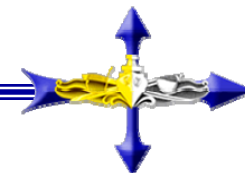




# 75<sup>th</sup> MORSS 712CD Cover Page

12-14 June 2007, at US Naval Academy, Annapolis, MD



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Name of Principal Author and all other author(s):

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Original title on 712 A/B:

"Summary of SHAREM Exercise Lessons Learned"

**(Please use the same title listed on MORSS Form 712 A/B. If the title was changed please list the revised title below.)** Revised title:

Title on PowerPoint slide is "SHAREM – 37 Years of Lessons Learned"

Presented in: WG(s) # 33 CG \_\_\_\_\_, Special Session \_\_\_\_\_,

Demonstration, \_\_\_\_\_, Tutorial, \_\_\_\_\_ or Focus Session # \_\_\_\_\_

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## Report Documentation Page

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			19a. NAME OF RESPONSIBLE PERSON

*Commander,  
Surface Warfare Development Group  
(SWDG-21)*



*“SHAREM – 37 Years of  
Lessons Learned”*

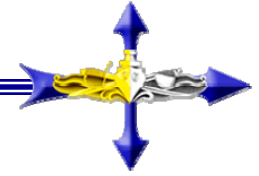
*David E. Gilbert – SWDG TD*



# SHAREM

*37 Years of Lessons Learned*

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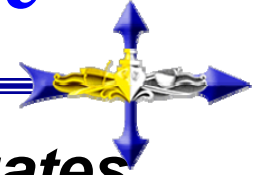


- Background/Overview***
- Improved-SHAREM Process***
- Metrics***
- Lessons Learned***



# *Naval Warfare Center of Excellence*

Surface Warfare Center of Excellence

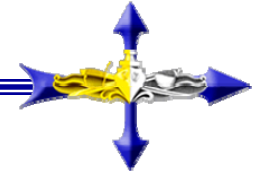


- ***Develops, improves, tests, validates, and evaluates fleet doctrine and platform- and mission-specific TTP***
- ***Secondary roles in enhancing the capability of the Navy forces to operate effectively in unilateral, joint, and coalition operations***
- ***Additional Duties Include:***
  - ✓ *Responsibilities in the areas of operational test and evaluation,*
  - ✓ *Research and development,*
  - ✓ *Experimentation,*
  - ✓ *Modeling and simulation,*
  - ✓ *War gaming,*
  - ✓ *Requirements definition,*
  - ✓ *Joint and allied doctrine and TTP development.*



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# SWDG-21



## The Readiness Effectiveness Measuring (REM) Program(s)

### Technical ...

*How well does it work?*



### Training ...

*Do we know how to operate it ?*



### Tactical ...

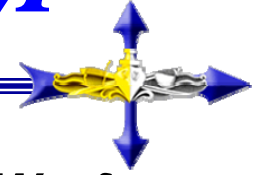
*How is it employed against the threat ?*





# *High Level Assessment vs. REM*

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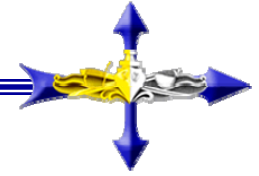
- **High Level Assessments conducted at the integrated or Warfare Commander & above level**
  - ❑ *Primarily ascertains Staff's ability to effectively plan & implement a campaign at the operational & tactical level*
  - ❑ *Planning considerations are driven by expected unit performance*
  - ❑ *Asset allocation driven by performance trade-offs*
- **REM analysis conducted at the unit level down to the individual unit, sensor package & weapon**
  - ❑ *Empirical data collected provides critical performance feedback to tactical & operational planners*
  - ❑ *Allows individual units to ascertain innate capabilities and adjust operational plans at the tactical level*
  - ❑ *Identifies performance levels and sets operational capabilities*
  - ❑ *Provides optimal asset mix for various tactical considerations*
  - ❑ *Identifies potential game changer systems or weapons*
  - ❑ *Identifies and provides capability gap non-materiel solutions*



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# REM Program

## Where is the Focus?



*Fundamentally unit performance  
determines IPCLs & Gaps*

- **REM programs analyze unit performance**
  - Sensor performance
  - Weapon effectiveness
  - Human factors
  - Overall system effectiveness
  - Causality factors
- **Integrated assessment is the Monday morning Coaches debate**
  - What could have been done differently?
  - How well did we execute the plan?
- **Individual units make the plays on the battlefield – not the staff**
  - Unit performance determines where gaps exist
  - Gaps determine integrated priority capability lists

**Find – Fix – Track – Target – Engage – Assess**

**All Unit Level Functions – Regardless of Warfare Area**

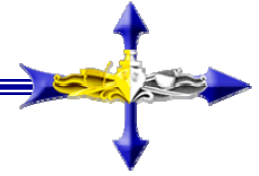




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# REM Program

## What does it Measure?



- **Find** – sensor capabilities against known targets
  - ❑ Structured events establish optimal performance – “as good as it gets” – involves ability to correctly classify
  - ❑ Exceptions: National Sensors and other programs
- **Fix** – ability of sensor system to localize TOIs
  - ❑ Function of sensor’s collective errors in range and bearing
- **Track** – ability of sensor system to maintain contact and establish course and speed information
- **Target** – ability of sensor-weapon system pair to achieve targeting quality solution
- **Engage** – sensor-weapon system ability to consummate the kill chain
- **Assess** – ability of sensor-weapon system pair to ascertain engagement success
  - ❑ May be some staff functions in this area

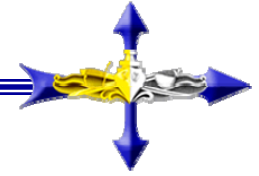
**Generally Broader in Scope ... Than pure experimentation**



