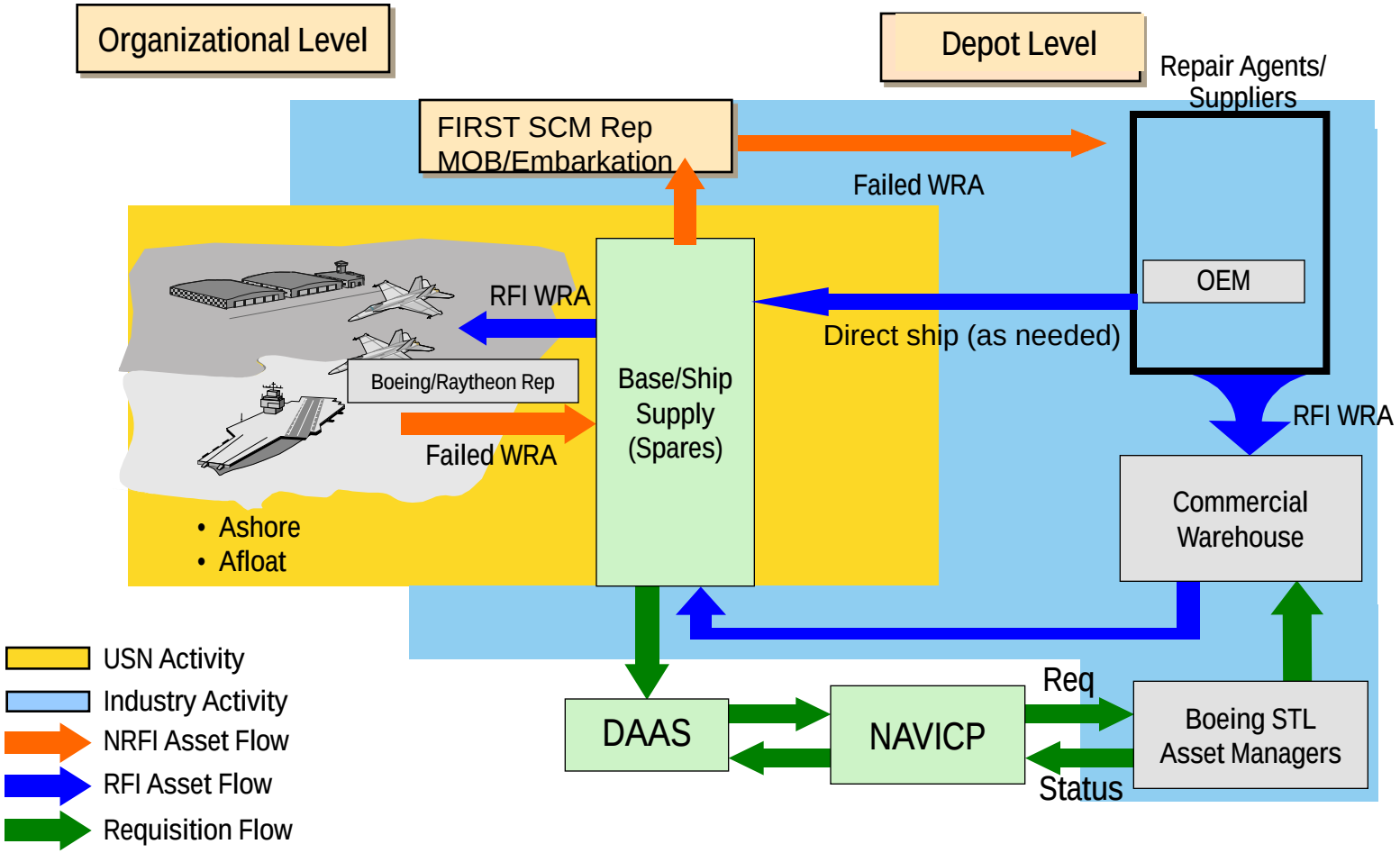
	H/W List of Items	Comment	Priorities: High	Med	Low
1	Antenna Filter	Special tools and training will be needed. Difficult to do on airplane			√
2	Reload Spares with H4 OFP	GPP, ARI, PPM, SNBC, and MFA/BSC need to be loaded with H4, 8P	√		
3	Check busbar torques	Should check for torque value		√	
4	Spare IRR Attach bolts	Top and bottom bolts (different bolts) have been know to strip and bind		√	
5	MFA Attach bolts	- check torque value - spare bolts - spare green loctite		√	
6	FC Cables	extra set of FC cables for IQ and AL between CISP and REX			√
7	Spare RF Green Y Cable	RF cable between Antenna and REX			√
8	MFA Busbar Screws	see parts list		√	
9	PCU Repair kit	upper bolt repair kit		√	
10	Spare IRR's	When the MSS bolts fail, there are ways to fix. 1- swap IRR 2- complete teardown of the IRR (risk of break if maint. in depropely)	√		
11	Cover Hinge Loctite	CISP, REX, RPS		√	
12	WRA Shipping containers				√
13	BIT Tool	Laptop which contains the BIT Tool to help troubleshoot		√	
14	Check CAL information	Run the BIT CST and TR Element tests on the airplanes to trend performance		√	
15	Subrack Spare Parts	Special tools and parts will be needed--1/4 Turn Cover Fasteners, Attach bolts, EMI gasket, QD's (module and subrack)	√		
16	Review A/C "Grey" failures	Some A/C were having issues at power up (FCAL not connecting) and Arrays failing and healing itself. It hasn't officially failed.		√	
17	Cable assembly for support pan	in case it breaks			√

