Final Project Report

NightSight Field Assessment Creative Technology Solutions to Law Enforcement Problems

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TABLE OF CONTENTS

LIST OF TABLES

Field Assessment of the Raytheon NightSight Forward Looking Infrared Technology in a Law Enforcement Environment

1.0 Introduction

In November, 1996 Raytheon Systems Company submitted a proposal to the National Institute of Justice for a project in response to a solicitation from NIJ for "Creative Technology Solutions to Law Enforcement, Courts and Corrections Problems". The solicitation proposed the application of Forward Looking Infrared (FLIR) technology to solve specific problems in law enforcement. These problems, listed by Raytheon, included (but were not limited to):

- Suspect detection and apprehension;
- Surveillance by law enforcement of suspected criminal activity;
- Warrant service in problematic environments; and
- Law enforcement operations in remote locations.[1]

A total of nine law enforcement agencies and the independent evaluation organization responded positively to Raytheon's invitation to participate in the proposed project. The nine law enforcement participants were chosen to provide a cross-section of law enforcement agencies – urban, rural, small town, etc. – and the independent evaluation organization was chosen based on reputation, qualifications, and proximity. Four law enforcement agencies were subsequently added to the project to enhance the cross-section goals. The selected agencies agreed to cooperate with Raytheon and the independent evaluator for "ride-alongs", interviews, data collection, feedback, and appropriate media coverage. Raytheon's invitation letter also encouraged each agency to discover and relate innovative new uses for the equipment in the law enforcement field. NIJ and Raytheon agreed to provide hand-held and vehicle mounted FLIR units for the participants and Raytheon agreed to provide for initial training on the use of the equipment.

Within weeks of the kick-off event, Raytheon arranged initial training for the law enforcement participants by engaging the Law Enforcement Thermographers Association (LETA) to train the project participants. LETA is a nationally recognized professional law enforcement organization dedicated to promoting the legal and ethical use of thermal imaging in support of law enforcement operations. More than 50 officers from all participating partnership agency attended the LETA Basic Thermographer Course, conducted by LETA at the University of Texas at Dallas. The participants received their certification as basic thermographers. The certified 40-hour course consisted of three days of classroom lessons, two evenings of practical exercises, and a written half-day

[1] Source: Letters to invited law enforcement organizations, dated October 15, 1996.

exam. Key concepts from the course included recognized applications of thermal imaging in law enforcement, camera operation, and infrared theory. Raytheon also provided personnel to demonstrate the equipment and provide hands on training. Feedback from participants was consistently positive, with the general sense being that the instruction was valuable and useful.

For various reasons, start-up of the planned independent evaluation that was to follow closely behind the kick-off and initial training was delayed. This resulted in a long period of time (more than six months) during which the law enforcement agencies were using the FLIR equipment without a viable independent evaluation process. The independent evaluation was eventually started, but was never successfully executed and Raytheon terminated the subcontract for convenience (more than a year after the kick-off meeting). Raytheon requested, and NIJ concurred, with a new evaluation plan to be developed and executed by the Center for Justice Policy (CJP) at St. Mary's University in San Antonio, Texas.

While the initial proposal was for an "evaluation" of FLIR in a law enforcement environment, insufficient research design parameters were present in the current deployment to allow a scientific field evaluation. The Center for Justice Policy proposed a field assessment of infrared sensors in law enforcement applications, based on specific goals and objectives identified below. This document represents the results of that field assessment.

1.1 Description of the Technology

Forward Looking Infrared (FLIR) technology, while not new to the United States military, is relatively new to ground applications in American policing practice. The FLIR technology assessed in this project is Raytheon's "NightSight" technology, fielded as both vehicle-mounted and hand-portable units that allow police officers to detect temperature differentials by viewing a given area through FLIR-enhanced images. The FLIR technology as fielded by Raytheon can detect radiation emitted in the infrared spectrum, depicting temperature differentials as small as one-tenth of one degree Fahrenheit, and can image objects over a range of ten to 2,400 feet.

For this field assessment, Raytheon provided a basic vehicle-mounted unit with a FLIR control head and viewer mounted inside the police vehicle, and the "camera" mounted atop the patrol vehicle. The control head consists of an on/off switch; a "joystick" to allow the officer to pan or tilt the camera; an "autoscan" function, which allows the officer to set the speed and degree of rotation of the auto-scanning process; a reset button; a focus control; and a button to switch the viewer from displaying hot temperatures as black to hot as white. The camera-head for the vehicle-mounted unit, obviously, is waterproof. The camera will pan 360 degrees, and will tilt from negative 16 degrees to positive 40 degrees. The

unit focuses from 10 feet to 2,400 feet. A mechanical camera lens wiper clears the lens of water or snow, etc. The vehicle unit has the capability to output a signal to a videocassette recorder.

The hand-portable unit resembles a video camera, with controls for on/off and standby; auto/manual focus; adjustments for focus, brightness, gain, level, etc.; a "select" button for menu driven controls; a "white/hot-black/hot" button; and a battery eject button. Use of the hand-portable unit is very similar to use of a hand-held video camera. The hand-portable NightSight unit is water resistant, but not water proof. The hand-portable unit will output a signal to a videocassette recorder. It can be powered by either a Nickel Metal Hydride rechargeable battery or a DC in-car power plug.

1.2 Purpose of the Field Assessment

The purpose of the field assessment of the Raytheon "NightSight" technology was to determine:

> "To what degree, and how, is vehicle- and man-portable Forward-Looking Infrared (FLIR) technology applicable in various law enforcement environments, and what are the costs, benefits and alternatives to such applications?"[2]

Six specific objectives of the field assessment were established in November, 1998. These included to determine whether:

1). The processes used for implementation of vehicle- and hand-portable FLIR technology by the law enforcement partners has an impact on the overall effectiveness of the technology;

2). Vehicle- and hand-portable FLIR technology is an effective and cost-feasible tool in law enforcement environments;

3). Vehicle- and hand-portable FLIR technology works better or worse in varied types of law enforcement environments, e.g., rural v. urban, large v. small law enforcement organizations, etc;

4). Vehicle- and hand-portable FLIR technology is more—or less—effective in various types of law enforcement activities, e.g., narcotics investigations, surveillance activities for criminal behavior, search and rescue, routine patrol operations, etc.;

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[2] "A Proposal for a Technology Assessment for the Raytheon-TI Systems "Nightsight" Technology Program in Law Enforcement Applications," Center for Justice Policy, St. Mary's University, p. 1.

5). Vehicle- and hand-portable FLIR is more or less successful than available alternative technologies, such as "normal" surveillance technologies, etc.;

6). There is a difference in technology outcome attributable to innovation and implementation strategies exhibited by the various law enforcement partners.[3]

Further, the original proposal outlining the goals and objectives of the field assessment noted "Under no circumstances should this be interpreted to be a comparative study, based on individual departments. The question addresses a comparison of implementation planning methodologies. All discussions of implementation planning will be conducted in a non-attributional manner, not identifying partner's, but assessing implementation practices".[4]

A secondary issue associated with the field assessment was that the assessment was not a part of the original "start-up" of the demonstration project implemented by Raytheon and its law enforcement partners. At original project start-up, the assessment was managed by another entity. St. Mary's Center for Justice Policy entered the assessment after six months of operations, based on a request to reassess and re-engineer the field assessment.

2.0 Methodology

Raytheon engaged the cooperation of 13 law enforcement agencies to gauge the effectiveness and efficiency of FLIR technology in policing. The thirteen agencies included:

- Allen Police Department;
- Collin County Sheriff's Department;
- Dallas County Sheriff's Department;
- Dallas Police Department;
- Denton County Sheriff's Department;
- Farmers Branch Police Department;
- Garland Police Department;
- Grayson County Sheriff's Department;
- Highland Park Department of Public Safety;
- McKinney Police Department;
- Plano Police Department;
- Richardson Police Department; and
- Texas Rangers.

The field assessment, as re-engineered by the Center for Justice Policy, used a ethno-methodological approach to data collection for the proposed project. Data collection consisted of five processes:

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[3] *Ibid.*, pp. 1-2.
[4] *Ibid.*, p. 2.

- Use of a discrete variable data collection form;
- Completion of "ride-alongs" with, and interviews of, police officers using FLIR technology;
- Periodic "focus groups" with supervisory personnel from among the police agencies participating in the study;
- Interviews with project coordinators from each agency participating in the study; and
- A "post project" wrap-up questionnaire completed by police officers who had used the FLIR technology in the normal course of their policing duties.

Each of these data collection methodologies is discussed in some detail below.

2.1 Discrete Variable Data Collection Forms (DVDCFs)

One of the emergent problems associated with the difficulties experienced with the earlier assessment of the FLIR technologies was a data collection process that required large amounts of supporting data regarding each use of the technology. The CJP assessment process replaced this process with a two-sided 5"x8" card stock report, entitled "FLIR Incident Report". This form was distributed to all officers using the FLIR technology, along with instructions on how to complete an incident report.

