SIMS – Smart Information for Mission Success

Enhancing joint mission planning and training

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ABSTRACT

In the European Defence Agency's Joint Investment Programme on Force Protection, the SIMS consortium is working on the delivery of a Proof of Concept on innovative battlefield information dissemination to enhance mission planning, execution, assessment, and training. Primarily asymmetric threats and possible countermeasures for force protection will be addressed, especially in an urban environment, with the specific focus on closing the information loop between the various levels of command; from planning to execution. To design SIMS, asymmetric threats and the (urban) environment must be modelled with reasoning algorithms for next generation C2-systems.

Information is becoming today's main currency in the battlefield and putting it to use is as challenging as it is necessary. Distributing information within or between armed forces is growing more complex and extensive, especially in the battlefield where timely and specific information can be of decisive importance. Taking current experiences from the field into consideration, it is clear that the nature of threats is volatile and ambiguous. The increasing importance and complexity of information on the asymmetric threat environment includes topics such as population, culture, politics and economics, next to the specific characteristics of the mission environment and military information. Consequently, the methods and processes to plan, execute, assess and train military actions are becoming increasingly extensive and complex. These processes all serve to enable and support decision-making in military missions. Smart and rapid information dissemination can provide an advantage to our coalition forces to predict, anticipate or counter (new) asymmetric threats, yielding a better force protection to military troops.

In this paper we will describe the SIMS concept and approach. Key to success are a human centred design approach and smart reasoning techniques. In the experiments and final demonstration, foreseen in spring 2012, it is our intent to deliver a SIMS Proof of Concept that enhances force protection, mission planning, execution and debriefing by closing and re-enforcing the military information loop. In addition, we will demonstrate the potential of using SIMS in a joint mission training environment.

ABOUT THE AUTHORS

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1. INTRODUCTION

Modern-day missions are becoming more and more complex. Not only are insurgents hard to identify, inscrutable and resourceful, but missions take place in very diverse environments which are nothing like the traditional battlefield. Even though the strategic goals of asymmetric warfare remain constant, the increasingly destructive nature of the asymmetric tactics (facilitated by increased access to advanced military technology), coupled with greater international scrutiny of the more powerful belligerent, requires that new approaches for dealing with asymmetric warfare be developed that seek to neutralize potential asymmetric threats and at the same time reduce collateral damage. As insurgency is currently the most imminent threat, countering insurgency has become a major challenge in modern warfare (Sepp, 2005). A key factor in counter-insurgency (COIN) is the (local) population, in all its aspects. Military intelligence branches in theatre are involving the population and its relation to the operational environment more and more in their intelligence collection plan.

Traditionally, military intelligence focused on threat and enemy, and the physical terrain of the area of operation. However with operations becoming increasingly complex (with more actors and non-combatant parties active on the 'battlefield'), and a focus shift to population centric operations the Human Terrain[1] (Arnold, 2010) becomes increasingly important for achieving mission goals. Human Terrain includes topics such as various population groups, their culture, local customs and traditions, political systems, tribal structures, and economic development. Consequently, as the operational environment becomes more complex, the methods and processes to plan, execute, assess and train military operations are becoming both more extensive and more complex. These processes all support mission effectiveness, and serve to enable effective decision-making for commanders in military missions and operations.

From an international (coalition) perspective, military decision-making takes place on several levels within the command structure, from the highest level of political-strategic to the lowest level, the tactical / technical level (NATO AJP3-2, 2009). On all levels, planning processes serve to gather, combine and interpret all relevant information in order to understand the mission environment and to derive a feasible plan to achieve desired effects. In a more complex mission environment and because of newly developed concepts such as NEC (Network Enabled Capability) hierarchical command levels are becoming increasingly interconnected and (inter)dependent (Command and Control Centre of Excellence, 2010). The flow of information within and across these levels is crucial to provide the right persons with correct and relevant information (and the right amount) at the right time. Thus, a staff officer has to be able to locate and access all relevant information to prepare, support or execute a mission. This means that the process of formulating a plan (based on a higher-level assignment) with coordinated military activities needs to be transparent and straightforward, and moreover flexible in case of a change in circumstances, insights or assignment.

In the European Defence Agency's Joint Investment Programme on Force Protection[2], the

[1] Human terrain refers to the socio-cultural dynamics of an area. This concerns demographics as well as the cultural intricacies that drive a population. The goal of better understanding local cultures and social structures is to improve the units' operational effectiveness.

