

Incident Command Decision- Making at the Orange County Fire Rescue Department:

How can we improve?

William Sturgeon

Orange County Fire Rescue

Winter Park, FL

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Certification Statement

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

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Abstract

In 2004, senior officers of the Orange County Fire Rescue Department realized that a significant loss of experienced command officers would occur during ensuing years and commissioned the development of an incident command school. What was developed was a multi-player computer simulation program and curriculum based on exercising standard operating procedures, reading smoke, integrating the National Incident Management System (NIMS), and a review of tactics and strategies. The problem is that the Orange County Fire Rescue Department (OCFRD) does not have a validated training curriculum to improve command decision making. The purpose of this research was to determine a pathway to improve decision-making capabilities of Orange County Fire Rescue's incident commanders. Using descriptive research, an extensive literature review, a survey of 132 (n=132) OCFRD command officers and a questionnaire of several subject matter experts this project answered the following questions: 1. How do incident commanders make decision-s during emergency operations? 2. Do applied decision- making models appropriate for emergency operations exist? 3. Are there practical training approaches to improve decision- making? Results determined experienced fire officers make decision-s intuitively based on experience and training, that there are numerous decision-making models which can be applied to incident command, and simulation and tactical decision- games are useful tools to improve decision- making if properly designed. Recommendations include convening a task force of subject matter experts from academia, simulation/training, other stakeholders, and command officers to develop objective-centered curriculum based on improving pattern recognition, problem solving, and situational awareness skills, as well as, institutionalizing the use of specific decision--making models, debriefings, pneumatic phrases, and checklists as aids to improve incident command decision- making.

Table of Contents

CERTIFICATION STATEMENT 2

ABSTRACT..... 3

TABLE OF CONTENTS..... 4

LIST OF FIGURES 5

INTRODUCTION 6

BACKGROUND AND SIGNIFICANCE..... 7

LITERATURE REVIEW 12

PROCEDURES..... 23

RESULTS 27

DISCUSSION..... 30

RECOMMENDATIONS 34

REFERENCES 37

APPENDIX A: NFA/STICO WORKSHEET 39

APPENDIX B- OCFRD OFFICER SURVEY 40

APPENDIX C- CV DR. JONATHAN KAYE 42

APPENDIX D-CV RON TARR..... 47

APPENDIX E- ANSWERS TO QUESTIONNAIRE (DR. KAYE)..... 57

APPENDIX F- ANSWERS TO QUESTIONNAIRE (RON TARR)..... 66

List of Figures

FIGURE 1: PRESENT RANK 71

FIGURE 2: SERVICE AT CURRENT RANK 71

FIGURE 3: COMMAND EXPERIENCE 72

FIGURE 4: ATTENDANCE OF COMMAND SCHOOL..... 72

FIGURE 5: ATTENDANCE OF UNIFIED COMMAND SCHOOL..... 73

FIGURE 6: DECISION-- MAKING STYLE..... 73

FIGURE 7: ASSIGNING TACTICAL/STRATEGIC PRIORITIES 74

FIGURE 8: EXPERIENCE..... 74

FIGURE 9: LAST ATTENDANCE AT COMMAND SCHOOL 75

FIGURE 10: IMPROVING INTUITIVE DECISION- MAKING..... 75

Introduction

In 2004, senior officers at the Orange County Fire Rescue Department realized that a significant loss of experienced command officers would occur during ensuing years and commissioned the development of an incident command school. What was developed was a multi-player computer simulation program and curriculum focused on exercising standard operating procedures, reading smoke, integrating the National Incident Management System (NIMS) into the organization, and review of tactics and strategies.

The problem is that the Orange County Fire Rescue Department (OCFRD) does not have a validated training curriculum to improve incident command decision-making. The purpose of this research was to determine a pathway to improve decision-making capabilities of Orange County Fire Rescue's incident commanders. Using descriptive research, this project answered the following questions: 1. How do incident commanders make decisions during emergency operations? 2. Do applied decision-making models appropriate for emergency operations exist? 3. Are there practical training approaches to improve decision-making?

In recent years, The Firefighter Near Miss Reporting System and The International Association of Fire Chiefs have attempted to institutionalize Crew Resource Management (CRM) to reduce Line-of-Duty-Deaths and injuries. CRM is focused on human factors training and how errors can be identified and trapped. Interestingly, "...human error accounts for 85% of all mishaps" and trapping errors prevents mishaps (IAFC, 2002). Components of CRM training include "effective communications, leadership, followership, situational awareness, advocacy, task allocation, debriefing, and critical decision-making" (Lubnau II & Okray, 2004). This research focused on one component of CRM — critical decision-making, specifically, how to improve incident command decision-making at the Orange County Fire Rescue Department.

Background and Significance

The Orange County Fire Rescue Department (OCFRD) is an Internationally Accredited Metro-Class fire and rescue department located in Central Florida. The department provides services to the 786 square miles of unincorporated Orange County. The fixed population of 786,000 is bolstered daily by over 200,000 transient workers and a tourist population that exceeds 45 million annually (Orange County Fire Rescue Self Assessment Document [SORC], 2007). Services include fire suppression, emergency management, emergency medical services (EMS), hazardous materials mitigation, technical rescue response, fire inspection services, and public safety education. Service is accomplished through the strategic placement of 41 fire stations, 41 engine companies, 35 Advanced Life Support rescue units, four ladder trucks, two quints, six tenders, three combination hazardous materials / technical rescue squads, 16 wildland interface response vehicles, one air ambulance and 1150 operational and support personnel. The departments operation's division operates on a three platoon system (A, B & C shift), working a typical 24/48 schedule. The organizations' management is structured with a fire chief, deputy chief, and six division chiefs (Operations, Logistics, Communications, Administration, Training, and Emergency Management). Daily supervision is provided by one shift assistant chief, six battalion chiefs, and three EMS supervisors; each suppression unit is assigned a company officer or an acting officer per shift. In 2008, the Department answered 93,139 calls for service. (Orange County Fire Rescue Department [OCFRD], 2008).

OCFRD has a fully developed incident command system including detailed Emergency Operating Procedures requiring the first arriving officer to establish and maintain command until relieved by a higher ranking officer.

In 2004, the OCFRD Training Division was directed to develop an incident command school curriculum to improve command and control capabilities of incident commanders. Managers realized mandatory and voluntary retirements would increase the number of inexperienced command officers during the ensuing years (Brown Personal Communication, June 3, 2009). In addition, explosive growth of the community and retirements of key operations personnel required the organization to promote a significant amount of new company and chief officers. In point of fact, 70 engineers (acting officers), 94 lieutenants, 17 captains, and 19 battalion chiefs were promoted from 2004 to 2009. As well, all three shift commanders were replaced during the same period as were most of the department's division chiefs (Orange County Fire Rescue Human Resources [OCFRDHR], 2009). Realizing the future challenges this would bring with incident management, senior managers commissioned development of the OCFRD Command School.

What was developed was a state-of-the-art multiplayer computer simulation program and curriculum founded on meeting several objectives including improved communications, exercising standard operating procedures, reading smoke, integration of National Incident Management System (NIMS-ICS) concepts, tactics/strategies, and command & control (Brown, Personal Communication, June 3, 2009). To ensure realism, computer simulations included both internal and external modeling of selected structures. Digital photographs of structures were utilized with realistic computer animated three-dimensional smoke and fire to immerse officers during exercise scenarios. OCFRD partnered with Doctor Jonathan Kaye, P.H.D. of CommandSim™ to develop and beta test the simulation program. Both the vendor and OCFRD took extraordinary steps to ensure realism. Exercises included residential structures, commercial structures, multi-story buildings, and mayday scenarios. The department required every officer to

attend the 32-hour command school. Currently, all newly appointed officers must attend the program before being detailed to the Operations Division.

Recently, the curriculum has been updated to include portions of the National Fire Academy (NFA) Strategy and Tactics for Initial Company Operations (STICO). After several years of instructing the course, instructors realized students needed a decision--making model to lead them through the scenarios and improve the educational value of the program. The NFA/STICO command sequence model was chosen due to its scientific approach to decision-making (Gaut, personal communication, June 3, 2009).

In 2007, OCFRD was approached by the Orange County Sheriff's Office (OCSO) to assist in developing a unified command school with an emphasis on improving interagency cooperation and communications during high risk incidents. This program design afforded OCFRD an opportunity to incorporate principles of Crew Resource Management (CRM) into the coursework. The syllabus included a brief overview of CRM and how it applies to emergency incidents. Both computer simulation and HO scale maps and vehicles were used. Scale aerial photography of real structures and roadways in Orange County were used to improve the learning process. Objectives emphasizing the practical use of NIMS and establishing common ground concerning size-up, scene safety, integration of CRM, and command & control were paramount. The course was 23 hours in length and included wildland interface fires with mass evacuations, hazardous materials incidents, hostage situations, explosives, and a high rise fire. The course culminated with an active assailant situation at a local middle school and included principals from the local school system. The curriculum focused on size-up and meeting benchmarks.

For years, critical decision-making has been studied by the military and the aviation industry; as a result, significant research to improve decision-making during stressful situations has emerged. Applying this research may improve command decision-making during emergency operations in Orange County and also has implications for the entire fire service

During emergency operations, incident commanders (ICs) are required to make time critical decision-s in chaotic environments without the luxury of all information ensuring appropriateness, “Decision-making during emergency incidents is based on obtaining information and conducting a rapid risk-versus-benefit analysis” (International Association of Fire Chiefs [IAFC], 2002, p. 5). Generally, command decision-s on emergency scenes is sound and without consequence but other times poor decisions have initiated catastrophic events. These include water shed incidents such as Charleston-South Carolina (2007), Storm King Mountain-Washington (1994), Worcester-Massachusetts (1999), (IAFC, 2002). Additionally, OCFRD lost two firefighters during a commercial structure fire in 1989.

From a command and control perspective, “Too little information results in poor risk assessment by the decision-maker and results in errors, injury, and death. Too much information overloads the decision-maker and makes it difficult to make effective decision-s” (IAFC, 2002, p. 5). A review of data from the National Fire Firefighter Near Miss reporting system from 2007 to 2008 demonstrates decision-making and situational awareness as the most common contributing factors of near misses from nationally compiled reports (International Association of Fire Chiefs [IAFC], 2007-2008, p. 7). Comparatively, a review of OCFRD’s own internal near miss reports (2006-2009) revealed 92.6% of the reported incidents cited decision-making as a contributing factor. (Orange County Fire Rescue [OCFRD], 2007-2009). While these reports are

not specifically directed towards incident command decision-making, they demonstrate a need to improve decision-making during emergency operations.

One connection to the Executive Leadership class is the use of storytelling to improve leadership communication effectiveness. Lubnau II and Okray (2004) mention one of the most effective training programs that exist in every fire department is the storyteller. Additionally, human beings learn by the telling of great stories. In the fire service stories are known as case studies. By reviewing case studies many lessons can be learned and applied to future incidents preventing recurrence of poor decisions. By debriefing, critiquing, and documenting, critical decision-making can be improved. "Stories teach us to adapt and overcome. More than that, it places a pattern in our mind" (Lubnau II & Okray, 2004, p.242). The student manual for Executive Leadership (2005, p. SM 13-5) identifies five components which result in a successful story, these are a character, trouble coming, crisis, insight (by living through the crisis), and affirmation (reassurance that if the same crisis were to occur again, it would be dealt with). These ideas can be applied to debriefings in the context of emergency incident reviews. A good debriefing should have all of these components. In sum, there is a significant linkage between storytelling to enhance intuitive memory and pattern recognition attributes known to improve decision-making.

Furthermore, the topic of incident command decision-making is of personal interest. The idea of studying how the human mind operates during emergency operations, especially the thought of the person in charge, is compelling. As a firefighter safety advocate, student of continuous improvement, and OCFRD Chief of Training, it is logical to seek out ways to improve decision-making during emergencies resulting in improved firefighter safety. As a command officer and instructor of the command school, several personal observations have been

made in incident management after initiation of the command school program including improved incident communication and coordination, integration of NIMS, improved ability to read smoke and fire conditions, and meeting benchmarks. One concern is the over emphasis on teaching benchmarks during training scenarios potentially causing a decline in critical decision-making skills. In other words, if something happens out of the ordinary the curriculum has possibly conditioned ICs to follow a script and has potentially hampered developing critical decision-making skills required to address extraordinary incidents.

Futuristic implications of this research are improved training curriculum and decision-making during emergency incidents for OCFRD's incident commanders. Additionally, this research meets one of the United States Fire Administration's newest Strategic Goals: Goal 3, objective 3.1, "Improve the Nation's incident decision-making skills" (United States Fire Administration [USFA], 2008, p. 8)

Literature Review

Classical decision-theory centers around two main parts: Bayesian probability theory, for drawing inferences and multi-attribute utility theory for selecting optimal action. "Bayesian probability theory requires decision-makers identify a mutually exclusive and exhaustive hypothesis; the multi-attribute theory requires decision-makers to specify a set of possible actions, an exhaustive mutually exclusive uncertain state of the world, and a set of evaluative dimensions" (Cannon-Bowers & Salas, 2008, p. 156). During emergency incidents commanders do not have the luxury of time to make optimal decision-s; therefore the multi-attribute theory may not apply during dynamic emergency incidents. "Optimizing is hard and takes a long time, satisficing is more efficient" (Klein, 1999, p. 20). The Bayesian theory is more

applicable during times of stress. This theory weighs heavy on pattern recognition and problem solving, both of which require real life or exceptional training experiences to foster these skills.

