MTM: Mitigation Techniques for Munitions

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Abstract

Mitigation Techniques for Munitions (MTM) is a web based application including a database of mitigation techniques and a powerful search engine. It is currently in development within MSIAC with the aim of being deployed on MSIAC server by the end of 2015. It will allow the user to find mitigation techniques to mitigate against IM threats.

In the past, MSIAC developed a software named M^3 (Mitigation Methods for Munitions) which is a compendium of mitigation methods. This software has several limitations, including a limited search capability and the fact that every update requires the user to install of a new version on their computer.

MTM will improve the user and administrator experience by adding several features. The product will be updated online by the administrator, which will allow an increase of the number of techniques available. The searching feature will be improved, allowing the user to make complex queries and searching for more data than currently possible. This product will be accessible from the MSIAC portal.

This paper will detail the technical specification of this application and the associated presentation will present the architecture and some features of the database.

1   General presentation

The AIMS application was developed about 2 years ago to consolidate test result databases. It is complemented by an MSIAC database of munition reaction mitigation techniques which takes the form of a Delphi application: M^3 (Mitigation Methods for Munitions). The MSIAC wishes to convert this into a web application, for the purposes of homogeneity on the one hand and ease of maintenance on the other.

This document first gives a brief presentation of the existing application, then states what we expect of the future application and describes the technical environment in which it will have to operate.

2   Existing application

The M3 database covers mitigation methods (techniques). There are 29 methods in the latest version of the database. The existing application allows users to run through these methods, or to search for those which meet certain criteria, and to record the results.

In the current application, each method has the following attributes given in textual form:

- advantages
- disadvantages
- restrictions
- availability

Examples of each method are given (amounting to some 300 examples in total for all the methods). Each example comprises:

- a descriptive text
- one or more reference documents
- in some cases one or more images

The search criteria are as follows:

- munition configuration
- component
- threat

They all have multiple values, that are taken from fixed lists.

There are two ways of using the application:

- simply scrolling through all the methods, using arrows to navigate
- searching for a criterion or criteria, which produces the methods that meet the criterion or criteria specified. Users then navigate between the methods thus obtained in the same way

Finally, the application allows users to print out the results obtained, including the examples and the references but not the images.

Users can also export the results to Word, this time including the images as well as the examples and references.

Note that the Delphi application described here is complemented by two external elements:

- an Excel worksheet comprising all the information from the database
- a Laserfiche (or Weblink) extension allowing access to all the documents organized by family. Many attributes are included in these documents, but they are in PDF, and often very voluminous, and the relevant information (such as images) is difficult to find.

3   Future application

Clearly the functions performed by the current application must be preserved in the future one. But many new functions should also be incorporated, which we will review.

One of the key points of this development is to centre the application on the examples rather than on the methods. In parallel, the "method" object, which currently embodies several concepts, in particular the configuration, which is already present elsewhere, and the technique, shall be redesignated "technique" in the web application. The "technique" part shall become an attribute of each example. The current attributes associated with the "methods" (advantages, disadvantages, restrictions, availability) shall not be carried over to the "technique" object. In fact they will as such quite simply not be transferred to the new

application.

NB: It is of fundamental importance that the attributes, and hence the search criteria, are fully orthogonal (i.e. mutually independent). This will make the application richer and easier to use.

Here are the attributes of the example in the future application, with their type and cardinality:

- ID number (integer, 1..1, assigned automatically)
- Description (text, 1..1)
- Short description (text, 1..1)
- Reference document (reference, 1..n)
- Image (image, 0..n) (possibly restricted to a maximum of four images)
- Technique (reference list, 1..n)
- Component (reference list, 1..n)
- Category (reference list, 1..n)
- Threat (reference list, 1..n)
- Configuration (reference list, 1..n)
- Permanent modification (boolean, yes or no)

All the values shall be retrieved in the Excel table to be provided by the MSIAC.

Initial values:

ID number: a number, for example assigned automatically starting with 1 and increasing by "+1" for each new example.

Description: text describing the example.

