LAW ENFORCEMENT ASSISTANCE ADMINISTRATION (LEAA)

POLICE TECHNICAL ASSISTANCE REPORT

SUBJECT	Survey of the Development and Evaluation of Firearms Training (DEFT) Program
REPORT NUMBER	75-064-012
FOR	Los Angeles, California, Police Department
	Population: 2,809,596 (1970)
	Police Strength (Sworn): 7,500
	Square Mile Area: 469
CONTRACTOR	Public Administration Service 1776 Massachusetts Avenue Northwest Washington, D.C. 20036
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CONTRACT NUMBER	J-LEAA-002-76
DATE	February 3, 1976

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1.0 INTRODUCTION

The MITRE Corporation, under contract to the Public Administration Service (PAS) Task Order Number 75-064/12, was requested to:

> "Conduct a reconnaissance survey of the Los Angeles Police Department's 'Development and Evaluation of Firearms Training (DEFT) Program' to determine (1) program status, (2) the technological feasibility of completing the program, (3) the level of effort required for program completion, and (4) a recommended schedule of work."

This report is in response to Section 1c of the above PAS task order which requested that MITRE present to PAS a concise letter report summarizing task findings and recommendations.

This report documents the results of a two-day, on-site visit (Task 1a of the above task order) by two MITRE representatives to the Development and Evaluation of Firearms Training (DEFT) Project at the Los Angeles Police Department (LAPD), and subsequent analysis of the engineering tasks that will be necessary to bring the DEFT to operational status.

In summary, it is concluded that although a number of engineering problems exist which presently preclude the DEFT simulator from being operationally satisfactory, it is technically feasible to overcome these problems and provide a properly functioning system (Task 1). Those tasks considered necessary to provide a fully functioning and integrated system are identified below (see Section 3.3 for details):

Task 1: Accomplish DEFT System Engineering and Integration
Task 2: Provide Additional Enactments
Task 3: Integrate Live-Firing Mini-Ranges Into Overall DEFT Concept

Task 4: Improve Efficiency of Trainee Processing
Task 5: Accomplish Branching Feasibility Study
Task 6: Accomplish DEFT Concept Evaluation Phase

Section 2.0 of this report describes the LAPD DEFT Project background. Also included in Section 2.0 is a brief description of the DEFT training concept.

Section 3.0 discusses: (1) the program's current status; (2) the technical feasibility of completing the project; (3) an outline of a specific program to complete the system; and (4) the estimated level of effort and a recommended schedule for program completion.

Conclusions and Recommendations to PAS and the Law Enforcement Assistance Administration (LEAA) are found at the end of the report in Section 4.0.

2.0 BACKGROUND

In September 1970, the Law Enforcement Assistance Administration (LEAA) awarded a $250,000 discretionary grant (71-DF-572) to the Los Angeles Police Department (LAPD) for the "Production and Evaluation of a Firearms Training Facility." The purpose of the grant was to design and construct a dedicated LAPD facility which would be used to train and evaluate officers' ability to properly utilize weapons under stressful situations. Underlining the theme of this firearms simulation project, was LEAA's feeling that the successful development of the DEFT system would be useful for the training of officers in other cities.

LAPD* issued an RFP to industry in July 1972 for the DEFT project. A $110,000 contract was subsequently issued to a private contractor in May 1973.

During the contract period (June 1973--June 1974), the DEFT contractor developed and installed the system in a specially constructed building located at the LAPD Training Academy. LAPD purchased the necessary hardware/software components of the DEFT system with LEAA grant funds.

The system failed to perform adequately at the end of the contract period and the contractor was allowed to spend further time at the facility to complete the system.

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* Technically, the City of Los Angeles awards contracts; but the actual grantee, LAPD, is used throughout this report.

Additional delays and failure of the contractor to make the system operate properly resulted in the contract termination by LAPD in the spring of 1975. In August, LAPD requested the LEAA Regional Office to provide technical assistance for the purpose of examining the firearms simulator to determine its "precise state of completion, feasibility of completion, and requirements for completion."* LEAA Headquarters requested PAS to provide the necessary technical assistance. PAS contracted with The MITRE Corporation in December 1975 to perform the tasks requested by the LAPD.

The basic DEFT training concept was based on placing a trainee in a special simulation room which contained a large projection screen and sound system. A specially prepared movie was to be projected onto the screen (with 360-degree quadraphonic sound) to simulate stressful scenarios that an officer might face in actual day-to-day police work. The scenes were to be designed to test the officers' judgment with respect to using his weapon under stressful conditions.

Video cameras were to be located in the room to record the officers' reaction to scenes projected on the screen.

Also, the film was to be video-taped for simultaneous split-screen playback with the officers' reactions during the scenario.

Special bullets were to be used in conjunction with a video camera and mini-computer system to display the bullet impact on the movie screen and to score whether or not a hit occurred on a suspect, fellow officer, or bystander.

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* LAPD letter to LEAA dated 21 August 1975.

