



# Antisubmarine Warfare System Evaluation. The experience of DIPRIDA.

December 02, 2009



# Agenda

1. OR in the ASW knowledge loop.
2. Inside our OR organization.
3. Our experience and challenges.

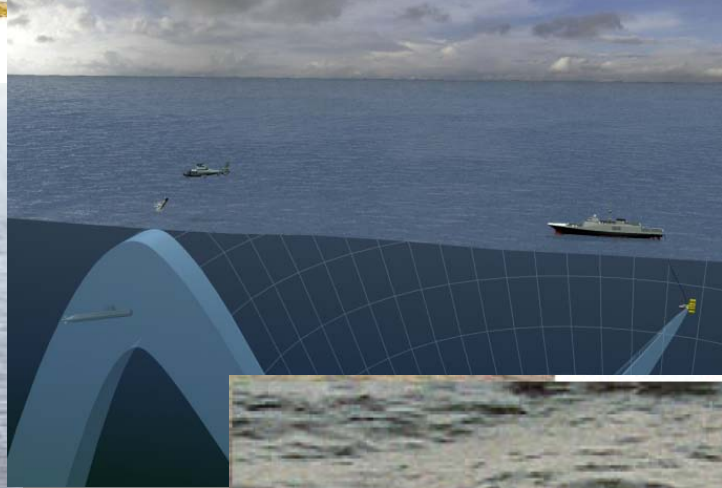


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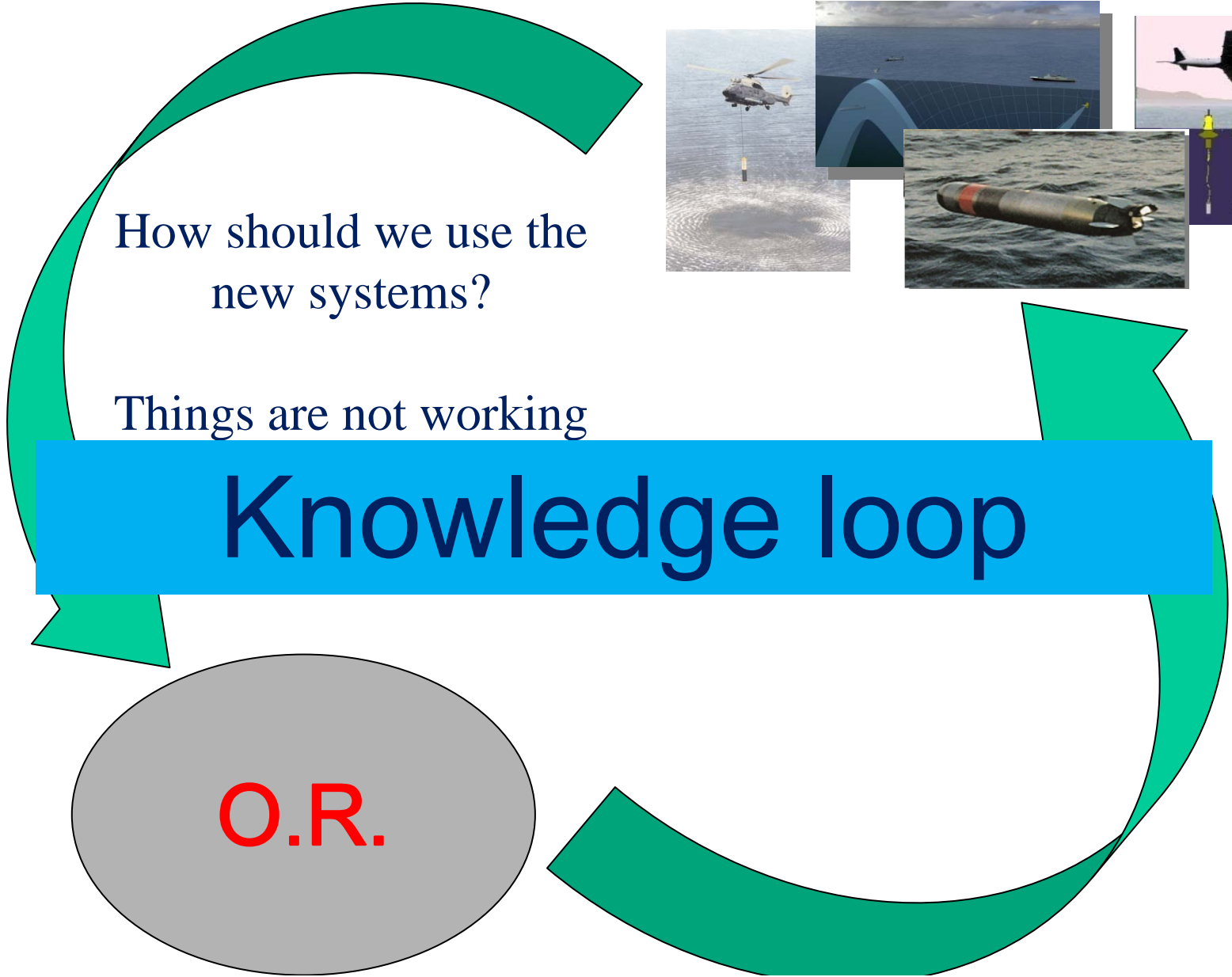
# 1.0 OR in the ASW knowledge loop.