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# *REM Program*

## *What does it Provide?*



### ➤ **Acquisition Community**

- Provides legacy system performance feedback – identifies potential upgrade points
- Early evaluation of developmental systems
- Identifies human factor issues
- Operational capability vs. engineering assessment

### ➤ **Research & Development Community**

- Focuses R&D efforts in capability gap areas
- Venue for evaluating developmental efforts

### ➤ **Training Community**

- At-Sea Operational Feedback loop
- Data for FST-U implementation
- Identifies NCEA requirements

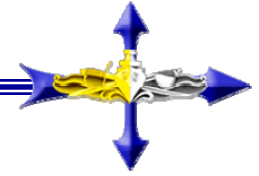
***Real World – Operational Environment – Representative Threats***  
***Systems Tactically Employed – ROC & POE Validation – Fleet Operators***



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# *REM Program*

## *What does it Provide?*



### ➤ **Warfighter**

- Hot Wash-up Rapid feedback on exercise results – 90% solution*
- What happened – may not have answers to why it happened*
- Current capability assessment in areas of immediate interest*
- Feedback for MCO planning*

### ➤ **Doctrine & Tactics Community**

- Tactical development, validation, verification & refinement venue*
- Identifies and develops non-materiel solutions to mitigate or resolve current capability gaps*

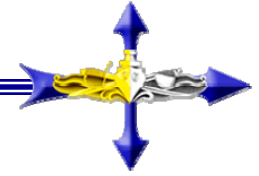
***Real World – Operational Environment – Representative Threats***  
***Tactically Focused – Areas of Interest - What it takes to win...***



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# REM Program

## What makes It Effective?

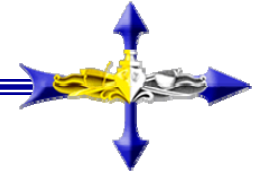


- **Annual Goal End State established**
- **Objectives agreed upon up & down Chain of Command**
  - ❑ *Prioritized to achieve End State Goals*
- **Analysis Plan developed that supports objectives**
- **Exercise/Experimentation Time & Assets Allocation**
  - *Determined by assessing the objective data collection requirements*
- **Post-ex Analysis – Levels of Granularity**
  - ❑ *Participant Feedback*
  - ❑ *Determine progress towards end-state goals*
  - ❑ *Assess key performance parameters*
  - ❑ *Update trend analysis*
- **Review, Revise & Refine Annual Plan to attain Goals**
  - ❑ *Compare to hypotheses – make corrections as necessary*
  - ❑ *Feedback to Sponsor & Stakeholders*



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# *SHAREM History*



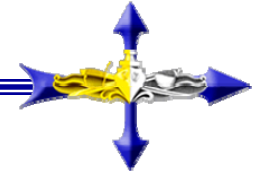
- ***Established by CNO in 1969 to quantitatively assess surface ship ASW performance (circa UPTIDE Experimentation)***
  - ❑ *COMSURFWARDEVGRU: Executive Agent*
- ***Assess surface ship and ASW force performance***
- ***Identify fleet deficiencies and shortfalls***
- ***Informs Fleet Investment Strategy - identifying requirements and guiding procurement process***
- ***Provide test bed to evaluate new technologies, systems, and prototypes***
- ***Maintain database on ASW sensor & weapon performance***
- ***Site specific areas of interest shift in 1992 – more tactically relevant/representative – response to C5F request***

***Ships' ASW Readiness, Effectiveness Measuring (SHAREM) Program***



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# *SHAREM Evolution*

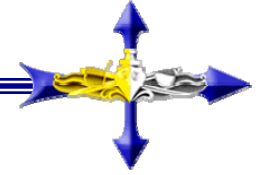


- **Originally purely an engineering evaluation**
  - ❑ *ASW systems were groomed*
  - ❑ *Performance evaluated against established acceptance metrics*
- **Gradual shift to tactical evaluation**
  - ❑ *Exercises limited, primarily, to East Coast assets*
  - ❑ *Typically regarded as goal-post to goal-post events*
- **Area of interest shift in early 1990s**
  - ❑ *Conduct exercises in forward deployed, tactically significant areas*
  - ❑ *Participants on deployment*
  - ❑ *Representative threats and/or threat tactics*
  - ❑ *Assess current state expected performance*
  - ❑ *Combination structured and freeplay evaluations*



# *Think Again...*

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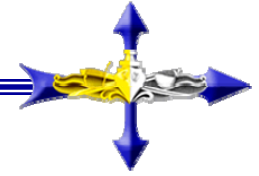




# SHAREM

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- ✓ **Background/Overview**
- ❖ **Improved-SHAREM Process**
- **Metrics**
- **Lessons Learned**

