



# Sustainable Ammunition Safety – Interaction with IM

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# Sustainable Ammunition Safety

## Content:

1. Research programme V815
2. Conclusions V815
3. The way ahead?
4. Research programme V1322



## **Ammunition Safety in all aspects**

### › Health Monitoring

- › Munitie
- › Missiles
- › Pyro compositions
- › New energetic materials

### › Qualification of Energetic Materials

- › Functioning, safety and certification

### › Munitie safety

- › IM philosophy and testing
- › Risk analysis (storage/transport)
- › Qualification studies

### › Risk effects and Toxicology

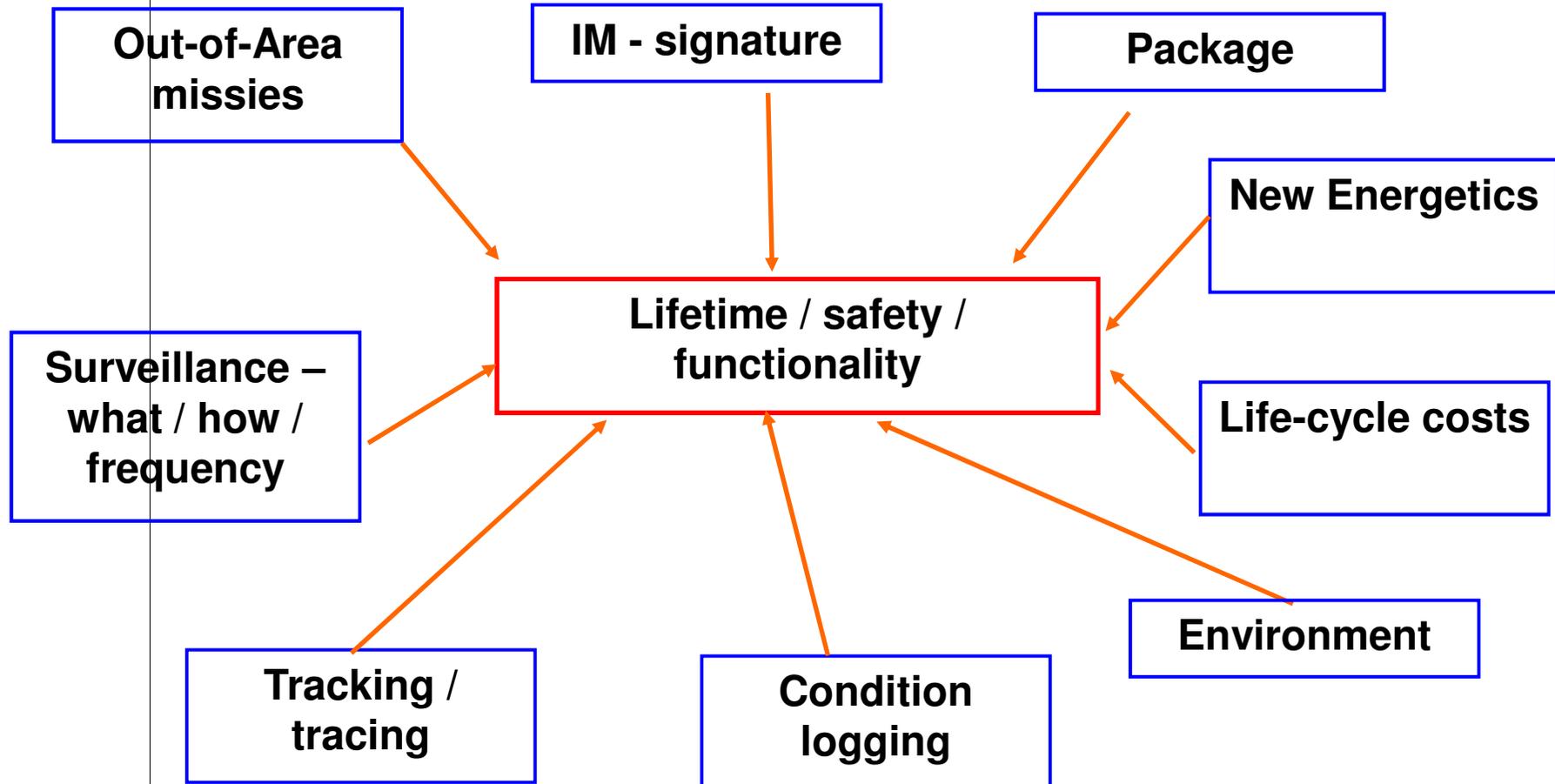
- › Human
- › Flora and Fauna
- › Dispersion (air / soil / water)
- › Sound (impact and protection)