How many systems are needed?  
What is the expected operational performance?  
Can we achieve the required capabilities?



# 1.0 OR in the ASW knowledge Loop.





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# Agenda

1. OR in the ASW knowledge Loop.
2. Inside our OR organization.
  - ✓ History of OR in DIPRIDA.
  - ✓ What kind of problems do we solve.
  - ✓ Finding solutions.
3. Our experience .

The OR Department in DIPRIDA was created on 1991.

- Previously, OR people was working on technical posts.
- Beginning with 2 persons (no studies in OR).
- Currently 10 persons
  - 1 Ph.D. in Industrial Engineering
  - 1 M.Sc. In O.R. and 1 M. Sc. Ind. Eng
  - 8 engineers and Physicists.



## What kind of problems do we solve

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### Data Collection .

- ✓ The basis for all our work.
- ✓ Automated data collection.
- ✓ Data Management and data mining tools.

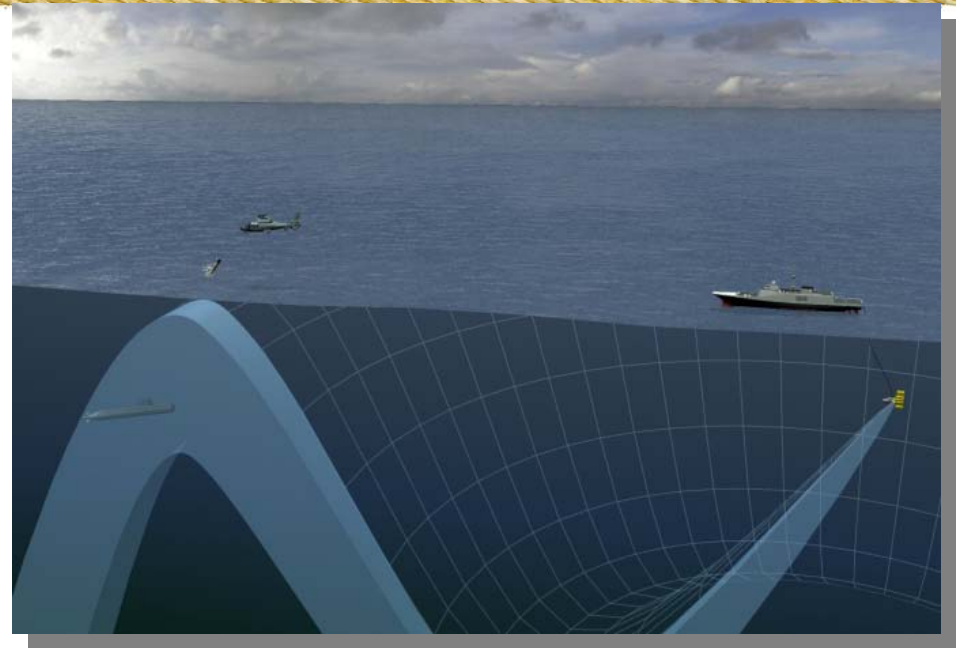


- The goal is to extract useful information out of massive amounts of data and to provide data to build and statistically validate our models.