“Decision- making refers to the process of making choices or reaching conclusions and can be as simple as deciding to point a finger or a complex action such as deciding to purchase a home, or commanding an emergency incident” (Paulus, 2005, p. 2).

“Decisions can be divided temporally and functionally into partially distinct processes: (1) the assessment and formation of preferences among possible options; (2) the selection and execution of an option; (3) the experience or evaluation of an outcome (Paulus, 2005, p.3).” During the initial stage, individuals assign value to each option and then select one. According to Klein (1999, p.20) this is known as the “singular evaluation approach” and is based on the premise of satisficing or selecting the first option that works. This theory can be easily applied to fire-ground commanders due to the pressure of time they are under to make decision-s. “During the second stage, individuals initiate, perform and complete an action according to preferences established during the first stage. During stage three, decision- makers generate and possess a signal that is related to the difference between expected and experienced outcomes” (Paulus, 2005, p.3).

Klein’s (1999) research focused on fire-ground incident commanders, naval officers, and neo-natal intensive care nurses. Individuals in stressful environments make intuitive decision-s based on recognition of previous experiences and applying one that works for a given situation. As part of his research, Klein (1999) validates his theory by interviewing the decision-makers and attempts to determine how certain conclusions were reached. Most of the decision-makers questioned could not explain why certain decision-s were made. Klein (1999, p. 17) calls

this approach to decision-making “recognition-primed- decision-making (RPD)” or decision-s based on previous experience and mental modeling.

Klein (1999) proposes the RPD model combines two processes: the way decision- makers size-up a situation to recognize a course of action which makes sense, and the way they evaluate the course of action by imagining it. There are three variations to this strategy: variation 1, decision- makers recognize the situation as common or well-known—a typical house fire, extrication, gas leak, or a routine EMS call—and take immediate action. The decision- maker quickly recognizes which goals and cues are important (prevents overload of information) and make sense; variation 2, occurs when the decision- maker may have to spend more time diagnosing the situation, since the information may not be matching a typical scene; variation 3, explains how decision- makers evaluate single options by imagining how each may play out.

Some have questioned Klein’s research, stating that his theories are nothing more than a learning model. "The research shows that the theory generalizes to different domains even those without times pressure, real novices get stuck figuring out options, but quickly move up the ladder. By gaining any experience with a task, they start to see different features that are important and times when a certain course of action makes sense” (Azar, 1999, p. 3)

According to the Marine Corp Institute (MCI, n.d., p.1-9) there are both benefits and limitations to the intuitive decision-making theory. Benefits include time effectiveness, focused on satisficing rather than reaching an optimal solution, can be updated and infused with additional experience constantly. Misapplication of intuitive decision- making could include current situations not matching past experience, obsolete experience being applied to a current situation, and lessons learned become distorted as memories becoming distant. In other words, limitations of the intuitive decision-making process consist of obsolescence and distortion.

“Obsolescence occurs when the technical or tactical skills of the decision- maker no longer apply to current methods of applications used” (MCI n.d., p 1-9). A commitment to study current emergency operations procedures and up to date techniques can minimize the effects of obsolescence. “Distortion is the deviation between perception and reality. When memories and learning fade, the sequence of events leading to the understanding becomes deviated from what actually occurred” (MCI n.d., p.1-10).

Clearly, the effect of stressful conditions on human judgment is of importance to emergency response personnel. Decision-s must be made in the first few minutes, hours, or days which are critical to successful mitigation. During an emergency, critical judgments are frequently made under acute temporary or prolonged stress. Decision- making under stress requires processing of massive amounts of information, which is sometimes incomplete or faulty, usually under time constraints (Kowalski-Trakofler & Vaught, n.d., p. 1)

Another decision- making method is known as the classical analytical decision- making process. The analytical process is an approach used to analyze a dilemma and determine the best solution. The problem solver systematically employs a process that consists of the following actions (Marine Corp Institute [MCI], n.d., p. 1-9).

- Carefully taking a problem apart,
- Collecting and testing the information required for the problem or task
- Conducting a comparison of the solutions or options,
- Selecting an alternative, which should preferably be the best solution

This approach also has several challenges and limitations:

- Requires explicit instructions,
- Requires a detailed analysis,

- Procedure based process,
- Focus is process oriented that can become separated from reality,
- Requires multiple options,
- Comparison criteria are subject to change before process is complete,
- Focuses on optimization,
- Offers limited opportunity for creativity,
- Consumes time.

Limitations:

- Time intensive, so it is less effective for time sensitive decision-s,
- Requires complete information to produce best results,
- Difficult to apply to high-risk decision-s,
- Needs a clearly defined outcome before you can generate alternatives,
- If misapplied the approach will be poorly executed,
- Inflexibility in the approach can produce excessively academic or impractical results.

Clearly, this method has implications for longer term incidents which may require an Incident Management Team, but is very limited during short term and dynamic events such as multi-alarm fire incidents, MCI, or other type incidents.

One other component of the decision- making process is developing and maintaining situational awareness: Situational awareness (SA) is recognizing a situation as it actually exists. Lubnau II and Okray (2004, p.66) state that “SA is the next best thing to a crystal ball.” There are limitations to the use of SA also; SA is subject to expectancy bias or a commander bypassing or assuming certain strategies or tactics are being deployed and overlooks critical decision points

(Klein, 1999). To fight a fire or mitigate an incident the ICs need to be aware of three things: The fire or incident, the plan, and the people (Lubnau II & Okray, 1999). Furthermore, an IC must have the skills necessary to maintain SA; these include “monitoring, evaluating, anticipating, and considering” (Lubnau II & Okray, 1999,).

The United States Marine Corp (n.d.) MCI teaches a process known as the Boyd decision- making model or Observe-Orient-Decide-Act (OODA) Loop. This process uses cognitive skills such as perception, motor control, attention, memory, and learning that quantify situational decision- making process in tangible terms. The OODA loop transitions decision- making theory into a simplistic and useful approach to teach and improve decision- making during stressful situations.

According to Chong (2004, p. 43), a decision- making model suited for crisis decision- making is the “Coping, Rethinking, Initiating, Sensing, Intervening, Sand bagging (protect assets or resources), [CRISIS]) model.” This strategic thinking model is used for crisis management and could be applied to emergency incidents. Arguably, using this approach has limitations and must be combined with sensing or scanning the entire situation.

The use of a command sequence has been taught as a system of incident command by the National Fire Academy. A review of the primary factor size-up chart used in the NFA-STICO (2003) course reveals thirteen primary decision- points and twenty-nine sub-primary decision- points (Appendix A). In addition, incident commanders must develop objectives and employ strategies to resolve the emergency while constantly reviewing the effectiveness of strategies and matching those with objectives. Sometimes critical factors during emergency incidents are ignored or not given the proper amount of attention. This could result in poor use of resources, inappropriate strategy and tactics, safety problems, higher incident costs, and lower effectiveness

(NFA-STICO, 2003). “Ideally, humans can only process up to seven pieces of information simultaneously” (Putnam, 1995, p. 2). This command sequence model teaches six sequential steps: understanding the situation (size-up of primary factors), establishing incident objectives, developing incident strategies (activities), giving tactical direction, assigning resources, and implementing and evaluating the plan (Federal Emergency Management Agency [FEMA], 2003). During the size up evaluation, commanders must not only realize what is happening (cues), but more importantly what is not occurring. Expert commanders easily identify missing steps in the evaluation process (Klein, 1999).

Brunacini & Brunacini (2004) purports another approach to incident size-up and decision-making. ICs use a combination of four basic information forms to assist in the decision-making process; previous experiences (intuitive); visual, reported/reconnaissance; pre-incident planning-familiarity; and previous experience as well as lessons-learned. Next, Brunacini & Brunacini (2004) propose the notion that visual observation and inspection is the most common factor used for initial and ongoing incident evaluation by the IC. Evaluation of the situation from the inside, outside, and around requires the “...critical perception of the IC and the team” (Brunacini & Brunacini, 2002, p.99). Requiring information to be reported by command staff members and outside agencies is a must for the IC to devise strategic and operational plans. Moreover, critical information must be transmitted by functional and geographic assignments. Brunacini & Brunacini (2002, p. 99) cites familiarization and pre-incident planning as “pre-packaged intelligence” which allows ICs to make more rapid decisions.

Klein (1999, P. 127) states most decision-models can be boiled down to a four-step process:

1. Define the problem

2. Generate a course of action
3. Evaluate the course of action
4. Carry out the course of action

Lubnau II and Okray (2002) propose that people under stress revert back to over learned behaviors and suggest fire service personnel should train like they play and that training should simulate the real world as closely as possible. What is proposed is a concept known as over learning; “Over learning is a process of providing trainees with continued practice far beyond the point at which they perform the task successfully” (Blanchard and Thacker, 2003, p.207).

One opportunity to train personnel is the use of debriefings. When properly conducted, debriefings provide experiences which can be stored in the intuitive memory banks. Debriefings are nothing more than stories which provide “...content, relevance, and the emotional ties necessary to remember and relate to the information and learning experience” Lubnau II and Okray (2002, P.237).

One other area to improve decision-making includes teaching the use of checklists, timers, and pneumatic phrases to recall critical information (Lubnau II & Okray, 2002). Each of these tools requires comprehensive training to be effectively utilized. For instance, airline pilots have thousands of hours of flying experience but still utilize procedural checklists on every flight. Another technique is the use of a timer. A timer should be deployed on all emergency incidents. Time benchmarks can be translated into decision-points. Finally, the use of pneumatic phrases can be used to memorize critical information. During times of extreme stress human beings may revert to long- term memory. Teaching pneumatic phrases is known as “chunking” examples from the fire service include L.U.N.A.R.(Location, Unit, Name, Air, Resources), and

the D-E-C-I-D-E (Determine the problem, Evaluate the scope of the problem, Consider available options for mitigating the problem, Identify the most appropriate action, Do the most appropriate action, Evaluate the effectiveness of actions) model (IAFC, 2002). In other words, chunking is putting information into smaller chunks that can be recalled under stress and is a proven technique to improve long-term memory when short-term memory fails, mostly under stress (Lubnau II and Okray, 2002).

For years, The United States Military has used Tactical Decision Games (TDG) to exercise mental agility and to meet the demands of the situational stimuli while implementing problem solving solutions (MCI, n.d.). These games can be either orally administered by a facilitator or proposed from paper media.

The purpose of TDG is to gain breadth in experience and skills in decision-making to meet a specific set of circumstances. While these games are not a substitute for experience they can improve pattern recognition skills, exercise the decision-making process, improve and practice communications skills, and increased leadership potential (MCI, n.d. p.6-3).

When discussing training techniques one must realize that there is no perfect method. Every training methodology has benefits and limitations. The benefits of TDG are “interactive training, hot seat thinking, experiential learning, command experience, and a positive training atmosphere” (MCI, n.d., p. 6-6). Several limitations of TDG include “...one move training (a single snap shot in time and does not capture the ongoing interactive nature of decision-making), difficult to simulate a dynamic operating environment, works best at the initial attack, extended attack, or company level, and is difficult to apply to special operations” (MCI, n.d., P.6-6).

According to Blanchard and Thacker (2003), one of the primary strengths of games and simulations is that it allows trainees to make mistakes in a safe environment. Training during actual incidents is not practical due to the consequences of poor decision-making, which can range from minor to catastrophic. Simulations fit nicely into this concept because they allow mistakes to be made in a safe and controlled environment, however, if not conducted properly can result in “lowered self-esteem, confidence, increased defensiveness, and other negative effects” (Blanchard and Thacker, 2003, p.262). Simulations and games allow trainees the opportunity to develop their skills in a situation where the costs of making a mistake are low or nonexistent. A simulation must be structured in a pre-determined fashion providing instructors with control over both process and content. Moreover, simulations and games must be combined with other learning opportunities to foster the learning process. “Without the proper preparation, orientation, and follow-up activities, trainees will learn less than they could and may miss important concepts entirely” (Blanchard and Thacker, 2003, p.262).

How do we use games and simulations to teach? Games and simulations train people in context. This process assumes trainees have a declarative (factual) and procedural knowledge baseline to draw from; “If the focus of training is specifically on declarative or procedural knowledge acquisition, games and simulation are not the most effective methods” (Blanchard and Thacker, 2003, p.263). If the intent is application of knowledge then games and simulations are an effective tool.

Since OCFRD was already using an interactive simulation program for command training designed by CommandSimTM it was logical to contact the developer to glean additional insight into the utilization of simulations to improve decision-making. Therefore, Dr. Jonathan Kaye was contacted as a Subject Matter Expert (SME) in simulation design. Interestingly, as a

simulation platform designer the responses to an electronic mail questionnaire weighed heavy on educational design components and teaching objectives.