Subsequent to the enactment, it was intended that a firearms instructor play back the video tape of the episode and discuss with the trainee his reactions during the scenario and to objectively critique the actions of the trainee with respect to the scenario and the scenario's relationship to actual situations that might have to be faced by the trainee.

The total system was designed to rapidly process trainees and was, at a future date, to be able to "branch" in real-time to other films, based upon the results of the trainees' actions and the target "hit" by the trainee.

The following paragraphs describe the manner in which the simulator was implemented by the DEFT contractor.

As shown in Figure 1, the trainee enters the lower level of the building and faces the projection screen. A special movie is shown on the screen, with 360° sound coverage through the quadraphonic sound system and the four (4) speakers. The film is projected from the upper level of the building from the center room of three rooms.

The output of Video Camera 1, located on one side of the projector, monitors the scene being projected on the screen and is recorded for subsequent split-screen viewing. Video Camera 2 is used to record the light emitted when a bullet hits the screen (a small incendiary charge is added to a .38-caliber wax bullet fired at approximately 300 feet-per-second by a primed case).

The video from Camera 2 is inputted to a minicomputer via an interface unit from which the x-y coordinates of the bullet impact

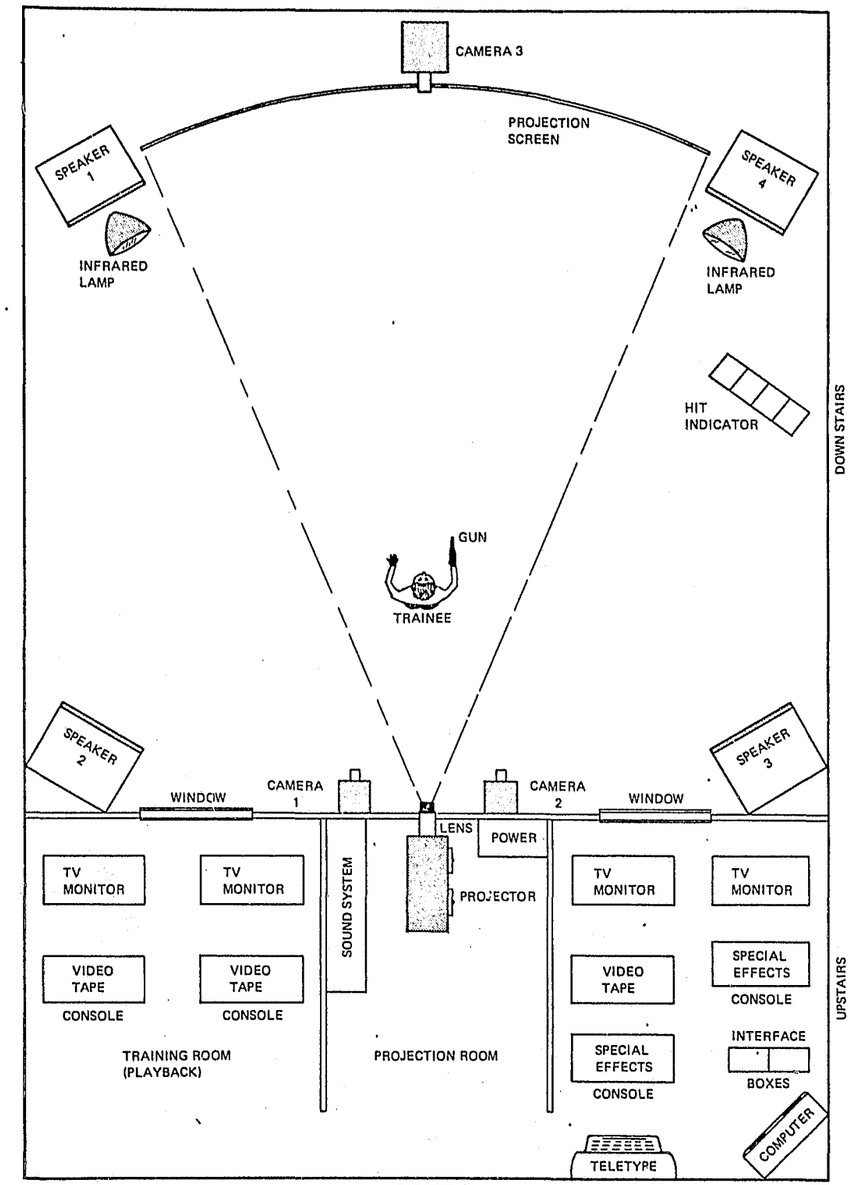

FIGURE 1
DEFT PROGRAM PHYSICAL LAYOUT

are determined. Based on stored target data in the computer and frame-count information supplied by the movie projector, the computer calculates whether a hit occurred, and whether or not a suspect, fellow officer, or bystander was hit. The hit-or-miss data are indicated on a light display located near the projection screen. Also, the computer prints out the results of the encounter on a teletype machine.

Video Camera 3 is used to record the actions of a trainee during the scenario. The video from Cameras 1 and 3 is combined into a split screen (top and bottom) format and recorded on a video tape cassette recorder.

