

AN UPDATE FROM THE COMBAT TRAINING CENTRE

THE LAV III/LEOPARD C2 MOBILE AUTOMATED INSTRUMENTATION SUITE FIELD TRIAL

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In combat development studies it was concluded that the most critical capability requirement for the high-intensity battlefield will be for a mechanized infantry organization to form the basis of the all arms battle group.¹ (1985)

The principal fighting force of the U/A (units of action) brigade will be the FCS combined arms combat battalion.² (2002)

BACKGROUND

A key element in the successful fielding of the light armoured vehicle (LAV) III and the Leopard C2 is the development of validated and relevant company and combat team tactics, techniques and procedures (TTPs). On 16 November 2001, the

LAV III/Leopard C2 mobile automated instrumentation suite (MAIS) field trial concluded in Gagetown, the result of approximately four years of staff effort, testing, simulation and analysis. The fielding of the LAV III and Leopard C2 by the Canadian Army will have a revolutionary effect on Canadian combined arms tactics. Accordingly, the various elements of the LAV III's command and control, tactical employment and maintenance have been considered and refined through the combat development process. These efforts will contribute to improving the army's war-fighting capability, and will put the best tools to effectively fight the respective combat systems in the hands of soldiers and their leaders. While it is understood that combat development is a continual process, it was considered that the

increase in combat effectiveness must be scientifically measured and demonstrated to the field force as the vehicles' fielding nears completion.

To accomplish this, arrangements were made for an international trial with the United States (US) army. The weapons effects simulation (WES) used during the field trial was provided by Operational Test Command (OTC) in accordance with a project arrangement and the Canada-United States test and evaluation program (CANUSTEP). MAIS proved to be an extremely capable, soldier-friendly system providing an excellent WES platform. In particular, MAIS provided a real-time casualty assessment (RTCA) capability that was fundamental to the conduct of the trial. MAIS captured and displayed in real time all direct and indirect fire engagements between forces and simulated area weapon effects. This was coupled with an extremely effective after action review facility and capability. More importantly it provided the necessary data to provide scientific and analytical validity to the TTP development process. An illustration of the MAIS RTCA architecture is provided at Figure 1.

Following the direction of the Commander Land Force Doctrine and Training System (LFDTs), a Field Trial was conducted in three phases to develop validated company group and combat team TTPs:



MAIS Real-Time Casualty Assessment

Phase 1—Constructive trial. A constructive trial utilizing the Modular Semi-Automated Forces (ModSAF) constructive simulation system was conducted to obtain verifiable data through the use of simulation. This was intended to support previous work that had been based solely on professional judgment;

Phase 2—Elementary field trial. An uninstrumented field trial was conducted to develop initial TTPs; and

Phase 3—Instrumented field trial. An instrumented field trial utilizing MAIS was conducted to provide instrumented and analyzed data to validate the draft TTPs.

The plan of tests developed for the MAIS trial was designed to investigate and answer three master questions. Does the LAV III augment the ability of the company, company group or combat team to:

- conduct operations in reduced visibility conditions?
- destroy the enemy?
- conduct combat operations?

Five scenarios were developed to serve as a framework for the collection of data for subsequent detailed analysis. The main variables within the trial plan of tests were operations during daytime, nighttime, and nighttime with illumination. The only dismounted activities permitted in all of the scenarios were those of the ERYX teams, RPG teams and dismounted reconnaissance. The five scenarios were:

Scenario one—LAV III company advance to contact;

Scenario two—LAV III company meeting engagement;

Scenario three—LAV III company advance to contact and assault;

Scenario four—mixed LAV III/Leopard C2 force in a blocking position;

Scenario five—mixed LAV III/Leopard C2 force in a meeting engagement.

AIM

The aim of this update is to stimulate discussion on the validity of the MAIS field trial with regards to its impact on the evolution of company and combat team tactical doctrine and army experimentation.