Developing good simulation-based training foremost is about developing good training, and therefore about how appropriate the stimuli and resources are to the intended outcome(s), rather than purely about fidelity to the system in question. The ultimate goal with good simulation-based training, or any training, for that matter, is to capture the “right” level of detail—detail in the environment, interactivity, etc. appropriate for the skills being transferred/taught (Jonathan Kaye, Personal Communication, July 10, 2009).

To obtain additional insight, contact was made with the University of Central Florida Institute for Simulation and Training. In turn, an electronic mail questionnaire was sent to Mr. Ronald Tarr, Program Director and Principal Investigator. His answers concurred with Dr. Kaye in that he stated

The first thing is to have it properly designed. Simulation training must be done by experts in learning and simulation technology in careful coordination with SMEs in the performance that is being trained. We have gotten too used to SMEs giving lectures with no real understanding of how people learn that we mistakenly believe those same people can design simulation training. Designing any training requires special skills and simulation training requires even more specialized skills. The second way would be to more carefully design how the simulation training is integrated with the other training be used, to ensure that the learning strategy is consistent across all the methods of

instruction being used and that they don't interfere with each other (Ron Tarr, Personal Communications, July 11, 2009).

In sum, the literature led the research in the following way: It allowed for a better understanding of current literature concerning decision- making and that decision- making is based on several factors including pattern recognition, problem solving, and situational awareness. Additionally, it led to a wealth of knowledge gained from the interview conducted via electronic mail with two SMEs in the simulation field. What was gleaned is; simulations are tools that can improve decision- making if properly designed with clearly defined objectives and timely student feedback.

Procedures

Research for this project began with an extensive internet search using the Google search engine. The Google search engine was used to search for available decision- making literature. The words "decision- making" and "decision- making under stress" were input into the search engine. The search revealed numerous articles, books, and educational materials concerning the subject.

Based on these findings an additional search for fire service texts and other literature related to incident command decision- making or decision- making under stress was conducted. This resulted in discovering one text on Crew Resource Management (CRM), a pamphlet on CRM published by the IAFC, and references to CRM in the National Firefighter Near Miss Reporting System documents. Several other fire service texts were discovered which outlined factors in the decision- making process during emergency incidents. Also, several other generic texts were discovered and are listed in the reference section of this applied research project.

Reports from the Firefighter Near Miss Reporting System were analyzed (2007-2008) to find linkage between near-misses and decision-making. This was further carried forward by reviewing OCFRD's own internal near-miss reports for a period of three years (2006-2009).

After completion of an extensive literature review, a survey for OCFRD incident commanders (lieutenant, captain, battalion chief, and assistant chief) was developed. There are currently 200 command level officers (n=200) assigned to various functions in the department. According to Krejcie & Morgan (1970) the sample size needed to assure a 95% confidence level is 132 responses. This population was selected for several reasons including completion of OCFRD command school, department alarm load experience, and varying levels of command experience. In addition, the survey sample had a good chance of being scientifically valid due to the ability to make contact with all of the respondents via teleconference and internal electronic mail. A survey was sent via electronic message to all command level officers in the Orange County Fire Rescue Department using Survey Monkey with the following electronic mail message (Appendix B):

“As part of my Executive Fire Officer Program at the National Fire Academy I am conducting research on how we can improve our incident command decision-making. Please take a few moments to take this brief survey. Your answers to this survey will remain anonymous. Please complete this survey no later than July 31, 2009. If you would like a copy of the results of this survey please contact Chief William Sturgeon.”

1. What is your present rank?
2. How long have you served at this rank?
3. Approximately how many significant incidents have you commanded (fires, extrications, hazardous materials)?
4. Did you attend the OCFRD command school?
5. Did you attend the OCFRD/OCSO unified command School?
6. During emergency incidents, how do you make decision-s?
7. How do you assign tactical and strategic priorities during emergency incidents?
8. Do you feel OCFRD Command Schools gave you sufficient training/experience to prepare you to make decision-s based on intuition (finding the first solution that works)?
9. When did you last attend the OCFRD command school (not unified command)?
10. Do you feel if the command school program were enhanced with improved curriculum on decision- making and improved technology (better simulations including more realistic visual pictures/video, sounds, lighting) this would improve your intuitive decision- making capabilities?

The survey responses were then compiled and exported into Excel and visual charts of the responses were created to simplify analysis and demonstration.

Subsequently, a brief electronic email was created and sent to Dr. Kaye to glean additional insight into the utilization of simulations to improve command decision-making. The following open-ended questions were submitted to Dr. Jonathan Kaye developer of CommandSim™ (Appendix C):

“I am conducting an Applied Research Project for my Executive Fire Officer Program at the National Fire Academy. I am asking for you to take a few moments to answer the following questions: Also, if you would attach a resume or CV so that I can cite it in my paper.”

1. Do you feel realistic simulations are effective teaching tool for improving decision- making? Why or why not?
2. Do you feel that simulations can improve intuitive decision- making?
3. Based on your experience what are the limitations of simulation training?
4. What are the benefits of simulation training?
5. How can simulation training be improved?
6. Based on your experience using educational and simulations techniques, how do people make decision-s under stress? Intuitively or analytically? Please explain.
7. What do you feel is the future of simulation training?
8. Do you see simulation applications for the fire service potentially improving incident command decision- making?

Next, contact was made with University of Central Florida (UCF-IST) Institute for Simulation and Training to find a subject matter expert on the educational components of using simulations to improve decision- making I was directed to Mr. Ron Tarr, a retired Army Lieutenant Colonel and expert in simulation training. Mr. Tarr currently serves as the Program Director and Principal Investigator for UCF’s IST (Appendix D). The same battery of questions was administered to Mr. Tarr that was administered to Dr. Kaye.

Results

1. How do incident commanders make decision-s during emergency operations?

Based on the research conducted by Klein (1999) experienced incident commanders make decision-s intuitively. Decisions are derived from past experience and are based on what is not occurring rather than what is occurring. Both Cannon-Bowers & Salas (2008) and Klein (1999) concur the most effective way to make decision-s in stressful situations (i.e. an evolving incident) relies heavily on pattern recognition and problem solving both which require real life or exceptional training experiences. This concept is known as recognition-primed decision- making (RPD).

Decisions are divided temporally and functionally into partially distinct processes: (1) the assessment and formation of preferences among possible options; (2) the selection and execution or an option; (3) the experience or evaluation of an outcome (Paulus, 2005, p.3).” During the initial stage, individuals assign value to each option and then select one. This is known as the “singular evaluation approach” and is based on the premise of satisficing or selecting the first option that works (Klein 1999, p.20).

There are three proposed exceptions to these hypotheses: misapplication taking place when the current situation does not match past experience, obsolete information is applied to the current situation, lessons learned become distorted as memory of previous experiences becomes distant.

It is fascinating that 59.4% (figure 6) of the command officers (mostly lieutenants, figure 1) at the OCFRD feel that they make decision-s intuitively. Almost 40.6% (figure 6) feel they make decision-s analytically. This is based on responses from personnel (52.3%) with less than

five years of experience in their current rank (figure 2), but who had completed extensive incident command training prior to promotion (figure 4), demonstrated by the 133 responses (100%). Additionally, 48.1% reported that they had commanded less than 25 significant incidents (figure 3). The survey also demonstrated that line officers, (93.2%) (figure 7) at the OCFRD use a combination of intuition, procedures and the human senses to make decisions during emergency incidents.

2. Do applied decision- making models appropriate for emergency operations exist?

Due to the stressful environment in which ICs work under it is very important to design decision- making models which can be recalled in small chunks (Lubnau II & Okray, 2002). In fact, Putnam (1995, p.1) states “...human beings can only process seven pieces of information at one time.” Accordingly, ICs must maintain a high level of situational awareness to ensure the proper use of resources, appropriate strategies and tactics, handling safety problems, as well as incident costs.

One model proposed is the decision- making model taught by the National Fire Academy’s STICO course. This process is known as the command sequence (Analytical Size-up Process) and encompasses six steps (Appendix A):

1. Understanding the situation (size-up of primary factors),
2. Establishing incident objectives,
3. Developing incident strategies (activities),
4. Tactical direction,
5. Resource assignments,
6. Implementing the plan and evaluating the plan.

Another approach proposed by Brunacini & Brunacini (2002, p. 99) includes:

1. Previous experience (intuitive),
2. Visual (size-up),
3. Reported reconnaissance,
4. Pre-incident planning (familiarity).

Another approach identified is a model used for crisis management. This model is the "...Coping-Rethinking-Initiating-Sensing-Intervening-Sand-Bagging" (CRISIS) approach (Chong, 2004, p.43) and the Boyd Decision- loop Orient, Observe, Decide, Act (MCI, n.d.) were identified as decision- making models which could also be applied to emergency operations.

3. Are there practical training approaches to improve decision- making?

Both Lubnau II and Okray (2002) propose that people under stress revert back to over learned behaviors and suggest fire service personnel should train like they play and that training should simulate the real world as closely as possible. They propose a concept known as over learning; "Over learning is a process of providing trainees with continued practice far beyond the point at which they perform the task successfully" (Blanchard and Thacker, 2003, p.207).

Additionally, they point out that debriefings are an opportunity to learn from both good and bad techniques during emergency incidents and if properly conducted can be stored in intuitive memory banks. Furthermore, they state "debriefings are nothing more than stories which provide "content, relevance, and the emotional ties necessary to remember and relate to the information and learning experience" (Lubnau II and Okray 2002, P.237). In addition, they propose the use of checklists, incident timers, and pneumonic phrases as aids to improve decision- making.

Another technique used to improve decision-making is Tactical Decision Games (TDG).

The purpose of TDG is to gain breadth in experience and skills in decision-making to meet a specific set of circumstances. While these games are not a substitute for experience, they can improve pattern recognition skills, exercise the decision-making process, improve and practice communications skills, and increasing leadership potential (MCI, n.d. p.6-3).

According to Blanchard and Thacker (2003) one of the primary strengths of games and simulations is they allow trainees to make mistakes in a safe environment.

According to the survey of OCFRD line officers, 90.9% (figure 10) feel that enhancing the curriculum and the fidelity of the current command school would improve intuitive decision-making. This is a valid assumption because all respondents 100% (figure 4) have completed the command school with over 70% (Table 9) completing the school within the last five years. Furthermore, 80.3% (figure 5) completed the Unified Command School and understand the implications of making appropriate decisions to effectively mitigate incidents.

A majority of the respondents felt they were somewhat prepared (48.5%) or not prepared (9.8%) to make intuitive decisions compared to 41.7%, which felt they were prepared (figure 8).

Discussion

This research has led to several observations concerning incident command decision making; including how ICs make decisions during emergency operations, identified several decision making models, and the appropriateness of using tactical decision games or simulations

to improve decision- making processes.

Accordingly, the Bayesian probability theory can be applied to incident command decision- making. This theory weighs heavily on pattern recognition and problem solving both of which require extensive experience or exceptional training to foster skills (Cannon-Bowers & Salas, 2008). Experienced ICs make decision-s based on intuition as well as situational awareness looking for what is not happening rather than what is (Klein, 1999).

Based on Klein's (1999) extensive research using fire ground commanders, naval officers, and neonatal intensive care nurses most decision- makers use a "singular evaluation approach" due to the time constraints they are placed under during crisis situations. This decision- making model is known as Recognition-Primed-Decision-Making or decisions based on previous experience and mental modeling. This process translates into how ICs size up a situation and the way they evaluate a course of action by imagining it. Klein (1999) also proposes that satisficing is more efficient than optimization. In other words, ICs find the first solution that works based on their experience/training. Interestingly, almost 60% of the command officers at the OCFRD believe they make decision-s based on intuition compared to almost 40% who believe they use a more analytical approach. However, there are noted benefits and limitations to this theory: First, benefits are "...time effectiveness, focused on satisficing rather than optimizing, and can be updated and infused with experience. Secondly, misapplication includes the current situation not matching past experience; obsolete experience is applied to a current situation and lessons learned become distorted as memories become distant" (MCI, n.d., P 1-9).

Another component needed for effective decision-making is gaining and maintaining situational awareness. Lubnau and Okray (2004, p.66) purport SA is the "...next best thing to a crystal ball" or perceiving a situation as it actually exists. Although this approach is subject to

expectancy bias or ICs assuming or bypassing certain strategies being deployed and overlook critical decision- points (Klein, 1999).

Several aids are proposed by Lubnau II & Okray (2004) to assist in decision- making processes including the use of debriefings, timers, checklists, and pneumatic phrases to recall critical information (chunking). Furthermore, several decision- making models were identified which could be applied to emergency operations. These include the Boyd decision-making model Observe-Orient-Decide-Act (OODA Loop) (MCI, n.d). This is a streamlined approach used by the Marine Corp to improve decision- making during stressful situations.

Another approach identified comes from the business world and is a model used for crisis management. This model is the "...Coping-Rethinking-Initiating-Sensing-Intervening-Sand Bagging" (CRISIS) approach (Chong, 2004, p.43). Specific to the fire service, National Fire Academy curriculum (STICO) purports the use of a command sequence consisting of six sequential steps: Understanding the situation (size-up of primary factors), establishing incident objectives, developing incident strategies, implementing and evaluating the plan.