[2] http://www.eda.europa.eu/genericitem.aspx?id=184

SIMS consortium[3] is working on the delivery of a Proof of Concept on innovative battlefield information dissemination to enhance mission planning, execution, assessment (including Lessons Learned process) and training. Primarily asymmetric threats and possible countermeasures for force protection will be addressed, especially in an urban environment, with the specific focus on closing the information loop between the various levels of command. In this paper we will describe the SIMS concept and approach. Key to success are a human centred design approach and smart reasoning techniques. In the experiments and final demonstration, foreseen in spring 2012, it is our intent to deliver a SIMS Proof of Concept that enhances force protection, mission planning, execution and debriefing by closing and re-enforcing the military information loop. In addition, we will demonstrate the potential of using SIMS in a joint mission training environment.

In the remainder of the paper we will first describe the major challenges as indentified for mission training, planning and execution (section 2) and our vision on how SIMS can address these challenges (section 3). In section 4, we will describe the innovations as foreseen by SIMS, followed by an example of how the SIMS concept could be incorporated in the military planning process (section 5). An overview of the SIMS research methods is described in section 6. The paper concludes with a brief summary of the concepts discussed (section 7) and ideas for the way ahead (section 8).

2. CHALLENGES

As the quantity and complexity of the information regarding the mission environment grows continuously, standard processes and systems can fail to keep pace and the need for supporting intelligent tooling (models, simulation, automated processing) grows. In this respect, the SIMS consortium has identified six shortfalls in the following areas:

1. **Asymmetric Threat & Behavioural Modelling**: There is a lack of standard asymmetric threat models and reference data usable for military decision aids. Specifically relevant for asymmetric operations, there is also a lack of behavioural and/or cognitive models, suitable for modelling the human terrain.
2. **Decision Making Support Tools**: There is a lack of decision aids based on Artificial Intelligence (AI) models, machine based intelligence able to handle uncertainty, and little or no use of automation to conduct asymmetric threat analysis. Additionally, the level of confidence in such systems by operational users is low.
3. **Mission Planning Support Tools**: There is a limited availability of mission planning, training and rehearsal tools at tactical level, based on accurate recent information regarding asymmetric threats from the operational environment. There is a need for easily updatable, portable, interactive and user friendly support systems, including rapid, possibly on-line updates on the mission environment.
4. **Mission Execution Support Tools:** There is a limited availability of mission execution support tools, allowing distribution of (smart) information to mission executors in rapidly changing situations and potential asymmetric threats, and efficient re-tasking of operational forces.
5. **Assessment Methods:** There is a lack of support tools and methods for *structured* gathering and recording of information acquired during the daily mission execution and mission debriefing process.
6. **Training Techniques**: There is a lack of means, methods and guidelines for (joint) mission training, planning, and execution for asymmetric threat defence

[3] The SIMS consortium partners are based in France (Thales Raytheon Systems, Thales Research & Technology and PY Automation), the Netherlands (Thales Netherlands and TNO), Poland (ITTI and the National Defence University) and Slovakia (Academy of Armed Forces).

With respect to the above mentioned shortfalls, other sources provide similar indications. A study on intelligence in the Dutch Armed Forces for instance (van Bemmel, Eikelboom & Rios Loogman, 2010) identifies that the Intelligence community struggles with:

- delivering an integrated environment analysis (including political, economic, social/cultural and information aspects);
- gathering intelligence (and additional information) on the mid- and long-term;
- connecting to related intelligence processes, external and on different levels;
- a lack of capacity, training and (networked) tools for integrating and analysing gathered data.

3. SIMS VISION AND FOCUS

Aiming to overcome the above mentioned shortfalls and challenges, the envisioned SIMS concept has been formulated as follows:

SIMS aims to improve the planning, execution, assessment, and training of military missions by enhancing threat assessment and force protection. SIMS will provide a Knowledge Database (KD), from and to which information on potential and current threats and their action possibilities is 'smartly' distributed. The focus will be on asymmetric threat information, and the Knowledge Database will consist of two layers:

1. **Static layer**. This layer consists of analysed and validated information – intelligence (intell) – on asymmetric threat. This contains for instance historic background intell on asymmetric threat, from both the operational and the tactical level, intell on physical and human terrain, present actors, assessment of threat levels in the (mainly urban) area of operation, etcetera. Changes in the information in the static layer will be minor and slow;
2. **Dynamic layer**. This layer consists of information on, and experiences with (asymmetric) threat directly from the field. Explicitly stating the difference with intell (as it is information not analysed and validated), these are the current experiences with (asymmetric) threat, our own actions (what is and is not working), and the enemy techniques and tactics (what they have adapted to)[4]; lessons identified that other units can use to their advantage. It contains information on the current (threat) situation in the area of operation, and lessons identified from reactions on certain threats (and their outcome).

