THE RIGHT DECISION

Evidence-based Decision Making for Fire Service Professionals

Paul S. Maxim, Len Garis, Darryl Plecas and Mona Davies

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About the Authors

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For additional public safety publications, please visit http://cjr.ufv.ca

Forward

This workbook is designed to be used in conjunction with the text, *The Right Decision: Evidence-based Decision Making for Fire Service Professionals.* It can be used as a self-study guide or in either a classroom or workshop setting. While many of the techniques outlined in the text can be used very effectively by an individual working with a paper and pencil or a laptop, many are best implemented in a group setting. Environmental scans and SWOT (strengths, weaknesses, opportunities and threats) analyses are good examples of this.

Each section of this workbook starts with a review of the relevant material in *The Right Decision*. A number of exercises are then outlined.

We have also provided accompanying examples drawn from the field as starting points.

To get the most out of the exercises, however, we would suggest you choose an issue or example within your own organization. Using material with which you are most familiar makes the exercises much more relevant. It also helps to illustrate the strengths and limitations of the techniques outlined in the text. The procedures we present are not meant to make decisions for you but, instead, to help you make better informed decisions. Using the procedures we outline will also provide you with an evidence-based rationale for justifying the choices you make.

Defining the Problem

Introduction

The objective of this chapter is to provide you with a basic guide and some tools to design a framework for decision making—such as constructing a strategic plan.

Effective evidence-based decision making is tightly linked to an organization's plan.

A good plan will allow you to clarify what issues are relevant and what options are available for you to consider. It will help identify what evidence you will need to consider in weighing those options.

Why is Evidence-based Decision Making so Important?

Evidence-based decision making uses the best available information generated through research, experiments and observation, and other factual sources, to influence the best possible decisions and policies. It takes a systematic and rational approach to researching and analysing available evidence to inform the policy making process.

Evidence based decision making:[1]
- Helps ensure policies are responding to the real needs of the organization or community which, in turn, can lead to better outcomes for the population in the long term.
- Can highlight the urgency of an issue or problem which requires immediate attention. This is important in securing funding and resources for the policy to be developed, implemented and maintained.
- Enables information sharing among other members of the public sector with regard to what policies have or have not worked. This can enhance the decision making process.
- Can reduce government expenditures which may otherwise be directed into ineffective policies or programs that could be costly and time consuming.
- Can produce an acceptable return on the financial investment that is allocated toward public programs by improving service delivery and outcomes for the community.

Quick Review

Not all decisions are alike, and you will need to work through a formal process to identify whether the issue is something that is of value to your department.

Key points to consider:
- What is the issue? Can you propose a clear definition of the problem?
- Identify the options and alternatives.
- Generate new ideas–think creatively.
- How can we generate alternatives?

What is the Issue?

The issue should be connected to the goals or mandate of the department or organization to ensure that the choices you are considering are consistent with these goals.

The mandate is usually part of the department's or organization's strategic plan or standard operating procedures (SOPs).

Generating Ideas

Accept the fact that you will need to overcome your prejudices, and be willing to be open to new perspectives.

- Talk to people outside your normal circles–this helps get around a "group-think" mentality.
- Engage in group brainstorming sessions.
- Read widely, especially books and journals outside your area of interest; surf the web.
- Focus on your clients—in this case the general public.
- Hire a reputable consultant—consultants can be a valuable resource and can play a big role in helping you shape your organization's strategy and goals.

Embedding the decision within the framework of a pre-existing plan—such as a strategic plan—makes your decision defensible on strategically assessed grounds.

Developing a Framework for a Strategic Plan

A strategic plan communicates the organization's goals, the actions needed to achieve those goals and all of the other critical elements developed during the planning exercise.

Developing an effective strategic planning process within your department or organization is an important part of creating future excellence within your department. It will provide you with guidance and direction to help your department excel, rather than simply responding to changes after they have occurred.

A plan should consist of the following elements:

- **Vision and mission statement:** a general statement of your department's or organization's values. It is essentially what your department or organization aspires to achieve. Mission statements are similar to vision statements, but they are more concrete. They are more "action-oriented" than vision statements. For example, your mission might be to develop a safe and healthy neighborhood through collaborative planning, community action, and policy advocacy.

- **Objectives:** how much of what will be accomplished, and by when. These should be measurable results or outcomes.
- **Strategies and action plans:** how the initiative will reach its objectives and how strategies will be implemented to accomplish the objectives developed earlier in this process.
- **How to measure the results or success:** determine the indicators you will use to measure the outcomes. These can be either quantitative measures such as call response time or staffing per shift, or qualitative measures such as level of community satisfaction.

Statement of organization values

Statement of goals and objectives

Outline of how to achieve the goals

Indication of how to measure success

Once you have given the above some thought, you would then start to develop a framework. The framework could look something like this:

Vision	• Service and protection through excellence
Mission	• To serve the community by protecting life, property and the environment. • Provide excellent service through prevention, education, preparedness and mitigation; recognizing that our people are the key to success.
Goals	• Improve communications with the community, employees and policy makers. • Achieve financial stability and growth to provide needed resources. • Protect life, property and the environment through public education and prevention initiatives.
Measures	• Customer service satisfaction survey results. • Meet budget targets. • Program successes in community outreach.

Logic Model

Once you have outlined your general direction, you can now start to develop a logic model. A logic model is like a roadmap you can use as a guide to help you achieve your goals. It outlines the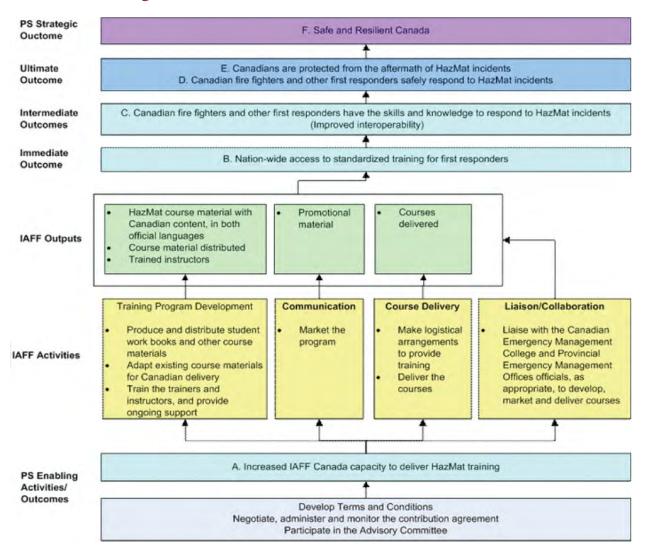 intended results (that is, outcomes) of the program, the activities the program will undertake, and the outputs it intends to produce in achieving the expected outcomes.[2] It is a very useful tool to help you evaluate and think about whether the goals and objectives you have outlined above are achievable and measurable.

Main components of a Logic Model:

Inputs	▶	Activities	▶	Outputs	▶	Immediate Outcomes	▶	Intermediate Outcomes	▶	Ultimate Outcomes

It is useful to present your thoughts using a flow chart or diagram as it will help you visualise your thought process. There are many examples of logic models but it is entirely up to you to come up with one that works for you and your organization.

Once you have given all these components some thought, your logic model could look something like the one below. Again, it is entirely up to you to come with your own model. There are hundreds of examples on the internet.