(activities), tactical direction, and resource assignment (FEMA, 2003). In addition, Brunacini & Brunacini (2002) explain a four step process using experience, visual, reported/reconnaissance, and pre-incident planning-familiarity to gain situational awareness and make appropriate decision-s. All of these models fit within the confines of human limitations described by Putnam (1995), where he states, "... human beings can only process up to seven pieces of information simultaneously" (Putnam, 1995,p.2).

In sum, each of these models has appropriate applications and fits into what Klein (1999) calls a four-step process: define the problem, generate a course of action, evaluate the course of action, and carry out the course of action. While these models can be applied to incident

command decision- making, a large majority (93.2%) of the command officers at OCFRD use a combination of intuition, procedures, and human senses to make decisions. Again, this fits into Klein's (1999) hypothesis of the four-step process of defining the problem (senses, intuition, situational awareness), generating a course of action (based on intuition, procedures), evaluating (mental modeling), and initiating (take action).

Tactical decision- games and simulations provide an opportunity to train ICs in context and allow for trainees to over learn. Blanchard & Thacker (2003, p.207) present over learning as "... a process of providing trainees with continued practice far beyond the point at which they perform the task successfully." TDGs require trainees to respond to situational stimuli while implementing problem solving solutions. It is also well noted that games and simulations are not substitutes for real life experience. However, TDG and simulation do improve pattern recognition skills, exercise the decision- making process, improve communications skills, and increase leadership potential (MCI, n.d., p.6-6). Several limitations to TDG exist: These include one move training (single snap shot in time), it does not capture the ongoing nature of decision- making, and it is difficult to simulate the operational environment. Optimally, TDG training works best for initial attacks, extended attacks, or company level training (MCI, n.d., p. 6-6). The primary strengths according to Blanchard & Thacker (2003) are that it allows trainees to make mistakes in a safe environment. However, TDG and simulations that are not designed or controlled properly can result in "...lowered self esteem, confidence, increased defensiveness, and other negative effects" (Blanchard & Thacker, 2003, p. 262). Additionally, there must be a structure which allows for proper preparation, orientation, and follow up activities. If these are absent trainees will learn less than they could and may miss important concepts entirely. One assumption connected to this concept is that trainees have both declarative (factual) and

procedural knowledge to draw from. "If the focus of the training is specifically on declarative or procedural knowledge acquisition, games and simulations are not the most effective methods. If the intent is on application of knowledge, then games and simulation is an effective tool" (Blanchard & Thacker, 2003, p.263). In personal communication both Tarr and Kaye (2009) concur that the most important step of TDG and simulation is the design of the training. In point of fact, it is about capturing the objectives and the right level of detail (Dr. Kaye, Personal communication, July 10, 2009). Concurrently, Tarr (Personal Communication, July 11, 2009) proposes that simulations must be designed by experts in both simulation and training in concert with Subject Matter Experts. To summarize, "...design of training curriculum requires integration with other types of training to ensure the learning strategy is consistent across all methods of instruction being used and that they do not interfere with each other" (Ron Tarr, Personal Communication, July, 11 2009).

As a result of this research it was surprising to find that simulation training is more about the design of the training rather than fidelity. The research clearly points towards needed improvement of the OCFRD Command School curriculum. In its infancy, the current school was an outstanding stepping stone and accomplished initial objectives. Currently, the curriculum needs to be updated to improve command decision- making based on problem solving, pattern recognition, and situational awareness skills. It also needs to include the use of checklists, debriefings, pneumonic phrases, and decision- making models to provide an overall all learning and retention experience for command officers.

Recommendations

1. The OCFRD should convene a joint task force of command officers, academics, and simulation designers to refine goals and objectives to improve and validate future

curriculum. This curriculum should be based on improving pattern recognition, problem solving, and situational awareness skills. This panel should include personnel from the University Of Central Florida, Institute of Simulation and Training, as well as, Dr. Jonathan Kaye of CommandSim™. Both have agreed to participate in a task force to improve the simulations and the use of TDG. As with any project of this magnitude it will require research funding. Within one year OCFRD should seek funding based on a cooperative effort between several stake holders (IAFC, IAFF, NFPA, NFA, and Near Miss Reporting System, and UCF). One opportunity that exists is to apply for funding through the Assistance to Fire Grants (AFG), Firefighter Safety and Prevention Grant for Research and Development which is restricted to educational institutions. In this instance, OCFRD could serve as SMEs for this research project and as a test/observation group.

2. Conduct additional research based on learning/teaching strategies and personality traits. This could be coupled with the research partnership between the University of Central Florida, Institute of Simulation and Training ,OCFRD and firefighter safety stakeholders.
3. The OCFRD should devise a policy and teach a distinct decision- making model for utilization during both training and emergency incidents. This should be based on the premise that human beings can only deal with seven pieces of information simultaneously. Use of these techniques will institutionalize the decision- making process and contribute to good crew resource management. Examples include the O.O.D.A. Loop or command sequence (NFA). This can be accomplished by integrating a model into the current curriculum and policies. In addition, the organization should devise a policy requiring the use of checklists during training and during emergency incidents to ensure all applicable decision points are considered during emergency

operations.

4. The OCFRD should institutionalize the use of tail board debriefings to pass on critical information derived from best practices or from areas needing improvement. These debriefings could be recorded and disseminated by way of podcasting. This will allow for all personnel to have access to real time lessons learned. The agency currently has a radio show known as FlashPoint which could be used as a vehicle to pass on this important information. This would require a standardized format and debriefing checklist to ensure consistency.

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Appendix A: NFA/STICO worksheet

Column #1 Primary Factor Size-Up Chart (Check appropriate boxes)		Column #2 Incident Objectives Attainable/ Measurable/ Flexible	Column #3 Strategies	Column #4 Evaluate Effect of Strategies Every 10 Minutes
Pertinent Factors (P)	P			
Life Hazard	Occupants Firefighters Where and how big Exposures on Arrival After Arrival – Burn Time Radiation/Conduction/Convection F/R, NC, HT, ORD., WF	Examples of Incident Objectives: <ul style="list-style-type: none"> Remove all civilians from danger. Contain and Control Fire. Remove smoke from the building. Care for any injured civilians or FF's. 	[R] Rescue <ul style="list-style-type: none"> Interior/Exterior/Both 	Effective Ineffective
Location/Fire	Fire Bldg./Exposures Fire Building Exposures Fire Building (Front/Rear) Exposures (Front/Rear) Fire Building/Configuration Proximity of Exposures /Contig. Fire Building Structural Collapse Collapse Zone Apparatus Placement Visibility Temperature/Humidity Wind – Direction/Velocity Special Equipment - RIC Sufficient Companies/Personnel			
Construction	Fire Bldg./Exposures Fire Building Exposures Fire Building (Front/Rear) Exposures (Front/Rear) Fire Building/Configuration Proximity of Exposures /Contig. Fire Building Structural Collapse Collapse Zone Apparatus Placement Visibility Temperature/Humidity Wind – Direction/Velocity Special Equipment - RIC Sufficient Companies/Personnel	List Incident Objectives: 1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____ 8. _____ 9. _____ 10. _____	[E] Exposure Protection <ul style="list-style-type: none"> Exposure lines 	Effective Ineffective
Occupancy (Contents)	Fire Bldg./Exposures Fire Building Exposures Fire Building (Front/Rear) Exposures (Front/Rear) Fire Building/Configuration Proximity of Exposures /Contig. Fire Building Structural Collapse Collapse Zone Apparatus Placement Visibility Temperature/Humidity Wind – Direction/Velocity Special Equipment - RIC Sufficient Companies/Personnel			
Height	Fire Bldg./Exposures Fire Building Exposures Fire Building (Front/Rear) Exposures (Front/Rear) Fire Building/Configuration Proximity of Exposures /Contig. Fire Building Structural Collapse Collapse Zone Apparatus Placement Visibility Temperature/Humidity Wind – Direction/Velocity Special Equipment - RIC Sufficient Companies/Personnel	List Incident Objectives: 1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____ 8. _____ 9. _____ 10. _____	[C] Confinement <ul style="list-style-type: none"> Hose/line Placement – six sides 	Effective Ineffective
Area	Fire Bldg./Exposures Fire Building Exposures Fire Building (Front/Rear) Exposures (Front/Rear) Fire Building/Configuration Proximity of Exposures /Contig. Fire Building Structural Collapse Collapse Zone Apparatus Placement Visibility Temperature/Humidity Wind – Direction/Velocity Special Equipment - RIC Sufficient Companies/Personnel			
Exposures	Fire Bldg./Exposures Fire Building Exposures Fire Building (Front/Rear) Exposures (Front/Rear) Fire Building/Configuration Proximity of Exposures /Contig. Fire Building Structural Collapse Collapse Zone Apparatus Placement Visibility Temperature/Humidity Wind – Direction/Velocity Special Equipment - RIC Sufficient Companies/Personnel	List Incident Objectives: 1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____ 8. _____ 9. _____ 10. _____	[E] Extinguishment <ul style="list-style-type: none"> Hose/line Placement 	Effective Ineffective
Weather	Fire Bldg./Exposures Fire Building Exposures Fire Building (Front/Rear) Exposures (Front/Rear) Fire Building/Configuration Proximity of Exposures /Contig. Fire Building Structural Collapse Collapse Zone Apparatus Placement Visibility Temperature/Humidity Wind – Direction/Velocity Special Equipment - RIC Sufficient Companies/Personnel			
Apparatus/Personnel	Fire Bldg./Exposures Fire Building Exposures Fire Building (Front/Rear) Exposures (Front/Rear) Fire Building/Configuration Proximity of Exposures /Contig. Fire Building Structural Collapse Collapse Zone Apparatus Placement Visibility Temperature/Humidity Wind – Direction/Velocity Special Equipment - RIC Sufficient Companies/Personnel	List Incident Objectives: 1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____ 8. _____ 9. _____ 10. _____	[O] Overhaul <ul style="list-style-type: none"> Expose Hidden Fire 	Effective Ineffective
Auxiliary Appliances	Fire Bldg./Exposures Fire Building Exposures Fire Building (Front/Rear) Exposures (Front/Rear) Fire Building/Configuration Proximity of Exposures /Contig. Fire Building Structural Collapse Collapse Zone Apparatus Placement Visibility Temperature/Humidity Wind – Direction/Velocity Special Equipment - RIC Sufficient Companies/Personnel			
Special Matters	Fire Bldg./Exposures Fire Building Exposures Fire Building (Front/Rear) Exposures (Front/Rear) Fire Building/Configuration Proximity of Exposures /Contig. Fire Building Structural Collapse Collapse Zone Apparatus Placement Visibility Temperature/Humidity Wind – Direction/Velocity Special Equipment - RIC Sufficient Companies/Personnel	List Incident Objectives: 1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____ 8. _____ 9. _____ 10. _____	[V] Ventilation <ul style="list-style-type: none"> Removal of smoke/toxic gases Fire Control 	Effective Ineffective
Water	Fire Bldg./Exposures Fire Building Exposures Fire Building (Front/Rear) Exposures (Front/Rear) Fire Building/Configuration Proximity of Exposures /Contig. Fire Building Structural Collapse Collapse Zone Apparatus Placement Visibility Temperature/Humidity Wind – Direction/Velocity Special Equipment - RIC Sufficient Companies/Personnel			
Time	Fire Bldg./Exposures Fire Building Exposures Fire Building (Front/Rear) Exposures (Front/Rear) Fire Building/Configuration Proximity of Exposures /Contig. Fire Building Structural Collapse Collapse Zone Apparatus Placement Visibility Temperature/Humidity Wind – Direction/Velocity Special Equipment - RIC Sufficient Companies/Personnel	List Incident Objectives: 1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____ 8. _____ 9. _____ 10. _____	[S] Salvage <ul style="list-style-type: none"> Water – Run-Off Apply Covers 	Effective Ineffective
	Fire Bldg./Exposures Fire Building Exposures Fire Building (Front/Rear) Exposures (Front/Rear) Fire Building/Configuration Proximity of Exposures /Contig. Fire Building Structural Collapse Collapse Zone Apparatus Placement Visibility Temperature/Humidity Wind – Direction/Velocity Special Equipment - RIC Sufficient Companies/Personnel			

Identify alternative strategies for firefighter safety when occupant safety has been determined not to be a Primary Factor.

- _____
- _____
- _____
- _____
- _____
- _____
- _____

Appendix B- OCFRD Officer Survey

Decision Making at OCFRD

1. Default Section

1. What is your present rank?

Lieutenant

Captain

Battalion Chief

Assistant Chief

2. How long have you served at this rank?

less than 5 years

5 to 10 years

over 10 years

3. Approximately how many significant incidents have you commanded (fires, extrications, hazardous materials)?

less than 25

25-50

50-100

over 100

4. Did you attend the OCFRD command school?

Yes

No

5. Did you attend the OCFRD/OCSO unified command School?

Yes

No

6. During emergency incidents, how do you make decisions?

Analytically- You attempt to find a perfect (optimize) solution to mitigate the incident.

Intuitively- You find the first solution that works to mitigate the incident.

