

SAS-108: Methods to Support Decision Making for Joint Fires

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Outline

- Background
- Objectives
- Summary of Work
- Outputs and Exploitation
- Recommendations
- Questions

Background

- **Type:** STO Task Group (RTG)
- **Dates:** Activity Start: April 2014
Deadline: April 2017
- **Product:** Technical Report
- **List of Participating Nations:** NLD (chair), DEN, GBR, NOR, ESP, FIN (observer), CAN (reviewer)
- **List of other entities participating:** NCIA, NAAG ICGIF SG2
- **Time scale:** 7 meetings and teleconferences in between



Objectives

The goal of this research task group was:

- To develop methods to quantify and balance the operational risks, effectiveness and costs of Joint Fires for given scenarios.



Summary of work

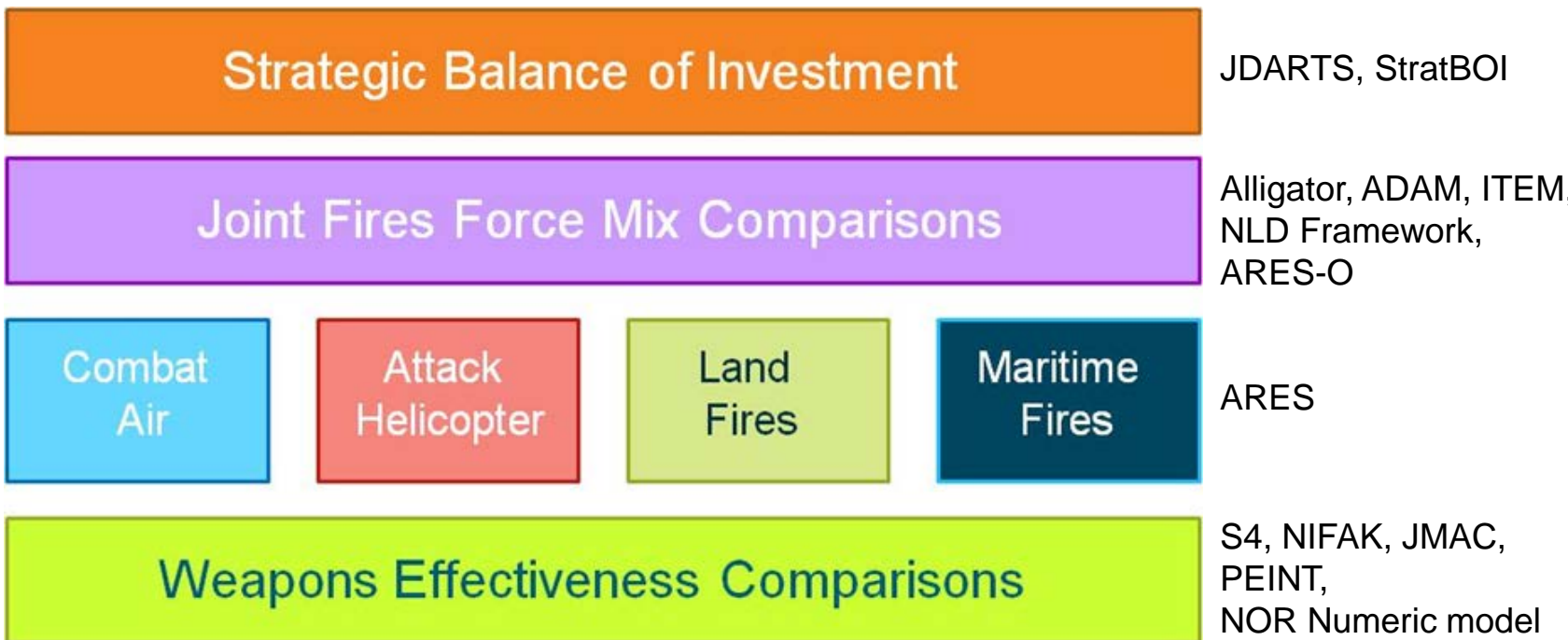
- Establish Definitions, **Scope** & Boundaries
- Investigate Current **Methods & Models**
- Development of an **Analytical Framework**
- Framework applied in **Case studies**