Logic Model of the International Association of Firefighters (IAFF)/Canada Contribution Program[3]

PS Strategic Outcome	F. Safe and Resilient Canada
Ultimate Outcome	E. Canadians are protected from the aftermath of HazMat incidents D. Canadian fire fighters and other first responders safely respond to HazMat incidents
Intermediate Outcomes	C. Canadian fire fighters and other first responders have the skills and knowledge to respond to HazMat incidents (Improved interoperability)
Immediate Outcome	B. Nation-wide access to standardized training for first responders

IAFF Outputs
- HazMat course material with Canadian content, in both official languages
- Course material distributed
- Trained instructors

- Promotional material

- Courses delivered

IAFF Activities

Training Program Development
- Produce and distribute student work books and other course materials
- Adapt existing course materials for Canadian delivery
- Train the trainers and instructors, and provide ongoing support

Communication
- Market the program

Course Delivery
- Make logistical arrangements to provide training
- Deliver the courses

Liaison/Collaboration
- Liaise with the Canadian Emergency Management College and Provincial Emergency Management Offices officials, as appropriate, to develop, market and deliver courses

PS Enabling Activities/ Outcomes

A. Increased IAFF Canada capacity to deliver HazMat training

Develop Terms and Conditions
Negotiate, administer and monitor the contribution agreement
Participate in the Advisory Committee

This is a visual representation that links what the IAFF/Canada Contribution Program is funded to do (activities) with what the program produces (outputs) and what the program intends to achieve (outcomes). It also provides the basis for developing the evaluation matrix, which gave the evaluation team a roadmap for conducting this evaluation.
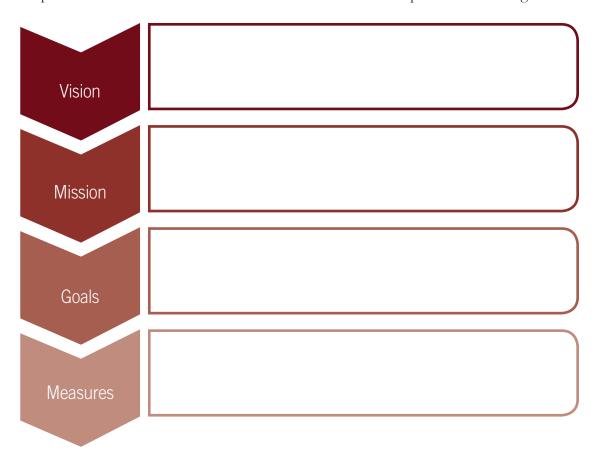
Case Study 1

Obtain your own, or locate a Fire Services Strategic Plan from the internet.

Most large to medium-sized departments make theirs publically available, such as:

- **City of Vancouver:** http://vancouver.ca/files/cov/vfrs-strategic-plan.pdf
- **City of Toronto:** https://www1.toronto.ca/City%20Of%20Toronto/Fire%20Services/Shared%20Content/Files/master_plan.pdf
- **City of Cambridge, Ontario:** http://www.cambridge.ca/relatedDocs/CambridgeFireMasterPlanFinalReportJuly2013.pdf
- **City of New York:** http://www.nyc.gov/html/fdny/pdf/publications/FDNY_strategic_plan_2011_2013.pdf

Exercise 1
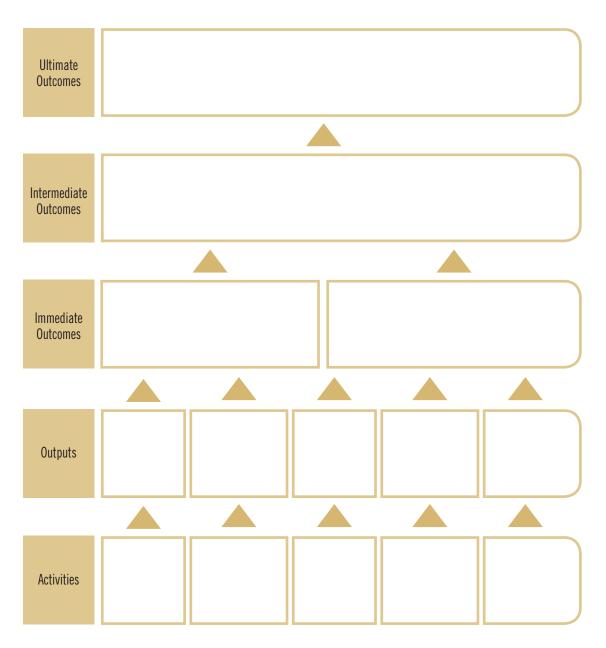
Drawing on the case study you have just read and using the process outlined earlier in the chapter:

1. Outline a strategic plan below. Give some thought as to how you would measure the performance and goals.

Vision	
Mission	
Goals	
Measures	

2. Create a logic model. Do not feel discouraged if you are having difficulty filling in the blanks; it may be that the plan itself has shortcomings. Logic models will help you identify weaknesses in your plan and guide you to making logical, achievable goals. This will require some thinking especially for the input section.
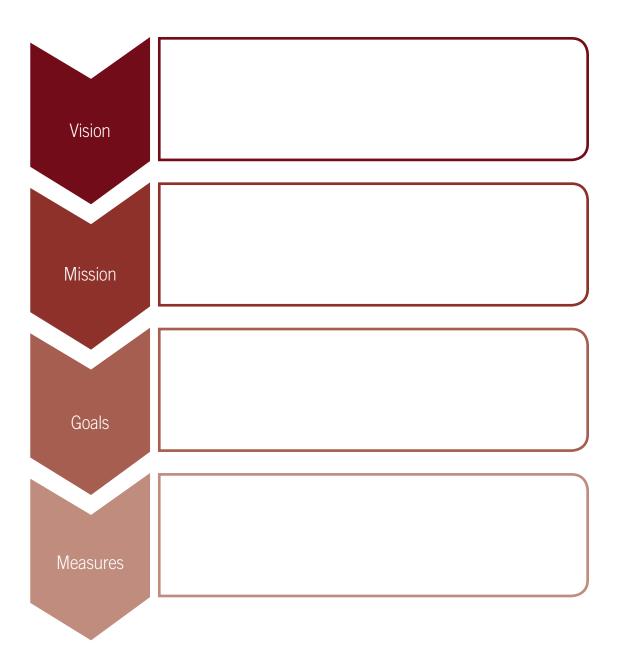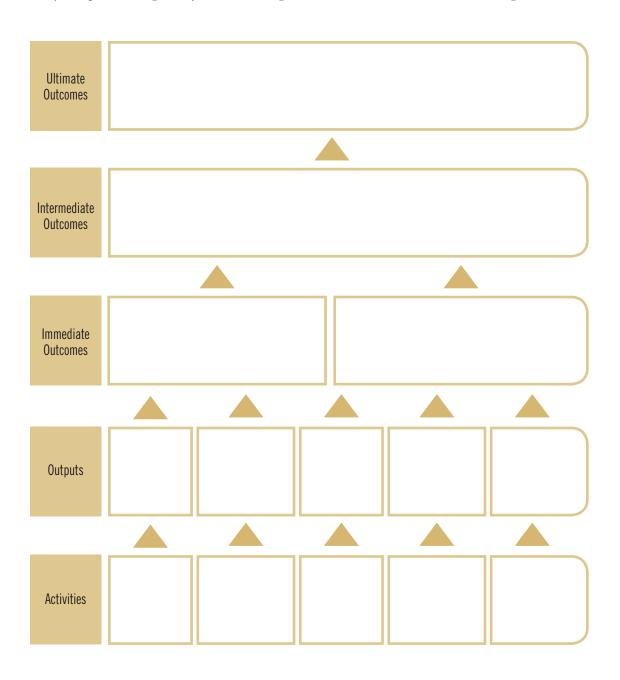
Use the table below as a guide to help you plan it out.

Ultimate Outcomes	
Intermediate Outcomes	
Immediate Outcomes		
Outputs					
Activities					

Exercise 2

1. Outline a strategic plan for **your** department or unit. Use the chart below as a guide.

Vision	
Mission	
Goals	
Measures	

2. Create a logic model for your plan. Remember, not all boxes may be relevant for your plan. Logic models will help you identify weaknesses in your plan and guide you to making logical, achievable goals. This will require some thinking, especially for the input section.

Use the table below as a guide.

Ultimate Outcomes	
Intermediate Outcomes	
Immediate Outcomes	
Outputs	
Activities	

Exercise 3

As the newly appointed Chief of your municipality or division, one of your main priorities is to plan and implement the transition of five volunteer departments into full-time departments.

The task:
If you are doing this as a group exercise, break into small groups (ideally four to five people). Brainstorm and come up with a strategic plan on how you would approach this transition. Remember, strategic planning is a joint exercise and the more feedback and input you get from a variety of sources the more comprehensive your plan will likely be.

Think of all possible issues/challenges/advantages when devising your plan.

How might you accomplish a successful transition using the current personnel who are volunteers to accomplish your goals? Are the fire stations equipped for 24/7 occupancy? Are there policies already in place for such things as compensation? Do you need to hire command staff? How will you budget or provide for this? How should you staff the station and schedule your staff?

Many questions come to light. The best approach is to break it down piece by piece.

Once you have come up with a strategic plan, work out your logic model to determine if your plan is achievable based on your goals and objectives. Use the charts in this chapter as a guide.