### › Demil and UXO





# Lifetime





## Safety

**Munitions** are normally required to withstand exposure to a wide range of environmental conditions without becoming **unsafe or unsuitable for handling**, storage or transport and then function as designed when required. This may mean that the most extreme climatic environments are experienced by the munition concurrently with induced environmental conditions arising from service use. The safety or suitability for service of a munition may be terminated by **an unacceptable degree of degradation of components** or materials when subjected to normal service environments, or after exposure to certain extreme conditions.



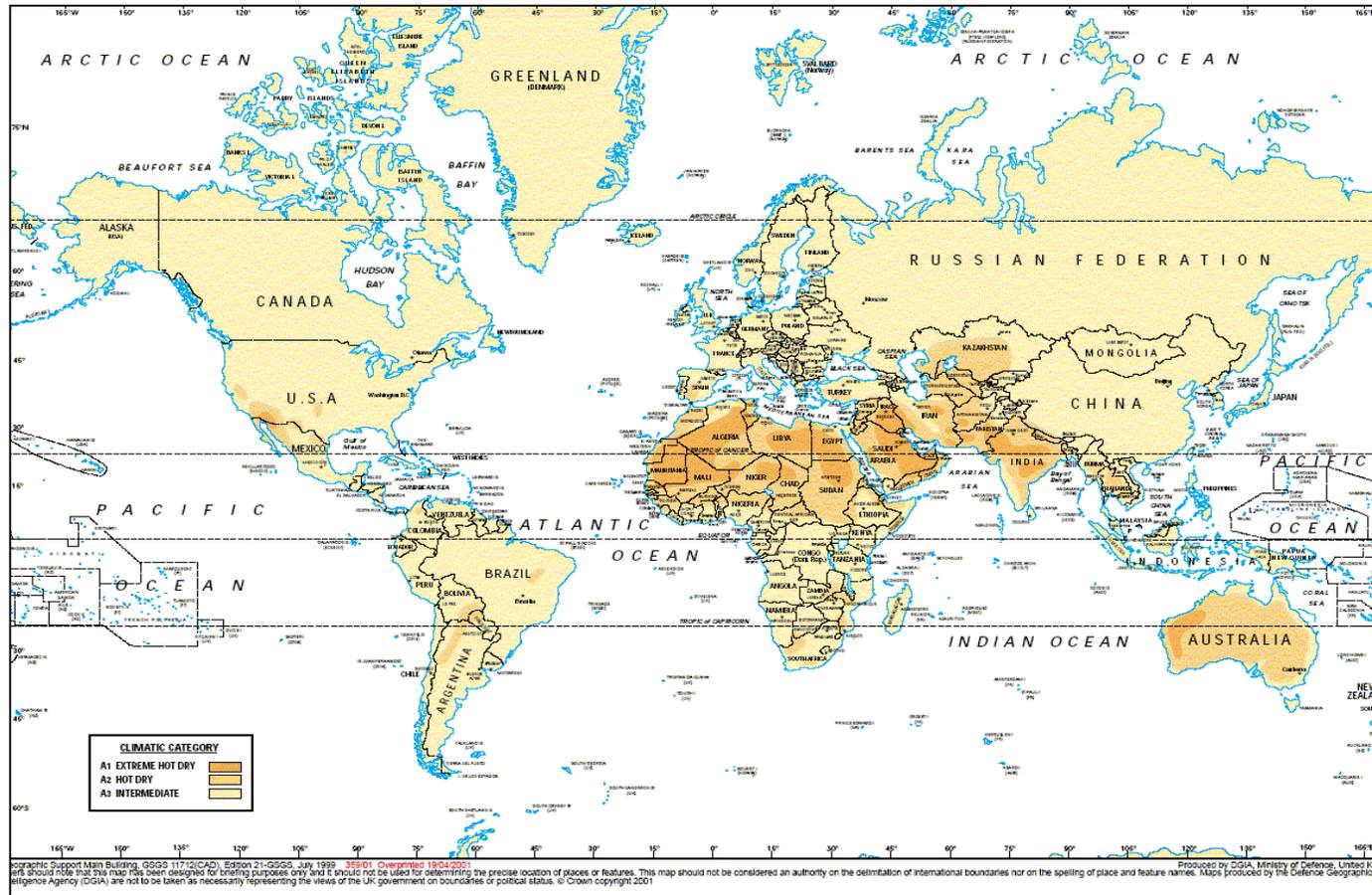
## Sustainable Ammunition Safety

Research programme V815 started in 2008 and should give an better understanding of:

- The effects of mission profiles on munitions safety.
- The effects of combinations of mission profiles on the lifetime of munitions.



# Sustainable Ammunition Safety

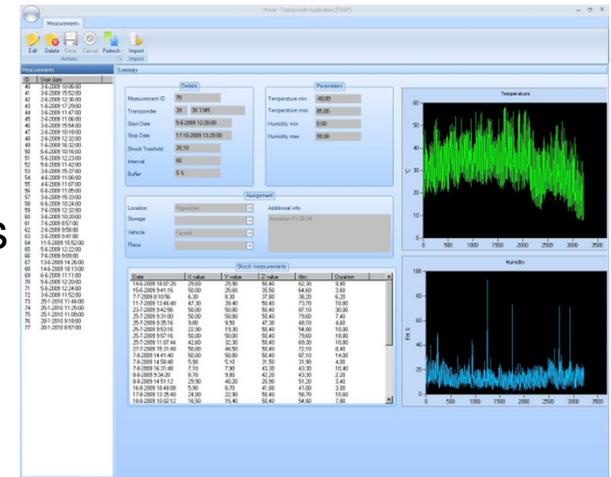




# Field Sensors



Data analysis





## Sustainable Ammunition Safety

Research programme V815 started in 2008 and should give an better understanding of:

- The possibility to reduce costs.
- Criteria to decide if munitions can be used after redeployment from a mission.



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## Sustainable Ammunition Safety

# Why?



## Transport conditions - examples





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## Sustainable Ammunition Safety





## Sustainable Ammunition Safety

### Results V815 (1):

- Complexity when mission profiles are translated to test programmes.
- Data logging during missions is critical.
- Average temperature versus average kinetic temperature.



