# Assessing the effectiveness of Defensive Aid Suite technology using a field trial and modelling and simulation

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**Abstract**

Over the last 10 years, changes in the global strategic environment gave rise to a trend to equip armies with lighter, more rapidly deployable forces. Instead of armoured formations equipped mostly with 50-70 tonnes Main Battle Tanks (MBT), future armoured formations will be equipped mostly with 20-30 tonnes Light Armoured Vehicles (LAV). LAVs lack the protection of MBTs. It is the opinion of the Defence Science and Technology (S&T) community that Defensive Aid Suite (DAS) technologies can improve the protection of LAVs. A prototype DAS system was developed by DRDC – Valcartier and tested in field trials held in 1995 and 1999. This paper reports on the DAS field trial conducted in 1999 at the Canadian Forces (CF) Combat Training Centre (CTC) Gagetown (New-Brunswick, Canada). This field trial had two main objectives. The first one was to collect DAS data during a technical evaluation of the sensors and during simulated tactical LAV operations. The second objective was to evaluate the impact of basic DAS prototypes on LAV survivability in a simulated laser threat environment. Analysis of field trial data demonstrated the effectiveness of DAS in protecting LAV. The DAS development program also provides the opportunity to use Modeling and Simulation (M&S) to guide technology development. To this end, a M&S program was launched in DRDC – Valcartier, and this paper also reports on the current status of this M&S program.

## 1. Introduction

Over the last 10 years, changes to the global strategic environment gave rise to a requirement for lighter, more rapidly deployable forces. Current forces are mainly equipped with 50-70 tonnes Main Battle Tanks (MBT), and lack the strategic and operational mobility required by the new strategic environment where military forces are required to deploy over large distances in a short period of time to respond to a crisis. Hence, armoured formations need to be equipped with lighter, more rapidly deployable vehicles. Light Armoured Vehicles (LAV) in the 20-30 tonnes range have better strategic and operational mobility than MBTs, but lack the protection and firepower of the heavier vehicles. However, it is the opinion of the Defence Science and Technology (S&T) community that overall battlefield effectiveness of LAVs can be increased by implementing technologies to improve crew situational awareness and with a Defensive Aid Suite (DAS) to improve survivability [Cantin and Espenant, 1999]. This paper discusses the development of DAS technology at DRDC-Valcartier and reports on a field trial where a DAS

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prototype integrated on a LAV was tested during simulated tactical Armoured Fighting Vehicle (AFV) operations.

Development of DAS started in DRDC-Valcartier in the mid 1990s' following the development of the High Angular Resolution Laser Irradiation Detector (HARLID™) [Cantin *et al.*, 1997]. A prototype for a Laser Warning Receiver (LWR) capable of detecting laser irradiation from Laser Range Finder (LRF) and Laser Target Designator (LTD) was developed and tested during a first field trial held in Combat Training Centre (CTC) Gagetown (New-Brunswick) in 1995. Following this initial trial, a new and better integrated LWR and DAS prototype was built. This new prototype was installed on a Coyote Armoured Reconnaissance Vehicle and field tested in CTC Gagetown in 1999. This last field trial is the main subject of the present paper.

## 2. **Defensive Aid Suite**

Figure 1 illustrates the concept of Defensive Aids Suite. A DAS includes three main components: a sensor package, a countermeasure package, and central processor. The role of the sensor package is to detect the threats. The central processor processes the information from the sensors and displays threat information to the crew on the Operator-Machine Interface (OMI). The central processor can also send command signals to assist the crew in deploying countermeasures, depending on the level of automation built into the DAS system. The role of the countermeasure package is, obviously, to protect the vehicle from threats. The exact manner in which countermeasure protect the vehicle depends on the type of countermeasure.

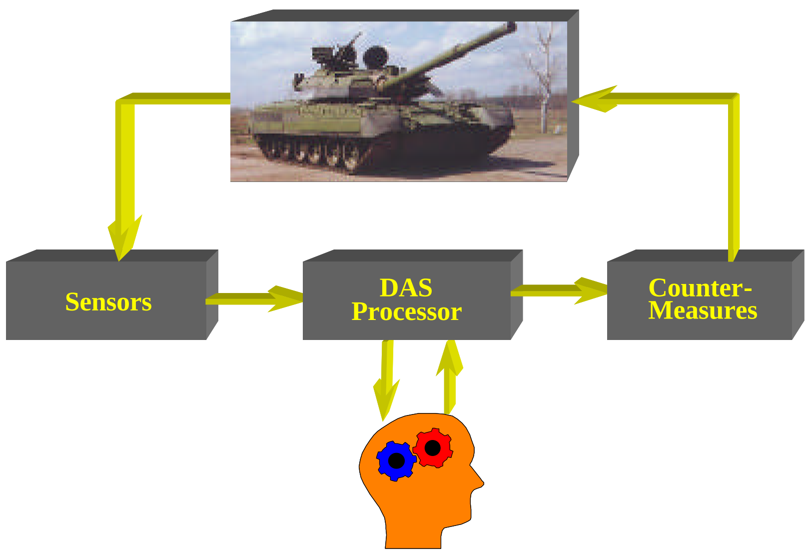


Figure 1. Defensive Aid Suite concept.

The components of the first development stage, known as DAS Phase I, are shown in Figure 2. In DAS Phase I, the sensor package only includes a Laser Warning Receiver (LWR). This LWR is based on the 2-band HARLID™ laser irradiation detector. The 2-band HARLID™ LWR can locate a laser threat within ± 1° over 360 degrees in azimuth and 90 degrees in elevation, at wavelengths of 1.06 µm and 1.54 µm. Algorithms in the LWR can discriminate between a LRF and a LTD by measuring the Pulse Repetition Frequency (PRF) of the detected laser irradiation.