Decision Making at OCFRD

7. How do you assign tactical and strategic priorities during emergency incidents?

- Based on Emergency Operating Procedures?
- Based on your experience?
- Based on what you see, smell, feel?
- All of the above

8. Do you feel OCFRD Command Schools gave you sufficient training/experience to prepare you to make decisions based on intuition (finding the first solution that works)?

- I do not feel prepared
- I feel somewhat prepared
- I feel well prepared

9. When did you last attend the OCFRD command school (not unified command)?

- less than 1 year
- 1-5 years
- greater than 5 years
- I never attended OCFRD command school

10. Do you feel if the command school program were enhanced with improved curriculum on decision making and improved technology (better simulations including more realistic visual pictures/video, sounds, lighting) this would improve your intuitive decision making capabilities?

- Yes
- No

Appendix C- CV Dr. Jonathan Kaye

Jonathan M. Kaye, PhD

221 Head House Court

Philadelphia, PA 19147

jmk@eqsim.com ▪ (215) 627-8146<http://www.linkedin.com/in/equipmentsimulations>**Experience Summary**

Advanced technology learning systems strategist with 15 years of technical and business experience, particularly in the development and use of complex equipment simulations and related processes for training and performance certification.

Work and Research Experience

1997-Present. President, Equipment Simulations LLC, Philadelphia, PA. Founded a nationally-recognized interactive design and engineering firm that develops computerized equipment training applications for mission-critical industries. Responsible for all aspects of business, in particular:

- Developed best-in-class multiplayer simulation system for the Fire and HazMat communities, including marketing and selling the platform to dozens of major organizations across the United States,
- Become Principal Investigator for SBIR Phase I and Phase II grants from the National Institute of Health,

- Designed and programmed industry-leading training and marketing applications that feature realistic, interactive simulations of equipment,
- Evaluated coordination of training content and developers as part of a major US Naval (NAVAIR) contract,
- Lead-authored the definitive book on designing, building, and using complex online equipment simulations,
- Marketed and sold projects to major manufacturers, including Pierce Manufacturing, Hospira, Bayer Diagnostics, Dade Behring, and Verizon,
- Established business relationships with the ADL Co-Labs (producers of SCORM), HealthStream, ECRI, Jefferson Medical College, the Department of Defense, various medical societies, Adobe, and other organizations,
- Presented on the topic of equipment simulation at leading industry conferences,
- Taught clients, from executives to developers, on simulation-based training, and technical computer and simulation skills.

1993-1996. Ph.D. Dissertation Research, University of Pennsylvania. Researched, designed and implemented an innovative virtual 3D environment for simulating heart, lung, and human body functionality and pathology. Established a new standard for visualizing physiological processes based on the integration of new mathematical models with 3D deformable body dynamics.

1990-1996. Chief Integrator, the TraumAID project, University of Pennsylvania. Responsible for coordinating and documenting original contributions and the work of graduate

students involved in an evolving, eight-year decision--support program to assist emergency physicians with the management of penetrating trauma.

1988-1990 Associate Programmer, IBM Bethesda, Maryland. Key, award-winning member of the Natural Language Processing Development Laboratory, developing programs for multilingual text processing and grammar checking.

Federal Grant Awards

HazCommand: HazMat Incident Command Training, Phase I SBIR, 2005 *Principal Investigator*, awarded by the National Institute of Environment Health Sciences

HazCommand: HazMat Incident Command Training, Phase II SBIR, 2008 *Principal Investigator*, awarded by the National Institute of Environment Health Sciences.

Education

University of Pennsylvania, Ph.D. in Computer Science, December, 1996.

Thesis title: *TrauMAP: The Design of a 3D Virtual Environment for Modeling Cardiopulmonary Interactions.*

Cornell University, B.A. cum laude in Computer Science, May 1988.

Awards and Honors

Among top five simulation service vendors (2002 internal US Navy e-Learning report).

Most Innovative Service from the Ben Franklin Technology Partnership, January 2001.

Company received PhillyGold's Best Medical/Pharma Sales Aid award, April 2001.

Recipient of the 1996 Morris and Dorothy Rubinoff Award for best dissertation in Computer Science at the University of Pennsylvania.

Technical Skills

Programming Languages: Extensive experience in Flash ActionScript, C/C++ and Lisp, experience in Pascal, Basic, PL/I, Fortran

Programming Environments/Packages: Flash, Visual C++, Lucid Common Lisp.

Selected Publications

Kaye, J. and D. Castillo, *Flash MX for Interactive Simulation: How to Construct and Use Device Simulations*. Delmar Thomson Learning, December 2002.

Connell, S, S. Haywood, J. Vaccaro, G. Gradwell, H. Patrick, J. Kaye, F.P. Primiano, Jr., VENTMED: An interactive computerized simulation for teaching ventilator management protocols. *Proceedings of the 46th AARC International Congress*, Las Vegas, NV, 1999.

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Kaye, J., F.P. Primiano, Jr., D. Metaxas, Anatomical and Physiological Simulation for Respiratory Mechanics, *J Img Guid Surg*, 1(3), 1995, pp. 164-171.

Special Presentations

“Online Medical Equipment Simulation for Documenting Operational Competency”, Institute of Rural Health Think Tank Series, Idaho State University, March, 2006

Workshop: “Building Simulation-Based Training for Medical Devices”, 4th International Meeting on Medical Simulation, Phoenix, January 2004

“How Do You Measure Learning from Simulations?” NACFAM: Addressing the Manufacturing Skills Crisis, November, 2003.

Personal

Excellent oral, written, and public-speaking communication skills.

Fluent in Spanish, good abilities in Hebrew.

Appendix D-CV Ron Tarr

RONALD W. TARR

4064 Lake Mira Drive, Orlando, Florida

(407) 673-1191

- EDUCATION:** -BA Degree, Social Science & Psychology, Florida State University. 1970
- Masters Degree, Instructional System, Florida State University, 1980
- Joint Service Officer, Armed Force Staff College (Master Degree Equiv) 1986
- PhD (ABD) Doctorial Studies (Adult Education) FSU/UCF 1997

PROFESSIONAL EXPERIENCE

2006-PRESENT **Program Director & Senior Principal Investigator**, Advanced Performance Technology Group, Institute for Simulation & Training, and Project Director, Simulation and Performance Technology Division, Center for Advanced Transportation Simulation Systems, and Adjunct Professor, College of Education, University of Central Florida. Responsible for advanced learning, simulation and performance technology research, development and assessment of advanced technology prototypes and non-traditional, adult learning programs. Supervises the RAPTER group of 15 faculty, staff and graduate and undergraduate students, 2 research laboratories and a learning systems test beds. Advisor to the Director, National Center for Forensic Science, UCF on Advanced Learning Technology issues. During this time also served as supervisor of numerous graduate interns, served on several graduate committees, and worked on several department level programs across various colleges and with outside research agencies. Appointed to Research Council of the American Transportation

Research Institute and the Executive Scientific Committee of the Driving Simulation Conference North America. Has done extensive academic symposium, presentations and published articles in periodicals and journals.

2003-2006 **Senior Program Manager & Principal Investigator** Advanced Performance Technology Group, Institute for Simulation & Training, University of Central Florida. Also was the Program Manager, Project Prime Skills, O-Force, responsible for a design and implementation of the Prime Skills Systemsm a program to integrate “soft skills” in educational curriculum, which is in its 3rd year of development and validation across the 5 county central Florida region. Adjunct Faculty and guest graduate lecturer in Industrial Engineering, M&S Graduate Program and Instructional Design, College of Education. Have supervised numerous graduate interns, served on several graduate committees, and worked as faculty representative on focus groups of the UCF strategic planning committee. As an additional duty at IST I have acted as a organizational briefer and demonstration guide for numerous visiting groups, both national and international.

2002-2003 **Deputy Director**, Information and Learning Technology Department, Institute for Simulation and Training, University of Central Florida. Program Manager/PI for the Joint ADL Co-Lab and responsible for research in support of Advanced Distributed Learning Initiative, a DoD sponsored program focused on research and development of web based learning applications. Principal Investigator on NASA/FSRI project to develop web based training for their Advanced Learning Environment Program on cryogenics engineering. Program Manager, Advanced Learning Technology, Air Force Activity for M&S, and PI on AF M&S Education Program, a research and prototype development project that has led to a major new web based educational program in the USAF.

1995-2002 **Program Manager**. Performance Technology Group, Institute for Simulation & Training, University of Central Florida. Responsible for the DoD sponsored research and technology

applications in the area of Modeling and Simulation, Instructional Systems & Educational Technology, Human Performance Assessment and Cost & Training Effectiveness, organizational behavior and training systems, with special emphasis on human performance through technology interventions. PI on Defense M&S Education Program, which designed and developed the 4 major elements of this program to include conducting workshops for DOD military and civilian personnel both nationally and internationally, training over 6,000 people in the 4 years of the program. The program content developed continues to be used by the DoD offices as primary source of DoD M&S education for staff officers.

1992-1995 **Principal Investigator.** Global Approach Team, Institute for Simulation & Training, University of Central Florida. Investigated policy, procedures and methodology that was established for a DoD wide program. Program covered Cost and Training Effectiveness activities for simulators, simulation and other training interventions. Projects included Distributed Interactive Simulation research and advanced applications, multi-agency research, and analysis of current approaches being used across the military and development of the primary 5 year plan for the programs execution.

1970-1992 **Career Military Service** in the US Army, as commissioned officer, retiring as Lieutenant Colonel. Held a wide variety of assignments in both the operating forces and headquarters assignments. Assignments include command duties, staff duties ranging from operational support to joint service, three overseas tours, special assignments working for general officers, and research and development activities. Sample of these positions are listed below.

1990-1992 **Program Director:** Training Strategy and Effectiveness Area & Deputy Director, Equipment Integration Division, Training and Performance Data Center, Office of Secretary of Defense. Conducted and managed research and development for OASD programs that included directing DoD military and civilian personnel, support contractors and students. Projects included research and

management of Modeling and Simulation Information systems support (Close Combat Tactical Trainer), Training Strategy Management research and development support (Army Standards in Weapons Training), Cost & Training Effectiveness Study (CTEA) for OASD:FM&P & DMSO, Human Systems Integration automation research support (DoD HSI).

1988-1990 **Division Chief**, Military Operations Division, Joint US Military Assistance Mission to Turkey (JUSMATT). Responsibilities included planning, negotiating, executing and supervising bi-lateral military operations between the US Forces and Turkish Forces, joint force operations and training, anti-terrorism, classified intelligence and counter-intelligence work and support of nuclear weapons operations/storage.

1986-1988 **Acting Director/Project Manager**, Performance and Technology Division, Defense Training Data Analysis Center. AS Acting Director, filled position normally held by Colonel/GM 15, supervised 15 military and senior DoD civilians, who conducted research and development for OASD training and information programs. Projects included designing DoD/Joint Service Task Data base; research in standardizing military Performance Measurement technology, a joint study with Rand Corp. on effectiveness of technologies in military training, conducting requirements analysis for unified space operations training.

1983-1985 **Chief, Basic Training Task Force**; responsible to the TRADOC Commanding General for the complete revision of the U.S. Army Basic Training program, from defining requirements to validation of the new program. Program included all aspects of major instructional design research, to include formally executed and documented front end analysis, desing of fully modulitized curriculum development, instructor training, prototype and operational validation with complete formative evaluation and implementation details such as manning and budget justification and training effectiveness evaluation.

1980-1983 **Deputy Chief**, Analysis Division, Training Development Institute, HQ, US Army Training & Doctrine Command. Responsible for policy and procedures, oversight for all facets of training requirements analysis, including Job and Task Analysis, New Weapons Systems Requirements, Collective/Unit Task Analysis, Leadership Skills Analysis, Basic Skills Analysis. Conducted semi annual conference/workshops for professional development of Army personnel and applications of systems approach to training.

Personal: Married, 3 children. Excellent health. Willing to travel. Current Industrial Secret

Sample of Professional Articles (Complete list available on Request)

Tarr, R.W. Tanner, Scott; Safety Inspector Certification Program, Final Report, Oct 07

Tarr, R.W. Training Effectiveness of Driving Simulators For Commercial Truck Drivers –ATA Safety and Security Conference, Las Vegas, NV, Sep 07

Tarr, R.W Allen, Talleah, Tanner, Scott; CATSS Annual Report, June 07

Tarr, Ronald, Whitmire, James; The Driver Simulation Implementation Pilot Study, Interim Report, Sep 07

Tarr, R.W. Methods of Cost-Effective use of Driving Simulators For Commercial Truck Drivers –ATA Leadership and Management Conference, Dallas, Tx, Oct 07

Tarr, RW; Simulation Applications in Commercial Driver Skills; ATA NAFC Conference, Mar 07

Tarr, Ronald, Whitmire, James; The Virtual Check Ride as a Diagnostic and Remediation System; Driver Assessment Conference , Jul 07

Tarr, RW; Simulator Fidelity for Specific Skills in Novice Drivers; Driving Simulation Conference NA, 2007

Tarr, R.W. Training Effectiveness of Driving Simulators For Commercial Truck Drivers –US DOT Presentation Wash, DC, Aug 07

Tarr, R.W, Allen, Talleah, White, John: Virtual Check Ride, Phase 2 Interim Technical Report

Allen, Talleah & Tarr, Ronald; *Driving Simulators For Commercial Truck Drivers -Humans In The Loop*; Driver Assessment Conference, Maine, July 2005.