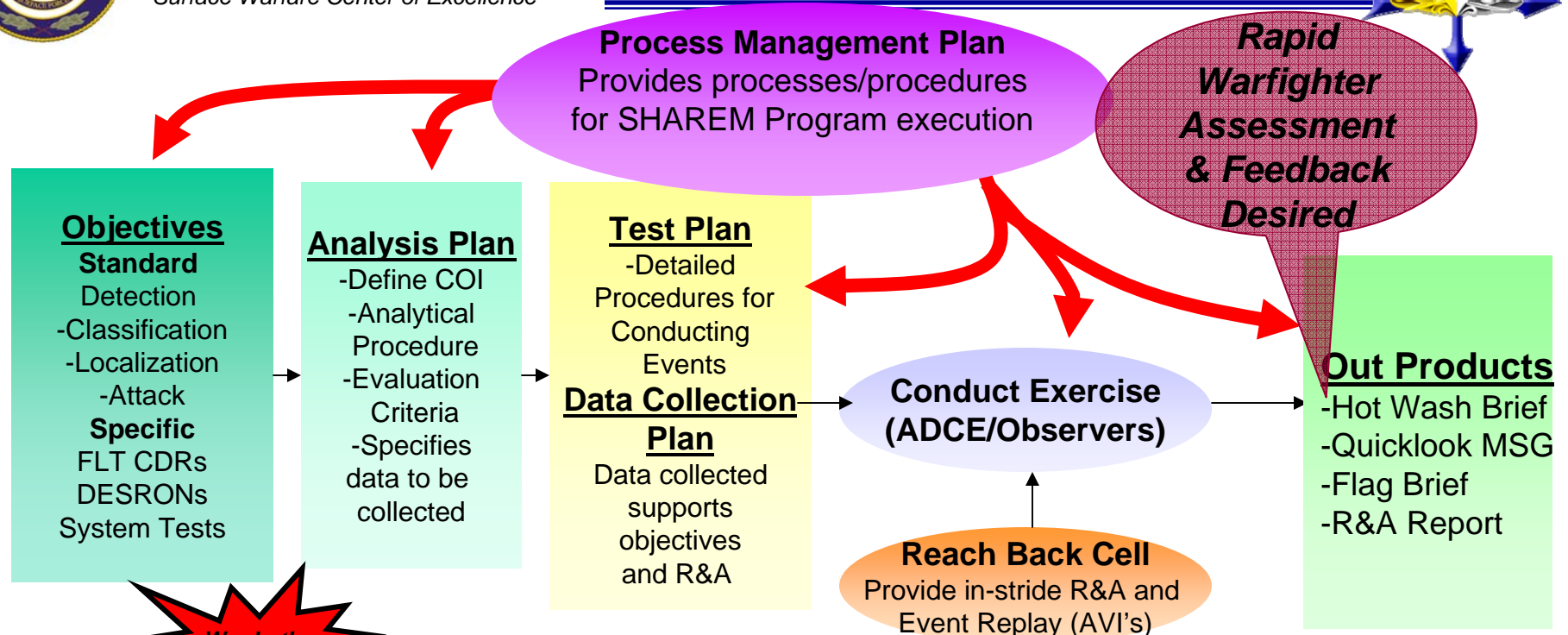
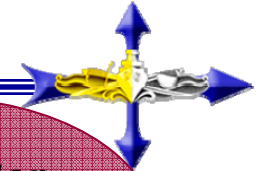




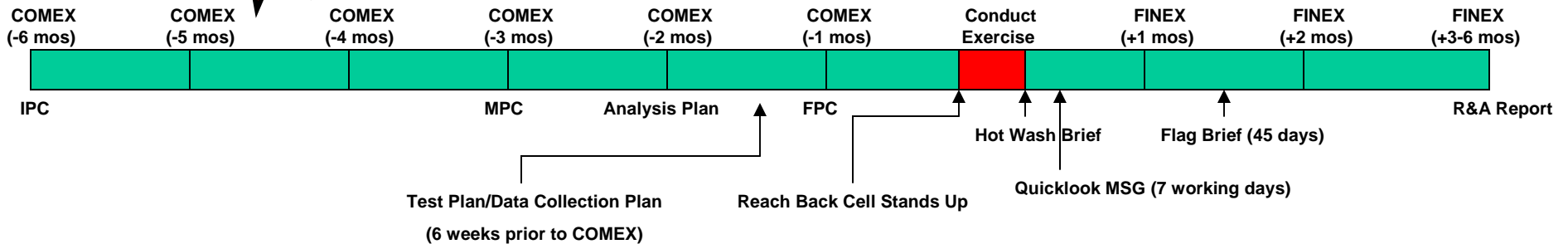
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# Improved SHAREM

## Analysis Thread



## Improved SHAREM Timeline

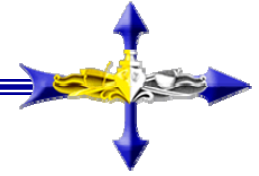




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# I-SHAREM

## Program Specific Goals



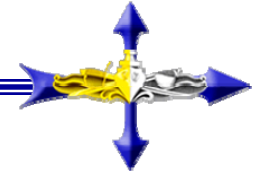
- **Provide a tactical development and validation vehicle**
  - Realistic, tactically significant environments
  - Multi - platform USW force: ships, aircraft, submarines, SURTASS
  - Coalition partner involvement
  - Ground truth track reconstruction
  - Extensive analysis & meteorological impact assessment
  - Validated results for training, doctrine, and programmatic decisions
  - Identify and provide non-materiel solutions
  - Mitigate current gaps and optimize fielded systems with TTP
  - Address Warfighter concerns and provide rapid feedback
- **Sensor & Weapon System performance assessment**
  - Employed in tactical areas of interest
  - Representative threats & tactics (or emulations thereof)
  - Performance across the 'kill chain'
  - Identify materiel performance shortfalls



# *I-SHAREM*

## *Measurements & Evaluations*

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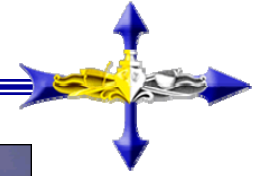
- ***Acoustic & non-acoustic sensor detection & classification effectiveness***
- ***ASW localization procedures & tactics; accuracy & timeliness***
- ***ASW attack procedures, weapons & tactics***
- ***ASW C4I and data fusion in Task Force operations***
- ***Acoustic and non-acoustic vulnerability to detection and attack by (diesel) submarines***
- ***Ability of ASW forces to exploit the environment***