Short description: summary description of the example. Not generated automatically from the description, but created by the administrator. (As an option, it could be generated automatically from the first XX words of the full description)

Reference document: allows listing of the reference(s) on which the description of the example is based. One or more hyperlinks may point to a document or documents in Weblink. The attributes of a reference are as follows:

- a reference number (integer, 1..1, assigned automatically);
- a title (text, 1..1);
- one or more authors (text, 1..1);
- the year of publication (integer, 1..1);
- the conference or patent (text, 1..1);
- the country or countries of origin (3-letter code, 1..n).

The country codes are those used by NATO, found in STANAG 1059. The codes chiefly used in the application are given in an annex. Where documents are issued by the MSIAC, the code MSI shall be used. This list shall be implemented by default in the administrator's section, and the administrator shall be able to add further codes as required.

Technique: active venting device, passive venting device, thermal protection, case, diverter, liner,

container, arrangement, barrier

Component: warhead, motor, propelling charge

Category: mortar, artillery, medium calibre, tank, missile, torpedo, bomb, grenade, mine, rocket

Threat: SCO, FCO, BI, FI, SCJ, SR.

Configuration: bare, packed, storage

In most cases it will be possible (and desirable) to use either short designations (of 7 characters maximum) or codes in the reference lists. This will restrict the width of the columns in the table of results, so that there can be more of them.

Search criteria

The current search criteria (component, configuration, threat) must be kept. But it is also necessary to define new search criteria. In addition to searching the text in the description, all the attributes must be search criteria. The examples must be searchable through the reference documents using the attributes of title, author and country of origin.

Here are the characteristics of the criteria:

Criterion	Attribute	Value
Title	Contains or Matches	Text
Author	Contains	Text
Country	List (using an "OR" type logical operator if several values are selected)	List from the "country code" table. Several values can be selected
Description	Contains or Matches	Text
Component	List	List from the "component" table
Configuration	List	List from the "configuration" table
Permanent modification	List	"Yes" or "No"
Technique	Contains or Doesn't contain / list (using an "OR" type logical operator if several values are selected)	List from the "technique" table. Several values can be selected
Threat:	2 lists preceded by Contains or Doesn't contain. Logical "AND" or "OR" connector between the 2 lists	List from the "threat" table. 1 value can be selected from each list. Possibility of only populating one list.
Category	List (using an "OR" type logical operator if several values are selected)	List from the "category" table. Several values can be selected

When the value is text, it shall not be case-sensitive.

When several values can be selected, this shall be indicated by a sentence such as: "Use the CTRL key to select several values".

Here is an example of a search using the threat attribute:

The user is seeking all the examples with the FCO attribute but not the SCO attribute, i.e. examples of mitigation of fast cook-off but not of slow cook-off.

It must of course be possible to perform a multi-criterion search.

A "Clear search" function shall be provided allowing removal of all the search criteria. It must also be possible to delete each criterion individually.

Display and functions

The database page of the application must correspond to a detailed view of the first example. It shall be possible to go through all the examples in this way (by navigating using "next/previous" arrows or by swiping on a tablet). In this mode a "Go to #" box should allow direct selection of the number of a particular example to be displayed.

The search function shall be offered on the database page.

After an initial search, the number of results should be indicated and the results themselves displayed in a table. It must be possible to sort this table in ascending or descending order of each column. It is highly desirable to be able to configure the table by selecting the columns displayed; the most frequently used ones are shown by default, but the user should be able to add or remove columns. The configuration set by each user should be saved. It must also be possible to return to the default configuration.

Default display of results from a search:

18 examples

ID	Short description	Threat:	Technique	Ref.	Select all ☐
Number	Alea jacta est (max XXX characters)	SCO, FCO	Thermal protection	28 32	☐
Number	Alea jacta est…	BI	Barrier	10	☐

The user may wish to change the display but the following columns at least should always be shown: ID, short description and selection.

From the table, it shall be possible to access the detailed view of an example by clicking on its ID number. When they have opened the detailed view, the navigator's "back" button shall allow users to return to the search results.

When in the table the full description and the main image must be displayable by opening out the short description. It shall likewise be possible to "roll up" the full description and return to the short description.

In the table, it must also be possible to access the detailed view of the reference by clicking on the reference number.