During playback of the enactment an instructor discusses and critiques the trainee's performance as described earlier.

3.0 DISCUSSION

In this section are discussed: (1) the DEFT program status as of 9 January 1976; (2) the technical feasibility of completing the program; (3) an outline of the program considered necessary to complete the program; and (4) the estimated level of effort and recommended schedule for program completion.

3.1 Program Status

The status of the project is discussed in two parts: (1) specific status of the hardware and software elements of the system, and (2) the operational status of the total system and facility.

In general our survey of the DEFT facility on 8-9 January 1976 confirms the LAPD assessment of the simulator deficiencies. The LAPD assessment is provided in Appendix A.

3.1.1. Hardware/Software Status

a. Building - The building which was constructed by LAPD for the DEFT facility is complete and appears to provide the essential elements for a successful simulator system. A modification to the first-floor layout for improved processing of trainees is discussed in Section 3.3.

b. Projection System - The projection system, which includes the projector, lens, screen, film, and audio system, appears to be the strongest element of the DEFT system today. The projector is a modified, standard commercial 35mm movie theater projector which provides the necessary image size and illumination on the screen.

The screen is made up of 12 sections of 1/4"-thick aluminum plate, suitably formed and mounted to provide the necessary screen curvature. The screen is painted white to provide the proper reflective surface for the film. The film, which was produced by a commercial film company under LAPD direction, is an excellent production and provides a high-quality image with 360-degree, four-channel sound effects, which are very realistic.

c. Video Cameras - The system contains three video cameras. Two of them (Cameras 1 and 2 in Figure 1) are standard vidicon tube cameras (Panasonic) with fixed focus 16mm F1.6 lenses. These cameras are fixed on rigid mounts connected to the upper wall surface adjacent to the projection room. The third camera is a silicon target vidicon camera and lens with an automatic iris. This camera is poorly mounted on a wooden platform with temporary metal C clamps on top of the projection screen. This mount is inadequate.

Two infrared illuminators (300-watt incandescent bulbs placed inside a container with an infrared filter) are placed in front of the screen to help illuminate the trainee.

All three cameras perform poorly. The two vidicons adjacent to the projector (Cameras 1 and 2) utilize a standard vidicon tube which "burns in" an image of the screen. They also take a long time to recover from high light levels. In addition they are not sensitive enough to provide an adequate image at low light levels.

The third camera (called a low-light camera) does not burn in. However, its sensitivity, even with the illuminator, is not sufficient

to produce a satisfactory image of the trainee in a darkened room.

These three sensors are inadequate for the job they are required to perform.

d. Interface Units - There are two sealed interface units which are reported to provide the necessary circuitry to connect the video from Camera 2 (which records the bullet's impact) to the computer, and from the computer to the hit indicator light. These units were sealed with a contractor's seal; however, it was possible to view the general construction of the inside of the units through several holes. A look into these units revealed that several circuit boards (assembled from perforated boards and push-pin connectors) are mounted on an ordinary piece of plywood board.

These construction techniques are unacceptable based on accepted commercial practice. In addition, there are no schematic diagrams available for these units. An evaluation of the electrical performance of these devices was therefore impossible.

e. Computer/Software - The computer system consists of a NOVA 1220 minicomputer, DIABLO 43 disc, Decision model 3170 controller and XINCOM 3100 analog to digital converter. There was no documentation for the applications software, interface units, or the interconnection between the computer and other external devices. The two-page "operational manual" provided by the contractor is not considered adequate. At the time of the MITRE survey, the computer was not connected to the external devices. Inside the computer rack the wiring

is loose and makeshift, including some "tinfoil" shielding of a group of wires.

In summary, the computer and software have not been properly completed, and for the reasons stated above, it was not possible to demonstrate or fully evaluate this portion of the system.

f. Output Equipment - A teletype machine, ASR33, is located in the computer room and appears to be in operating condition. Since the computer was inoperative, it was not possible to test or evaluate this standard device.

g. Monitors, Tape Recorders, Special Effects Generator - In general, it was found that these devices (which are standard commercial items) appear to be in good operating condition. However, it was observed that the coaxial connections to the special-effect generators were unmarked and confusing, and possibly incomplete. The consoles appear to be well designed and constructed, although the placement of wooden back stops (2 x 4 boards) behind the monitors is an unsatisfactory solution to this aspect of console construction.

h. Ammunition - During the MITRE visit to LAPD, it was indicated that the contractor had only provided a limited number of special-purpose bullets and that there were only three such bullets left in the LAPD inventory. Tests could not be performed to determine all of the necessary characteristics of these bullets. However, the LAPD staff fired them for demonstration. The bullets shatter, which results in a number of small pieces of wax flying in all directions. This is a potentially dangerous and undesirable situation, particularly with

ignitied incendiary fragments. Additionally, these fragements cause blooming and an excessively large impact image on the impact scoring camera (Camera 2 in Figure 1) with the result that the automatic scoring accuracy by the computer is open to question.