## Sustainable Ammunition Safety

### Results V815 (2):

- A better understanding of the effects of mission profiles is needed.
- Packaging must be designed from a users point of view.
- The need for decision criteria for redeployment of munitions.



## Sustainable Ammunition Safety

### Conclusion:

A better understanding of mission profiles (real life) and the effects on munitions is needed.

### Recommendation:

Research programme “***Sustainable Ammunition Safety***”

***(S.A.S.)***



## Sustainable Ammunition Safety

The focus of “*Sustainable Ammunition Safety*”:

- Gain insight on the effects of mission profiles on the behavior of energetic materials.
- How to link risk management to acceptance of test data?



## R&D topics (1)

- › Maintaining and further developing the technological knowledge and skills regarding the effects of ageing on the safe use of munitions and energetic materials contained therein;
- › Providing a method for combining mechanical loads (IM perspective) in order to support the safety and reliability of ammunition during deployment in a dynamic spectrum;
- › Developing a methodology that on the one hand provides insight into the factors that affect the life of the ammunition and other measures that can be used to positively influence the security, availability and lifetime taken;



## R&D topics (2)

- › Developing a methodology in an operational situation to take regarding an extended lifespan in compliance with safe use and deployment a sound decision;
- › Conducting an analysis focusing on the possible risks of taking on qualification and classification records of ammunition articles from other NATO countries or external parties and the transition from a full to a tailor-made TC process;