# *I-SHAREM*

## *Hot-Wash Products*

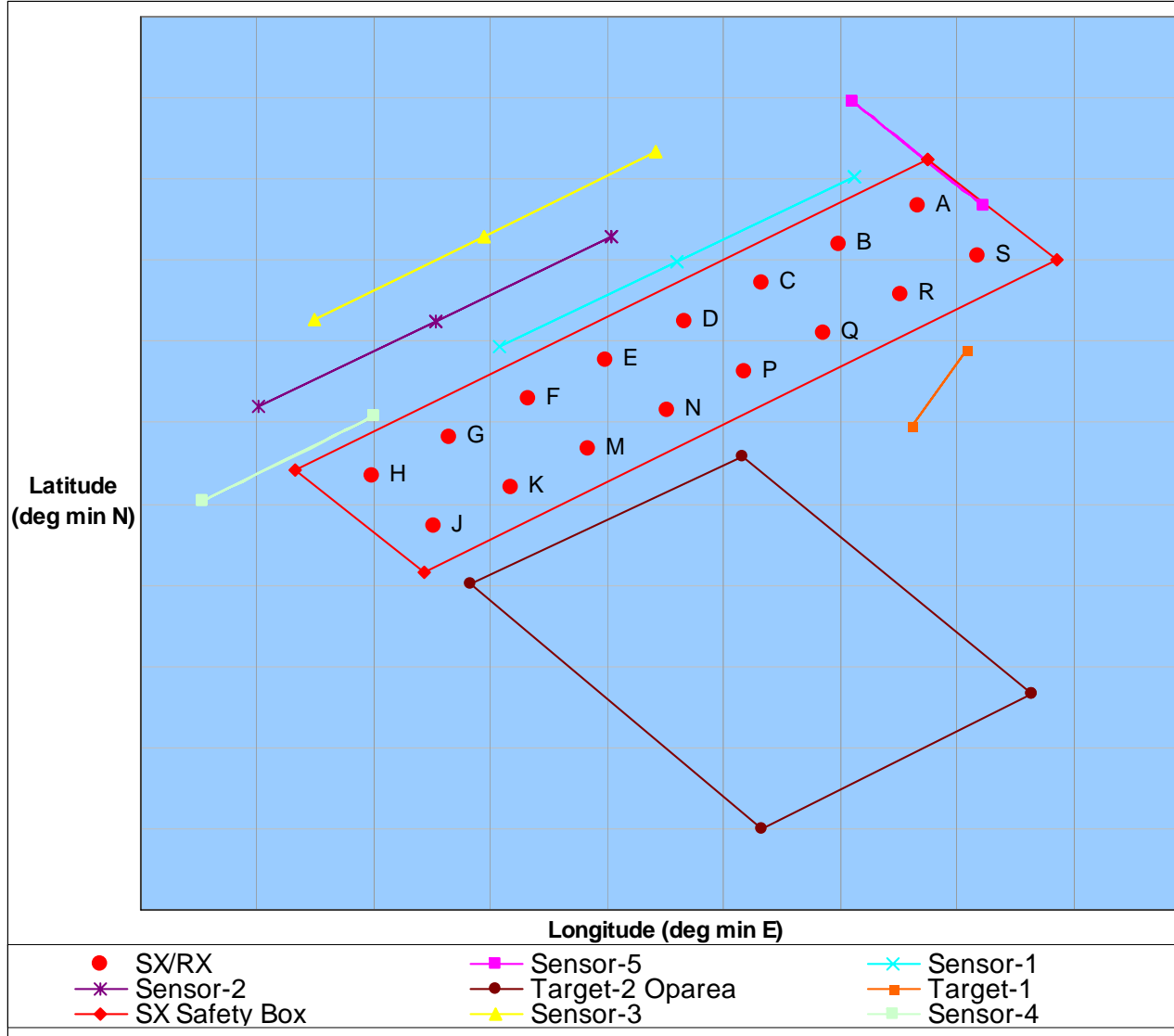
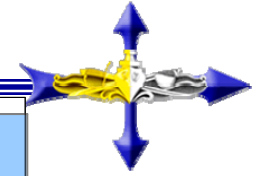
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# Multi-Static ASW Physics Experiment/Test