Summary of Work: scope

- Decision making for:
 - Procurement , Pre-deployment planning, In-Theatre operations
- Ability to select:
 - The 'best' platform/weapon combination(s) for given task(s)
- Taking into account:
 - Effectiveness, Cost and Risk
- Risk: primarily Collateral Damage Risk
 - Also Platform Attrition, Mission Failure
- All Joint Fire Support Systems (Land, Air, Maritime)
- Land targets only, with a focus on lethal effects

Summary of work: review existing models

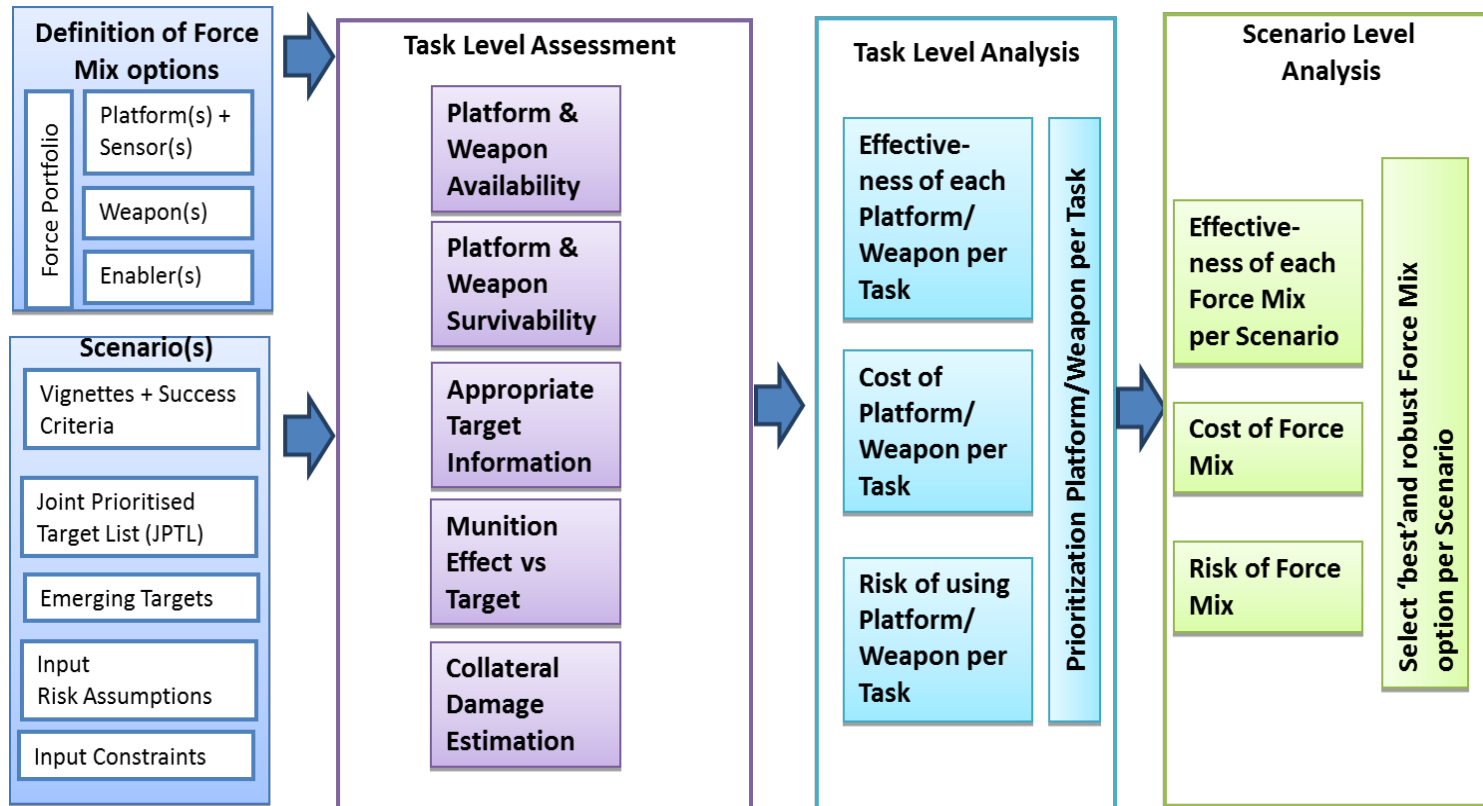
- Over 20 models reviewed from NATO and participating organisations and placed in an analytical hierarchy



Summary of work: findings review existing models

- **No single, existing, model that fully meets the scope of SAS-108.**
 - Each model has some limitations deriving from their design and intended use.
- **Majority of models focussed on effectiveness calculations, with limited consideration of operational risks and cost.**
 - Number of models not able to compare different types of joint fires capabilities.
 - Some models lack flexibility to trade cost, risk and effectiveness.

