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Briefing +
Paper

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(AR 530-1, Operations Security)

I am aware that there is foreign intelligence interest in open source publications. I have sufficient technical expertise in the subject matter of this paper to make a determination that the net benefit of this public release outweighs any potential damage.

Reviewer: Brian Novak (Name) GS-13 (Grade) Intelligent Systems Team Leader (Title)

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Description of Information Reviewed:

Title: Crew integration and Automoation Technologies

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Publication/Presentation/Release Date: June 10 2003

Purpose of Release: Pub/Pres at the 3rd Annual Intelligent Vehicle Systems Symposium

An abstract, summary, or copy of the information reviewed is available for review.

Reviewer's Determination (check one)

[✓ 1.] Unclassified Unlimited.

2. Unclassified Limited, Dissemination Restrictions IAW ____________

3. Classified. Cannot be released, and requires classification and control at the level of ____________

Security Office (AMSTA-CM-XS):

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STA 7114-E
Sep 1999

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# Crew integration and Automation Technologies

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## ABSTRACT

The U.S. Army's Tank-automotive and Armaments Command (TACOM) Research Development and Engineering Center (TARDEC) Vetronics Technology Area is responsible for technology applications that support reduced crew operations in ground combat vehicles. The current program meeting this challenge is the *manned* Crew integration and Automation Test bed (CAT) Advanced technology demonstration (ATD). The CAT is the culmination of past technology efforts that include the Vetronics Technology Test bed (i.e., the intra vehicle electronics suite science and technology objective (STO)), future scout virtual prototype ACT II effort, and Crewmen's Associate ATD.

## INTRODUCTION

The goal of the CAT program is to demonstrate a multi-mission capable common crew station that supports a two-crew concept. Its key technology focus areas are cognitive decision aids, an improved Soldier Machine Interface (SMI) including an indirect vision driving system and driving aids, an advanced electronic architecture design and network topology, and embedded simulation. These capabilities demonstrated by the CAT ATD will prove technology readiness leading to possible design transition and the integration of hardware and software components into the Army's Future Combat Systems (FCS) variants.

The Stryker vehicle is the army's mobility platform supporting the Interim Force and is critical to bridge the gap between the Legacy Force and the Objective Force. This new vehicle is the first major combat system purchased by the Army in 14 years. The last major combat system the Army bought was the Bradley infantry-fighting vehicle. The Styker platform provides the Vetronics Technology Integration (VTI) team with a FCS like chassis to integrate and prove out advanced component technologies for transition into FCS.

TARDEC's VETRONICS Technology Area is also responsible for a second ATD program known as the *unmanned* Robotic Follower (RF). Collectively, the CAT and RF ATDs are referred to as the VTI program. The goal of RF ATD is to demonstrate a near term low risk solution to achieving an unmanned capability for the Army's FCS program. Both ATDs are supported by a single integration contractor, use the Stryker Infantry Carrier Variant (ICV) vehicle as a test bed platform and share many common components and capabilities. Another benefit to managing both ATD efforts out of the same office is that each program supports the other. The manned CAT vehicle functions as the lead vehicle during RF testing. The RF vehicle functions as an unmanned asset during CAT workload tests.

This paper focuses on the CAT ATD and the experiments performed to demonstrate the advanced warfighter interfaces (AWI), automation, and integration technologies required by future combat vehicles. The CAT ATD is a multi-year joint effort between TARDEC, its lead system integrator - General Dynamics Land/Robotic Systems, and a number of other industry partners, all of who have contributed significantly to the success of the first set of experiments. Several key technologies and capabilities incorporated into the CAT ATD include:

- Cognitive decision aids
- Drive-by-wire controls
- Day and night operation
- Indirect vision as the primary means of driving
- Multi-modal interfaces
- Speech recognition
- Multi-function displays with touch screens
- Multi-function yoke
- Keyboard with trackball
- Embedded simulation as an enabling technology for embedded training and mission rehearsal

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- Three-dimensional (3D) audio system

## TECHNICAL APPROACH

During the beginning of fiscal year (FY) 2002, all ATD managers were asked to look at how their program could support the FCS program by demonstrating technologies with near term solutions. For the CAT ATD, this meant a 13-month schedule to go from concept to prototype. To effectively meet technical program goals, engineers identified relevant technologies, long-lead items, drew upon past lessons learned and formed an integrated products team (IPT).

As another means to meet schedule with no cost increase, the CAT ATD leveraged component technology and architectures developed by the Army Research Lab (ARL) Demo III program. A key leveraged component technology for both the CAT and RF ATD is the autonomous mobility (AM) sensor suite.

In order to accurately define system capabilities and develop system specifications, one must first understand the problem domain. To accomplish this task, IPT membership included representatives from the Unit of Action Maneuver Battle Lab (UAMBL) Experimentation and Analysis Directorate (EAD) at Fort Knox. The role of EAD was to help in the development of militarily significant scenarios and vignettes representative of what the Army's Objective Force expected to encounter. EAD provided soldiers whose Military Occupational Specialty (MOS) best matched the programs needs. These soldiers served as crewmember test subjects during the programs test period, which lasted over 2 months (6 January to 28 Mar 2003).

With the operational needs identified, development engineers began defining system requirements for both software and hardware. The IPT, including government, contractor and EAD members, worked to define an advanced multi-mission AWI supporting the fight (19K), scout (19D), and carrier (11M) MOS as well as the command and control of unmanned assets. Test engineers were then able to develop the operational and engineering evaluation test plans.

The CAT ATD system [1] was matured through an iterative approach as follows:

- Task analysis of the three MOSs.
- 
- A VTT IMPRINT workload model developed by the Human Research and Engineering Development (HRED) Center out of the ARL located at Aberdeen Proving Grounds (APG) served as the baseline model.
- A human machine interfaces (HMI) IPT was formed to design the human computer and crewstation design.
- Micro Analysis & Design (MAAD) revised the baseline IMPRINT model to represent the new CAT HMI/crewstation design. This will allow for future workload and human performance modeling and analysis.
- Development of advanced Vetronics technology components for ground combat vehicles.
- Integration into Stryker vehicle and demonstrate Functionality.
- Conducting field tests.
- Establishing baseline results for comparison against subsequent system developments.

