PRODUCING AN ON-CALL-HELP DISPATCHER GUIDE FOR THE ADVANCEMENT OF THE COSTA RICA FIRE DEPARTMENT

An Interactive Qualifying Project submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science.

Submitted by:

Sneha Arjun

Jeffrey Greenwood

Nitya Karki

December 16, 2009

Submitted to:

---	---
Prof. Isa Bar-On	Prof. Ingrid Shockey

Project Liaison:
Señor Rodrigo Leandro Quesada, Chief of Communications, Cuerpo de Bomberos

Abstract

As Costa Rica becomes subject to a highly dynamic emergency scene, Cuerpo de Bomberos, the country's fire department, is in a constant search for ways to improve its response services. This includes everything from improving firefighter training to updating technological devices. This report details our contribution to a digital on-call-help dispatcher guide to complement their efforts of improvement in the fire department. Our guide was created specifically for the dispatchers at the Office of Communications, Santo Domingo, the site of this project.

Acknowledgments

For help in the completion of our project, we would like to thank our:

Sponsor:
Señor Rodrigo Leandro Quesada

Professors:
Isa Bar-On
Ingrid Shockey

Site liaisons:
Doña Marcela and Don Jimmy Music

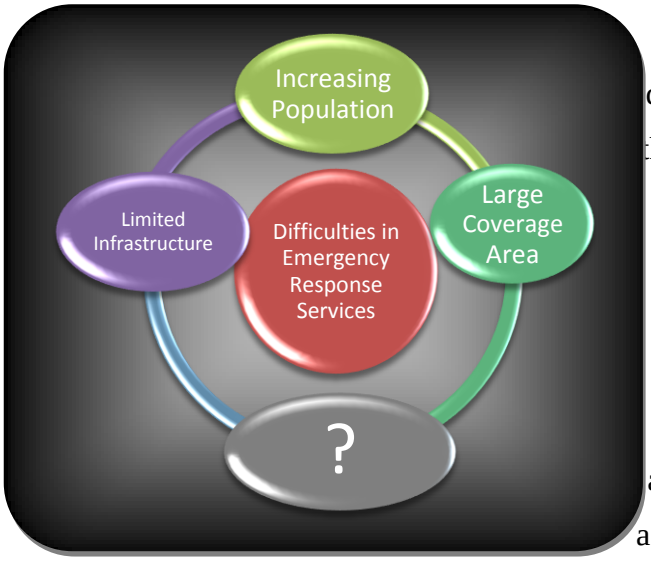
Contacts in the United States:
Bob Manners
Chief Michael Winn
Captain Seth Colby
Ed McNamara

Thank you for all your help!

Executive Summary: *Producing an On-Call-Help Dispatcher Guide for Advancement of the Costa Rica Fire Department*

The Costa Rica Fire Department and Challenges for Response Services

Since its establishment in 1865, it has become ever more challenging for Costa Rica's fire department to successfully carry out the goals of their mission statement to "provide protection when life, property, and environment are threatened by fires and emergency situations, based on the highest human principles and the ongoing quest for excellence" (Bomberos, Costa Rica). The country has several characteristics that contribute to the difficulties faced by the fire department emergency response system.



One of these characteristics includes its mountainous geography, which makes it difficult for the firefighters to navigate through the roads of these parts of the country due to its limited roads. Another obstacle for the fire department is the large area of coverage that fire departments are subject to in the rural part of the country due to smaller population density in those areas. While these areas have a few inhabitants, the population of Costa Rica as a whole is continually growing and between the years 1970 and 1990, this growth rate was 2.6% per year ("*At a Glance: Costa Rica*", 2004). This increase in the Costa Rican population led to the simultaneous increase in population of cities, which therefore leads to the potential of both higher quantity and severity of crises such as inner-city fires. While these components present a challenge for the Costa Rican Fire Department, the emergency situation will continue to change. Thus, the firefighters of Costa Rica, known as Bomberos, need to continually strive for improvement in their emergency services to overcome new challenges and still achieve their mission.

Our Suggestion for a Step in Improvement

While the response system has indeed improved over the years, such as with the implementation of CAD (computer aided dispatch) in the dispatching office, there is still room for development. Currently, the Bomberos at O.C.O. (Office of Communications) do not provide on-call help to the emergency caller. This is a shortcoming in the response process for the fire department because every second is important during an emergency. Thus, providing pre-arrival instructions would help reduce the severity of the emergency at hand because the crisis response would begin before the arrival of the fire department

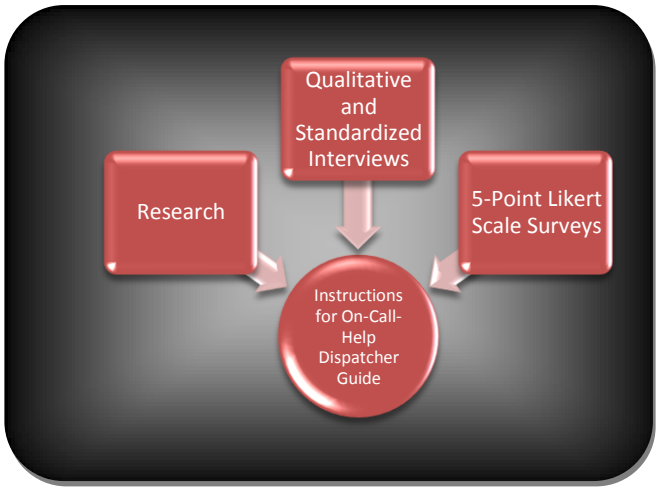
Hence, our aim was to produce an on-call-help dispatcher guide that will serve as a resource to the fire dispatchers at O.C.O. for the continual improvement of the emergency response process.

To address the challenges faced by Costa Rican Fire Department and to provide a Costa Rica specific guide we took the following steps:

- Learn and analyze the changes in the emergency situation of Costa Rica
- Understand background differences of the dispatchers
- Compile relevant set of instructions
- Create the on-call-help dispatcher guide

The Strategies Used

In order to learn and analyze the changes in the emergencies that occur in Costa Rica, the logs of emergencies that the fire department responded to between the years 1991 and 2006 were analyzed. Specifically, this was used to identify the trends in the call volumes and the nature of the emergencies. To understand the dispatchers themselves and their background, individual interviews and surveys were completed. Interview and survey questions dealt with work experience, training, and opinions of producing a pre-arrival instructions dispatcher guide. We gathered pre-arrival instructions for each type of emergency for which the Costa Rican Fire Department would provide on-call help.



We drew upon the records of several accredited United States organizations. In order to edit the set of instructions to enhance efficiency and quality specific to Costa Rica, several rounds of feedback interviews were conducted with the O.C.O. dispatchers. The nature of all interviews was standardized and qualitative. Lastly, these instructions were put into an HTML template to create the on-call-help dispatcher guide.

Our Findings and the On-Call-Help Dispatcher Guide

Along with the diversity within the workers, the emergency situation for Costa Rica, as seen in figures 2 and 3 respectively, has shown to be dynamic in two main ways: the increased quantity in the number of responded calls and the amplified diversity of those calls.

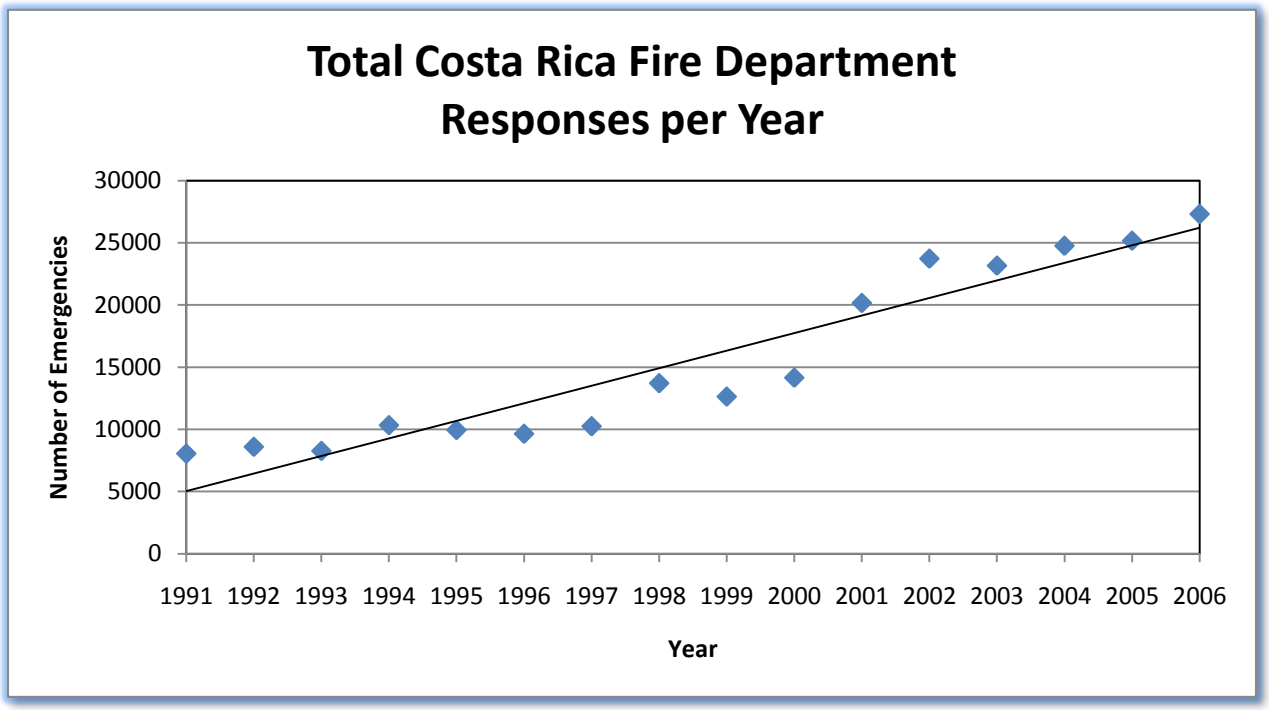


Figure 2: Total Costa Rica Fire Responses per year

While it is not obvious in figure 3 below, detailed analysis of the logs showed that additional sub types of emergencies appeared in some of the categories. These include hazardous materials and tending to bees, which led to differences in the percentages for each emergency that the Bomberos responded to in 1991 vs. 2006.