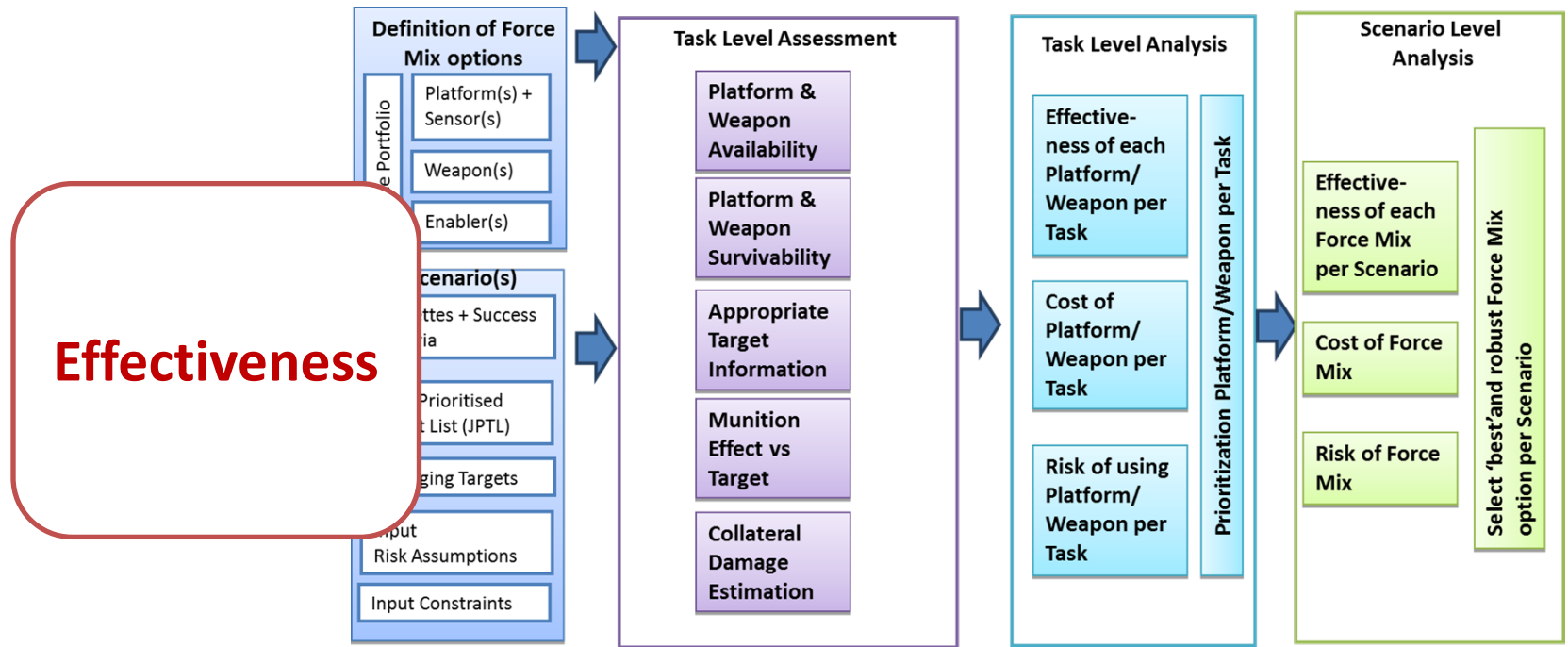
Summary of work: analytical framework



Summary of work:

