Integrated Munitions Health Management Program
(Covering Smart Defence Initiative 2.102)
1st Workshop Proposal and Call for Papers

On behalf of CASG, the NATO Munitions Safety Information Analysis Centre (MSIAC) and the UK Defence Ordnance Safety Group (DOSG) are pleased to announce a workshop to establish the scope for the NATO Smart Defence Initiative (SDI) on Integrated Munitions Health Management (IMHM).

The primary goal of the IMHM Smart Defence Initiative (SDI) is to provide a definitive guide to the intelligent management of munitions’ health. This process requires that Nations’ representatives develop a scope for the guide that will ensure that the standard is aligned with technology development, fits with acquisition requirements, facilitates logistics, and increases the availability of the Alliance’s capabilities in the long term. To that end, this workshop will begin the process of defining the scope for the IMHM SDI and establish a structure to produce a sensible guide to foster implementation of IMHM capabilities. Further workshops will follow to finalize the guide.

Objectives

The aims of the workshop will be:

- To share current practice in munitions health management across the participating nations
- Identify national interests and commitment of support to the SDI
- To agree the detailed SDI goals and plan the work required to achieve these goals
- To identify the common areas that require standardization and guidance

Background

Integrated Munitions Health Management (IMHM), often combined with lifecycle management is receiving increasing attention in several NATO countries. It has been addressed by several activities within the NATO Collaboration Support Office and the Applied Vehicle Technology (AVT) Panel. The importance of IMHM has been recognized by the AVT Strategic Committee, which included this topic in its guidance for action to the AVT Technical Committees.

The Smart Defence Initiative is a result of successful cooperation activities of the United Kingdom, Canada, France, Germany, the Netherlands and the United States (Cooperative Demonstration of Technology, AVT-212). The SDI will seek to consolidate the needs of the contributory / involved nations along the structure of a NATO STANAG, and produce a guide to IMHM that will assist all nations in the development and deployment of these technologies in existing and future munition systems.
Output

It is expected that the output of this workshop will be:

- A thorough understanding of the scope for the SDI,
- To establish that the product that will result from the SDI (the IMHM Guide) fits in line with best practice, takes account of acquisition and logistics requirements and constraints, and is congruent with developments in technology,
- To capture national requirements and concerns,
- To develop a more detailed development plan, define participant nations’ roles, and assign tasks

An interim report will be issued compiling the discussions of the Workshop and any presentations given.

Meeting date

3 to 5 April 2017 (the week of the AC/326 SG/B meeting (6-7 April))

Meeting location

Kromhout Kazerne in Utrecht (Netherlands), at the same location of the SG/B meeting.

Abstracts

Individuals should submit abstracts in relation to the areas described in this call for papers no later than the 31st of January 2017. The abstracts should indicate which area(s) is covered by the paper.

The abstracts should be sent to the following points of contact at MSIAC, with a copy provided to the AC/326 SG/B national representative:

Wade Babcock: w.babcock@msiac.nato.int; 0032 2 707 56 36

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Classification

The meeting is open to government representatives of NATO nations and MSIAC member nations. The discussions will be at the NATO Unclassified level, and releasable to Australia, Finland and Sweden. If needed, a NATO-only session can be arranged.

Registration

Registration will be open from the 12th December 2016 to the 28th February 2017 via the MSIAC website.
Tentative structure of the 1st workshop

Day 1

Opening Remarks

UK DOSG and DI: general presentation of the Smart Defense Initiative

MSIAC: feedback from the use of data loggers (AREA 1)

AVT (or MSIAC): summary of available technologies and demonstrators + AVT-212 CDT for IMHM process (AREA 1)

Statement of Requirements from all National Representatives (AREA 2): Why the nations are involved? What are the national expectations and requirements? What are the national experiences?

Presentations on current national IMHM Topics

Day 2

Presentations and discussions on key IMHM Topics:

- AREA 9: Acquisition and Integration strategy
- AREA 4: Cost Benefit Analysis Models
- AREA 6: Life decision process
- AREA 8: Presentation of the information

Introduction to other areas

Day 3

Discussion on what an IMHM guide should look like

Discuss common areas of guide

Identify work areas and recruit volunteers for future workshops

Planning of work streams

Wash-up and review of the overall plan.
Topics to be covered

The following areas have been identified to open discussion for the whole SDI, and are further described in Appendix 1:

1. Background on demonstrators (ATOS, MINERVE, METEOR Companion, RRAPDS, MEDLS) and use of dataloggers
2. Current and future national activities
3. Definitions – terminology (glossary of terms, what do we mean by Health Management, Health Monitoring,...)
4. Cost benefit analysis model and methodology
5. Gathering and transformation of data process
6. Process on life decision: understanding of the current life decision process based on ISS and reflection on the future decision process (Who will be involved, who will make the decision and based on which evidence?)
7. HUMS – EDL – communication and network requirements / system constraints
8. Presentation of the information. Who needs it? Define what is needed for whom.
9. Acquisition and integration strategy
10. Storage requirement / data sensitivity

Table 1 identifies at which stage of the SDI these areas should be discussed and the contributors.
Those to be discussed during the 1st workshop are highlighted in green.