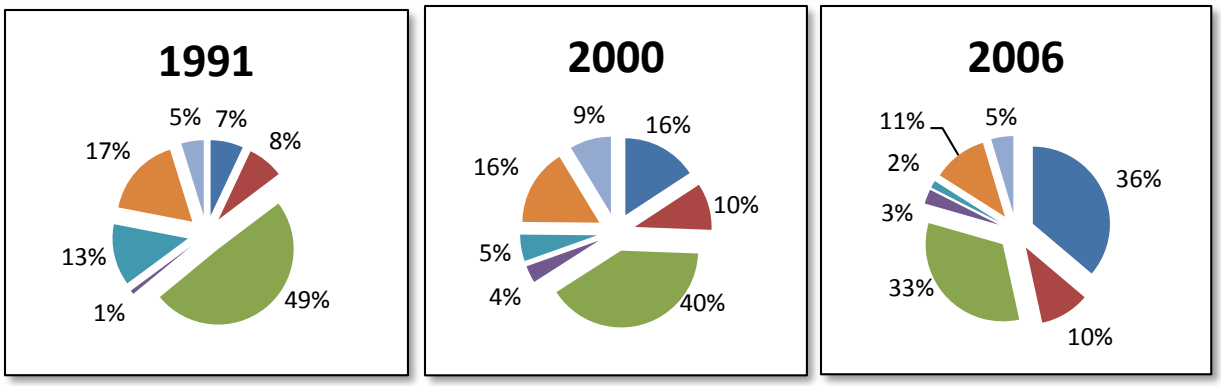


Figure 3: Costa Rica Fire Department Emergency Responses in 1991, 2000, 2006

The Costa Rican Fire Department has to constantly adapt and improve due to the great volume and diversity of the emergency calls. Now, more than ever, people are in need of pre-arrival aid and this guide will provide that help for the growing population. In order to adapt to the changing crises, the dispatchers will also be able to easily add in new emergency categories.

This HTML-based on-call-help dispatcher guide that we created consists of up-to-date instructions for the wide variety of Costa Rican emergencies. It can be implemented by simply uploading a folder containing multiple layers, which represent different depths of the guide such as the homepage and the page with the actual instructions. Seen in figures 4, 5, and 6 are respectively, the homepage (listing each major category), a page with related sub-groups, and the list of instructions.

Figure 4: Homepage of Guide

Figure 5: Sub- groups for Fire Emergency

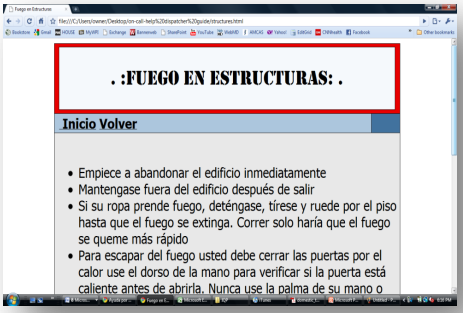


Figure 6: Instructions for Structural Fires

The simple and user-friendly interface allows locating the instructions at a quick pace to be assimilated into their present protocols. The consistent layout of the pages is very simple; there are not unnecessary images or words to allow for easy navigation.

Throughout our study, we found that 90% of O.C.O. dispatchers were in favor of using this guide in the emergency response process. Whether it is used to serve as a set of instructions to be dictated to the caller or as a resource while formulating a personalized and situational set of instructions, the guide will be an improvement in the O.C.O. station. It was important to promote this advancement of the Costa Rican Bomberos because it is a step in the direction of continuously improving their performance by handling emergencies more effectively in a varying emergency environment.

Recommendations

With this product and the conclusion of our study we would like to mention multiple recommendations for the optimal benefits of the on-call-help dispatcher guide as well as for the general improvements of O.C.O.:

- We recommend performing a follow-up evaluation on this guide, rating the effects of its instructions and the general usability of the guide. This will be beneficial in identifying any shortcomings and the resulting enhancement will promote the development of the fire department.
- Through our study, we found that some additional upgrades expressed by dispatchers included updating technology such as consoles and radios. We recommended that studies are conducted to evaluate the effect of technology on O.C.O. performance. If

technological advances have indeed proven to be highly effective, these studies should also include suggestions for further advancement.

- We believe that it will be beneficial for the fire department to regularly evaluate the performance of the Bomberos. Multiple dispatchers expressed the need for more training. Thus, it will beneficial to identify any possible areas of improvements directly relating to dispatchers.

Conclusion

The purpose of this report was to produce an on-call-help dispatcher guide that will serve as a resource to the fire dispatchers at O.C.O. in order to facilitate their efforts in continual improvement of the emergency response process. Upon completion of our study the following were important outcomes:

A. Finding that the call quantity of emergency calls is increasing and the emergencies are diversifying.

B. Finding that there is a range of experience among O.C.O. dispatchers leading to varied skills of judgment.

C. Creating an on-call-help dispatcher guide.

D. Receiving positive feedback from dispatcher about guide as a step in improvement

In summary, our study resulted in finding additional challenges for the response services in Costa Rica as well as the production of a resource for O.C.O. that will aid in their strong efforts for continual advancement. It is important to promote this advancement of the Costa Rican Bomberos because it is a step in the direction of continuously improving their process of handling emergencies more effectively, especially with the emergent trends. Throughout the years, they continue to change their training process to include any new additions to the department and update the Bomberos on information about new types of emergencies for which they will be responsible. It is evident Bomberos are a very united and motivated group of brothers and have a strong will to keep striving in their mission and vision. Overall, the fire department today is very well respected and received by the community they protect, and it is easy to see that their future is brilliantly lit, as well.

Authorship Page

This report is the result of the equal and collaborative efforts from all of the authors. Each member played an equal role in the writing and editing for each section of the project.

Sneha Arjun

Jeffrey Greenwood

Nitya Karki

Table of Contents

Table of Figures:

Table of Tables:

Chapter 1: Introduction

Prior to the year 1865, Costa Rica did not have an organized force to fight fires. Fire emergency services were established after a devastating fire burned down the house of Don Francisco María Iglesias, a prominent figure in politics, agriculture, and trade, on January 26, 1864. Since then, the fire department of Costa Rica, officially founded in 1864, has grown significantly from a single station in San Jose to the current sixty-three fire departments scattered throughout the country, as well as a firefighting academy and a communications office (Bomberos, 2009). Although the Costa Rican Fire Department has changed significantly since its formation, its ideals have remained consistent. The mission of Bomberos today is,

> *"To provide protection when life, property, and environment are threatened by fires and emergency situations, based on the highest human principles and the ongoing quest for excellence"* (Bomberos, 2009).

Over time and the progression of society, challenging emergencies have arisen. The nature of these emergencies has diversified and increased in number with the modernization of the society and technology in Costa Rica. For example, fires that previously started due to simple sources such as matches have evolved to incorporate other, more complex ignition sources, such as flammable chemicals. Emergency plans, which were developed to prepare citizens for emergency situations, must be updated frequently "based on new technology, the outcome of emergency drills and responses to past emergencies" to accommodate proper management for these altering catastrophes (Flores, 2009). The fundamental idea behind this statement harmonizes with the vision statement of the Bomberos:

> *"To be a first responder state organization known for its high standards of quality, effectiveness, and efficiency in responding to emergencies within their competence, and to provide fire prevention services that fully contribute to national development by improving the levels of protection of life, property, and the environment"* (Bomberos, 2009).

There have been advancements pertaining to society and technology since the first fire department was commenced. Before the introduction of the 911 system in 1994, Costa Rica had a number, 118, for directly reaching the fire department in cases of fire related emergencies. This resulted in prank calls that caused the loss of valuable time. (R. Quesada, personal communication, November 16, 2009). Today, all calls are received via a single 911 number at

the main dispatching center in Tibas, which are then forwarded to the specific emergency department for which the call is better suited. The fire department related calls are then forwarded to O.C.O. (Office of Communications) – Costa Rica's sole fire dispatching station located in Santo Domingo. This new system allows dispatchers at O.C.O. to allocate their time more efficiently since the prank calls get filtered out by the dispatchers at Tibas.