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[1] What is Evidence Based Decision Making? Australian Bureau of Statistics.
http://www.abs.gov.au/ausstats/abs@.nsf/lookup/1500.0chapter32010
[2] Supporting Effective Evaluations: A Guide to Developing Performance Measurement Strategies. Treasury Board of Canada Secretariat. http://www.tbs-sct.gc.ca/cee/dpms-esmr/dpms-esmr05-eng.asp
[3] 2011-2012 Evaluation of the International Association of Fire Fighters/Canada Contribution Program - Final Report. Logic Model of the IAFF/Canada Contribution Program.
http://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/vltn-ntrntnl-ssctn-frfghtrs-2011-12/index-eng.aspx#a2.4

Thinking Critically

Introduction

Let us assume that you have been asked to look into the frequency of occurrences of fires started by children, and what the likely factors that could influence these incidents might be. Are most of these fires caused by younger children under the age of 12? Does the neighbourhood and property type have any influence on this? How would you go about conducting your research?

Part of your responsibility in your role of leader of your department or organization is to conduct research on various public safety matters related to fire and rescue services.

This research can help you make sound and useful decisions. Your research findings could also play a strong role in changing public safety policy, thus contributing to overall public safety.

This is where you would have to apply yourself, think critically and approach your research rationally and logically. The research you conduct will be heavily dependent on data, and reliable and rational evidence.

This chapter will lay out the steps that can serve as guide for you to prepare a research report.

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Quick Review

Be careful to avoid being caught up by the following when conducting your research:

- **Logical Fallacies** – contradictions and irrelevancies. If the argument does not appear to make sense, stop and question it. Ask for more details or evidence.
- **Personal Arguments** – arguments or attacks targeted at undermining someone's credibility. The key here is to separate the argument or assertion from the speaker. The assertions, "Trust me" and "Don't listen to him, he is a fool" do not speak to the validity or worth of the argument a person is making.
- **Red Herrings** – irrelevant issues. Sometimes people raise issues that are unrelated to the problem at hand. Question how the red herring is actually related to the problem being considered.
- **Pink Herrings** – when the issue raised is sufficient to address the problem but is NOT necessarily a solution to the problem.

- **Circular Arguments** – logical fallacies. Essentially the argument is that if the premises are true, the conclusion must be true. For example, someone may state that they are poor because they have no money. You ask them, "Why do you have no money?" Their answer will be, "Because I am poor." That is circularity and it provides you with little useful information for action. If, however, they indicate they have no money because they are unemployed, then you have an item on which action can be taken— dealing with their unemployment.

Causal Linkages

Just because two things appear associated does not necessarily mean that one causes the other, or that they are causally connected in any way.

As a guide, consider these three conditions for a causal relationship:[1]
- The cause and effect must coincide or occur together.
- The cause must come before the effect.
- There is no other underlining factor resulting in the cause and effect appearing together. In other words, you want to be confident that the cause really is producing the effect rather than just appearing to do so.

Remember, it is very difficult to prove something is true; it is much easier to show that something is not true.

Testing a Theory

Let us assume that your hypothesis is that most household fires are caused by children who live in rental housing. Now you will have to prove this theory.
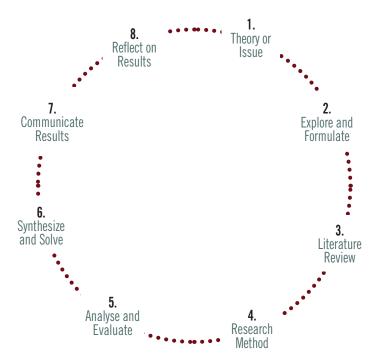
To prove a theory:
- You must find an explanation that is consistent with at least most of the evidence you have collected to date.
- You must then conduct secondary tests to see whether those explanations hold up.

The Research Report

You already have your working hypotheses; now you need to think of how you would conduct your research. Typically you would follow these steps:

1. **Identify the theory or issue:** Seek some preliminary background information on the issue.
2. **Explore and formulate:** Brainstorm options, identify the problems and alternatives; frame your ideas.
3. **Literature review:** Search, locate and identify useful sources of data; scan the sources for usefulness.
4. **Develop your research:** Develop your methodology; sort and organize the information based on your criteria; cause/effect, compare/contrast, chronological etc.

5. **Analyse and evaluate:** Determine importance of the information and its relevance to the essential question; identify trends, interpret data.
6. **Synthesize and solve:** Draw conclusions and if necessary create new meaning based on sound reasoning and authenticity of information.
7. **Communicate and present:** Communicate your findings using effective communication skills.
8. **Reflect:** Transfer the knowledge to solve new problems.
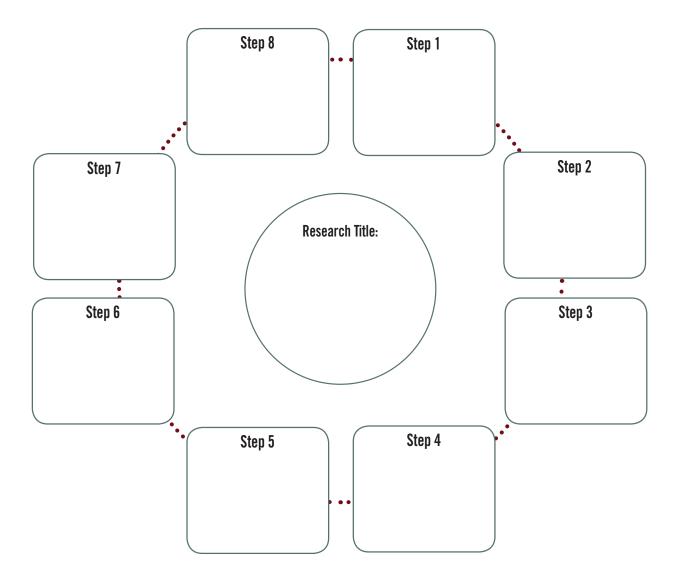
Case Study 2

Read **Case Study 2** at http://www.firereporting.org/documents/resources/11.pdf. This case study analyses the risk posed to both the firefighter and the occupant by increasing atmospheric toxicity in a structure.

This is not the complete report, but for the purposes of this chapter, the summary fact sheet will provide an overview of what your report will cover.

As you are reading the case study, use the chart below to try identifying the various elements of the research project that were highlighted above.

Step 8	Step 1
Step 7	**Research Title:**	Step 2
Step 6		Step 3
Step 5	Step 4

Exercise

Based on your years of experience as a fire service professional, you would have encountered countless situations where injuries or death could have been avoided if better research or information had been available.
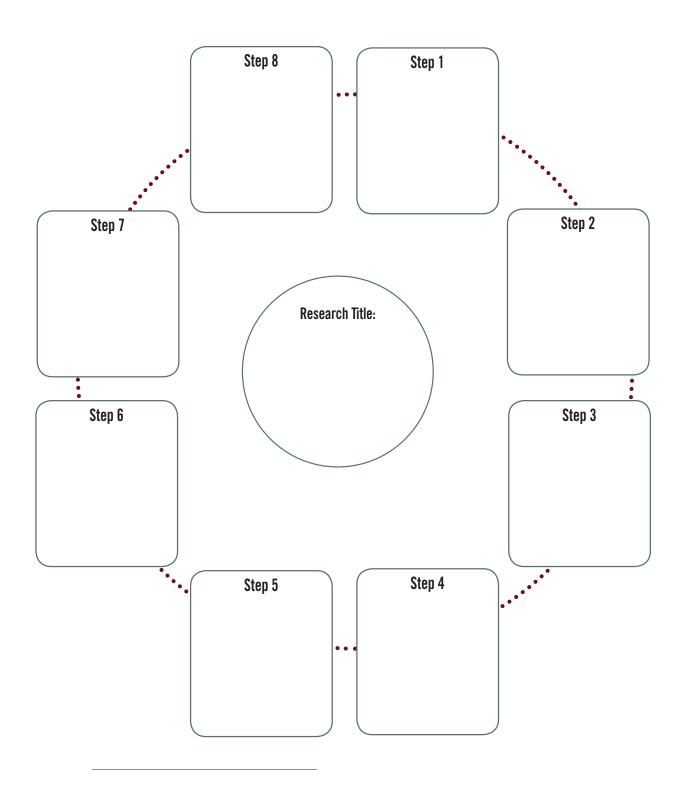
One of the issues on your mind lately is home smoke alarm usage, effectiveness and operationality, and fatalities in fires with and without working smoke alarms. You have a suspicion that most fire incidences are caused by cooking fires and that at a minimum, having a smoke alarm in the kitchen makes a significant difference in reducing fire incidences.

