TRAINING OPPORTUNITIES FOR THE THERMAL IMAGING CAMERA

STRATEGIC MANAGEMENT OF CHANGE

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ABSTRACT

Through a community-supported fundraiser, the Ipswich Fire Department (IFD) will be the recipient of a new thermal imaging camera (TIC) in the near future. The problem was the IFD did not have a training program for the TIC.

The purpose of this applied research project was to develop a list of training opportunities for the thermal imaging camera. Action research methodology was used to answer the following three research questions:

1. What types of situations have thermal imaging cameras been used for?
2. What are the disadvantages of thermal imaging cameras that relate to possible training opportunities?
3. What types of training do fire departments require for their personnel to utilize thermal imaging cameras?

The procedures that were used for this applied research project included a literature review and a survey. The initial literature review was conducted at the Learning Resource Center at the National Fire Academy in Emmitsburg, Maryland. Applicable information was obtained from trade journals, books, periodicals, and applied research projects. Additional information was gathered from the IFD video library, manufacturer brochures and an exhaustive internet search. The second procedure was a survey sent to fire departments in Massachusetts that have a TIC. The survey was used to find what types of training were required for their personnel to utilize a TIC.

The results showed there was a multitude of situations in which a TIC can be used, with successful results. As with any new tool, disadvantages were relevant to a TIC. The leading disadvantage was training, in some cases the lack of training on a TIC. The research found a

wide range of training requirements for firefighters using the TIC. The survey results indicated the majority of the fire departments in Massachusetts, with a TIC, have had manufacturer and/or in-house training.

The following recommendations were made to address concerns and ideas on TIC training.

- Initial training to be conducted by the manufacturer or their designee.
- Hire Safe-IR or similar company to provide practical training.
- Develop the training program around the training opportunities.
- Establish monthly training.
- Establish an annual refresher.
- Use the TIC during training sessions to document and show member progress.
- Update the department’s standard operating procedures.

TABLE OF CONTENTS

INTRODUCTION

On December 3, 1999 six Worcester firefighters lost their lives at the Worcester Cold Storage and Warehouse Company (Eisner, 2000). This tragic fire became the catalyst for a community wide fundraiser to purchase the Ipswich Fire Department (IFD) a thermal imaging camera (TIC). The fundraising campaign began in March of 2000 (Mehaffey, 2000a). Cook (2000) states, “The TIC is just a tool, and you have to apply standard training and tactics to ensure continued safe operations in the event a failure occurs. Lack of adequate personnel training can render a TIC useless” (p. 32). The problem is the IFD does not have a training program for the TIC.

The purpose of the applied research project (ARP) is to develop a list of training opportunities for the TIC. Action research methodology was used to answer the following three research questions:

1. What types of situations have thermal imaging cameras been used for?
2. What are the disadvantages of thermal imaging cameras that relate to possible training opportunities?
3. What types of training do fire departments require for their personnel to utilize thermal imaging cameras?

BACKGROUND AND SIGNIFICANCE

Ipswich, founded in 1633, is one of the oldest towns in the United States. The town is situated along the Atlantic coast approximately 30 miles north of Boston, the state capital. The town encompasses 33 square miles. Ipswich is well known for the famous “Ipswich Clams” and 17th century homes. There are over 40 homes built prior to 1725 that are still standing and

occupied. The town has a variety of industries and businesses, but is primarily a residential community (*History,* 1999).

The protection of the town and its 13,497 residents (Richards, 1999) is the responsibility of the IFD. The IFD protects $1,148,032,462 in real estate and personal property (Ragonese, 1999). In 1999, the IFD responded to 1,292 calls for assistance, conducted 1,514 inspections and completed 2,110 hours of training (Durrell, 1999). The IFD is a combination department organized as part of the Ipswich Department of Public Safety (Ipswich Fire Department, 1996). The department consists of an 18 member career force and a 21 member call force.