The FLIR Incident report, included in Appendix A of this report, collected data on five types of data:

- Who used the FLIR and when it was used;
- Where the FLIR was used;
- Why the FLIR was used (what types of law enforcement function was being fulfilled);
- How FLIR was used; and
- Narrative information about the technology's use.

The first group of questions in the FLIR incident report included queries of the officers using the technology regarding the officers' names and badge numbers, agency name, date, time, temperature and weather. The second section included queries about the physical locations in which the technology was used: in a house, apartment, commercial building, wooded area, pasture, etc. The third section of the report included queries concerning why the technology was used, e.g., searching for property, persons, evidence, suspects, etc. The fourth section of the FLIR incident report identified which type of unit was used (hand-held or vehicle-mounted), and asked the officers to identify whether or not the

FLIR functioned as expected. The fifth section of the FLIR incident report asked the officers to write a brief narrative describing the incident and the FLIR's part in the incident.

2.1.1 Development of the DVDCFs

The DVDCFs were developed by project staff by assessing Raytheon's and the law enforcement partner's goals and objectives, and developing a draft "report form" designed to garner information related to the goals and objectives of the demonstration project. This draft was subjected to critique by Raytheon, its law enforcement partners, and others interested in the research. After revisions based on the critiques, the report was field tested at two separate police agencies. Revisions to the form were made as a result of the field test, and the forms were released to the 13 law enforcement agencies participating in the study. Full written documentation with instructions on how to complete the field FLIR report were made available to each of the 13 law enforcement partners.

2.2 "Ride-Alongs" and Interviews with Police Officers

CJP staff, during the 12 months of the assessment phase for the Raytheon NightSight project, conducted a series of ride-alongs and interviews with police and sheriff's personnel who were using the FLIR technology as part of the performance of their police duties. A total of 26 such ride-alongs and interviews were conducted, using an interview schedule developed by Center staff. The interview schedule is included as Appendix B of this report. During the second phase of ride-alongs and interviews, six questions were added to the interview schedule in response to a perception—developed during focus group meetings with the partners—that actual use rates of the FLIR technology were being under-reported. These six questions are also included in Appendix B of this report. During the ride-along process, staff observed officers using the technology and noted the ease of use and frequency of use associated with the FLIR units.

The interview schedule for ride-alongs with patrol personnel included topics designed to collect information regarding:

- Technical problems with the equipment;
- Notable successes of the technology;
- Problems with the equipment;
- Officer safety issues related to the equipment and the technology;
- Citizen safety issues with the technology;
- Needs for new or additional training;
- Recommendations for new adaptations for the equipment; and

- Recommendations for design changes for the equipment.

For the second phase of ride-alongs, six questions were added to gauge use rates.

2.3 Periodic "Focus-Groups" with Law Enforcement Partners

The 13 individual law enforcement agencies associated with Raytheon met monthly, as a partners' coordinating group, to discuss issues, uses, training, applications, etc. Staff from the Center were present at most of these meetings, and used the meetings to update data collection methods, urge more complete reporting, monitor problems and issues, etc. These meetings were used as opportunities for two-way communications between members of the Center's project staff and members of the law enforcement partners' coordinating group. As an example of the utility of these meetings, project staff noted an apparent under-reporting of use rates and discussed with the members of the coordinating group methods of improving the rates of reporting FLIR uses. As a result of these meetings, six new questions were added to the interview schedule for staff ride-alongs and interviews of police officers and sheriff's personnel using the FLIR technologies (See Appendix B).

2.4 Interviews with Project Coordinators

Each of the individual law enforcement agencies participating in the Raytheon project appointed a project coordinator who was responsible for implementation of the technology at the agency. Members of the Center's project assessment team interviewed each of these coordinators, using a specifically developed interview schedule designed to identify issues regarding:

- Deployment of the technology;
- Training in using the technology;
- Coordinating the implementation of the technology;
- Problem-solving processes related to the technology;
- Supervision of the use of the technology;
- Success and failure anecdotes involving the technology;
- Maintenance issues related to the technology;
- Court challenges to the technology; and
- "Best" and "worst" nominations for peers' implementation strategies for the technology.

2.5 *Post Project Wrap Up Surveys*

As an unplanned "validation" process, the Center developed a wrap-up survey, offered to all law enforcement personnel who had used the technology as part of their patrol practices. It was also designed to collect information regarding the (perceived) disparity between use rates and reporting rates (discussed in more detail in Section 4.7.2, below). The post-project surveys collected data regarding:

- The number of hours of FLIR training each officer recalls receiving regarding FLIR operation;
- Rates at which the officers recalled *using* the FLIR technology;
- The ways the officers recalled using the technology;
- The comparative value of the FLIR technology to police officers;
- Methods to improve FLIR technology for policing;
- Rates at which FLIR usage resulted in arrests; and
- Rates at which FLIR usage was contested in court proceedings.

A copy of the Post Project Wrap Up Survey is included in Appendix C, below.

3.0 Project Start-Up and Data Collection

The field assessment was initially funded in late November, 1998. Development of data collection instruments, training of staff, development of training documentation for the data collection instruments and other prefatory activities took two months. Initial data collection, using DVDCF, began in February, 1999. Ride-alongs and officer interviews began in March, 1999. Focus group meetings with the partners coordinating group began in November, 1998. Interviews with the principals of each of the participating law enforcement agencies were conducted toward the end of the project's term, and, obviously, the post-project surveys were fielded and returned at the end of the project's term. All data for the field assessment were collected by mid-December, 1999.

Within three months of the start-up of data collection, it was clear to members of the assessment team that reporting rates using the "FLIR Incident Report" were low. The project director met with members of the coordinating group and encouraged them to increase their reporting rates, to more closely reflect the rates at which the members of the group were "certain" the technology was being used by their members. The importance of "good data" and accurate reporting were reinforced, and additional copies of the "FLIR Incident Report" reporting protocol were provided to the members. A script for a videotape was developed by the director of the project team—for use of each individual department coordinator—to encourage increased reporting and reporting

accuracy. Members of the group felt a message from the individual department administrator would be the most effective method to encourage increased reporting, as compared to a message from an "academic". For various reasons, the videotape was never made or aired. Reporting rates continued to lag, despite reminders and requests at each monthly coordinating group meeting to spur accurate and representative reporting.

3.1 Description of the Participants and Participants' Deployment Practices

Raytheon selected 13 police agencies for participation in its demonstration project for the FLIR technology. As noted in Section 2.0, above, these included the following agencies:

- Allen Police Department;
- Collin County Sheriff's Department;
- Dallas County Sheriff's Department;
- Dallas Police Department;
- Denton County Sheriff's Department;
- Farmers Branch Police Department;
- Garland Police Department;
- Grayson County Sheriff's Department;
- Highland Park Department of Public Safety;
- McKinney Police Department;
- Plano Police Department;
- Richardson Police Department; and
- Texas Rangers.

Following is a brief description of the these agencies, most of which are situated in the Dallas Metropolitan area, along the US-75 corridor in and north of Dallas, Texas. The 13 participating agencies include four county agencies, seven municipal police agencies, one department of public safety, and one state investigative agency. The smallest population served by these agencies was the Highland Park Department of Public Safety, with 9,251 residents[5]. Obviously, the largest participating agency was the Dallas Police Department, with 1,087,178 residents.[6] Participating agencies represented rural areas (Collin County, Grayson County and Denton County), smaller suburban areas (Allen, Farmer's Branch, Highland Park, and McKinney) and larger suburban areas (Garland, Richardson, Plano). Two urban areas (Dallas and Dallas County) and one statewide agency participated (Texas Rangers).

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[5] "Crime in Texas, 1998," Texas Department of Public Safety, p. 122.
[6] *Ibid.*, p. 121.

Population statistics, as reported in "Crime in Texas, 1998" for the participants are listed in Table One, below, as are sworn staffing levels.

Table One: Population Statistics and Staffing Levels for the Raytheon NightSight Demonstration Project Partners

Jurisdiction	1998 Population	1998 Sworn Complement
Allen Police Department	34,068	51
Collin County Sheriff's Department	45,819	98
Dallas County Sheriff's Department	4,351	1,200
Dallas Police Department	1,087,178	2,714
Denton County Sheriff's Department	37,471[7]	111
Farmers Branch Police Department	26,175	66
Garland Police Department	195,995	281
Grayson County Sheriff's Department	41,439	58
Highland Park Department of Public Safety	9,251	51
McKinney Police Department	35,472	54
Plano Police Department	210,109	310
Richardson Police Department	84,068	152
Texas Rangers	19,760,000	100

The numbers of sworn law enforcement personnel fielded by the Raytheon Law Enforcement partners also are depicted above.

[7] Denton County population is reported in "Crime in Texas, 1997," p. 111.

3.2 *Deployment Processes*

Not surprisingly, the 13 separate law enforcement agencies involved in the Raytheon NightSight demonstration project took separate and distinct approaches to deploying the technology. In keeping with the agreement with Raytheon and its law enforcement partners, reporting on performance of the various law enforcement entities involved in the project will be via a non-attributional basis. The performance reporting schema selected for this report is by type of agency: rural, small suburban, larger urban and urban/statewide.