*...the LAV will have greatly increased capabilities over any previous Canadian infantry vehicle. These increased capabilities will not have a major impact on Canadian doctrine, however, as that doctrine was written based upon the Infantry being equipped with a similar vehicle—APC 86. If anything, the introduction of the LAV APC will allow the Corps to achieve the doctrine*³

If you accept the logic provided in the Infantry Journal, why was it necessary to conduct the MAIS trial to provide answers to questions we already knew? On the surface, it is hard to rationalize the expenditure of funds and the commitment of significant personnel and equipment for seemingly insignificant gains. However, if you scratch away at that surface, and view the MAIS trial not as an isolated activity, but rather as one step in the process towards the development and refinement of the tactical and doctrinal application of the LAV III and Leopard C2, it gains in relevance and significance. The MAIS trial must also be viewed with regards to the collective whole. Specifically, lessons learned from the MAIS trial must be placed in context of what we already know from previous trials, experimentation, and the field force; what we would like to know (future study and effort); and where we would like to apply this information (doctrinal development, field force training applications, etc.).

LESSONS LEARNT—RE-LEARNT?

If you do not answer the questions, what is the point? One of the challenges during the development

of the trial was establishing questions that could, in fact, be categorically answered through the use of dedicated instrumentation. The trial report explains this evolution and process in great detail. The three master questions were answered definitively. For the purposes of this article, the major findings were as follows:

- **Conduct operations in reduced visibility conditions.** The LAV III fights at night and during reduced visibility conditions effectively. Consideration must, however, be given to crew fatigue and the need for dedicated night training cycles. There was a demonstrated and quantifiable advantage over the BMP-2. The LAV III contributes to and enhances combat team situational awareness in all weather and light conditions. However, the LAV III target acquisition systems were degraded by certain weather conditions. These results were found to be comparable to the surveillance and target acquisition (STA) trial. Illumination proved to be a greater asset to the red force than that of the blue. The relevance and significance of illumination

The fielding of the LAV III and Leopard C2 will have a revolutionary effect on combined arms tactics.

to the final assault was not observed. The Leopard C2 performed equally as well at night as during the day, but was found to be inferior to the LAV III in navigational aids (TACNAV).

- **Destroy the enemy.** The LAV III was not compared to the M113, as previous trials such as IRON RENAISSANCE have demonstrated the obvious—that the LAV III was much better. During company level testing the LAV III effectively contributed to the destruction of the enemy (the consequence of blue tactical error

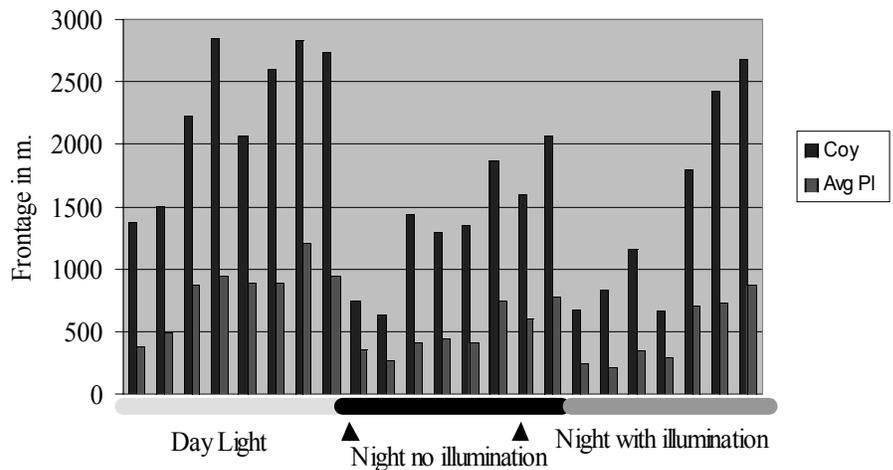
was also demonstrated). During the combat team level testing, there was a LAV/BMP loss exchange ratio (LER) of 1 to 7. This is partly attributable to the construct of the scenarios and the opportunity and limitations of BMP-2 at night. The LAV III demonstrated a clear, measurable and quantifiable advantage when engaging the BMP-2 at ranges between 800 and 2 000 metres.