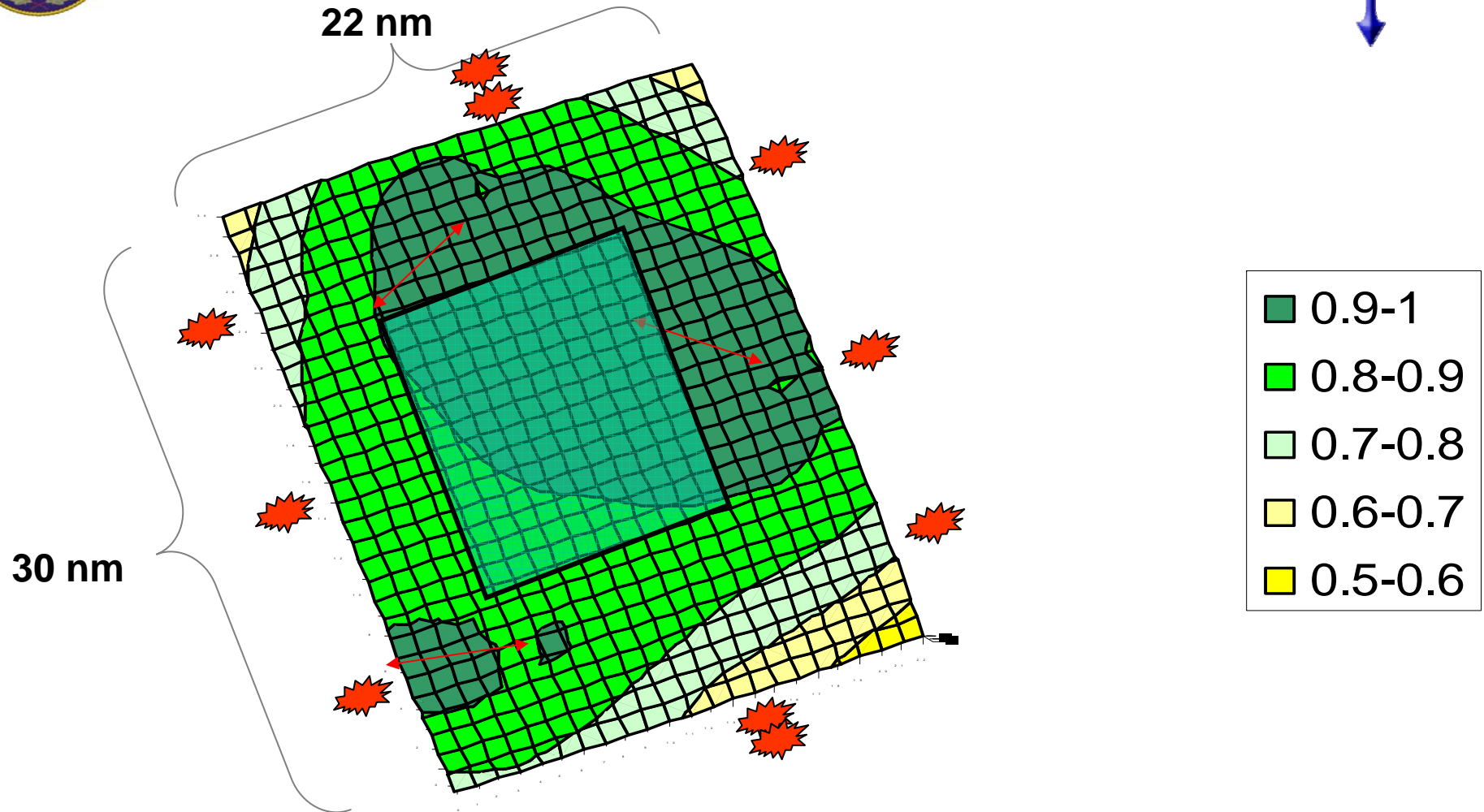
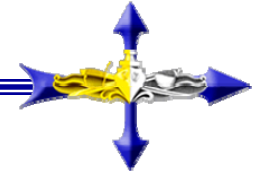
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# Multi-Static ASW Tactical Experiment

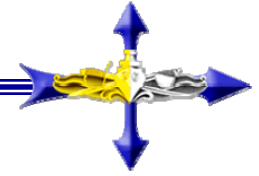




# SHAREM

## *37 Years of Lessons Learned*

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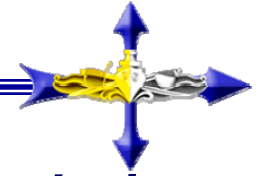


- ✓ **Background/Overview**
- ✓ **Improved-SHAREM Process**
- ✦ **Metrics**
- **Lessons Learned**



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# Improved SHAREM Analysis



**Best metrics are independent of platform actions or exercise design**

## Probability of Detection as a Function of Lateral Range

Proper implementation requires imposing course and speed restrictions on the target.

## Hold Time

Assumes the presence of a target in the area. Difficult to normalize size and shape of the target OPAREA.

## Contact Validity Ratio

Assumes the presence of a submarine in the operating area and is a function of target operating area and target density.

Legacy SHAREM Metrics

## Cumulative Probability of Detection

Accounts for target distance regardless of target movement.

## Time Expended Tracking Invalid Contacts

Independent of submarine location or size of the target operating area “cost of doing business” concern relatively independent of other factors.

## False Contact Rate

Considers invalid contacts only. Submarine location and OPAREA size do not matter.

Improved SHAREM Metrics

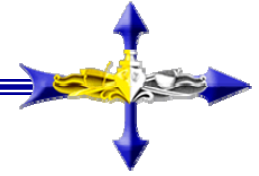
***“An exercise without analysis is, at best, a demonstration...”***