3.1.2. Operational Status

The DEFT system was not operational due to: (1) the system not being connected; (2) lack of documentation that could enable the LAPD staff to reassemble, operate, or maintain the system; and (3) the deficiencies discussed in Section 3.1.1. However, in the recent past, the contractor had demonstrated the system and several video cassette recordings were available for review.

Based on a review of these recordings, the performance of the system appears to be inadequate and unable to meet the stated needs of the project vis-a-vis evaluation of officer performance under stress.

It is questionable whether the present system configuration could meet the design goals with respect to: (1) accuracy and determination of a hit location; (2) alignment of the projected image and the video cameras; and (3) resolution of the trainee image when viewed on playback.

3.2 Technical Feasibility of Completing DEFT

It is considered technically feasible to make the DEFT firearms simulator operational and to provide performance which would meet user requirements. The technical feasibility of completing the system is considered dependent on four factors:

a. The method of indicating and recording bullet impact.

b. Obtaining satisfactory quality video recordings.

c. Proper design and programming of the scoring subsystem (computer and interfaces).

d. Accomplishment of system integration and preparation of adequate documentation for operation and maintenance of the system.

These factors are discussed below.

It was indicated by DEFT personnel that recent research has indicated that firearms recoil plays a relatively small role in a police officer's decision whether or not to use his weapon and on first-shot accuracy. Based on the primary DEFT training objective concerning officer decisions to use his weapon rather than shooting accuracy, inclusion of recoil in the weapon was not considered mandatory by LAPD DEFT personnel. Based on this consideration, it is not necessary that the weapon used in the enactment fire a projectile.

An alternative approach, the technical feasibility of which was demonstrated on 8-9 January 1976, would be to incorporate in a modified service revolver or shotgun a light source collimated with the barrel to indicate the bullet impact point. Although in the demonstration a laser light source was used, it is possible that a non-coherent light source could be used, and as discussed in Section 3.3, an experimental effort should be considered to provide data from which a decision can be made. This undertaking is considered straightforward and should pose no severe problems, except possibly for packaging the light source in a modified service revolver.

The present video cameras are inadequate for proper system performance. One sensor camera, the silicon target vidicon, may be usable in the final system, provided that the lens is changed. The other two sensors must be replaced with proper low-light level cameras with suitable lenses.

Tests were performed by MITRE, using a borrowed low-light level TV camera (from LAPD Narcotics personnel) and a set of lenses suitable for low-light level operation. The tests verified that the DEFT sensor system could be made to perform with the appropriate cameras and lenses.

Therefore, the technical risk is considered minimal provided that adequate video engineering is accomplished.

With proper engineering, design, and construction of computer interfaces, software design and implementation, synchronization between the computer and movie projector, and mechanical alignment of the movie projector and bullet impact vidicon (Camera 2), it is felt that the impact and scoring subsystem can be made to function properly. The technical risk of successfully accomplishing the above is considered minimal with proper system engineering performed by a qualified contractor.

Based upon an understanding of the overall DEFT operational concept and the capabilities of the present computer, it is felt that it is probably adequate for the current DEFT configuration. However, there is no documentation for the applications software and interfaces. The arithmetic operations performed by the computer are estimated to

be of only modest complexity. For this reason, it would probably be more efficient to reprogram the applications of software rather than to attempt to "decode," interpret, analyze and debug the existing software. Also, the necessary interface units to connect between Camera 2, the computer, and the hit indicator light panel would have to be designed and/or acquired.

The systems integration function includes those tasks necessary to assure that the functional and procedural relationships between components, equipments, and subsystems are such that their combined performance results in a system functioning to satisfy user requirements. Accomplishment of the systems integration often includes the consideration of subtle as well as complex interrelationships that can be overlooked by firms concerned solely with hardware design and production. With the use of a properly qualified systems engineering firm, the technical risk associated with systems integration should be minimized.

For the DEFT system, preparation of adquate operation, repair, and maintenance documentation should pose no difficulty to a properly qualified contractor, provided adequate funding and time are made available.

In summary, it is felt that development and completion of the DEFT system is technically feasible. The recommended approach in Section 3.3 to complete the program is considered to be a low-risk effort.

3.3 Recommended Program to Complete the DEFT System

In this section are described those tasks considered necessary to provide the LAPD with an overall functioning DEFT firearms simulator system that can best achieve the objective of training police officers to exercise the best possible judgment concerning use of their firearms under stress situations involving suspects that are possibly armed or dangerous. As such, it is considered that the tasks involved not only include the "fixing-up" of hardware and software within the DEFT facility (Task 1), but also include the accomplishment of closely related and necessary tasks to assure that a fully integrated and overall training system results from the effort. To this end, the following six tasks are considered important to achieving LAPD's training objectives:

Task 1: Accomplish DEFT System Engineering and Integration
Task 2: Provide Additional Enactments
Task 3: Integrate Live-Firing Mini-Ranges Into Overall DEFT Concept
Task 4: Improve Efficiency of Trainee Processing
Task 5: Accomplish Branching Feasibility Study
Task 6: Accomplish DEFT Concept Evaluation Phase

The following paragraphs describe the above tasks.