Tarr, R.W. & Morris, Christina; Low Cost PC Gaming and Simulation Research; Technical Report, US Army STRICOM, Orlando, FL; Oct 2005

Allen, Talleah & Tarr, Ronald; *Validation of a “Virtual Check Ride”*; A Study of an alternative testing process for Commercial Drivers License using Simulation; IITSEC, Dec 2004

Tarr, Ronald, *A Virtual CDL Test; Can it be done?*; DSC 2004, Europe, Paris, FR; Sep 2004

Tanner, Scott & Tarr, Ronald; SCO's Revisited: Proposing New Categories of Shareable Content Objects to Enhance the Reuse and Sharing of Content Among the Training Community; IITSEC Dec 2003

Koenig, John & Tarr, Ronald: Project Prime Skills Facilitator's Guide; O-Force, Feb 2003.

Dahan & Tarr, Performance Technology Applications across 4 Projects, Sloan C Conference, Orlando, Nov 03

Maguire, F; Lent, M; Prensky, M; Tarr, R; Defense Combat Simulation Olympics; Book Chapter; July 2002

Morris, C & Tarr, RW; Templates for Selecting PC Based Synthetic Environments for Application to Human Performance Enhancements and Training, VR 2002, Orlando, FL, Mar 02

Tarr, RW, Mulligan, P, Parrish, D: Using Multimedia in an Air Force Modeling and Simulation Web-Based Course without Losing Instruction; SISO, Spring Workshop, Mar 02

Tarr, Ronald W.; PC Gaming Utility for Army Training; Simulation Training and Instrumentation Command, Technical Report; Nov 01

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Tarr, Ronald W & Tanner, Scott; M&S Basics: An Introductory Web Based Course; Industry/International Training, Simulation & Education, Nov 00 (First Complete SCORM Compliant)

Tarr, R.W., Degnan, E.J, Jacobs J.W., (1999) *Modeling and Simulation 101 Alpha Test Report*, Report submitted to the AB Technologies, Alexandria, VA

Degnan, E.J, Tarr, R.W., Jacobs J.W., (1999) *Modeling and Simulation Staff Officer Course Final Report (99-01)*, Final report submitted to AB Technologies, Alexandria, VA

Tarr, Ronald W. (1997). *Why is Modeling and Simulation So Hard to Do?*- Program Manager: Modeling and Simulation Feature Issue-Sep-Oct 1997

Tarr, Ronald W, Degnan, Edward, Jacobs, John, W., (1997) Tech Report, *Operational Test of the Light Armored Vehicle Advanced Gunnery Training System*, Institute for Simulation and Training, UCF, Dec 17, 1997

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Medin, Julia A., Ph.D., Degnan, Edward, Tarr, Ronald W. (1997). *School's Out*, Modern Simulation and Training - The International Training Journal 2 / 1997

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Degnan, E.J, Jacobs, J.W., Tarr R.W., Foshee, N.J. (1995). Commercial Software And Simulation Technology For Computer Assisted Instruction Market Survey, in J. Medin (Ed.) *Simulation and Computer-Based Technology for Education*. Final report submitted to U.S. Air Force (Contract #6401-004). Orlando, FL, Institute for Simulation and Training.

Jacobs, J.W., Degnan, E.J., Tarr R.W., Foshee, N.J., (1995). Military Programs in Education and Training, in J. Medin (Ed.) *Simulation and Computer-Based Technology for Education*. Final report submitted to U.S. Air Force (Contract #6401-004). Orlando, FL, Institute for Simulation and Training.

Degnan, E.J, Tarr, R.W., Jacobs J.W., (1995) Results of the Army National Guard Aviation Warfighting Simulation Strategy Effort Final Report Final report submitted to the Army National Guard, Arlington, VA

Appendix E- Answers to Questionnaire (Dr. Kaye)

Answers to Chief Sturgeon's Questions

Jonathan Kaye

7/10/2009

1. Do you feel realistic simulations are effective teaching tool for improving decision- making? Why or why not?

Getting right to the bottom line, throwing caution into the wind regarding loaded, assumption-laden words like “realistic”, “effective”, and “simulation”, I do believe that simulations can be used effectively in training for improving decision- making, for example, when the environment, available interactions, and instruction adequately enable the student to develop or practice an effective process. But I also believe that simulations can be used ineffectively and actually hurt decision- making. For example, putting students on their first day of flight training into full-motion flight simulators is not a good idea, for several reasons, including that it is not the right tool for teaching what the student needs to acquire at his or her current level of training.

Without delving into the question of what constitutes a simulation (many people try to address this broad concept, but I don't think it fits neatly into one definition), I think that the plain meaning of the question states the important part of the answer: simulation is a

tool, and thus by itself cannot improve decision--making. It depends on the skills one is trying to teach or demonstrate, and of course on the instructor (live or programmed).

I like to say that developing good simulation-based training foremost is about developing good training, and therefore about how appropriate the stimuli and resources are to the intended outcome(s), rather than purely about fidelity to the system in question. The ultimate goal with good simulation-based training, or any training, for that matter, is to capture the “right” level of detail—detail in the environment, interactivity, etc. appropriate for the skills being transferred/taught. Therefore, to determine the “right” level of detail, one must articulate the training objectives to identify the relevant clues in the environment and the range of likely interactions and consequences. Fidelity/faithfulness to real-world systems plays an important part when the clues require that correspondence.

I think a lot of money and time are wasted on the innocuous and unproven assumption that good simulation is about precision to the real-world counterpart. That is not to say fidelity is unimportant, only that fidelity may not be so crucial to good training as simulation developers would have one believe.

2. Do you feel that simulations can improve intuitive decision-making?

I think that all practice can reinforce making decision-s, by virtue of the fact one is presented with the situations repeatedly, but I don't believe simulations can necessarily improve any intuitions. At best it can reinforce the action-consequences that one witnesses in a simulation, to help prepare for those possibilities, but it is debatable whether this is all good—can a simulation pigeonhole someone's thinking inadvertently, if the student runs up against a false assumption that is embodied in the simulation? In that case, the simulation is actually providing negative training.

When people talk about simulations, particularly computer or mathematical simulations, without having the experience of developing them, they get a false sense of security about the simulation. Stripping it down to its essence, a simulation embodies some model of the real-world. Every model has an assumption—if it did not, then it would be the real thing itself!

This sounds academic, but the important point is that all simulations have assumptions, and as a trainer, you want make sure that students are operating with assumptions are that are compatible with the assumptions of the model. Therefore, you as an instructor need to be comfortable with the range of predictions that the simulation will make based on the student interaction. This points back to my argument that you have to understand your training objectives very well, so that you allow the student to stay comfortably in the range of correct predictions of the system (correct in the sense of what you want the student to infer from the system's behavior).

3. Based on your experience what are the limitations of simulation training?

If all simulations (models) have assumptions, then it stands to reason that all simulations have limitations as they violate their assumptions. Regarding training, it's easy to say that limitations show up when the type of simulation does not capture the "right" level of detail for the skill(s) being taught. For example, we originally thought that we could help teach correct search skills (right or left-handed searches) using our photograph-based command simulation system. We realized, once we put the scenarios into practice, however, that teaching skills based on realistic navigation was a limitation of our approach to scenario building—the constrained stimuli presented through the discrete photographs did not provide adequate physical orientation when moving to overcome the artificiality of the discrete movement.

In a positive example, we believe our system is ideally suited to teaching how to "read smoke" because we spent a great deal of time putting the elements, or clues, into the way in which the smoke can be modeled and placed. Most other fire training programs don't invest in the details to make practicing smoke reading as effective in our system.

I think an important point about limitations of simulation training has to do with issues outside of modeling technique—if simulation is applied as a cure-all, with less regard for the training problem/issue to address than a desire to make the training like the real world, then the simulation can limit the effectiveness of the skill transfer. One of my favorite phrases I use all the time is from Thomas Gilbert. In his talks about addressing

performance issues, he coined the term (I believe) “worthy” performance problems. What I glean from this is that there are many problems that can be addressed with training, and simulations as a part of training, but good training should focus on solving the problems that make a difference to worthwhile performance. Therefore, if you value a technological approach over really understanding what you are trying to teach, and crafting the model to capture the right level of detail, you could be limiting the effectiveness of training by introducing details that detract from the training objectives, even if you are using very precise analogies to the real world.

An obvious example is that if you are performing maintenance on some components of a device behind a panel, and you first have to expose the panel by undoing clasps or unscrewing support screws, you can make training tedious if you require the student to turn the screws just as they would in the real world. If the act of turning the screws is not relevant to the skills you need to teach, you are making the training tedious, which can interfere with the skill training process you are teaching.

4. What are the benefits of simulation training?

In a nutshell, I think that practicing appropriate skills in a hands-on, similar context/approach to real-life situations can introduce, reinforce, and evaluate conformance with proper procedures. Therefore, simulation training can be better than conventional training methods (both classroom and field) in the simulations are

- Safer to conduct
- Often less costly in the long run
- Repeatable
- Measurable
- May be easier to deploy
- May provide more varied environments in which to apply skills.

Some types of 'learning to perform' can be accomplished with carefully-constructed questions (I really like the work of Will Thalheimer [<http://www.work-learning.com/>] in this respect), since the setup or question itself is a model of the context (in a limited form, but nonetheless a model that may be appropriate if it expresses the right level of detail).

I am obviously also a huge fan of simulation for practicing 'hard skills' (in contrast with 'soft skills'), namely with equipment, which is why I am also surprised that there doesn't seem to be more of it, especially in the B2B arena. I think the technology has arrived long ago to provide valuable experiences, but still the perceived costs are high, especially as the simulation community (the ones who develop simulations) tends to focus on fidelity over tuning to training objectives.

5. How can simulation training be improved?

I don't see technological limitations to most types of training problems, but I think that instructors by in large do not know how to teach with simulations, that is, learning how to meaningfully engage students. That may be why many who talk about simulations (without understanding how they're built) tend to be conservative about how simulations should perform ("make it perform like in the real world"). This tends to produce bloated simulations that may be overly complicated by virtue of the fact they use the real-world situation as the gold standard.

6. Based on your experience using educational and simulations techniques, how do people make decision-s under stress? Intuitively or analytically? Please explain.

I don't have the experience to answer this regarding stressful situations, except to state the obvious reference to Gary Klein's work on Recognition-Primed Decision- (RPD) making.

7. What do you feel is the future of simulation training?

My answer to #5 addresses where I think it can be improved, which I hope is the future. I also believe that as simulations are applied in more disciplines, we will get better case studies and processes for what works or does not work in those situations. Certainly there will be better, easier tools for developing simulations, but I think real progress will

occur in a field when the training process and integration of simulation is laid out more clearly, typically through a process of “we did it this way and here were the deficiencies, and here is how we learned to do it better.”

In the Fire Service, I think Brunacini’s and Abbott’s Command Training Center in Phoenix is a wonderful example of really nailing the training process using simulation. People are drawn to the tools, and many software sales have been made as a result of viewing their setup, but the genius is in how they have codified the training process, through years of iterative development. While the software has enabled them to explore training methods beyond conventional means, its deficiencies (and all software has deficiencies) may have constrained their exploration.

While it’s not relevant to the Fire Service, since I brought up equipment training, I see the future of simulation training stepping over the line of training into product marketing. There is a commonly-used cliché that “advertising is education,” but I think we still have a lot to explore in how product marketing and training interact using simulation.

8. Do you see simulation applications for the fire service potentially improving incident command decision- making?

I am very biased here because I am out selling a simulation platform for the Fire Service (and other public and private safety organizations). I definitely believe it can improve

incident command decision-making, so long as it is applied in the context of teaching good practice. In simple terms, I see simulation applications enabling organizations to train and evaluate adherence to accepted practice, and potentially exploring what was “accepted practice” to devise better practices. For example, SOP’s are often devised based on what the authors believe should be accepted practice, along with an integration of local, state, and national standards. But SOP’s are rarely tested until something bad happens. Simulations have a great potential for virtual ‘field testing’ of SOP’s, and ultimately devising new ones.

For several years, we’ve been selling our system on the premise that one can create scenarios to practice and evaluate real-life situations for command, strategy, tactics, and communication. Interestingly enough, even the immersive, 3-D systems that claim to be more realistic have these same objectives, and I have yet to hear exactly why their approach, given the extra technological burdens, contributes meaningfully more to any of these goals.

However, the issue of SOP adherence has led to our current focus of research, which is using simulation to help organizations answer the basic question “are my company officers and battalion chiefs following SOP’s”, in a performance-based way.

Appendix F- Answers to Questionnaire (Ron Tarr)

1. Do you feel realistic simulations are effective teaching tool for improving decision- making? Why or why not?

Yes I do, but only if they are properly designed, meaning they are designed using learning methods and include proper level of detail, evaluation and feedback. Too often SME instructors design simulations to replicate reality and expect students to derive the learning points rather than design them to actually train the student and let them practice until they master the skills involved.