Despite these differences, some similarities in initial "roll-out" processes were noted. All agencies attended the first Raytheon sponsored LETA 40 hour Certified Basic Thermographers' training course and had multiple representatives present. Due to attrition and changing duty assignments, some of those initially trained were unable to complete the project. Therefore, Raytheon along with the group chair, provided ongoing training to the entire group and its new members. Both LETA certified Basic Thermographers' courses and a Basic Operators' courses through a local regional police-training academy were provided on an ongoing basis at no cost to the participating agencies. Most participating agencies took advantage of this "no cost" ongoing training or developed their own, while others did not.

The implementation process was distinguished, however, by its variety among the 13 participating agencies. The following sections discuss the varied implementation strategies.

3.2.1 Rural Agencies' Training and Deployment Practices

Raytheon's law enforcement partners group consisted of three rural agency participants. One rural agency deployed a total of five FLIR units, four vehicle-mounted and one hand-held. These units were assigned to specific deputies, with permanently assigned vehicles. Two of the deputies worked afternoons, and two worked nights. The hand-held unit was assigned to narcotics surveillance activities. All personnel using FLIR technology were trained informally, using a "hands-on" approach, which included a "mini-ride-along" used to demonstrate proper technique and to show the FLIR units' capabilities to the new user. The coordinator for the FLIR project for this agency is a certified thermographer.

A second of the rural agencies deployed a hand-held and a vehicle mounted unit. The vehicle-mounted unit was deployed in a patrol unit for routine patrol practices (with later assignment to drug interdiction efforts). The hand-held unit was assigned to the warrant section. This agency sent four officers to a Law

Enforcement Thermographer's Association (LETA) training program. These four certified officers then trained seven others on the technology.

A third rural agency assigned three vehicle-mounted units to specific officers operating the same patrol vehicles on each shift. The hand-held unit was assigned to narcotics. Each of the three patrol officers using the units was trained in FLIR technology during an 8-hour training program at a regional police academy.

3.2.2 Small Suburban Agencies' Training and Deployment Practices

Raytheon's law enforcement partners group consisted of four small suburban participants. One small suburban agency installed two vehicle-mounted units in patrol vehicles, which were used on a rotating basis by various officers. This agency also deployed a hand-held unit in the narcotics section. This unit, later, was "rotated around" to stimulate use in other units. This agency sent four police officers to a regional training program, but had no certified thermographers serving as on-site trainers.

A second small suburban agency used three vehicle-mounted units that were assigned to officers who "expressed an interest." This agency also reserved a hand-held unit for the sergeant's office for use "as needed" by the investigations unit or by patrol. This agency initially trained each of the officers "expressing an interest" in the use of the FLIR by sending them to a LETA-sponsored workshop.

A third small suburban agency took a more universal approach to the technology. This agency installed two vehicle-mounted units in patrol units, and considered the technology as part of the routine patrol package. All patrol officers were trained in the technology, and nearly all were assigned to the FLIR equipped vehicles at one time or another. The vehicles with FLIR were given "first responder" status by communications for prowler/suspicious persons calls. Deployment of the two vehicles was "balanced" geographically, so that one unit was in each side of town at most times. This agency reserved one hand-held unit for the sergeant's patrol vehicle. This agency trained all of its patrol officers in the use of the FLIR as part of its normal in-service training process. The training was conducted on-site, using a two-hour in-service program buttressed by a series of special issue videotapes used as supplementary roll-call training during the life of the program. This agency's training program also included a supervisory "ride-along"/FTO process which required the supervisor to "demonstrate" the unit's capability to the patrol officers. This agency developed two separate training programs, one each for vehicle-mounted and hand-held units.

The fourth small suburban agency used two vehicle-mounted units, which were assigned to patrol and "balanced" geographically, so that one unit was on each

side of town at most times. A third, hand-held unit was kept in the supervisor's office to be accessible to everyone. This agency trained its personnel at a regional police training academy.

3.2.3 Larger Suburban Agencies' Training and Deployment Practices

Raytheon's law enforcement partners group consisted of three larger suburban participants. One of the larger suburban agencies deployed two hand-held units and one vehicle-mounted unit. The vehicle mounted unit was placed in a supervisor's vehicle that patrol officers could "check out" for routine patrol. This agency trained 15 of its patrol officers in FLIR operation during the initial stages of the assessment project. A second group of four officers was trained at a regional police academy.

A second large suburban agency deployed one hand-held unit and one vehicle-mounted unit in patrol service. Both of these units were assigned to specific patrol officers for the duration of the assessment. Each of the officers assigned FLIR units was trained by certified thermographers in the operation of the technology.

A third large suburban agency deployed two vehicle-mounted units in each police sector (for a total of eight). This agency also deployed two hand-held units, one at each of its two police stations, to be "checked out". This agency sent six non-supervisory officers to the project's initial LETA 40-hour basic thermography course at the University of Texas-Dallas. Within a few months, two of these graduates were sent to both LETA advanced and instructor courses. After which, an eight-hour Basic User Course (four hours of classroom and four hours of field practical) was developed and wide scale training of Officers within this agency was implemented. This training was also made available, at no cost, to all the agencies involved in the study through a local regional police-training academy. An administrative directive was written and put into effect on 12-15-97 on The Use of Thermal Imaging Equipment, applications, required training, legal considerations, authorization for use, etc. Over 90 percent of all patrol officers attended the necessary training required to operate the FLIR units. This agency currently employs eight LETA certified thermographers, two of which are certified instructors. This agency's training program is an ongoing process through annual in-service training for all officers as well as periodic recruit and remedial training.

3.2.4 Urban/State-Wide Agencies' Training and Deployment Practices

One of the urban/state-wide agencies deployed two hand-held FLIR devices to its warrant section, for its use in locating and taking into custody fugitives from justice. One of the units was mounted on an extendable pole with a remote focus, allowing the unit to be placed into remote locations such as attics and crawl spaces and allowing the operator to remain safely below or above the unit. This agency took a broad-based approach to training, sending 20 police officers to various thermography courses. Ten officers attended the LETA "basic" course, and ten others were trained "in-house" by certified thermographers. This agency has three certified thermographers on staff.

A second of the urban/state-wide agencies deployed two hand-held units that were "reserved for loaning to smaller agencies" in the areas surrounding the offices to which they were deployed. Two officers from this agency attended the 40-hour course offered at the University of Texas at Dallas during the initial stages of the assessment project. This agency did not take advantage of additional training offered during the program.

A third urban/state-wide agency originally assigned four of the hand-held units to the physical evidence and narcotics sections. Eventually, these units were reassigned to patrol. Training for this department was conducted using non-certified trainers, providing both classroom and field/practical exercises.

4.0 Results

The results of the FLIR field assessment are presented in eight sections, below:

- How and why FLIR was used;
- Where FLIR was used;
- Why FLIR was used;
- How effective FLIR use was when used;
- Contributions to officer safety and the safety of others;
- Utility of FLIR use;
- Post-project wrap-up survey results; and
- Peer assessments.

Each of these sections is discussed in detail, below.

A total of 384 FLIR Use Reports were submitted to the assessment team. These covered the time period of February, 1999-December, 1999. Only seven agencies of the 13-member Raytheon Law Enforcement Partners group submitted use reports to the assessment team. This low reporting rate, in part, is due to the difficulties encountered at the initial project start-up, when the reporting regimen required large amounts of supporting documentation. In part,

the project never recovered from the problems created during this phase. The failure is also due, however, to the inability of the new project team to persuade complete reporting of FLIR usage from all members of the law enforcement partners group. Despite reducing the reporting overhead to a 5x8-inch form (from the previous requirement to include copies of arrest reports, supplementary reports, incident reports and a full-page "NightSight Information" report) self-reporting rates remained low. Despite repeated requests for complete reporting, and comments at monthly meetings regarding the need for complete reporting, self-reporting rates for many agencies remained low. Nonetheless, the 384 use reports completed by members of the Raytheon law enforcement partners group did provide useful information. This information is provided below.

4.1 How and Why FLIR Was Used

Data available from the FLIR Incident Use Report allowed the assessment team to determine how and when FLIR technology was used, and why it was employed. As one might expect, given the name, NightSight technology was used predominately during the 11pm-7am shift, with 145 (56.2 percent) of reported use occurring during the traditional "night." An additional 94 (36.4 percent) use reports were completed during the 3pm-11pm "evening shift", and only 19 (7.3 percent) of the FLIR use reports were completed during the "day shift" hours of 7am-3pm. A total of 258 FLIR use reports were completed with time of day data available. Table Two depicts these data.

Table Two: Time of Use Of FLIR Technology

Time of Day	Number of Cases (%)
7am-2:59pm	19 (4.9)
3pm-10:59pm	94 (24.5)
11pm-6:59am	145 (37.8)
Missing Data	126 (32.8)
Total	384 (100)

Surprisingly, given the fact that data for the project were collected beginning in February, the vast majority of FLIR incident reports were completed during weather which the reporting officers listed as "very warm", or "warm". A total of 65.1 percent of all collected FLIR incident reports were completed regarding an incident which took place in these two categories of temperature. Table Three

depicts the temperatures reported at the time of the incident for the 379 incidents that had these data recorded.