The task:
Using the chart on the next page, work through how you would approach this research. Be as detailed as possible. The more you think through the process the more robust your research will be.

Work through the steps using the guide outlined in this chapter.

Step 8

Step 1

Step 7

Step 2

Research Title:

Step 6

Step 3

Step 5

Step 4

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[1] The Right Decision, Evidence-based Decision Making for Fire Service Professionals. Paul S. Maxim, Len Garis and Darryl Plecas at pg. 31

Collecting Evidence

Introduction

Now that you have gone through the basics of how to structure a research project, it is time to get your hands dirty and dive into the nitty-gritty of data gathering and crunching.

The data or evidence that you will use for your research can come from a variety of sources. Some is available administrative data from the government sources or other formal organizations that routinely collect information. Evidence can also come from formal policy and program evaluations, as well as from the work of government and academic scientists.

Don't overlook the fact that your own organization, department or unit could also be a valuable source of information.

It is up to you to decide on your research method – decide on the methods you will use in order to be able to assess and study your research and data. Will you conduct research by studying behaviours of existing groups of individuals? Will you collect numerical data or anecdotes? The "method" is essentially a strategy for conducting an investigation to answer a research question.

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Quick Review

Environmental Scan

Before deciding on what sort of information you are going to rely on, you might want to conduct an environmental scan. A key part of conducting an environmental scan is finding sources to help guide your knowledge, thinking, research process, and any direction you might want to take.

It also gives you an informed, comprehensive picture of the current circumstances or environment in which your organization exists. It is a sequential process that involves gathering information from both primary and secondary sources.

Primary sources of information are data you put together by directly contacting or speaking with groups or individuals. Secondary sources come from the review of existing research reports, statistics and other information.
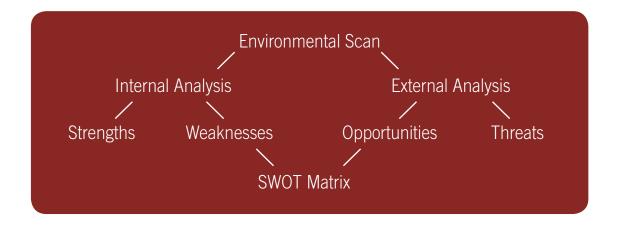
An environmental scan can provide:
- a fresh, objective look at issues within your organization's, department's or unit's mandate;
- ideas on how to rank your objectives effectively;
- an opportunity to access existing research, information, statistics and other data;
- an opportunity to engage community stakeholders, organizations, individuals and groups in decisions that affect them;
- an opportunity to discover the strengths and assets in the larger community;
- a framework to understand the assets and strengths possessed by your own organization; and,
- an opportunity to learn how your organization's programs and practices are affecting other organizations, agencies, groups or individuals and to what degree your programs are meeting your mandate.

There are two types of environmental scans:
- Primary (internal) research, which is based on your own knowledge and experience, or research you conduct yourself.
- Secondary (external) research, based on reviews of journals, news articles, policy documents, government publications, etc.

The internet has a wealth of information and is literally your oyster when it comes to information gathering. Where possible, engage your municipal librarian or a college/university librarian. Reference librarians are an important resource and will know how to glean and narrow your research focus.

The diagram below breaks down the thought process on how you would analyse your research.

Environmental Scan

Internal Analysis

External Analysis

Strengths Weaknesses Opportunities Threats

SWOT Matrix

Framing Your Environmental Scan

It is easy to be overwhelmed by the wealth of information out there and what you read and gathered from discussions. You could spend hours, days and sometimes weeks just going through the material. To avoid this, and in the interest of time and costs, it really helps to frame your environmental scan.

Focus your question:
- What is the key issue?
- What do you need to know about the issue?
- What are the trends and drivers affecting these factors?

Once you have gathered your information from both primary and secondary sources, it is time to analyse it.

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Swot Analyses

Environmental scans are often accompanied by a SWOT analysis of **strengths, weaknesses, opportunities,** and **threats** affecting the organization's ability to fulfill its organizational mandate. A SWOT analysis is an excellent tool that can be used to create a long-term plan by which your department/unit can properly direct its future.

It is best conducted in a collective group environment with a diverse cross-section of members from your organization or department. The more perspectives that can be brought to bear on your organization, the more likely you will be able to be identify the full range of opportunities and challenges it faces. Too often, while focusing on our day-to-day jobs, we miss important issues in other areas of the organization.

The SWOT exercise will be more effective if you share the results of the environmental scan with the team in advance.

Consider each of the four SWOT areas in turn, and make note of all the ideas, suggestions and comments made. These can be reviewed and edited after the brainstorming session.

Strengths

Consider your department's or unit's strengths from your own point of view and from that of your clients and the general public. Be realistic and honest.

Try answering the following questions:
- What is it that you do well?
- What advantages do you have over other fire departments and emergency services?
- What makes you different from them?

Weaknesses

Weaknesses are areas capable of improvement. Is your department or unit lacking skills or requiring upgrades? Do you have a higher cost base than other fire departments? Is your department or unit experiencing high staff turnover?

You must face any unpleasant truths and be realistic and objective in your analysis.
- Can the department/unit do anything better?
- Is your department doing anything badly?
- What are the causes of problems or complaints you receive?

Opportunities

Identify any new opportunities or untapped areas that your department or unit can focus on. Are there any interesting technologies you can take advantage of? The focus of opportunities is not solely on existing service, but on expanding and developing new possibilities both inside and beyond the traditional service area.

Examples of opportunities include:
- Changes in technology and equipment
- Changes in government policy or regulations or legislation
- Social factors, for example, population increases or changes in social demographics

Threats

Threats are usually anything that can adversely affect your department or unit. External threats could be budget cuts, new legislation, or terrorist activities. Internal threats could include a skill or staff shortage, or pressure to deliver under budgetary constraints.

Try answering the following questions:
- What challenges are your department/unit experiencing?
- What are other similar departments/units doing?
- Are there any changes in products, services or technology that could threaten your delivery methods?
- Is your department facing any budget cuts?

Once you have completed your SWOT analysis, it is essential that you make note of the following:
- What must you address immediately?
- What can be handled now?
- What needs researching further?
- What needs to be planned for the future?

Case Study 3

Numerous fire departments have conducted SWOT analyses for their organizations. Again, many of these are readily available on the internet. Use Google or another search engine to locate "Fire Department SWOT analysis". For those interested in a more direct route, SWOT analyses have been done by:

- **Wollongong, Australia:** http://wollongong.ses.nsw.gov.au/strategic_plan.pdf
- **Jackson Township, New Jersey:** http://www.jacksonfiredist3.org/Jackson%20 Fire/Main%20Page/Strategic%20Plan%20Docs/STUDY%20SWOT.pdf
- **Stratford, Ontario:** https://www.stratfordcanada.ca/en/insidecityhall/ resources/Core_Service_Review_Fire.pdf

In putting together their strategic plans, the departments conducted SWOT analyses to:
1. Determine key areas to focus on over the course of the plan.
2. Establish goals pertaining to these areas.
3. Put in place strategies to achieve these goals.

Those plans will give you a general idea as to how to list out your SWOT, and how to collate, analyse and summarise your findings. After reviewing your chosen plan, proceed to answer the exercises that follow.

Exercise

You have been Fire Chief for your department for over three years, and in that time period have come to the conclusion that your department requires a system to manage information as well as evaluation tools on departmental processes to ensure efficient operations while providing a high standard of service to your community. You have gathered some information from discussions with colleagues from other fire departments and now think a highly flexible records management system would suit this need.

As this is a big cost for your department and one that would require funding assistance, you would need to submit a funding request to the Province. To do so you would have to prepare a comprehensive report to substantiate your request for funds. How would you go about preparing this report?

The task:
Use the steps outlined in this chapter to work your way through the process on the following pages. This exercise should ideally be completed as a group brainstorming exercise, especially step 2. If necessary, Step 1 and 3 can be done individually (not ideal), but step 2 should be completed as a group if possible.

Step 1: Conduct Your Enviromental Scan

1. What is the key issue?

_____

_____

_____

2. What do you need to know about the issue? What do you already know about the issue? (internal research). List the information.

_____

_____

_____

_____

_____

3. What are the trends and drivers affecting these factors? (external research). List your sources for this additional information (magazines, government policy papers, case studies, and so on).