## TECHNOLOGY DEVELOPMENT

The Crew Station designs have evolved through a number of previously mentioned technology demonstration efforts. Key enabling technologies integrated in the vehicle include AWI, embedded simulation, and advanced systems architecture.

Implemented decision aids and automation include driving (lane tracking, GPS waypoint following, and obstacle avoidance) and mission planning.

The AWI includes indirect vision driving, drive-by-wire technology, robotic mission planning and control, multi-modal interfaces, speech recognition, 3D audio, a Crewman's Associate multi-functional display concept, and panoramic displays (multiple flat panels). The AWI also includes a simulated virtual world model supporting virtual indirect vision driving, a simulated target acquisition sensor suite with automatic target recognition (ATR) system, and simulated main gun and coax-machine gun. All simulated components are accomplished via the on-board embedded simulation system (ESS).

On-the-move ESS includes Battlefield Visualization, Terrain Registration, Virtual Sensor Coverage, and Virtual Lethality Coverage. A goal of the ESS is the mixing of live and virtual images. This is also the program's most difficult challenge and the highest risk element.

The advanced systems architecture is a combination of work resulting from the VTT based on the weapon systems technical architecture working group (WSTAWG) and the ARL eXperimental Unmanned Vehicle (XUV) program. (Note: The XUV is the product of the Demo III program mentioned earlier.)

## TECHNOLOGY INTEGRATION

Our integration approach was to procure the most promising commercial of the shelf (COTS) hardware technology and reliably integrate and package components into the two crew stations. Prior to Stryker vehicle availability, these two *common* crew stations functioned as system integration lab (SIL) resources for early hardware and software development, integration, and test.

Later we integrated the same CAT crew stations in the Stryker vehicle platform in preparation for the field tests. The goal of the field tests was to prove out technology developments using a FCS class chassis to test against the CAT ATD's exit criteria. The original plan was to layout system components so the crew stations may be placed in either a side-by-side or front-to-back configuration. Figure 1 shows the crew stations in side-by-side configuration. Due to the accelerated schedule, we delayed testing the tandem configuration for our initial set of experiments.

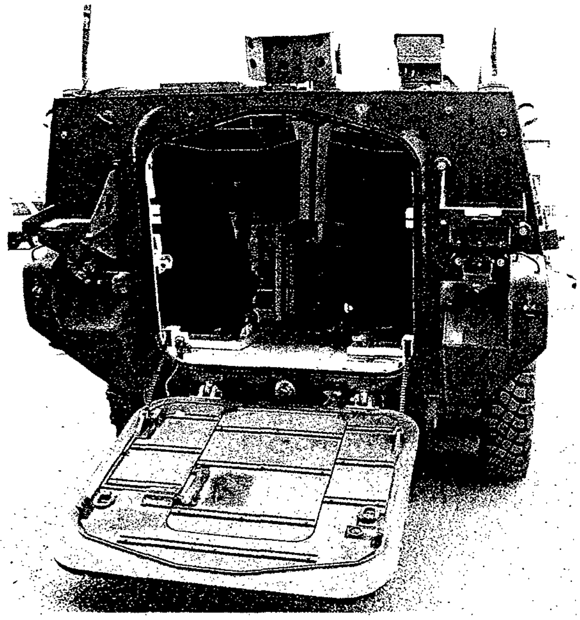

**Figure 1**

## TESTING OVERVIEW: ENGINEERING EVALUATIONS, AND OPERATIONAL TESTS

The purpose of these experiments is to show feasibility and readiness of near term technology solutions for both manned and unmanned systems within the FCS program. The two-month VTI CAT/RF test period conducted at Ft. Bliss, TX is separated into four phases: (1) Soldier Vehicle Training, (2) Shake Down Tests (3) Soldier Operational Testing, and (4) Engineering Evaluation Testing (EET).

During phase one, soldier's received on-board vehicle training in February 2003. Active duty tankers and scouts from UAMBL based in Ft. Knox were trained in the actual operation of the CAT and RF platforms, crewstation, and robot control in preparation for the soldier operational testing phase.

In phase two, the "Shake Down" tests were conducted in the field at Ft. Bliss, Texas. The goals were to exercise the system in the field to make the final system calibration and to resolve any other issues critical to successfully completing field tests. Engineers from the Government, General Dynamics and its industry partners supported this effort.

In phase three, soldiers conducted several mission scenarios with the CAT, RF, and XUV in military relevant situations. Data from this operational experiment will allow us to determine workload requirements and the effects of automation technologies on the ability of the soldiers to conduct four main tasks: infantry carrier, fight, scout, and control of unmanned assets.

In phase four, EETs of the CAT and RF, the objective was to characterize the performance of the integration and application of crewstation and robotic technology in a ground mobile platform system. The goal EET phase was to verify the technical parameters of the relevant system and subsystem components as well as the overall systems performance. Measured, demonstrated, and analyzed values will be used to characterize and verify compliance to the system specification and applicable technical design documents. These values will also be used to calculate performance metrics relevant to evaluating the performance of the system and/or subsystem.

Four test subjects were used to capture sufficient crew performance and vehicle data for each of the tests. Specific tests included driving from multiple positions in the vehicle, multi-modal SMI evaluation for preparing/submitting a spot report, and evaluation of speech recognition system to send spot reports.

The objective of the driving tests was to demonstrate an equal or better ability to drive or navigate the CAT vehicle using alternate means. Driving from the original Stryker driver's compartment with the hatch open provided the driving performance baseline. Operators also drove the CAT vehicle with the hatch closed and from the crew station using the indirect vision system. The indirect vision system consisted of externally mounted day and night cameras covering a 120 degrees horizontal field of regard that mapped 1 to 1 to the crew station's three flat panel displays. The final driving test included the CAT autopilot capability. This test required the CAT vehicle to autonomously follow a pre-planned path using its autonomous mobility system.