The career force is comprised of a chief, 5 lieutenants and 12 firefighters. The career force is divided into 4 duty shifts designated as A, B, C, or D. Each shift is comprised of a lieutenant and three firefighters. The town receives 24-hour coverage with the shifts working a schedule of 24 on, 24 off, 24 on and 5 days off (Town of Ipswich, 1999). The fifth lieutenant is assigned as the department's staff lieutenant working a Monday through Friday schedule (Town of Ipswich, 1997). All career members, except for the chief, belong to the union represented by the Ipswich Fire Fighters Local 1913, an affiliate of the International Association of Fire Fighters (IAFF).

During the month of March, retired firefighter Robert Gambale kicked off a fundraising campaign to purchase the IFD at least one TIC. Gambale states, "It's a very worthwhile cause. If everybody in town donated $1.41 we'd be there today" (p.3). The goal is to raise a minimum of $19,000 to purchase the TIC and the necessary equipment to connect the TIC to a monitor (Mehaffey, 2000a).

During the ensuing weeks, the IFD experienced three incidents in which a TIC would have been an invaluable tool. On March 26, 2000, the department responded to a two alarm

structure fire in a 2½ story residential home which resulted in extensive heat, smoke and water damage (Theriault, 2000). Mehaffey (2000c) stated,

> Firefighters initially knocked the fire down and a crew moved to the second floor. When the first floor crew began removing ceiling tiles they discovered fire above the ceiling. The second floor crew was ordered back down, and the fire inside the walls quickly moved from the second floor into the attic, prompting a second alarm. (p. 1)

On March 29, 2000, the department responded for a smoke investigation in a residential home. Edwards (2000) stated,

> Upon arrival, we found a small area on the outside of the house that was charred. There was a light smoke condition on the first floor of the house and a moderate to heavy smoke condition in the crawl space under the house. (p. 1)

On March 31, 2000, the department would respond to its second structure fire in five days (Mehaffey, 2000b). French (2000) stated,

> On arrival I found a 2 story wood frame cape style structure with heavy fire in the rear and heavy black smoke coming from all windows. A 1½" hose line was advanced through the front door and moved toward the rear of the house. A second line was taken to the rear door of the house. The main fire was knocked down. Crews worked checking for extention [sic] in the walls and ceilings. Fire was found in the first and second floor walls and ceilings. (p. 2)

Mehaffey (2000b) stated,

> Durrell said in this fire, the one last week on High Street, and another reported Thursday at 50 Mile Lane firefighters could have used a Thermal Imaging Camera (TICS).…If the

> department had the camera, said Durrell, especially in the High Street fire which flared up after firefighters thought they'd knocked it down due to fire in the walls and ceilings. "We would have been able to use it to see if it got into the walls," he said. "A lot of times you have to open the walls or remove shingles, which causes damage. When we don't have heat we have to check," he said. (p. 1)

The past and present indicate that a TIC will be a welcome asset to the IFD in handling emergency incidents. The goal of this ARP is to develop a list of training opportunities for the TIC. In the near future, it is hoped that training programs can be developed around the training opportunities.

This applied research project was completed to fulfill the course requirements for the Strategic Management of Change program. To accomplish this, the Change Management Model in the student manual was utilized (Federal Emergency Management Agency, 1996).

LITERATURE REVIEW

Research Question 1: Thermal imaging cameras have been utilized in a broad range of situations around the United States and abroad. A brochure from Bullard (n.d.) identifies seven areas in which a firefighter can use a TIC. A TIC can be used for size-up, attack, search and rescue, overhaul, training, hazardous materials, and wildland firefighting. A *Fire Rescue Magazine* ("Image Is Everything," 1998) article identifies 12 areas in which a firefighter can use a TIC. This includes response, size-up, attack, search, extension, command in the sky, hazardous materials, water rescues, rapid intervention teams (RIT), wildland fires, overhaul, and mutual aid. In addition to the above, *American Heat* ("Thermal Imaging Cameras," 2000) identified firefighter accountability as a use for the TIC. Cogan (1992) states, "The uses of the thermal imaging camera are only limited by the imagination of the user" (p. 38).

During an underground fire in a New Orleans commercial dump, a TIC was used to map the location of the fire. The fire was extinguished in a day and a half instead of the normal 7-10 days, which resulted in savings of $325,000 for the city (Love, 1999).