Task 1: Accomplish DEFT System Engineering and Integration

The following paragraphs describe the engineering effort and actions considered necessary to make the DEFT simulator operational in accordance with the user requirements.

a. Video Recording System

Analysis with respect to the screen-shooter geometry and light levels should be accomplished to permit selection of the proper cameras

and lenses. Based on the limited tests accomplished on 8-9 January 1976, it appears that the following general approach should be used.

The existing silicon target vidicon is inadequate to monitor the trainee during low-light-level conditions. Also, the focal length of the present vidicon is not adequate to monitor facial features of the trainee during the enactment. A new low-light-level camera and lens should be selected to overcome these problems. Also, because LAPD intends to eventually employ scenarios with two trainees, a second camera mounted over the screen and pointed toward the trainees will probably be required. Additionally, in order to monitor facial features, it may be necessary to have the trainee-monitor camera joystick controlled, because it will be necessary to employ a longer focal length lens to see these features; which in turn would reduce the field of view of the cameras.

To record the enactment for playback on a split-screen with the trainee's reactions at acceptable playback light levels will require further analysis and selection of equipment. At least three approaches should be investigated: direct recording from the movie screen as is now done (if this approach is used, the present vidicon would have to be replaced); pre-recording of scenario video and subsequent synchronization with the movie projector during actual enactment; and use of a beam-splitter at the movie projector to video-record the scenario during projection at higher light levels than exist from reflection at the movie screen. Subject to further investigation, it appears that the first approach would be the least expensive, if shown to be practicable.

b. Impact Determination and Scoring Subsystem

It will be necessary to redesign this subsystem, because no documentation exists from which any basis exists to permit a modification of the existing design. Before committing to a particular design approach, there should be an initial period during which alternatives to the present design approach are analyzed, evaluated, and compared to permit a determination of the most cost-effective approach to the design of this subsystem.

Based on the discussions held on 8-9 January 1976, it is felt that the existing computer and peripherals can be employed in the redesign (with the possible exception that increased random access storage may be required to store target x-y coordinate data for up to 40 enactments). However, it will be necessary to develop the detailed design requirements for hardware and software from the performance requirements, and to then design the necessary hardware and software, utilizing to the maximum extent practicable, existing hardware. Without applications software documentation, it is felt that the most cost-effective approach is to reprogram the computer from the beginning.

As part of the redesign of this subsystem, documentation adequate for operation, repair, and maintenance should be provided as well as design documentation to permit replication of the simulator by other law enforcement agencies.

(1) Weapons

During the initial period referred to above, alternatives to the use of incendiary wax bullets should be analyzed and compared to determine the approach that can best meet user requirements. Although it appears at this time that the "firing" of a light beam may be the best approach, others should be considered, analyzed and recommendations presented to LAPD for their concurrence. Should the light beam approach be recommended, the following paragraphs describe the requirements to be satisfied and tasks to be accomplished during the design and implementation phase.

A service revolver and 12-gauge pump shotgun would be modified to "fire" a light beam to indicate point of impact on the movie screen. The size, intensity, and duration of the light flash must be compatible with the video camera used to record the impact point to assure that blooming is minimized and that the impact point can be determined with sufficient accuracy to meet the overall system accuracy requirement on the measurement of impact point of ±1 inch.

Additionally, during firing, the service revolver and shotgun should provide a stimulus to the sound system, which in turn is to produce the sound of the service revolver or shotgun firing. The peak sound pressure level (PSPL) should not exceed 140 decibels to avoid hearing damage to the trainee. The stimulus to the sound system may be either RF (radio frequency), ultrasonic, or video as long as the stimulus does not interfere with the officer's vision or hearing, and does not interfere with proper operation of the other

system components (e.g., video cameras).

Although desirable, it is not mandatory that recoil be provided when either the revolver or shotgun is "fired."

The resultant weight of the modified revolver and shotgun should closely approximate that of the fully loaded, unmodified service revolver and shotgun. The external appearance of each weapon should remain essentially unchanged.

For certain of the future enactments (scenarios), it is intended by LAPD that two officers participate in the scenario. Up to six shots may be fired per shooter within five seconds. The system design must accommodate this need without ambiguous scoring by the Impact Determination and Scoring Subsystem (see below).

It is our opinion that the service revolver and shotgun can be modified to achieve the above requirements. Experimental work will be required to finalize the design approach for providing the light source and lens system for the weapons. The selection of either a laser or a non-coherent light source would be part of this experimental effort. Also, it will be necessary to accomplish experimental work to establish the best approach to providing a stimulus for the weapon firing (i.e., whether or not to use RF, ultrasonic, or light), and to assure that the delay between stimulus and the firing report over the sound system is acceptably short (e.g., the time delay between the hammer falling and ignition on a flintlock is unacceptable with respect to a .38 special).