## What kind of problems do we solve

### Sensor Performance Prediction

- ✓ Basic information for any ASW analysis.
- ✓ Many conditions under which system's performance must be estimated.
  - Bathythermography
  - Depth
  - Bottom.
  - Environment.



- The goal is to estimate system performance.
- Tools: Underwater propagation models, Statistics.



## What kind of problems do we solve

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### Helicopters in the ASW Screen.

- ✓ Location of the screen depending on the tactical situation.
  - ✓ Define size and number of dipping sector depending on environmental conditions and available assets.
  - ✓ Find most effective sequence, depth and dipping time.
- 
- The goal is to achieve the highest probability of detection
  - Tools: Computer simulation and man-in-the-loop simulation.





## What kind of problems do we solve

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### Torpedo Countermeasures

- ✓ Evaluate evasive maneuvers according to sensor performance, countermeasure systems, and ship acoustic characteristics and dynamics.
- ✓ Optimizing countermeasures: what kind, how many and timing.
  - The goal is to achieve the highest survival probability.
  - Tool: Simulation



## What kind of problems do we solve

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### Aircraft search plans

- ✓ Define aircraft track according to platform dynamics and sensor performance
- ✓ Search plans must account for the time required for the force to avoid the threat.



- The goal is to achieve the highest detection probability before any threat reaches launching distance.
- Tool: Simulation.

## Submarine Patrol Area

Model must account for :

- ✓ Threat speed and general direction of movement.
- ✓ On-board submarine sensor performance.
- ✓ Submarine routines and tactics.



- The goal is to provide tools for the Command Team where patrol areas can be evaluated by their detection probability.
- Tools: Simulation, optimization.



## Finding solutions.

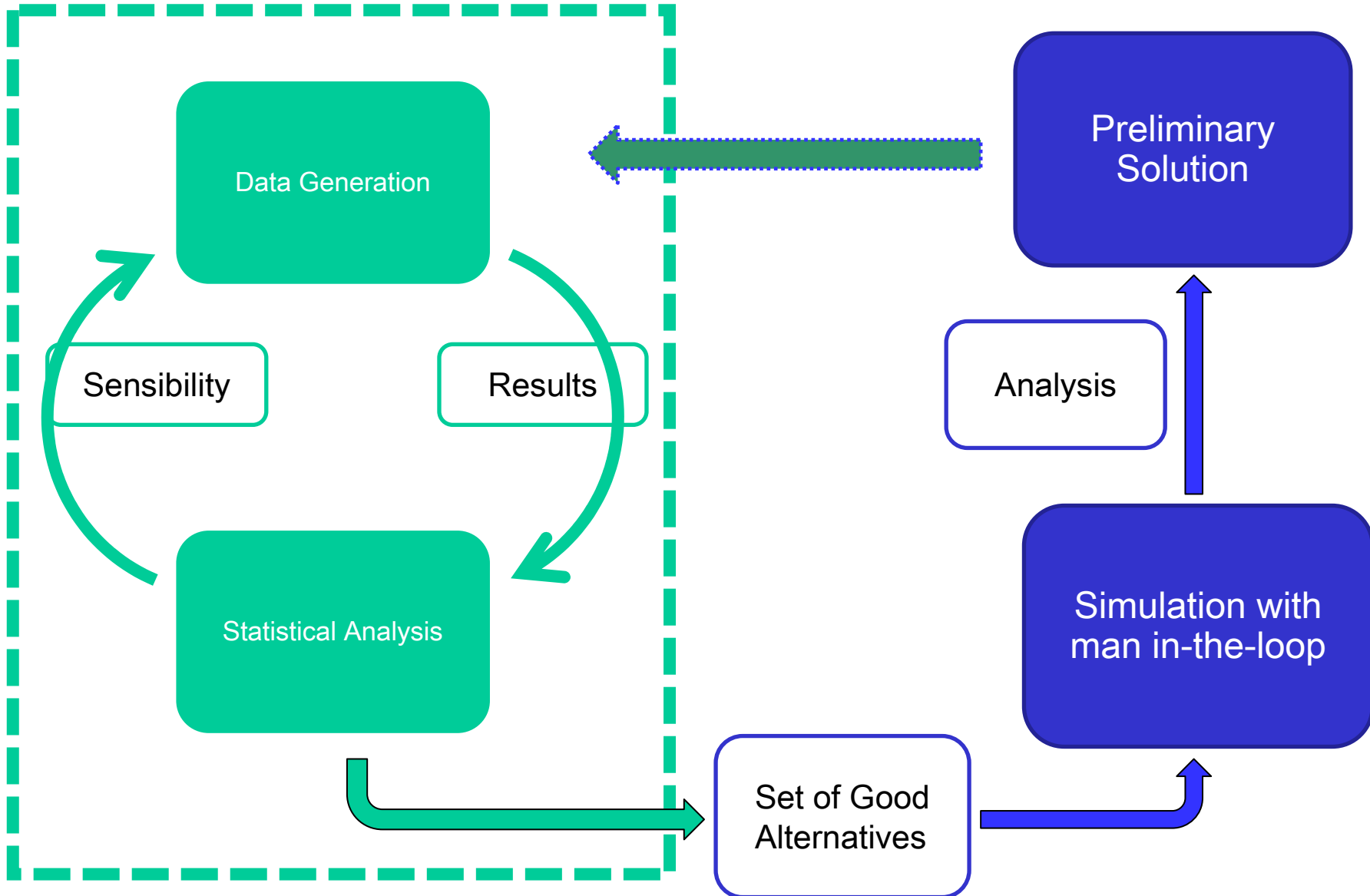
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1. Study the problem.
2. Develop a Conceptual Model.
  - Agreement with the end-user.
3. Decide if it is required to develop a new model .
  - In-house development or acquisition?
  - Data collection.
  - Develop a model according to the Conceptual Model.
  - Develop the proper HMI to allow for exploitation (Documentation please!!!!)
  - Validate the model.
4. Analysis with the model.
5. Repeat the loop as needed
  - Results do not agree with reality.
  - Adjustments needed for end-user utilization.
6. Deliverables: Manuals, computer tool/procedure to automate response.