A TIC is credited with saving the lives of four Granbury (Texas) Fire Department firefighters. During an interior attack in an auto body shop, the officer scanned the interior of an office. The officer saw that several ceiling joists had burned through and ordered the interior crews to leave the building. A few moments later the ceiling collapsed dropping stored items above the ceiling and an air conditioner. This potential tragedy occurred about 5 minutes after initial entry of firefighters ("Imager Saves Firefighters," 1999).

After the bombing in Oklahoma City, thermal imaging was used to locate cavities in the rubble that may have harbored people possibly still alive. The TIC was able to locate 21 people in the rubble (Kienlen, 1999).

In Charlottesville, Virginia, firefighters were able to search a two-story home, identify and remove the victim in about 5 minutes. The search was credited with saving the victim's life. It would have taken more than 15 minutes to conduct a conventional search and rescue (Richardson & Scholer, 1999).

In North Carolina, a TIC was used to locate victims that were swept away in floodwaters. The rescue team of three covered about a half mile of wooded shoreline in about 10 minutes (Pease, 1999).

In an unusual situation, the Cedar Hammock and Southern Manatee Fire Districts in Florida used a TIC at a vehicle versus pedestrian accident. The rescuers searched for the victim's amputated right leg for about 30 minutes. After arriving on scene, the engine company, with a

TIC, quickly located the amputated limb about 150 feet from the accident scene after being directed to the area by a helicopter equipped with a TIC (Hollins, 2000).

On June 16, 1994, the Cleveland County Fire Brigade (UK) responded to a fire in a building housing a motor vehicle repairs and paint spraying business (Lyons & Parmenter, 1995). The article states,

> The TIC was brought into use in the early stages of the fire to locate the cylinders. Two sets of oxy/acetylene were quickly located. These were in the main part of the fire, were extremely hot and were immediately cooled by jets. Visibility at this stage of the fire was zero. The cylinders were towards the rear of the premises and would have not been located for some time without the TIC.…they would have exploded had they not been located quickly by the TIC with perhaps serious consequences to firefighters. (p. 7)

During a hazardous materials incident, the Atlanta Fire Department used a TIC to determine the location of hydrochloric acid vapors and where the vapors were traveling. With this information the incident commander was able to direct resources for an effective evacuation (Woodworth, 1995).

During training the TIC can be used by an instructor to monitor students at all times to ensure their safety (Siuru, 1996).

Research Question 2: As with any new piece of equipment, the TIC has its own disadvantages that need to be addressed through training. A leading disadvantage is concerning training on the TIC itself. There have been no fire service standards established for a TIC. The current discussion is on who should provide the training, the department, the manufacturer or training agency and to what level firefighters should be trained to (Woodworth, 2000). Richardson and

Scholer (1999) state, “Ultimately, a thermal imager is only as good as the operator using it, so continuous learning is critical to its long-term effectiveness” (p. 30).

Crickenberger and Sojka (2000) identified five disadvantages that are related to a TIC:

- Firefighters tend to speed up in their process of search, causing them to get deeper into buildings.
- Firefighters have a natural desire to stand as they have gained a sense of vision.
- Firefighters become too dependent on the TIC and in time of a failure become disoriented.
- Firefighters inadequately trained in interpreting what they see may be in significant danger.
- Polished surfaces cause a reflection of thermal signatures creating a false idea of where the fire is located. The reflection may be the thermal signature of the rescuer, there by causing a false search for a victim that does not exist.

Cogan (1992) states, “The TIC may act erratically in an area where a sprinkler is discharging. This is due to the shielding effect of the water droplets” (p. 42). In Lyons (1996) article, a firefighter progressing behind a fog stream will not be presented with a clear image of the scene beyond the stream. It is not possible to image through water.

The field of view of the TIC poses problems for the firefighter. The field of view is narrowed by the TIC’s design (“Thermal Imaging Cameras,” 2000). Although the TIC restores the vision for a firefighter, it is tunnel vision. The firefighter operating the TIC must scan an entire room or they could miss a victim (Woodworth, 1997a). Another problem that relates to the field of view is depth perception. Most TIC’s focus 6-8 inches or more away from the camera

lens (“Thermal Imaging Cameras,” 2000). If a firefighter is not aware of this, they may believe what they see or are reaching for is closer than it actually is.

