

Is Benefit Cost Analysis a Plausible Tool for the Fayetteville Fire Department?

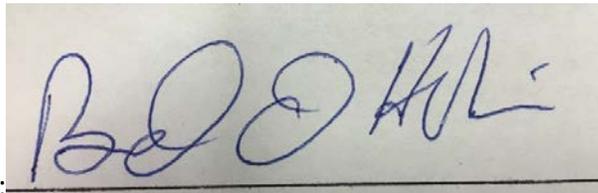
Brad Hardin

Fayetteville Fire Department, Fayetteville, Arkansas

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.

Signed: _____

A handwritten signature in blue ink, appearing to read "BOOHL", written over a horizontal line.

Abstract

The problem was the Fayetteville Fire Department (FFD) did not utilize a benefit cost analysis when it appraised the services provided by the department. The purpose of this research was to determine why the FFD did not utilize benefit cost analysis (BCA) when it appraised the services provided by the department. The action research method was utilized to complete this research. The research questions were as follows: a) Why did the FFD not utilize a benefit cost analysis for the services provided? b) Were there any benefit cost analysis models that could be applied to the fire service? c) Was benefit cost analysis even plausible for the Fayetteville Fire Department? The procedures utilized to complete this project were two surveys, one external and one internal, and a literature review. The surveys were intended to determine the knowledge within the FFD and the fire service, and to determine the attitude of the leaders of the FFD towards BCA. The literature review was utilized to search for any available BCA tool and any challenges that might prohibit its use within the FFD. The results showed there was wide spread use of BCA among federal agencies. The literature provided very little research on the subject within the fire service. It also failed to yield a BCA tool that could be used by the FFD. The survey on the other hand showed that fire departments do utilize BCA in at least some capacity. The survey showed good results on the attitude towards BCA with the leaders of the FFD. The recommendation made was to start the utilizing BCA on small decisions and to partner with the University of Arkansas for the creation of a more comprehensive BCA tool.

Keywords: Benefit cost analysis, BCA, CBA, Value of a Statistical Life, VSL

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Is Benefit Cost Analysis a Plausible Tool for the Fayetteville Fire Department?

Introduction

The problem is the Fayetteville Fire Department (FFD) does not utilize a benefit cost analysis when it appraises the services provided by the department. This is a problem because it is very difficult to justify any new expenditures. The city’s budget is very tight, and there is always a large amount of competition for any new funding in the general fund. The purpose of this research is to determine why the FFD does not utilize benefit cost analysis (BCA) when it appraises the services provided by the department. A benefit cost analysis of the services provided by the department would provide better justification for any newly proposed expenditures. The action research method was utilized to complete this research. This method was chosen because it is the intent of this author to locate, modify, or create a BCA tool that could be utilized by the department. The research questions are as follows: a) Why does the FFD not utilize a benefit cost analysis for the services provided? This question was intended to determine if there was any underlying distain for BCA that would prohibit its use within the department. The next research question is: b) Are there any benefit cost analysis models that could be applied to the fire service? This question was posed to prevent the re-creation of the

wheel. If there was one available, that would be better than creating one from nothing. It was also asked to aid in answering the last question. If there are BCA tools currently used by other fire department or agencies, there should not be any reason that the FFD couldn't as well. The final research question is: c) Is benefit cost analysis even plausible for the services provided by the Fayetteville Fire Department? This question was important because there is no reason to create something that the needed data sets are not available or that the leaders of the FFD are not willing to use.

Background and Significance

Last year research was conducted to locate or create an outcomes based measurement to appraise the services provided by the Fayetteville Fire Department (FFD). The research was very informative, but it did not yield the desired results. The FFD is in a state of constant competition for every penny it gets in funding. The old faithful "go to" justification of "bad stuff will happen and you will die without us" lost its power better than a decade ago. The just a few years later came the recession, and we have been struggling to stay afloat ever since this time. In the early 2000's, we started looking objectively at our performance but it was too little too late. Today, we utilize the same methodology as the majority of the fire service. We strive to comply with the benchmarks established by National Fire Protection Agency (NFPA) 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*, and the guidelines established by the Insurance Services Office (ISO). We then measure our success or value based on our ability to meet these benchmarks. But what does that truly mean? Society provided us with millions of dollars of capital assets and another \$10 million dollars annually in operating budget. What do we give them in return, the ability to achieve a self-imposed

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benchmark? What does this mean? This is a serious problem for the FFD and we need a new methodology to appraise our services.

The premise of the research paper is to develop a more analytical approach to aid in the decision making process in regards to the services provided by the Fayetteville Fire Department (FFD). This paper should answer whether a benefit cost analysis (BCA) will provide this analytical approach. More times than not the deciding factor in any decision is money. We currently lack the ability to assign monetary value to the services we provide. To elaborate on our decision making process, in the past 20 years the Fayetteville Department has built five new stations. Four of the five stations were built on property the city owned. While the Fire Department had some input as to the general location, the final decision was based on cheap property. This is not a wise approach. Our Station 1 has been in the same location for 50 years. If we save \$10,000, \$50,000, or even \$100,000 dollars on a piece of property today, what impact will that have over the course of 50 years? The savings of \$100,000 dollars would equate to \$2,000 dollars a year, but if the location added an extra minute of travel time, how many people died and how much property was lost annually. Currently we have no way to quantify the value of our services or the ability argue against free property.

The first goal in the USFA's strategic plan is: "Promote Response, Local Planning, and Preparedness for all Hazards" (U.S. Fire Administration [USFA], 2014, p. 9). A more analytical approach to decision making will enable the Chief and the city's administration to make informed decisions. This will ultimately result in achieving the above goal. One of the areas lacking within our department is fire prevention. This year's course: Executive Analysis of Community Risk Reduction (U.S. Fire Administration [USFA], 2015) focused on fire prevention and mitigation. With the competitive nature of funding within in our city, it is unlikely without

better justification that we will ever get to where we need to be in fire prevention. We currently have six people assigned to this department, and we need 10 more to accomplish the current workload. There has been emphasis on community risk reduction (CRR) since the first America Burning was published, but the fire industry has really suffered in this area since the recession (USFA, 2015). The FFD is no different in this respect. We have, however, seen an increase in potential funding but we are only one department within our city. A good benefit cost analysis would go a long way in justifying increased funding in this area.

Literature Review

The literature is divided into sub-sections based on each of the three research questions. a) Why does the FFD not utilize a benefit cost analysis for the services provided? b) Are there any benefit cost analysis models that could be applied to the fire service? c) Is benefit cost analysis even plausible for the fire services? Each of the research questions are again divided into more specific questions. The final section is the summary which ties all of the literature review together and explains how it applies to this applied research paper.

Research Question 1

The first research question is as follows: a) Why does the Fayetteville Fire Department not utilize a benefit cost analysis for the services provided? This question was divided into three questions in an attempt to reach the root of the problem. Does the FFD's Administration understand the principle of a benefit cost analysis (BCA)? Is the FFD's Administration opposed to the utilization of a BCA. Are there other factors that would prohibit the utilization of a BCA?