The results of the experimental work and resulting recommendations would be presented and demonstrated to the DEFT personnel for their concurrence. Following this, design drawings and documentation would be finalized and the weapons modified for delivery to the DEFT facility.

For "bullet impact" determination, the limited tests conducted on 8-9 January 1976, indicated that the present silicon target vidicon may be adequate, if a different lens is employed. Further analysis and test are required to confirm this or indicate that another vidicon is required.

The LAPD simulator contractor provided interface equipment between the bullet impact-recording vidicon and the computer. It is understood from LAPD DEFT personnel that this interface unit contains the necessary logic and circuitry to compute the bullet impact x-y coordinates and input them to the computer. Because no documentation exists on the unit, and because the contractor sealed the unit to preclude opening, it was not possible to positively confirm this interface unit's function, although the above explanation appears plausible.

Without adequate documentation, it will be necessary to experiment and test this unit to attempt to establish its function and to permit preparation of adequate documentation. If this cannot be done in a reasonable time, another unit will have to be designed, tested, and installed. In any event, based on what could be seen of the inside of the unit through holes in the case, if it is used at all

it will have to be repackaged to conform to acceptable commercial practice (it could be seen that the circuitry was mounted on a plywood board!).

(2) Computer

As indicated above, it is felt that the computer and associated equipment will probably be adequate to accomplish the automatic impact determination and scoring function. Because of the absence of documentation, it is not possible to judge the adequacy of the applications software. Based on experience in similar situations, it will probably be more economical to reprogram than to interpret, analyze and debug the existing applications software.

Based on the design approach selected during the initial phase of work (see above), the computer would be programmed and then integrated with the necessary interfaces and other equipment.

(3) Projection Subsystem

To synchronize the movie frame with the stored target data, a magnetic frame counter was installed on the projector. It is understood that synchronization is "achieved" by simultaneously, but manually, starting the computer and projector. Because the projector frame counter is sequential, removal of film from the roll (e.g., splicing the film to repair damaged or jammed film as occurred on 8 January 1976) will probably cause an improper or inaccurate response by the computer during its scoring computations.

To overcome this problem will require analysis and design of a means to better synchronize the movie frames with the computer for purposes of computing impact point.

The mechanical alignment of the movie projector and bullet impact vidicon is critical to determination of impact accuracy. An analysis should be undertaken to assure that mechanical tolerances in combination with other hardware and software inaccuracies can assure that the overall system accuracy requirements can be met. Alignment procedures should be developed, and if necessary hardware changes incorporated.

c. System Integration

In parallel with the effort described above, engineering analyses should be undertaken to assure that the components, equipment, and subsystems will function as specified when assembled and operated as a system.

For example, analysis and system design will have to take into account and specify a method to assure synchronization between the movie frame in which a shot occurred (the film projector), the impact determination equipment (Camera 2 and computer interface unit), and the scoring computation within the computer itself. Compounding this problem is assuring that the mechanical alignment between the projector and Camera 2 is such that the computed x-y coordinate of bullet impact is within acceptable tolerances for proper scoring by the computer.

d. System Assembly and Checkout

Following accomplishment of the above subtasks, the redesigned and modified equipment should be assembled and checked-out at the DEFT facility. At this time, tests (for which the plans and procedures have

been coordinated by DEFT personnel) should be accomplished to demonstrate proper functioning first of the subsystems, and then the full system. Any problems and deficiencies found should then be corrected.

At this time, operational use of the DEFT system could commence. During this period of initial operational use, the system contractor should monitor the operations to establish, in conjunction with DEFT personnel, the extent of any operational limitations that may be uncovered during actual operations. Should any limitations exist, they should be defined and a judgment made whether they should or could be overcome.

e. System Documentation

During the later stages of design, preparation of equipment and system documentation should be initiated. This documentation should describe by means of circuit diagrams, text, interconnection diagrams, mechanical drawings, etc., the design of the system exclusive of the documentation provided by individual equipment manufacturers. Importantly, adequate computer applications software documentation should be included.

Additionally, documentation should be prepared and provided to permit personnel unfamiliar with DEFT to align, operate, repair and maintain the equipment comprising the system. As part of this effort, the contractor should recommend those spare parts considered necessary for adequate repair and maintenance of the system. Where in-house LAPD equipment repair or maintenance is not considered practicable, recommendations should be made for appropriate maintenance contracts or additional spare equipment to be held in reserve to maximize the

availability of the DEFT facility for training.

Finally, performance specifications should be prepared to permit replication of the DEFT facility by other federal, state, and local law enforcement agencies.