Additional problems can occur with the ability of firefighters to interpret the images. Woodworth (1997b) reports that a firefighter must understand what thermal contrast and thermal inversion are and be aware of how it affects the image. A firefighter must be able to recognize a thermal signature and understand what it means. Boes (2000) states,

> On entering a bedroom at an apartment fire, I noticed, through the heavy smoke conditions, the shape of a person lying in the bed several feet across the room. I quickly reached for it and could feel nothing. I looked again and saw the shape right in front of me. I felt the bed, saw the dark shape of my own hand patting the bed right over the shape, and felt nothing. I flipped up the screen and put my face on the bed. I saw nothing but bedsheets. After the fire, we investigated and found the occupant had been in bed and fled when the smoke detectors went off. What I was seeing was the heat from the occupant’s body radiating from the bed. (p. 36)

Research Question 3: Fire departments have a wide range of training requirements for their firefighters in order to be capable of utilizing a TIC. It is astounding how many fire departments have put a TIC into service with little or no training (Woodworth, 2000). In Woodworth’s (1997a) fifth article, he states,

> The absolute first objective after purchasing a thermal imaging device should be to have all personnel properly trained in its use. This training should include both classroom and practical sessions during which potential users are shown how to use the unit effectively. (p. 16)

Cook (2000) states, “The TIC is just a tool, and you have to apply standard training and tactics to ensure continued safe operations in the event a failure occurs. Lack of adequate personnel training can render a TIC useless” (p. 32). In the article by Woodworth (2000) he goes on to state,

> At the least, training should provide basic information on how to interpret the image, tactics, and safety. Training should also include a live-fire portion that enables the users to witness changing fire conditions in a controlled setting. Operating the thermal imager in a “baptism by fire” situation could prove to be very disastrous. (p. 84)

Crickenberger and Sojka (2000) state, “Every firefighter who will use a thermal imaging camera must be trained in its use, know how to interpret what is seen and be re-taught the basic firefighting fundamentals” (p. 67).

The Granbury (Texas) Volunteer Fire Department conducts search and rescue drills at buildings within their district after closing. The drill is conducted in the dark, victims are hidden, firefighters use the oriented search to locate victims, and the TIC is taken away at some point during the training to see if the crews act accordingly (Cook, 2000).

The Virginia Beach Fire Department (1998) requires each member to be fully trained in the thermal imaging system, procedures and techniques. The department requires ongoing training that includes in-station training for at least one hour per month and annual live fire evolutions.

In summary, the literature review has shown that there is a need to start a training program for the TIC. The starting point will be by establishing a list of training opportunities. Although it may take a considerable amount of time to develop such a training program, this does not detract from the project.

PROCEDURES

Definition of Terms

Combination Department. A career force supplemented by a call force.

Incident Commander. The person responsible for directing and controlling operations at every incident.

Mutual Aid. An agreement between communities to provide firefighting resources when needed.

Overhaul. The process of searching for and extinguishing hidden or remaining fires (International Fire Service Training Association, 1998).

Rapid Intervention Teams (RIT). A team of firefighters used for the rescue of other firefighters at an emergency incident.

Size-up. The ongoing process of identifying and evaluating the conditions of an emergency incident.

Thermal Contrast. The difference in temperature between objects.

Thermal Imaging Camera (TIC). A heat sensitive device that displays heat pictures (McLaughlin, 1992).

Thermal Inversion. The change in color representation due to a change in the ambient temperature of the surrounding area.

Thermal Signature. The impression that is still visible through the TIC after a person touches an object or gets up from a piece of furniture.

Assumptions and Limitations

An assumption made during the research project was that fire departments would require minimum levels of training for their personnel to use a TIC. The literature review and survey

indicated that this assumption was not correct. In fact, training ranged from no training requirements at all to a very high standard of training.

There were a number of limitations found during the research project in regards to the literature review and the survey. During the literature review there was an abundance of information on TIC's in general, but limited information on training aspects. A search on the internet was cumbersome and time consuming.