As the literature review commenced it became glaringly obvious why the FFD does not utilize a BCA. There is a huge gap in research in this area in relation to the fire service. This is covered in more detail in the next section. For years the FFD has concentrated on the

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performance measures set forth by the National Fire Protection Agency (NFPA) and the Insurance Services Office (ISO) (I delve more into this topic in the next sub-section), but have they considered the cost of striving for these goals, and more importantly, the benefits for reaching these goals. The benefit, I believe, will be less than obvious. Certainly to protect lives and property or possibly to be in compliance with NFPA and ISO. Possibly even lower insurance rates. However, none of this is something that easily quantified. In fire prevention for instance, how do you place a value on a house fire that never happened? The highway departments across the nation face a similar challenge. An analysis by the Puget Sound Regional Council (2009) provides a solution to the problem by setting up an alternative model that represents what would have happened had the road not been built. While there is certainly more moving parts to the services provided by the fire department, this seems like a viable solution. There is yet other cost that should be considered, the social and political cost.

In Dr. R. Boyd's (2009) dissertation, he discusses the impact of response times and the equal distribution of resources. Both of these carry weight in NFPA (Flynn, 2009) and ISO (ISO, 2012). Dr. Boyd (2009) shows, using geospatial information system (GIS), that this is a poor model. The larger portion of the calls are in lower socioeconomic areas. This equates to second, third or even fourth arriving units responding a longer distance to emergency calls. This happens because the first, second, or third arriving units are already on an emergency call. He makes the point that there is a social impact due to the equal distribution of emergency assets. He also makes the point of the political cost of moving units from the higher socioeconomic areas to the area where they are actually needed.

The question: "Does the FFD's Administration understand the principle of a benefit cost analysis (BCA)?", is an unfair question. Most decisions we make during the course of our lives

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is based on trade off. In fact, the very principles of BCA are dependent on the probability that humans will act in a certain manner when faced with trade-offs. So, of course, they understand benefit and cost but that's not say that they fully understand the principles of BCA. The Office of Management and Budget (OMB) (2015) provides explicit directions for the executives of federal branches to follow when faced with making a decision on the investment of social goods. Why would we assume the FFD Administration would have a complete grasp of the principles, when the upper executives of our country need a step by step guide to follow. The Circular A-4 and the Circular A-94 are maintained by the OMB. The Circular A-94 goes in to great detail describing how to calculate both the cost and benefit and how to measure them based on a person willingness to pay, the trade-offs mentioned earlier. This was the main document used in researching the factors that may prohibit the use of a BCA to measure the performance of services provided by the FFD. It recommends the use of market prices to determine a person's willingness to pay. They warn, however, to be aware of externalities that may interfere with market prices. The externalities they were referring to were "monopoly power, and taxes or subsidies" (Office of Management and Budget (OMB), 2015, p. 7). For the fire service there may be many other externalities to consider. Perhaps not the effect of market prices but certainly when considering the benefit placed on the fire service.

When it comes to identifying and measuring the benefits and cost it becomes a bit more dynamic and challenging. As far as the overall benefit cost analysis process, none of steps listed in the Circular 94 are unsurmountable challenges to the FFD. According to the OMB (2015), the benefit and cost should be based on social cost and social benefit, both tangible and intangible. It should also account for any benefits or cost from other policies or programs as well as consider what would have happened if the policy or program would have never been implemented. The

latter, while complicated, does not sound like a deal breaker for the FFD. The earlier, social benefit and cost, may be a bit more challenging and will certainly require some research and thought. The Office of Management and Budget (2015) explains measurement of benefit and cost which sheds a little light on the effect to society. They explain it is based on a person's "willingness-to-pay" and that "consumer surplus provides the best measure of the total benefit to society from a government program or project" (OMB, 2015, p. 4). The Department of Transportation (DOT) (2015) updated the value in 2014 to \$9.4 million. The policy essentially explains the principle of VSL and the difficulties. They listed another difficulty with VSL is different people's ability to recognize and analysis risk (Department of Transportation (DOT) (2015). They provided an example but another, more applicable to the fire service, came to my mind, the interstate. For us in the fire service, we recognize the risk of working on a busy interstate. The lay person, however, does not respect the interstate which can be witnessed daily on any busy interstate in the country. People walk around their cars just inches from death. They, unlike us, have not seen what an inattentive driver in a SUV can do to the human body. So, to add yet another variable to the one listed previously, an analysis should consider a person's inability to recognize risk. The overall process will be covered in more detail in the next section.

Research Question 2

The second research question is: b) Are there any benefit cost analysis models that could be applied to the fire service? This question, like the first, was divided into multiple questions. The first being: Do any agencies currently use a benefit cost analysis? Followed by: Are there any Fire Departments utilizing a cost benefit analysis? The last being: Could the benefit and cost of the services provided by the Fayetteville Fire Department (FFD) be quantified?

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As mentioned in the previous section federal agencies are tasked with utilizing a benefit cost analysis, so the answer to the first question is yes. These agencies utilize a publication called the Circular A-94 to guide them through the process. This publication is maintained by the Office of Management and Budget (OMB) and is updated annually. It goes into great detail when describing the utilization of BCA. The decision to fund government programs is based on the "net present value" (OMB, 2015, p. 4). "Net present value is computed by assigning values to benefits and cost, discounting future benefits and costs using an appropriate discount rate, and subtracting the sum total of discounted costs from the total sum of discounted benefits (Office of Management and Budget, p.4)." It goes on to say the net present value is not always computable but it's informative to do so anyway. This is one way in which the benefits can be quantified. Another means of measurement, mentioned in the previous section, is a person's "willingness-to-pay" (WTP) and that "consumer surplus provides the best measure of the total benefit to society from a government program or project" (OMB, 2015, p. 4). An option, not covered in the Circular A-94, is the value of a statistical life (VSL); it is covered in another circular also maintained by the OMB, Circular A-4. One article I found covered both WTP and VSL.

Cass R. Sustein (2015) explains the interdependence of VSL and WTP. Before delving into the agencies that utilize VSL, I will first provide a basic explanation of VSL. Instead of fumbling along with my own analogy Sustein (2015, p. 241) explains it best: "Suppose that workers must be paid \$900, on average, to assume a risk of 1/10,000. If so, the VSL would be said to be \$9,000,000." The arithmetic is just that simple. Assigning that \$900 value, however, may be a bit more difficult. The Office of Management and Budget's (OMB) (2003) Circular A-4 provides another example, and they also make the point that VSL is a source of confusion to many. The example they provide is as follows: "If the annual risk of death is reduced by one in a

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million for each of two million people, that is said to represent ‘two statistical lives’ extended per year” (OMB, 2003, p. 29). Sustain (2015) states one way of doing this is by simply asking the person how much they would be willing to pay to avoid the risk. He describes another option, that seems more plausible, which is to use the market to decide the WTP. He states an agency can determine WTP for a given VSL by looking at what people pay for insurance, or how people with similar jobs but one with a higher risk receives more compensation (Sustain, 2015). Sustain (2015) also argues that no one VSL will work. Different age people and individuals from differing socioeconomic backgrounds will certainly place different values on avoiding a given risk. The DOT (2015) explains VSL like explain above by the Circular A-4, and with doing so there is less emphasis placed on age or socioeconomic income. It’s not about valuing a human life, it’s about valuing the risk reduction. So, what are people willing to pay to reduce a given risk by one in 10,000 which could also be stated as one less person perishes out of a population of 10,000 people (DOT, 2015). Regardless of the difficulty “the value of a statistical life (VSL) is the most influential economic parameter used in the evaluation of governmental regulations” (Viscusi, 2015, p. 228) and will be covered in more detail using other examples. This is a prelude to the question of the ability to quantify the benefit, and the answer would be yes. Now, moving to agencies that utilize the BCA.