Task 2: Provide Additional Enactments

It is clear that to achieve the intended LAPD training objective, additional enactments are required. The existing single enactment produced under the direction of LAPD is considered excellent. It is recommended that at least ten additional enactments be provided, the exact number of which would be determined based on the outcome of Task 5: Branching Feasibility Study. For example, if branching is determined to be technically and economically feasible, the number of non-branching enactments produced should be the minimum required (e.g., 10-15) on an interim basis until the branching capability is developed and implemented, at which time additional enactments with branching capability would be prepared and delivered to bring the total to approximately forty, as requested by Chief Davis.*

Task 3: Integrate Live-Firing Mini-Ranges Into Overall DEFT Concept

As a valuable adjunct to the simulator, five live-firing "mini-ranges" have been constructed behind the DEFT simulator building. These ranges provide the opportunity for the trainee to be faced with the following types of simulated circumstances that require him to make decisions whether or not to draw his weapon and fire:

a. Two ranges simulating search of buildings in suspected burglary cases.

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* LAPD letter to Director, LEAA, dated 6 November 1973.

b. One range for approaching a stopped vehicle.

c. Running target range.

d. Park scene against multiple suspects.

To date, the mini-range training capability has not been fully integrated with DEFT. By integrating the mini-ranges with DEFT, the potential exists for better "psyching-up" the trainee for the stress situation presented within the DEFT facility. For example, if the trainee were to be faced with the DEFT scenarios following exposure to one or more of the mini-ranges, the degree of tension produced at the start of the DEFT scenarios should be higher than without that exposure.. This increased tension could better contribute to the DEFT training objective of teaching the officer how to react under high-stress situations.

The following improvements to the mini-ranges are suggested to better integrate them into the DEFT concept.

a. Utilize the DEFT computer for scoring trainee performance and reaction time.

b. Add a sound system to provide typical scenario background noise and voice exchange between suspect and officer (suspect voice could be pre-recorded or supplied by the instructor during the actual confrontation).

c. Modify pop-up targets to provide immediate feedback to the officer whether or not a hit has occurred in the kill zone (in multiple-target situations, this feedback would contribute to the officer's

judgment with respect to conserving ammunition for use on other suspects).

d. Utilize vidicons designated surplus in Task 1 to provide a video tape capability to record trainee actions and responses during the live-firing scenarios for subsequent instructor critique to the trainee.

Task 4: Improve Efficiency of Trainee Processing

To achieve the fullest efficiency of the simulator facility, trainee debriefing and video playback of the enactments should occur on the first floor of the simulator building rather than on the second floor, in partitioned areas on either side of the movie projector. To accomplish this, enlargement of the present first-floor storage area and addition of an outside entrance appears to be warranted.

Task 5: Accomplish Branching Feasibility Study

An engineering study and analysis should be undertaken to establish the technical and economic feasibility of incorporating a branching capability into the simulator. By branching is meant the capability to change the scenario during projection as a consequence of the trainee's actions. This effort should include working with the projector manufacturer and film-making industry to assure that the branching technique recommended is both technically feasible and one that represents the most economical approach possible.

Based on the results of this effort, the LAPD could then make a

decision whether to proceed with incorporation of branching into the simulator design.

Task 6: Accomplish DEFT Concept Evaluation Phase

In parallel with commencement of DEFT operations, a formal evaluation phase should be implemented. The objectives of the evaluation should include:

a. Establishing the viability and utility of the DEFT system concept as an alternative to traditional methods of teaching proper judgment of firearms use under stressful situations so as to minimize the possibility of mistake, improper or illegal shooting operations.

b. Establish the effect of DEFT system training as to its effect upon the number of field shooting in which poor judgment was exhibited by police officers.

The first of the above objectives could probably be achieved during the first year of operational DEFT system usage.

Of necessity, the second objective is long-term, and depending on the number of shooting incidents occurring annually, the number of officers involved in the shooting incidents and whether or not they received DEFT training, as well as many other uncontrollable factors, achievement of this objective could require some years, depending on the statistical design of the evaluation.

As an aid to the evaluation phase, the computer portion of the DEFT system could be programmed to include a statistical analysis package as well as DEFT training records, and records of officer-involved shooting incidents. This approach could materially reduce

LAPD manpower requirements for record-keeping, and data reduction and analysis.

3.4 Estimated Level-of-Effort and Recommended Schedule for DEFT Program Completion

In this section are discussed the estimated budgetary costs and schedule considered necessary to accomplish the program outlined in Section 3.3. Certain assumptions and considerations strongly influence the resulting estimates and are listed below:

a. Average labor rates, overhead and travel costs familiar to us have been used.

b. The costs and schedule assume accomplishment of the program by a single "prime" contractor, except for Task 4. Should the work be subdivided and separately contracted, both costs and schedules could be affected.

Table I summarizes the estimated budgetary costs to complete the DEFT system. Up to $225,000 may be required depending on the outcome of Task 1B, the definition and recommendation of the design approach to be used for the Impact and Scoring Subsystem. Also influencing the estimated Task 1 costs is the requirement for two simultaneous shooters (Paragraph 3.3a(1)). Should this requirement be relaxed to one shooter, some cost reduction would be realized.