Technological advancements have also contributed significantly to improvements within the fire stations of Costa Rica. For example, the availability of the internet enables dispatchers to search for helpful emergency information for issues such as hazardous material incidents. Moreover, the acquisition of CAD (Computer Aided Dispatch) is another addition that has made the response process effective and efficient. While the fire department system has improved immensely throughout the past century, there is still room for improvement.

Currently, the dispatchers at O.C.O. do not provide pre-arrival aid to the emergency caller. This is primarily due to the lack of time between phone calls, the shortage of dispatchers, and the absence of a standardized set of instructions. For a dispatcher to provide on-call help, it is essential to have good judgment. Even with the aid of technology, a lack of proper judgment can prove to be fatal in critical situations. The O.C.O. dispatchers have a range of experience in dispatching and it would be difficult for them to give effective and consistent instructions over the phone without the presence of a pre-arrival instructions guide. As the fire department call volume increases and diversifies, the need for an on-call-help dispatcher guide becomes more and more apparent. Therefore, the goal of this project was to produce an on-call-help dispatcher guide containing standardized pre-arrival instructions for a wide range of emergencies that will serve as a resource to the fire dispatchers at O.C.O. This will facilitate their efforts in continual improvement of the emergency response process.

Chapter 2: Literature Review

In order to produce an effective on-call-help dispatcher guide, we investigating the current dispatching conditions in Costa Rica, specifically in the Office of Communications. We learned how the dispatchers are trained and what resources they currently have. We also examined the effects of experience on judgment in emergency situations and give light to how standardization plays a role in creating protocols. These topics provided a background for the on-call-help dispatcher guide.

2.1 The Emergency Situation around the World

Natural disasters have caused a great deal of loss throughout history. Recently, the impacts of disasters such as floods, droughts, earthquakes, hurricanes, and fires have increased in severity and frequency. One of the main reasons for this is that the world's population has been increasing, and crowding has caused a much greater potential for these emergencies (Chan, 2009). Humans have acted as a catalyst in the changing characteristics of these emergencies. For example, due to recent deforestation, floods, landslides, and mudslides have had a much greater impact on their surrounding communities ("Why is it," 2009). These severe situations put strain on emergency departments to adequately protect the public people and it is important for them to constantly adapt to the changing natural environments.

2.2 Difficulties for the Costa Rica Fire Department

The Costa Rican Fire Department is responsible for responding to any fire related emergencies for all of Costa Rica's 4,253,877 citizens within the 51,060 square kilometers of the country. These emergencies incorporate everything from various types of fires to electrical issues. Due to the area of coverage that the Costa Rican Fire Department must be held accountable for, there are many challenges that have arisen in responding to these various types of emergencies.

Costa Rica has several inherent traits that contribute to the difficulties present in the fire department emergency response procedure. One of these traits includes its mountainous geography. These parts of the country are very hard to navigate through because of limited infrastructure. Hence, response times have the potential to be very delayed in these locations. Another obstacle for the fire department is that thirty seven percent of the Costa Rica's citizens live in rural parts of the country ("The World Fact book: Costa Rica", 2009). The fire stations

protecting the rural country regions typically cover a greater land radius due to the smaller population density. Therefore in these areas, the stations take longer to respond to emergencies ("Cuerpo de Bomberos", 2009). In addition, the growth in population has caused a major impact on the emergency response process. For example, the population growth rate between 1970 and 1990 in Costa Rica has increased an average of 2.6% every year ("At a Glance: Costa Rica", 2004). This led to the simultaneous increase in the population of cities, which therefore results in the potential of both higher quantity and severity of crises such as inner-city fires.

O.C.O. dispatchers have confirmed that all of these components present a challenge for the Costa Rican Fire Department, giving rise to the necessity for an improvement in their emergency services.

2.3 Office of Communications and its Dispatchers

The Costa Rican Fire Department functions as a single unit, and it is therefore important for firefighters to work together as a team. The O.C.O. is home to sixteen dispatchers, who are also firefighters for the station located directly above the dispatching office building. There are five dispatchers in house every day and of these, two are on shift at the dispatching desk while the rest manage other work relating to the office and the fire station. The two dispatcher stations in O.C.O. are each complete with four computer monitors, a radio, a phone, and a dispatching console. Each station is assigned to a different half of the country, which is further broken down into ten zones. O.C.O. dispatchers use phones or radio transmissions to forward emergency information to the appropriate fire stations.

The emergency process begins when an emergency caller dials 9-1-1. From there, dispatchers in Tibas collect information about the emergency and then determine which departments are required to handle the situation. These calls are then forwarded to the appropriate emergency department(s), such as the Red Cross for medical emergencies, the police department for any criminal and traffic related emergencies and O.C.O. for fire related emergencies. All non-urgent calls involving the fire department are relayed via digital data, and all urgent calls are relayed verbally. After a call reaches O.C.O. by radio or telephone, a dispatcher assigns the call to the fire station that is located nearest to the emergency.

2.3.1 Dispatcher Training

There are several requirements for the dispatchers who work at O.C.O. In order to become a dispatcher, one must first graduate with a bachelor's degree. Next, the individual must enroll in a three-day class that teaches about the different software and programs that are in use at the dispatching office and how to correctly operate them. Finally, the trainee comes to O.C.O. where he/she must shadow a full time dispatcher to learn any technicalities about the job, such as how to work the dispatching console. The length of the shadowing period is dependent on the skills of each dispatcher in training. The newly trained dispatcher must also study the Manuel de Politicos, Lineamientos y Procedimientos (L.E.O.S.), which lists all of the standard procedures for the situations that the person may encounter as a dispatcher (J. Guillermo, personal communication, November 23, 2009). In summary, there are several different training sessions that prepare dispatchers for their job. .

2.3.2 Resources for Dispatchers

Over the years, several types of resources have become available to the dispatchers, such as computer software, instructions, and guides with standard protocols. As technology began to improve around the world, CAD (computer aided dispatch) programs became more prevalent. These programs assist emergency dispatchers in four main ways; they help dispatchers locate the address of the incident, gather vital information about the emergency situation, assist callers on the other end of the line, and record the time of any action made by the dispatcher. The CAD software used by the dispatchers in Santo Domingo is called SIGAE. SIGAE prompts dispatchers for information about the emergency, such as identifying the nature of the situation to quickly develop a summary on the specifics of the emergency. It consists of information that aids the dispatchers locate the address of the incident as well as gather information about the emergency situation such as the caller's name. Furthermore, SIGAE also contains a map of Costa Rica and has the ability to show where landmarks and resources, such as fire hydrants, are located to help the response team easily locate the emergency. These landmarks, which consist of popular, commercial centers in the community, are points of reference for Costa Ricans when giving an address. Aside from using technology, the dispatchers in Santo Domingo have other resources they rely on. These resources include books and binders provided to every fire department in Costa Rica. One of the books, L.E.O.S., consists of general protocols that dispatchers need to follow once they become a firefighter. It's regarded as their "Bible"

according to dispatcher Sr. Luiz Gonzales because it contains everything that a firefighter is required to know. Manual de Procedimientos Internos Oficina de Communicaciones is another resource available at O.C.O. This book is for the firefighters of this particular station and consists of procedures on how to communicate via radios and telephone. The book has daily protocols that the Bomberos, who are also dispatchers, need to follow. This includes anything from having a protocol on how to answer a phone call to instructions on how to operate the dispatching machines. Even though this book consists of different types of instructions, it lacks pre-arrival instructions for various emergencies that the dispatchers could give to the caller.

2.4 Experience and Judgment

Experience and judgment are two interrelated qualities that play a major role in the quality of emergency care provided by emergency personnel. Judgment refers to one's general ability to make effective decisions, while experience describes one's familiarity with situations. Both of these traits are important in making decisions, specifically when providing emergency care (Heskett, 2008). This is especially true for dispatchers because they essentially begin the fire department's emergency response process. They are in charge of receiving notification of emergency situations, determining the details of it, and relaying information to the necessary personnel. Therefore, dispatchers are constantly put in situations in which they have to make important and quick decisions due to the hectic nature of dispatching.

The decisions made by dispatchers are affected by their work experience, specifically the number of emergency phone calls they have handled and additional qualifications they might have. For instance, a dispatcher who has been handling frequent 911 calls for ten years would be more familiar with dealing with difficult scenarios regarding public help than a dispatcher who has only been answering calls for one year (Clawson, Martin, & Hauert, 1994). Also, the more experienced dispatcher will most likely have a more stable state of mind amidst the chaos of an emergency call than the less experienced one (Redelmeier, Schull, Ferris, & Hux, 2001). In addition, a dispatcher who is an experienced paramedic is more likely to have better judgment in making decisions about situations involving problems. These examples illustrate that experience has a positive impact on dispatcher performance. Experienced dispatchers are better at handling many situations such as being able to calm emergency callers and obtain the necessary information about the emergency quickly so that they can continue handling the call ("Key components of," 2007).