2. Do you feel that simulations can improve intuitive decision- making?

Yes; although I believe some people are born with better abilities to make decision-s I believe the chance to practice them in structured simulations can improve the natural ability, like practicing any skill, e.g. athletic or musical talent, can be improved by proper practice and coaching.

3. Based on your experience what are the limitations of simulation training?

The biggest limitation is usually it is not properly designed. The second is that certain skills lend themselves to simulation training and some don't. Those skills that require specialized psychomotor performance can be limited in simulation, especially if there are special cues or physical feedback are required, such as emergency procedures situations for a pilot.

4. What are the benefits of simulation training?

There are several. First, the opportunity to experience dangerous or costly situations and practice how to react, such as driving Code 3 through traffic. Second, the opportunity to practice and get objective, detailed evaluation and feedback, as long as needed to master the targeted skills. Third, demonstrate and immerse the student in complex situations that are hard to describe in lecture or PPT, but need to be experienced to even understand; such as provide a “gods eye” view of a complex situation and observe how to implement procedures that could never be visualized in other ways’ such as close observation of a Flash Over, or a gas line explosion.

5. How can simulation training be improved?

The first thing is to have it properly designed. Simulation training must be done by experts in learning and simulation technology in careful coordination with SMEs in the performance that is being trained. We have gotten too used to SMEs giving lectures with no real understanding of how people learn that we mistakenly believe those same people can design simulation training. Designing any training requires special skills and simulation training requires even more specialized skills. The second way would be to more carefully design how the simulation training is integrated with the other training be used, to ensure that the learning strategy is consistent across all the methods of instruction being used and that they don’t interfere with each other.

6. Based on your experience using educational and simulations techniques, how do people make decision-s under stress? Intuitively or analytically? Please explain.

I have seen people make decision-s both ways, depending on their personality and how they have been trained. There are usually two different types of approaching a decision-, one is procedurally and the other is conceptually. Often people in public service (military, fire, police) are trained to follow SOPs or manuals that include step by step instructions on how to solve a problem or make a decision- and when they run into a problem or situation that requires a decision- they fall back on that training. This is often seen with less experienced people. Other people and those with more experience may appear to make decision-s more intuitively as they observe the situation and then seem to leap to a decision- or solution. In the case of the more experienced person, it may be that they are still going through a procedure but it happens very fast or they simply remember a similar situation and they go with the decision- they made before that worked. Some people actually make decision-s in a more conceptual way by pulling various pieces of the situation together and making a decision- in a more holistic fashion. They often have trouble describing how they make a decision- as it is really more intuitive or subconscious. Under stress, the method that has been most successful for them is what they use; it means that the procedural person may actually take time to go through a process that may appear to be confused or slow, but the process helps them get through the stress.

7. What do you feel is the future of simulation training?

My hope is that we will make better use of it by making better simulation training applications; but it will only work if people began recognizing that it is a sophisticated learning intervention that requires properly trained personnel from several disciplines to develop and must be properly implemented. It is often more expensive to implement properly which is why short cuts are taken but it will only achieve its cost benefit/ROI if it is properly designed, implemented and maintained. I believe it could return us to a much more individualized and effective method of education and training but it will require instructors to change the way they do business and the overall training hierarchy to use different metrics of success, such as students throughput and hours of class time.

8. Do you see simulation applications for the fire service potentially improving incident command decision- making?

As both a retired Army Officer and a senior faculty research focused on enhancing human performance through the use of technology I strongly believe simulation applications can improve incident command decision- making. This is especially true with the reduced opportunities for young leaders in the fire service to deal with incidents in their initial years as firemen. We learned in the Army that command decision- making, like any other skill, is improved with proper practice and exposure to situations in which a decision- must be made. When looking at incident command decision-s the only practical method of learning and practicing such situational awareness that leads to proper decision- making can only be achieved in simulation

in a reasonable amount of time. Although the saying goes there is no substitute for experience, I believe simulation can go a long way if properly designed to provide “virtual experience” that can server well as an alternative.