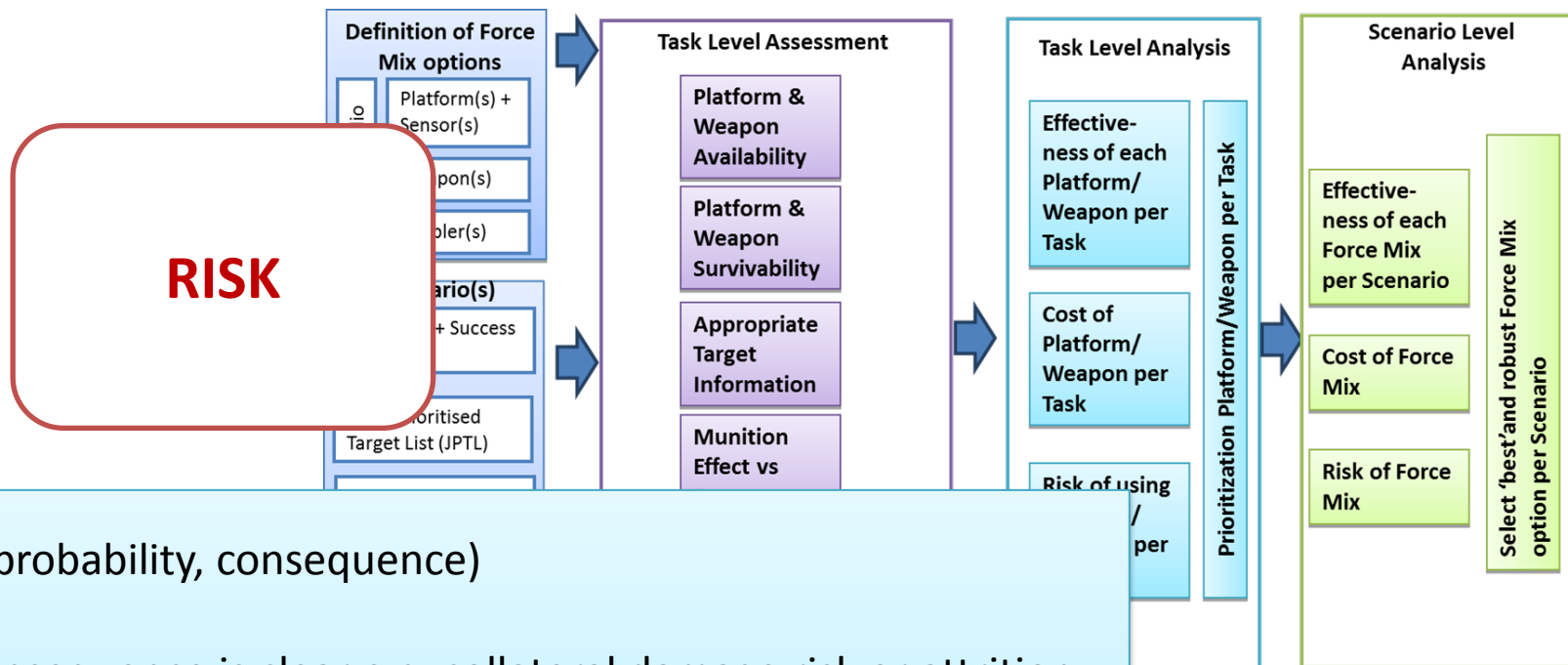
Case studies to test framework

- Six examples:
 - Artillery acquisition
 - Future force mix
 - Weapon design
 - National pre-deployment
 - Judgement based approach
 - Mathematical model
 - In-theatre planning



Task level Effectiveness =
 $P(\text{availability}) * P(\text{survivability}) * P(\text{appropriate targeting}) * P(\text{desired effect}) * P(\text{acceptable collateral damage})$

Output =
 Prioritised list of options for each task



Risk = f (probability, consequence)