2.5 Effects of Standardization

Due to the reason that emergencies are constantly evolving and increasing in number, it is important to have a resource to provide on-call help that will regulate and standardize the assistance for controlling these situations. Standardization is a technique that improves the effectiveness of procedures through repeatability and standards that enhance the quality, safety, and reliability of protocols (International Organization of Standardization, 2009). For the context of our project, standardization can "best be understood as the process aiming to define common and mutually agreed solutions" for the different types of emergencies to provide to the callers (Brusse & Wenning, 2005).

By creating a single guide for on-call-help, we will be aiding the dispatchers in becoming more efficient and uniform. Standardization is important to account for the differences in dispatcher experience and skill set to provide uniform emergency care. This also allows dispatchers with varying judgment to respond in the same and efficient way. An example of how standardization currently helps facilitate matters in O.C.O. is SIGAE. The standardized interfaces of this software make it easy for the dispatchers to navigate through the software quickly. Furthermore, all the dispatchers obtain the same type of information and they use the same file as a resource as the call goes from one station to another. This guarantees that all calls are treated in the same manner and handled with the same quality. Another example of standardization can be seen in their training process. All dispatchers study the same material and are given the same instructions every Monday of the week. Additionally, they have a guide of protocols for each type of emergency, which is reviewed during training. The term "guide" refers to any set of instructions that assists dispatchers, and can include everything from computer program prompts to a standard way of answering an emergency phone call. Guides act as tools to facilitate the dispatching process (J. Quesada, Personal Communication, November 30, 2009). These guides are updated yearly to account for any changes in their protocols and updates on the types of emergencies they are responsible for. Providing the dispatchers with the same protocol allows the response process to be habitual (R. Quesada, personal communication, October 28, 2009).

Chapter 3: Methodology

Our objective was to produce an on-call-help dispatcher guide for the Bomberos at O.C.O. that provides the dispatchers with a standard set of pre-arrival aid. To accomplish this goal, our team implemented several strategies to gather and finalize a set of instructions, learn and analyze the changes in the emergency situation of Costa Rica as well as the differences in the background of dispatchers, and produce our guide. These techniques consisted of investigating models for pre-arrival instructions, making observations, and carrying interviews and surveys at the station.

3.1 Developing a model for pre-arrival instructions

We needed a template for pre-arrival instructions for each type of emergency for which the Costa Rican Fire Department would provide on-call help. The O.C.O. station has a list of all the types of emergencies that the fire department responds to, some of which do not require the dispatchers to directly communicate with the emergency caller. With the help of Sr. Leandro, we were able to eliminate those events in which on-call help would not be pertinent. We used several credible electronic sources to locate information for the guide including sources in the US such as The National Highway Transportation Safety Administration, FEMA (Federal Emergency Management Agency), and OSHA (Occupational Safety and Health Administration). The information from this research was organized and condensed into a first draft of the on-call-help dispatcher guide.

We also examined the log of emergencies that the fire department responded to between the years 1991 and 2006. This information was analyzed to identify the trends in the call volumes and the character of the emergencies.

3.2 Interviews with O.C.O. Dispatchers

Multiple interviews were conducted to gain feedback about our guide and to learn about O.C.O. dispatchers' experiences and work backgrounds. In order to receive feedback, two types of interviews were used: group and individual. The group interview (see appendix A) served the purpose of gaining preliminary insight on any additional data that was needed and any information that should be excluded from the guide as per the recommendations provided by the dispatchers. It also enabled us to correctly organize the instructions as per the preference of the dispatchers. Furthermore, O.C.O. dispatchers provided advice on areas of the guide that were

unclear, mainly due to the cultural differences between the source of the instructions and the community in which they will be applied. In short, the interview served the purpose of collecting overall dispatcher opinions about the quality and effectiveness of the first draft of the pre-arrival instructions for the guide. It was beneficial to have dispatchers that were also trained firefighters and emergency medical technicians to aid in critiquing the content of the advice pertaining to fire and medical emergencies. This process was successful in gathering an assortment of opinions because the personnel cooperated in the interview and offered many constructive feedbacks related to the content and the chronology of each set of instructions. The individual feedback interviews (see appendix C) were conducted to receive feedback on certain sets of instructions that were rated low on feedback surveys. The poorly rated instructions each pertained to medical emergencies. They were improved through personal interviews with O.C.O. paramedics and EMTs from Worcester Polytechnic Institute.

Individual interviews were also completed to learn about the background of the dispatchers and their general views on our guide. These interviews (see appendix E) shed light upon their opinion of the implementation of an on-call-help guide and about the type of atmosphere that was present in their work through stories about emergencies that were significant for them. This also helped us understand the sense of strong brotherhood that can be seen in their mission and vision as Bomberos.

The format for all interviews was largely standardized and had a qualitative aspect so that there was room for flexibility in the responses as the interviewer added questions based on the replies (Doyle, J.K., 2009). To ensure that the collected information represented the general opinions of the O.C.O. workers, all sixteen dispatchers (and the station's chief for the group interview), each having dispatching and firefighting experience, participated in the interviewing process.

3.3 Creating the On-Call-Help Dispatcher Guide

The on-call-help dispatcher-guide was produced using the HTML template "fade out", clouser 2002©. The HTML code was opened in notepad, where information such as the categories of emergencies and the set of instructions was inputted. Tables were removed from the original template and additional codes were inserted to add buttons such as "home" and "return". The homepage was a single html document that will serve as the main link to open the

guide on the computer. The codes for the different layers of the guide, including the home page, were saved in a single folder, which was then uploaded on the computers for use.

3.4 Evaluation Surveys

Several surveys were utilized in our study to receive quantitative feedback on the efficiency of the instructions and the usability of the digital guide. Surveys were also used to gather background information about the dispatchers. Each type of survey was given to all sixteen dispatchers at O.C.O.

We asked dispatchers to evaluate the initial set of instructions for our on-call-help dispatcher guide, which was created from information gathered at the fire station. Every O.C.O. dispatcher responded to a 5-point Likert scale survey (see appendix B) to collect opinions on the effectiveness and the layout of the set of instructions for each individual emergency. Dispatchers who rated a set of instructions under 3 were further questioned to determine how to improve the guide. These suggestions were then applied to our design.

Along with evaluating the initial prototype, we also hopes to evaluate the usability of the updated version of the dispatcher guide with a 5-point Likert scale survey (see appendix F). In this case, usability refers to how comfortable dispatchers were with the format of the guide. We wanted to speak with all dispatchers who reported a rating lower than 3, and adjust the guide accordingly for a final product. Improving the usability of the on-call-help dispatcher guide plays an important role in implementing it into the emergency dispatching process at O.C.O. because if dispatchers are not comfortable with the structure of the guide, they will be much less likely to use it (J. Guillermo, personal communication, October 28, 2009). Unfortunately due to time constraints, this could not be completed.

A third survey used was to collect information about the background of the O.C.O. dispatchers. The survey questions dealt with work experience, training, and general opinions of producing a pre-arrival instructions dispatcher guide.

Chapter 4: Findings and Analysis

After the implementation of different techniques, important results were found to achieve our goal of creating an on-call-help dispatcher guide for a contribution in the advancement of the emergency services in Costa Rica. Specifically, we focused on the Office of Communications in Costa Rica to learn about the dispatchers who will be using the guide and how their background would play a role in its creation. Analyzing the dynamic system of the emergency services in Costa Rica gave importance for addition of the on-call-help dispatcher guide. All the aforementioned results came together to ultimately produce the HTML-based on-call-help dispatcher guide.

4.1 A Dispatcher's Experience and Judgment

While the bomberos at O.C.O. have undergone the same basic training to become a dispatcher, we found differences in their background leading to varied experience. Experience and judgment play a vital role when responding to emergencies. Experience is primarily defined as "the number of emergency calls which a dispatcher has handled". Señor Leandro, the chief of communications at O.C.O., does not log the number of calls that each dispatcher handles. Instead, he uses the number of years working in the station as the main indicator of experience. As can be seen from figure 1 below, O.C.O. dispatcher experience differs greatly. As can be seen from figure 1 below, examples include 1 year, 7 years, 11 years, and 19 years.