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<td>Area 9: Acquisition and Integration strategy</td>
<td>WS 1, WS 2 &amp; 3</td>
<td>All, especially acquisition manager and program manager</td>
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<td>(WS1) WS 3</td>
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The work areas will be further defined during the 1st workshop.
Potential contributors and attendees

The meeting will be open to NATO + Australia, Sweden and Finland and we expect the following countries to attend and contribute (To be confirmed, based on SDI commitment): Australia, Belgium, Canada, Denmark, France, Germany, Netherlands, Norway, Spain, Sweden, Turkey, UK and the USA. We also expect contribution from MSIAC and the NATO IMS. Of course, other nations are warmly invited to attend and contribute.

The expected number of participants is around 30, with a maximum of 40 due to room limitation. If numbers demand, the SG/B national representatives will manage their national contribution.

Functions involved in or impacted by the IMHM implementation that should contribute to the SDI:

- Acquisition manager
- Program manager
- Logisticians (International Military Staff / Logistic committee/ NSPA)
- Weapons Designers/ Life Modelers
- ISS coordinator
- Safety authority (AC/326 community)
- Security community to support Area 10.

Why are they involved and/or impacted?

**Acquisition manager**: IMHM could improve the estimate of the remaining life of the stockpile. Hence, it should provide better information for future acquisition: planning future acquisition, actual life exposure and life duration. He/She needs to weigh the initial investment of implementing IMHM capabilities versus the potential benefit in terms of life extension, reduced surveillance and more informed decisions. He/She will assist with the construction of the Cost Benefit Analysis Model and the definition of the acquisition strategies. He/She also needs to know how to specify IMHM capabilities.

**Program manager**: IMHM can lead to a drastic change in the way munitions stockpile is managed. He/she will understand the requirements and the needs for IMHM. He/she will provide the big picture. He/She will assist with the construction of the Cost Benefit Analysis Model, balancing near term investments with long term costs of ownership.

**Logisticians**: IMHM will provide data on the three pillars of inventory management: what the items are, where they are, what condition they are in. Logisticians shall be invited to explain to the group how they currently deal with the allocation, inventory, storage,... of munitions as well as what improvements could be made.

**Designer**: Discuss how IMHM will change the development and qualification phases of munitions, requiring additional effort to generate, improve and validate ageing models, and implement useful technologies at the appropriate location.

**ISS coordinator**: IMHM will complement In-Service Surveillance (ISS) efforts and in the long term can be the driver of life decision. How will IMHM information integrate with ISS results to improve predictive capabilities?
**Safety authority:** AC/326 representatives will manage the SDI project. They provide the global view on safety requirements, S3 assessment and failure modes. They will benefit from more accurate information leading to more informed decisions.

**Security community:** Make them aware of the type of data that will be collected and distributed. They will help in defining the protection requirements.

**Acronyms**

CBM: Condition Based Maintenance  
CDT: Cooperative Demonstration of Technology  
DI: NATO Defence Investment Division  
EDL: Environmental Data loggers  
HUMS: Health and Usage Monitoring System  
IMHM: Integrated Munitions Health Management  
IMS: International Military Staff  
ISS: In-Service Surveillance  
S3: Safety and Suitability for Service  
SDI: SMART Defence Initiative  
WS: Workshop
Appendix 1: description of the areas

First thoughts on the content of each area are provided below:

Area 1: Background

- Presentation on the goals of the SDI from the lead nation and/or DI Division
- MSIAC: feedback from the use of data loggers
- AVT (or MSIAC): Available technologies and demonstrators and the IMHM process (as described during the AVT-212 Cooperative Demonstration of Technology)

Area 2: Current-and future national activities

This area is for gathering input from every national representative from nations who have expressed an interest either through the SDI or AC326. The national representatives should be equipped to give a summary on their national activities related to IMHM, and their involvement, requirements and expectations for this SDI.

Why are the nations involved? Assuming that the current practice works, why nations are investing money in IMHM? What are the goals of the current IMHM activities?