Table Three: Temperature at the Time of The Incident

Reported Temperature at Time of Use	Number of Reports (%)
Very Warm	149 (38.8)
Warm	101 (26.3)
Average	73 (19.0)
Cool	47 (12.2)
Cold	8 (2.1)
Other	1 (0.3)
Missing Data	5 (1.3)
Total	384 (100)

Only 14.3 percent of the FLIR use reports were completed during times of peak efficiency for the NightSight units, i.e., times at which large temperature differentials were likely to exist.

Most of the FLIR use reports were completed in good weather, with 328 of the 384 reports (85.4 percent) completed regarding an incident which took place in "clear weather". Only nine incidents were reported occurring in fog; 16 (4.2 percent) in "drizzle", 16 (4.2 percent) in rain, 11 (2.9 percent) in "windy" conditions, and one (0.3 percent) in snowy conditions. These data are reported in Table Four below.

Table Four: Weather Conditions at Time of Use of FLIR Technology

Weather Conditions	Number of Reports (%)
Clear	328 (85.4)
Fog	9 (2.3)
Drizzle	16 (4.2)
Rain	16 (4.2)
Windy	11 (2.9)
Snow	1 (0.3)
Other	32 (8.3)
Total	384

Based on the data reported by officers using FLIR technology, it appears to be a "fair weather" technology. Whether this is due to a propensity of officers using the technology to use it only in good weather, or this use pattern is due to the officers' belief that the technology would not work in inclement weather is unclear. All of the six "not well" ratings on the technology's functions occurred during poor weather. Interview and ride-along questions did not address this aspect of the technology's use.

4.2 Where FLIR was Used

It appears from the data available that the NightSight units were "outdoor" units. This is understandable, given the nature of policing: the vast majority of police activity takes place outdoors. Similarly, the majority of FLIR usage took place on residential streets (52.1 percent). Again, this is the location where most policing takes place, and, given the fact that the vehicle-mounted units were the most widely distributed, and the most frequently used, (vehicle mounted units were used in 347 of the 384 incidents resulting in a FLIR use report being competed) it should come as no surprise that "residential street" was the location at which most FLIR usage occurred. Table Five, below, depicts the reported location of use of FLIR units during the course of the field assessment. According to the FLIR incident report data, only 4.2 percent of the FLIR usage occurred indoors. Use rates totaled more than 384 incidents, since officers could report multiple "locations of use" of the technology during a single incident.

4.3 Why FLIR Was Used

The NightSight technology was used for a variety of purposes by police officers during the assessment project. Use of the FLIR technology to search for "things," evidence, fruits or instruments of crimes, lost property, contraband, etc. accounted for 12.7 percent of the reasons for using the FLIR technology. Use of FLIR technology to search for people, criminal suspects, missing persons, search and rescue, animals accounted for 60.6 percent of the reported FLIR usage. Police officers using the FLIR technology reported using the units for proactive surveillance 87 (22.7 percent) times and for reactive surveillance 161 (41.9 percent) times. Use figures total more than 100 percent, as officers could report multiple uses of the technology during a single incident. For example, after using the unit to search for a suspect at a prowler call, the officer could set up on a reactive surveillance on the residence.

Table Five: Location of Use of FLIR Units

Location of Use	Number of Reports (%)
House	12(1.4)
Apartment	1 (0)
Mobile Home	1(0)
Outbuilding	0 (0)
Commercial Building	2 (.02)
Pasture	56 (6.5)
Wooded Area	74 (8.6)
Lake	17 (2.0)
Vacant Lot	72 (8.4)
River	2 (.02)
Creek	31 (3.6)
Cemetery	7 (.08)
Park	92 (10.7)
Construction Site	105 (12.3)
Parking Garage	11 (1.3)
Residential Street	200 (23.4)
Roadway	71 (8.3)
Commercial Area	38 (4.4)
Apartment Complex	29 (3.4)
Other	35 (4.1)
Total	856 (100)

Table Six indicates that the FLIR technology was used indoors mainly as a criminal investigation tool, with officers using it most frequently to search for stolen property and evidence (more than 80 percent of indoor usage). Outdoors, the FLIR technology was used similarly, with 45 of 47 reported uses related to criminal activity and the search for evidence.

Table Six: Reasons for Indoor Use of the FLIR Technology to Search for Inanimate Objects

Reason for Use (Total)	Total Number of Reports (%)[8]	Reason for Use (%)[9] (Indoor)	Reason for Use (%)[10] (Outdoor)
Search for Lost Property	2 (0.5)	0(0)	2(4.3)
Search for Stolen Property	10 (2.3)	1(20)	9(19.1)
Search for Fruits of a Crime	14 (3.1)	2(40)	12(25.5)
Search for Evidence or Contraband	14 (3.6)	0(0)	14(29.8)
Search for Criminal Instruments	12 (3.1)	2(20)	10(21.3)
Search for Explosive	0 (0)	0(0)	0(0)
Total	52 (12.6)	5(100)	47(100)

Table Seven (below) depicts the uses of the FLIR technology of the study group in outdoor settings. Indoor use of the FLIR technology appeared to be evenly divided between the active search for persons and suspects and the use of FLIR in surveillance activities. Outdoor use of the FLIR also appeared to be evenly divided between searches for persons and suspects and surveillance activities. The most frequent reported use of the technology for surveillance involved both proactive and reactive surveillance of construction sites, with officers working to thwart repeated theft of equipment and supplies from construction areas.

[8] Percent of total of 384 uses.
[9] Percent of total Indoor uses.
[10] Percent of total Outdoor uses.

Table Seven: Reasons for Outdoor Use of the FLIR Technology to Search for Animate Objects

Reason for Use	Number of Reports (%)[11]	Reason for Use (%) (Indoor)[12]	Reason for Use (%) (Outdoor)[13]
Search for Persons/Suspects	229 (42.8)	29(44.6)	200(42.6)
Search for Animals	18 (.03)	3(4.6)	15(3.2)
Search and Rescue	6 (1.3)	1(1.5)	5(1.1)
Proactive Surveillance	93(17.4)	11(16.9)	82(17.4)
Reactive Surveillance	161(30.1)	14(21.5)	147(31.3)
Other	28(.05)	7(10.8)	21(4.5)
Total	535 (60.7)	65(100)	470(100)

At times, police officers reported using the NightSight for proactive surveillance activities (not in response to a specific call for service) or reactive surveillance (in response to a specific call for service). The units were used for proactive surveillance in 93 incidents and for reactive surveillance in 161 incidents. Officers reported 28 incidents of use of the FLIR technology for "other" purposes than those listed above.

4.4 How Well Did FLIR Work?

Based on data collected from the FLIR use reports, the NightSight FLIR technology worked exceptionally well in the law enforcement environment. Fully 226 of 232 (97.4 percent) officers reporting an evaluation of how well the technology worked stated that it worked "well." Only 2.6 percent (six of 232 reports) felt the technology worked "not very well." Image clarity was also rated as good to excellent by 90.8 percent (337) of the officers completing this section

[11] Percent of total of 384 uses.
[12] Percent of Total Indoor uses.
[13] Percent of Total Outdoor uses.

of a use report. Only 9.2 percent (34) of the officers completing this section of a use report noted image clarity as "poor" or "very poor".

4.5 Contributions to Officer Safety and the Safety of Others

A total of 311 officers responded to question 13 of the FLIR Incident Report, "Did the use of FLIR contribute to officer safety?". A total of 187 completed reports indicated that the FLIR contributed to officer safety, comprising 60.1 percent of all responses to this question. A total of 124 completed reports (39.9 percent) indicated that the FLIR did not contribute to officer safety. Similarly, 199 of 363 reports completed by officers using FLIR indicated that the units contributed to the safety of others (54.8 percent), while 164 reports failed to note such a contribution (45.2 percent).

4.6 Utility of FLIR

Police officers using the NightSight gave the units high marks for utility. Of 374 officers noting an opinion, only 100 (26.7 percent) rated FLIR as less than useful in completing whatever law enforcement task they applied it to. The vast majority of officers using FLIR technology, and completing use reports concerning the incident, found the technology "useful" or "very useful." A total of 274 (73.3 percent) officers rated the technology in one of these two categories, with 154 rating the technology "very useful," and 120 rating it "useful."

4.7 Post-Project Wrap-Up Survey

As part of the project termination phase, an unplanned "wrap-up" survey was conducted of users of the Raytheon FLIR technology. A two-page survey was provided to every officer who used the NightSight devices on a routine basis. The survey was designed to obtain some insight into officer's perceptions about the use of FLIR technology in a policing environment. A copy of the wrap-up survey is included in Appendix C of this report. The survey was provided to 420 officers through the point-of-contact for each department serving on the Raytheon Law Enforcement Partners coordinating group. Blank envelopes were provided with each survey, to allow the individual officers to complete the surveys, seal them in the envelope, and return them to a central point to be mailed to the project team. Only 127 officers returned the surveys, a response

rate of 30.2 percent. This lower than expected response rate can be partially attributable to several of the departmental liaisons classifying the "wrap-up" survey as "voluntary."