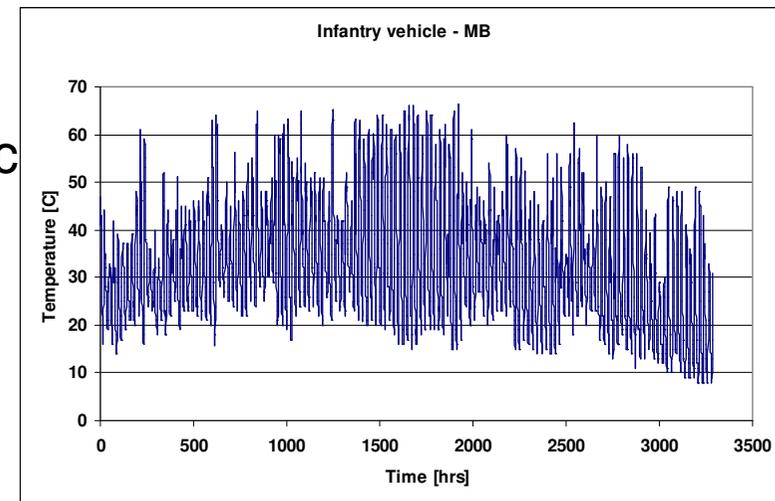


## Sustainable Ammunition Safety

### Life cycle monitoring (2):

#### Research questions:

- Introduction of new test methods for combined test profiles?
- Effects of aging of new energetic materials.
- Development of new energetic materials based on policy like REACH.





## Sustainable Ammunition Safety

### Storage and Transport:

#### Research questions:

- What are the effect of IM materials on NEQ?
- Can the effects of munitions be reduced by changing the package configuration?





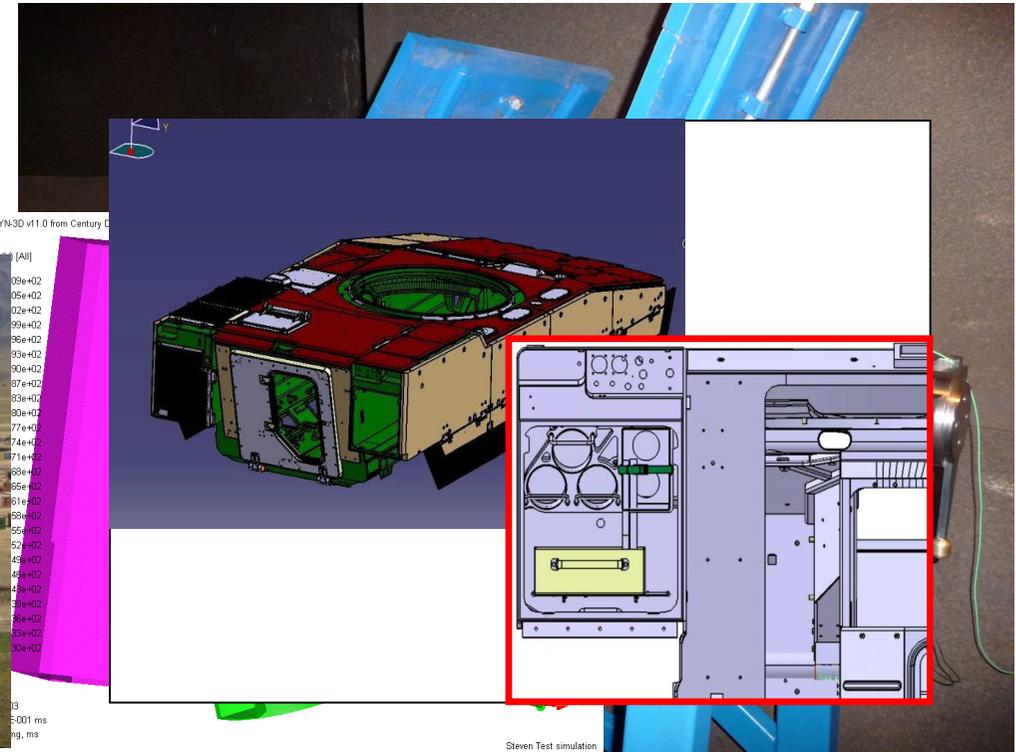
## Objectives

- › Solid insight in the vulnerability and safety of ammunition stored in Dutch military platforms
- › Coupling of developed calculation and modelling tools
  - › Munition vulnerability tools
  - › Platform vulnerability tools
- › Enabler for adequate risk analyses
- › Identification of effective protection concepts
  - › Mitigating materials
  - › Smart Structures