_____

_____

_____

_____

_____

_____

Step 2: Conduct a SWOT Analysis

For your department, conduct a SWOT analysis – fill in the matrix below to help you visualise your thought process.

Internal Analysis of Your
Department/Unit

External
Influences

Strengths

Opportunities

Weaknesses

Threats

Step 3: Explore Your SWOT Analysis

From your matrix, identify the following.

1. What must you address immediately? For example, were there any gaps that if not addressed could pose a risk (such as risk of calls being dropped, delays in dispatch, or staffing issues)?

_____

_____

_____

2. What can be handled now? Can some interim processes be put in place immediately?

_____

_____

_____

3. What needs researching further? For example, you may need to do more research on the flexibility of the system. Are there other cheaper systems that could produce the same results?

_____

_____

_____

4. What needs to be planned for the future? Will you need staff training or a change in the management structure? What upgrades might be needed and how will you take these into account into your budget?

_____

_____

_____

Statistics

Introduction

The key to understanding data analysis is to see it as a way of organizing and making sense of a world dominated by uncertainty. Many professionals feel daunted but the concepts are fairly simple. Generally, what we want to know is how "typical" something is, and how much variability is there in a bunch of observations. Keep in mind that the origins of statistics lie in games of chance such as playing cards and dice.

Statistics however, can reveal a lot of latent information that you would not normally know. It can be a very powerful tool and can be used to great advantage even if you do not have the underlying math or technical aspects. Statistics are a vital source of evidence as they provide us with clear, objective, numerical data on important aspects of your community, city, province or country.

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Quick Review

The study of statistics is usually divided into two categories:
- **Descriptive statistics** are methods of organising, summarising, and presenting data.
- **Inferential statistics** (or statistical inference) are methods used to determine something about a population on the basis of a sample.

Descriptive Statistics

A variable is a quantity or characteristic of interest that is allowed to change within a particular problem. There are two basic types of variables:
- **Quantitative variables** are measures, values or counts that are expressed as numbers.
- **Qualitative variables** are descriptive in nature, for example, a person's gender, religious affiliation, type of automobile owned, place of birth, and eye colour. That is, the characteristic being studied is nonnumeric.

Examples of Quantitative vs. Qualitative Data[1]

Data unit	Numeric variable	= Quantitative data	Categorical variable	= Qualitative data
A person	"How many children do you have?"	4 children	"In which country were your children born?"	Australia
	"How much do you earn?"	$60,000 p.a.	"What is your occupation?"	Photographer
	"How many hours do you work?"	38 hours per week	"Do you work full-time or part-time?"	Full-time
A house	"How many square metres is the house?"	200 square metres	"In which city or town is the house located?"	Ottawa
A business	"How many workers are currently employed?"	264 employees	"What is the industry of the business?"	Retail
A farm	"How many milk cows are located on the farm?	36 cows	"What is the main activity of the farm?"	Dairy

Other Important Key Measures and Terms

Mean: the arithmetic average. The sum of the value of each observation in a dataset divided by the number of observations.

Median: the middle value in distribution when the values are arranged in ascending or descending order.

Mode: the most common value occurring in a distribution or set of observations.

Range: the difference between the smallest value and the largest value in a set of observations. The range represents the actual spread of data. It is the difference between the highest and lowest observed values. As with calculation of the median, it is helpful to order data observations to find the highest and lowest values.

Standard deviation: measures the scatter in a group of observations. It is a calculated summary of the distance each observation in a data set is from the mean. Standard deviation gives us a good idea whether a set of observations are loosely or tightly clustered around the mean or average.

Variability: how widely the measures range or vary.

Variance: measures the spread of the data around the mean.

Reading Tables, Graphs and Maps

It is common when conducting data research to be presented information in the form of tables, graphs and maps. When reading data in tables, graphs and maps, it is helpful to follow a logical process.

The following steps may help you analyse and interpret data in tables, graphs and maps:[2]

- Observe the layout in order to understand how the data are arranged. Check the row and column names in a table; the x and y axis in a graph; or the key of the map to get a clear idea of the variables being displayed. Are there just numbers, or are percentages also used?

- Next, scan any totals as this may assist you to get an idea of any overall trends in the data.
- Also, make sure you look at any additional information and footnotes as they may contain important information that can be used to assess the accuracy of the data, or to understand the limitations of the data.
- Now, have a look at the data and how it is represented. Does anything stand out? Are there any trends in the data? Are the data uniform? What relationships can you see between the data? What summary measures could you use to gain a better understanding of the data? What conclusions can be drawn?

Example 1

	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004
Fire service deaths	4	8	5	5	15	6	7	6	6	13

Let's now interpret the data in the table above.

1. What is the **mean or average** number of fire service deaths for the fire departments for the last ten years?

   Answer:
   Total number of fire service deaths   = 75
   Total number of years   = 10
   Mean or average (total deaths ÷ total number of years)   = 7.5 round up to 8

   This means that there has been an average of **eight fire service deaths** for the past 10 years.

2. What is the **mode (the most frequent value)** for fire service deaths?

   Answer: The mode for fire service deaths is 6.

3. What is the median for fire service deaths for the past 10 years?

   Answer: If you re-arrange the table in an ascending order, you will see that the median falls in the middle point between the two middle values: 6 and 6.
   i.e. [6+6] ÷ 2 = 6

Example 2

			Median							
Fire service deaths	4	5	5	6	6	6	7	8	13	15

4. Now referring to the table above again, is there any variability in the data?

In datasets with a small spread, all values are very close to the mean, resulting in a small variance and standard deviation. Where a dataset is more dispersed, values are spread further away from the mean, leading to a larger variance and standard deviation.

The smaller the variance and standard deviation, the more the mean value is indicative of the whole dataset. Therefore, if all values of a dataset are the same, the standard deviation and variance are zero.

To calculate the standard deviation:[3]

Step 1: Calculate the mean of the dataset:
4+5+5+6+6+6+7+8+13+15] ÷ 10 = 8

Step 2: Calculate the deviation of the individual values from the mean by subtracting the mean from each value in the dataset [value – mean]:
-4, -3, -3, -2, -2, -2, -1, 0, 5, 7

Step 3: Square each individual deviation value:
16, 9, 9, 4, 4, 4, 1, 0, 25, 49

Step 4: Calculate the mean of the squared deviation values. This will give you your variance.
16+9+9+4+4+4+1+0+25+49] ÷ 10 = 12

Step 5: Calculate the square root of the variance.

Standard deviation = 3.5

Inferential Statistics

Inferential statistics are used to infer or deduce conclusions about a population from a sample of that population. It is the result of techniques that use the data collected from a sample to make generalisations about the whole population from which the sample was taken.

Random Selection and Equal Chance

In statistics, inferences are made on a random sample of the population, meaning a random selection of the population chosen using a chance mechanism. A lottery draw is a good example of simple random sampling, where the numbers are randomly generated from a defined range of numbers (for example, one through to 45) with each number having an equal chance of being selected.

Analysing, Interpreting and Evaluating the Information

Once you have analysed and computed some statistics from the data and feel you have a grasp of what the data is saying, you can start looking at drawing conclusions about the data. Your analysis can provide you with the basis for describing what happened but there may be many possible reasons for why this has occurred.

Try to think about the interrelationships between social, economic and environmental factors that could influence the data.

Some things to consider when drawing conclusions may be:
- Do the results support your theory/suspicions? Are they different?
- What are the main results or conclusions that can be drawn?
- What other interpretations could there be?
- Can the results or conclusions be supported statistically?
- Do the conclusions make sense?

Communicating your Statistical Findings[4]

Now that you have your statistical findings, you will need to communicate them accurately. Effective communication of your statistical findings is vital for sound effective decision-making.

The strength of statistics is that it provides an opportunity to present your analysis in a way that tells a story about the data. Statistical writing can bring data to life, making it real, relevant and meaningful to the audience. The numbers are hard evidence that can change the mind of a skeptic. It could get you that equipment upgrade your department has long needed, or it could get you additional personnel.

When communicating statistical information, it is important to ensure the information presented is clear, concise and accurate. It is also important to provide contextual information and to draw out the main relationships, causal linkages and trends in the data.

Here are some basic guidelines to follow when writing your report:
- Describe the context within which the topic sits.
- Present the complete picture to avoid misrepresentation of the data.
- Accurately convey the main findings clearly and concisely.
- Include definitions to support correct interpretations of the data.
- Where necessary, include information on how the data was collected, compiled, processed, edited and validated.
- Include information on data quality and data limitations.
- Use plain, simple language where possible; minimise the use of jargon.
- Ensure your information and data are accurate.
- Use tables and graphs to present and support your written commentary.