- Conduct combat operations.** Coupled with the specifics of trial LERs, the LAV III contributed to the combined arms team by destroying BMPs, thereby freeing Leopards to destroy T72s. This capability has previously not existed. The trial also demonstrated that this is subject to risk assessment, as the LAVs were vulnerable to tank fire if exposed too soon, or retained in position too long. The demonstrated mobility, firepower and STA capabilities of the LAV III during the trial have created a force multiplier allowing commanders to take greater risk. The addition of the 25 mm cannon has significantly increased the firepower of the combat team and provided commanders greater tactical flexibility. This improvement concurrently provides the battle group commander the same increased capability. This is very much in line with the recent initiatives in the US Army's objective force design, particularly with regards to its analysis of "...situational awareness, ISTAR, development of the situation out-of-contact and precision manoeuvre leading to acting first and finishing decisively."⁴

The trial demonstrated some issues quite categorically, that as stand-alone bullets, are reinforced here and served as food for thought. The reader is free to make whatever deductions or conclusions from them as they wish:

- Artillery caused 40 % of all red and 37% of all blue casualties. Keep in mind that each side only had a battery of either 155 or

Company Frontages



Company and average platoon frontages

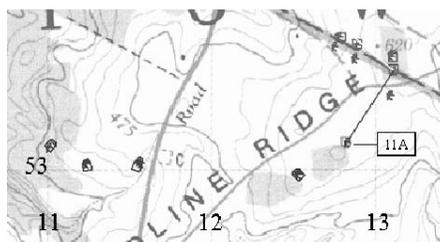
152 mm guns with a specific and limited number of rounds allowed per iteration and artillery was only played during the first three weeks of the trial (company level testing only).

- During company level testing, the LER when the company commander was killed was 1 (LAV) to 0.7 (BMP), whereas when he remained alive, the LER was 1 to 2.63.
- Crew commander and turret skills are extremely important in the development of section and platoon commanders as they demonstrated direct fire results proportionally greater than their numbers.
- Company frontage averaged 1 700 metres but expanded to 2 000–2 800 metres. While there are terrain implications involved, demonstrated success at dispersed distances increased the confidence level of crews,

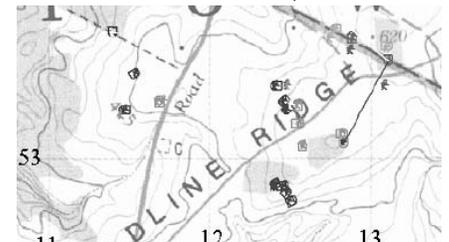
platoons and the company.

The trial reinforced and confirmed some common tactical principles. It demonstrated that it will not be easy to locate a determined enemy, and therefore, the necessity and relevance of reconnaissance at all levels. The standard danger areas such as crests, roads and obvious features remain obvious (both to us and the enemy) and that current, low-level drills (ie. crest drill) remain valid and relevant. Movement on roads, although presenting an attractive option for the LAVs mobility and speed, still comes with the associated risk. The TTPs that were developed and validated throughout the process were found to be sound and effective tools for commanders in the field.

Despite the advantages that the LAV III brings to the battlefield over the BMP-2, tactical acumen still remains fundamental to success. There were numerous occasions on the trial where friendly forces were



11A is killed by 23A at 1010hrs



1A is killed by 23A at 1049hrs

destroyed and/or ambushed by a well-placed, smart and aggressive enemy. On one particular occasion, a BMP-2 platoon navigated cross-country at night (while the LAV company remained road-bound) and destroyed the depth LAV platoon in less than 15 seconds. On several occasions, when the BMP-2 platoon was sited in reverse slope positions allowing for an 800 metre kill zone for their 30 mm cannon and flank shots for their AT-5, errors on behalf of the LAV company resulted in casualties that effectively neutralized the company. An example is illustrated below where within 39 minutes, five LAVs were destroyed within 800 metres of the enemy position