Mitigation:

- Recommend a spare radar
- Provide consumable parts for deployment

AESA Maintenance Concept



Developed Plan to Address Items in the Readiness Assessment

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- Hardware upgrades
  - Plan for retrofitting Hardware
- Software Upgrades
  - Identified required version of tactical software (OFP)
  - Identified issues with software performance
  - Published new instructions for Pilots to mitigate or eliminate problems
- Generated a minimal Spares List
  - WRAs
  - Consumables
  - Special tools
- Ensured adequate repair contract in place
  - Arranged for surge capacity
- Identified Additional Maintainer Training
- Established a 24 hour help desk
- Established contract for tech reps to go to sea
- Provided list of required Support Equipment
- Communicated plan and status to all stakeholders weekly/daily

24 Hour Help Desk/Repair Communication Flow Process Implemented

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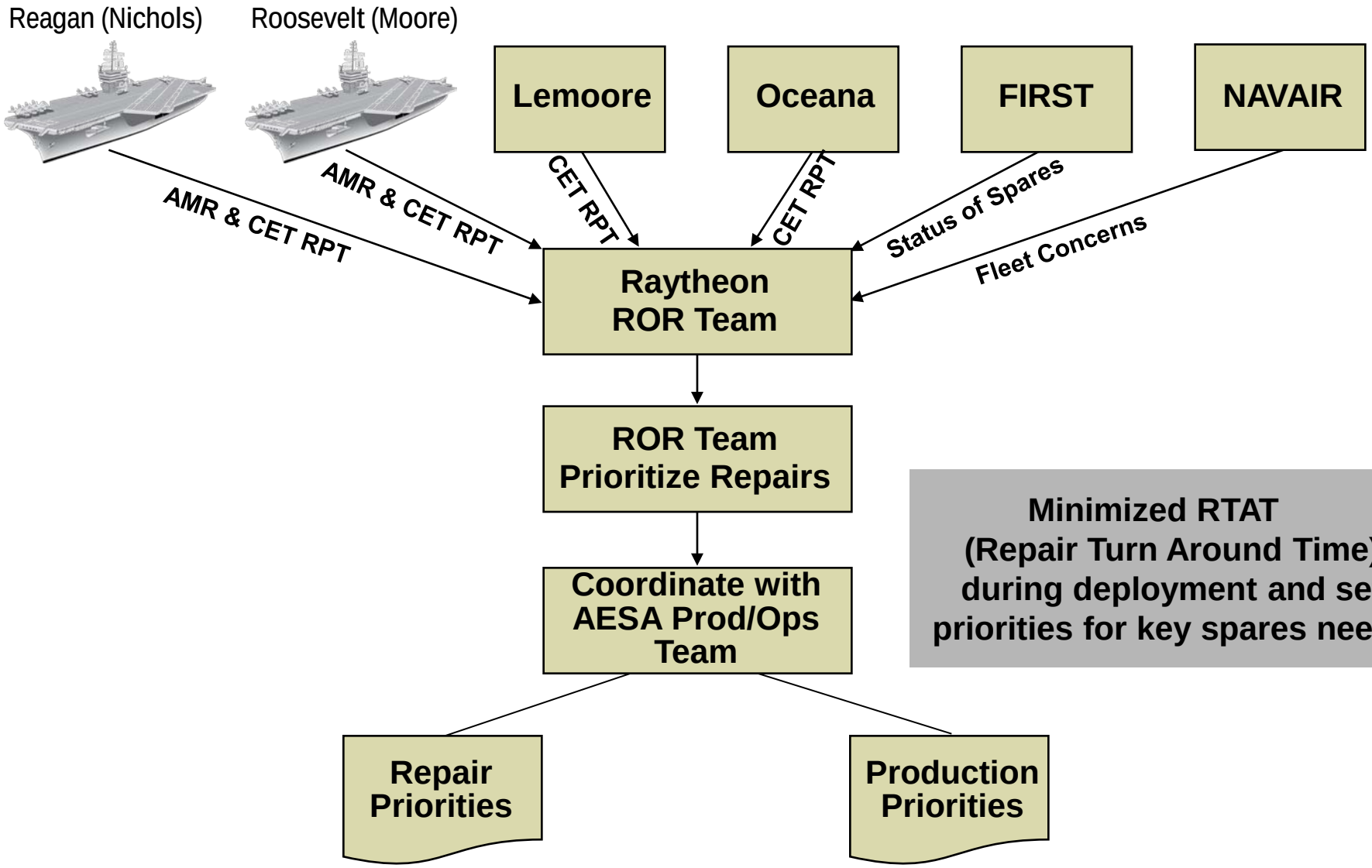