In regard to the survey, there were a number of factors limiting the survey results. The first factor was the accuracy of the information obtained from manufacturers and distributors on fire departments in Massachusetts that had a TIC. A number of surveys were returned, along with one telephone call, indicating these fire departments in fact did not have a TIC. The second factor influencing the survey results were the number of surveys that were returned. The assumption being 100% of the surveys mailed would be returned. In this case, only 71% of the surveys were returned. The possible factors influencing the rate of return include the recipients ignored the survey, the fire departments did not have a TIC or the recipient did not receive the survey. A third factor limiting the survey results was the make up of the survey sample of fire departments. The sample was restricted to a specific geographical location, the state of Massachusetts. The assumption being that sending the survey to a cross section of fire departments from across the country would result in a more balanced result. The six-month time frame for completing the project and personal finances prohibited such a survey.

Research Methodology

Action research methodology was used to complete this research project. The first step was to recheck the problem statement for clarity and comprehensiveness. The goal of the research project was to develop a list of training opportunities for the TIC. The action research

methodology used an extensive literature review, an exhaustive internet search and a survey sent to fire departments in Massachusetts with a TIC.

The initial literature review was conducted at the Learning Resource Center at the National Fire Academy in Emmitsburg, Maryland. Periodicals, books, trade journals and applied research projects were researched for pertinent information. An exhaustive internet search was conducted to locate manufacturers, distributors, and information on thermal imaging technology. Additional research was conducted at the IFD library.

As part of the research project, a survey (Appendix A) was created. The survey consisted of 10 questions based on training requirements, problems encountered with a TIC and unusual incidents. A cover letter (Appendix B) was included with the survey to explain the survey, why it was being sent out and a due date to return the survey. Fourteen manufacturers and distributors (Appendix C) of TIC's were contacted through E-mail, and follow up telephone calls, to establish a database of fire departments in Massachusetts with TIC's. This resulted in 120 fire departments being sent surveys. To facilitate a better return, a self-addressed stamped envelope was included with the survey.

RESULTS

Research Question 1: The literature review has shown that there are a multitude of situations for which a TIC can be used. In a broad sense, the TIC can be used for size-up, attack, search and rescue, overhaul, training, hazardous materials, and wildland firefighting (Bullard, n.d.). A *Fire Rescue Magazine* ("Image Is Everything," 1998) article recognized 12 areas in which a firefighter can use a TIC. The firefighter can use the TIC for response, size-up, attack, search, extension, command in the sky, hazardous materials, water rescues, rapid intervention teams

(RIT), wildland fires, overhaul, and mutual aid. Firefighter accountability is a good use for the TIC ("Thermal Imaging Cameras," 2000).

The literature review identified a number of incidents, using a TIC, which had successful outcomes. A city realized a savings of $325,000 from an underground dump fire that was extinguished in a day and a half (Love, 1999). Four firefighter lives were spared when the officer realized that a potential ceiling collapse was imminent ("Imager Saves Firefighters," 1999). Twenty-one people were located in the rubble after the Oklahoma City bombing (Kienlen, 1999). A victim was located within 5 minutes by firefighters at a structure fire (Richardson & Scholer, (1999). The TIC has been used to locate victims swept away in floodwaters (Pease, 1999). An amputated leg was located quickly with the TIC after a 30 minute conventional search was unable to locate the leg (Hollins, 2000). Firefighters located two oxy/acetylene cylinders in a structure fire that had the potential to explode with serious consequences (Lyons & Parmenter, 1995). During a hazardous materials incident the location and direction of travel of hydrochloric acid vapors with the TIC allowed the incident commander to direct an effective evacuation (Woodworth, 1995). The TIC can be used during training sessions to monitor the progress of firefighters and ensure their safety (Siuru, 1996).

These incidents are just the tip of the iceberg. Fire departments and firefighters should keep an open mind. Cogan (1992) states it the best, "The uses of the thermal imaging camera are only limited by the imagination of the user " (p. 38).

Research Question 2: Research has identified a number of disadvantages for a TIC that relate to training needs. First and foremost, training is the leading disadvantage for a TIC. Currently, there are no national standards established for a TIC. As such, the focus is on who should provide

training and to what level, on a TIC; the manufacturer, the department itself or some other training agency (Woodworth, 2000).