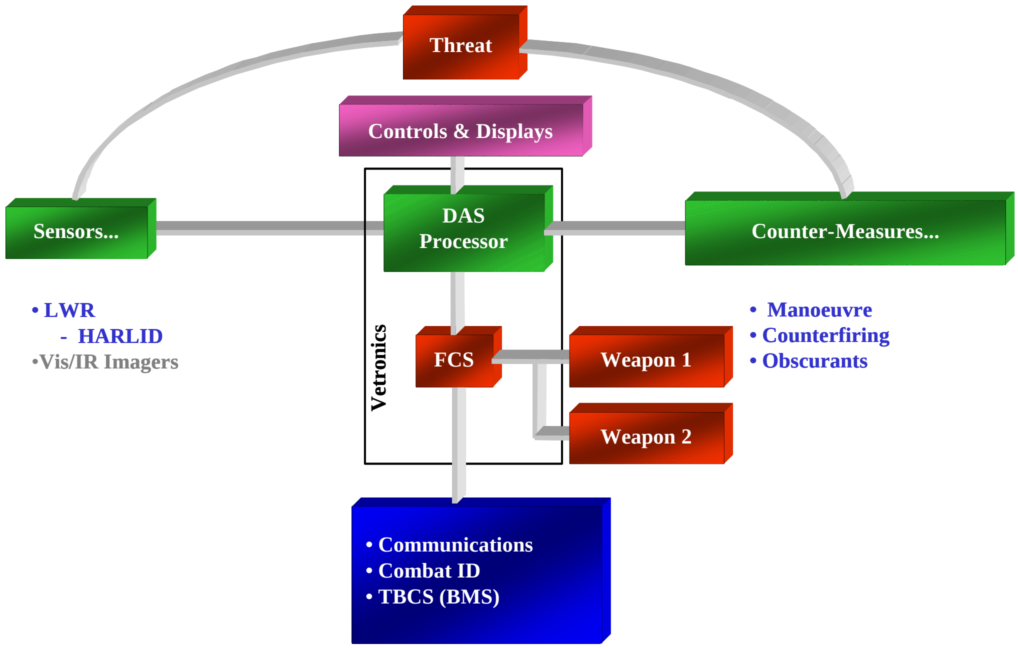


Figure 2: DAS Phase I components.

The LWR is linked with a central processor that receives and processes threat information from the LWR. The OMI shown in Figure 3, provides the interface between the crew of the vehicle and the DAS system. The OMI is installed at the Crew Commander's station in the turret. The Crew Commander operates the DAS prototype with the touch-screen display shown in Figure 3. The OMI includes a clock representation of the azimuth angle of the laser threats as well as the orientation of the canon - both by a radial strobe. The thinner strobe shows the orientation of the main gun (and hence the turret) relative to the vehicle hull, and the larger strobe shows the Angle of Arrival (AOA) of the laser threat relative to the turret. The Crew Commander can select the mode of operation for rotating the turret and launching smoke grenades. The turret has two rotation modes: manual and semi-automatic. In manual mode, the Crew Commander uses a hand controller to orient the turret in the threat's direction. In semi-automatic mode, all the Crew Commander has to do is to press on a switch on the turret hand controller and the central DAS processor will send command signals to the turret electric drive, directing it to rotate towards the threat at a rate of $45^{o}$ per second, and stopping turret rotation when the main gun is aligned at $\pm 1^{o}$ of the angle of arrival of the threat.

The countermeasure package in DAS Phase I includes smoke grenades, counter fire, and evasive manoeuvres. Smoke grenades can be launched manually by the crew commander or automatically by the central processor. In manual mode, the Crew Commander selects and fires a bank of smoke grenades using the control panel in the turret. In automatic mode, the DAS central processor fires all eight smoke grenades when the turret is at $\pm 5^{o}$ from the threat's angle of arrival. The objective of the smoke grenades is to produce a smoke cloud between the laser threat and the vehicle in an attempt to break the line of sight with the threat before a weapon hits the vehicle. Evasive Manoeuvres serve the same purpose, but in this case it is the Driver, following direction from the Crew Commander, that uses terrain features to break the line of sight with the threat. Finally, if the threat is within range of the DAS vehicle's main armament and the crew has detected the threat, counter fire (i.e. shooting back at the threat) can be used to destroy or disturb the threat by forcing it to hide, thereby preventing it from guiding a weapon onto the DAS vehicle.

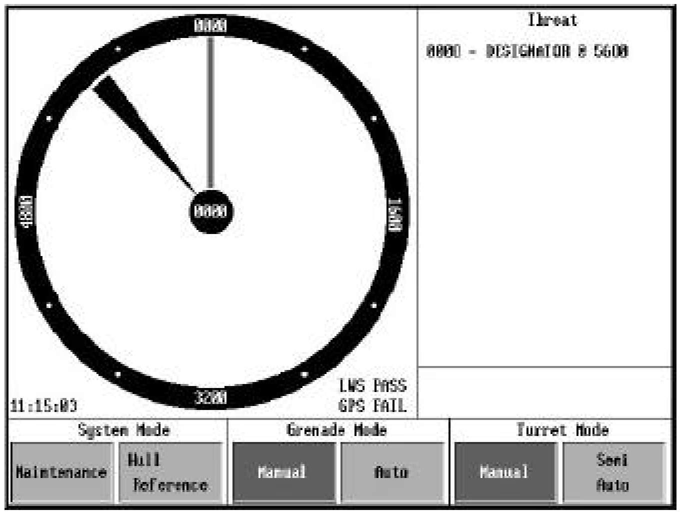

Figure 3: DAS Operator-Machine Interface for the DAS Phase I tested in Gagetown in 1999.

The DAS Phase I prototype is integrated to a Coyote LAV. The Coyote is a modern reconnaissance vehicle acquired by the Canadian Army since 1995. The Laser Warning Receiver (LWR) unit is mounted at the rear of the LAV turret, shown by the arrow in Figure 4.


Figure 4: DAS Phase I prototype installed on a Coyote LAV.

## 3. **DAS field trial description**

The DAS field trial was conducted at Canadian Forces Base Gagetown in October 1999. The aim of this field trial was twofold. The first aim was to collect Defensive Aid Suite (DAS) data during tactical Armoured Fighting Vehicle (AFV) operations. The second aim was to evaluate the impact of basic DAS prototypes on AFV survivability in a simulated laser threat environment.