Sustain (2015) references the Department of Transportation (DOT) and states that they have assigned a VSL of \$9.1 million. In an interest to learn more about the DOT policy on BCA, I read the document referenced by Sustain. The DOT (2015) utilizes the VSL for determining fatalities but also for the consideration of reducing injuries. The document provides resources to help with assigning VSL to the workers mentioned earlier. The DOT (2015, p. 4) utilizes hedonic wage studies and has been able to increase their accuracy “with the availability of more

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complete data from the Bureau of Labor Statistics' (BLS) Census of Fatal Occupational Injuries (CFOI), supported by advances in econometric modeling, including the use of panel data from the Panel Study of Income Dynamics (PSID).” This document is well written and will certainly be considered if this research finds that BCA is an appropriate measure for the services provided by the FFD.

Vicusi (2015) illustrates the danger of using a BCA with the utilization of a VSL. He illustrates several examples, but the one I will share here was the Ford Pinto. He states Ford used previous wrongful death cases to establish a value of a life as \$200,000 and the cost to do a recall \$137 million. The obvious result of their BCA was to ignore the defect. After \$125 million dollars was awarded for one life, their estimation of the value of a life was seriously lacking. Viscusi (2015, p. 238) “has been able to identify over 100 block buster awards” (over \$100 million), and what was “particularly sticking is that most of these auto-related blockbuster awards have been triggered by the company doing a risk analysis.” This shows that the private side utilizes a BCA and provides yet another example of the application. It also shows the importance of not only quantifying the benefit but also insuring that the method is sound. In the interest of researching these blockbuster awards Viscusi (2015) set up mock juries and mock cases and discovered regardless the value a company assessed the value of a life at, the jury awarded a higher amount. He concludes that the companies will be penalized greater than governmental agencies. Why is this? The Circular A-94 states that a BCA must be based on the benefit and cost to society (Office of Management and Budget, 2015). Could the answer lie in the motivation of the BCA? Had the premise been on doing what was best for society, would have the penalties been this stiff? These questions are posed to undermine the thoughts of avoiding a BCA for liability reasons and to highlight the importance of VSL. In 1982, OSHA

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proposed a regulation that would value a life based on missed wages and medical expense, which was later denied but according to Viscusi (2015) this was the pivotal moment and would lead to the widespread governmental use of VSL in their BCA.

There is widespread use of BCA at the national level, as it is required by law, but the use within the fire service is less prevalent. I was able to find two examples of fire departments utilizing a BCA to make decisions. In a master's thesis paper written by David S. Flamm (2009), the Federal Emergency Management Agency (FEMA) BCA tool was utilized to complete a BCA for the Santa Barbara Fire Department. Flamm (2009) was able to show a 1.75:1 benefit cost ratio for the purchase of four pieces of property for purpose of multi-hazard mitigation. He considered the building values, the risk of future fires, and the probability of a resulting mudslide. He was able to create a very comprehensive BCA using the same tool that the Fayetteville Fire Department has available. Another Fire Department that utilized a BCA was Raleigh Fire Department. Jeffery L. Harrison completed a BCA as part of an EFO paper. His paper researches the benefit and cost of the utilization of overtime as opposed to hiring additional fire personnel. Harrison (2014) was able to show an \$80,000 dollar saving in hiring overtime as opposed to hiring additional personnel. He did not use an existing BCA tool to complete his analysis. His analysis only measured the dollars saved by the city and failed to measure the impact, good or bad, to the existing firefighters. Both of these papers provide examples of the use of BCA within the fire service. They were able to quantify the benefits and the costs. All of the literature in this section provides proof that both benefits and costs can be quantified. The literature also provides proof that many agencies utilize BCA on a regular basis.

Research Question 3

The last research question is: c) Is benefit cost analysis even plausible for the services provided by the Fayetteville Fire Department? With the previous two research questions I have displayed multiple examples of real life application of benefit cost analysis (BCA) and even a couple examples of its use with in the fire service. The assumption could be made that the answer to this question would be yes. Thus far, however, there has been very little research as to how difficult and cumbersome this process might be. Is it possible that more resources are used in the preparation of the analysis than the net benefit provides? With that question in mind, I researched the literature attempting to find a benefit cost analysis of the BCA. Surprisingly, this literature was the hardest to find. It would appear that the different agencies are so busy doing benefit cost analyses that they never took the time to objectively weigh the benefits and cost of the BCA process.

In one piece of literature reviewed it states “it is very hard to measure the total benefits... in general we must be content with measuring how it performs relative to some base case” (Puget Sound Regional Council, 2009, p. 7). This is far from an analysis of BCA but it does show that there may be problems with measuring certain things. Sustain (2015) referred to this as “hard cases” repeatedly throughout his paper, and defined cases as situations where there is no simple answer. The benefits may outweigh the cost but the willingness to pay for the benefit is not there. When it comes to the application of BCA to all the service provided by the Fayetteville Fire Department, there may be services this will not work for. Misuraca (2014, p. 2) states that some “factors cannot be accurately measured or quantified... [and] is not intended for all quantifiable purposes”. Misuraca (2014) states that a BCA provides decision makers with a comprehensive look of the proposed policy and allows them to make an informed decision. She

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also points out that VSL is not a requirement for BCA and illustrate the source of contention this can cause (Misuraca, 2014). Misuraca (2014, p. 8) states the critics of BCA “generally misunderstand its role. It provides one critical input into the decision-making process.” Most of the literature listed certain difficulties and problems with BCA but this researcher was unable to find literature that studied the cost of completing and maintaining the BCA.

The second research question found that there was indeed BCA’s utilized by all federal agencies and even a couple fire departments. When it came time to actually create the BCA tool for the Fayetteville Fire Department I found myself adding this portion to the literature review. While there are many BCA tools available there are none that come even close to meeting the general needs of the fire service. Flamm (2009) was able to utilize the FEMA BCA tool but that is a very isolated occurrence. It is not often that a fire department would consider the purchase of property to mitigate a hazard. The FEMA BCA tool is utilized to determine the worthiness of grant request for hazard mitigation for natural disasters i.e. floods (Federal Emergency Management Agency (FEMA), 2009). Aside from being intended for natural disasters, the FEMA BCA tool is also a software which removes the option of tweaking it to suit our needs. I went on to search the websites of the following federal agencies: Department of Commerce, Department of Defense, Department of Energy, Department of Education, Department of Health and Human Services, Department of Homeland Security, and the Department of Labor. Some of them did not have anything listed at all. The remainder utilized Excel workbooks but they were very pointed and most of them utilized macros which made them difficult to modify. This backed me into a corner as I did not feel qualified to create a BCA tool from scratch. I continued to scour the web and came across a very well written document that would walk even the most novice Excel user through the process of creating a basic BCA tool. I will reiterate this later, but

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I wanted to mention it here: while this may enable me to create a BCA tool, I intend to contact our local university to assist with refining the tool.