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# Improved SHAREM Metrics



## Find

### Detection and Classification

$CP_d$   
 $CP_{d\&c}$   
False Contact Rate  
Probability of False Contact

## Track

### Tracking

Percent Time Tracking Invalid Contacts  
Ability to maintain track

## Fix

### Localization

Localization Probability

## Target

## Engage

### Attack Effectiveness

Invalid Attack Rate  
Invalid Attack Probability  
Valid Attack Probability

## Assess

*Independent & Defensible Measures*



# What's Reported – Vice Quoted

## Presentation Matters

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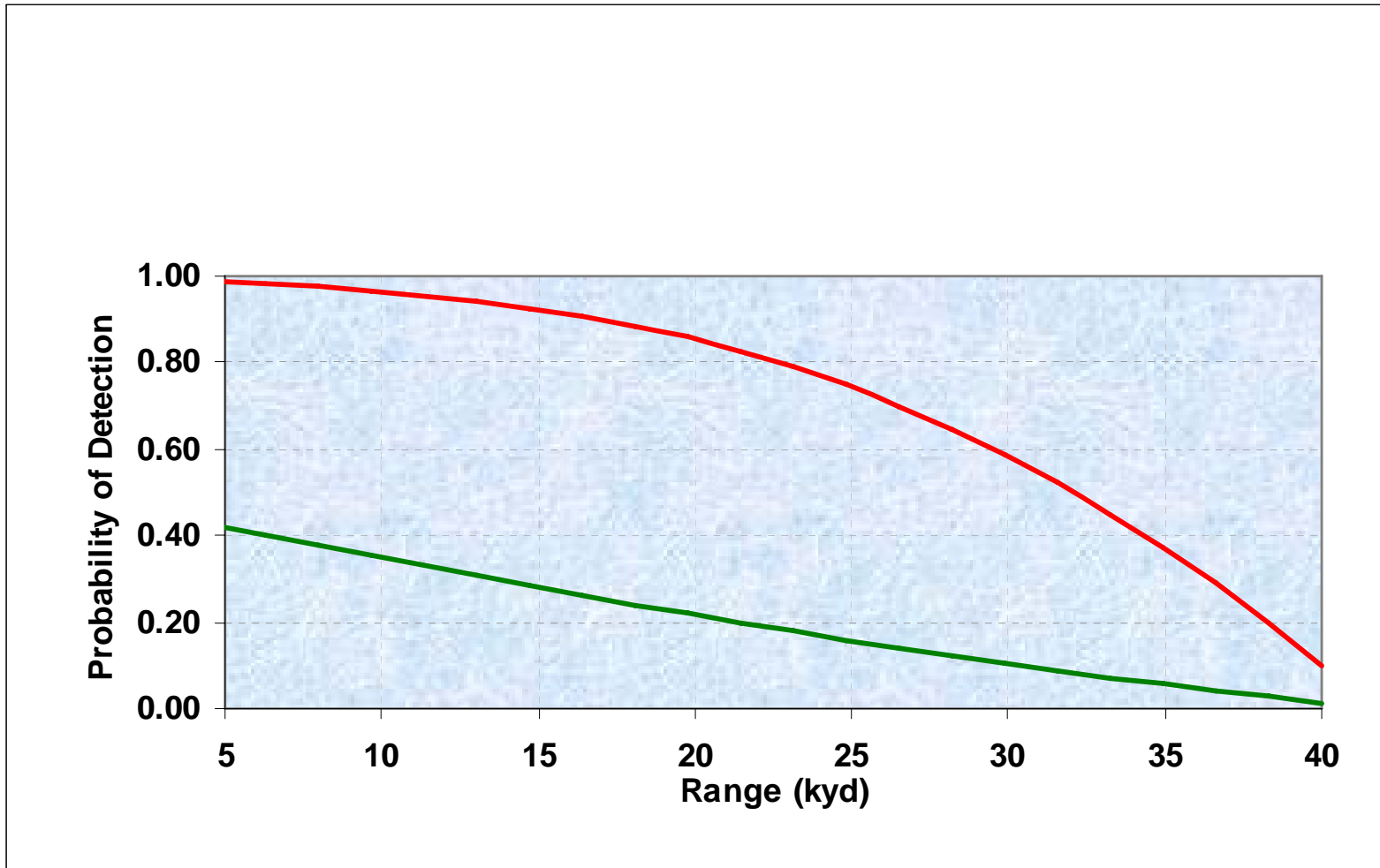
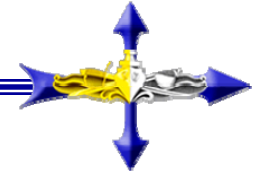
<i>Event</i>	<i>False Alarm</i>	<i>False Alarm per Day</i>	<i>Exp</i>	<i>Det</i>	<i>Det/Exp (%)</i>	<i>Exp Time</i>	<i>Hold Time</i>	<i>Hold/Exp (%)</i>
09100	1	3	84	47	56	3:59:30	3:25:41	86
10400	0	0	2	2	100	4:23:00	3:02:56	70
10900	7	7	32	12	38	6:26:47	5:02:18	78
1			2	1	50	1:02:00	0:26:21	42
2								
12100	0	0	2	2	100	2:23:00	1:55:11	81
12500	0	0	11	9	82	8:50:55	8:44:40	99
12800	0	0	N/A	N/A	N/A	N/A	N/A	N/A
14100	3	4	14	7	50	1:09:48	1:10:16	100
15100	3	2.1	29	9	31	00:49:11	0:09:05	19
<b>Struc</b>	<b>1</b>	<b>0.89</b>	<b>99</b>	<b>60</b>	<b>61</b>	<b>19:36:25</b>	<b>17:08:28</b>	<b>87</b>
<b>F-P</b>	<b>13</b>	<b>4.1</b>	<b>77</b>	<b>29</b>	<b>38</b>	<b>9:26:59</b>	<b>6:48:00</b>	<b>72</b>
<b>Total</b>	<b>14</b>	<b>2.8</b>	<b>176</b>	<b>89</b>	<b>50</b>	<b>29:03:24</b>	<b>23:56:28</b>	<b>82</b>