The table shall provide for selection of all the items or just certain selected ones. From this selection, the user may then:

- go over to the detailed view to display all the attributes of each example. In this mode, arrows shall allow navigation to the following or previous examples
- print out the selected examples, including references and images
- export the selected examples, with the same information, to Word format

The detailed view shall also allow:

- printing or export of the current example,
- deselection of examples that are not required as the user navigates among them,

- printing or export of all selected results

- and return to the table of results, the current criteria having of course been saved.

Printed or exported documents must bear the following statement: "Information reserved for MSIAC nations only"

IMPORTANT NOTE: The user interface is of prime importance for this application; it must be given high priority, and will surely require a number of adjustments after delivery of the initial version to take account of user feedback, both from within the MSIAC and among the member nations.

Format of the document or print-out created:

The document and printed matter must include the following:

"Information reserved for MSIAC nations only"

Search criteria

Examples sorted by method

Images in each example

Reference(s) in each example

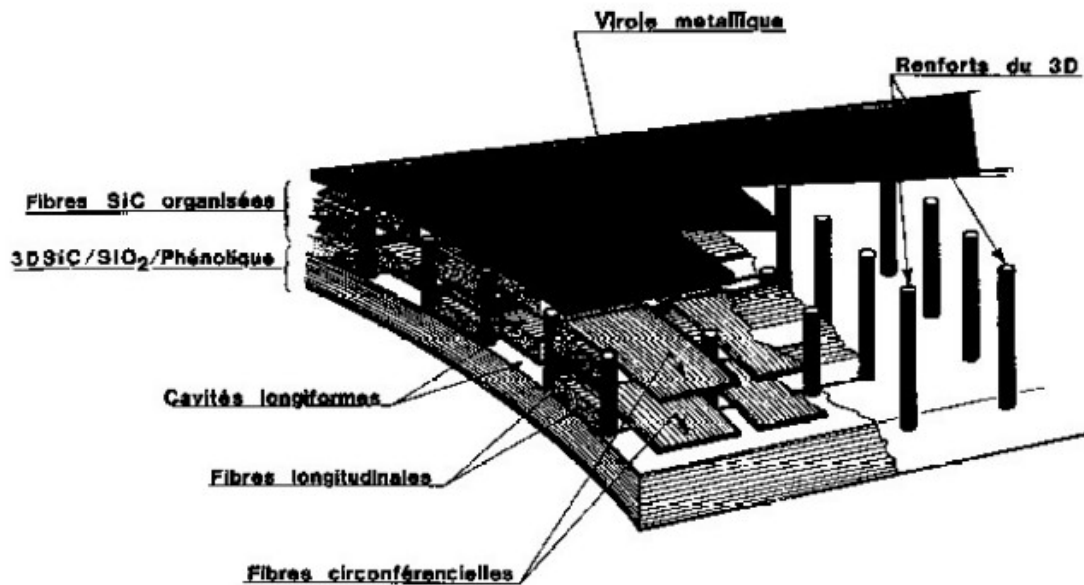A proposed arrangement is shown below:

Search criteria:

These examples are applicable to the following munition configuration(s):
Container, Packaged and Storage.
These examples can be used to mitigate the following threat(s):
Fast Heating, Slow Heating and Thermal Threat.

Method: Applying thermal protection

Example 1

Use of a 3D arrangement of silicone based fibres designed for ramjets. This concept can address very severe heating requirements during a long time. It would have to be adapted to make it suitable as a protection from munition threats.

Fibres SiC organisées
3D SiC/SiO$_2$/Phénolique
Virole métallique
Renforts du 3D
Cavités longiformes
Fibres longitudinales
Fibres circonférancielles

Reference:

"Insensitive Munition (IM) Enhancement of the 120mm M934A1 High Explosive (HE) Mortar Cartridge". Sotsky L.; Nausheen Al-Shehab N.; Mazzei R.;. PARARI 2005.