The course layout for the driving tests consisted of three segments; 1) paved road, 2) secondary road, and 3) cross-country. The results from the driving tests were as follows:

- Open hatch driving was the best.
- Closed hatch driving was comparable to open hatch driving except when making turns. A possible cause for the slower operator reaction time maybe due to limited left and right periphery views as compared with the open hatch.
- Indirect vision driving on paved and secondary road driving was comparable with closed hatch operations, but cross-country proved a bit more difficult. Especially, when driving over the cross-country terrain.
- Autopilot driving performed comparably to manned drivers on improved and secondary roads. However, cross-country terrain and unimproved roads are still a challenge that the VTI program plans to address and improve.

The objective of the multi-modal SMI testing was to evaluate the use of various input mechanisms, which minimize the time to complete tactical reports and/or reduce crew workload. The multi-modal tests were accomplished by having a safety driver traverse a dynamic course over various terrain types. A crewstation operator was then required to enter data using soft buttons on a touch screen, keyboard track ball, thumb cursor on a yoke/handle and via the speech recognition system.

Tactical reporting was the fastest input device for the dynamic and stationary test conditions across all terrain types. Target icon placement while on cross-country terrain using the touch screen proved to be difficult. Part of preparing a spot report required placing the target at a specific location. To change the location of the icon the test subject had to drag it with his finger over the touch screen. It was very easy to loose finger contact with the flat panels while going over berms in the desert making it difficult. Users indicated that a better and more accurate solution would be to use soft button numeric control to input target coordinates.

The keyboard trackball was the fastest device for the stationary and paved Terrain for icon placement on the map. While using the trackball in the secondary terrain, one subject struggled to move the icon without dragging previously placed icons across the map. For completion of a SPOT report, scrolling the trackball cursor to the touch buttons often took too much time, especially if the buttons were on opposite sides of a display.

The thumb cursor and speech recognition modes of input showed great promise for entering data when precision was required or when the operator was under a great deal of dynamic motion. Tests results did not accurately reflect the technology potential due to some technical problems possibly brought on by an accelerated integration schedule. The user often had to repeat a command before the speech system recognized it. On a positive note, the system better-understood natural language commands over the deliberate articulation of words in a phrase.

## HUMAN FACTORS

The test subjects were experienced Stryker operators selected to assess and provide feedback related to high stress situations during the operational experiments. They were also asked to provide feedback on usability of technologies during both the Operational Experiment and the Engineering Evaluation Tests.

Army Research Lab's Human Research Engineering Directorate developed the workload questionnaires. Human Factors Engineers from General Dynamics, and Micro Analysis and Design developed both the usability questionnaires. The same engineers also setup the field tests, collected, assessed, and reported the feedback from the test subjects.

The purpose of the workload questionnaires is to gather subjective participant data to support workload analysis of the operational tasks. The soldier interviews will be used along with simulated workload data (IMPRINT), time-stamped operational data from the crew stations in the SIL, and time-stamped video tapes of the operators to determine the areas of high workload, and the extent of the workload in those areas. These questionnaires are only focussed on workload, and not on usability of the SMI or ergonomics, except to the extent that it affects the operator workload. The list of the workload questionnaires follows [2]:

- Participant Information
- Pre-Exposure Physiological Status Information
- Baseline Subjective Stress Scale
- Motion Sickness Susceptibility
- NASA Task Load Index Workload Rating
- Scenario Review Questionnaire
- Estimating Workload Attention Allocation Questionnaire
- Situation Awareness Rating Questionnaire
- Ergonomic Factor Questionnaire
- Subjective Stress Scale
- Estimating Motion Sickness Questionnaire
- Goal Accomplishment Questionnaire

The purpose of these usability questionnaires is to understand the user, develop good user-oriented design principles, apply them to the future SMI design, and then to make sure the enhanced interface is usable through more field tests.

Subjective Questionnaires [3]:

Typical of any engineering testing program, the collection of data is both quantitative (vehicle/operational digital data, video, audio etc) and subjective. While video and audio also fall under the category of subjective evaluation, for the CAT tests a number of subjective questionnaires were developed for the test subjects to relate their views on their individual experiences during testing while utilizing the advanced technologies. The subjects were given questionnaire after completing each test to ensure all the user feedback is collected while the information is still current. The list of questionnaires is as follows:

- Speech Recognition Experience
- Tactical Vehicle Driving Experience
- Participant Information Questionnaire
- Speech Recognition Exit Evaluation
- Speech Recognition System Evaluation
- Input Device Exit Evaluation
- CAT Driving Evaluations
- CAT Driving Exit Evaluation
- Motion Sickness Susceptibility Questionnaire

At this time, both the quantitative and subjective data are under evaluation by our industry partners.

## TECHNOLOGY TRANSITION

The VTI program was successfully demonstrated to a high-level audience, which included high-ranking government and industry personnel. These demonstrations include 1) Unmanned Combat Demonstration (UCD) Maneuver and Live Fire Experiments, and 2) VTI Technology Demonstrations.

### 1) UCD MANEUVER AND LIVE FIRE EXPERIMENT

The CAT and RF ATDs were instrumental assets supporting the FCS Lead Systems Integrator (LSI) UCD maneuver and live-fire events. The UCD experiments consist of both virtual SIL and field experiments. The virtual SIL experiments were conducted at TARDEC 6-24 January 2003. UCD field experiments included operational maneuver and live-fire segments conducted at Ft. Bliss. The maneuver demonstrations were conducted during 17-21 February 2003. Live-fire preparation and demonstration was conducted 3-7 March 2003.

The first objective was to validate the virtual findings regarding the amount of human interaction that is required to operate and control the surrogate armed robotic vehicle (ARV) in a tactical environment. The second objective was to confirm that the level of technology maturity for an ARV exists in order to enter the System Development and Demonstration (SDD) phase of the system acquisition process. The third objective was validation of existing ARV modeling tools by having subject matter experts (SME) analyze data collected during the demonstration and compare the results to the existing models.