# I-SHAREM

## One Exercise – One Day

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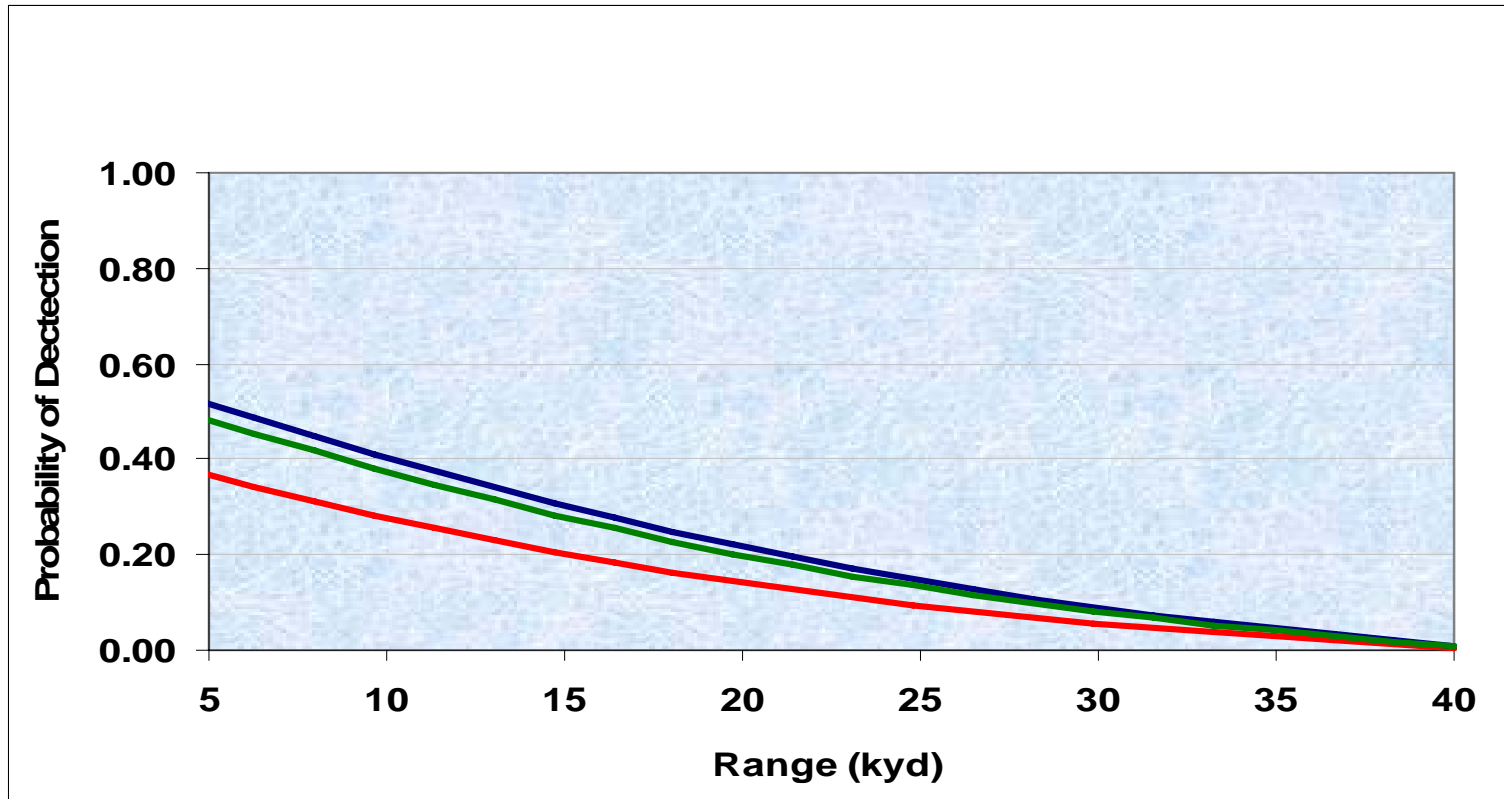
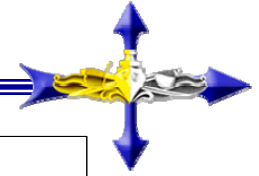




# I-SHAREM

## *Same Exercise – Another Day*

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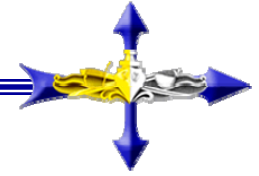
*Judging overall performance based on data from one event = Danger!*



# SHAREM

*37 Years of Lessons Learned*

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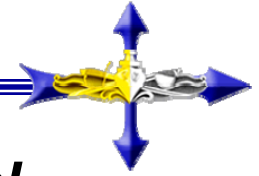
- ✓ **Background/Overview**
- ✓ **Improved-SHAREM Process**
- ✓ **MOEs & MOPs**
- ❖ **Lessons Learned**



# Lessons Learned

## *Evolving to Match Environment...*

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- **Exercises designed to objectives - Sequence is critical**
  - ❑ *Start with objectives – limit the number or acknowledge failure*
  - ❑ *Develop analysis plan to support objectives*
  - ❑ *Identify data requirements based on objectives and analysis plan*
  - ❑ *Design exercise (experiment) to support objectives*
  - ❑ *Detailed data collection and analysis plan up-front!*
- **Expanded use of Limited Objective Experiments (LOEs)**
  - ❑ *Smaller scale easier to manage,*
  - ❑ *Better ensures goal attainment*
- **Trade-offs between exercise and experiment requirements**
  - ❑ *Requires early “buy-in” on priorities by all concerned*
  - ❑ *Prioritization of events to ensure realization of objectives*
  - ❑ *Incorporation of desires requires deconfliction*
- **SHAREM IPT sets objectives and schedules venues**

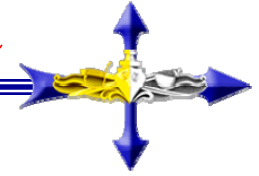
*SWDG remains the honest broker for Surface Warfare Capabilities*



# *Lessons Learned*

## *Technologies - Only part of the solution*

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- ***Unrealized potential remains when systems are used without complete understanding***
- ***New systems require different thinking & TTP***
  - ❑ *Systems lacking TTP will be sub-optimized*
  - ❑ *New systems may not perform as advertised – but will definitely be sub-optimized without accompanying TTP*
- ***Technology inserts are not silver bullets and may only have niche applications***
  - ❑ *Systems need to be integrated & interoperable*
- ***Improved SHAREM analysis provides comparable answers between disparate technologies***

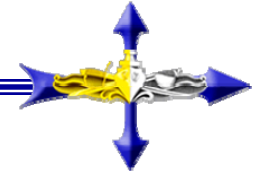
*“Any order of magnitude change requires completely new thinking – old methods may no longer be applicable...” – Richard Hamming*



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# *Lessons Learned*

## *Training & Proficiency*



- ***Training provides basics – practice yields proficiency***
- ***Establishing training & proficiency levels key***
  - ❑ *Assesses training/proficiency impact on overall performance*
  - ❑ *Informs training community on knowledge gaps*
  - ❑ *Establishes ‘remedial’ and/or ‘refresh’ training requirements*
  - ❑ *Guides synthetic trainer developments*
  - ❑ *Informs Fleet Response Plan requirements*
- ***Feedback for acquisition and research & development communities***
- ***Consistent & coherent metrics needed***