Using Tables, Graphs and Maps

Presenting statistical information in tables, graphs or maps can be highly effective, but it is important to ensure the information is presented in a manner that is accurate and not misleading to the reader.

The key to presenting effective tables, graphs or maps is to ensure they are easy to understand and clearly linked to the issue you are trying to address. Ensure that all the necessary information required to understand what the data is showing is provided, as the table, graph or map should be able to stand alone.
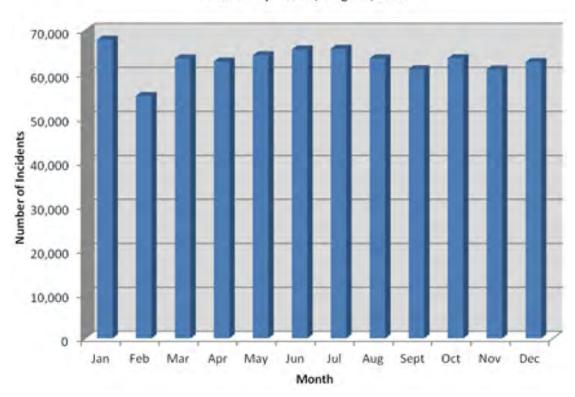
Tables, graphs and maps should:
- relate directly to the argument;
- support statements made in the text;
- summarise relevant sections of the data analysis; and
- be clearly labelled.

It is up to you to choose the most suitable visual representation of your findings. Sometimes a simple bar chart (or a table, pie chart, etc.) can effectively communicate the weight of your findings.
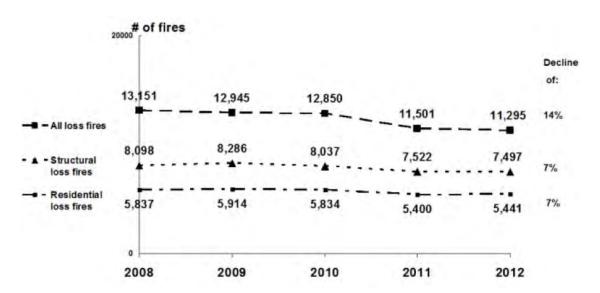
Following are some samples of how you can present your information visually.
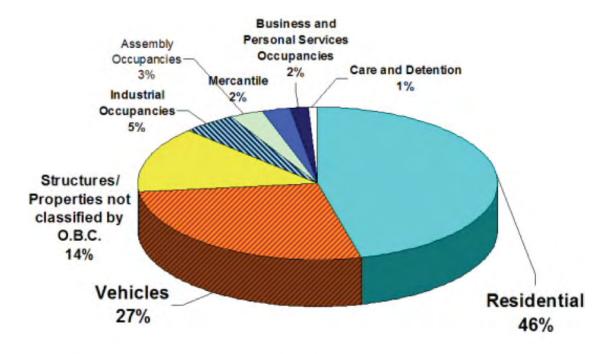
Bar Chart

Incidents By Month, Virginia, 2013

Time Series[5]

Pie Chart

Number of loss fires 2008 to 2012: 61,742

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Case Studies 4-6

Read **Case Study 4** at http://www.nfpa. org/~/media/Files/Research/NFPA%20 reports/Major%20Causes/oschildplay. pdf (Page 8 in that document.)

Read **Case Study 5** at http://www.nfpa. org/~/media/Files/Research/Fact%20 sheets/FireOverview.pdf

Read **Case Study 6** at http://www.ofc. alberta.ca/documents/fco/making-sense-article-ofc.pdf

The case studies present examples of how one would present research findings. Note, however, that some of these are merely extracts of the full reports. Most reports have an executive summary which contains the main gist of the report.

Exercise

Below is a table listing the total fire losses in apartments in Calgary and Edmonton for the years 2000 to 2012. In itself, the listing of numbers is not that interesting. However, we can ask several questions of the data that make it more relevant.

For example, what is the typical or average number of fires per year? How much variability is there in the amount of losses from year to year? Is there an overall pattern to the data or do the annual events just seem to be random?

Data alone do not provide enough information to answer our questions, but with statistical analysis, we can use the data to find the answers.

The exercise is a review of the chapter.

Fire Losses in Apartments in Calgary and Edmonton, Alberta: 2000-2012[6]

SOURCE: Office of the Fire Commissioner

Year	Fires	Fire Deaths	Fire Injuries	$ Losses
2000	294	5	51	8,232,233
2001	308	6	55	10,097,340
2002	339	5	47	58,690,172
2003	285	1	51	9,023,059
2004	260	3	51	17,198,939
2005	234	4	31	14,278,621
2006	269	4	38	12,742,813
2007	241	1	15	14,587,166
2008	294	2	28	11,730,611
2009	251	2	30	22,872,020
2010	313	0	26	61,749,614
2011	225	1	27	18,032,082
2012	18	0	2	33,566,760
Total	**3,331**	**34**	**452**	**292,801,430**

Given the data in the table, determine the following:

1. Based on the table, what are your general observations? Are there any unusual observations?

_____

_____

_____

2. What is the **mean or arithmetic average** for fire deaths and fire injuries?

_____

3. What is the **mode** for fire deaths? What is the **mode** for fire injuries?

_____

4. What is the **median** for both fire deaths and fire injuries? *(Remember, you will have to re-create the table and re-arrange the data in ascending order to determine the middle point.)*

Fire Deaths	Fire Injuries

5. Now let's see if there is any variability in the data. To do this you will need to calculate the **standard deviation** for both fire deaths and fire injuries.

Fire Deaths	Fire Injuries

[1] Australian Bureau of Statistics
http://www.abs.gov.au/websitedbs/a3121120.nsf/home/statistical+language+-+quantitative+and+qualitative+data
[2] Australian Bureau of Statistics
http://www.abs.gov.au/websitedbs/a3121120.nsf/home/statistical+language+-+quantitative+and+qualitative+data
[3] Australian Bureau of Statistics
http://www.abs.gov.au/websitedbs/a3121120.nsf/home/statistical+language+-+quantitative+and+qualitative+data
[4] A guide for using statistics for evidence based policy, 2010.
http://www.abs.gov.au/ausstats/abs@.nsf/lookup/1500.0chapter92010
[5] Fire Loss in Ontario 2008–2012 Causes, Trends and Issues.
http://www.mcscs.jus.gov.on.ca/english/FireMarshal/MediaRelationsandResources/FireStatistics/OntarioFires/
FireLossesCausesTrendsIssues/stats_causes.html
[6] http://www.ofc.alberta.ca/documents/fco/FIRE_LOSSES_IN_APARTMENTS_IN_CALGARY-EDMONTON-revised_1.pdf

Experimental Design

Introduction

A well-designed and constructed research project or experiment should be able to withstand questioning and criticism. The nature of the design of the research project determines whether and how well you can answer your research question.

Therefore, the experimental or research design you use choose should clearly and effectively address the research problem in a coherent and logical way. Remember that the function of a research design is to ensure that the evidence obtained enables you to effectively address the research problem as clearly as possible.

Your research topic/problem will determine the type of design. Most of the research projects you will conduct in your role as fire chief/marshal will be evidence-based, with repeatable observations that can be seen, shared and evaluated by others.

Why is Research Design Important?

The type of research design used to evaluate a program is important because it determines how well we are measuring its effectiveness.

The more rigorous the research design:
- the better we can interpret outcomes;
- the better we are able to determine effectiveness of a program and be sure there is not some other explanation for measured outcomes; and
- the more confident we can be in our findings.

Quick Review

What is good evidence?
- Evidence that has been rigorously tested, or evaluated.
- Evidence that helps produce the desired outcome.
- Evidence that exists to help determine that something other than this program/project is responsible for producing the desired outcomes.

Evidence is rarely absolute and it has varying degrees of reliability or credibility associated with it.

Research Designs

Here are some research designs you could consider for your project.

The One-shot Test – Comparisons with Targets

This is the simplest of designs, where the effects of an action, policy or program are measured against a set of standards or targets. The limitation with this design is that it does not account for alternate explanations for a result or for why the desired results were not met.

The Before-and-after Design

This design allows one to measure change more objectively. It basically measures the results before and after the experiment or research. It shares similar limitations to the one-shot test in that you can never be sure if an intervention or some external influence had an impact on the results or if it was merely coincidental.