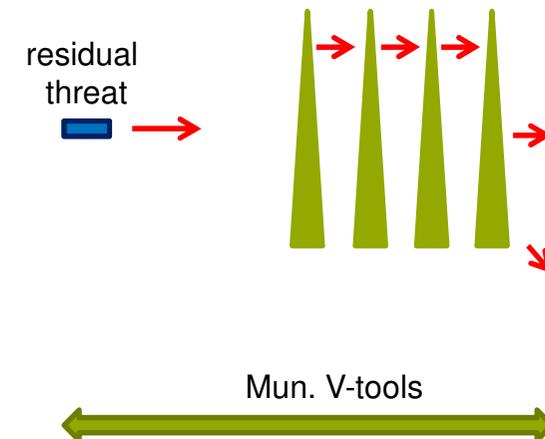
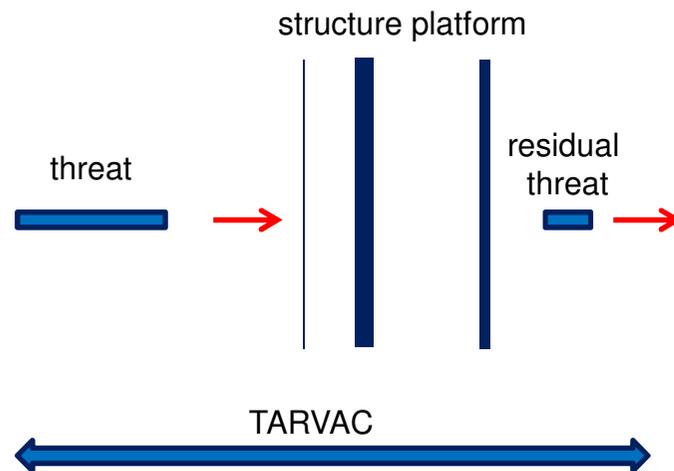
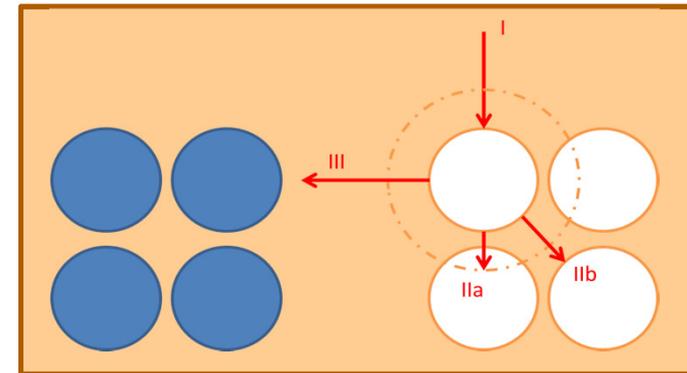
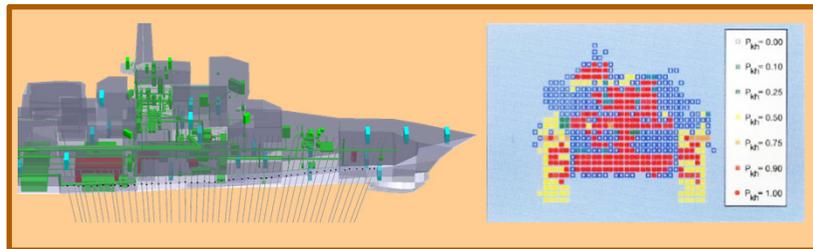
## Munitions & IM research

- Experimental and theoretical approach
  - Material level (assessment initial properties & research on enhanced IM explosives, PhD's)
  - Systems approach
  - Containment
  - Ageing aspects
  - Environmental impact