To fully integrate the DEFT system and provide a fully functioning training system, Tasks 2 through 6 should be accomplished. As shown in Table II, the estimated costs for this effort, exclusive of Task 4, the building modification, are $251,800. The largest portion

TABLE I

SUMMARY OF ESTIMATED BUDGETARY COSTS

FOR COMPLETION OF DEFT SYSTEM

Task	Description	Estimated Budgetary Costs: Labor	Materials, Travel and Subcontracts	Total
1A	Complete Video System	$10,500	$52,000	$ 62,500
1B	Define/Recommend Impact and Scoring Subsystem Design Approach	$25,000	$13,000	$ 38,000
1C	Design/Implement Impact and Scoring Subsystem		-- See Note --	
	Total	$35,500	$65,000	$100,500

NOTE: To be determined during Task 1B, but should not exceed approximately $125,000.

TABLE II

SUMMARY OF ESTIMATED BUDGETARY COSTS FOR

INTEGRATION OF DEFT SYSTEM

Task	Description	Estimated Budgetary Cost: Labor	Materials, Travel and Subcontracts	Total
2	Provide Additional Enactments	$10,400	$122,600	$133,000
3	Integrate Mini-Ranger	$29,000	$ 26,000	$ 55,000
4	Building Modification	Should Not Exceed $50,000		
5	Branching Feasibility Study	$12,500	$ 1,800	$ 14,300
6	Evaluation Phase	$45,500	$ 4,000	$ 49,500
	Total	$97,400	$154,400	$251,800

of these costs is a subcontract for film production of 10 enactments (estimated at $12,000 each).*

Figure 2 is the estimated schedule for accomplishment of the full program.

It is felt that further discussions with LAPD concerning these estimated costs and schedule including the proposed technical approach could result in some cost reduction and schedule improvement.

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*See LAPD letter to Director, LEAA, dated 6 November 1973.

FIGURE 2

ESTIMATED SCHEDULE FOR COMPLETION AND INTEGRATION OF DEFT PROGRAM

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the on-site review of the DEFT system, it is concluded that the concept is both technically and operationally viable. Although the present implementation of the system results in unsatisfactory performance, it is believed that it is technically feasible at low-risk to modify and redesign certain portions of the DEFT firearms simulator to provide the required performance.

The budgetary cost and schedule estimates provided in Section 3.4, although considered conservative, should be interpreted as the best available within the time and cost constraints imposed by the PAS task order. The LAPD should reconsider the requirement for two simultaneous trainees firing at the screen, because of the additional complexity and cost that will be incurred.

To minimize the time required to begin work, it is recommended that a single contractor be selected for accomplishment or subcontract of the work in Section 3.3 under the direction of, and in coordination with LAPD DEFT personnel, except for the building modification (Task 4) which could be separately contracted by the LAPD.

It is recommended that further discussions be held with the LAPD and LEAA concerning the proposed technical approach, costs and schedule with the objectives of further refining program requirements, reducing estimated costs and improving the schedule.

Because of the potentially large benefits to law enforcement firearms training for both LAPD and on a national basis, it is recommended that LEAA and the LAPD proceed with completion of the DEFT program subject to the results of these discussions.

APPENDIX A

DEFT PROJECT PROBLEM AREAS

The Development and Evaluation of Firearms Training (DEFT) project coordinator, associated Police Academy staff, and the Training Review Authority of the Los Angeles Police Department consider the following items of the simulator system unacceptable for training purposes:

1. Video image - The image viewed on the monitor while recording and playback of the recording does not have sufficient detail or clarity to define persons in the critical moments of enactment, much less clarity to give positive identification of either person. It is planned that future enactments will have scenes with several people in a dark area. In such a case, good target definition will be essential.
2. Video image of bullet impact - The video images of targets (persons in the enactment were obliterated by the image generated by impact of the projectile. The oversize bloom prohibits identification of the target and makes precise impact determination (i.e., head, arm, torso, etc.) impossible. The original plan to use a marker generator might have eliminated the problem. Also consideration should be given to using a laser-type light source that could be emitted from a .38 caliber-type weapon.
3. Video system ultra sensitivity to normal room lighting - The system is ultra-sensitive to light and the need to

completely darken the room for "a couple of minutes" after opening exterior doors or turning off room lights before starting the enactment is not acceptable.

4. Video/computer subsystem interface - It has been indicated that because of electronic "noise" or static, the computer prints out false or phantom impacts. Because the printout will comprise a permanent record of trainee performance, non-existent or false impact information is not tolerable.

5. Computer printout of multiple impacts from one shot - Because of lingering heat at the impact point, the computer has indicated that several impacts occurred at one location, when in fact only one shot was fired. It is not acceptable to require the instructor to decide whether only one shot was fired because, indeed, an officer could fire more than one shot in the same location in rapid succession. The system equipment must make the determination, not the instructor, and the determination must be accurate and reliable.

6. Training of LAPD staff - There has been insufficient formal training of the Department staff in the operation and maintenance of the simulator system.

7. Video image of trainee - The image of the trainee as shown on the monitor and playback does not show enough of the trainee nor does it allow the trainee sufficient mobility.

The image should show the entire trainee anywhere within the probable shooting area and clearly show the officer's posture, grip, stance, and use of props, if any.

END