The field trial included two different parts. The first part was a technical trial during which adjustments to the LWR were made and technical measurements such as off-axis detection of the LWR were taken. The data collection equipment was also installed and tested during the technical part of the trial. The second part of the trial was a tactical trial during which engagements between laser threats and Coyote vehicles were simulated while the vehicles advanced on open terrain towards an objective. This paper discusses the tactical trial and the evaluation of the Canadian DAS Phase I prototype.

### 3.1. **Tactical trial design**

A major effort went into planning the tactical trial, starting with the identification of key variables. As explained above, the DAS Phase I prototype was installed on a Coyote vehicle. Another Coyote vehicle equipped with the Raytheon Type 218S LWR was used as a reference for comparison. The Raytheon Type 218S LWR is the standard LWR installed on Coyote vehicles. Throughout this article, the Coyote vehicle equipped with the DAS Phase I prototype will be referred to as the DAS vehicle, and the Coyote vehicle equipped with the Raytheon LWR will be referred to as the standard vehicle. The standard vehicle had a different OMI (see Figure 5) and turret rotation and launch of smoke grenades was done in manual mode only. Comparing Figure 5 with Figure 3 shows that the standard vehicle had a less elaborate OMI and that threat angle of arrival indication was less accurate than on the OMI of the DAS vehicle. Threat angle of arrival was displayed in the standard vehicle by one of the 10 luminescent diodes (the narrow triangles in Figure 5). Detection of a LRF is indicated by steady illumination of one or more triangles. Detection of a LTD is indicated by one or more flashing triangles. The larger arrow in the centre of the indicator shows turret orientation relative to the vehicle hull.

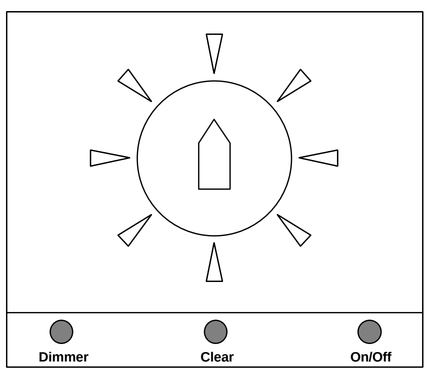

Figure 5: DAS Operator-Machine Interface in the standard vehicle.

Hence, the LWRs, the central processors, the Operator-Machine Interface (OMI), the level of automation, and one countermeasure, were different for each vehicle. Three countermeasures (Manual Smoke, Counter Fire and Evasive Manoeuvres) were common to both vehicles. In addition, the DAS vehicle had the capability of deploying smoke grenades in automatic mode. Several laser threats (LRF at 1.06 µm and 1.54 µm, LTD at 1.06µm) were positioned in five different locations. The LTDs were operated in two different manners, by direct designation and offset designation. All these factors turned into a high number of variables, and lead to a small number of engagements for each combination of variables.

The crews manning the vehicles were provided by CTC Gagetown. They varied in experience levels. Some of them had just completed their qualification on the Coyote vehicle, others were instructors at the armoured school. It was initially planned to rotate the crews among the vehicles in an attempt to balance the experience levels of the crews who would operate the different DAS systems installed on the vehicles. However, contingencies caused the technical trial to last longer than expected and training the crew to operate the DAS systems also took more time than expected, such that it was not possible to rotate the crews between the vehicles. Instead, each crew stayed with the same vehicle for the whole duration of the tactical trial. As a consequence, the crews became more proficient at operating their respective DAS system as the tactical trial progressed and learning effects were not controlled.

Figure 6 shows one way of synthesizing the trial variables on which vehicle survivability depends. It sets a conceptual framework to express vehicle survivability as a function of trial variables. It should be noticed that for any given vehicle, trial data does not allow to separate the effect on survivability of the sensors suite from the effect on survivability of the crew, the OMI, or the level of automation in the turret. Hence those variables are grouped under the variable “Vehicle”. Figure 6 shows that vehicle survivability depends on countermeasures, on the vehicle (through its crew, its sensors, its OMI and the level of automation of its turret), on reaction time, on environmental factors, on the laser threat, and whether the vehicle is static or is moving when engaged.

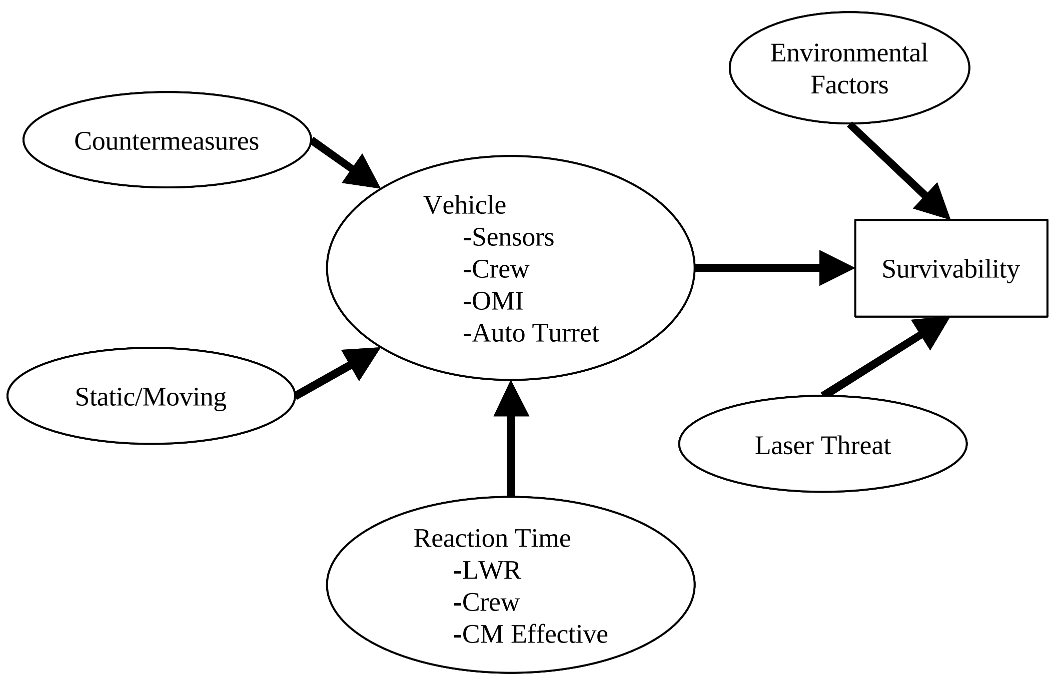


Figure 6: Conceptual framework for vehicle survivability.