Canesio Predo and David James teamed up in 2006 to create a book: *A User Manual for Benefit Cost Analysis Using Microsoft Excel*. While the Excel instructions may be a bit dated all the information is correct, but it might be located in a different location now. The BCA information however was adequately sufficient to create a basic BCA Tool or even a complex one if you are a mathematician or statistician. I, however, am a firefighter and will be seeking out help to develop a more comprehensive BCA tool, but for the purpose of this research a basic BCA tool is sufficient. Like I mentioned above the Circular A-94 (OMB, 2015) uses the net present value (NPV) as a determinant in the BCA Tool. Predo and James (2006) use two other main factors in addition to NPV: Benefit cost ratio (BCR) and internal rate of return (IRR). Like above the NPV is still the main determinant and any project or policy should project a positive NPV (Predo & James, 2006). The BCR is a ratio between benefit and cost and is compared to various options but the NPV is still the final determinant (Predo & James, 2006). An example of the utilization of a BCR would be Option A has a BCR of 1.38 but Option B has a BCR of 1.67 so Option B has a better BCR. The IRR like the name would suggest is a return on investment and is displayed as a percentage, with this too a higher percentage is more desirable. The only other factor that has yet to be mentioned is discount rate. Previously the need to account for opportunity cost was mentioned and the discount rate would be a way of capturing that. "The annual discount rate... might represent the rate of inflation or the interest of a competing investment" (Predo & James, 2006, p. 38). The NPV, BCR, and IRR are all calculations within our grasp.

Summary of Literature Review

The literature review consisted of a comprehensive research of the literature regarding each of the three research questions. There was no existing research on: a) Why does the FFD not utilize a benefit cost analysis for the services provided? The research of the literature did reveal a real lack of research on application of benefit cost analysis (BCA) within the fire service. From this portion of literature review, it was concluded that there would be very little use of BCA within the fire service. The research showed that the FFD utilizes benchmarks to measure performance as opposed to a BCA. The last thing researched was if there were other factors prohibiting the use of BCA. The literature highlighted a few hurdles but nothing that would stop the utilization of BCA within the FFD. The findings of this research inspired the creation of two surveys one to get a general status of the fire service in regards to BCA and the other to get the attitude of the FFD towards BCA. The next question researched was: b) Are there any benefit cost analysis models that could be applied to the fire service? There was an overwhelming amount of research available on this topic. The research revealed that it was not only prevalent but its use within federal agencies is required by law. When the search turned towards the application within the fire service it quickly became discouraging. I was only able to find two research papers on the topic. The literature did not reveal a usable BCA tool. This research aided in the creation of the surveys and brought me to the realization that we would be required to create our own BCA tool. For the last question, c) Is benefit cost analysis even plausible for the fire services? The required components of its application were reviewed. The literature did not provide a useable BCA tool but it did unearth a book that provides step-by-step instructions into the development of a BCA. Some of the data will be hard to collect, but none

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the less, with every federal agency using BCA it was certainly plausible that its application within the FFD was certainly plausible. This research aided in the creation of the BCA tool.

Procedures

To answer the first research question, a) why does the Fayetteville Fire Department (FFD) not utilize a benefit cost analysis for the services provided, two surveys were completed. The first as a control group and the second was given to the FFD leaders, both administrative and shift. The control group survey was posted on the International Association of Fire Chief's (IAFC) Knowledgenet. The IAFC has a membership of approximately 10,000 chiefs and emergency personnel and 231 responses were received. The survey was posted on June 5th, 2016 and remained open for five days. The reason for this was to get a sampling from outside our department that are not influenced by our internal biases. This survey asked the following questions: Are you aware to what extent the federal government utilizes a benefit-cost-analysis (BCA)? Are you familiar with the value of a statistical life (VSL) and its use? Does your department use a benefit-cost-analysis, as used by the federal government, to aid in the decision making process? If you answered yes to the previous question, does your department utilize a benefit-cost-analysis when determining the level of service provided? Does your department use a benefit-cost-analysis in any capacity for anything? If your department uses a benefit-cost-analysis, please include your department name below. The first two questions were asked to determine the general knowledge of the fire service in regards to the use of BCA within the federal government. The purpose of the remaining questions was to see if others in the fire service were utilizing a BCA. The assumption was made that there would be a general lack of knowledge of BCA and more specifically its application at the federal level. This survey was intended to check the general knowledge about BCA and provide a base comparison for the FFD.

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The internal survey asked the same first two questions, but then I added some different questions as I already knew the answer to the remaining questions asked in the control survey. The survey was emailed to 16 leaders within the FFD on June 5th 2016 and the last one was completed on June 10th. There was a total of eight responses. The questions asked were: Would you consider the use of a BCA within our department? Please list any advantages you see in using a BCA to guide us in our decision making on the level of services we provide? Please list any disadvantages you see in using a BCA to guide us in our decision making on the level of services we provide? The first two questions, like the IAFC survey, were intended to check the general knowledge of the FFD leaders about the use of BCA within the fire department. The remaining questions were intended to check attitude and how willing the FFD leaders were to the application of BCA within the FFD. A basic description of the BCA process was provided so they could make an informed decision when answering these questions. The intent of these surveys was then to compare the information gained from the control survey with the information gained from the internal survey and hopefully answer the first research question as to why the FFD does not utilize BCA. This survey also solicited any advantages or disadvantages they may foresee. This was also intended to see the general attitude towards BCA.

The second research question, b) are there any benefit cost analysis models that could be applied to the fire service, was accomplished through literature review and a survey to the IAFC. The literature review was conducted from April 20th, 2016 and concluded on June 10th. The literature was searched for references to the use of BCA in any domain and within the fire service. The survey sent out to the IAFC asked if their department utilized BCA. I, as listed below in limitations, failed to ask the correct question. Which would have been: If your

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department utilizes BCA, as utilized by federal agencies, to determine the services provided, please include your department name and contact information. The last research question, c) is benefit cost analysis even plausible for the fire services, was also accomplished through literature review. This portion of the literature review focused on specific datasets required to accomplish BCA. As for the plausibility of the use of BCA, my own knowledge was used to recognize whether the required datasets were available for the analysis of each factor. Once a resource was found that would enable the creation of a BCA tool, the tool was then created for the FFD. This question also utilized the surveys. Questions were asked regarding the application of BCA within their department. The intent of this question was to determine if the BCA was actually utilized within fire departments. If they were, it would be reasonable to assume that it could be utilized within the FFD. The internal survey also solicited any advantages or disadvantages they foresee, which may provide some insight into the willingness to try the model. In the literature review, we saw the importance of an individual's willingness to pay. The same line of reasoning could be applied here. If the FFD leaders are not willing to try BCA, it does not matter how plausible BCA is to the rest of the fire service.

Limitations:

The first survey being posted on the IAFC's Knowledgenet is, of course, a convenience sampling and has its limitations in that the responses typically received are from people interested in the same subject with the same mindset. The Knowledgenet, however, is a powerful resource in that it reaches thousands of fire chiefs across the nation every day. While they may be of the same mindset they are not necessarily interested in the same topic. I, for instance, complete many surveys on the premise that I know how hard it is to get people to respond, and many of the fire chiefs have been through the same process I'm going through now.