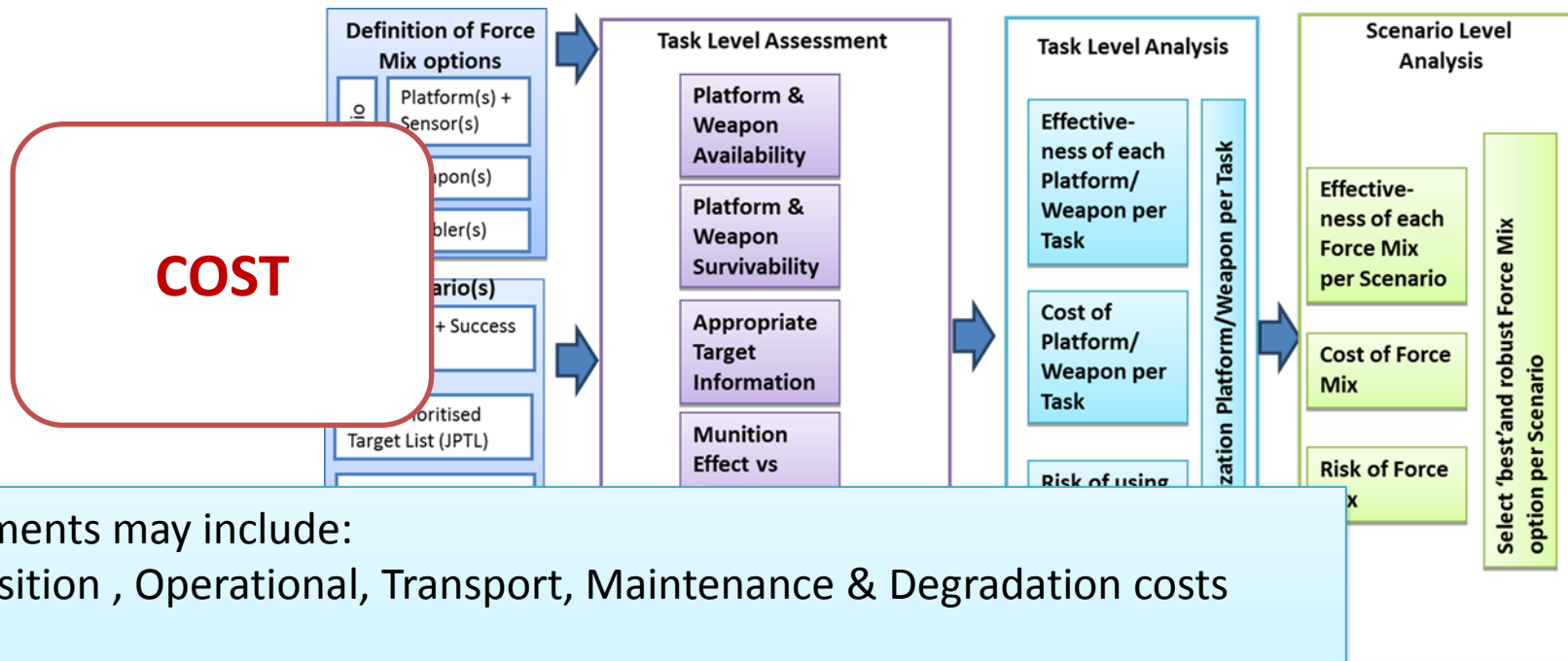
When consequence is clear e.g. collateral damage risk or attrition, it can be quantified as a probability.

- Apply acceptable risk thresholds
- Risk becomes an integral part of the effectiveness calculation

Other risks may need to be considered as a more generic 'risk factor',

- Present separately.

Essential that different types of risk are explicitly identified. Detailed discussion with stakeholders is recommended.



Cost elements may include:

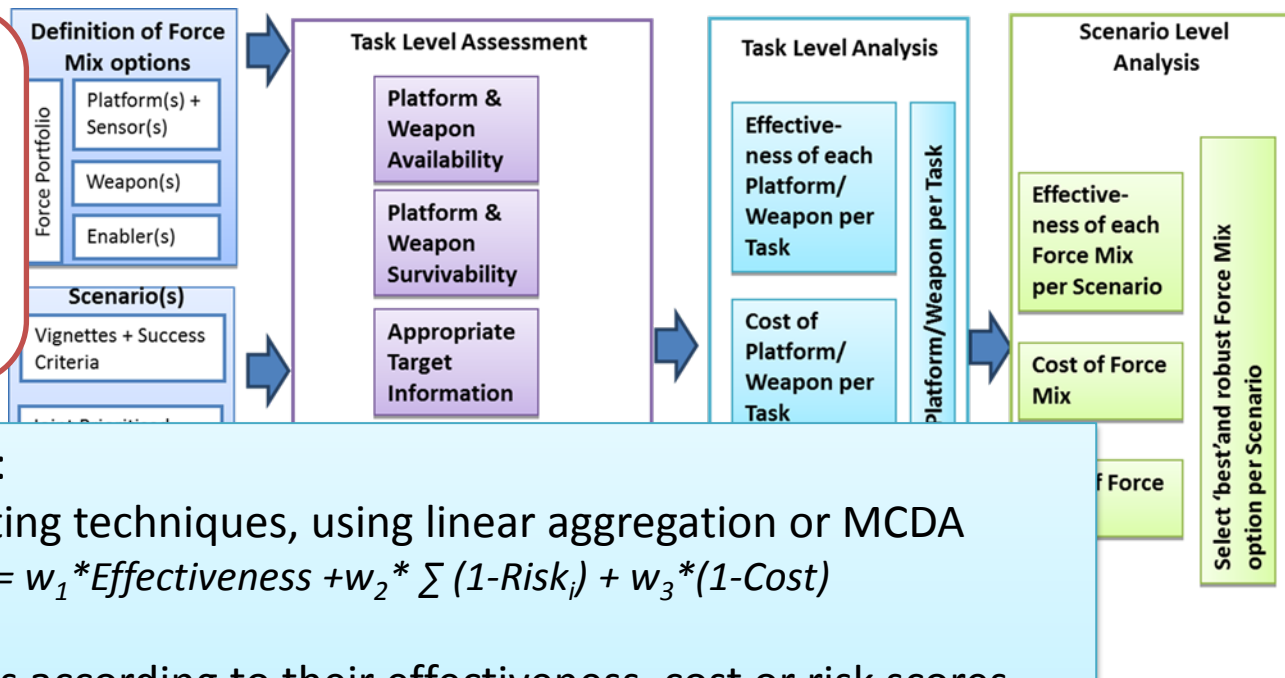
- Acquisition , Operational, Transport, Maintenance & Degradation costs

At task level, typically limited to Operational costs, e.g. expenditure of fuel, oil, ammunition, required to complete the task

Cost of the Force Mix estimated at scenario level, but not all cost elements are relevant to all types of question:

- Only Operational costs were applicable to all Case Studies
- In-Theatre example – costs can be defined as an expenditure related to the available resources in theatre, rather than financial/monetary

**Effectiveness,
Cost & Risk
Trade-offs**



Approaches identified:

- Scoring and Weighting techniques, using linear aggregation or MCDA
 - $Utility\ Function = w_1 * Effectiveness + w_2 * \sum (1 - Risk_i) + w_3 * (1 - Cost)$
- Ranking of solutions according to their effectiveness, cost or risk scores, or alternatively ratios of the scores, or some other utility function
 - $Utility\ Function = MOE / Cost = [Effectiveness \times (1 - Risk)] / Cost$
- Constraining cost using the input and calculating the resulting MOE
 - $Utility\ Function = MOE = [Effectiveness \times (1 - Risk)]$
- Plotting Cost and Effectiveness values (and Risk included in effectiveness)

Outputs and exploitation

- Output
 - Overview of models being used to support decision making for Joint Fires
 - Framework developed and tested with a number of case studies
 - Final report: Draft version already distributed. Final version is projected to be completed before end 2016.
- Specific Target Audience
 - Framework should be valuable to Nations, Joint Force Commands and Land, Air and Maritime Component Commands.
- Military relevance
 - Provides a common language to discuss and structure planning Joint Fires operations
 - Flexible Framework – Suitable for a wide range of decisions/study types and can be used with a wide range of analysis methods
- Dissemination
 - Results have already been presented at international OR conferences:
 - National reporting and briefings to sponsors and potential customers.
 - SAS-108 members sharing experience gained while applying the framework

Recommendations

- Develop, further explore and test methods and metrics for operational risk and how to incorporate in models
- Developing a single analytical tool is not recommended
 - Different questions ask for different approaches and analytical tools
 - However, framework can be used to evaluate existing models, and provide a guideline for new models
- Investigate if the framework is also suitable for non-lethal effects (CAN)
- Examine the trade between mounted/dismounted troops and Joint Fires Systems (GBR)

Questions ?