Information from the dynamic layer will be processed by the intelligence cell, further analysing, validating and cross-checking it with other sources and intell present in the static layer. As a result of this intell process, some information from the dynamic layer will trickle to the static layer. At the same time, the dynamic layer needs to be monitored to keep the information updated and prevent 'overflow'.

SIMS can provide support to planning, execution, assessment, and training of military missions. For planning, there is the benefit of information on the current situation in the field (during operations) and intelligence (static and dynamic layer information), that can be integrated directly into the planning process. For execution, soldiers in the field can benefit from this dynamic planning, and from information on the most recent threat situation that can be encountered with decision support on how to best deal with those situations. Monitoring and assessing which threats are encountered and (the effectiveness of) how they are dealt with, enables this enhanced prediction and decision support for soldiers executing operations. Finally, soldiers

[4] This concept is also used in an intranet application as developed for the US 1st Cavalry Division in Iraq, called CAVNET: see the article on http://www.pbs.org/wgbh/pages/frontline/shows/company/lessons/

can benefit from training scenarios adapted to current expected threat situations.

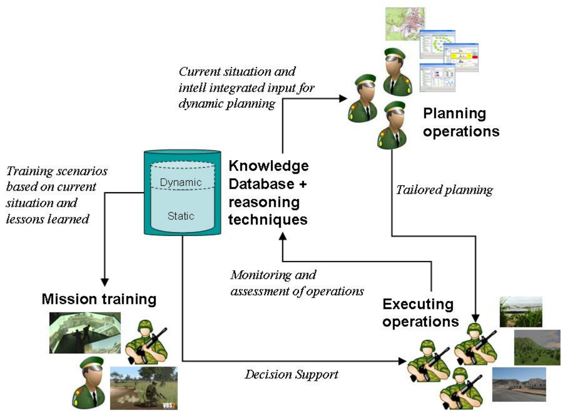

Figure 1: SIMS Vision

By using smart reasoning techniques, the SIMS Knowledge Database could provide decision and planning support on for instance:

- Actual threat levels: by comparing these to the threat assessment beforehand, statements can be made on increases, decreases or changes in threat sources, and if these are trends or incidents;
- (Re)actions to threats or threat levels: what kind of reaction(s) on specific threat have worked best (or worst)?;
- Effects of own operations: how do own operations (including Presence, Posture and Profile) effect threat levels or incidents. For instance, will a dismounted patrol have a different effect than executing a patrol under armour?

The SIMS focus will be on asymmetrical operations in an urban environment, providing decision support and smart information dissemination solutions to units at the tactical level (brigade level and below). At this level, all planning efforts result directly in tasks to be carried out by the units in the field, and the causal and (mostly) sequential relationship between planning, decision-making and execution is the most evident. When the commander formulates his Operational Plan[5], assumptions and deductions on the environment are made. Therefore changes in a certain (f)actor in that environment could lead to changing assumptions, which in turn could lead to changes in the initial plan (as the outcome of the planning process would be different). Certainly when multiple changes occur on several (f)actors, the outcome of the initial plan could be quite different from the anticipated outcome.

4. SIMS INNOVATIONS

The SIMS concept is about creating a more dynamic use of all relevant -mission and threat related- information for the planning, execution and training of operations. The main innovations provided by SIMS are:

1. Smart Information Storage.
2. Smart and Rapid Information Flow.
3. Smart Information Extraction and Analysis
4. Dynamic Mission Planning & Execution Support.
5. Enhancing the Lessons Learned Process.
6. Enhancing Mission Training & Rehearsal.

1. Smart Information Storage: The Knowledge Database contains information on asymmetric threat(s) in two 'categories', the static layer and the dynamic layer. The database serves the planning process (on all levels), units executing operations, and training purposes.

2. Smart and Rapid Information Flow: The available information from the knowledge database is disseminated through the planning processes and transformed into orders and tasks to soldiers in the field. Dynamic planning and enriched information can only be achieved by a smart and rapid information flow back from the field. This requires a streamlined process, in which all 'field' information is gathered into the Knowledge Database. Human Factors issues need

[5] A commander (and his staff) issues orders to the subordinate commanders based on an Operational Plan (OPLAN). The subunits in turn execute these orders with the available means and assets.

to be taken into account when developing the interface between the knowledge database and the users, i.e. how to extract this information and how to present it to users.

3. Smart Information Extraction and Analysis: The information from the Knowledge Database will have to be presented and distributed in a 'smart' manner, which means the relevant information to the right person at the right time, clearly indicating the difference between the static and dynamic layer information, and in the right way. E.g. considering the human factors, such as human cognitive capacity, display modality, etc,. The reports and logs from the executed operation are translated into lessons learned. The lessons hold information on encountered threats, deployed activities and their effects, complemented with information from the operational debriefing (how did we perform the operations, what were the results, were there any conspicuous events or things seen, etc.). This will require a structured way of debriefing, in which all information coming from an operation will be structurally and consequently addressed, and recorded.