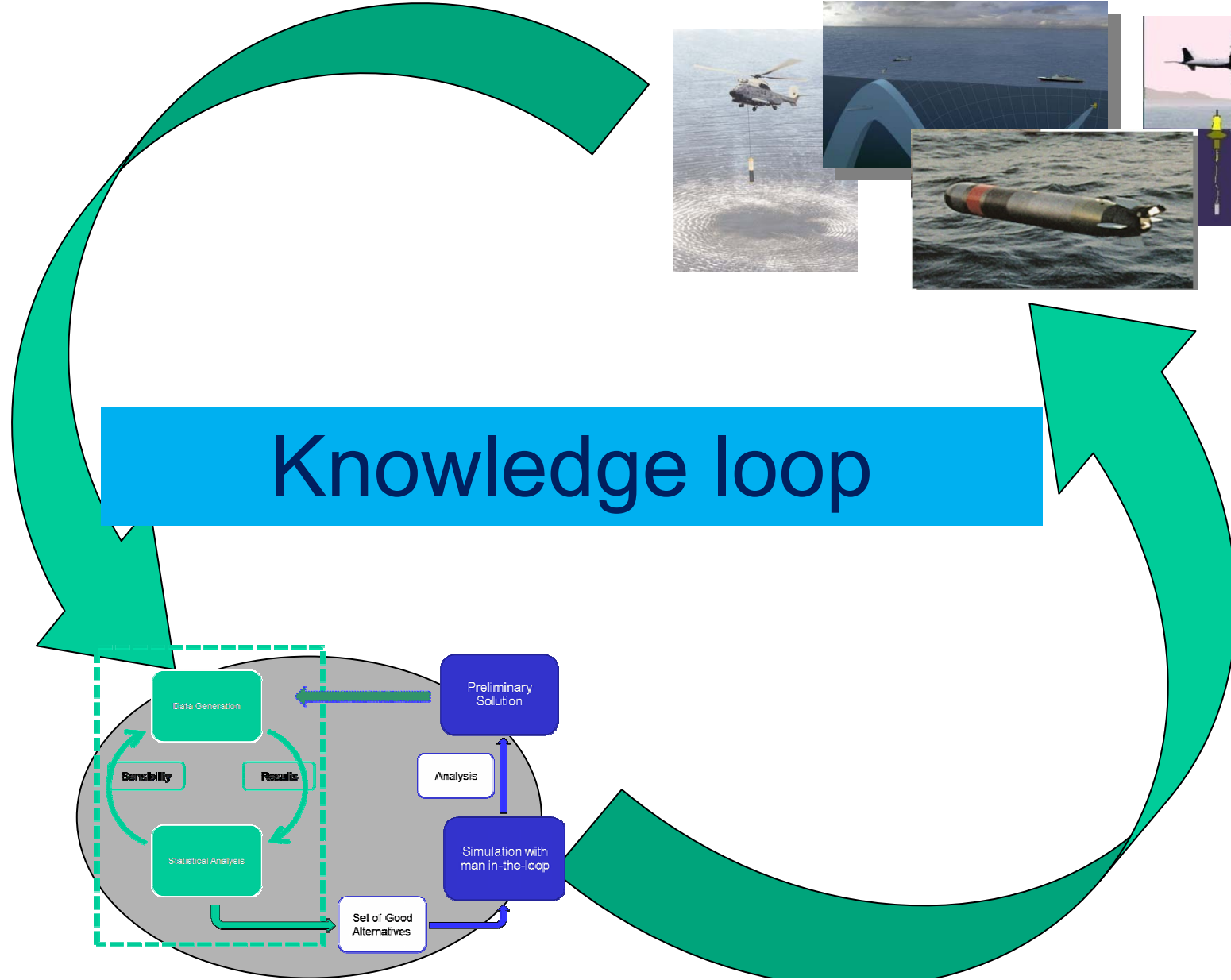
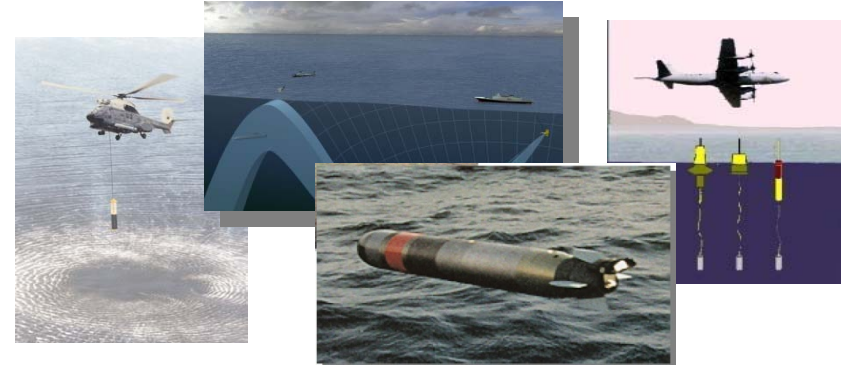
# Finding solutions.