> What makes sense logically does not always work out in the observable world. What you need is hard evidence based on repeatable observations.

The Classical Experimental Design

This is the gold standard among evaluators and researchers. It is a combination of the before-and-after design with a control group added to the equation. It involves setting up two groups. One group (the control group) will remain constant, with no exposure to treatment or intervention. The other group (the experimental group) will be exposed to treatment. If the experimental group exhibits significant change and the control group does not, then you have strong evidence that the intervention or treatment does indeed have an effect on the outcome.

The key to the strength of classical design experiments is to ensure the comparison (control) group is equivalent to the experimental group. For practical purposes, this can include statistically equivalent groups. They need not always be physically or characteristically similar. When selecting a sample group, be careful to avoid **sample selection bias.**

Remember that the intent of your research is to help you make the right decision. Choosing the right framework is an important element in helping you determine how credible your evidence and findings are.

This means selecting a sample group that you know will most likely help you prove your theory. Your research has to be objective.

The best way to avoid sample selection bias is to conduct a random assignment to the conditions where possible.

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Case Studies 7 and 8

Case Study 7

Download "Sprinkler Systems and Residential Structure Fires " from http://www.surrey.ca/files/sprinklersystemsand residentialstructurefires.pdf.

This is a good example of a full research report. It lays out the information in a very structured manner. The executive summary is often the most read portion of a report. If you want to find out the key issues or findings of a research report, this is where you will find it.

As you read, consider the following:
- Take note of how the executive summary is structured and laid out.
- Can you identify the type of research design?
- Take notice of the different ways the data is presented; each table demonstrates a different finding but still relates back to the main key issue.

- Read the discussion section carefully and take note of how it repeatedly ties back its explanations to an evidence-based finding. The use of graphs/charts are helpful tools to visually show the findings.
- Every report MUST have a conclusion. This is where you restate your hypothesis, whether it is proven correct or not, and why you think so.

Case Study 8

Download "A Review of the Research Literature on 24-Hour Shifts for Firefighters" from https://www.ufv.ca/media/assets/ccjr/publications/24+Hour+Shifts.pdf.

This case study is different in the sense that it is based entirely on literature review and not on data 'crunching'. This is another way of conducting your evidence-based research.

Exercise

1. Now that you have read the case study, what are your impressions?

_____

_____

_____

2. Was it easy to follow?

_____

_____

3. Would you present your research in a similar manner? Why?

_____

_____

_____

4. Is there an alternative approach to presenting this sort of research? How would you go about doing it?

_____

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Costing Analysis

Introduction

In today's environment of rising costs and funding cuts, fire departments are forced to constantly watch their bottom line while making sure that the efficiencies and cost savings they are trying to achieve do not compromise the levels of service they are required to provide to the public. It is a difficult balance to maintain.

You are responsible for the lives and safety of the general public by responding to emergency situations and protecting people, as well as protecting the environment and civil property. You are also required to work closely with the local community to increase their level of fire safety awareness to help prevent fires and accidents from occurring in the first place.

And rounding all this up, you are also the operational manager of your unit/department and are responsible for, among other things: budget administration and control; allocation of personnel and resources to achieve performance targets; dealing with external agencies; planning and resource management; and, dealing with political aspects of the authority.

In essence, you wear many hats!

As the operational manager of your unit/department you will have to oversee numerous financial aspects of your unit, such as equipment purchases and upgrades, and staffing costs. In order to be able to make the most cost-effective decision, you would do well to conduct a costing analyses to identify whether the investments you will make in purchasing, upgrading to new equipment or hiring additional personnel will bring you the desired returns or benefits.

Costing studies will:

- Link the outcomes you wish to measure with the goals and objectives of your operational and strategic plans. It will help you focus on the question about whether the activity is within the organization's mandate.
- Help you focus on the many line items that make up actual costs.
- Provide a transparent and fairly mechanical way of helping you decide on options.

Quick Review

The purpose of costing is not simply to collect cost data, but to provide unit/department managers with information they can use to make better management decisions.

There are two forms of costing:
- **Straight costing analysis:** determines the costs associated with doing something, such as the decision to purchase a document management software program, or the decision to purchase or update new equipment, computers or purchasing a new fire truck.
- **Cost-benefit analysis or cost-effectiveness analysis:** this is the weighing of all the costs associated with a decision against the value of the expected benefits.

Opportunity cost is a benefit, profit or advantage that you will have to give up so that you can acquire or achieve something else. For example, in choosing to become a firefighter, you are giving up predictability in your daily life, and some loss of leisure time and possibly time with your family.

Costing studies will allow you to identify the total cost of a decision and what the returns or benefits associated with that decision might be.

Choosing the Type of Costing Analysis

There are five overall steps to consider when conducting either a straight costing analysis, or a cost-effectiveness or cost-benefit analysis:
1. Identify the issue or subject to which the analysis relates.
2. Set out the objectives that you want the decision to achieve.
3. Identify the options or choices that are available.
4. Conduct a financial (cost-benefit or cost-effectiveness) analysis of the option selected or the options under consideration.
5. Prepare an accounting statement or report summarising your findings.

Cost Analysis

Straight costing involves estimating the total life cycle of a particular piece of equipment or service. The life cycle is the period during which you intend to use the product or service.

To conduct an accurate cost analysis, be sure to include all the relevant costs.

For capital-related costs, such as those for equipment, vehicles, buildings and fixtures, the costs could include:
- Depreciation rate–difference between the purchase price and selling price
- Interest on capital
- Maintenance fees
- Licensing or regulatory fees
- Operator or labour costs

Example: Simple Depreciation Calculation

Assuming a new fire truck costs $80,000 and that it depreciates at a rate of 35% per year, you would like to know what it is worth at the end of the two years after purchasing it.

Calculate the depreciation:

Year 1:	$80,000 x 0.35	=	$28,000
Year 2:	$52,000 x 0.35	=	$18,200
Total depreciation after two years		=	$46,200

Residual value of the truck after two years =   **$33,800**

A key element in analysing cost-effectiveness is being able to identify appropriate output measures and being able to measure them appropriately.

Fixed and Variable Costs

Fixed costs are also called "sunk costs" because they must always be paid. These include such items as loan payments, rent, insurance, and leasing fees.

Variable costs generally relate to operating and maintenance costs where the amounts or occurrence are not a constant. For example, these would include maintenance costs for fire trucks, building maintenance and upkeep.

Direct and Indirect Costs

Direct costs are those absorbed by your department directly, such as new employee uniforms and safety gear, staff salary, and loan payments.

Indirect costs are those not directly incurred by your department but are necessary in order to run the department. These could include advertising costs for hiring, screening and testing of applicants or insurance, and equipment maintenance.

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Exercise 1[1]

Your department has been experiencing dramatic increases in its overtime budget and is confronted with continual pressure from the city leadership to reduce this cost. To face this problem you, as unit head, are tasked with conducting an analysis to determine whether it is more cost effective to hire additional personnel or to continue to use your current crew to work overtime to fill this shortages.

The two tables on the next page summarize the annual and hourly salary for the various positions. The hourly salary is determined by the annual regular salary divided by 2,912 hours scheduled per year inclusive of any benefits. The overtime rate is the normal hourly rate multiplied by 1.5 times. Personnel working overtime are not paid benefit costs.

The second table outlines the salary breakdown costs if you were to hire more staff. The annual salary listed includes benefits but excludes overtime cost.

The task:
For the two tables, calculate the hourly and overtime rate for the current staff levels and for hiring new staff.

Current Staff Annual Salary with Overtime Payment

	Salary	Hourly Rate (Salary / 2,912 Hours)	Overtime Rate (Salary / 2,912 Hours) x 1.5
Firefighter	$81,799		
Firefighter/ paramedic	$87,671		
Fire Engineer	$95,567		
Fire Captain	$107,383		

New Personnel Hire: Annual Salary

	Salary	Hourly Rate (Salary / 2,912 Hours)
Firefighter	$53,697	
Firefighter/ paramedic	$57,908	
Fire Engineer	$60,894	
Fire Captain	$70,490	

Based on your calculations above, what are your findings? Is it more cost effective to hire new personnel or to pay overtime? How big is the difference in cost savings/ increase?

If hiring additional staff is more cost effective based on this calculation, are there any other additional costs that you would have to factor in when deciding to hire new personnel?

If you opt for overtime payments, what other cost factors could affect your departmental budget? Note: consider both the direct and indirect costs.