The UCD Live Fire began when the reconnaissance surveillance and target acquisition (RSTA) XUV identified an enemy target (i.e., M113) and sent a report back to the CAT or surrogate control vehicle (CV) operator. The CV operator then commanded the surrogate ARV-Assault (i.e., the RF ATD equipped with a Cougar Turret and Javelin missile system) vehicle to autonomously move to an engagement point and re-identify the target. Live video from surrogate ARV-A was sent back to the CV operator, who identified the target, initiated a fire sequence and remotely destroyed the enemy target with a javelin missile fired from the surrogate ARV-A.

At this time, both the quantitative and subjective data is under evaluation by our industry partners. Results may be obtained upon completion of analysis.

2) VTI TECHNOLOGY DEMONSTRATIONS

The CAT and RF ATDs combined with experimental unmanned vehicles (XUV) supported the VTI Technology demonstrations, which included improved road following, cross country autonomous mobility, unmanned system teleoperation, and dismounted and mounted follower. Again, key enabling technologies required to demonstrate these abilities are an indirect vision system, autonomous mobility sensor suite, a common crew station including command and control for remote unmanned assets, task automation, global positioning system, personal data assistant, common system architecture and multiple communication systems.

The demonstration incorporated three main segments and began with the RF autonomously following a route along an improved road. The next segment incorporated the control of the RF and XUV executed in parallel from the two CAT crew stations. The first CAT operator issued the RF a series of waypoints and commanded it to autonomously drive cross-country using its autonomous mobility sensor suite while the second CAT operator remotely controlled the XUV (i.e., teleoperated) cross-county. At the same time, but in a separate location, a dismounted operator walked a cross-country route and was autonomously followed by an XUV acting as a mule. The final segment completing the demonstration consisted of the manned CAT vehicle traveling cross-country acting as the lead vehicle with the *unmanned* RF performing a mounted follower capability.

## CONCLUSION

The two months of CAT ATD field tests provided the much-needed data (video, audio, digital) to facilitate maturation of the advanced crew technologies. Government and contractor engineers will meet to discuss lessons learned from the field test(s) and the resulting metrics.

Our current plans and present efforts will be to focus on further refining and completing key enabling technologies identified by CAT ATD. We will also continue research of new technologies and to plan for future testing in order to create a system that will enhance the capabilities of the soldiers in the field.

## REFERENCES

[1] Brian Novak, “Vetronics Technology Testbed”, 2001 Vehicle Technologies Symposium--Intelligent Systems for the Objective Force, May 2001.

[2] Micro Analysis and Design / General Dynamics, “VTI Maneuver Data Collection Plan”, December 2002.

[3] General Dynamics / Tank-Automotive RD&E Center , “VTI Engineering Evaluation Test Plan”, March 2003.