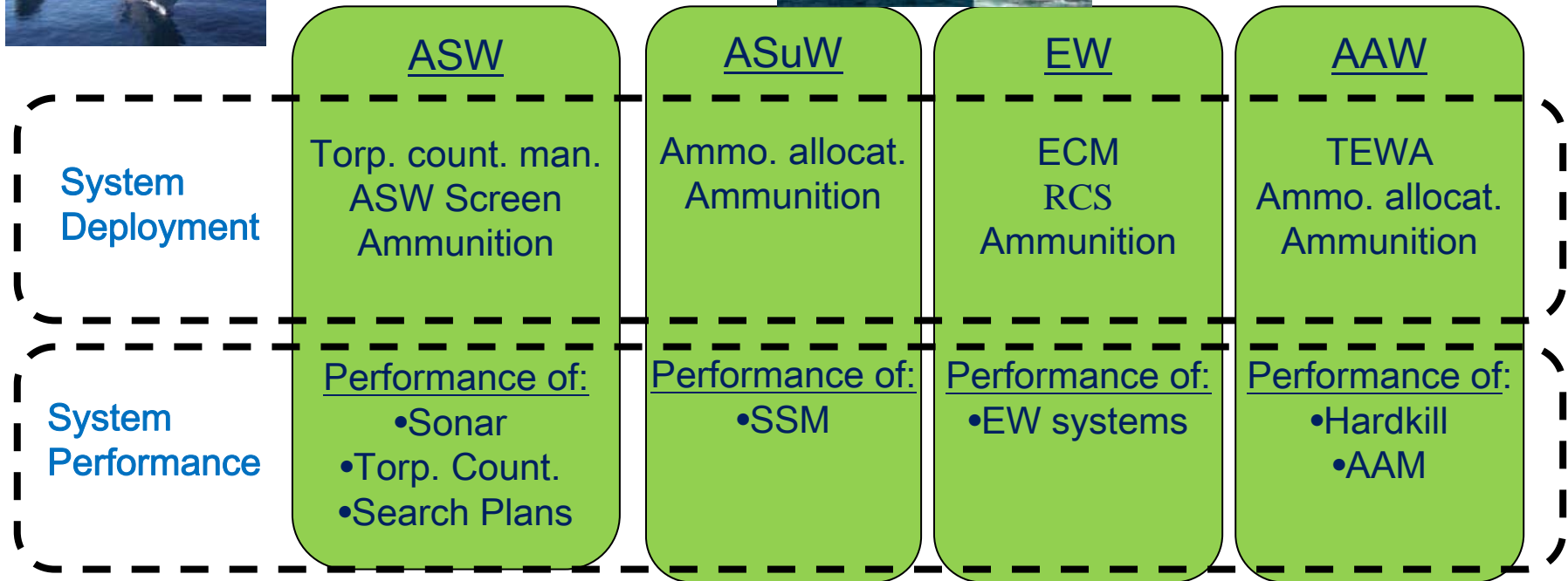
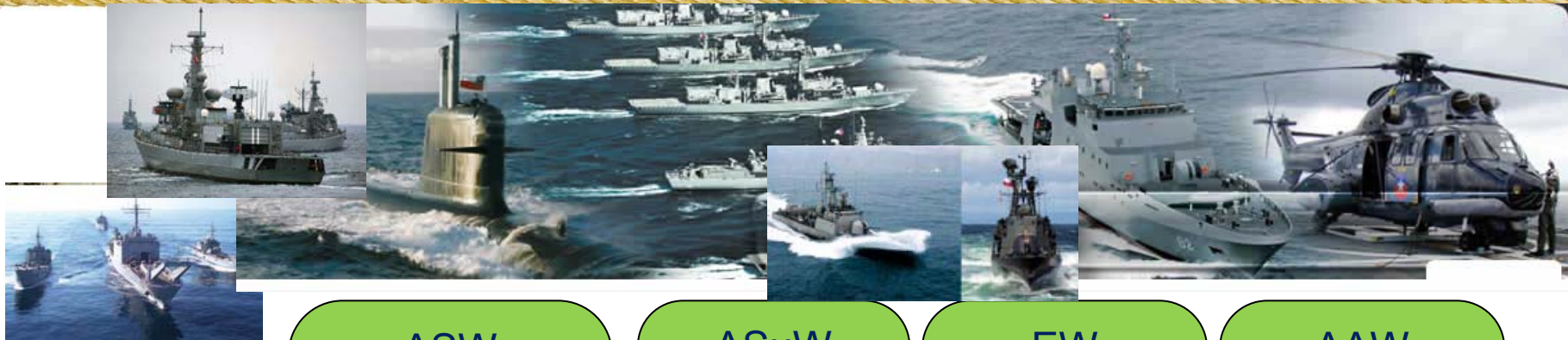
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Finding solutions.





# We support naval operations



Modeling  
Simulation, Optimization, Regression



# Agenda

1. OR in the ASW knowledge Loop.
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## 1. The information Loop

- ✓ The knowledge loop is strong only if all parties contribute actively.

## 2. Analysis.

- ✓ Hard to hire external analysis: classified access, operational experience, timing and available information.
- ✓ In-house analysis is a must with strong participation of operational representatives.
- ✓ All steps in the process are mandatory (don't skip)
- ✓ Need to develop own plans and tactics reference not always work well for us

### 3. Model Development.

- ✓ Variety of Results with external model development: need for a better development process.
- ✓ Model identification is hard: need to find good/representative models faster reducing developing time.
- ✓ Model development is extremely slow: in-depth system characteristics not provided, people capable to develop such kind of models is scarce.
- ✓ Model documentation: need to have the capability to “maintain” the models at the lowest development cost.
- ✓ Validation.

### 4. Permanent Learning.

- ✓ Seminars.
- ✓ Experience exchange.



## 5. Our challenges.

- ✓ Need more people prepared to contribute in the loop.
- ✓ How can we include external practitioners in the knowledge loop including universities and institutes that can help us to do a better job without jeopardizing security.



Our experience .



# Questions?



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December 03, 2009