Example 2

Testing of 6 insulative material coatings to a simulated fast cook-off. Insulative materials are used as thermal barriers to protect a substrate (e.g., wood, metal, or ordnance) from heat sources (e.g. fires or aerodynamic heating). Insulative coatings can be either inert, ablative, intumescent, or a combination of these three. This paper describes a cost-effective approach that was developed to screen candidate materials for an application before proceeding with expensive qualification testing. Both radiant heat and hydrocarbon flame environments were used and compared. Several applications are discussed in this paper with emphasis on fast heating simulations. Eight insulative materials were tested and compared. Mass loss, maximum expansion, backface temperature, thermal margin, and surface and subsurface intumescent materials are used.

Reference:

"Insensitive Munition (IM) Enhancement of the 120mm M934A1 High Explosive (HE) Mortar Cartridge". Sotsky L.; Nausheen Al-Shehab N.; Mazzei R.;. PARARI 2005.

Method: Placing heat shields

Example 37:

Description

Reference.

4   Site architecture

The site shall include the following principal pages:

- Home

- Database/search

- References

- Help

- Administrator

The site shall have a menu bar for navigation between the pages.

The "Home" and "Help" pages will contain text and images.

The "References" page shall display the list of references in table form, showing the attributes Reference number (assigned automatically), title, author(s), year, conference/patent, country of origin. It shall be possible to sort each column of the table. When users click on the reference, the associated example(s) shall be displayed in addition to the above-mentioned information. Furthermore, if the document is available to users in Weblink, it shall be possible to create a link pointing to that document so that it can be viewed. A reference generally comprises 2 electronic documents – a paper and a presentation.

The "Database" page shall give access to the database of examples, and allow the user to perform searches and change the table display preferences.

5   Administrator's interface

The administrator's interface should allow data to be added to, modified in or deleted from the database and the reference lists.

It shall also be possible to modify existing pages containing only text and images.

Where attributes are defined by lists, the administrator's page shall allow the addition of new entries to these lists.

By default, the boolean "permanent modification" value shall be "Yes".

Additional details of each attribute will be defined during development.

6   Description of the technical environment

The MTM application must be accessible via the MSIAC portal, and included in the existing SSO[1] system. The technical characteristics of the portal and SSO have been or will be communicated to the involved parties concerned. As with the other MSIAC applications, the users' authorizations shall be managed through security groups in the project Active Directory (AD). The designations and uses of the groups will be fixed by the IT party responsible for the project.

The application must be deployed on a virtual machine (VM) under Linux Ubuntu 12.04 LTS[2]. This machine already exists and hosts other similar web-based applications.

For ease of maintenance and homogeneity with existing applications, this application will need to be developed in the Python language using the Django framework. The database used will necessarily be PostgreSql, in a version to be specified at the project launch meeting.

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1 Single Sign-On
2 Note that this VM may be migrated to Ubuntu 14.04 LTS before the final deployment of the application. Precise details will be available from the MSIAC IT service.

The application must have an administration interface that is only accessible to users who belong to a distinct AD security group. This interface shall in particular allow consultation of the database according to the entire set of criteria, and updating of the reference tables.

Ultimately the MSIAC portal will include a general search engine that can retrieve information from all the applications deployed. It is essential for MTM to be incorporated in this system, so that the engine can return relevant results from this application. Here again, precise details will be given to the parties concerned.

Operation must be possible in different environments (Windows, Apple, smartphones and tablets) using several search engines (Internet Explorer >8, Safari, Chrome, Firefox). There shall be functional compatibility with IE 8, even if some functions are not guaranteed.

3-letter codes of the main countries mentioned in the application, in accordance with STANAG 1059

AUS   Australia
AUT   Austria
BEL   Belgium
BRA   Brazil
CAN   Canada
CHN   China
CZE   Czech Republic
DNK   Denmark
FIN   Finland
FRA   France
DEU   Germany
IND   India
ISR   Israel
ITA   Italy
JPN   Japan
KOR   South Korea
SVK   Slovakia
NLD   Netherlands
NOR   Norway
NZL   New Zealand
POL   Poland
PRT   Portugal
RUS   Russia
ZAF   South Africa
ESP   Spain
SWE   Sweden
CHE   Switzerland
TUR   Turkey
GBR   United Kingdom (Great Britain)
USA   United States
MSI MSIAC