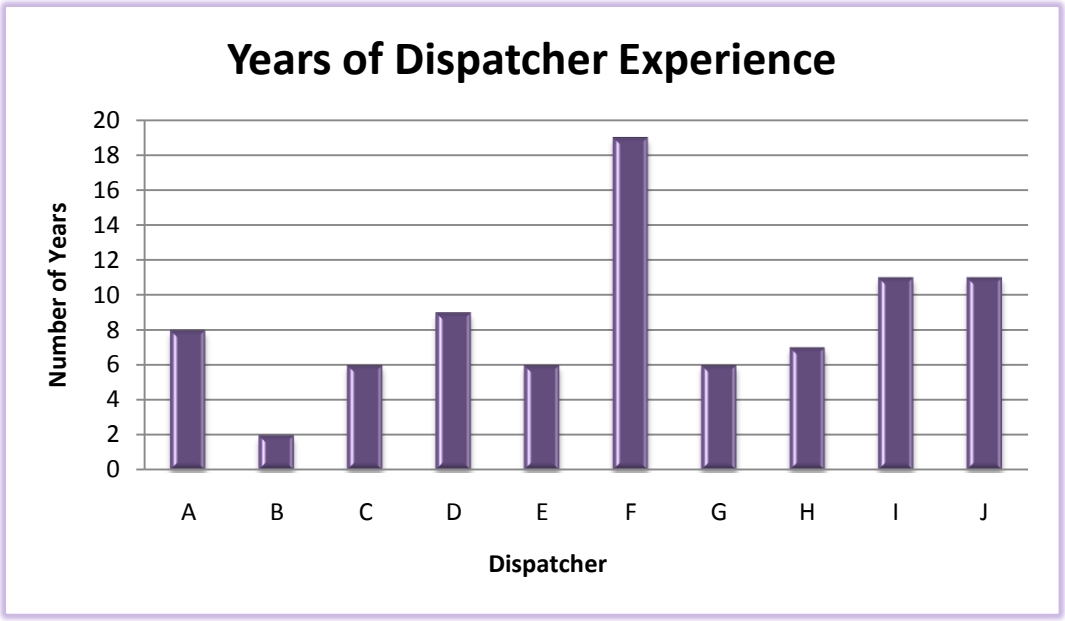


Figure 1: Years of Experience for O.C.O. Dispatchers

Not only is there diversity in the dispatchers' experience, but also in their skill sets. Many of the dispatchers are not simply dispatchers, but they are also experienced firefighters, and some are even paramedics. These instances of varied backgrounds give each dispatcher a different area of expertise – the paramedics have better judgment in situations involving medical crises, while experienced firefighters are able to make more of a difference in an emergency such as rescuing someone from a burning building. Therefore, it is important to O.C.O. that the station procedures are able to incorporate these assets of their dispatchers to allow for optimal performance.

The on-call-help dispatcher guide will serve to level the playing field, so to speak, for dispatchers by providing a standardized collection of pre-arrival instructions. Therefore, whether the dispatcher is an amateur or a veteran, they will be able to instruct the caller with the same effective aid for all emergencies.

4.2 A Dynamic Emergency Situation

Handling emergencies for the fire department of Costa Rica has become increasingly complex with the progression in society and technology. The logs of the calls that the Bomberos have responded to between the years 1991 and 2006 confirmed this difficulty. Upon their analysis, it was seen that the emergency situation is dynamic in two main ways: the number of the calls over the fifteen-year period has increased and the nature of those calls have become diverse. In order to keep up with this influx of emergencies, the number of dispatchers at O.C.O. increased as well. In the beginning, only one dispatcher would tend to emergency calls at a time. Around 1991, the number of dispatchers attending calls at a time increased to two.

As seen by figure 2 below, the general trend of the calls that were responded to shows that the fire department has become busier. Specifically, in 1991 the Bomberos responded to 8058 calls and by 2006, this volume increased to 27,305 calls. We found that the main reason for this increase in calls is due to the addition of fire departments throughout Costa Rica. More stations meant that that the calls that were previously taken care of by the community themselves were now able to get help from the Bomberos.

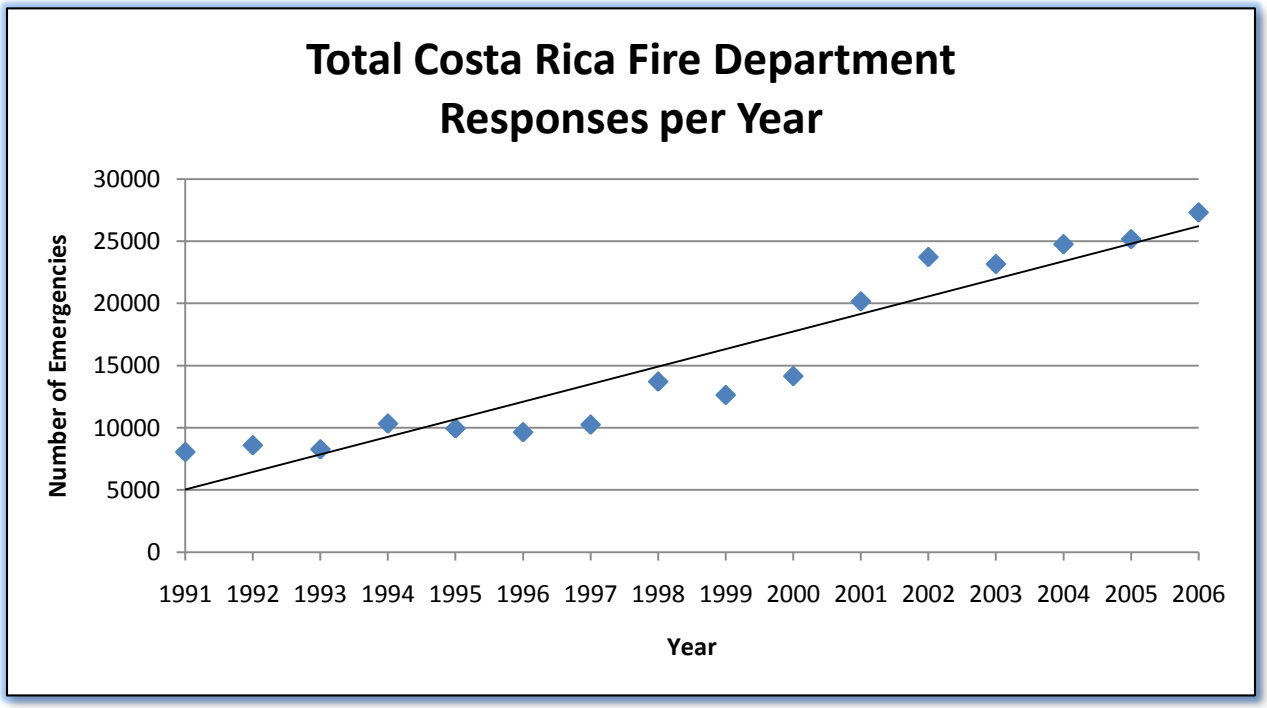


Figure 2: Total Costa Rica Fire Department Responses per Year

In addition to the increased work-load, the fire department has also been fronted with new types of calls as the years go on. An important example would be situations regarding hazardous materials. In 1991, there were no logged calls for hazmat, while in 2006 there were fifty three logged calls. This was due to law number 7331 passed on April 13th, 1993 by the Costa Rican government. This gave the fire department of Costa Rica the responsibility of responding to emergencies related to hazardous materials. Hence, the Bomberos began encountering a new type of emergency. This new group is especially complex because it consists of several sub-topics that the Bomberos must be trained to handle. A few of these include gases, agrochemicals, solid and liquid flammables and poisons. Although the total number of fire department responses has a general positive trend, it is not only dictated by consistently

increasing types of emergencies. As seen in figure 3 below, while the number of fires overall increased from 1991 to 2006, there are peaks and valleys as the call volume varies year to year. This trend is common among types of emergencies, which means that the frequencies of these emergencies vary every year. Therefore, some emergencies greatly contribute to the increase in total emergencies on select years but not on others, which adds to the diversity of types of crises.

In addition to being accountable for a wider range of situations, the fire department cannot predict which types of existing emergencies will emerge to be more critical over the years. An example would be killer bee swarms. As depicted in figure 4 below, in 1991 killer bee swarms made up approximately eight percent of total emergencies in Costa Rica. However, in 2006, they made up around twenty two percent of total emergencies. In 1995, the Health Ministry, which was originally in charge of incidents regarding bee attacks, decided that bee stings were too trivial a situation for their time and resources. Therefore, it was decided in a meeting that the fire department was to tend to any emergencies relating to the bees, greatly increasing their call quantity for situations regarding killer bees.