Minimized RTAT (Repair Turn Around Time) during deployment and set priorities for key spares needs

Results of VFA-22 Squadron Deployment

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- Deployed on cruise with 12 F/A-18F aircraft
- 6 month deployment (May to November)
  - 1,713 sorties flown
  - 3,773 hours flown
  - 19 Radar Parts (WRAs) ordered
  - 137 Maintenance Discrepancies written against the radar

Radar Reliability Exceeded Predictions and Maintainers Complained of Nothing to DO

Results of VFA-213 Squadron Deployment

Raytheon

- Deployed on cruise with 12 F/A-18F aircraft
- Over 7.5 month deployment (September to April)
  - 2,120 Sorties flown
  - 6,536 Hours flown
  - 24 Radar Parts (WRAs) ordered
  - 245 Maintenance actions written against the radar

Lessons Learned - The Good

- Communications throughout the planning & deployment crucial
- Getting all the stakeholders involved early led to better planning and execution
- The work-around procedures eliminated the previously experienced pilot problems
- Had the right set of Support Equipment to perform majority of required maintenance actions
- Had sufficient spares on board
- Broken Non-Classified Hardware was quickly removed and sent back to Raytheon for repair
- Additional tools and consumables were useful
- Great support from 24 hour help desk
- Prior to deployment, the verification of spares, consumables and support equipment paid huge dividends while deployed!
  - Inventory discrepancies
  - Incorrect NIIN's
  - Wrong location
  - Missing quantities

Did it but could have been easier

Lessons Learned – The Not so Good

- Was very difficult and time consuming to perform pre-deployment verification of spares, consumables and support equipment
- Lacked ability to remove Integrated Radar Rack without improvising a stand and using extra bodies
- Process to get broken classified hardware off the ship and back to depot was inconsistent and slow.
- Didn’t identify all the consumables that were needed.
  - Missing one cable

VFA-22 & VFA-213 and AESA

Raytheon

- First AESA squadrons to:
  - Complete the workup cycle
  - Fly Combat Missions
  - Drop ordnance in Combat
  - Fire the gun in Combat
  - Complete a successful CVN deployment
  - Numerous AESA articles written
    - Defense daily
    - Stars and Stripes
    - Sea Power Magazine

A Successful Deployment – Setting the Standard

Question and Answer