Figure 6 distinguishes between variables related to the vehicle and variables that are not. The ovals labelled “Countermeasures”, “Static/Moving” and “Reaction Time” are related to the vehicle and point directly to the oval labelled "vehicle". “Laser Threat” and "Environmental Factors" affect survivability, but are not directly related to the vehicle. The physical parameters (wavelength, power output, etc.) and the manner in which the laser threat is operated (such as offset designation with a LTD) can affect detection of the laser irradiation by the vehicle’s LWR, and hence the reaction to the threat.

Little control was exerted over "Environmental Factors" during the trial, although they influence survivability. "Environmental Factors" include weather conditions (wind, precipitation, visibility, ambient light level), but also the type of terrain and the location of the vehicle on the terrain when it was engaged. As an example, if the vehicle was close to good concealment positions when it was engaged, this might have increased Evasive Manoeuvres success rate. The trial was interrupted when precipitations reduced the visibility enough to prevent clear lines of sight between the laser threats and the vehicles.

All possible combinations of key trial variables were put on a list of engagements to conduct during the tactical trial. It was expected to conduct each of these engagements three times.

### 3.2. Tactical trial traces

Figure 7 shows a map of the area showing the path followed by the vehicles (the three large arrows), the position of the laser threats (labelled D1 to D7) and the Command Post (labelled CP) where trial control and recording equipment was located. The vehicles departed from the straight road on a North East-South West axis (middle of the map, left of centre), and advanced towards the Command Post (CP). While the vehicles advanced on the terrain, they were engaged by the laser threats located at the positions indicated by the boxes D1 to D7. The type of engagement to conduct (laser threat, countermeasure, vehicle static or moving) was decided by the trial controller from the list of engagements.

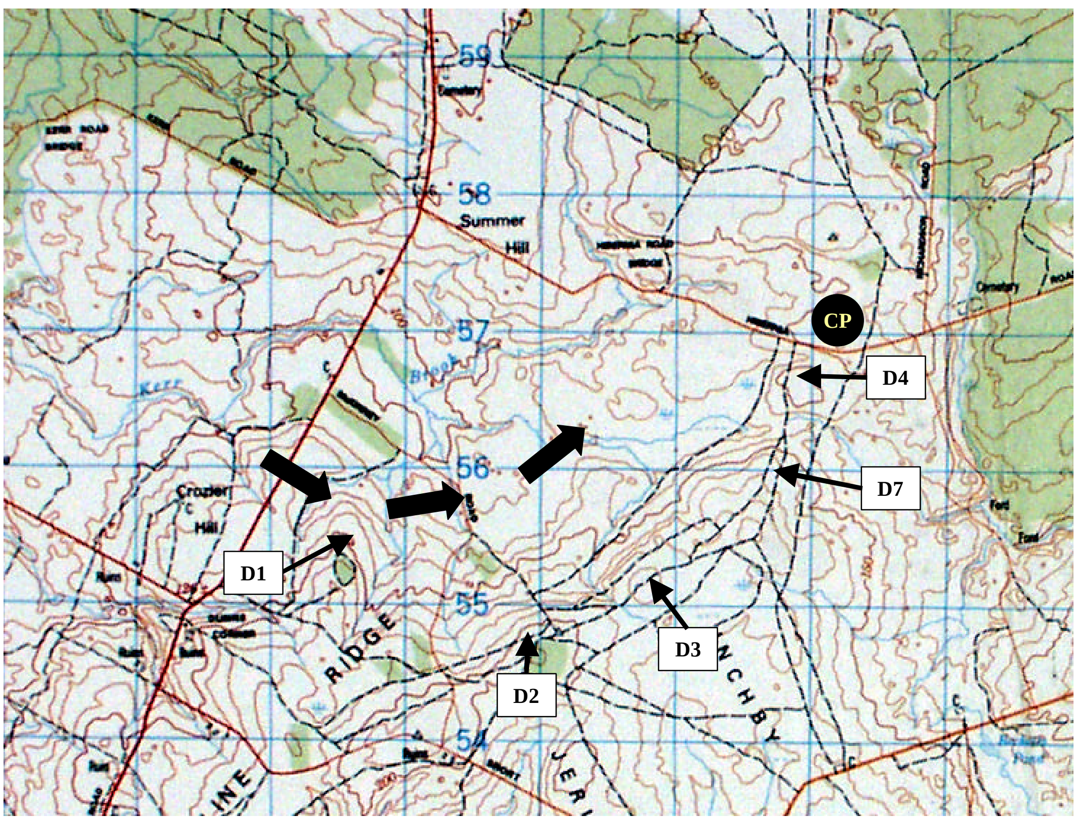


Figure 7: Path followed by the vehicles (arrows), location of the laser threats (D1 to D7), and Command Post (CP).

### 3.3. Tactical trial data sources

A large amount of data was collected during the trial. Electronic trial data recorded automatically onboard all four vehicles and in the Command Post was supplemented with a considerable amount of video recording. Boresighted cameras were installed on the main gun of each vehicle and on each laser threat. Additionally, the display of the LWR in each vehicle was videotaped. An audio track was also recorded with the videotapes. All the electronic, audio and video data recorded at the laser threats and onboard the vehicles were transmitted to the Command Post where the time from a GPS clock was inserted in the recordings. Electronic data transmitted to the Command Post was then stored in the data files of a visualization software for a near real-time display and later retrieval.

## 4. Tactical trial results

### 4.1. Countermeasures Success Rate

Figure 8 shows an example of the information produced from trial data. Success criteria for each type of countermeasure were defined, and the number of countermeasure successes and failures was obtained by examining video recordings of the engagements. The most interesting comparison is between Automatic Smoke and Manual Smoke. For both these countermeasures, the DAS vehicle had a higher success rate than the standard vehicle. However, this trial result must be interpreted with caution since success or failure of the smoke countermeasure depends heavily on environmental factors such as wind direction and velocity. For that reason, the higher success rate of Automatic Smoke on the DAS vehicle cannot be credited with certainty to its DAS system.