4. Dynamic Mission Planning & Execution Support: Currently, only decisions and outcomes of the planning process are recorded in the Operational Plan. The SIMS dynamic support planning tools also need to capture considerations on the actors and factors and the (causal) relationships between them. In other words, while developing the plan, the reasoning behind decisions needs to be captured: the arguments considered, accepted or rejected (and why), and the assumptions made. If the argumentation behind a plan is laid down in a (dynamic) model, consequences of changing (f)actors can be made explicit and visible, e.g.: "if this factor changes, it effects the plan in this way". Getting this insight requires an effective information exchange between planning and execution. Both smart information dissemination and feedback are needed to enable dynamic planning.

5. Enhancing the Lessons Learned Process: SIMS will also improve the management and distribution of information acquired during daily mission execution and debriefings. It will allow for structuring the information gathering process and its results, perform additional analysis and processing and maintain relationships of processed information with other information related to the mission. Next to enhancing the mission planning and execution of adjacent operations in the current operational environment this processed information, in a form of Lesson Identified or Lesson Learned, will provide the possibility to issue recommendations for higher levels of command in order to enhance the process of updating techniques, tactics, procedures (TTPs) and/or doctrine.

Building a Lessons Learned 'system' is a part of the common activities of commanders, staff and armies involved in NATO's military operations. However, a meaningful acquisition, analyzing and generalization of the data, information, and experiences from operations is considered to be a main challenge. The SIMS concept for a LI/LL KD element closes the information loop and makes a clear contribution on how operational information can be transformed into Lessons Identified and Lessons Learned to be used for mission training purposes and tactics and doctrines development. In this way SIMS can become the source of experiences from the practice of armies and affect the training and readiness of forces at the same time.

The SIMS Lessons Learned 'system' will be part of the SIMS KD and aims to improve the information gathering process, considering both the structure of information gathered, including its relationships to other mission related data, and the process itself with e.g. a predefined scope and moderators role, and supports the analysis of information in order to elaborate Lessons

Identified e.g. by pattern recognition; but it can also cover additional gathering activities. The distribution of information is supported by providing:

- processed information for daily mission planning and execution as part of Knowledge Database content,
- the review of Lessons Identified and observations for officers responsible for developing training content; mainly in pre-deployment trainings and general military training in order to adjust them to current needs and new approaches in armed conflicts,
- the content relevant in the process of updating organisational assets (e.g. procedures) and military doctrine up to the political level.

6. Novel Mission Training Methods and Techniques. Using content from the SIMS KD for training scenarios, together with the use of simulated or virtual environments enables a more realistic training in mission preparation. Based on novel mission training solutions, the SIMS project will prepare guidelines for improving mission training methods and techniques. Mission Training Trough Distributed Simulation (MTDS) and Live-Virtual Constructive (LVC) Training Environments have become a novel training paradigm over the past decade since highly successful demonstrations have been conducted within NATO and its collation partners. One of these examples was Exercise First WAVE (Gehr et al, 2005 and NATO RTO Report, 2007). Many nations, among which the US, UK, Canada, Australia, France, Germany, Italy, The Netherlands (Janssen, 2002 and Voogd et al, 2008), and NATO are creating or have created a Distributed Mission Training (DMT) Environment to foster mission training and rehearsal, within their nations and amongst coalition partners, in a more realistic, more effective, more timely, and last but not least, more cost-effective manner (Voogd et al, 2008; Lemmers et al 2010)

However, the successful application of simulation use for mission training stands or falls by the ability of creating an *immersive* training environment that contains all relevant aspects of the actual operational environment, e.g. terrain (Kuijper et al, 2010), weather, characteristics of civilians and their behaviours, etc., and includes recent and accurate information on the mission environment, e.g. changes in the political climate and human terrain; ideally even comprising the lessons learned of previous or current missions in the operational theatre. Moreover, simulation upgrades the mission training process even further when combined with appropriate training methods and techniques. Some inputs to and characteristics of recently evolved training paradigms, relevant for SIMS, are:

Integrated Task Training: Complex decision making skills - which are key elements in planning and executing military operations- can best be learned by actually making these complex decisions as many times as possible in a relevant and sufficiently realistic environment/context (Klein, 1998). Application of this concept is the basis for the decision to start from the very beginning with the training of the complete and integrated task instead of using a part-task training approach.

Theory follows Practice: Theoretical insights are best acquired while solving realistic challenges. Therefore, theoretical studies should not be the start of a mission training followed by a simulation event, but should be reversed or going hand in hand in the simulated training environment to foster meaningful learning (Hulst et al, 2008).