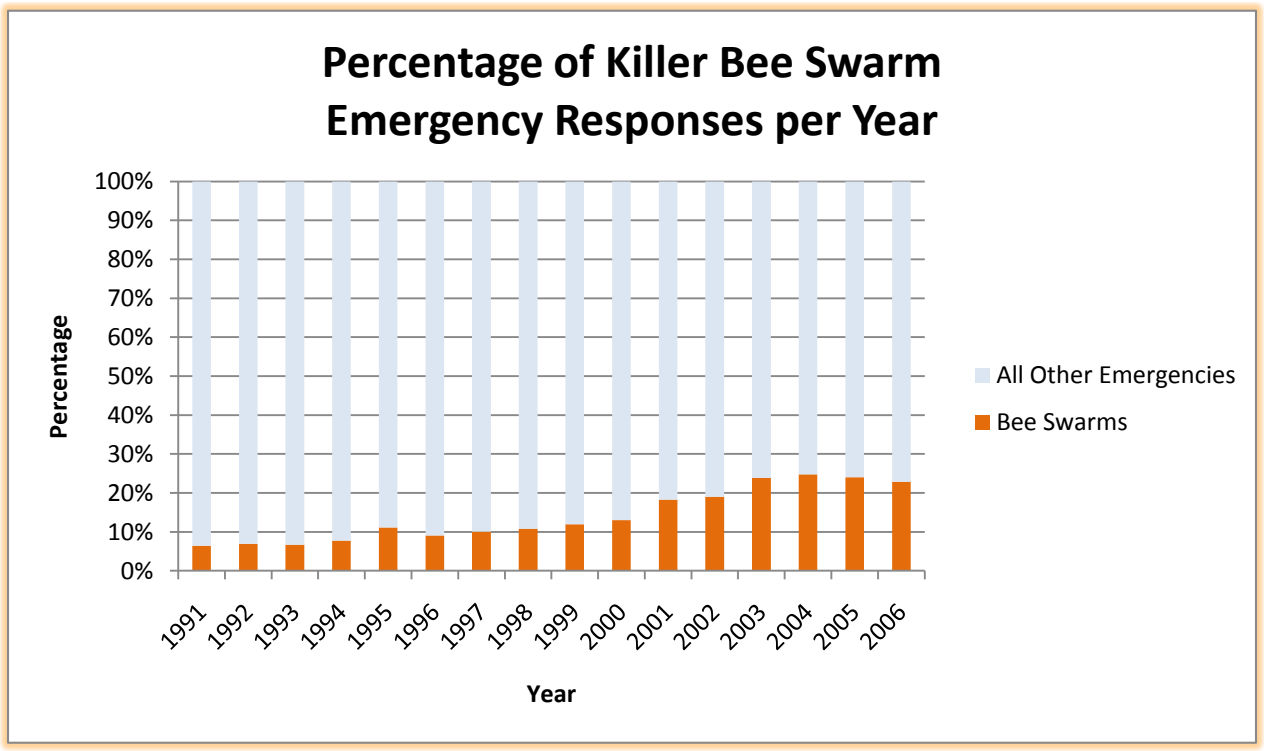
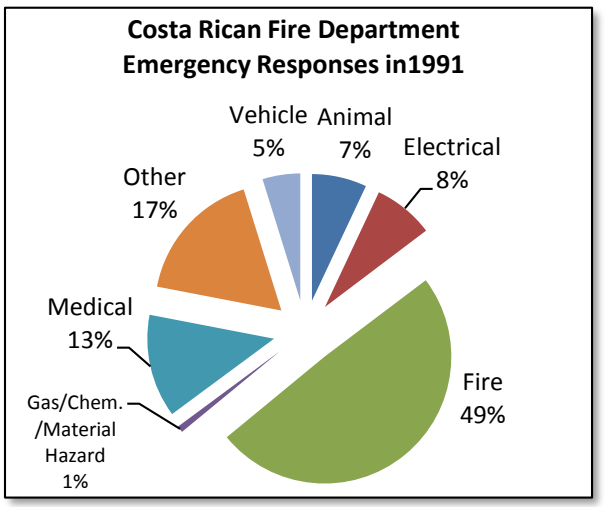


Figure 3: Percentage of Bee Swarm Emergencies per Year

Speaking with today's dispatchers, we found that it is currently one of the more frequently occurring emergencies. This indicates that killer bee swarms, as well as several other types of emergencies, have evolved from a minor focus to a major focus of the Costa Rican Fire Department.

When comparing for the percentages of different types of emergencies that the fire department responded to from 1991 to 2006, several differences are evident. Figure 5, seen below, indicates that the frequencies of some emergencies have increased between these years, while others have decreased. For example, fires have progressively become less of a focus of the fire department between the years of 1991 and 2006. In 1991, fires composed forty nine percent of emergency responses. This percentage decreased to forty percent in 2000, and finally thirty three percent in 2006. Also, animal emergency responses (which includes bee responses) increased within this time frame. Animal related emergencies made up seven percent of total fire department responses in 1991. This value jumped to sixteen percent in 2000 and then sky rocketed to thirty six percent in 2006. Additionally, medical emergencies decreased from thirteen percent to two percent between 1991 and 2006. There are four fire stations in Costa Rica that have medical resources, Tibas, San Jose, Pavas and Desamparados. Because the fire department only tends to medical emergencies near these areas, the number of medical emergencies remains nearly constant from year to year. Hence, due to the increase in emergency responses between 1991 and 2006, the percentage of medical emergency responses compared to total fire department emergency responses has decreased.



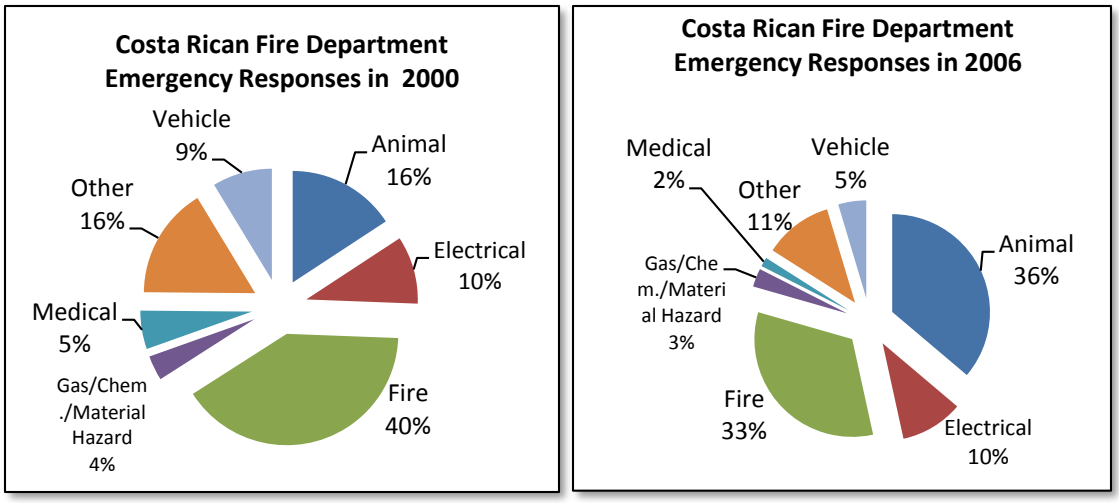


Figure 4: Costa Rica Fire Department Emergency Responses by percentage in 1991, 2000, and 2006

This shift in importance cannot be predicted due to the varying characteristics of emergencies. It is possible that a situation that occurs only in spurts today can occur more frequently in the next five to ten years due to new legislation and assigned responsibilities to the fire department. Thus, the fire department has a significant obstacle to overcome while striving to achieve their mission to improve and adapt in order to protect the society and environment of Costa Rica.

Our on-call-help dispatcher guide is a solution to the aforementioned varying emergency scene. This guide will help reduce the extremity of the emergency situations that are constantly increasing, as well as those which are considered a minor focus of the fire department. Now, more than ever, more people are in need of pre-arrival aid due to the considerable increase of emergencies in Costa Rica. This pre-arrival instructions guide will provide that help for the Costa Rican citizens. The guide includes up-to-date instructions for the wide variety of emergencies. Furthermore, to keep up with the changing times and the addition of situations, the dispatchers will be able to insert further categories by simply inputting the information into the HTML document for the guide. A simple set of instructions will be included with the on-call-help dispatcher guide for this purpose.

4.3 The On-Call-Help Dispatcher Guide

The instructions are in an HTML-based electronic on-call-help guide that can easily be incorporated into their computer systems to assimilate with their current state of technology

based dispatch station. The guide is non-internet based and was implemented by uploading a file folder onto the computers. It contains multiple layers that represent different depths of the guide such as the homepage and the page with the actual instructions. The simple and user-friendly interface allows locating the instructions at a quick pace to be incorporated into their present protocols. Due to time constraints, we were not able to complete surveys of efficiency. Initial review by Chief Leandro rated the guide as being user-friendly with an efficient layout for providing on-call help. The homepage, seen below in figure 6, consists of links for the major categories of the emergencies for which the dispatchers receive calls. These categories include: fires, floods, electrical, hazardous materials, attacks, terrestrial, and medical. The order mimics what was seen in the list of emergencies that the fire department encounters, which is already present in the station. The user-friendly interface allows dispatchers to navigate through the guide and quickly locate necessary pre-arrival instructions.

Figure 5: Homepage for the On-Call-Help Dispatcher Guide

Figure 7 below shows the second layer in the guide if one were to click “fuego” (fire emergency) on the homepage. There are no images in this layer and it simply lists sub-groups for a major category of emergency across the top center of the page. For example, for “fuego”, there are two sub-groups:“fuego en Estructuras” (structural fires) and “incendo forestal” (forest fire). In this page, one can also see the “incio” button, which allows the user to navigate back to the homepage quickly.

Figure 6: Sub-groups for Major Category "Fuego" (Fires)

The following layer in the guide is a page containing the actual instructions. As seen below in figure 8, there are no more sub-categories, and the only buttons present are “inicio” (home) and “volver” (return). These buttons bring the user back to the homepage or the previous page, respectively. The instructions are in bullet form and in gray box, which follows the same layout as the previous layers.