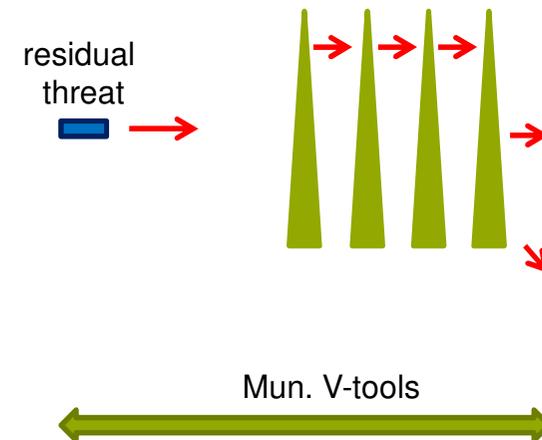
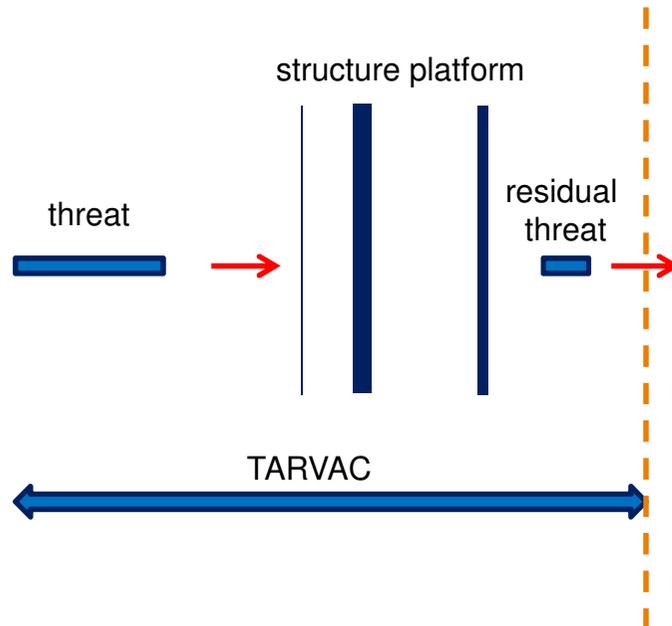
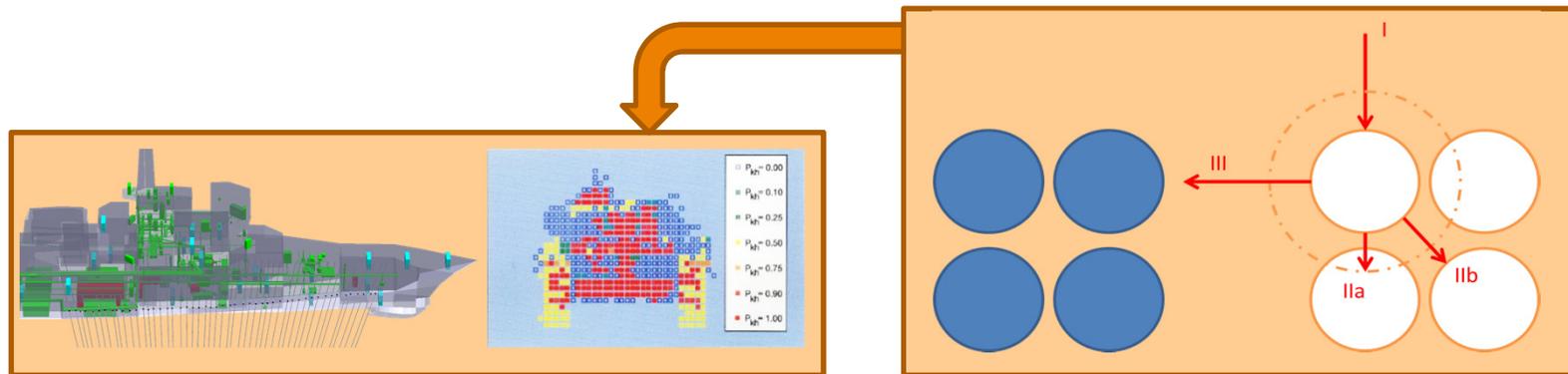