A Job Oriented Training (JOT) Approach puts professionals in a realistic job environment where they can train integrated tasks in a realistic manner. The JOT philosophy is based on modern insights about learning and human development. It puts the trainees, their responsibilities and performance on the job, at its centre. It supports 'natural learning' by making use of the self learning ability of people (Stehouwer et al, 2005)

Mission Essential Competencies: Train what you need to train and train as you (think) to fight: In this novel military training paradigm, initially developed and implemented by the United States Air Force, the focus is on obtaining Mission Essential Competencies (MECs) based upon a Mission Essential Task List. MECS are: *"higher-order individual, team, and inter-team competencies that a fully prepared individual, team or unit requires for successful mission completion under adverse conditions and in a non-permissive environment."* (Colegrove & Alliger, 2001). MECs are broad in nature, but they are not abstract knowledge or general skills. They are demonstrated in the context of an actual or simulated mission, under wartime conditions. MECs are readily identifiable, in that they relate to overall mission processes and phases, flow from the operations chain – Find, Fix, Track, Target, Engage, Assess (F2T2EA). They have distinct starting and end points, and if not successfully completed before going onto the next process or phase, jeopardize successful mission completion. MECs provide the structure to analyze mission execution at high individual and team performance levels. They also inform the design of appropriate combinations of training media that maximize learning and skill development, ranging from individual techniques and procedures to complex mission taskings for one or multiple teams.

Enhance (Ad-Hoc) Team Training: In modern military warfare key to mission success is the successful cooperation, mutual understanding, and trust amongst and between various teams in the operational theatre. These teams are often assembled in an ad-hoc manner to maximize the expertise within a team. To enhance ad-hoc team formation and team effectiveness mission training and mission rehearsal is focussing more and more on enhancing team performance using team training and assessment concepts such as developed by, e.g. Cannon-Bowers & Salas.

Enhancing learning of teams with Innovative Debriefing Solutions: Debriefing is a crucial aspect of military training. In typical mission debriefings, large amounts of data are recorded, often from different sources such as on-board systems and sensors. However, the available time for processing and debriefing this information and relating it to mission-specific or user-specific learning objectives is limited (Jacobs et al, 2008) This provides challenges for data integration, synchronization and presentation, and requires solutions to provide military operators with the right information at the right time in the right format (van Son, 2005). Together with these debriefings tools, providing novel solutions to give the user more control, novel debriefing techniques and methods have been developed, tested and implemented (Jensen et al, 2006; Pitz et al, 2007; van Son et al, 2009). Examples of these are *peer-to-peer debriefing* methods and more frequent use of *cross-training*.

Create a training environment that is Fit for Purpose and focuses on delivering Effective Realism: Learning needs to take place within a so called 'relevant reality'. Militaries need to become aware of the aspects that are important for performing their job. Consequently, in serious gaming and simulation, the training environment has to provide the cues essential to operational and tactical decision making. However, this certainly does not imply the requirement for a 100% fidelity (simulation) environment. Research clearly showed that a training environment should be fit for purpose and that one should strive for effective realism instead of trying to create 100% realism, which is often either simply impossible, or to timely and to costly to realize (Hays, 1989;Boomgaardt et al, 2007; Voogd et al, 2008; Voogd et al, 2009; SISO GM-VV PDG, 2010).

Cultural Awareness Training: Since many operational theatres are placed in regions with different (from European) cultures, customs, religions and habits many mission preparation training programmes focus on providing their militaries with culture awareness training.

5. SIMS in the military planning process

In the previous sections 3 and 4, we described the general vision of the SIMS concept. In this section, we want to provide the context of how SIMS could be used in the military processes of planning, training and execution of military operations.

In general, military decision making can be described by the OODA loop: a concept developed by military strategist and USAF Colonel John Boyd, originally applied to combat operations process mostly at the strategic level[6]. We can use this concept for SIMS to show the cycle of planning – execution – assessment, as depicted in Figure 2:

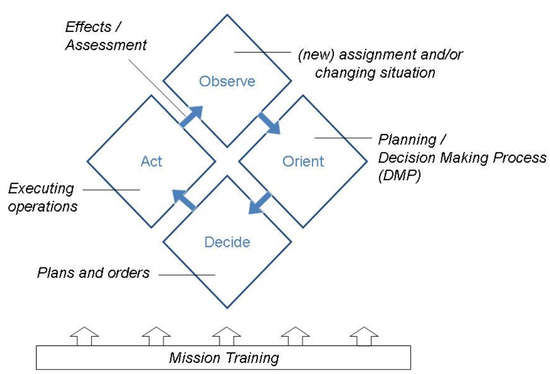

Figure 2: the general decision making cycle as based on the OODA loop

Based on a changing situation or an order from a higher-level commander, a planning process is started. In the planning process, the environment (physical and human terrain), all relevant actors and factors, as well as own means and assets, are assessed in order to create a plan for executing operations to achieve the intended effects. The following plan or order describes the desired effects, the commander's intent, and the available means to achieve the desired effects (which units will execute what activities). When formulating this plan the commander with his subordinated staff needs to make assumptions and deductions, as not all information is always available, for instance on the environment or opponent[7]. The plans are then translated into orders, which result in units executing operations. The operations are monitored in order to be able to deliver potential (higher level) support, and reported on afterwards in mission reports (including lessons identified).