The success rate of evasive manoeuvres was slightly lower for the DAS vehicle than for the standard vehicle. Once again, this must be interpreted with caution since the success of evasive manoeuvres heavily depends on the availability of good concealment positions in the area where the vehicle was engaged.

Finally, sensitivity to backscattering in the LWR installed on the DAS vehicle contributed to the lower success rate of Counter Fire compared to the standard vehicle. Trial data allowed the identification of the causes of failures of the countermeasures, and hence provide directions for improvements to the DAS Phase I prototype.

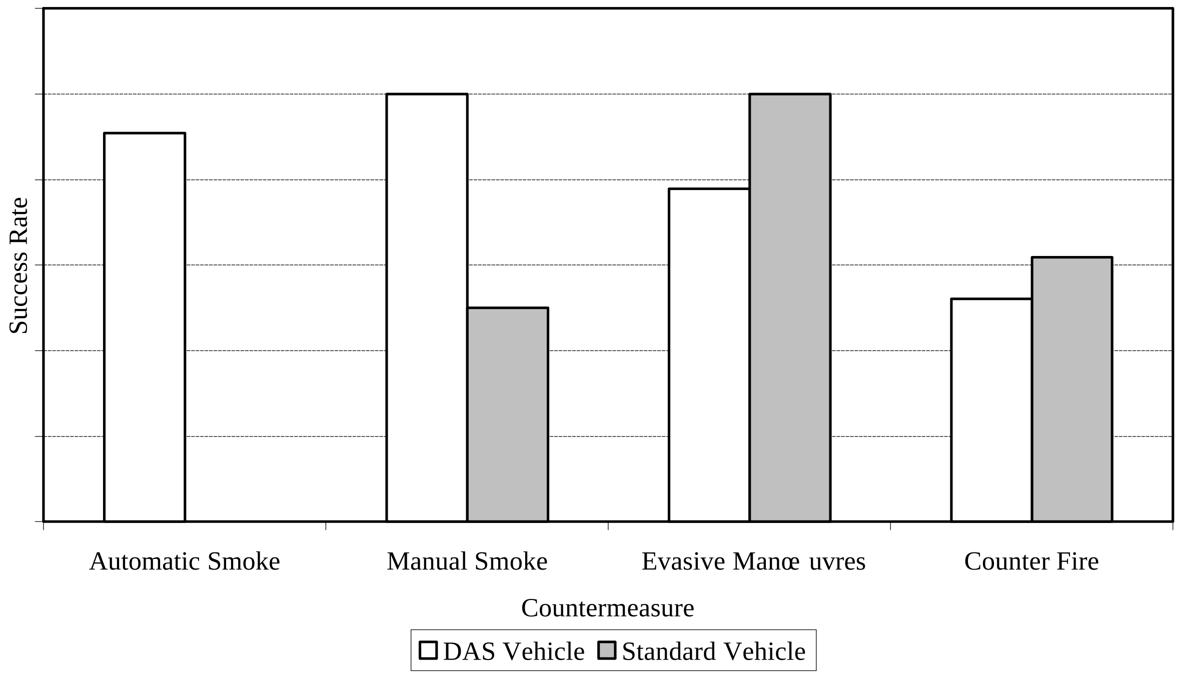


Figure 8: Countermeasure Success Rate for the DAS vehicle and the standard vehicle.

## 4.2. **Average Total Reaction Time**

Average Total Reaction Times were calculated for each countermeasure and each vehicle and are shown in Figure 9. Comparison of the average reaction time for Automatic Smoke on the DAS vehicle with the average reaction time for Manual Smoke on the both vehicles definitely shows a shorter reaction time for Automatic Smoke. However, other factors such as environmental conditions could have played a role in the shorter reaction time on the DAS vehicle. Counter fire is a better indication of the advantage of automation. Figure 9 shows indeed that the reaction time with counter fire was shorter for the DAS vehicle than for the standard vehicle.

The shorter average reaction time observed for Evasive Manoeuvres with the DAS vehicle is most likely caused by the more experienced and better coordinated crew in the DAS vehicle. The more accurate threat information displayed on the OMI in the DAS vehicle could also have contributed to the shorter average reaction time. Finally, there is a possibility that the DAS vehicle was closer to good concealment positions when it was engaged and directed to respond with Evasive Manoeuvres.

The average reaction times calculated from trial are a good indication of the capability of the DAS systems tested in the field trial to protect LAVs against generic subsonic anti-armoured weapons.