The trial also illustrated a number of training challenges that must be met to fully exploit the capabilities of both the LAV III and the Leopard C2. It was demonstrated that determining the location of the enemy posed the greatest challenge in “developing the contact” and the majority of friendly casualties were incurred during this process. This has implications with regards to the evaluation of crew/group cohesion



Soldiers from 2 RCR receiving training on a “MAISed” LAV III in September 2001

and the need for greater emphasis to be placed on target identification (thermal image training as an example). More emphasis should be placed during both simulation and live fire training on target engagements against realistic targets (turrets only, moving, different ranges, light conditions). The field trial easily demonstrated that more frequent TACNAV, global positioning system (GPS), Tactical Command, Control and Communication System (TCCCS) training is required as crews

undergo significant skill degradation over time. Finally, the benefits offered by the MAIS WES system and RTCA for realistic training were religiously embraced by the trial participants. The direct application to the Canadian Manoeuvre Training Centre (CMTC) is obvious.

Documented trial evolution/methodology/conduct/Canadian Manoeuvre Training Centre

The use of a graduated, instrumented trial for the development of TTPs is new for the Canadian army. As such, it must be emphasized that the use of instrumentation, and the field trial itself, was designed to support, not replace, the professional knowledge and judgment of the field force commanders by providing detailed data to support decisions incorporated within the TTPs. It must also be understood that evaluation and analysis will be an ongoing process involving structured, experimental evaluation and through detailed coordination and supporting efforts by many of the Land Staff directorates and the field force.

The LAV III field trial was a very positive demonstration of the use of quantitative data collection from this sort of instrumentation, supported by qualitative observations from participants. The operational research participation in the LAV III field trial consisted of three components: advice given to the trial personnel in the Combat Training Centre on trial design, provision of weapon system characteristics to the US Army OTC for insertion into MAIS, and assistance in the analysis of results of the trial. While MAIS provided the greatest amount of quantitative data from the trial, the analysis included a number of other sources, such as focus groups, video, still photography, questionnaires, data collector observations, etc.

The objective of the field trial was to further illuminate aspects of the tactical employment of the LAV III and Leopard C2. Previously, operational research personnel were involved in the development of LAV III tactics through the IRON RENAISSANCE war game series conducted in the Operational

Research Division in National Defence Headquarters (NDHQ), Ottawa in 1998 and Army Experiment 5 conducted in 2000 at LFDTS in Kingston. Experience with this LAV III experimentation, although conducted through modeling and simulation, was of considerable benefit during the field trial. The LAV III field trial has many parallels to experiments and research war games conducted in recent years by operational research personnel and military colleagues in Ottawa and Kingston. MAIS allows a trial to be carried out with real troops on real ground and to collect data to a fidelity equivalent to that done with a war game or simulation like Janus or ModSAF, e.g., the results of engagements during mock combat.

The MAIS field trial (and report) provided the following:

- A comparison of simulation systems (ModSAF, Janus and MAIS) used throughout the various phases of the field trial.
- A comparison of the quantitative results produced through the use of constructive simulation (ModSAF and Janus) and live simulation (MAIS).
- Demonstrated and documented trial methodology throughout the complete breadth of its evolution, development, conduct and post conduct activities.
- A demonstration of the value and importance of dedicated and professional analytical teams to support all aspects described above.
- Significant inroads into American experimental and operational testing to include an excellent working relationship with US Army OTC.

DIRECTION FOR FUTURE EXPERIMENTAL ENDEAVOURS

It is envisioned that as one of its roles, CMTC should be capable of supporting force development experimentation.⁵ As such, the MAIS trial has provided invaluable information on the structural, organizational and operational conduct of trials of this magnitude

that should be some assistance to the developers of CMTC. This includes those tools utilized by the MAIS trial and provided by OTC with respect to the MAIS and those developed by the trial organization themselves, such as low-level standard operating procedures (SOPs) for data collectors, control centre (or tactical operations centre—TOC operators), information flow charts for the processing of data, functional layout diagrams and numerous other aids. All are included in the trial report.