Some of the comments on this current planning to execution process express[8] however that:

- Intell analysis processes can take a long time, so current information is not always directly available for the units in the field;
- Current information can remain 'unused' as some pieces of information coming directly from the field remain in soldiers/commanders minds for too long;
- Units have the feeling they don't see anything 'back' of their operations reports (as it is input for a time-consuming process which takes place on a higher level);
- It takes time to adjust plans based on the current situation, and the rationale behind the original plan is not always recorded (so it remains unclear how changes in environmental (f)actors affect the plan);

To overcome these issues, the SIMS concept envisions enhancing the flexibility and adaptability of the planning process by adding

[6] OODA: Observe, Orient, Decide, Act (concept developed by military strategist and USAF Colonel John Boyd, see for instance http://pogoarchives.org/m/dni/john_boyd_compendium/essence_of_winning_losing.pdf

[7] In reality, several planning processes are simultaneously carried out on all levels of command, and several planning processes could also be carried out simultaneously at one level. The analysis made by the staff leads to preparations at least two proposals for operations for the commander.

[8] from personal communication

'smart' information into the process. SIMS adds the KD together with reasoning techniques to the process, from which information can be 'smartly' disseminated from a dynamic layer and a static layer. On the lower (tactical / technical) level, the added value of SIMS in the planning – execution – assessment cycle is depicted in Figure 3:

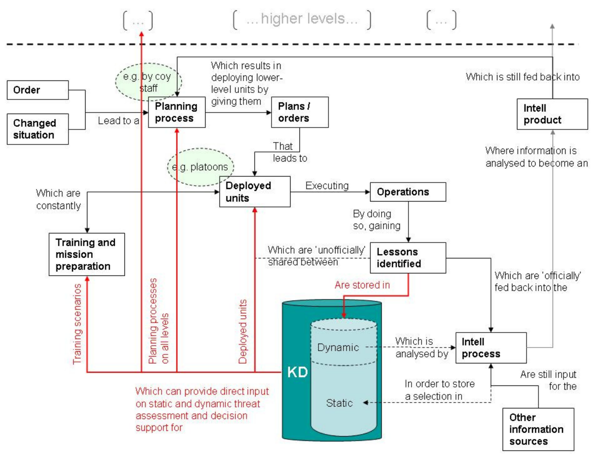

Figure 3: the (simplified) military planning process at the tactical/technical level as it could be with the SIMS Knowledge Database. Aspects improved or added by SIMS are indicated in red – 'it closes the loop smarter and shorter'

Note that the KD is not specifically linked to a specific level (e.g., operational, tactical), as all levels can benefit from the information. Also, the responsibility of database control and management is important and needs to be allocated; however this is an aspect which is outside the scope of the SIMS project.

The basis for being able to smartly disseminate information from the KD is that experiences and observations from the field are actually captured and recorded. This can be done in different ways (e.g. low-tech via radio, or high-tech via automated logging or digitally entering information for instance using a tablet PC). Independent of the final chosen mean for this, the most important thing is that it needs to be done.

This means that soldiers in the field will need to report, for example, on:

- The actual threat level and/or encountered threats;
  - Observations in physical and human terrain (e.g. holes in the road, enemy positions, (changes in) human behaviour of local population, etc.);
  - Encountered indicators of threat (e.g. IED modus operandi, just before the ambush I saw…, etc);
  - It 'feels' (un)safe here;
- What activities the units performed / what actions they took.
- What the used Force Protection (FP) means and measures were[9].
- Their experiences with which actions worked / didn't work, or which means of FP were effective.

When all this information is stored in the Knowledge Database, smart reasoning techniques and other analysis techniques (e.g. text and data mining) could be used to make comparative analyses between the stored items in the Database, allowing SIMS to use the KD to provide decision and planning support on for instance (1) actual threat levels; (2) (re)actions to threats or threat levels; and (3) effects of own operations.