The surveys inquired about:

- The number of shifts worked in the last year with a FLIR unit;
- The frequency of use of the unit;
- The method of use of the unit;
- Officer opinions regarding the relative utility of FLIR compared to other policing tools;
- Changes that would make Raytheon's FLIR more useful;
- Rates at which the officers completed FLIR Incident Reports after using the Technology; and
- The number of arrests facilitated by FLIR; and whether or not the technology had been contested in court.

The results of the wrap-up survey were interesting on several fronts.

4.7.1 Reported Hours of Training Received

Interestingly, while all law enforcement agency coordinators reported training all or nearly all of their officers who used FLIR technology very carefully in the use of FLIR technology, the officers who used the technology recalled the training process in a different way. The most frequently reported training status (21 percent) was "received zero hours of training." Fully 51.9 percent of the officers responding reported receiving between one to four hours of training in FLIR and NightSight operation. The median number of hours of training reported was two hours.

4.7.2 Relative Frequency and Reporting of Use

Officers were asked three questions of interest in computing use rates for the FLIR technology. The first question, "How many shifts do you estimate you worked during the last year with a NightSight unit assigned to you?" was designed to assess availability of the technology to police officers who, police coordinators said, were the primary users of the FLIR units. Most respondents reported working 50 shifts during the last year with a FLIR unit available to them. A total of 31 percent of the 127 officers reporting, however, reported working 7 or fewer shifts with the units.

The second question asked the officers to report the number of times per shift they used the FLIR technology. While many (19) of these officers reported never using FLIR equipment in the last year, many officers reported multiple "per shift" uses of the equipment. More than half of the officers reported using the FLIR

units between one to ten times per shift. The median use rate for the 127 officers reporting was three times per shift.

The third interesting question, "How many FLIR Incident Use Reports do you estimate you completed per shift?" yielded results that, as expected, indicated that use rates, apparently, differed substantially from reporting rates. While more than half of the reporting officers noted that they used FLIR technology three times per shift worked, nearly 55 percent of the officers responding to this question noted that they completed only one-half report per shift. Fully 60 of the 127 officers responding to this question indicated that they never filled out a FLIR Incident Use Report. As anticipated, it appears that police officers involved in this field assessment substantially under-reported the rates at which they used the technology. Based on the author's experience with other field-based research, this finding is not surprising. Police officers, perhaps justifiably, feel that their role is the active role of using law enforcement tools, not necessarily in reporting on that use. A residual artifact from the initial evaluative process, which placed an onerous reporting requirement on the users of the technology, may also have reduced the reporting rates experienced in phase two of the project.

4.7.3 FLIR as a Law Enforcement Tool

Question ten inquired as to the officers' use of the NightSight assisting in making arrests: "Did your use of the NightSight unit assist you in making arrests?" The majority of officers (66.9 percent) reported that the FLIR technology was not an arrest-assisting technology. Fully 28.3 percent, however, stated that the technology did assist them in making arrests. Those who did use the technology in arrest situations, however, appear to have found the technology helpful in multiple arrest-focused situations: 15.7 percent of the officers responding stated that the unit assisted them in making more than one arrest—and as many as five arrests—in the last year (Question 11: "How many of your arrests do you estimate were facilitated by the NightSight in the last year?"). Arrest-based processes, however, appeared not to be the primary use of FLIR technology. The majority of officers responding to questions about how the NightSight was used indicated that they used it as a law enforcement tool (Question 4: "How would you say the NightSight unit was most often used by you?"). More than 56 percent of the officers responding checked "law enforcement tool". Use as a "crime prevention tool" was reported in 17 percent of the responses. "Officer safety tool" was reported in 10 percent of the responses.

While the most frequently reported use category was "law enforcement tool", however, the relative importance of the FLIR technology as a law enforcement tool was ranked low by responding officers. While nearly 51 percent of the officers responding ranked the NightSight as one of the top three law

enforcement tools, compared with other existing law enforcement tools, only one officer ranked the FLIR technology as fielded in the NightSight unit as the most important law enforcement tool. The officers ranked as the order of importance of community service tools available to them:

- Police radios (110);
- Mobile Digital Terminals (11);
- Canine units (3);
- Helicopter support (2); and
- NightSight (1).

4.7.4 FLIR as an Officer Safety Tool

Surprisingly, the FLIR technology was not rated highly as an officer safety tool by the 127 officers responding to the wrap-up survey. The most important officer safety tools, in order reported by the responding officers (5. Please rank order the importance of the following officer safety tools) were:

- Portable radios (106);
- Rear-seat shields (12),
- OC spray (5);
- In-car video (2); and
- NightSight (1).

While 22 percent of the officers responding did rate the NightSight as one of the three most important tools to officer safety, more than a third ranked it the least important officer safety tool among the available choices.

4.7.5 FLIR as a Community Service Tool

Not surprisingly, police officers responding to question six "Please rank order (in your opinion) the following community service tools, including the NightSight" found 911 systems to be the most important community service tool followed by community policing activities neighborhood watch and NightSight. Fully 50 percent of responding officers, however, ranked the NightSight technology second or third in order of importance as a community service tool. The officers ranked as the order of importance of community service tools available to them:

- 911 (109);
- Neighborhood watch programs (9);
- Community policing (6); and
- NightSight technology (2).

4.7.6 FLIR as a Crime Prevention Tool

The officers responding to question eight, "Please rank order (in your opinion) the following crime prevention tools, including NightSight" found the NightSight to be the third most important crime prevention tool available to them. The officers ranked as the order of most important crime prevention tools:

- Specialized patrol (60);
- Neighborhood watch (40);
- NightSight (15);
- Crime prevention surveys (11); and
- "Operation ID. (4)"

As a crime prevention tool, 63 percent of the officers responding ranked NightSight as one of the three most important tools available to them.

4.7.7 FLIR as a Testimonial Tool

Question 12 inquired, "Was your use of the NightSight unit ever contested in court?" None of the 127 responding officers reported a contested arrest involving the use of the NightSight. (This number corresponds to data provided by coordinators during on-site interviews). The technology apparently has not arrived at the level of consciousness of defense attorneys in the State of Texas, although a recent United States Supreme Court decision (*Kyllo v. United States, 2001)* has classified FLIR technology as a law enforcement tool to be subjected to constitutional protections.

4.7.8 Making FLIR More Effective

Officers felt strongly that the FLIR technology as provided in the NightSight system was about as effective as it could be. The only "change" a majority of the officers felt would make the NightSight a more effective tool was "more NightSight units" (68.5 percent). The majority of the 127 officers responding did not think that more training, more effective operation, easier access to units, or better layout or installation would improve performance.

4.7.9 Maintenance Issues with the NightSight Technology

Maintenance issues with the units were assessed using wrap-up interviews with the law enforcement partners and by monthly focus-group meetings with the law enforcement partners. Several issues were noted during the course of the field assessment. In every instance, Raytheon engineers were quick to assess, diagnose and solve problems reported by the law enforcement partners. The issues noted by the partners included:

- A problem with moisture penetrating the camera-lens body on vehicle-mounted units, rendering the units ineffective;
- Problems with erratic zoom, tilt and pan on some of the older units;
- Circuit board problems on some of the older units;
- Broken or damaged camera windows, due to a failure of officers to rotate the unit to the rear on extended or high-speed trips, or due to failure to note the additional height created by the unit in parking garages or other restricted height locations; and
- Excessive wear on joysticks on some units.

Engineering responses to these issues are reportedly incorporated into the new Raytheon 4000B vehicle-mounted system available in August of 2000. According to the law enforcement partners, and based on observations of assessment project staff, Raytheon responded rapidly to these issues, fixing both the units experiencing problems in the field, and developing solutions to prevent the occurrence of problems with units that had not experienced problems.

Virtually all of the problems reported were with the vehicle-mounted units. While the hand-held units were trouble-free during the course of the field assessment, it appears that their use rates were much lower than the use rates for the vehicle-mounted units. Vehicle-mounted units accounted for 91.3 percent of all reported FLIR use (334 of 380 reports which included accurate data for this question). While hand-held units accounted for only 8.7 percent of reported usage, they comprise 43 percent of the deployed units. An understanding of the nature of police work explains the substantial differences in use rates. While the field assessment deployed more vehicle-mounted units than hand-held units (27 and 20, respectively), the vehicle-mounted units were widely distributed and easily accessible to patrol personnel. The hand-held units were considered "special item" tools, and, in some cases had to be signed out or used by "permission." As a result, 57 percent of the available FLIR technology (vehicle-mounted units) accounted for 91 percent of the use rates.