TIP OF THE ICEBERG— DEMONSTRATED FUTURE EFFORT

The completion of the field trial has not provided the army with all the answers. Given limitations to the trial, further study is needed to expand our base of knowledge. Specifically, further research and analysis should occur on the following:

- **Command and control.** Further research is required on the issues surrounding command and control. Specifically, the impact of the introduction of situational awareness systems (SAS) and the continuing digitization of the field force must be analyzed. The volume of radio traffic has increased substantially due to greater dispersion and the more aggressive application of the LAV III as a firing platform. The issue of command and control between mounted and dismounted elements of the combat team could not be studied due to trial limitations. Analysis of the trial radio tapes may provide further information to this matter. This is also ongoing within the purview of the Army Digitization Office Kingston (ADOK).
- **Actions on the Objective.** Given limitations imposed on the trial, the study of the assault could not be conducted. With the establishment of the Canadian Manoeuvre Training Centre and WES, experimentation should be conducted to provide data on the dismounted assault. While the field trial demonstrated that enemy vehicles on the objective could effectively be destroyed or neutralized by direct fire, there was no ability to determine the

impact of a “dug-in” enemy on the assaulting force. Without this information, it cannot be assumed that the enemy can be destroyed purely by fire.

- **Sustainment.** Further study is necessary to evaluate the sustainment capability of the LAV III company. Although the doctrinally based Operation CYCLOPS echelon is available as a model, current LAV III company echelons have developed in an ad hoc fashion as a result of not having the specialized vehicles for sustainment. Furthermore, ammunition consumption will be a major factor in LAV III sustainment. Further analysis through the use of ModSAF and further refinement and assessment of the MAIS data may provide a clearer picture.
- **LAV III with medium range anti-armour weapon (MRAAW) and long range anti-armour weapon (LRAAW).** LAV III currently has no capability to engage tanks. As was demonstrated on the field trial, LAV III is very vulnerable to enemy tanks and cannot participate in their destruction. Instead, the LAV III is limited to engaging BMPs. The addition of a MRAAW or LRAAW would provide a more potent capability to the company and combat team. It would allow the LAV III even greater flexibility to be employed on flank and security tasks. Further analysis through the use of ModSAF should demonstrate this.
- **LAV III with close reconnaissance.** The field trial demonstrated that significant



Friend or FOE?—LAV III Field Trial Night Iteration

effort was required to find and identify the enemy. It is recommended that the same plan of tests be conducted on ModSAF, with the provision of close reconnaissance.

- **US fatigue studies.** During the Field Trial, trial participants commented on the demands on crew members through the extended use of target acquisition systems at night. To maximize the capability of fighting in reduced visibility conditions, we will need an understanding of the effect of fatigue on crew members and steps that can be taken to mitigate these effects. The US trial has indicated that fatigue studies exist and are available from the US Army.
- **Research into information friend or foe (IFF) Systems.** Operations in reduced visibility conditions place greater demands on crews to correctly identify potential targets before engagement. The field trial demonstrated that fratricides will occur, particularly as the ability to identify thermal targets remains difficult. Although thermal imaging armoured fighting vehicles (AFV) recognition training is important, developments into the fielding of IFF for ground based forces are considered an important area for research and collaboration.
- **Comparative Analysis BMP-3.** The field trial demonstrated the effectiveness of LAV III against a BMP 2 equipped with a 30 mm cannon and rudimentary target acquisition systems. Future, comparative analysis should be conducted on ModSAF against a more sophisticated enemy. It is recommended that the plan of tests conducted on the field trial be conducted utilizing a BMP-3 with modern STA capabilities.