This 'smart' knowledge from the KD should be fed back by providing threat assessment input (amongst others) to the units in the field, the planning process, and mission training. Input is provided on:

- Analysed intell, in other words validated information (coming from all kinds of sources) and processed by intell cell, as coming from the static layer;

[9] The lower the level, the less 'choice' there is in available FP means. A deployed unit (e.g. brigade size Task Force) is deployed to the area of operations with a specific set of means (e.g. number and type of vehicles, etc.) which can not be changed once in theatre. Air based fire support is an asset also mostly controlled on brigade level or higher.

- Information from units from the field, not validated yet but useful for other units (e.g., the latest unit that went to that location encountered *X*), as coming from the dynamic layer;
- Action possibilities: coupling between encountered threat and the actions taken, or vice versa (e.g., when encountering a threat in this type of terrain, reacting in *X* way was useful in the past);
- …

In the decision and planning support from SIMS it has to be clearly made explicit that the advice is based on two separate parts: the static part ("this is the validated threat assessment") and the dynamic part ("but in addition we can inform that the last unit operating in this area has encountered *X* situation, which has not been validated but be aware of these experiences").

6. METHODOLOGY

The SIMS Proof of Concept is designed, developed, and assessed by using an iterative and user centred development method, which is based on the INTUITION methodology (Bastide, Bazalgette, Bellik, Nigay, & Nouvel, 2005). In essence this means that for the KD design and other SIMS tools, starting from the user needs, a Human Factors Design is ensured, i.e. creating solutions that are fitting with the user needs. Within the iterative development process therefore frequently the support and assessment of militaries of nations involved in this SIMS study is and will be sought.

7. SUMMARY

In this paper we have described the challenges of sharing all relevant information within today's military operations in an asymmetric threat environment. We have presented the SIMS concept that is currently designed within the EDA Force Protection Research Programme which aims to address these challenges.

In short, the following six unique points of the SIMS concept have been identified:

1. SIMS will deliver one, singular and multi-accessible, Knowledge Database:
    - With a Google-like search engine, that retrieves prioritized information;
    - Containing all relevant Human Terrain related information;
    - That will provide smart information distribution;
    - That will support risk mitigation.

2. SIMS will enhance the Joint Common Operational Picture, especially for tactical Command and Control.

3. SIMS will optimize Force Protection Asset Planning, e.g. with risk estimation / mitigation / justification.

4. SIMS will support the realization of a more realistic mission training and rehearsal environment for a specific mission preparation, by including all mission relevant characteristics and the latest information available on the operational theatre.

5. SIMS will provide user-friendly solutions, which includes providing novel HMI solutions for optimal performances of all SIMS users, such as soldiers deployed in the field.

6. SIMS will enhance the Lessons Learned process.

Using an iterative research and design approach we hope to design and refine SIMS within the next year, concluding with a final assessment and demonstration of the SIMS concept.

8. WAY AHEAD

The final SIMS assessment and demonstration will take place in spring 2012. For this demonstration a simulation environment is prepared in which militaries can work and train with the SIMS concept in various scenarios and multiple vignettes. To ensure both usefulness and ease of use various Human Factors related experiments are foreseen in the summer of 2011. Based upon the outcomes of these experiments, the iterative tools development will take place. To take the SIMS concept to the next level, the integration with an operational C2 system is foreseen after spring 2012 in a follow-on SIMS (implementation) study.

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10. REFERENCES

Arnold, M. (2010). Improving the Coalition's Understanding of 'The People' in Afghanistan: Human Terrain Mapping in Kapisa Province. Small Wars Journal, *http://www.smallwarsjournal.com.*

Bastide, R., Bazalgette, D., Bellik, Y., Nigay, L., & Nouvel, C. (2005). The INTUITION Design Process: Structuring Military Multimodal Interactive Cockpits Design According to the MVC Design Pattern. In: *HCI International 2005*, Las Vegas, Nevada, USA.

Bemmel, van I.E., Eikelboom, A.R., Rios Loogman, D. (2010). Inlichtingen in gebruik! Beschrijving van het spanningsveld tussen de beschikbare inlichtingenproducten en de inlichtingenbehoefte binnen een Taskforce. [Intelligence in use! Description of the area of tension between the available intelligence products and the intelligence need within a TaskForce]. *TNO report In Dutch only, Internal use MoD,* TNO-DV 2010 A405.

Boomgaardt, J.J., Kraker, K.J. de & Smelik, R.M. (2007), Achieving a Level Playing Field in Distributed Simulations, *Fall Simulation Interoperability Workshop,* 07F-SIW-009, Orlando, FL, USA.

Cannon-Bowers, J.A., & Salas, E. (1997). A framework for developing team performance measures in training. In: *Team Performance Assessment and Measurement*, Lawrence Erlbaum Associates, Inc, New Jersey.