## Current situation





## Envisioned situation



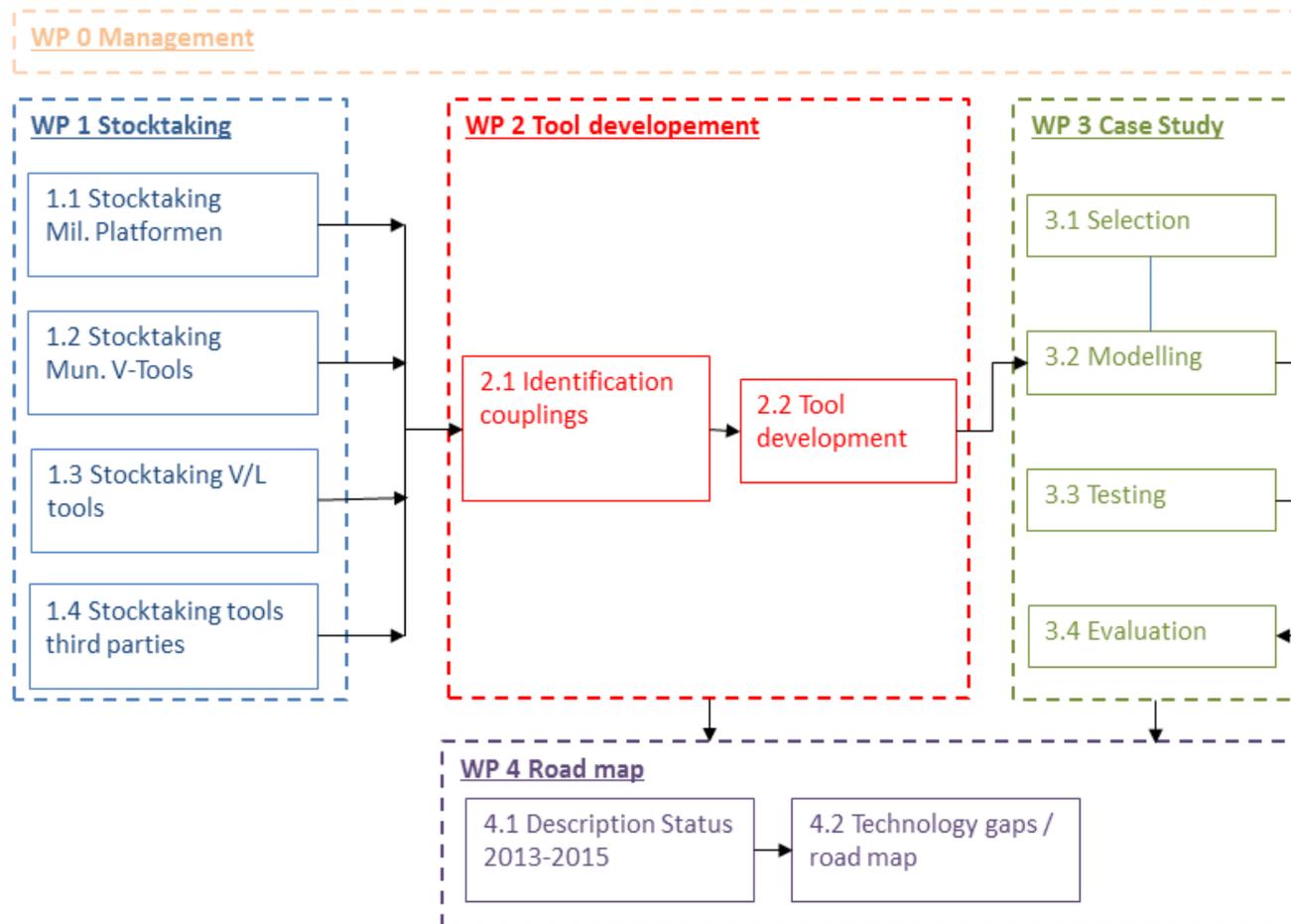


## Activities

- › Stocktaking & selection of relevant ammunition storage
- › Analysis relevant threat scenario
- › Analysis of factors that influence the ammunition safety in a negative way
- › Alignment of input and output parameters for coupling of tools
- › Analysis of solution directions protection concepts
- › Experimental testing of selected storage for comparison with results of calculations and simulations.