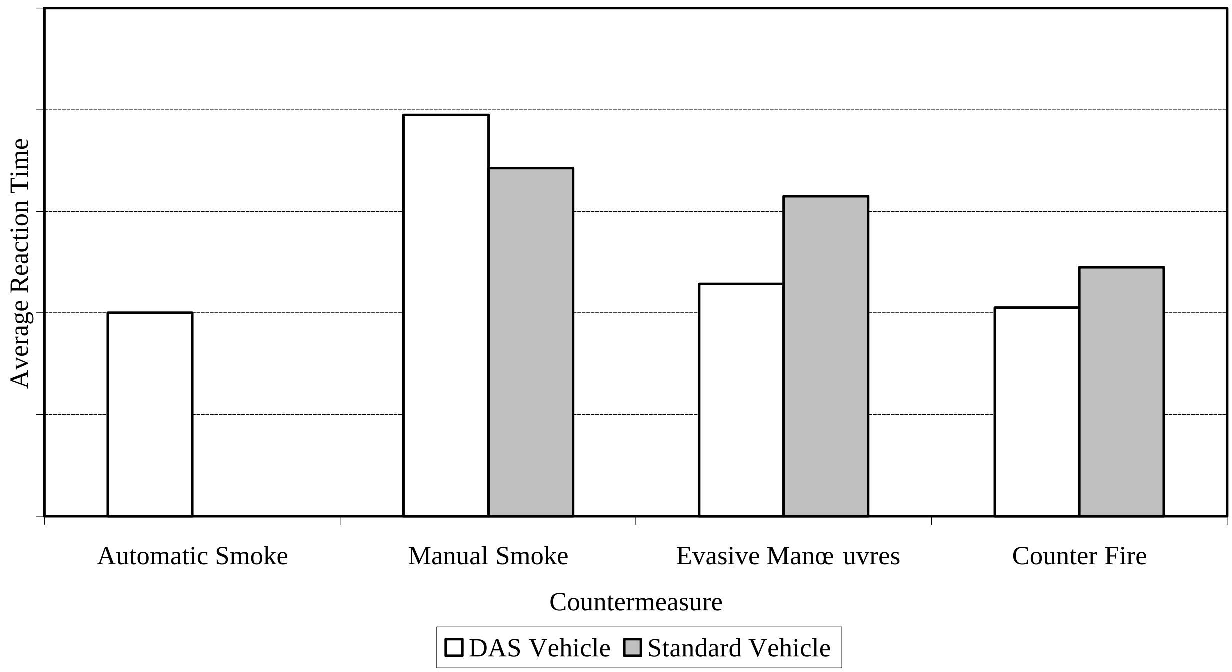


Figure 9: Average Total Reaction Time per countermeasure for the DAS vehicle and the standard vehicle.

### 4.3. General comments on trial results

Despite the massive amount of data that was collected during the trial, it often remains difficult to determine the exact causes of some trial results because the required data was not collected. It is important to bear in mind that the countermeasure success rates shown in Figure 8 and the average total reaction time shown in Figure 9 were obtained with prototype systems operated by crews who had limited previous exposure to DAS systems and who were given minimum training with DAS prior to the tactical trial. It is reasonable to expect that average values for success rates will be higher and average values for total reaction times will be shorter when fully integrated DAS systems are operated by highly trained crews. An additional cautionary note is that the average values shown in Figure 8 and Figure 9 were calculated from small samples, hence they are indicative only.

## 5. Observations and Comments on the Tactical Trial

### 5.1. Constraints and Contingencies

Despite the hard work of all parties involved during the planning phase and the conduct of the field trial, unexpected problems are going to happen that will force changes to the test plan of any field trial.

During the 1999 DAS field trial, the most critical problems were the late delivery of Canadian DAS equipment and making the adjustments required by the equipment (sensitivity of the LWR, susceptibility to back-scatter, etc.) before proceeding with technical measurements and crew training for the tactical trial.

The training area was available for a limited time only. Training each crew on the operation of the DAS system installed on their vehicle took more time than expected. This forced to cut down crew training from 2 days to half a day and abandon the plan of rotating the crews in the vehicles. Instead, crews stayed with the same vehicle (and hence the same DAS system) during all the tactical trial. As a consequence, learning effects were not controlled and the experience levels of the crews with each system were not balanced.

As the tactical trial began, some smoke grenade launchers failed and took one day to repair before the tactical trial resumed. Reloading the smoke grenade launchers took longer than expected, which further slowed down the sequence of engagements. One day was lost to weather, and there were a small number of changes in crew composition during the tactical trial because of other commitments or illness.

A list of required engagements was established prior to the trial (see section 3. **DAS field trial description**). Initially, those engagements were conducted as opportunities showed up on the terrain. However, as the trial progressed the occurrence of some engagements had to be forced in order to get the complete list of planned engagements.

The vehicles experienced some problems during the trial. They occasionally got stuck in the mud. Also, the processor on the DAS vehicle experienced some crashes that forced the temporary removal of the vehicle.

All these delays during the tactical trial cumulated and resulted in some engagements that were not conducted because time did not allow.

The type of constraints and contingencies described in this section are to be expected while running a field trial, and the test plan should allow some room for this type of difficulties.

### 5.2. Closing remarks on the tactical trial

A major effort went into trial planning. A massive amount of quantitative data on the different systems used during the tactical trial was collected. This data allows a better understanding of how the equipment operated and performed under field trial conditions, and also allows a technical comparison between the DAS Phase I prototype and the standard LWR and countermeasures suite installed on the standard vehicle. However, the large number of variables, the limited control that could be exerted over those variables during the trial and the small number of engagements for each combination of trial variables limits the statistical comparisons that can be made for countermeasure success rate and average reaction times.

Finally, after two DAS field trials (one in 1995 and one in 1999), there is now a good body of knowledge on the constraints and the contingencies that affect a field trial. Planning of the next field trial will draw heavily on these past experiences.

## 6. Modeling & Simulation

DAS is a complex technology and it is clear that its development can benefit from the support of a Modeling and Simulation (M&S) program. Provided that models with a sufficient degree of fidelity can be developed, simulation experiments are a low cost method of conducting parametric studies on key physical characteristics of DAS components (sensors, central processor, countermeasures), of studying the operational use of DAS in a controlled environment, and of planning future field trials. To this end, a M&S program was launched with the objectives of developing models of DAS technologies in a simulation environment and of using these models to conduct simulation experiments whose results will guide technology development.

The DAS M&S program uses the Modular Semi Automated Forces (ModSAF) Distributed Interactive Simulation (DIS) as the simulation environment. ModSAF was developed in the United States. Its initial purpose was training. ModSAF 5.0 International was distributed in Canada during the year 2000, and is used by the Army Simulation Centre, the Army Experimentation Centre, and DRDC-Valcartier for R&D and Operational Research (OR) studies.

Figure 10 illustrates how it is intended to use field trials and M&S to support DAS technology development. An initial field trial occurred in 1995. Its purpose was to test initial LWR prototypes and basic countermeasures (smoke grenades in automatic or manual deployment, counter fire, evasive manoeuvres). This first field trial provided LWR performance data. Development of the HARLID™ based LWR and DAS system continued after the 1995 trial to produce the DAS Phase 1 prototype shown in Figure 2 that was tested in a second field trial in 1999. LWR physical parameters and overall DAS performance like countermeasure success rates and reaction times were measured during this second field trial.