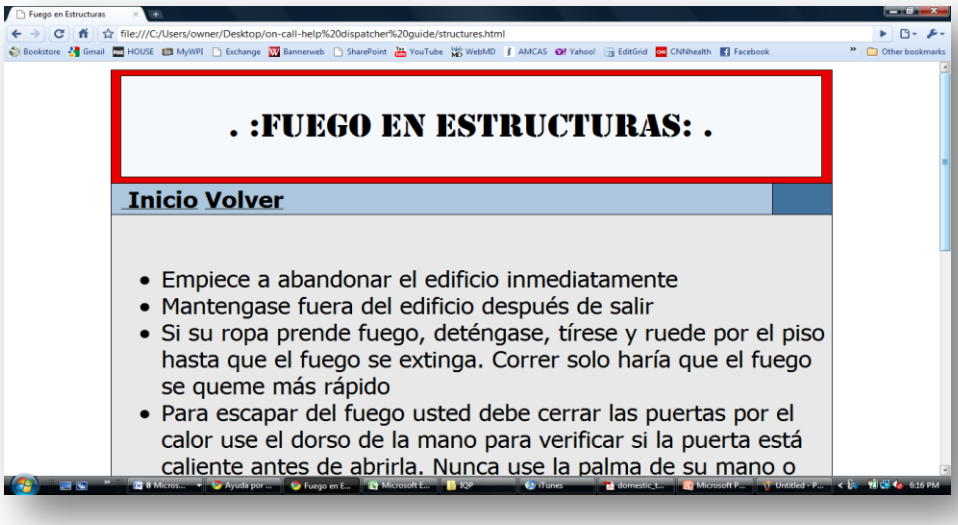


Figure 7: Set of Instructions for “Fuego en Estructuras” (Structural Fires)

4.4 The Dispatchers' Views about the On-Call-Help Dispatcher Guide

Surveys showed that ninety percent of the O.C.O. dispatchers were in favor of being able to reference a given guide in the emergency response process because the guide provides standards on how the dispatchers should perform their job. Although the dispatchers appreciate the availability of guides in the workplace, they do not all use protocols in their daily routines. For example, some dispatchers prefer to follow a set of instructions while others prefer to think freely while handling emergency calls and using guidelines as a resource (R. Leandro, Personal Communication, November 23, 2009).

The Bomberos critiqued our set of instructions by providing advice on specific chronology of the instructions for various emergencies such as structural fires. Additionally, they commented on information that was not necessary and on information that should be included. This information was beneficial, in that the Bomberos explained their reasoning by putting us into the emergency and allowed us to view the different situations from our guide from their point of view.

Upon sending out the edited instructions to each dispatcher, survey results indicated that from the dispatchers who responded, every one of them ranked the overall effectiveness of the instructions of the guide a three or above out of five (one being very ineffective and five being very effective). However, 10.2% of individual emergency instructions, or five of the forty-nine types of emergencies, within the guide had average effectiveness ratings below three out of five (see tables 1-4). The instructions for the five emergencies that scored low ratings in the evaluation survey were improved to meet the standards of the O.C.O. dispatchers. These emergencies are highlighted in tables 2 and 4. Individual interviews that questioned dispatchers on how to improve these instructions showed that they stressed the need for concise sets of instructions. The O.C.O. employees we spoke with made recommendations to improve these set of instructions. These suggestions mainly consisted of minor changes such as an additional instruction or exclusion of an instruction or two from a type of emergency. These improvements were then implemented to include only the most pertinent instructions for each emergency.

Time will be an important limiting factor for the practice of this guide due to the insufficient amount of resources at O.C.O. such as the number of dispatchers at a given time. Thus, although the dispatchers will not use the on-call-help dispatcher guide for every single emergency that they handle, 90% of surveyed dispatchers have said that it will be utilized in a

manner to make an important difference. Whether it is used to serve as a set of instructions to be dictated to the caller or a resource while formulating a personalized and situational set of instructions, the guide will be an improvement in the O.C.O. station. It is important to promote this advancement of the Costa Rican Bomberos because it is a step in the direction of continuously improving their performance, specifically by handling emergencies more effectively.

Recommendations

With this product and the conclusion of our study, we would like to mention multiple recommendations for the optimal benefits of the on-call-help dispatcher guide as well as for the general improvements of O.C.O.:

- We recommend performing a follow-up evaluation on this guide, rating the effects of its instructions and the general usability of the guide. This will be beneficial in identifying any shortcomings. The resulting enhancement will promote the development of the fire department.

- Through our study, we found that some additional upgrades expressed by dispatchers included updating technology such as consoles and radios. We recommended that studies be conducted to evaluate the effect of technology on O.C.O. performance. If technological advances have indeed proven to be highly effective, these studies should also include suggestions for further advancement.

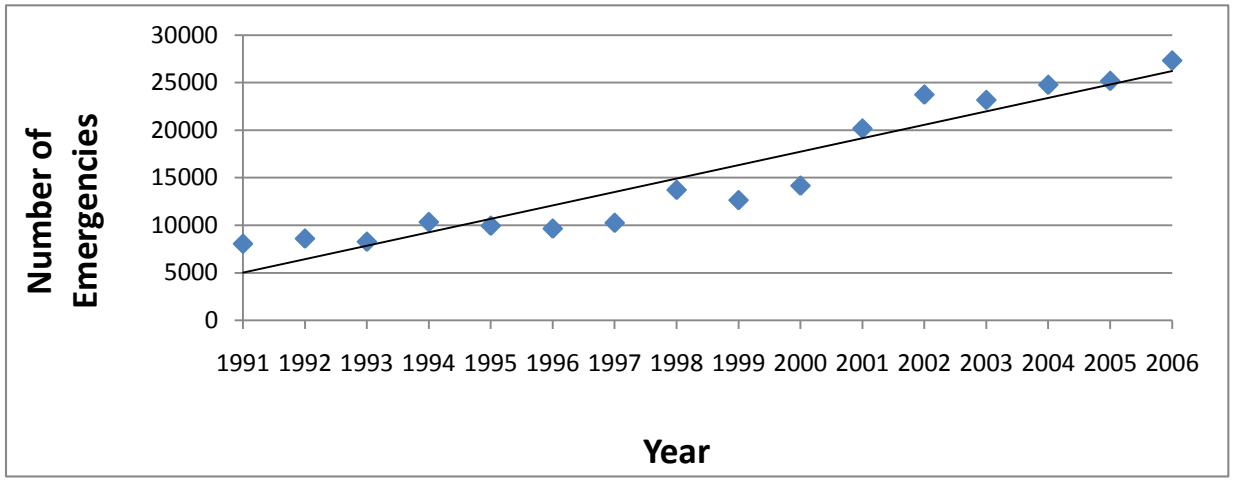
- We believe that it will be beneficial for the fire department to regularly evaluate the performance of the Bomberos. Multiple dispatchers expressed the need for more training. Thus, it will beneficial to identify any possible areas of improvements directly relating to dispatchers.

Chapter 5: Conclusions

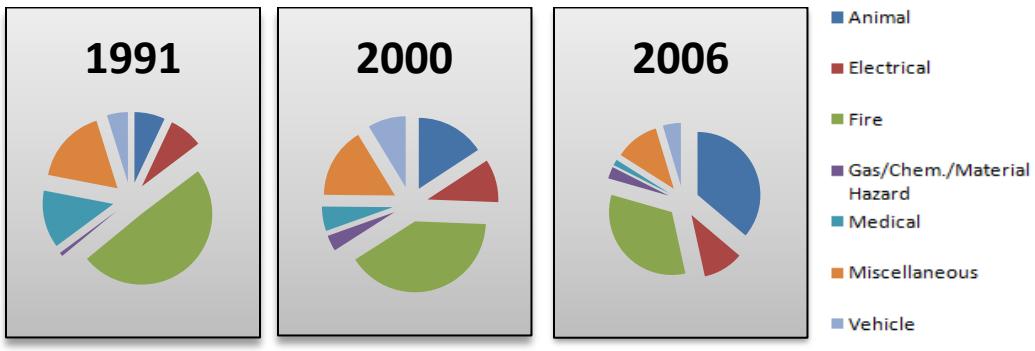
The purpose of this report was to produce an on-call-help dispatcher guide that will serve as a resource to the fire dispatchers at O.C.O. in order to facilitate their efforts in continual improvement of the emergency response process. Upon completion of our study, the following were important outcomes:

A. Finding that:

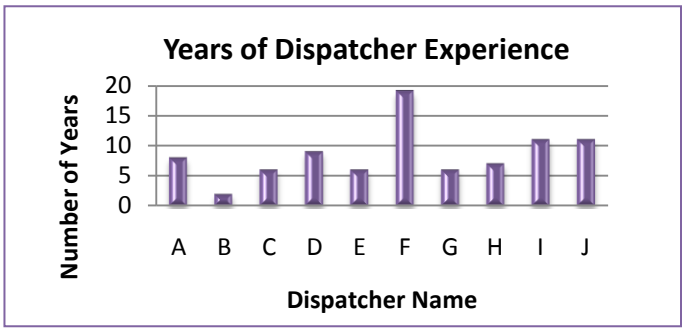
- **The quantity of emergency calls that the Bomberos response to is increasing**



- **The nature of these emergencies are diversifying**

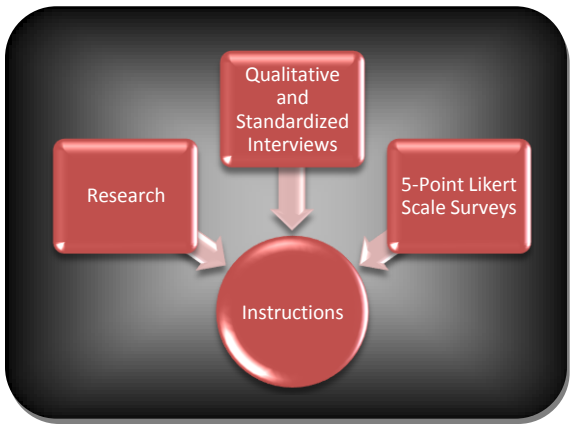


Differences in Percentage of Emergency Calls Tended to by Fire Department



B. Discovering that there is a range of experience among the Bomberos at O.C.O. due to additional qualifications and variation in numbers of years of being a dispatcher. This can lead to possible differences in their judgment.