Cost-benefit Analysis (CBA)

Literally, cost-benefit analysis means weighing the costs against the benefits or profits of a proposed project. It helps you evaluate several alternatives, and the one with the highest benefit ratio would be the prudent choice. For instance, the decision whether to hire more full-time staff over paying for overtime will identify both the potential benefits as well as who will incur the costs for either proposal.

You can use CBA to:
- decide whether a proposed project or programme should be undertaken;
- decide whether an existing project or programme should be continued; or
- choose between alternative projects or programmes.

As fire unit head, it would be expected that you conduct such an analysis to show that the recommended option you propose maximises the economic, environmental and social benefits to the department, community, and government.

Components of a CBA

1. Define the problem: link it back to your operational or strategic plan.
2. Identify any constraints or limiting factors: list out any challenges, which could include financial limitations, managerial or personnel challenges, environmental and other regulations.
3. List the alternatives: for example, whether to hire more full-time staff, amalgamating two fire stations/units, or integrating services.
4. List the benefits: for the benefits identified, what is the return on investment? This could either be in monetary terms or in other items such as an increase in productivity. Health and safety are often the 'soft' benefits in these situations.
5. How are the costs and benefits to be quantified?

All benefits and costs should be expressed in discounted present values.

Example: Cost-benefit Analysis

Assuming the net present value of the benefits of a program is $13.5 million and the net present value (NPV – see next page) of the costs is $10 million, the benefit cost ratio (BCR) would be:

$$\textbf{BCR} = \frac{\text{(NPV Benefits)}}{\text{(NPV Costs)}} = \frac{13.5}{10.0} = \textbf{1.35}$$

Net Present Value (NPV)

Net present value is the current worth of a future sum of money or stream of cash flow given a specified rate of return. It is used to calculate the total of all cash flow (in and out) that can be directly linked to your project.

If it is positive, good. Otherwise, you may want to reconsider the investment.

On a personal level, assume you have invested $5,000 in a locked–in savings certificate with a five-year redemption at a 3% interest rate. How much will you get in return at the end of the five years?

	Interest Rate 3%	Total Growth in % (1 + Interest Rate)
Year 1	1 x 3/100 =0.03%	1 + 0.03 = 1.03%
Year 2	1 x 3/100 =0.03%	1 + 0.03 = 1.03%
Year 3	1 x 3/100 =0.03%	1 + 0.03 = 1.03%
Year 4	1 x 3/100 =0.03%	1 + 0.03 = 1.03%
Year 5	1 x 3/100 =0.03%	1 + 0.03 = 1.03%
Total interest for 5 years $(1 + \text{interest rate})^{\#year}$		**1.03^5**
Investment in 5 years	1,000 x 1.03^5	
Total	**$5,769**	

Now consider the opposite – how much would you need to invest to get a return of $5,000 after five years at a discount (interest) rate of 3%?

In other words, what is the **net present value of your investment**?

Calculation:
Actual value / $(1 + \text{discount rate})^{\#year}$
$5,000 \times (1/1.03)^5 = \$4,313$

Exercise 2

One of the challenges facing all organizations is how to finance capital equipment. Equipment can be bought outright, but that requires the organization to have the money set aside in its budget. Another option is to lease or rent equipment. The advantage of leasing is that the cost is distributed over the term of the lease. Over the lifespan of the equipment, there may be a substantial difference between the cost of purchasing outright as opposed to the cost of leasing. That is a common question raised by senior managers and city councils. This exercise shows how we can conduct that type of analysis to determine which approach (if either) is the better deal.

The task:
Assume that you are to consider whether it is more cost efficient to purchase a new fire truck outright or to lease it.

- Option #1: Lease fire truck for $35,000/year for five years, with a 3.4% discount rate.
- Option #2: Buy the fire truck for $170,000, with a selling price of $15,000 at the end of five years with a discount rate of 3.4%.

Which is the best value? Complete the calculations below.

Option #1

Year	Payments	Discount Rate	Present Value
0	($35,000)	1.0	($35,000)
1	($35,000)	0.967	($33,845)
2	($35,000)		
3	($35,000)		
4	($35,000)		
5	($35,000)		
	NPV =		

Option #2

Year	Payments	Discount Rate	Present Value
0	($170,000)	1.0	($170,000)
5	$15,000		
		NPV =	

Which is the better option based on the NPV?

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Case Study 9

Go to https://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/90-238.pdf to read **Case Study 9**.

This case study is an example of a cost-benefit analysis conducted by the Canadian Housing Information Centre to determine the costs and benefits of installing sprinklers in new houses.

It provides you with an example of how to present and summarise your findings in a report format.

After reading the case study, complete the exercise on the following pages.

Exercise[2]

The following table is an excerpt from a cost-benefit analysis pilot study on the effectiveness of residential sprinkler systems conducted by the Building Research Establishment in the United Kingdom.

Property Type	House– Single Occupancy	House– Multiple Occupancy	Apartment Building– Purpose-built	Apartment– Converted
	Average Cost			
Capital cost of system (per unit)	$1,650*	$550	$900	$1,100
Water connection charge (per unit)	$465	$140	$78	$112
Capital recovery factor	0.043	0.043	0.043	0.043
Annual cost of loan	$90.17	$29.42	$41.70	$51.67
Annual inspection cost	$50	$50	$50	$50
Total Annual Cost	**$140.17**	**$79.42**	**$91.70**	**$101.67**
Deaths per million units	15	13	27	23
Sprinkler effectiveness factor	0.70	0.7	0.70	0.70
Deaths saved per million units	10.5	9.1	18.96	16.1
Monetary value per death saved	$1,243.000	$1,243,000	$1,243,000	$1,243,000
Monetary benefit per single unit	$13.05	$11.31	$23.49	$20.01
Injuries per million units	367	281	941	664
Sprinkler effectiveness factor	0.30	0.30	0.30	0.30
Injuries saved per million units	110.1	84.3	282.3	199.2
Monetary value per injury saved	$58,300	$58,300	$58,300	$58,300
Monetary benefit per single unit	$6.42	$4.91	$16.46	$11.61
Fires per million units	1616	1147	4841	2561
Sprinkler effectiveness factor	0.50	0.50	0.50	0.50
Unsprinklered property damage	$7,540	$7,540	$7,540	$7,540
Reduced property damage per fire	$3,770	$3,770	$3,770	$3,770
Monetary benefit per single unit	$6.09	$4.32	$18.25	$9.65
Total Monetary Benefit per Unit	**$25.56**	**$20.55**	**$58.20**	**$41.28**
Cost Benefit Ratio **Total Cost/Total Benefit**				

* Currency units have been changed

1. From the data provided in the table, calculate the cost benefit ratio for each of the dwelling types and insert it in the table.

2. What can you surmise from your calculations? Remember that ideally the cost-benefit ratio should be greater than 1. Anything less indicates the costs outweigh the benefits.

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3. Is there anything that stands out in the table that you initially assumed would have affected the outcome of your calculations? Based on your calculations, did this factor influence the end result?

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4. Are you surprised by your findings? Did your findings dispel your initial assumptions?

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[1] Earley, S., An Analysis of the Utilization of Overtime Versus Hiring Additional Personnel. Fire Service Financial Management. City of Riverside Fire Department, Riverside California. November 2001. [Excerpt] pgs 22-23

[2] Fraser-Mitchell, Jeremy Effectiveness of Sprinklers in Residential Premises: Section 6 : cost benefit analysis. Project Report number 204505. February, 2004 [Excerpt]

Summary & Conclusion

In essence there are four main steps that you should follow when formulating a good evidence-based strategy. Can you recall them?

Identify and Frame the Question

- Should be drawn from your strategic plan or organizational plan.
- Helps to focus the issue on the key purpose or objective of your unit/department.

Gather the Evidence

- Both internal data from your organization and external data.
- Use a librarian.
- Get comfortable with sourcing.

Organize the Evidence

- Present your data in a table, chart or a method that best suits the message you are trying to convey.
- Cite your data sources.
- Tie your data back to your question/theory. Put it in context.

Review the Decision-making Process

- What did you learn?
- Could the process have been streamlined?

The Right Decision: A Workbook

This companion to *The Right Decision: Evidence-based Decision Making for Fire Service Professionals* guides readers through the process required for sound decision making.

Using case studies, examples and exercises, this workbook will help you take the next step in ensuring your decisions are effective and justifiable because they are based on data and evidence.