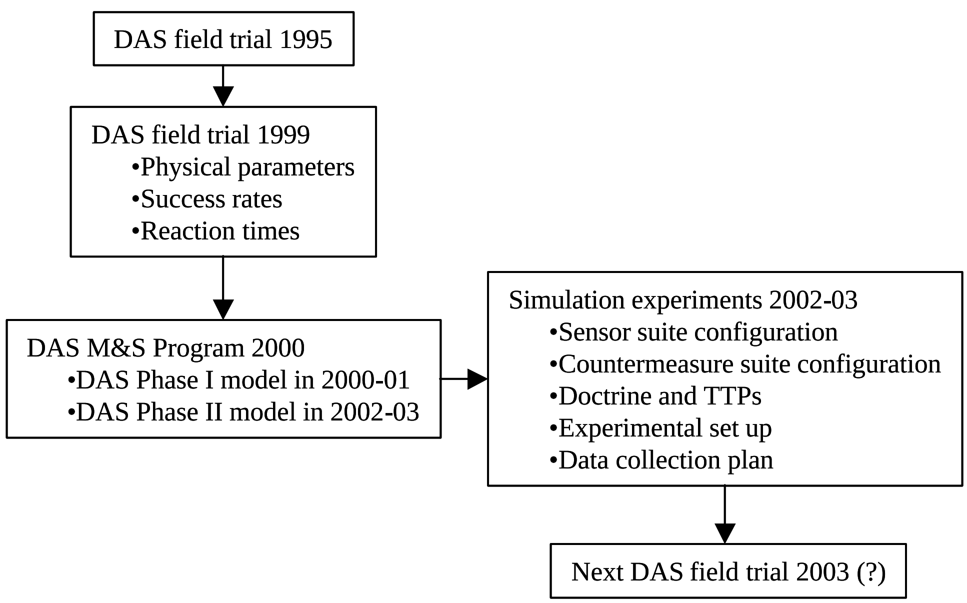


Figure 10: DAS development using field trials and M&S.

It became obvious after the 1999 DAS field trial that DAS technology development would benefit from a M&S program to study in a virtual environment how DAS technologies can improve the survivability of armoured vehicles before conducting field trials. A simulation laboratory was set up in DRDC-Valcartier and development of models for DAS technologies in ModSAF started in the last months of the year 2000. At the time of writing this article, models for laser sources (LRF and LTD) and for DAS Phase I components are built into ModSAF. The DAS components models are attached to a model of a Coyote vehicle. Data collected during the 1999 field trial is used as input for these models. Debugging the models is done by replicating parts of the 1999 DAS tactical trial in ModSAF. In these replications, a laser source (LRF or

LTD) designates a target vehicle that is advancing on a route. When the LWR on the target vehicle detects the laser irradiation, the target vehicle deploys smoke grenades to produce a smoke cloud that breaks the line of sight with the laser threat. Figure 11 shows a ModSAF screen shot of these replications. The reaction of a DAS vehicle to detection of a threat makes use as much as possible of the behaviours already available in ModSAF. The programming effort consist in identifying the most appropriate behaviour among those available and introducing it in the sequence of actions that the DAS vehicle takes when detecting a threat.

The first simulation experiment will attempt to quantify the increase in survivability provided to an armoured vehicle by a DAS system. This will be done by simulating one-on-one engagements between a DAS vehicle and a number of anti-armour weapons. To this end, military personnel versed into war gaming were met to discuss the issues related to the type of combat simulation required by DAS development. These military experts also provided vignettes (extracts from a larger battle simulated during a major war game study) that will be used to simulate engagements between a DAS equipped vehicle and a range of anti-armour weapons. The first simulations will be one-on-one engagements between a platform launching a laser aided weapon and a DAS vehicle. It is also intended, at least during the first simulation experiments, to program the vignette such as to avoid decision points, in an attempt to reduce to a minimum or even eliminate human intervention during each iteration. As experience is gained, more elaborate simulations at troop level (4 DAS vehicles) and possibly up to Company level (about 15 DAS vehicles) might be conducted. It is also intended to study with the appropriate simulations other aspects of DAS performance such as the composition of the sensor suite and of the countermeasure suite to identify the survivability drivers.

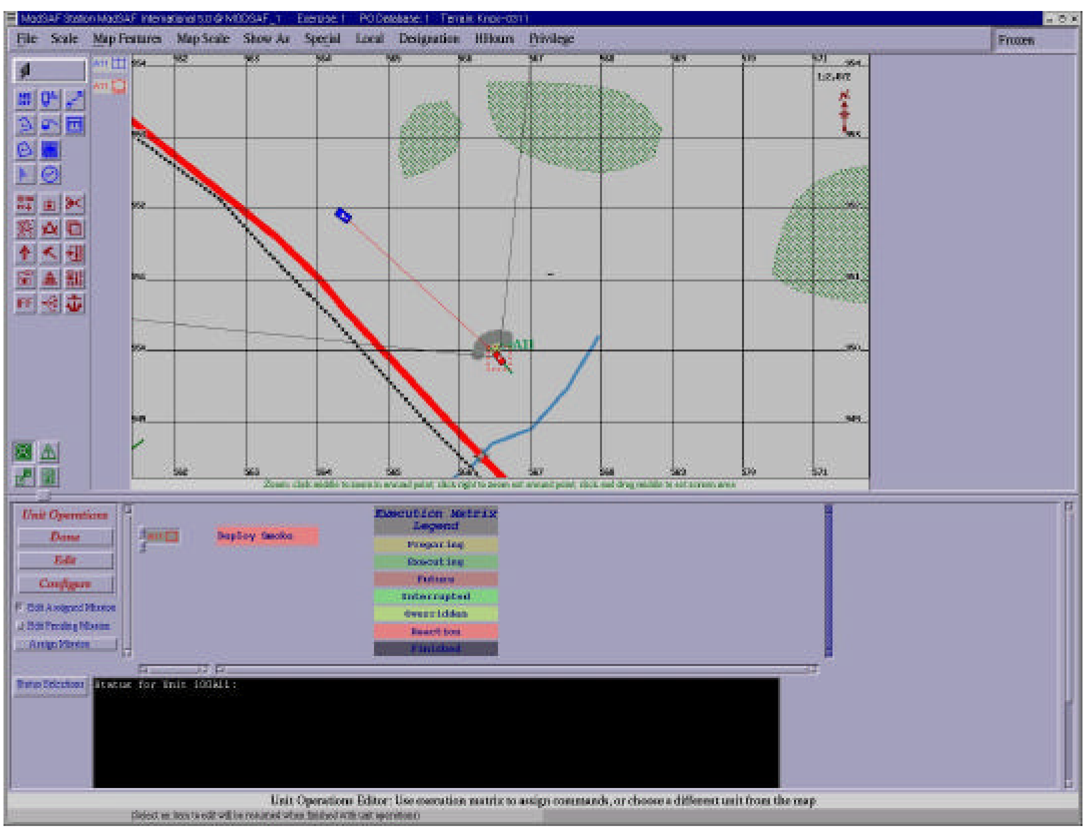

Figure 11: Reaction of a Red vehicle after being designated by a Blue vehicle; the Red vehicle deployed a salvo of smoke grenades.