In an article by Crickenberger and Sojka (2000), they identified five disadvantages related to the TIC. Firefighters tend to speed up their searches, which results in getting deeper into structures. With a sense of vision firefighters have a natural desire to stand. Firefighters become too dependent on the TIC, which can fail. Firefighters are inadequately trained on interpreting the image on the screen. Polished surfaces may cause a reflection that gives a firefighter a false location of the fire or indicate a non-existent victim.

The TIC cannot see through water. The TIC may act erratically where a sprinkler is discharging (Cogan, 1992). A firefighter that is using a fog stream will not be presented with a clear image beyond the stream (Lyons, 1996).

Research Question 3: Research has shown that fire departments have a wide range of training requirements for the TIC. Without any type of standards to follow, fire departments are on their own in regards to training requirements.

A survey was conducted to find out what training was required for Massachusetts's fire departments with a TIC. The results were tabulated by total number and by percentages for each question and answer. The results of the survey can be found in Appendix D.

The survey was sent to 120 fire departments in Massachusetts that had a TIC. Of that total, 85 or 71% of the departments responded to the survey. The group that returned the most surveys was from career departments with 45 or 53%.

The results have shown that the majority of the fire departments in Massachusetts, with a TIC, have received training from the manufacturer (93%) and conduct in-house training (94%). What is astonishing is that only 73% of the departments received practical training from the

manufacturer. In one case, the department responded that they were adequately trained on the TIC, but has never received training from the manufacturer or conducted in-house training. Although there are no national standards, only 61% of the respondents indicated that there should be training standards adopted.

DISCUSSION

The research has shown that there are a multitude of situations in which a TIC can be used. A firefighter can use a TIC for size-up, response, attack, search and rescue, extension, overhaul, training, hazardous materials, command in the sky, water rescues, RIT, wildland fires and mutual aid (Bullard, n.d.; "Image Is Everything," 1998). These are the same types of situations that the IFD can respond to on any given day. Without a doubt, this is not an exhaustive list of possible situations for the TIC. Cogan (1992) stated, " The uses of the thermal imaging camera are only limited by the imagination of the user" (p. 38).

The research has shown that there are disadvantages to the TIC. The disadvantages revolve around one common theme, training. As Woodworth (2000) has reported there are no national standards established for a TIC. This leaves the question: who is to provide the training, the department, manufacturer or training agency and to what level should the firefighter be trained (Richardson & Scholer, 1999).

The survey results have shown that the majority of the fire departments in Massachusetts have had training on a TIC. The type and quality of training varies considerably from department to department. In Woodworth's (1997a) fifth article, he states,

> The absolute first objective after purchasing a thermal imaging device should be to have all personnel properly trained in its use. This training should include both classroom and practical sessions during which potential users are shown how to use the unit effectively.

(p.16)

The survey results showed this to be the case for TIC users in Massachusetts. Classroom training was provided to 85% of the departments and practical training to 73% of the departments. Woodworth (2000) stated, “Training should include a live-fire portion that enables the users to witness changing fire conditions in a controlled setting” (p. 84). Live fire training was conducted by 24% of the departments surveyed.

The author’s interpretation is that there is a strong need for training on the TIC. This needs to begin with developing programs from the training opportunities list. The research and survey show that it is vital to be trained properly on a TIC for a firefighter to use it correctly and safely.

The implications are that, if not trained properly on the TIC, it may become a useless tool that is not used when necessary. A worse case scenario would be inadequately trained firefighters that work beyond their scope of training or abilities that could lead to injuries or even death.

RECOMMENDATIONS

The problem was the IFD did not have a training program for the TIC. The purpose of this ARP was to develop a list of training opportunities for the TIC. It is recommended that the IFD use the list of training opportunities in Appendix E as a basis to start a training program for the TIC.

During the literature review and reviewing the survey results, a number of ideas and concerns were raised. The following recommendations have been made to address these items:

1) It is recommended that the manufacturer of the unit should conduct initial training on the TIC for all department members.