Figure 1: Present Rank

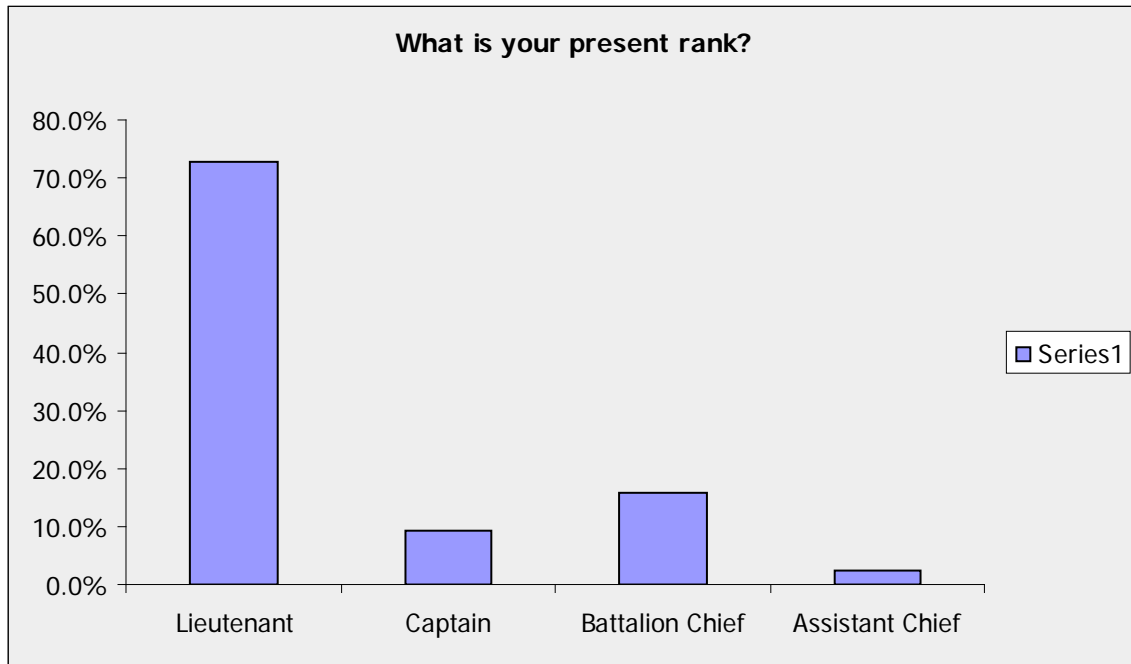


Figure 2: Service at Current Rank

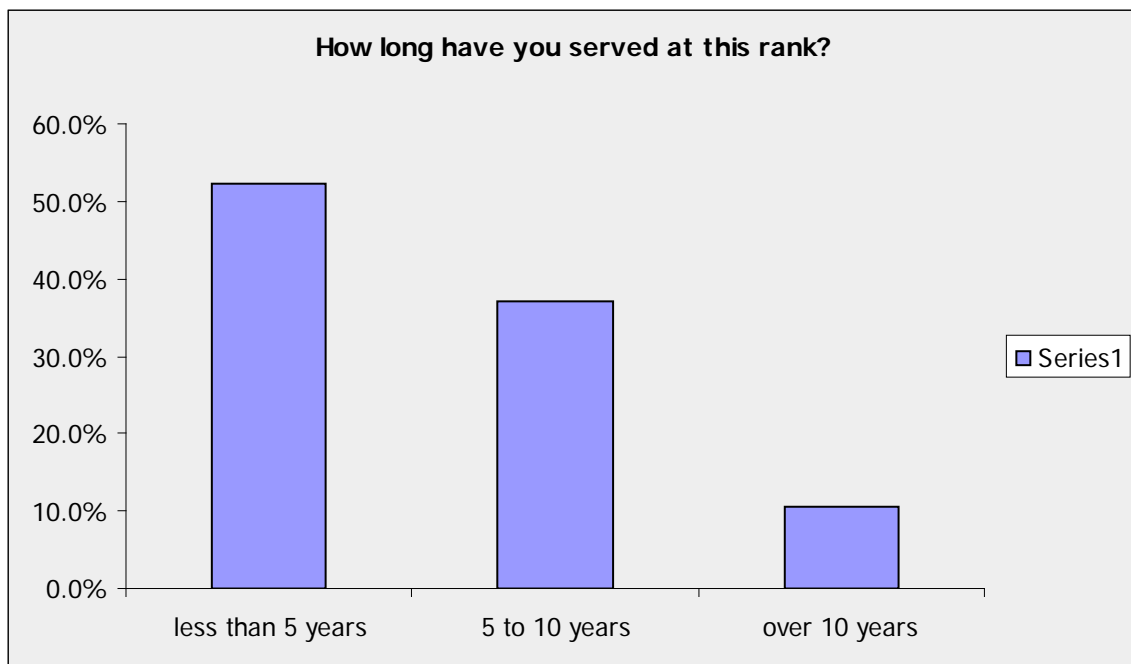


Figure 3: Command Experience

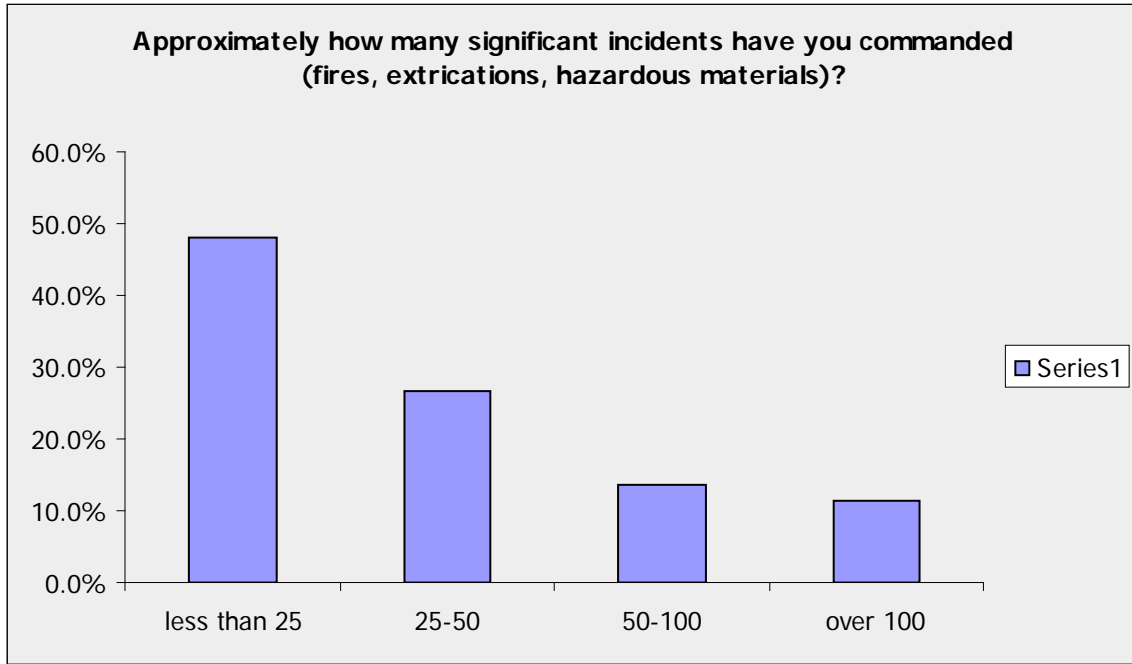


Figure 4: Attendance of Command School

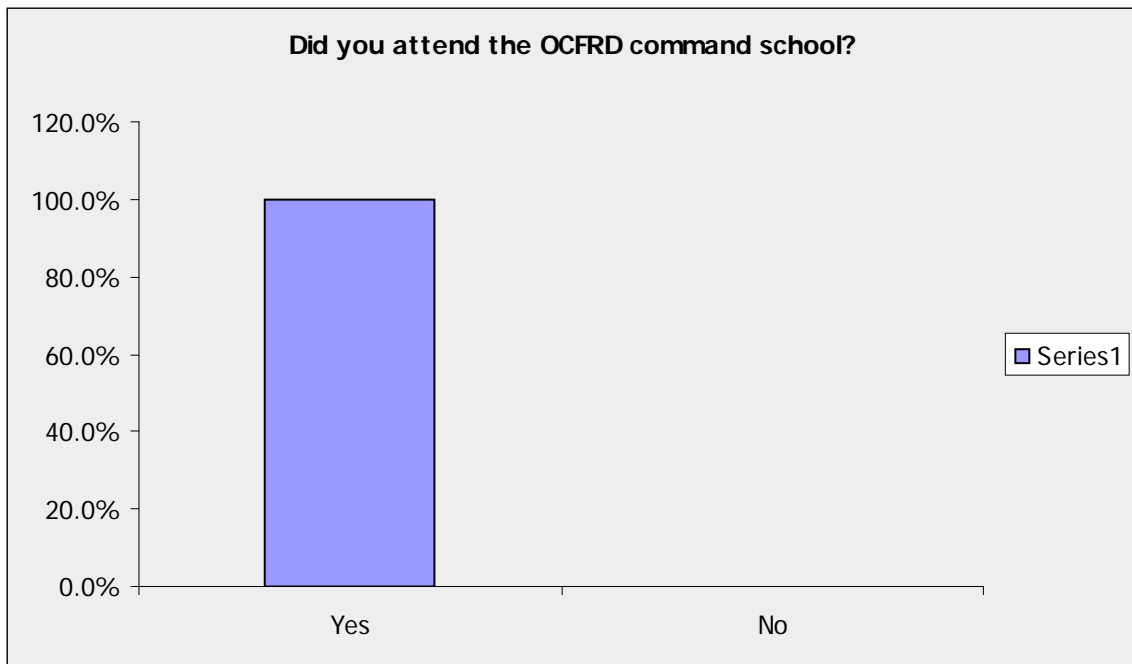


Figure 5: Attendance of Unified Command School

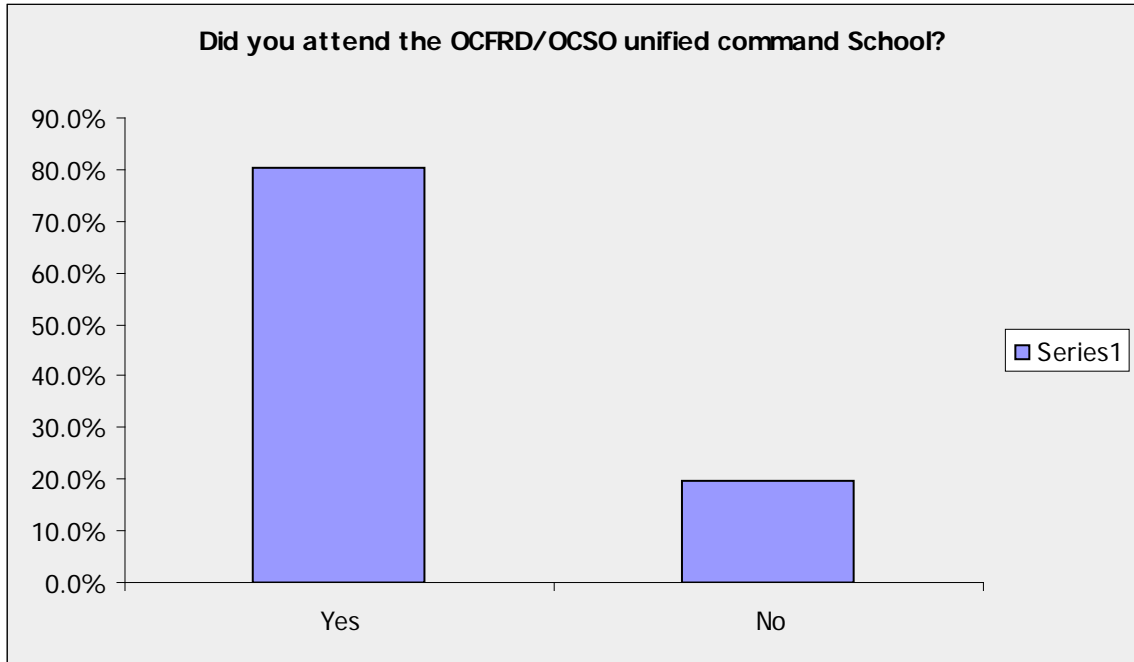


Figure 6: Decision- Making Style

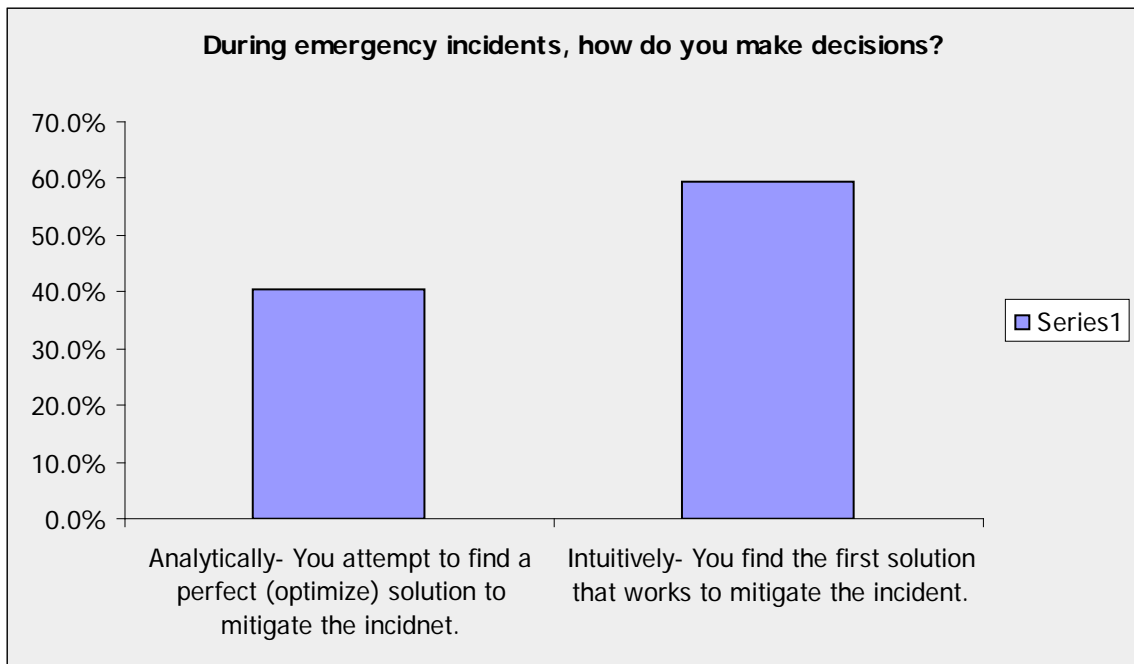


Figure 7: Assigning Tactical/Strategic Priorities

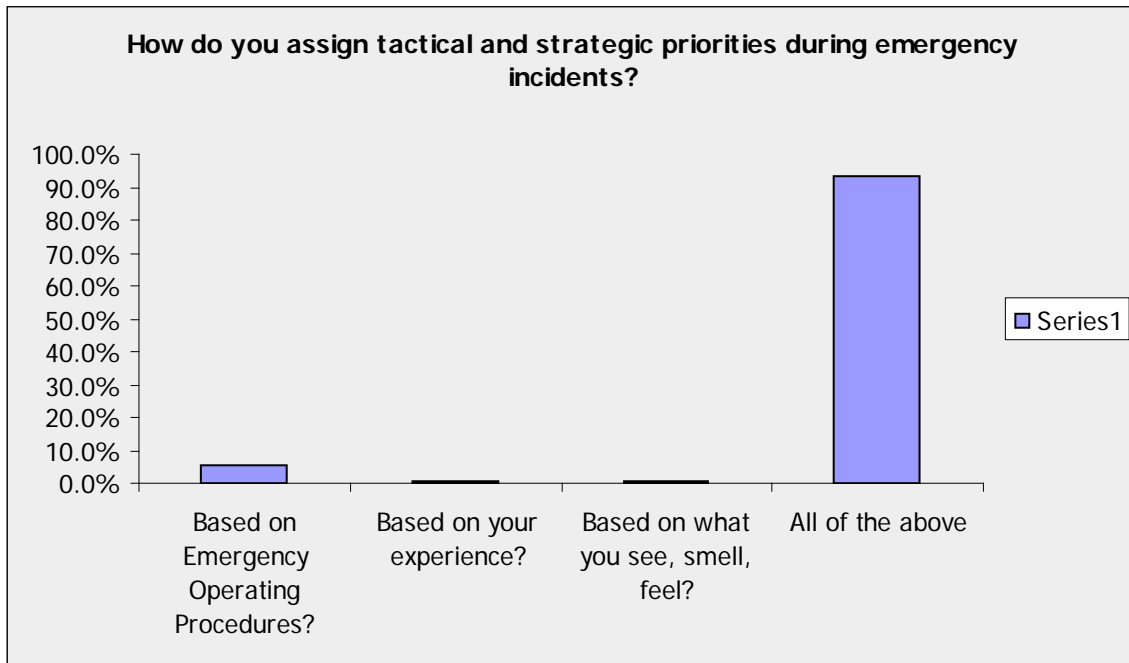


Figure 8: Experience

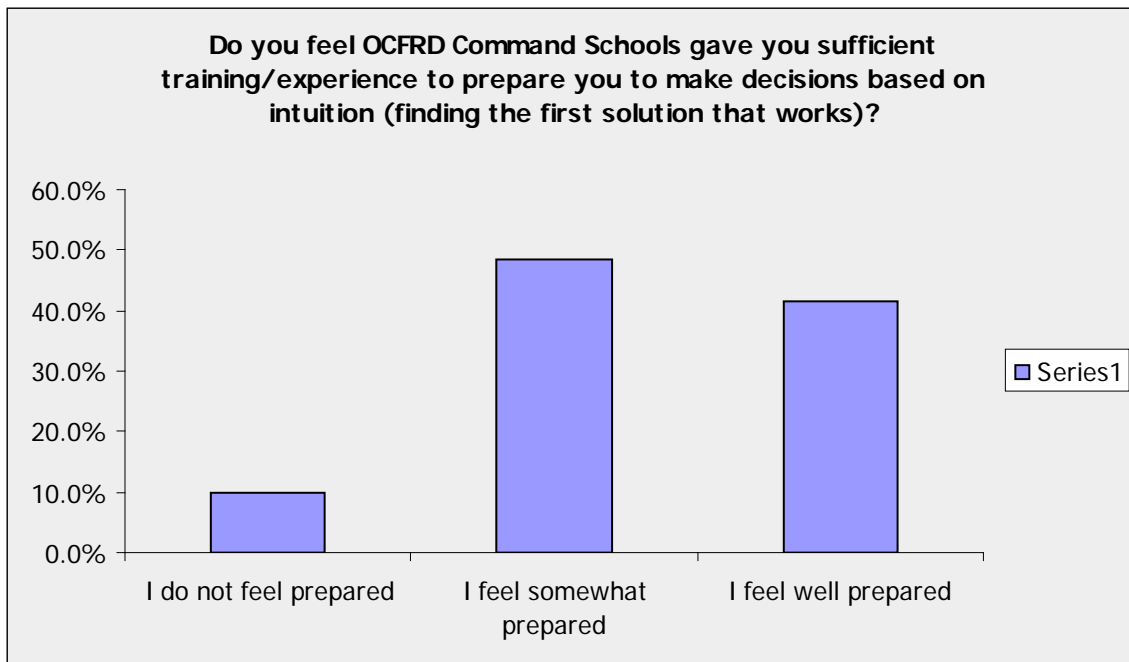


Figure 9: Last Attendance at Command School

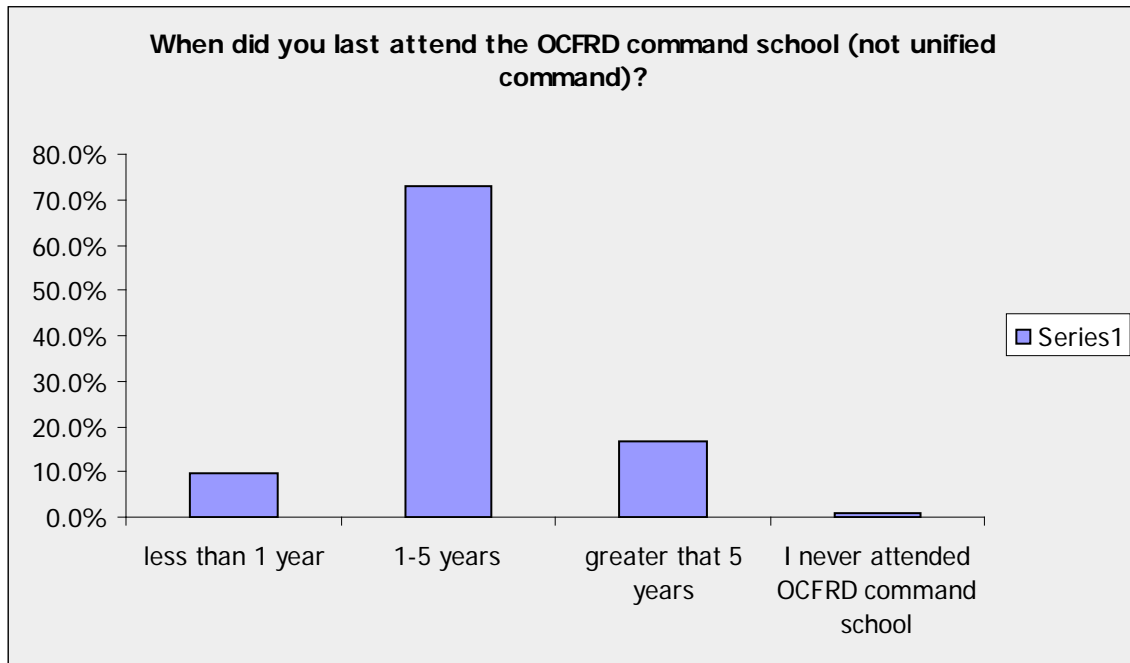


Figure 10: Improving Intuitive Decision- Making

Do you feel if the command school program were enhanced with improved curriculum on decision-making and improved technology (better simulations including more realistic visual pictures/video, sounds, lighting) this would improve your intuitive decision- making capabilities?