4.8 Results of Peer Assessment

While this field assessment was not intended to evaluate the performance of the various law enforcement partners, as part of the final interviews conducted with members of Raytheon's Law Enforcement Partners coordinating group, members of the assessment team asked each individual interviewed to name the agencies which had done the "best" and "worst" jobs of implementing the NightSight program. These recommendations were based on more than a year's experience with monthly coordinating meetings in which members exchanged ideas and experiences regarding implementation methods, problems, issues and solutions

surrounding the NightSight device and its deployment in a law enforcement environment. The question, "Other than your department, which agencies do you think did the best job implementing the program?" was designed to tap the participants' "real world" understanding of the issues surrounding the implementation of a new technology in policing. Results of responses to the question indicated that two large suburban, one small suburban, and one urban/state-wide agency were viewed by their peers as doing the "best" jobs of implementing the technology in law enforcement environments. Two urban/state-wide agencies were viewed by their peers as doing the "worst" job of implementing the technology in law enforcement environments. An assessment of implementation practices in these five agencies may be informative.

Several common characteristics can be identified for both high-use and low-use agencies, as identified by the peer group. These similarities seem to revolve around four issues:

- Training;
- Deployment choices;
- Organizational experience with and acceptance of technology; and
- The presence of champions of the innovation.

Each of these issues is discussed in some detail below.

4.8.1 Training

All of the high-use agencies, regardless of size, focused on strong training regimens for the officers who were to use the technology. Without exception, the three high-use agencies had LETA certified officers on staff, who had direct day-to-day use of the NightSight and who trained other officers using the units in their use. The second training tactic noted in common with all three high-use agencies was that the training was broad-based, often involving training "anyone who might use the units," or requiring complete training before any officer was allowed to use the units. Without exception, all three high-use agencies used both external (LETA or regional police academy) training and internal training. In addition, all three high-use agencies trained using both classroom (theory) and field exercises (application). One of the three high-use agencies included in-service refresher training in the form of five specially produced (in-house) training videos used as roll call training for all patrol officers. This agency also included a supervisory "ride-along/FTO" session for all patrol officers, requiring the officers' supervisors to introduce them to the technology in the field and to demonstrate its abilities and weaknesses.

Many of the low-use agencies, while they had trained personnel on-site, have trained, as one interviewee noted, "administrative types," rather than those with day-to-day operational responsibility for using the technologies. Few of the low-use agencies noted broad-based training regimens, and even fewer still noted using both classroom and field-based training. Many of the low-use agencies used a "hands-on" or "on the job" training regimen for most of their personnel involved in the assessment. One of the low-use agencies noted the use of a "supervisory ride-along/FTO" process as part of the training. Two of the three low-use agencies relied only on external training, with no agency-specific follow-up.

Common characteristics associated with high use rates (or inversely associated with lower use rates) regarding training seem to be:

- Existence of internal LETA certified trainers;
- Existence of internal training regimens;
- Broad-scale training of large numbers of officers; and
- Training in both theory and practice of FLIR usage (classroom and field-based training).

An initial assessment of training as it relates to FLIR yields the conclusion that, as a given technology becomes more widely available within a given agency, it becomes more important to train broadly and carefully. While FLIR technology in its design, development and dissemination is complex, the use of the technology is relatively simple, virtually akin to "point and click." Nonetheless, this assessment has documented substantial variances in effective utility of the technology, potentially tied to training strategies and processes.

4.8.2 Deployment Choices

Obviously, several choices exist regarding deployment of FLIR technology in a law enforcement environment. The three high-use agencies took two separate approaches: two of the agencies approached the deployment as a "normal course of doing business;" the third took a specialized unit approach. Two of the agencies (a large suburban agency and a small suburban agency) deployed the technology on a broad-scale basis in their patrol divisions. Both of these agencies reported training "all" of their officers in the technology, and both used both classroom and field-based training. In both of these agencies, the technology was viewed as pervasive, i.e., as being part of the routine patrol support package. The large suburban agency deployed eight units, equally distributed by geographic sector. The smaller suburban agency deployed two units, distributed by geographic sector. Officers were rotated through the vehicles equipped with FLIR in the same manner they would be rotated through any vehicle assignment process. In both of these agencies, no one group of

officers "possessed" the technology: it was universally available to all officers. All officers appeared to have an equal opportunity to learn to use, use, or not use the equipment.

The third high-use agency took a somewhat different approach. Instead of assigning the units to patrol, they assigned two hand-held units to the warrant section, responsible for locating and arresting fugitives. Even with this unit, however, the technology was not owned by a few officers; it was universally distributed to all personnel in the unit. All were trained—by LETA certified trainers—and all used the technology.

The low-use agencies took a more possessive approach to the technology. Without exception, their deployment decisions were restrictive: the units were assigned to a very small group of officers (in one case, only two officers handled the equipment during the entire field assessment phase), in specialized (non-patrol) units. The low-use agencies tended to compartmentalize the technology, rather than to distribute it.

Common characteristics associated with success (or inversely associated with less success) regarding deployment seem to be:

- Broad-based deployment (even in specialized units);
- Routinization of the technology;
- Group ownership of the technology;

4.8.3 Organizational Experience with and Acceptance of Technology

Two of the high-use agencies appeared to have heightened levels of experience with and acceptance of technology as part of the policing process. Both of these agencies (a larger suburban and a small suburban agency) have a fairly extensive list of technological tools at their disposal. The larger agency currently deploys Mobile Digital Terminals and is moving toward implementation of Mobile PCs; it has a LO-Jack system in place (a system allowing GPS tracking of stolen vehicles), as well as PRO-NET, an electronic (radio-frequency-based) bank-bag tracking system that allows the police to locate (geographically) stolen funds from bank robberies. Comments from officers working in this agency regarding technology seemed to be "I like it!" The second agency, a smaller suburban agency, can best be described as technology-rich. The agency has GPS-based fleet locators, electronic alarm monitoring in the communications section, Windows-based CADS, LO-Jack, PRO-NET, in-car video, in-car digital cameras used for appending photos to field interview reports, and in-car MDTs. Technology at this agency is so pervasive that the coordinator for the FLIR project noted that some officers feel overburdened by the array of technology deployed by the department.

Neither of the low-use agencies could point to unusual experience with or acceptance of technology, although one of the agencies does deploy MDTs for its patrol vehicles. This agency, however, originally assigned its FLIR units to non-patrol units.

4.8.4 Presence of Champions of the Technology

In virtually every instance of success, a champion of the technology existed within the department. In virtually every instance of lack of success, a champion was missing. Two of the three high-use agencies had mid-level champions (sergeants) and one had a high-ranking champion (a captain). Regardless of their ranks, they all had one thing in common: they had strong positive informal (and in some cases formal) working relationships with the people who were expected to use the technology. As one of the champions noted, "sometimes it's not the message; it's the person delivering the message." In one agency, the champion worked in the same unit in which the technology was deployed; in two agencies this was not the case. During interviews with these champions they tended to use words and phrases were noted such as "excited," "desire," "optimism," and a "belief" in the technology. The champions in all three high-use agencies seemed to take an active interest in the project, and seemed to work to make implementation as successful as possible.

In both instances of low-use agencies, the champion was replaced with a person responsible for coordination. No strong personal or working relationships were noted between the coordinators and those using the technology. During interviews, these individuals used words and phrases such as "chain of command," "compliance," "requirements," and "rank". The commitment to success evident in interviews with champions from high-use agencies seemed to be replaced with a commitment to organizational structure and policy.

5.0 Conclusions

Technically, the NightSight FLIR was well received by the police officers that used the technology. Based on data collected from the FLIR use reports, the NightSight FLIR technology worked exceptionally well in the law enforcement environment. Fully 226 of 232 (97.4 percent) officers reporting an evaluation of how well the technology worked stated that it worked "well." Only 2.6 percent felt the technology worked "not very well." Image clarity was also rated as good to excellent by 90.8 percent (337) of the officers completing this section of a use report. Only 9.2 (34) percent of the officers completing this section of a use

report noted image clarity as "poor" or "very poor". Further testimony to the effectiveness of the NightSight FLIR technology is that the only recommendation officers had for improving the technology was to have more of the units available. For those familiar with the ability of law enforcement to find fault with nearly any tool, this is a remarkable performance for a "new tool".

In addition, a total of 311 officers responded to question 13 of the FLIR Incident Report, "Did the use of FLIR contribute to officer safety?". A total of 187 completed reports indicated that the FLIR contributed to officer safety, comprising 60.1 percent of all responses to this question. As one Officer noted, "It worked great, all went as trained and Officer safety was GREATLY enhanced". Conversely, a total of 124 completed reports (39.9 percent) indicated that the FLIR did not contribute to officer safety. Similarly, 199 of 363 reports completed by officers using FLIR indicated that the units contributed to the safety of others (54.8 percent), while 164 reports failed to note such a contribution (45.2 percent). Based on these data, about half the time that a NightSight unit was deployed during this field assessment, it improved safety factors for officers and or civilians.

Individual comments from officers using the technology were uniformly positive. Words and phrases like "great tool", "invaluable", "invaluable for officer safety", "very effective", "astounded by its functions and capabilities", "very helpful", and "an important tool". While some negative comments were received (see below) most of those had to do with a perceived scarcity of available units and a lengthy lag time between call-up of the technology and its arrival. As one officer noted in the "additional comments":

> "Burglary suspects, who were blacked out 500 yards across a field were baffled on how they were seen; especially after they were earlier undetected by other units not equipped with FLIR "... "can't say enough in support of them".