THE COMMUNICATION PLAN

The lessons learned from the MAIS Trial are being distributed in a wide range of venues. The trial report itself was presented to Commander LFDTS on 1 March 2002 and accepted. Concurrently, the combat team TTPs and the LAV

company tactics were approved. The following initiatives are underway to distribute the lessons learned from the MAIS field trial and associated efforts:

- **Trial report.** The trial report is a three-volume report produced in Adobe Acrobat format encompassing the following:
 - **Volume one—trial report.** This volume contains the executive summary, main body, and all the associated annexes providing the data, analysis and history of each iteration.
 - **Volume two—parts one and two.** This volume contains the trial history and trial conduct portions of the report. They include all the information relevant to the evolution of the trial and those tools and aids developed or utilized during the conduct of the trial.
 - **Volume three—video history.** This volume captures all the battle history iterations on MPeg and includes the informational trial video produced by OTC and associated images and MPegs of trial activities. The battle iteration MPegs are an extremely good tool for training, providing tactical images of all aspects of the trial.
- It is the intent that the complete trial report will be placed on the DIN by LFDTS in the near future.
- **Tactics manuals.** The tactics manuals (currently TTPs) have been finalized and are in the process of final editing and translation. It is expected that LFDTS will have them ready for distribution by the end of

September 2002.

- **Trial video.** To compliment the trial report, a trial video has been produced and is in the process of being distributed across Canada concurrent to the release of this article. This professionally produced video incorporates the main lessons learned from the trial. It highlights lessons learned in the categories of sensors, firepower, movement, communications, battlefield survival and tactical lessons. Screenings will be provided to all major army bases and formations.
- **Army Lessons Learned Centre (ALLC).** The ALLC has been monitoring the outcomes of the trial and participated in the final series of presentations to Commander LFDTS. They followed this up with a visit to CTC on 11 June 2002 with a view to further developing themes for subsequent editions of
- **Personnel, leadership organization, training, equipment, and doctrine (PLOTED) Imperatives.** It is the intent to incorporate the lessons learned and further refine the issues that were brought forth from the trial through this process. This includes briefings to Commander LFDTS and subsequently to the Combat Development Board and Army Council on the myriad of issues related to the employment of the LAV III and Leopard C2.

CONCLUSION

The integration of the LAV III and Leopard C2 into the army's tactical inventory has evolved in a timely, progressive and efficient manner. Concurrently, the various

elements of their command and control, tactical application and maintenance have consistently been refined through the combat development process. All these efforts have been driven to improving the army's war-fighting capability. The end-state of these initiatives has always been to put in the hands of soldiers and their leaders, the best tools to effectively fight the respective vehicles. While it is understood that combat development is a continual process of study, experimentation, evaluation and re-evaluation, the importance of providing concrete and visible evidence of this to the field force cannot be understated. The LAV III/Leopard C2 MAIS field trial has

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demonstrated to the army that the TTPs for the LAV III company and the LAV III/Leopard C2 combat team are effective and validated guidance for the field force. All of this has been realistically tempered by the human factor, as demonstrated during the MAIS field trial. Soldiers and commanders have accepted and met the challenges provided by the use of a real-time casualty assessment tool.



ENDNOTES

1. LCol I.D. Barnes and Maj N.B. Jeffries, "The Mechanized Battlefield: A Canadian View," *The Mechanized Battlefield: A Tactical Analysis*, Willowdale: Pergamon Press, 1985, p. 131.
2. Maj (Retired) George A. Durham, LCol (Retired) Frank T. Myers II and LCol (Retired) Charles L. Hernandez, "The FCS-Based Force in Future Battle," *Field Artillery* (March-April 2002), pp. 10-13.
3. http://ctc.gagetown.mil.ca/infantry/infjrn/vol32/apc_e.htm, "LAV

- APC Doctrine," *The Infantry Journal*, (Volume 32—Spring 1988), p. 9.
4. Col M. Ward, Commander CTC, Memo 4500-1 (Comd) 22 May 2002, Future Battle.
5. LCol D.P. Casarsa, Director Army Training 4, Memo 3136-2058 (DAT 4) 28 May 2001, Canadian Manoeuvre Centre Concept of Operations—Revised.