13860

# Crew integration and Automation Technologies Advance Technology Demonstrator
# (CAT ATD)

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**10 June 2003**

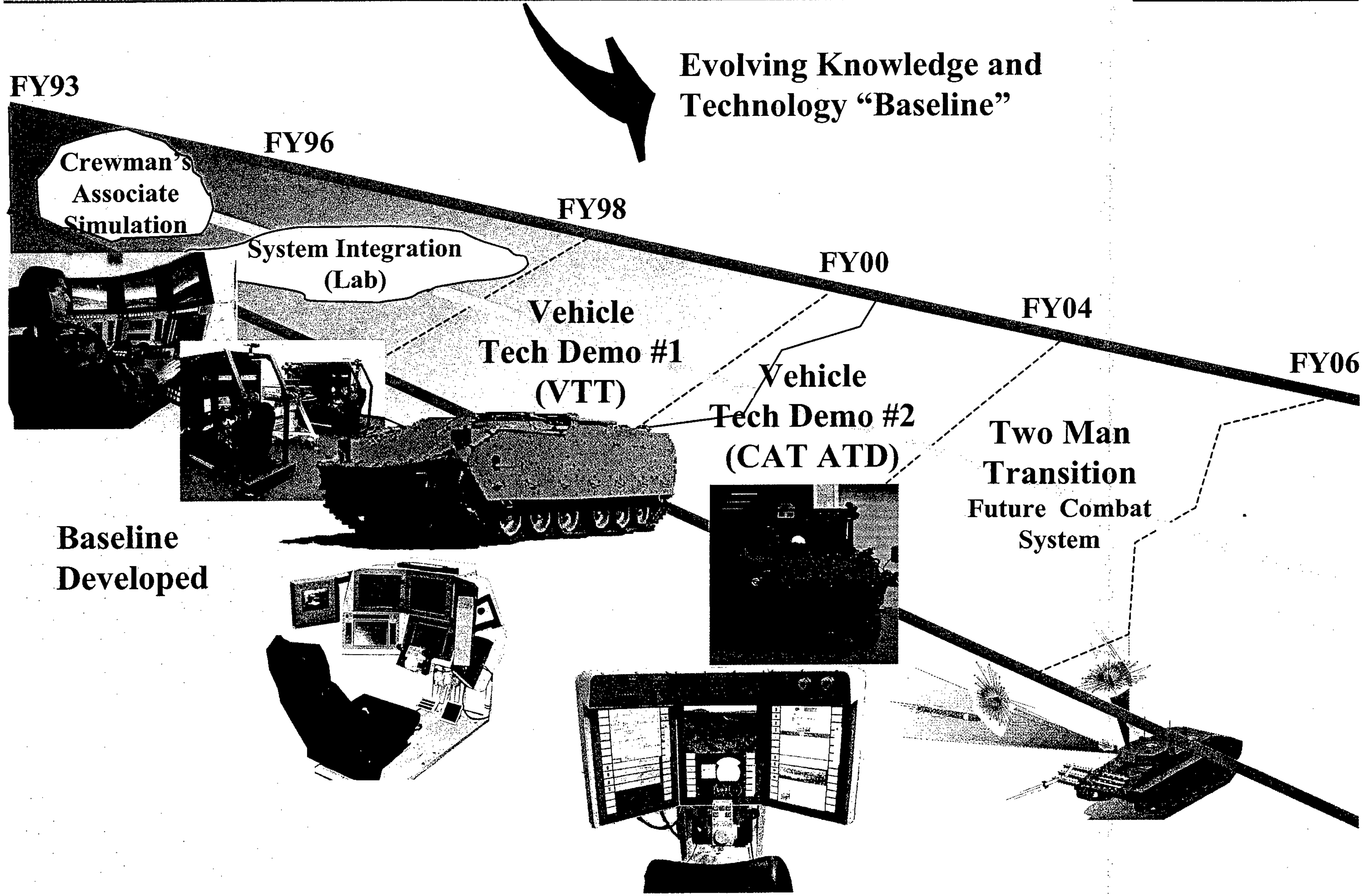
**UNCLASSIFIED**

# Vetronics Technology Area

## *Mission*

To conduct research in the Vetronics technology areas of crew stations, electronics architecture, embedded simulation, robotics, intelligent technology development, and telematics while leveraging advanced automotive technology to provide our soldiers with the world's most advanced ground vehicle systems and logistics support equipment.

# TARDEC Crew Reduction Efforts



Evolving Knowledge and
Technology “Baseline”

FY93

FY96

FY98

FY00

FY04

FY06

Crewman’s
Associate
Simulation

System Integration
(Lab)

Vehicle
Tech Demo #1
(VTT)

Vehicle
Tech Demo #2
(CAT ATD)

Two Man
Transition
Future Combat
System

Baseline
Developed

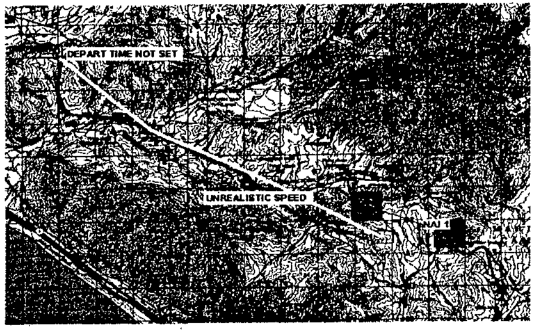
# Crew integration and Automation Technologie

## *Overview*

The purpose CAT ATD is to demonstrate advanced warfighter interfaces, automation, and integration technologies required by future combat vehicles.

The goal of this ATD is to demonstrate a multi-mission capable crew station that supports a two-crew concept. The crewstation was integrated into a Stryker Infantary Carrier Variant Platform, a C-130 transportable chassis, supporting the Army's objective force.

# CAT Technologies

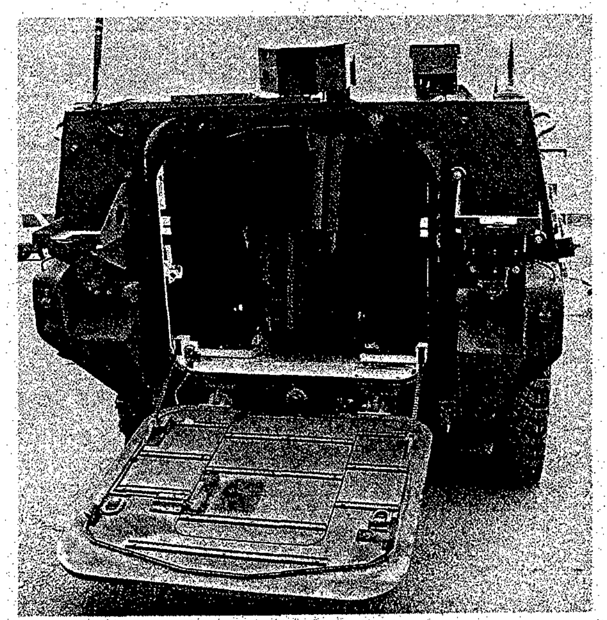


**Decision Aids**

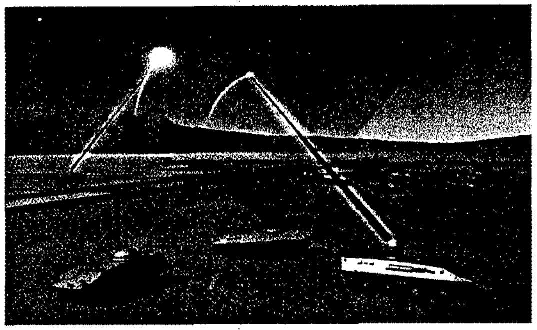
- Cognitive Aids
- Route Planning
- Auto Driving

**Soldier-Machine Interface**

- 3-D Audio
- Speech Recognition
- Indirect Vision Driving
- Control Multiple Unmanned Assets