2) It is recommended that the department should hire a firm, such as Safe-IR, for practical training for all department members.
3) It is recommended that a training program should be developed around the training opportunities whether individually or collectively.
4) It is recommended that all members have monthly training on the TIC.
5) It is recommended that all members have an annual refresher on the TIC.
6) It is recommended that the TIC be used during training evolutions to document and show progress.
7) It is recommended that the department's standard operation procedures be updated to incorporate the TIC.

In the future, this ARP may become a source for another Executive Fire Officer Program candidate. My recommendation to future readers is to use this as a guideline, but keep an open mind. The training opportunities listed may not be inclusive of all possibilities for the TIC. Each day will bring changes and new uses for the TIC.

The benefit to the IFD is that eventually a training program will be developed from these training opportunities, which will enhance the ability of the IFD, to use the TIC at incidents.

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APPENDIX A
Thermal Imaging Camera Training Survey

1) What is the make-up of the department?
____ Career ____ Combination ____ Call ____ Volunteer

2) What type of thermal imaging camera (TIC) does the department have?
____ Hand held ____ Helmet mounted ____ Both

3) What type of training did the department receive on the TIC? (check all that apply)
____ Manufacturer ____ In-house ____ Other (specify) _____

4) What type of training did the manufacturer provide? (check all that apply)
____ Classroom ____ Practical

5) What type of practical training did the manufacturer provide on the TIC?

_____

_____

6) What type of in-house training does the department provide on the TIC?

_____

_____

7) Do you believe the department is adequately trained on the TIC?
____ Yes ____ No

If no, why?

_____

_____

8) Has the department experienced any problems with the TIC that required additional training?
____ Yes ____ No

If yes, what were the problems?

_____

_____

APPENDIX A
Thermal Imaging Camera Training Survey

9) What was the most unusual incident that the TIC has been used for?

_____

_____

10) Should there be national standards adopted for training on the TIC?
____ Yes ____ No

Thank you for your time.

E-mail address: _____

APPENDIX B
Cover Letter

August 16, 2000

«Title» «FirstName» «LastName»
«Company»
«Address1»
«Address2»
«City», «State» «PostalCode»

Dear Sir,

As a lieutenant with the Ipswich Fire Department, I am currently enrolled in the Executive Fire Officers Program at the National Fire Academy in Emmittsburg, Maryland. One of the requirements of the EFO program is to complete an applied research project that relates to the Ipswich Fire Department. The purpose of my project is to develop a list of training opportunities for the thermal imaging camera.

A portion of my research project includes sending a survey to fire departments in Massachusetts that have a thermal imaging camera. Could you or your designee please take a few minutes to fill out the enclosed survey and return it. For your convenience, a self-addressed stamped envelope has been included. Please return the survey by September 1, 2000.

Thank you for your help in this endeavor. If you would like a copy of the survey results, please enclose a SASE or include an E-mail address with the returned survey.

Sincerely,

Andre J. Theriault
Lieutenant

APPENDIX C
Manufacturers and Distributors

Name	Telephone Number	Web Site Address
Bullard	1-800-827-0423	www.thermalimager.com
Cairns Iris	1-800-230-1600	www.cairnsiris.com
Conway Associates Inc.	1-800-426-6929	www.conwayassociates.com
Fire Research Corp.	1-800-645-0074	www.fireresearch.com
FLIR Systems	1-877-322-7282	www.fireflir.com/fhl
Infrared Components Corp.	1-888-422-2588	www.fireoptic.com
International Safety Instruments, Inc.	1-888-ISI-SAFE	www.intsafety.com
ISG Thermal Systems USA, Inc.	1-877-SEE-FIRE	
Marconi	1-888-587-0103	www.argusdirect.com
MSA	1-800-MSA-2222	www.MSAnet.com
Northeast Rescue Systems	1-617-325-3993	www.northeastrescue.com
Raytheon	1-800-681-8850	www.raytheoninfrared.com
Safety Vision Inc.	1-800-880-8855	www.safetyvision.com
SCOTT	1-800-633-3915	www.scottaviation.com

APPENDIX D
Survey Results

Surveys Sent: 120	**Surveys Returned:** 85	**% Returned:** 71

1) What is the make-up of the department?