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Another real limitation of this survey was my own biases and my short-sighted view of the fire service. I assumed that no department would fully utilize the BCA to the extent the federal government does. This assumption was made because I was able to find very little literature on the topic within the fire service. Had I been foresighted enough to think there were departments out there utilizing BCA, this process would have been much easier. A huge limitation in the second and third (final) research question was the availability of existing BCA tools that could be utilized for the fire service. While there were plenty of examples that were measuring the things we needed to measure, there was no plausible way with my limited programming knowledge to modify them to suit our needs. Another limitation with the final question was with the inability to actually utilize the BCA process in a real life decision made it very difficult to discern whether BCA was truly plausible. While it may seem completely plausible theoretically, the actual application may be another story. Another source of problems with the final research question was a lack of literature regarding the benefits and costs of the application of BCA. As ironic as it sounds, there are volumes of research out there on every facet of BCA but nobody, that I could find, has ever completed a BCA on a BCA.

Results

The three research questions are divided into subsections below. The first question was answered with the utilization of surveys, the second question was answered with literature review and surveys. The last question was also answered with literature review and surveys.

Research Question 1:

There was good participation for the survey submitted to the International Association of Fire Chiefs (IAFC) with 231 respondents (see appendix A). The internal survey had a decent participation rate with eight of the sixteen command staff responding. The assumption that was made, with both surveys, there would be a general lack of knowledge regarding benefit cost analysis was not correct

with the IAFC. In fact, 36% of the departments surveyed utilized a BCA in some capacity (see figure 1). The assumption, however, was correct within the Fayetteville Fire

Department (FFD) with not a single respondent knowing the capacity at which the federal government utilize BCA. The assumption was confirmed, in both cases, in regards to there being

a lack of knowledge of its application at the federal level with only 13% of the departments surveyed being familiar with BCA and none of the FFD leaders (see figure 2). Surprisingly the value of a statistical life

Figure: 1

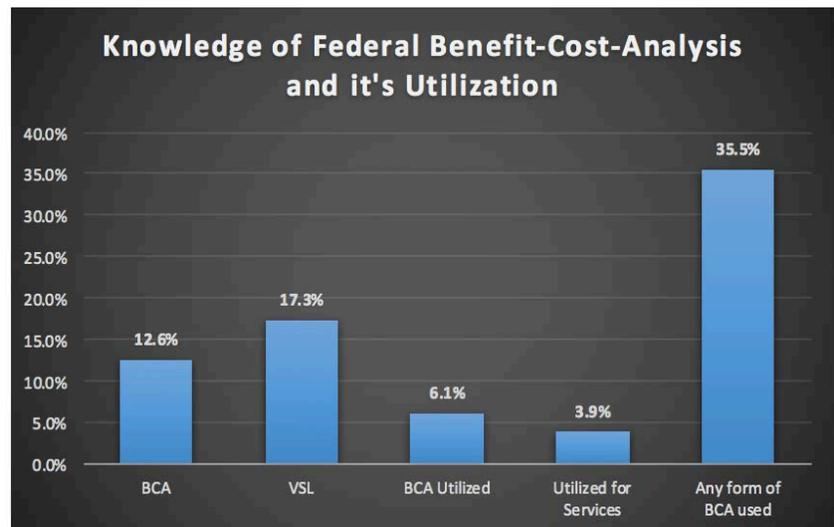
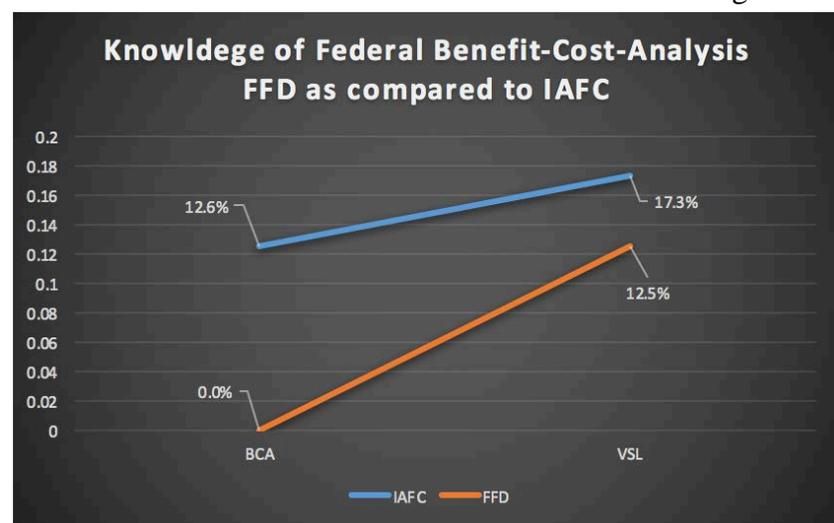


Figure: 2



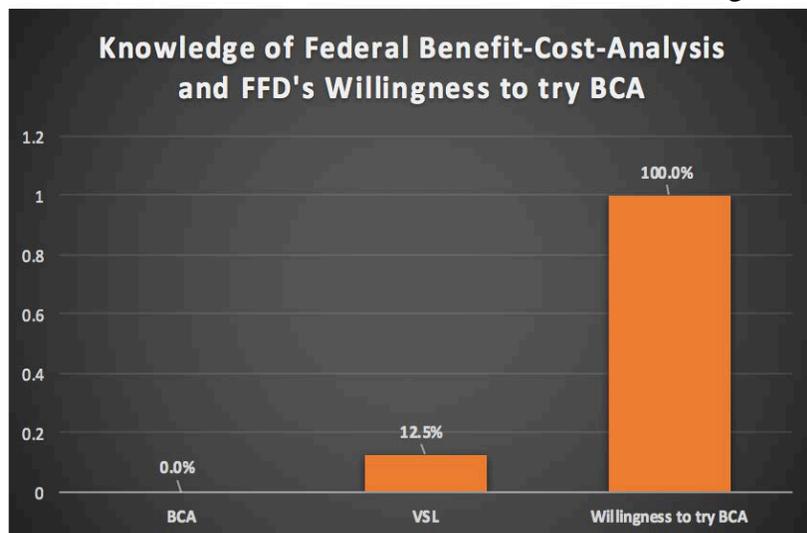
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(VSL) was more well-known with 17% of the department surveyed having knowledge of its application and 13% internally. When the FFD leaders were asked if they would consider the use of a BCA within our department, an overwhelming 100% said that they would consider its use within the FFD (see figure 3). When asked about what benefits they believe the BCA could offer, they had very

positive well thought responses, such as: “It provides one of many tools to review and analyze strategic planning and prioritizing existing and future policies or projects”, and another respondent

stated “fire departments are a benefit to a productive society. The use of BCA's help to determine how a department can best benefit that society.” The responses to potential disadvantages were equally well thought out. Here are a couple of the responses: “Sometimes the determination regarding the level of service we provide must be made with the external customer in mind first. The service we provide may not always be "cost effective" as a good analysis would show, but it is still the best for our customers. The Fire Department is not a business and must not be viewed as one”, and another stated that “we have many low-frequency high-risk (LFHR) events that we purchase equipment and train for. The BCA may say we're wasting our time and money.” For a complete list of answers (see appendix B).