The discussion should help the group to define the goals of the SDI, the key areas for discussion, and what the guidance should contain.

Area 3: Terminology

1st step will be to identify what words and groups of words have to be defined

2nd step: agreement on definitions

Get agreement on a set of terms for this activity that do not clash with other ammunition areas.

Area 4: Cost Benefit Analysis Model

Agree on the acquisition routes with or without IMHM capabilities.

Quantification: identify the potential savings and the additional expenses. (This should be level of implementation dependent and acquisition route dependent – see area 9)

1. short term: potential life extension saving costs vs. (investment in the system + creation of models and analysis of the data+ maintenance of HUMS)
2. midterm: reduction of ISS effort
3. long term: Introduction of weapon leasing procurement models

Get agreement on models of calculation.

For example:

Acquisition: A nation buys 10 000 items with an initial 15-year life. 9000 items will be used. 50 items will be used for ISS, 950 will be disposed of at the end.
Savings: what are the savings for keeping 950 items for 2, 3, X additional years in the stockpile + reduced effort on ISS?
Expense: What are the additional expenses? IMHM hardware + analysis + data storage?

WS 1: identify the different acquisition routes, additional expenses and the potential savings and agree on the models.

WS 2&3: use the model with real examples for several systems and/or system types.

Area 5: gathering and transformation of data process

Agree on the process to follow for gathering, validating and using the data. For example:

a. identify failure modes (is AOP-64 sufficient?),
b. identify failure mode drivers (T, RH, Vibration,...),
c. creation of ageing models, (What is already covered in AOP-46?)
d. determination of failure limits (some of them are already in national and NATO standards e.g. stabilizer depletion limits in AOP-48),
e. validation of the data: Qualification of model, accuracy of the data (related to quality of sensor – calibration – what is the initial time (T0) e.g. post curing effect?)
f. monitoring of the drivers (Temperature, Vibration,...) or monitoring of the conditions (physical, chemical characteristics,...), or both

Area 6: life decision process

How does the life decision process currently work? The process is described in AOP-62 & 63. Tests, human resources, sentence documents are available in every nation.

How do we transition from batch decision to item decision? How do we get enough confidence in IMHM to allow a reduction in destructive inspection of assets?

Identify who will make the decision on the life of munitions and what that decision will look like (to keep munitions in service, or for training only, or send them for disposal, or extent their life for a period)?

It is recognized that there is a need for a transition phase. ISS will continue as it is with the additional health management system (HMS) gradually factored into the decision process. During this early phase, the effectiveness of the HMS will be assessed and improved by improving / validating the ageing models and data collection. There will also be a phase where surveillance managers, designers, manufacturers, modelers, PMs and logisticians will need to adjust to the Integration of IMHM into the current process. This will require training and some change in attitude. Later the IMHM will drive the life assessment and destructive testing will be reduced.

Management of false positive and false negative results should also be discussed such that safety levels can be maintained.

The case of nations that rely on other nations ISS programs will be taken into account.
Area 7: HUMS – EDL – communication and network requirements / system constraints

What are the requirements for each sub system? What are the electrical safety requirements for active loggers? What process will be used for retrieving data? Will there be any additional RF hazards?

What constraints does this bring to the item design and the logistic management chain?

Area 8: Presentation of the information

We expect all the contributors to explain what they need to know to make their life decisions. This should help in defining how to report the information to make it valuable to every stakeholder.

For some data, such as vibration data, there could be a need for a short-form report that suggests an overall threshold and a long-form report that includes spectral shape or more detailed usage information.

Decision is needed on how data will be handled and at which point data will be reduced or summarized e.g. onboard the logger or after downloaded to a computer.

Area 9: Acquisition and Integration strategy

Identify the potential acquisition routes and the IMHM integration strategies including how the logged data is associated with the munitions.

4 integration steps seem to be possible:

1. EDL, 0 time data + ageing model (already improvement vs. ISS only)
2. External sensors on the munition: enables CBM, qualitative assessment of damage
3. Internal or embedded sensors on surveillance assets (fully instrumented – companion / canary like asset)
4. Fully instrumented fleet

These approaches will be presented and discussed during the 1st workshop.

More detailed discussion will follow during WS 2 &3 in order to identify the benefits, implications and limitations of each approach.

Area 10: storage requirement – data protection

Requirements and constraints related to the storage and communication of the data.

Data holder: who is holding the data and where?

What protection should we provide to the data, particularly in transit (e.g. encryption)?

What information is sensitive in the data and requires protection?

How can we declassify the data so it can be shared more widely in the community?