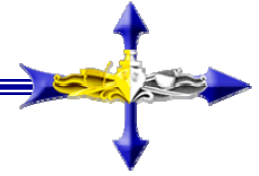




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# Lessons Learned

## Metrics



### ➤ **Metrics 'musts' :**

- Translatable*
- Defensible*
- Comparable*
- Understandable*
- Reproducible*
- Objective based*
- Identify KPPs*
- Pass Independence test*

➤ ***Introduction of new metrics will meet resistance***

➤ ***Single point evaluations are suspect***

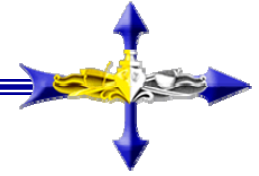
*"Not everything that counts can be counted, and not everything that can be counted counts." - Einstein (attributed)*



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# Lessons Learned

## *Kitchen sink...*



- **Quicklooks are always inaccurate**
- **Human factors and memories can skew results**
- **Piggy-backed evolutions will generally fall short**
- **True Freeplays yield little insight - often result in “no tests”**
  - ❑ *Freeplays with objective focused instructions can produce insight*
- **All results scrutinized – especially those contrary to perceptions**
- **Repeat Lessons Learned are Ongoing Discrepancies!**
- **Rapid warfighter/participant feedback critical**
  - ❑ *Best practices may only apply to given circumstances*
  - ❑ *Documentation is key to moving forward and not forgetting...*

*Questions?*





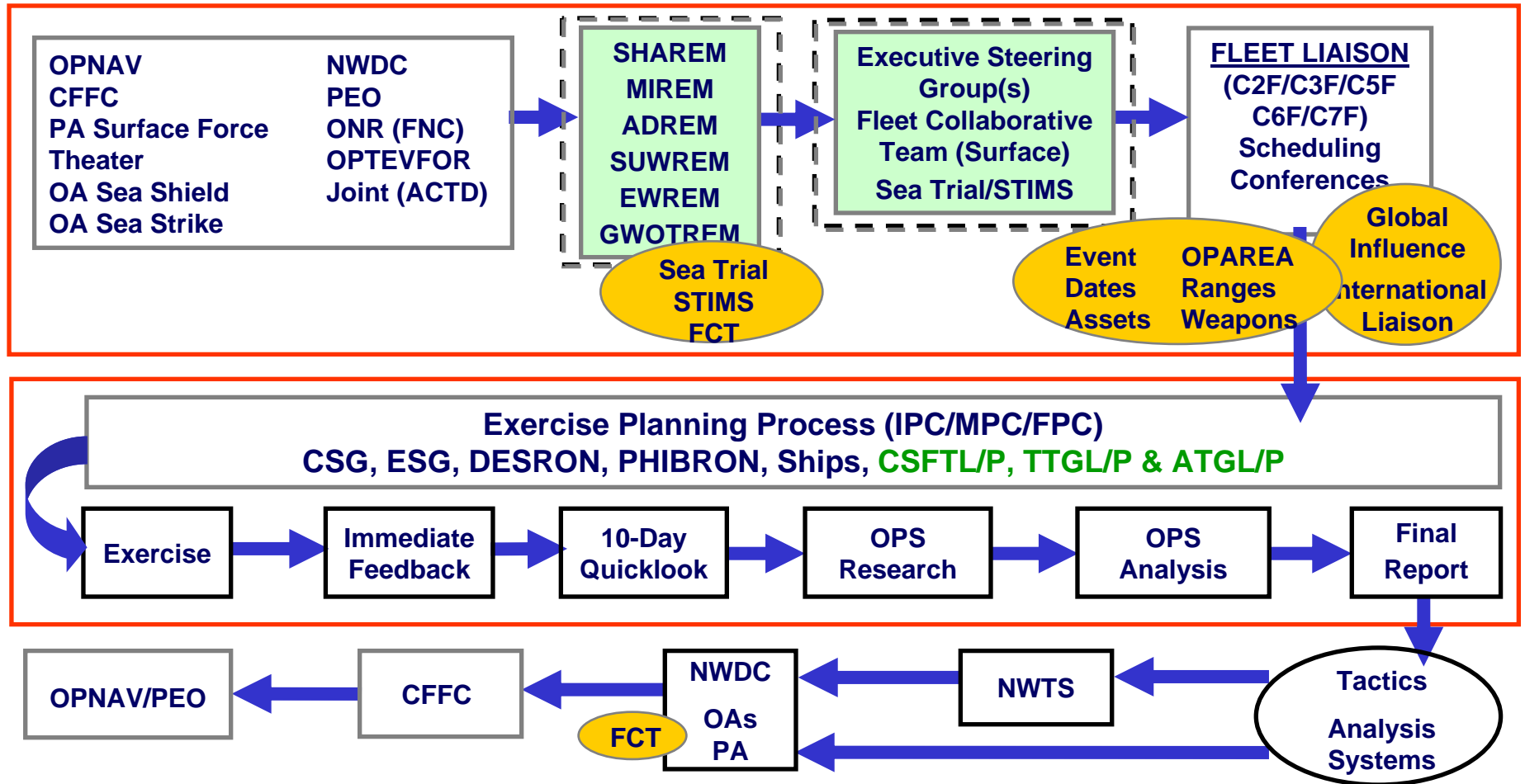
# I-SHAREM -> SURFREM

## Extension Across All Warfare Areas

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### SURFREM ... The Future Of The SHAREM / MIREM Process



Surface Force Programmatic Input... Tactical Development... Analytical Feedback