It is clear from this assessment project that FLIR is perceived to be a nighttime patrol tool, and that its major uses are outdoors, particularly on residential streets. The functionality of the unit as a "special unit" tool for narcotics, physical evidence, special operations, etc. was not supported by this field assessment. The degree to which this is attributable to poor reporting by these units versus poor deployment and poor utilization is not clear from the data available to the assessment team.

Compared to other available law enforcement tools, FLIR technology is clearly a support tool, not a replacement tool. This conforms well with the conceptualization of the NightSight units:

- Suspect identification and apprehension;
- Surveillance by law enforcement of suspected criminal activity;
- Warrant service in problematic environments; and
- Law enforcement operations in remote locations.[14]

When NightSight FLIR was used by police officers, it was used overwhelmingly to search for people. More than three quarters of the use of the units was reported to be for "proactive surveillance". In addition, officers reported a 42 percent use rate for "reactive surveillance".[15] Use of the NightSight unit for warrant service was the technology application selected by agency peers as one of the most successful applications of the FLIR technology. While the unit was no doubt effective in remote locations (one sheriff's agency reports that its patrol cars use the FLIR as a driving tool at night, to avoid hitting roaming livestock), the major use reported for the technology was on paved residential streets, looking for suspects.

As with so many law enforcement technology innovations, however, it appears that it is not simply the technology that makes implementation successful or not. Without question, some of Raytheon's law enforcement partners were more successful than others in implementing the FLIR technology, as fielded by Raytheon. For nearly half of the partners to have submitted no use reports is problematic for more than the ability to clearly assess the impact of the technology that was central to this project. Based on information received from the interviews conducted with the law enforcement partners at the termination of this assessment, it is clear that some members of the law enforcement partners group simply did not deploy the technology during the course of the project.

Further, it is clear from comments included on the narrative portion of post-project survey provided to 420 officers, and returned by 127, that some officers resented the technology—and even resented those who championed the technology within the departments. As one officer noted in his "additional comments:"

> "While the NightSight does have legitimate uses, it has been 'hyped' as being far more useful than it truly is. The few arrests and apprehensions that are used as examples for more spending on this apparatus are a "drop in the bucket." This is proven out when one sees the vigor with which the proponents of NightSight have when desperately seeking additional

[14] Source: Letters to invited law enforcement organizations, dated October 15, 1996.
[15] Officer could report multiple uses for each incident report.

and unorthodox uses for the equipment which even Raytheon did not have in mind."

The reader should note that this is the opinion of only one officer, and virtually the only forcefully negative comment gleaned about the technology. Also, during the project introduction, the partners were urged to test the technology by "developing new uses."

The one constant lesson available from attempts to engender change in law enforcement since the 1950s is that change and innovation do not come easily to the field. There are lessons to be learned from this project, however.

First, innovation will be resisted by some, no matter what the change or how it is introduced. For example, even in one of the agencies which was more successful in its implementation efforts, due significantly to the fact that it was a technology-rich environment, one officer noted that some officers felt over-burdened by the addition of another technological tool. Some of the resistance is organizational, some of it directly related to relationships with the champions of change, but it is real, nonetheless.

Second, there are common elements in the implementation processes of the high-use agencies which should help understand and drive future attempts to integrate any technology in policing, regardless of the nature of the technology or the nature of the environment in which it is implemented.

- For technology to work, it must be taken "out of the box." The disparity between use rates (reported) for vehicle-mounted v. hand-held FLIR is remarkable. With only six more units deployed, vehicle-mounted units out performed hand-held units by more than ten-to-one in terms of reported usage. Those agencies that envisioned the FLIR technology as "Everyman" technology were selected by their peers as the most effective agencies in implementing the FLIR technology. Those which envisioned FLIR technology as "reserved," or "supervisor-controlled" technology tended to be selected by their peers as the least effective agencies in implementing the FLIR technology.

- For technology to work, it appears that a broad spectrum of officers must be trained in its usage, and the training must include several key elements:

    - Basic familiarization with the technology (a process often referred to by many in the more successful implementing agencies as "switchology;"
    - Introduction to methods and manners of use that have been successful in other agencies;

- Practical application of the technology in the field;
- Frequent reinforcement of initial training at roll call; and
- Demonstration of commitment and support for the technology by direct supervisors, through supervisory "ride-alongs" to introduce, support and demonstrate the technology.

- For technology to work, it appears that it cannot exist in a vacuum. A sufficient base of support must exist in order for any new technology to take hold. Problem-solving systems, an overall acceptance of technology as a partial solution to policing issues, and some (even small) successes with technology in the past seem to be correlated with the high use agencies' histories. For example, one of the high-use agencies, described by the agency's project coordinator as "technologically rich," had in place an automated trouble reporting and resolution system—used for other technology elements, but adapted for NightSight. This facilitated a certain level of comfort with the NightSight technology as robust enough to "take a hit," without upsetting ranking officers because the technology was disabled.

- For technology to work within law enforcement organizations, it appears that it must have knowledgeable "champions", willing to support the technology, to introduce it to their peers, to trouble-shoot the technology when it does not work, and to resolve training, deployment, application and repair issues. Often, these champions are better received if they are closer to the day-to-day issues involving the technology. Two of the three successful champions of the NightSight technology were sergeants who had a reasonable working relationship with the individuals who were charged with the day-to-day use of the technology. The third successful champion was a captain who had successfully led the department through multiple technological challenges.

6.0 Summary

While the NightSight FLIR technology appears to be an extremely effective tool for policing, achievement of this status appears to require more than simply taking the technology "out of the box" and expecting it to work well. The technology appears to need to be nurtured, supported, championed, assessed, evaluated, and supervised to be effective. Successful implementation appears to require a proactive approach, not a reactive "orders given" mentality. Those who expect FLIR—or any other new police technology for that matter—to work simply because it's there seem destined to be disappointed. The lessons learned from this field assessment seem to indicate that no matter how good the technology—and NightSight FLIR seems to be a very technically competent technology—it is the human systems that support, nurture and "sell" the technology that are the true harbingers of success.

Comparatively, NightSight will not replace police radios, MDTs, OC spray, in-car video or rear seat shields as officer safety tools. But as a complement to these officer safety tools, FLIR technology appears to be well received by well-trained, well-supervised, well-supported patrol officers. Comparatively, NightSight will not replace 911, community policing, or neighborhood watch as a community service tool. But as a complement to these community service tools, FLIR technology appears to be well received by well-trained, well-supervised, well-supported patrol officers. Comparatively, NightSight may replace crime prevention surveys, and Operation ID as crime prevention tools, but it will do so only if the agency managing implementation makes the tool available to well-trained, well-supervised, well-supported patrol officers.

However, when viewed in relation to other "seeing" technologies, it appears that vehicle- and hand-portable FLIR systems offer substantial benefits. First, thermal imaging technology is not dependent upon light energy to allow the officer to see a given target. Trained and experienced officers familiar with the tactical and operational aspects of various detection technologies suggest that FLIR is superior to visible light systems in that:

- The use of light reveals the officer's position, giving advantage to the suspect who has the opportunity to hide, run or prepare for a confrontation.
- Officer's vision is limited by the intensity of the light beam.
- Light enhancement technology can be virtually rendered useless by bright light "blooming" directed at the officer virtually blinding the officer.
- Light technology has a limited field of view restricted by the size and direction of the beam of light.
- Light reflects off of foliage aiding the concealment of the suspect.
- Light is prone to scattering and absorption by smoke and dust severally limiting the officer's field of view.

Since FLIR utilizes heat energy to generate a picture, it is less limited and has been found to be more useful and reliable under most conditions, including being able to see through smoke, dust, a few layers of foliage, fog and light rain in both day and night conditions. From locating injured persons, hidden suspects, stolen vehicles and detecting criminal activity without being seen; to locating recently discarded evidence, hidden compartments or skid marks at accident scenes (unseen by sight), this assessment seems to indicate that thermal imaging technology is a valuable law enforcement and public safety tool that reduces manpower costs and arguably makes police work safer. Advances in technology, ease-of-use and decreasing cost may make thermal imaging technology practical for many police departments.

More important than technical advantages, however, given the results of this preliminary assessment, may be the support systems with which thermal imaging technology—and indeed any line-used technology in policing—are planned, designed, implemented and supervised. It appears that differences in the effectiveness of the NightSight units assessed during this project are attributable to differences in planning, implementation and supervision, not to weaknesses in the technology.

Critical lessons learned from this assessment of hand- and vehicle-portable FLIR technology may be directly attributable to attempts to introduce technology into other areas of policing and law enforcement. Training, deployment methodologies, organizational experience with and acceptance of technology, and the nature of the "champions" of the technology may all affect the outcome of a technology innovation.