Armoured vehicles always operate as part of a unit, be it a troop of four vehicles, a Company, a Battalion or a larger unit. It is suspected that off-axis detection by the LWR can impact on troop situational awareness. Provided that off-axis detection can be modelled with sufficient accuracy in ModSAF, its effect on troop situational awareness could be studied with simulation before attempting it in a field trial.

Plans for future DAS developments include a data link to share threat information between the vehicles of the same formation. More futuristic concepts include data links between the ISTAR network and the vehicles on the ground. Hence, DAS vehicles could send and receive threat information not only from the other vehicles that belong to the same unit (troop, company), but also from UAVs or other remote sensors. Once again, these are concepts that could be studied in a simulation environment, provided that the required models can be developed in ModSAF.

In addition to the technical aspects of DAS technology development, the operational use of DAS poses another set of problems. DAS is an emerging technology, and as such there is little, if any Doctrine and Techniques, Tactics and Procedures (TTP) developed to use it. This is another area where simulation could play an important role. Provided that the models have a sufficient level of fidelity, several possible Doctrines and TTPs can be studied in ModSAF to identify the most promising ones for testing in a field trial.

Development of the DAS model in ModSAF continues with the implementation of the sensors and countermeasures models for the DAS Phase II shown in Figure 12. Specifically, models for a Missile Approach Warning Receiver (MAWS), a Laser Beam Rider (LBR) detector, a wind sensor, the jamming countermeasure and the laser dazzling countermeasure, are presently under development.

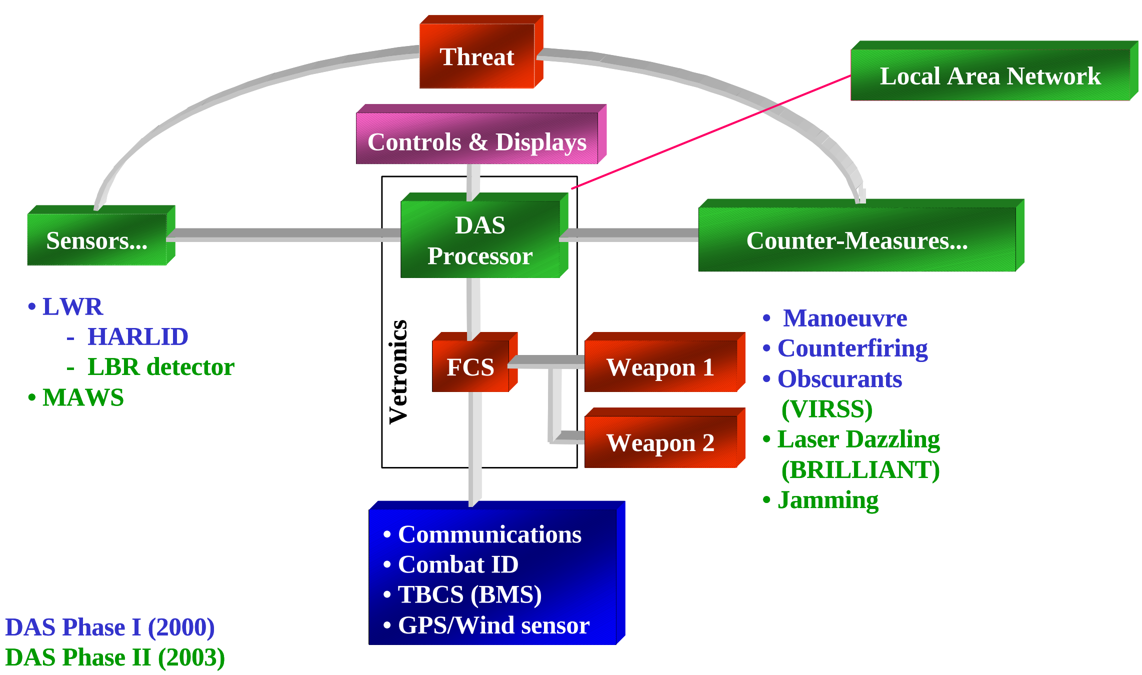

Figure 12: DAS Phase II development plan (in green).

## 7. **Closing Remarks**

Data collected during the tactical part of the 1999 DAS trial was used to demonstrate that DAS equipment can operate under field conditions and that it increases the survivability of Light Armoured Vehicles. It also showed the advantage of partial automation of countermeasure deployments to obtain shorter reaction times.

Despite a major planning effort, constraints and contingencies affected the trial plan and rendered an already tight schedule even tighter. Available tactical trial data limits the statistical analysis because of the high number of variables and the small number of engagements for each combination of trial variables. However, both the technical and the tactical trials provided real world data that is of great Operational Research value for the M&S program that supports DAS technology development, even though the 1999 DAS field trial was not intended as an OR trial. First of all, the data collected during the technical trial can provide the physical parameters for the DAS equipment models. The success rates and reaction times for the countermeasures calculated from tactical trial data can provide a baseline for the simulations. Furthermore, thanks to trial data analysis, there is now a better understanding of the factors that affect countermeasure success rates and reaction times.

In conclusion, M&S could help developing DAS technology by providing a controlled environment to conduct a high number of iterations at low cost. This fact should help sorting out some problems well before an actual field trial takes place and provide better insights into planning the next field trial.

## 8. **References**


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