Figure: 3



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Summary of Results to Research Question 1:

The intent of research question 1 was to determine why the FFD does not utilize a BCA to determine the services provided. The survey showed that the FFD leader's knowledge was lacking in regards to this topic. Their knowledge of the topic was not too far off from the other departments surveyed across the nation and Canada. It also showed that there was an interest in the topic and that an overwhelming majority (100% of the respondents) would entertain the application of BCA within the FFD (see figure:3). These surveys confirmed the original assumption that there was a lack of knowledge concerning the application of BCA within the federal agencies and the use of VSL. To answer the first research question: a) Why does the Fayetteville Fire Department not utilize a benefit cost analysis for the services provided? It is due to a lack of knowledge regarding its application and its ability.

Research Question 2:

The second question was intended to search out what existing BCA tools that are available for application within the fire service. The literature review revealed that not only do all federal agencies utilize BCA but it is required by law. After this finding, I was certain that I would find literature showing its use within the fire service. Unfortunately, only two were found and one of them was using FEMA's BCA tool. The obvious conclusion from this finding was to get one of the BCA tools already used by a federal agency, such as FEMA, and modify it to suit our needs. However, further research revealed there were none available that could be easily modified. When the survey was completed the erroneous assumption was made that very few departments would utilize BCA for the services they provide so there was no effort made to narrow down the responses. Instead an open-ended response given asking for their department name if their department utilized BCA in any capacity. An overwhelming amount, 66, stated

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their department utilized BCA in some capacity (see Appendix A). Had this type of response been anticipated more questions could have been asked to refine these down to a manageable amount and then interview them. Interviewing 66 departments simply was not an option. The survey, aside from proving the existence of BCA within the fire service, provided no useable information. Nor did the literature review yield a usable BCA tool.

Summary of Results to Research Question 2:

The literature review revealed that all federal agencies utilize BCA and that virtually no fire departments do. The survey conflicted these results of the literature review and showed there are several departments within the fire service that utilize BCA in some capacity. Neither, however, yielded a usable BCA tool that could be applied to the FFD. To answer the second research question is: b) Are there any benefit cost analysis models that could be applied to the fire service? The answer is complicated. The simple answer is no there are not any that can be easily modified and used. There are, however, many examples available that a new one could be modeled after.

Research Question 3:

This question was intended to determine whether or not BCA could be applied to the FFD. The assumption was made that a BCA tool would be found but the concerns were whether it would even be plausible to produce the required data sets. The research was completed with literature review and surveys. The literature review revealed a few hurdles. One example found was “it is very hard to measure the total benefits... in general we must be content with measuring how it performs relative to some base case” (Puget Sound Regional Council, 2009, p. 7). This fact limits the FFD to utilizing BCA for future decisions. With this model, in its current use, it is not possible to measure existing performance as that is assumed to be the base line. Another

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(Misuraca, 2014, p. 2) states that some “factors cannot be accurately measured or quantified... [and] is not intended for all quantifiable purposes”. These factors have yet to be discovered within the FFD. There may be many decisions where the BCA will not be a plausible choice. As referenced above by one of the FFD leaders “the Fire Department is not a business and must not be viewed as one.” While this is a simple statement it bears a lot of truth. We are not manufacturing widgets, therefore an overarching BCA may not be the answer.

An important finding to note is the IAFC survey which showed that only 6% of the departments surveyed utilize BCA with the same capacity as the federal governmental agencies (see figure 1). The survey showed that only 3.9% of the departments utilize BCA for the services they provide. That number is a bit misleading in that it’s based on all 231 respondents. If the departments that utilize BCA for the services they provide is divided by the number of departments that actually utilize BCA, that number grows to 64%. So, of the departments that utilize BCA at the same capacity as the federal governmental agencies, an overwhelming majority utilize it to determine the level of services they provide. That’s an encouraging statistic when considering the plausibility of its application within the fire service. Another important finding came from the internal survey. The open-ended response questions on advantages and disadvantages yielded some really positive attitudes towards the possible application of BCA within the FFD, so attitude and willingness will not be a limiting factor (see Appendix A).

The last and final piece to the question is an actual BCA tool for the FFD. Unfortunately, as mentioned above, there were no BCA tools available. The only true way to know if BCA is plausible for the FFD is through actual application. So, after the lengthy literature review was completed, I returned to the internet again and searched for a resource to aid in the creation of a BCA tool. I was able to find a book that provided step by step instruction on creating a BCA

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utilizing Excel. This however quickly outpaced my understanding, but a very rudimentary BCA tool was created for this research (see appendix D). The help of the University of Arkansas has already been solicited for a more comprehensive BCA tool.

Summary of Results of Research Question 3:

The research found that BCA is a tool used by many agencies across the country, including fire departments, 36% of the departments surveyed. While only 13% utilized it to the extent of federal agencies, it proves that it is certainly plausible. The research was unable to yield a BCA tool, but it did reveal a resource to aid in the creation of a BCA tool. The survey of the FFD leadership illustrated a positive attitude towards the utilization of BCA. To answer the question: c) Is benefit cost analysis even plausible for the fire services? Yes, this is a plausible option for the FFD.

Discussion

This applied research paper has been very encouraging in regards to the actual utilization of benefit cost analysis (BCA) by the Fayetteville Fire Department (FFD). The surveys showed a lack of knowledge on behalf of both the FFD and the International Association of Fire Chiefs' (IAFC) respondents. It is my belief this lack of knowledge is what has created deficit in its use across the fire service. This topic was originally chosen with the thoughts of assigning monetary value to the service we provide. There was a time, not too long ago, where "bad stuff will happen and you will die without us" was all the justification we needed to vindicate our budget. That is not the world we live in today. The benchmarks we strive to comply with are established by National Fire Protection Agency (NFPA) 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*, and the guidelines established by the

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Insurance Services Office (ISO). However, in both instance, these are not mandate and are up to the authority having jurisdiction to decide to what extend they will comply. We have chosen certain benchmarks and we point to our ability to achieve these self-imposed benchmarks as proof of our need. For the time being this has pacified the politician, but it doesn't truly tell us what good we are doing for society. The BCA is a powerful tool for comparing options and placing monetary value on the various options, with where we are today being our baseline of zero. Using this model would allow us to monetize any improvements made. A problem with the BCA tool is it fails to capture where we are today. One source stated "it is very hard to measure the total benefits... in general we must be content with measuring how it performs relative to some base case" (Puget Sound Regional Council, 2009, p. 7). This fact limits the current use of BCA to making future policy or procedure decisions. One possible way of assigning current value might be to pick a time and consider that the baseline them compare it with where we are today. More research in this area is required.

The Department of Transportation (DOT) (2015) states that as of 2014 the value of a statistical life (VSL) is \$9.4 million dollars. To reiterate how VSL is established "if the annual risk of death is reduced by one in a million for each of two million people, that is said to represent 'two statistical lives' extended per year" (OMB, 2003, p. 29). The BCA will aid in assigning monetary value to the services provided by the FFD. This will be a bit of a challenge in that we will have to create a linear regression model in order to find the correlation between Improvement X and Problem Y, for instance response times and property damage. After a correlation is made, it would then be possible to assume said benefit from said improvement. Those amounts would then be plugged into the BCA tool. The BCA tool in Appendix D is an actual functioning Excel workbook that was created for this research. The numbers provided are

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the numbers from an exercise illustrated in the book: *A User Manual for Benefit Cost Analysis Using Microsoft Excel*, discussed in Section 3 of the literature review (Predo & James, 2006).