Colegrove, C.M., & Alliger, G.M. (2001). Mission Essential Competencies: defining Combat Mission Readiness in a novel way. NATO ACC.

Command and Control Centre of Excellence (2010). Best Practices for Command and Control in a Network Enabled Environment. *http://www.c2coe.org/beta/index.php?option=com_content&view=article&id=156&Itemid=43*

Gehr, S., Schurig, M., Jacobs, L.M.R.A., Pal, J. van der., Bennet, W., & Schreiber, B.T. (2005), Assessing the training potential of MTDS in Exercise First WAVE, *NATO RTO-MSG-035 conference on the effectiveness of modelling and simulation*, Warsaw, Poland.

Jacobs, L.R.M.A., Cornelisse, E., & Schavemaker-Piva, O. (2006). Innovative Debriefing Solutions for Mission Training and Simulation: Making Fighter Pilot Training More Effective. *Proceedings of I/ITSEC 2006*, pp. 215-224.

Janssen, H.G.M (2002), ULT-JOIND, initial capability for MTDS in the Netherlands, *NATO*

RTO SAS-038 MTDS Symposium, Brussels, Belgium.

Jensen, R., Harmon, N., Nolan, M., & Caldwell, G. (2006). Visually Based Timeline Debrief Toolset for Team Training AAR. *Proceedings of I/ITSEC 2006*, pp. 234-243.

Hays, R.T. & M.J. Singer (1989). *Simulation Fidelity in Training System Design.* New York: Springer Verlag.

Hulst, A. van der, Muller, T., Besselink, S., Coetsier, D. & Roos, C. (2008). Bloody Serious Gaming – Experiences with Job Oriented Training. In: *Proceedings I/ITSEC 2008*.

Klein, G. (1998). *Sources of Power, How People Make Decisions.* Cambridge, Massachussetts: The MIT Press.

K.J. de Kraker, M. van Emmerik, P. Langeslag, W. Huiskamp (2007). Towards successful multifunctional reuse of simulation components, *Spring Simulation Interoperability Workshop (SIW),* Norfolk, VA, paper 07S-SIW-051.

Kuijper, F., van Son, R., van Meurs, F., Smelik, R., and de Kraker, K.J. (2010), Techniques for Automatic Creation of Terrain Databases for Training and Mission Preparation, *IMAGE 2010 Conference*, Scottsdale, AZ, USA.

Lemmers, A.J., Jacobs, L.R.M.A., Karelse, R.J., & Klomp, J.A. (2010). A Collective Mission Simulation Capability for the Royal Netherlands Armed Forces. In: *Proceedings I/ITSEC 2010*, Orlando, FL, USA.

NATO (2009). Allied Joint Doctrine for Land Operations, AJP-3.2.

NATO RTO Task group SAS-034/MSG-001 (2007), Mission Training via Distributed Simulation and First WAVE: Final Report, *NATO RTO Technical Report, RTO-TR-SAS-034.*

Pitz, R., & Armstrong, C. (2007). Advanced Distributed Debrief for Joint and Coalition Training. *Proceedings of I/ITSEC 2007*, pp. 201-212.

Sepp, K.I. (2005). Best Practices in Counterinsurgency. Military Review, pg. 8-12.

SISO GM-VV PDG (2010), *Guide for Generic Methodology (GM) for Verification and Validation (VV), and Acceptance of Models, Simulations, and Data, Handbook*, SISO-GUIDE-00X.2-201x-DRAFT-v1.5.1.

Son, R., van (2005). Supporting Situational Awareness in Large-Scale Virtual Environments. *Master's Thesis*, *Utrecht University, Utrecht, The Netherlands*. INF/SCR-05-15.

Son, R., van, Schavemaker-Piva, O., Jacobs L.R.M.A., Maarseveen R., van, & Stallmann, A. (2008), Innovative Debriefing Solutions to Enhance Fighter Pilot Training, *I/ITSEC conference*, paper 8161, Orlando, FL, USA.

Stehouwer, M., Serné, M. & Niekel, C. (2005). A tactical trainer for air defence platoon commanders*.* In: *Proceedings I/ITSEC 2005*.

Voogd, J.M., Kraker de, K.J., Jacobs L.R.M.A, Kuiper F., Keuning, M.F.R, and Karelse, R.J. (2008), Collective Mission Simulation in The Netherlands, Key Problems & Solutions, *I/ITSEC conference*, paper 8002, Orlando, FL, USA.

Voogd, J.M., Lemmers, A.J.J., Gerretsen, A., Roza, Z.C., Karelse, R.J. (2009), Effective Use of Simulation Means in Collective Mission Simulation, *I/ITSEC Conference*, paper No. 9198, Orlando, FL, USA.