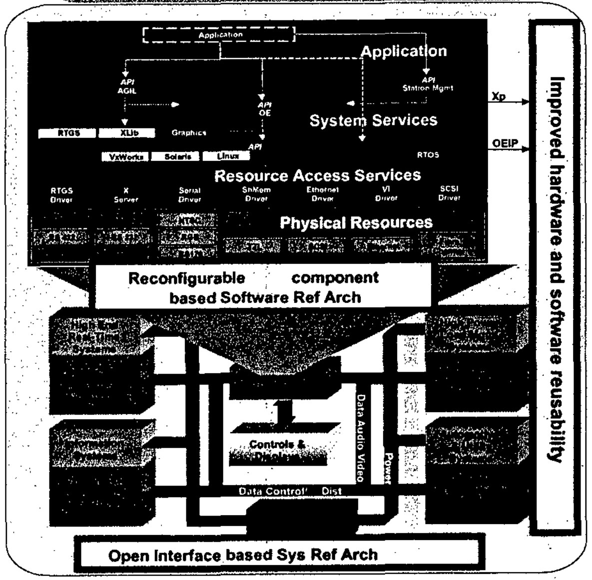
2003 Field Experiments, Ft. Bliss, TX



**Embedded Simulation**

- Mission Planning
- Mission Training
- Battlefield Visualization

**Electronics Architecture**



# Key Technologies

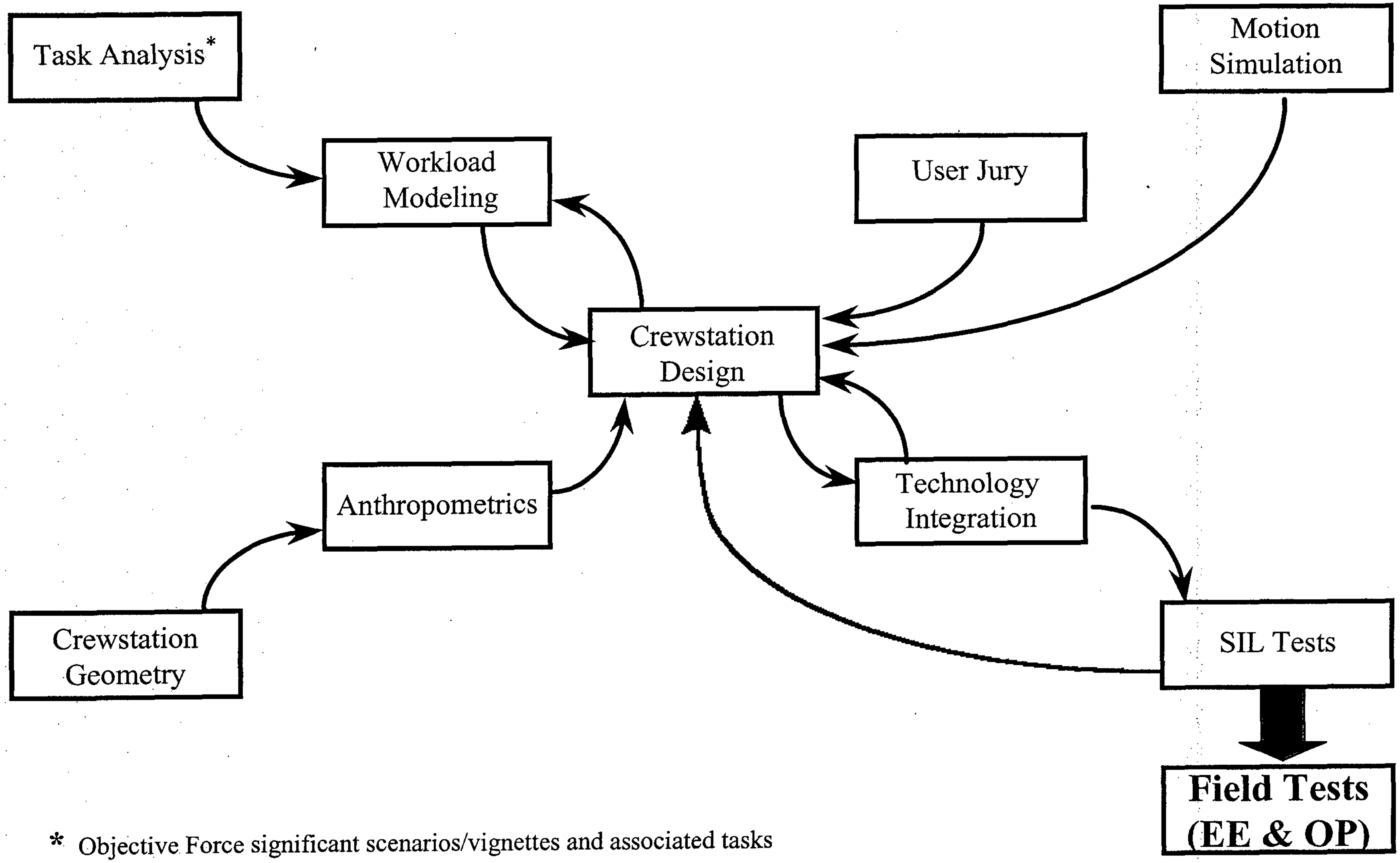
## *Demonstrated*

Key technologies and capabilities incorporated into the CAT ATD include:

- **Cognitive decision aids**
- Drive-by-wire controls
- Day and night operation
- Indirect vision as the primary means of driving
- Multi-modal interfaces
- Speech recognition
- Multi-function displays with touch screens
- Multi-function yoke
- Keyboard with trackball
- Embedded simulation as an enabling technology for embedded training and mission rehearsal
- **Three-dimensional (3D) audio system**

# Technical Approach

## *Individual Steps or Complete Process Performed in preparation of field experiments*



* Objective Force significant scenarios/vignettes and associated tasks

# VTI (CAT/RF ATD)

## *Experiments*

- The experiments demonstrated both technical performance capability, and tactical operational maneuvers at Ft. Bliss, TX.

- Multi-phased approach to experiments included;

  - Phase I. Soldier Vehicle Training
  - Phase II. Shake Down Tests
  - Phase III. Operational Tests
  - Phase IV. Engineering Evaluation Testing

- Four vehicles were used in demonstrations; one command (two man crew) Stryker, one robotic Stryker, and two robot XUV's.

# Experiments/Demonstrations

## *Phase I. Soldier Vehicle Training*

- Completed initial SIL Built with key capabilities (January 2003).

- The same crewstations built for SIL were integrated into the Stryker platform for training (Feb 2003 @ GD) without significant modifications.

- Crew trained on Stryker vehicle operation, Crewstation operation, and Robot Control in preparation for operational testing (Feb 2003 @ Ft. Bliss, TX).

# Experiments/Demonstrations

## *Phase II. Shake Down Tests*

- Exercised the system in the field to make the final system calibration and resolve any other issues critical to successfully completing field tests.

- Participants included RDECOM/TARDEC, General Dynamics and its industry partners.

# Experiments/Demonstrations

## *Phase III. Operational Tests*

- Conducted Objective Force significant scenarios/vignettes and associated tasks using Soldiers from Ft. Knox as test subjects.

- Determine effects of technologies on the ability of the soldiers to conduct four main tasks: Infantry Carrier, Fight, Scout, and Control of Unmanned Assets.