	Total	Percentage
Career	45	53
Combination	35	41
Call	4	5
Volunteer	1	1

2) What type of thermal imaging camera (TIC) does the department have?

	Total	Percentage
Hand held	61	72
Helmet	17	20
Both	7	8

3) What type of training did the department receive on the TIC?

	Total	Percentage
Manufacturer	79	93
In-house	80	94
Other (Safe-IR)	3	3.5

4) What type of training did the manufacturer provide?

	Total	Percentage
Classroom	72	85
Practical	62	73

5) What type of practical training did the manufacturer provide on the TIC?

	Total	Percentage
Hands On	12	14
Simulations/Scenarios	4	5
Technology	7	8
Smoke House	12	14
Live Fire	20	24
Search & Rescue Drill	7	8
Locating Hot Objects	2	2
None	21	25

APPENDIX D
Survey Results

6) What type of in-house training does the department provide?

	Total	Percentage
Simulations	2	2
In Service	16	19
Live Fire	17	20
Smoke House	23	27
Skill Enhancement	13	15
Search & Rescue Drills	7	8
Classroom	4	5
Training Maze	2	2
Annual Refresher	1	1
None	8	9

7) Do you believe the department is adequately trained on the TIC?

	Total	Percentage
Yes	65	77
No	18	21
No Answer	2	2

Reasons For Not Being Adequately Trained
No standard to meet
Not used in live fire conditions during training
Expanded uses need to be practiced
Not all members trained
Not enough experience
Formulating SOGs
Interpretation with screen for hot spots is not apparent, nor readily learnable at drills
Additional practical training with smoke
Could not afford to have everyone factory trained
New tool, may rely too heavily on the TIC and forget the basics
No hands on training

8) Has the department experienced any problems with the TIC that required additional training?

	Total	Percentage
Yes	10	12
No	74	87
No Answer	1	1

APPENDIX D
Survey Results

Problems Experienced with the TIC
TIC takes the firefighter out of the evolution, had to train when & who would use the TIC
Power supply – batteries
Operator checks
Problem with water tight seal
Identifying the temperature involved
Treating the TIC the same as other equipment

9) What was the most unusual incident that the TIC has been used for?

Hidden fire
Animal in the wall
Infant found in smoke filled bedroom
Smell of smoke – electrical
Assist police – locating a suspect, drug sting
Missing people
Locate amputated fingers
Search & Rescue – fires, MVAs
Water incidents
Fire in multilayered roof
Lightning strike – electrical
Hot ballasts
Presidential protection detail
Hot spots – fire works display
Ice rescue
Plugged flue pipe
Underground dump fire
Pinpointed trash fire in 100,000 tons of trash
Overheated refrigerator motor
Central vacuum cleaner with smoldering fire

10) Should there be national standards adopted for training on the TIC?

	Total	Percentage
Yes	52	61
No	24	28
No answer	9	11

APPENDIX E
Training Opportunities

Thermal Imaging Camera Operation

- Overall unit operation – type of sensor, power supply, controls, warm-up time, options
- Field of view – depth perception
- Thermal contrast
- Thermal inversion
- Thermal signature
- Reflection – glass, polished surfaces
- Water

Size-up

- Thermal layer
- Fire location
- Electrical – overheated electrical fixtures
- Holes in the floors
- Flashover – white out
- Smell of smoke calls
- Structural components – stability
- Ventilation
- Fire brands

Search & Rescue

- Victims in a structure – not concealed, concealed
- Victims in a structure – unit failure
- Water rescues
- Ice water rescues
- Lost people – woods
- Motor vehicle accidents – victims ejected
- Amputations
- Confined space rescue

APPENDIX E
Training Opportunities

Overhaul

- Hot spots – structure & wildland fires
- Structural integrity
- Fire extension
- Location of broken hot water or steam pipes

Rapid Intervention Team

- Firefighter accountability
- Missing firefighter – not concealed
- Missing firefighter – concealed

Hazardous Materials

- Vapors – location and travel
- Tanks/cylinders – product levels
- Fluid spills – location and travel
- Fires – areas of impingement
- Ignition sources