Appendix E is a more comprehensive BCA tool that is under construction. We are able to plot calls by areas, or in this case, wards. This would allow the cost and benefit to be broken down by ward. That would help with the political battle illustrated in the next paragraph. Another positive that came out of this research manifest itself in a bit of a detour.

One of the challenges with research is staying on track. Every once and a while you will find these little gold nuggets that interest you so but they tend to get you in the ditch, out of the ditch, and into the weeds in the field next to the ditch. One of those papers for me was Dr. Carr Boyd's dissertation and its managed to do it to me twice now as I found it during my first research paper. As mentioned in the literature review, it did have a small portion that was applicable to this research. The vast majority, while applicable to the fire service, is not applicable to this research. This research does, however, get to one of the problems highlighted in his paper. One of the problems with the current the model used by the fire service is the equal distribution of resource (Boyd, 2009). Equal distribution manifest itself in the benchmarks. We do our best to evenly blanket the response area to insure we have good response times throughout the area. Boyd's (2009) point is that we have a large amount of public capital setting in locations that do not get used. He continues to say that on the flip side we have areas where there are a high volume of calls but the same coverage based on theoretical response times. What happens in turn is many times we second, third, and even fourth in units responding to an area because the first, second, or third in unit is already on calls in that area (Boyd, 2009). The problem that this research addresses is justification. Boyd (2009) highlights this problem but then is quick to point out the political nightmare attached to moving a fire station out of an area

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where it set stagnant to an area where it is needed. Utilizing a benefit cost analysis (BCA) will enable the city's decision makers to take a look the big picture. If the BCA is completed on each ward, it will be easy to show that an area where the station is not utilized is placing a large social cost on the city as a whole.

Recommendations

It is my recommendations that a policy (Appendix C) and a BCA tool (Appendix D) be created for the utilization of a benefit cost analysis (BCA) within the Fayetteville Fire Department (FFD). The next recommendation to start with some simple problems for which a decision needs to made and utilize this experience to modify the attached BCA tool to suits our needs. It is also my recommendation that we partner with the University of Arkansas on this project. Further exploration into the modification of BCA should be completed in order to place value on the current services provided.

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Appendix

Survey #1		Appendix A	
Questions		Response	
		Yes	No
1	Are you aware to what extent the federal government utilizes a benefit-cost-analysis (BCA)?	29	202
2	Are you familiar with the value of a statistical life (VSL) and its use?	40	191
3	Does your department use a benefit-cost-analysis, as used by the federal government, to aid in the decision making process?	14	217
4	If you answered yes to the previous question, does your department utilize a benefit-cost-analysis when determining the level of service provided?	9	222
5	Does your department use a benefit-cost-analysis in any capacity for anything?	32	199
6	If your department uses a benefit-cost-analysis, please include your department name below.	-	-
Responses to Question 6:			
Abingdon Fire Department Akron Fire Department, Akron, Oh. Alpha Fire Company Altoona (Iowa) Fire Department Arlington Texas Berryhill Fire Protection District Campbell County Fire Department, Gillette Wyoming Central Jackson County Fire Protection District, Blue Springs, MO Charlottesville Fire Department Cheney (WA) Fire Department City of Westminster Colorado City of Yuma Fire Department Clovis Fire Department (CA) Comstock Township Fire & Rescue Cooper Nuclear Station Cost per resident for yearly operating budget Cy-Fair Volunteer Fire Department Durham New Hampshire East Grand FPD #4			

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Survey #1 continued

Emmaus FD
EMS staffing
Fayetteville Fire and EMS
Great Falls Fire Rescue
Hanford Fire Department, WA.
Hartsdale Fire District
Henrico County Division of Fire
Henrietta Fire District
Hingham Fire, Massachusetts
It is part of the City budget process of all information technology projects and major new capital improvements.
Kent Regional Fire Authority, Kent WA
Knoxville Fire Department
Lackawanna Fire Department
Lane Fire Authority
Las Vegas Fire & Rescue
Lebanon (OR) Fire District
Little Rock Fire Department
Mercer Island Fire Department
Mobile Fire Rescue Dept
Modified, EMS responses
New Vs used apparatus, New Vs remount on Rescue/Ambulances and now we are remounting a fire engine to a new chassis. Rocky Ridge Fire District, Alabama
North Tooele Fire District
Oak Hill Fire Department (Austin, TX)
Odessa Fire Rescue
Personnel and or overtime use
Prospect Heights, IL Fire District
Rincon Valley Fire District
Robert Whitaker
Rochester Fire Department, Rochester Mi
Rogers Fire Department
Schaumburg Fire Department
SFSF&R
Siloam Springs AR
Sioux Falls Fire Rescue
Springdale Fire Department
Staffing Projections

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Survey #1 continued

Tamarac Fire Rescue

The Virginia Department of Fire Programs

Utilized by parts of our community paramedicine/social work program to track incident reduction compared to costs of programs, specifically with frequent system users.

Very Loosely applied to decision making process

Victoria Fire Department, Victoria BC, Canada

Violet Fire

We do not but I would love to see the results of your project

We use a benefit-cost-analysis but I am not certain it is the same as the federal gov.

We use this for ongoing station maintenance and apparatus replacement

West Chester

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Survey #2

Appendix B

Questions		Response	
		Yes	No
1	Prior to reading the attached narrative, were you aware to what extent the federal government utilizes a benefit-cost-analysis (BCA)?	0	8
2	Were you familiar with the value of a statistical life (VSL) and its use?	1	7
3	Would you consider the use of a BCA within our department?	8	0
4	Please list any advantages you see in using a BCA to guide us in our decision making on the level of services we provide?	-	-
5	Please list any disadvantages you see in using a BCA to guide us in our decision making on the level of services we provide?	-	-
Responses to question 4:			
<p>It is already accepted practice being used in various places</p> <p>Fire departments are a benefit to a productive society. The use of BCA's help to determine how a department can best benefit that society.</p> <p>Justifying our existence and budget increases, personnel, equipment, etc.</p> <p>We could make the BCA a part of the reporting from the LMT Ops teams. simply cost vs, reward</p> <p>It provides one of many tools to review and analyze strategic planning and prioritizing existing and future policies or projects.</p> <p>Help locate apparatus near dense populations</p>			
Responses to question 5:			
<p>Sometimes the determination regarding the level of service we provide must be made with the external customer in mind first. The service we provide may not always be "cost effective" as a good analysis would show, but it is still the best for our customers. The Fire Department is not a business and must not be viewed as one.</p> <p>A BCA could show that society would benefit from a specific type of service that is not typically offered by a fire department (i.e. firefighters acting as dog catchers)</p> <p>I hope it gives us the information we want?</p> <p>We have many low-frequency high-risk (LFHR) events that we purchase equipment and train for. The BCA may say we're wasting our time and money.</p> <p>red tape and time constraints</p> <p>Initial implementation will require flexibility and understanding of initiative from broad grouping of people.</p> <p>Long response times to low populated areas</p>			



www.accessfayetteville.org

THE CITY OF FAYETTEVILLE, ARKANSAS



FIRE DEPARTMENT
303 West Center Street
Fayetteville, AR 72701
P (479) 575-8365 F (479) 575-0471

Administrative Operating Procedures:

Revised: 03-2016

Section 300: Customer Relations External

Subsection 307: Service Gap Analysis

Subsection 307.5: Benefit Cost Analysis

Purpose:

The purpose of this policy is to establish a method by which to perform a benefit cost analysis to aid in the decision making process.