- Collected workload and usability Questionnaires.

# Experiments/Demonstrations

## *Phase IV. Engineering Evaluation Tests*

- Evaluated crewstation and robotic technology in the mobile Stryker Platform. Specific EETs included;

- Driving from a number of positions in the vehicle
  - Open/closed hatch
  - Indirect Vision Driving
  - Auto-Pilot

- Multi-Model SMI evaluation for preparing/submitting SPOT Report
  - Touch Panel
  - Keyboard/Trackball
  - Thumb Cursor
  - Speech Recognition

- Speech Recognition System Evaluation
  - System subject to maximum vehicle noise
  - Varying terrain
  - Set of commands used to include a variety of phrases

# Experiment Results

## *Human Factors*

HF Engineers collected the necessary data associated with crew performance during the Operational Experiment. The data collection is distinguishable for each vignette performed as well as the associated task.

MAAD, an industry partner, had modeled these tasks in Improved Performance Integration Tool (IMPRINT), a human performance modeling tool

The crew performance data, corresponding to various tasks, collected using a number of methods will be input in to the IMPRINT model.

Execution of the model will identify peak workload areas where crew can benefit from automation and/or decision aids and/or enhanced Soldier Machine Interfaces.

Results may be obtained upon completion of analysis.

# Experiment Results

## *Driving Tests*

Objective: Demonstrate an equal or better ability to drive or navigate the CAT vehicle using alternate means.

Results:

- Open hatch driving was the best.
- Closed hatch driving was comparable to open hatch driving except when making turns. A possible cause for the slower operator reaction time may be due to limited left and right periphery views as compared with the open hatch.
- Indirect vision driving on paved and secondary road driving was comparable with closed hatch operations, but cross-country proved a bit more difficult. Especially, when driving over the cross-country terrain.
- Autopilot driving performed comparably to manned drivers on improved and secondary roads. However, cross-country terrain and unimproved roads are still a challenge that the VTI program plans to address and improve.

# Experiment Results

## *Multi-Modal SMI Evaluations*

Objective: Evaluate the use of various input mechanisms, which minimize the time to complete tactical reports and/or reduce crew workload.

Results:

Tactical reporting using

- Touch buttons worked well on both dynamic and static terrain
- Keyboard/trackball was easy to use but required time to traverse across the screen.
- Speech Recognition required the user to speak naturally but it consistently required user to make at least two attempts.

Target icon placement on the map using

- Touch screen was difficult especially on dynamic terrain. Easy lose finger contact with the touch screen
- Keyboard/trackball worked well on all terrain but it was easy to accidentally drag previously placed icon on the screen.
- Speech Recognition results were similar to those for Tactical reporting above.

# Experiment Results

## *Speech Recognition System Evaluation*

Objective: Evaluate the accuracy of the Speech Recognition system for tactical reporting while the system is subject to maximum vehicle noise.

Results:

- Showed great promise for entering data when precision was required or when the operator was under a great deal of dynamic motion.
- Tests results did not accurately reflect the technology potential due to some technical problems possibly brought on by an accelerated integration schedule.
- The user often had to repeat a command before the speech system recognized it.

On a positive note, the system better-understood natural language commands over the deliberate articulation of words in a phrase.

# Technology Transition to FCS

- The Stryker, the combat vehicle of choice for the Army’s Interim Brigade Combat Teams (IBCTs) is critical to fill the gap between the legacy force and the FCS programs vision of fielding an “Objective Force”.

- The goal of FCS program is to mature and demonstrate new and improved combat vehicle and automotive technologies to enable transformation of the Army to the Objective Force.

- VTI (CAT/RF) assets were instrumental in support of FCS Lead System Integrator Unmanned Combat Demonstration(s). The VTI team integrated advanced component technologies in the Stryker platform and conducted proof-of-operations for FCS like tactics.

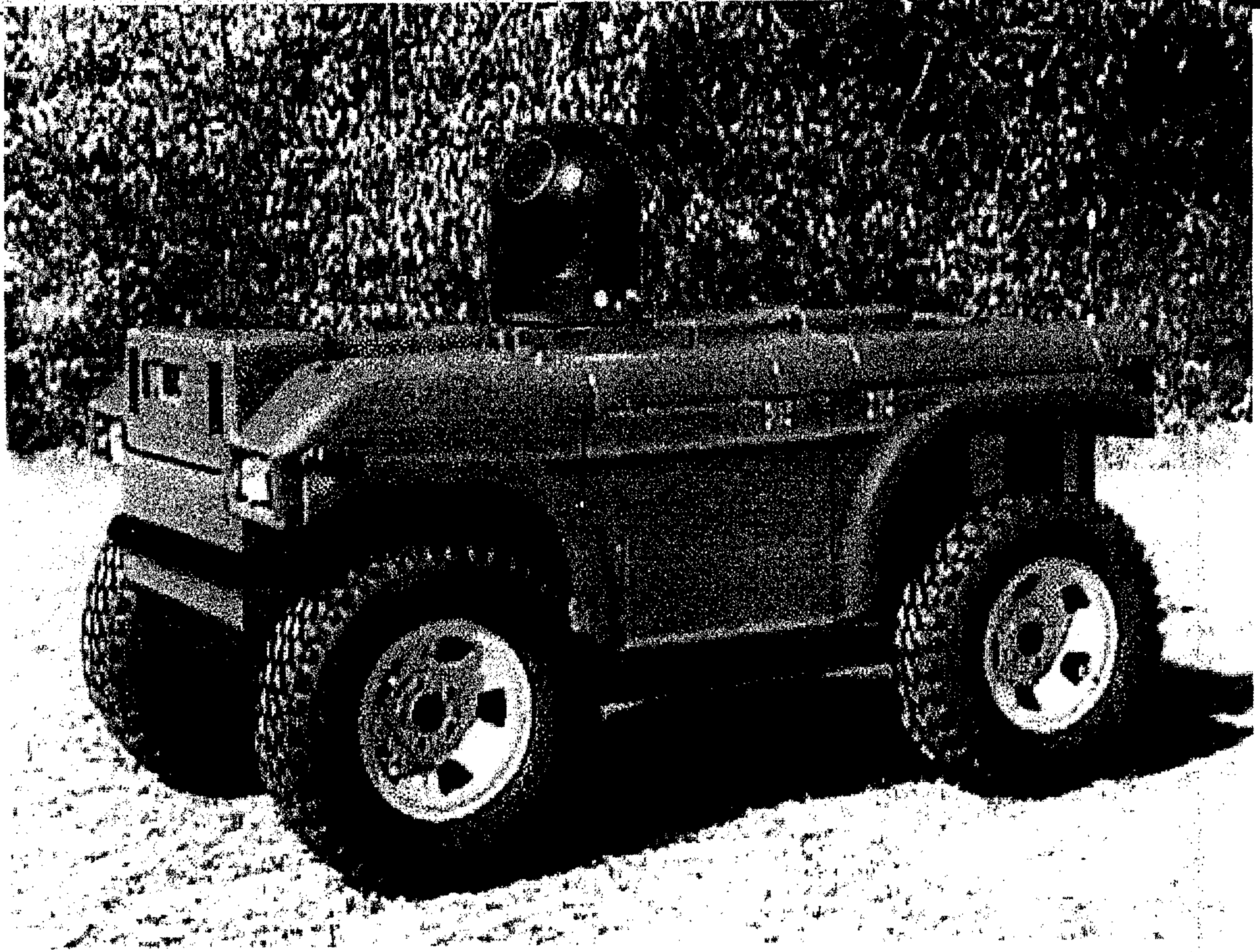
- Demonstrations included “*UCD Live-Fire Experiments*”, and “*VTI VIP Operational Demonstrations*”.