C. Understanding and gathering the types of information that would be beneficial in an on-call-help dispatcher guide.



D. Receiving positive feedback from dispatchers about the on-call-help dispatcher guide as a step towards the improvement of emergency services in Costa Rica.

In summary, our study resulted in finding additional challenges for the response services in Costa Rica as well as the production of a resource for O.C.O. that will aid in their strong efforts for continual advancement. It is important to promote this advancement of the Costa Rican Bomberos because it is a step in the direction of continuously improving their process of handling emergencies more effectively, especially with the discovered trends. Throughout the years, they continue to change their training process to include any new additions to the department and update the Bomberos on information about new types of emergencies that they will be responsible for. It is evident that Bomberos are a very united and motivated group of brothers and have a strong will to keep striving to achieve their mission and vision. Overall, the fire department today is very well respected and received by the community they protect, and it is easy to see that their future is brilliantly lit, as well.

Bibliography:

1. At a Glance: Costa Rica. (2004, February 26). Retrieved from http://www.unicef.org/infobycountry/costarica_statistics.html
2. Bomberos, *Benemerito cuerpo de Bomberos de costa rica*. Retrieved from http://www.Bomberos.go.cr/Bomberos/organizacion/mision.jsp
3. Bomberos,*Benemerito cuerpo de bomberos de costa rica*. Retrieved from http://www.bomberos.go.cr/Bomberos/organizacion/vision.jsp
4. Chan, M. (2009). Statement for world health day 2009. Retrieved from http://www.worldvision.com.au/Issues/Emergencies/EmergencyRelief/Why_is_it_happening_.aspx
5. Cuerpo de bomberos de costa rica. Retrieved from http://www.bomberos.go.cr/Bomberos/
6. Berg, B.L. (1954). Qualitative research methods for the social sciences. Boston: Allyn & Bacon.
7. Clawson, J.J., Martin, R.L., & Hauert, S.A. (1994). Protocols vs. guidelines: Choosing a medical-dispatch program. Retrieved from http://www.emergencydispatch.org/articles/protocolsvsguidelines1.htm
8. Dispatcher training manual: fire radio dispatching. (2005, November). Dispatch Magazine On-Line, Retrieved from http://www.911dispatch.com/training/train_fire.html
9. Doyle, J.K. (2009.). Chapter 11: Introduction to interviewing techniques. Handbook for IQP Advisors and Students.
10. Flores, Melissa. (2009). Mitigation, communication two keys to county preparedness. *Pinnacle Online*, Retrieved from http://www.pinnaclenews.com/news/contentview.asp?c=260875
11. Heskett, J. (2008). Does judgment trump experience?. Retrieved from http://hbswk.hbs.edu/item/5828.html
12. Key components of best practice dispatching. (2007). EMS Best Practices, 2(1), Retrieved from http://www.emergencydispatch.org/articles/keycomponents.htm
13. Lewis, D. , Mahoney, B. , Vogt, K. and Bultman, L. "Value of Pre-arrival Instructions" *Paper presented at the annual meeting of the National Association of EMS Physicians, Registry Resort, Naples, FL* . 2009-05-25 from http://www.allacademic.com/meta/p66715_index.html
14. NAED, Initials. (2009). Resources - emergency dispatch system. Retrieved from http://www.emergencydispatch.org/res_EDS.php
15. NFPA (2009). *National Fire Protection Association* Retrieved from http://www.nfpa.org/
16. Juckett, G and Hancox JG. Venomous Snakebites in the United States: Management Review and Update. American Family Physician 65(7), 2002.
17. Redelmeier, D.A., Tu, J.V., Schull, M.J., Ferris, L.E., & Hux, J.E. (2001). Problems for clinical judgement: 3. thinking clearly in an emergency. Canadian Medical Association Journal, 164(8): 1170-1175, Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC80976/
18. The World Factbook: Costa Rica. (2009, November 11). Retrieved from https://www.cia.gov/library/publications/the-world-factbook/geos/cs.html#top

19. Why is it happening? (2009, April 09). Retrieved from http://www.worldvision.com.au/Issues/Emergencies/EmergencyRelief/Why_is_it_happening_.aspx

Appendix: Interviews and Surveys

Appendix A: Group Interview

1. What are your opinions on [insert emergency]?
2. Are there instructions you would omit?
3. Are there instructions you would like to see added?
4. Any other comments?

Appendix B: Evaluation Survey

How do you classify the efficiency of this set of instructions for this emergency?

1	2	3	4	5
Not very efficient				Very Efficient

1) Are you in favor of guides or guidelines when you dispatch? Why or why not?

Appendix C: Feedback Interview

1) Why do you believe that this set of instructions was rated as having below average efficiency?
2) Is the medical information up-to-date?
    a. If no, why?
3) Do you have any suggestions for its improvement?

Appendix D Background Survey

1. How many years have you been a Bombero?
2. How many years have you been a dispatcher at O.C.O.?
3. What is your highest level of education?
    a. Secondary School
    b. University
    c. Other (Please Specify)
4. What you specific position at O.C.O?
5. What was required to reach this position?
6. What improvements would you like to see in the dispatching process at O.C.O.?
7. Do you think that there have been instances where pre-arrival help would have helped a 911 call?
8. Do you believe there will be benefits in using this guide?

Appendix E: Personal Interview

- Is it ok if we ask you questions for our project and use the information in our report?
- Why did you decide to become a firefighter? A dispatcher?
- How has your work experience been so far?
    - Positive aspects
    - Negative aspects
- Have there been events that have had a substantial impact on you?
    - Positive impact
    - Negative impact
        - How do/did you manage to deal with it?
- The firefighters and dispatchers here have a strong bond with one another. In your opinion, how important is the brotherhood aspect of your profession?
- How do you feel about the Office of Communications and its performance? (Please elaborate)
    - Is there anything at this office that you believe could be improved? (Whether it's technology, employee interaction, type of coffee etc.)
- We are producing a guide for the dispatchers at this station to provide pre-arrival instructions to emergency callers so that they can begin to treat the emergency before the firefighters arrive to the scene.
    - What are your thoughts on this?
    - Would you use it?

Appendix F: Usability Survey

How do you classify the usability of the on-call-help dispatcher guide?

1	2	3	4	5
Not very efficient				Very Efficient

1) Are there changes you would like to see made to the format?
2) Are there changes you would like to see made to the layout?

Tables: Ratings of Efficiency for Emergency Situations found in On-Call-Help Dispatcher Guide

Table 1: Rating of Efficiency for Fires, Floods and Electrical Emergencies

Type of Emergency	Rating of Efficiency (Out of 5)
Fires:	
Structural Fires	3.8
Survival in a Vehicle	3.5
If Trapped at Home	3.8
If caught in the Open	3.8
Floods:	
General Pre-Arrival Instructions	4.1
Electricity:	
Short Circuit Fires	3.9
Electrical Failure in Vehicle	3.3
Electrocution	3.8

Table 2: Rating of Efficiency for Attacks on People and Terrestrial Emergencies

Type of Emergency	Rating of Efficiency (Out of 5)
Attacks on People:	
General Animal Attacks (pre-arrival)	3.4
Bees	3.1
Reptiles	2.9
Terrestrial:	
Collision	3.3
Volcano	3.4
Landslide/Debris Flow	3
Hurricane	4

Table 3: Rating of Efficiency for Hazardous Materials Emergencies

Type of Emergency	Rating of Efficiency (out of 5)
Hazardous Materials:	
General Pre-Arrival Instructions	3.3
For Observer and Victim	3.3
Gases	3.1
Gas Ingestion	3.6
Carbon Dioxide	4
Liquefied Petroleum Gas	3.4
Chlorine	4
Ammonia	3.4
Oxygen	3.9
Liquid Flammables	3.9
Solid Inflammables	3.5
Agrochemicals	3.6
Peroxide Contact	3.9
Peroxide Spill	3.1
Poisons	4
Radioactive	3.1
Radiation	3.6
Caustic Soda	3.4
Sulfuric Acid	3.5
Chloric Acid	3.8

Table 4: Rating of Efficiency Various Medical Emergencies

Type of Emergency	Rating of Efficiency (out of 5)
Medical:	
Neurology	
Headache	3.1
Psychiatric	2.9
Stroke	2.8
Seizure	2.7
Cardio:	
Chest Pain	3.3
Heart Problems	3.3
Cardiac Arrest	2.6
Respiratory:	
Difficulty Breathing	3.3
Choking	3.1
Gastrointestinal:	
Poison Ingestion	3.6
Others:	
Bleeding	3.5
Burns	3
Eye Problems	3.1