# Work Break Down Structure

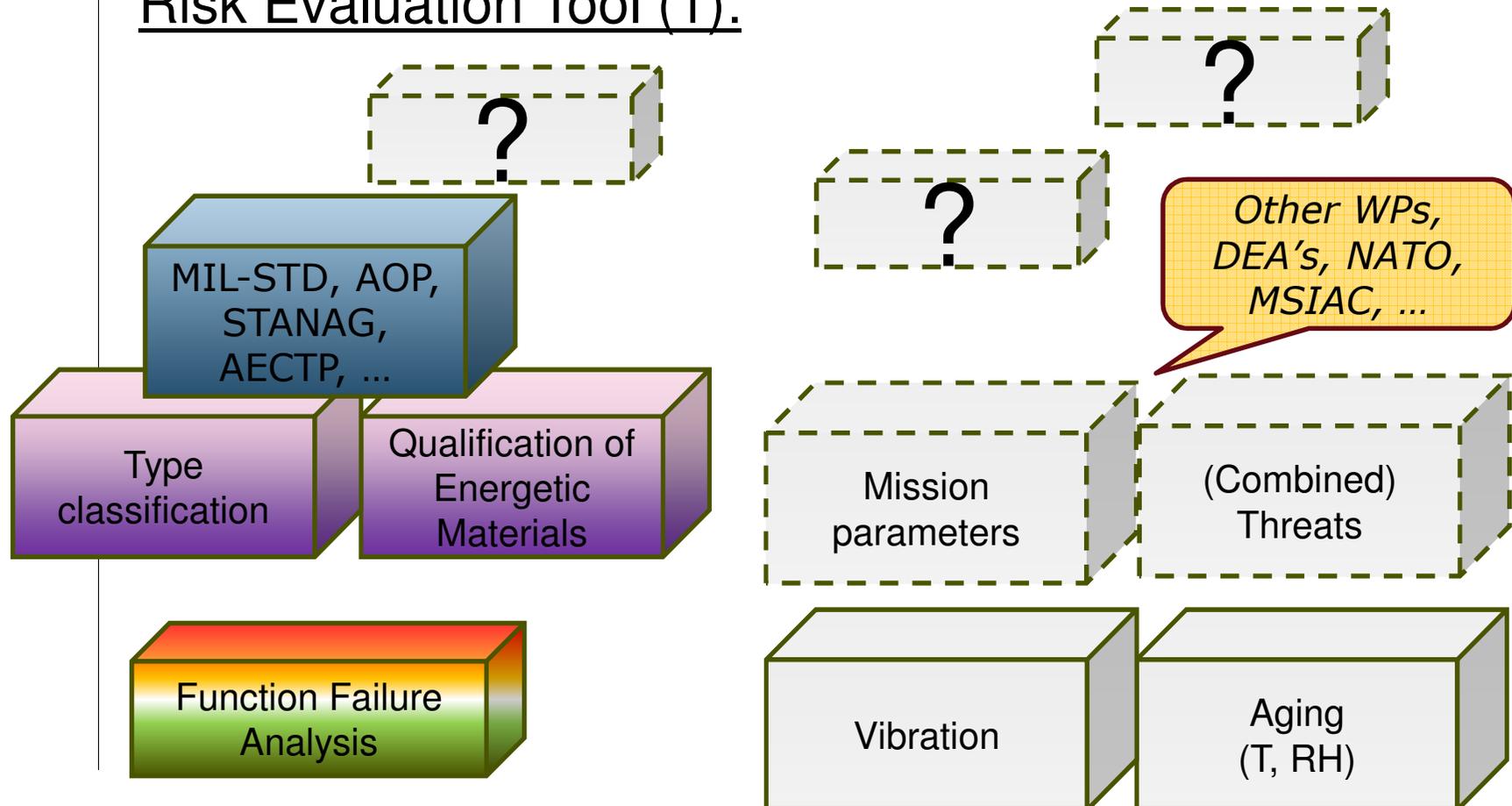




# Sustainable Ammunition Safety

“Building blocks”

## Risk Evaluation Tool (1):





## Conclusions

- › Substantial difference between effects mass detonation or limited event in compound environment
  - › Quantification of consequences
  - › Ammunition Safety remains important subject of attention
  
- › Engineering tools in the sympathetic detonation Toolbox guide the search for the right mitigating materials or structural solutions
  
- › This must lead to an improved Ammunition Safety in Military Platforms



## Future programme

- › Discussions has started to set up a longitudinal study on aging of (new) energetic materials and/or munitions.
- › The main goal is to predict the remaining life time of energetic materials/munitions that has been exposed to certain extreme environments and 'must' be used in other extreme environments.



## Program

- › Starting an international program in validating the temperature stress on ammunition, related to AECTP-300
- › Putting ammunition for long time under natural conditions (high T, RH), incl day/night cycle's), inside and outside original package
- › Testing on different intervals (chemical and functional)
- › Apply sensors close to the articles
- › Open for participants .....

# Questions?





## Sustainable Ammunition Safety

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