# Path Forward

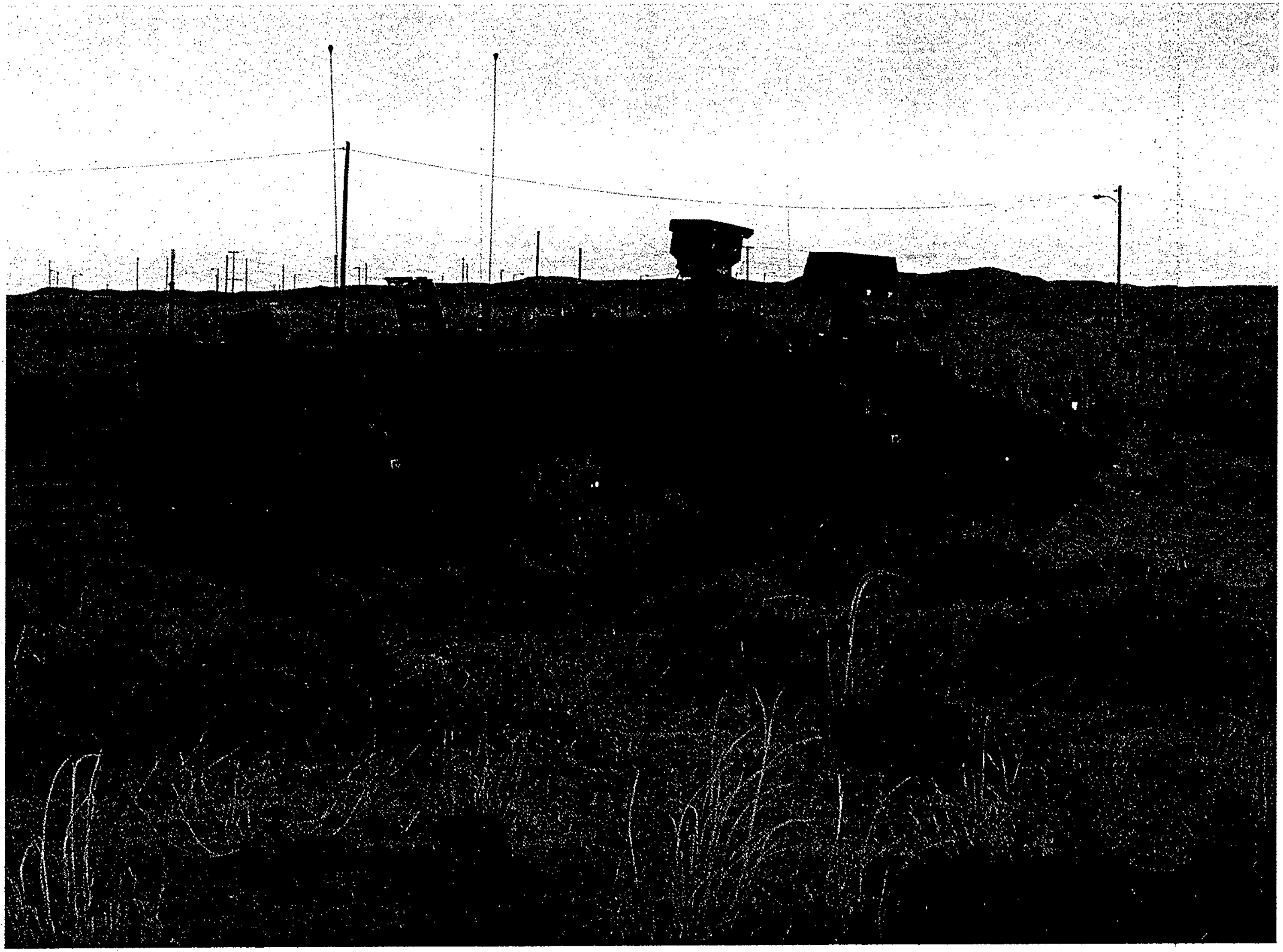
- Continue to develop/mature component technologies
- Review "Lessons Learned" and apply them to future effort(s)
- Transition VTI capabilities in the form of concepts, interfaces, and technology to PM FCS

# Platform Pics

# XUV Platform



# STRYKER
# CAT



# VTI VIP Day Video