Process:

The departmental expenditures (both capital and operating), NFRIS run data, and population shall be updated annually in the BCA tool (version 10.1). The value of a statistical life (VSL) shall be updated annually and the source of the VSL will be the Department of Transportation (DOT). For the utilization of VSL a linear regression model shall be used to model the correlation between the perceived problem and the proposed solution. The linear regression model shall utilize historical data. The benefit will be established by dividing the number of lives saved, in comparison to the base model, by the VSL. The results will then be inserted into the "Benefit" column of the "Proposed Project" sheet within the "BCA" tool workbook. The initial project cost and reoccurring costs shall be inserted into the "Cost" column of the "Proposed Project" sheet within the "BCA" tool workbook. The potential discount rates as well as the estimates for benefits and cost for each option shall be entered on a case-by-case basis.

The results of this calculation will yield in the sensitivity of each factor. These result can be found on the "Sensitivity" sheet within the "BCA" tool workbook. The results will provide a net present value (NPV), internal rate of return (IRR), and benefit cost ratio (BCR) for options 1 through 3. The determinant will be NPV but the IRR and BCR should also be considered as well. This analysis should be performed on each proposed solution to the problem.

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Benefit Cost Analysis Tool

Appendix D

Fayetteville Fire Department Benefit Cost Analysis Tool			
Data:			
Description	Amount	Option Description	Percentage
Total Population	84,500	Discount Rate #1	10%
Total Capital Investment	\$21,950,000	Discount Rate #2	10%
Total Annual Capital Expense	\$1,000,000	Discount Rate #3	10%
Total Operational Expense	\$10,000,000	Under Benefit #1	0%
Total Cardiac Deaths	69	Under Benefit #2	-10%
Total Fire Injuries	7	Under Benefit #3	-10%
Total Fire Deaths	2	Over Cost #1	0%
Total Fire Property Loss	\$1,673,683	Over Cost #2	0%
Total Other Property Loss		Over Cost #3	10%
Structure Fires	45		
Value of a Statistical Life	\$9,400,000		

Fayetteville Fire Department Proposed Project		
Year	Benefit	Cost
1	0	1000
2	200	300
3	800	300
4	1000	300
5	1000	300
6	1000	300
7	1000	300
8	800	300
9	800	300
10	800	300

Fayetteville Fire Department Benefit Cost Analysis Tool: Sensitivity						
Option	Benefit Adjust	Cost Adjust	Discount Adjust	NPV	IRR	BCR
1	0%	0%	10%	\$1,689.09	38%	1.68
2	-10%	0%	10%	\$1,272.21	32%	1.51
3	-10%	10%	10%	\$1,024.24	27%	1.38

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Fayetteville Fire Department Benefit Cost Analysis Tool: Cost Analysis					
Option 1 (Base Case)					
Year	Benefit	Cost	Net Benefit	Analysis	Amount
1	\$0	\$1,000	-\$1,000	Net Present Value: NPV()	\$1,689.09
2	\$200	\$300	-\$100	Internal Rate of Return: IRR()	38%
3	\$800	\$300	\$500	Present Value (PV) Benefits	\$4,168.83
4	\$1,000	\$300	\$700	Present Value (PV) Cost	\$2,479.73
5	\$1,000	\$300	\$700	Benefit Cost Ratio (BCR)	1.68
6	\$1,000	\$300	\$700		
7	\$1,000	\$300	\$700		
8	\$800	\$300	\$500		
9	\$800	\$300	\$500		
10	\$800	\$300	\$500		
Option 2					
Year	Benefit	Cost	Net Benefit	Analysis	Amount
1	\$0	\$1,000	-\$1,000	Net Present Value: NPV()	\$1,272.21
2	\$180	\$300	-\$120	Internal Rate of Return: IRR()	32%
3	\$720	\$300	\$420	Present Value (PV) Benefits	\$3,751.94
4	\$900	\$300	\$600	Present Value (PV) Cost	\$2,479.73
5	\$900	\$300	\$600	Benefit Cost Ratio (BCR)	1.51
6	\$900	\$300	\$600		
7	\$900	\$300	\$600		
8	\$720	\$300	\$420		
9	\$720	\$300	\$420		
10	\$720	\$300	\$420		
Option 3					
Year	Benefit	Cost	Net Benefit	Analysis	Amount
1	\$0	\$1,100	-\$1,100	Net Present Value: NPV()	\$1,024.24
2	\$180	\$330	-\$150	Internal Rate of Return: IRR()	27%
3	\$720	\$330	\$390	Present Value (PV) Benefits	\$3,751.94
4	\$900	\$330	\$570	Present Value (PV) Cost	\$2,727.71
5	\$900	\$330	\$570	Benefit Cost Ratio (BCR)	1.38
6	\$900	\$330	\$570		
7	\$900	\$330	\$570		
8	\$720	\$330	\$390		
9	\$720	\$330	\$390		
10	\$720	\$330	\$390		

DEPARTMENT?

Benefit Cost Analysis tool (Wards)

Appendix E

Fayetteville Fire Department Benefit Cost Analysis Tool			
Data:			
Description	Amount	Description	Amount
Ward #1 Population		Fire Fires Ward #1	
Ward #2 Population		Fire Fires Ward #2	
Ward #3 Population		Fire Fires Ward #3	
Ward #4 Population		Fire Fires Ward #4	
Capital Investment Ward #1		Fire Injuries Ward #1	
Capital Investment Ward #2		Fire Injuries Ward #2	
Capital Investment Ward #3		Fire Injuries Ward #3	
Capital Investment Ward #4		Fire Injuries Ward #4	
Annual Capital Expense Ward #1		Fire Deaths Ward #1	
Annual Capital Expense Ward #2		Fire Deaths Ward #2	
Annual Capital Expense Ward #3		Fire Deaths Ward #3	
Annual Capital Expense Ward #4		Fire Deaths Ward #4	
Operational Expense Ward #1		Value of a Statistical Life	
Operational Expense Ward #2			
Operational Expense Ward #3			
Operational Expense Ward #4			
Cardiac Deaths Ward #1		Option Description	Percentage
Cardiac Deaths Ward #2		Discount Rate #1	
Cardiac Deaths Ward #3		Discount Rate #2	
Cardiac Deaths Ward #4		Discount Rate #3	
Other Property Loss Ward #1		Under Benefit #1	
Other Property Loss Ward #2		Under Benefit #2	
Other Property Loss Ward #3		Under Benefit #3	
Other Property Loss Ward #4		Over Cost #1	
Fire Property Loss Ward #1		Over Cost #2	
Fire Property Loss Ward #2		Over Cost #3	
Fire Property Loss Ward #3			
Fire Property Loss Ward #4			