First, there appear to be several more successful training methods associated with those agencies in this study group who had success in introducing a new technology. The first among these was an organizational commitment to a strong training regimen. Certified, experienced on-staff trainers appear essential to success, as is a willingness to access external training resources. Virtually without exception, the agencies that were able to generate high use rates for the FLIR technology availed themselves of a broad spectrum of training assessment, development, delivery and assessment. The sole use of "hands-on" or "on-the-job" training modalities is not indicated by the results of this study.

Second, it appears that selections of deployment methods are also important to successful integration of technology in law enforcement. Agencies that subscribed to a broad based deployment within work units, i.e., training of and access to the technology by all patrol officers, or training of and access to the technology by all officers within a specific unit, appeared to be more able to attain high use rates for the technology. In effect, it appears that success in implementing an effective new technology is more a question of "ownership" than it is of the technology itself. From the results of this assessment, it appears that keeping the technology "special" and "safe" is an effective way of ensuring that its implementation is ineffective.

Third, it appears that organizational experience with, and comfort in, a technological environment is also important to the effective implementation of new technologies. It appears from this study that a minimum comfort level with new technologies is important to have effective implementation. Such a comfort level appears to serve as a foundation upon which an agency can build training, deployment and development processes to ensure effective implementation.

Fourth, it appears essential that, regardless of training and deployment levels, and regardless of the agency's comfort level with technology, success is dependent upon internal champions who take it upon themselves to foster the implementation and assessment of the technology. Without exception, the agencies in this study that had strong internal champions found effective implementation of the FLIR technology easier. These champions need strong formal (or informal) working relationships with the units implementing the technology, and, it seems, need to enjoy a good reputation within the agencies in which they foster the technology.

Common characteristics associated with high use rates (or inversely associated with lower use rates) regarding champions of the technology seem to be:

- A commitment to innovation;
- Assignment at lower levels of the organization (sergeants or lieutenants);
- Excitement about the technology as a problem-solving tool;
- A willingness to work to make the technology effective; and
- Good working relationships with the officers who will use the technology.

Fifth, virtually any new innovation, it appears, will be resisted by some. Eventual adoption and true institutionalization—although the latter was not addressed in this assessment—appear to be dependent upon several factors not directly related to the technology. From the information gathered during this study, it appears that this resistance to new technology is best overcome through effective training, use of deployment methods that generate "ownership," building familiarity with technology in general, and selecting a technology champion who has the ability to build informal acceptance for the technology and its implementation processes.

As policing moves to less militaristic, authoritative institutions, supportive technologies become more important than interdictive, controlling technologies. The ability to control space and activities through technology, rather than physical presence becomes essential. It appears that Raytheon and the Raytheon partners have identified two separate and distinct factors that will allow policing to move toward implementation of supportive technologies: a technology that it effective (hand- and vehicle-portable thermal imaging technologies) and implementation methodologies that assist in adopting effective technologies in a law enforcement environment.

Appendix A
FLIR Incident Report

FLIR INCIDENT REPORT

Section I. Description of WHO used FLIR and WHEN it was used:

1. Name: _____ 2. Badge #: _____ 3. Agency: _____ 4. Month-Day-Year of Incident: _____

5. Time of Incident: _____ (Military Time) 6. Temperature (check only one): __ very warm __ warm __ average __ cool __ cold __ very cold __ other _____

7. Weather (check as many as apply): __ clear __ fog __ drizzle __ rain __ windy __ snow __ icy __ other _____

Section II. Description of location WHERE FLIR was used:

8. FLIR was used (check as many as apply & explain in the narrative on the back of this card):

a. __ in a house
b. __ in an apartment
c. __ inside a mobile home
d. __ inside outbuilding
e. __ inside commercial building
f. __ other: _____
a. __ in a pasture
b. __ in a wooded area
c. __ in a lake
d. __ in a vacant lot
e. __ in a river
f. __ in a creek
g. __ in a cemetery
h. __ in a park
i. __ in a construction site
j. __ in a parking garage
k. __ on residential streets
l. __ on a roadway: surface type: _____
m. __ in a commercial area
n. __ an apartment complex
o. __ other: _____

Section III. Description of WHY FLIR was used:

9. FLIR was used to/for (check as many as apply & explain in the narrative on the back of this card):

a. __ search for lost property
b. __ search for stolen property
c. __ search for evidence (fruits)
d. __ search for evidence (contraband))
e __ search for evidence (instruments)
f. __ search for explosives
g. __ search for suspect(s)/person(s)
h. __ search for animals
i. __ search & rescue
j. __ proactive surveillance (pre-planned)
k. __ reactive surveillance (part of patrol)
l. __ other (list):_____

Section IV. Description of HOW FLIR performed:

10. Which FLIR was used? ____ car mounted unit ____ handheld unit 11. FLIR functioned: __ well __ not very well (explain in the narrative on the back of this card)

12. FLIR's image clarity was (check only one): __ very poor __ poor __ good __ very good __ excellent 13. Did the use of FLIR contribute to officer safety: __ yes __ no

14. Did the use of FLIR contribute to the safety of others: __ yes __ no

15. FLIR's usefulness in this situation was (check only one): __ very useful __ useful __ somewhat useful __ not useful 16. Was the incident videotaped: __ yes __ no

Section V. Provide a brief DESCRIPTIVE narrative of the incident on the back of this card.

Appendix B
Ride-Along Interview Schedules

Ride-Along Interview Schedules

Hello, my name is _____ I am an assessor with the Raytheon/NIJ/Dallas-Grayson Corridor Law Enforcement Partnership FLIR project. I'd like to ask you a few questions concerning your use of the Raytheon FLIR equipment during the past few months. None of your responses will be identified as coming from you, by name or by the department name, but the results of the interview will be used to evaluate the FLIR technology The last time I was here was._____ Do you mind if I take notes during our conversation?

1. Have you experienced any technical problems (durability, maintenance, etc.) with the equipment itself since the last time I was here?

2. Has the equipment produced any new notable successes in the field since the last time I was here?

3. Have you experienced any new notable problems with the equipment related to performance, not technology, since the last time I was here? (Any situations in which the equipment did not produce the results you expected?)

4. Have you noticed any direct officer safety issues (positive or negative) associated with the use of the FLIR technology since the last time I was here?

5. Have you noticed any direct citizen safety issues (positive or negative) associated with use of the FLIR technology since the last time I was here?

6. Have you noticed any areas of the use that show a need for more or different training since the last time I was here?

7. Have you noticed or thought of any better ways to adapt or use the equipment in law enforcement settings since the last time I was here?

8. Do you have any recommendations for changes to the design, installation or utilization of the equipment?

9. Have you noticed any issues, problems, successes, concerns or other factors associated with use of the equipment that we haven't talked about?

10. Is there anything you want to say that we haven't talked about?

Appendix C
Post-Project Wrap-Up Interview Schedule

Post Project Wrap-Up Interview Schedule

Deployment:

How was the technology deployed? How many units of each type (hand-held and vehicle-mounted)? Who received the units and how? Were units assigned to specific officers, mounted on cars and "rotated" through various officers, assigned to specific units, e.g., narcotics, warrant squad, etc.

Training:

What training methods were used? How many officers were trained, by whom, and on what topics? Approximately how many hours of thermal imaging (TI) training did each officer receive? Did certified thermographers provide the training? How many certified (LETA or other) thermographers are in the department?

Lynch-pin:

Who served as the project manager for the imaging project at the PD? Why was this choice made? What special characteristics does this individual have that made this a "good choice," e.g., lots of technology implementation experience, trained thermographer, good rapport with unit in which imagers were deployed, etc.

Problem-Solving:

What were the problem-solving methods used? Was there on-site technical assistance available in the person of a trained thermographer, a "techie," etc.? How did the problem solving process work? What were the "typical" problems processed by this person?

Supervision :

How was the use of the units supervised? What were the reporting policies (FLIR Incident Reports required on every use or simply made available and "asked for")? Who decided that the PD/SO would participate in the study? How important was this study/technology to the chief law enforcement officer?

Best/Worst Anecdotes:

What are the three "best" success stories for the technology? What are the three "worst" (failure) stories for the technology?

Maintenance Issues:

What maintenance problems/issues arose during the project? How were each of those resolved?

Court Challenges:

Has the technology been challenged in court? If so, how? What were the results of these challenges?

Best Implementing Agencies

Based on your understanding of the way the various partners deployed the technology, which three agencies - **other than yours** - would you say did the best job of implementation, in rank order? Why would this be your decision?

Which three did the poorest job, in rank order? Why would this be your decision?

Surveys:

Due to some variances in reporting rates, we need a "benchmark" against which to compare reported usage with "actual usage." We would like to leave one survey, consisting of two pages of questions, for each officer who has used the technology, and would like you to ensure that each officer completes the survey. [Show a copy of the survey to the interviewee]. Would you be willing to do that for us?

The surveys will be accompanied by a FedEx return envelope for the interviewee to use to return the documents to Public Management Resources. A two-week turn-around is needed.

Annual Report

Obtain a copy of the latest annual report or crime statistics. If no annual report available, identify the number of sworn, civilian personnel, and crime rate for last year.