A shift in focus

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Abstract

Based on Swedish conditions, aspects regarding fire cover were discussed. An alternative approach for providing fire cover, in the best interest of the public, was proposed. The proposition included a shift in focus, from "fire cover" to "safety cover", including a wide perspective on accidents and incidents. Applications of this approach included a shift in composition of fire and rescue teams; differentiated composition of fire and rescue teams, including a variety of competencies; allocation of such differentiated fire and rescue teams; new, different and differentiated vehicles; alternative actions, methods and procedures for dealing with accidents; and developed command and control functions. The objective of the paper was mainly to encourage a more flexible thinking when looking at fire cover.

1. Introduction

It is well known within the fire fighting community that experience is the foundation for activities performed by the fire and rescue service. Traditions have a large influence on organization and performance. Resistance against any changes is hard, and the introduction of new technology as well as new theories are laborious and time-consuming processes. However, accidents that occur in new as well as in existent infrastructures must be met with knowledge and efficiency, and as society changes the need for changes within the fire and rescue service becomes imminent.

The organizing of the fire and rescue service and the providing of fire cover as well as the more general development are in many cases driven by professionals. These professionals are experts on fires, fire fighting, rescue work, command and management of on-scene resources. However, due to their professional qualifications, it is reasonable to assume that they don't consider accidents and emergencies from the viewpoint of the public. It is well known that experts comprehend and assess situations differently than do novices [1]. When experts look upon problems related to the fire and rescue service, it is reasonable to assume that such problems are viewed upon depending on the experts field of interest, may it be a statistical, an economical or a logistic point of view. Then, accidents and emergencies may be reduced to a statistical, an economical or a logistic problem. Questions regarding history of a region, comprehension of safety by the public and profitability to individuals, things that really matter to people, are omitted. Consequently, there is a substantial risk that the organizing of the fire and rescue service and the planning of fire cover are not done in the best interest of the public, and that the fire and rescue service becomes an end itself.

This paper is based on Swedish conditions and it discusses a number of aspects regarding fire cover. In addition, it discusses and suggests alternative approaches for providing fire cover, in the best interest of the public. It should be noted that the problem that is being addressed is complex, and the purpose of the illustrations in this paper is to encourage a more flexible thinking when looking at fire cover.

2. Developing the fire service

In recent years, there has been a growing interest for fire fighting and other related problems in the scientific community. A large number of research areas related to fire fighting can be identified. Such areas include human behavior in fire [2], physiological aspects of fire fighting [3], [4], [5], and fire-fighters protective clothing [6], [7], [8], [9]. But they also include manual fire suppression using water [10], [11], [12], [13], or foam [14], [15], [16], and other fire fighting procedures, such as positive pressure ventilation [17], [18], [19].

In addition, performance based building codes is an area of applied science and in which humans and also fire fighters, have been identified as an integral part of fire safety [20], [21]. It is reasonable to assume that the growing interest in performance-based codes is a cause of the growing interest for manual fire fighting and related problems. On this matter, areas of statistics, cost-benefit and risk analysis are of great importance [22], [23], [24], [25], [26]. There are also substantial research on fire detection systems and sprinkler systems. Here, it should be noted that one of the purposes with such systems is to bring the fire service to the scene of the fire and to facilitate fire and rescue operations. Also, research is undergoing as to find methodology on e.g. staffing of fire companies and fire cover [27], which is within the scope of this paper.

Clearly, scientifically based methods have become available for the advancement of the knowledge of activities performed by the fire and rescue service, and it is reasonable to assume that the development of NFPA 1710 [28] is one result of such work. Similar applications and developments are becoming more and more common. Recently, a proposition of a reformed Swedish fire and rescue service act was presented [29]. In general, the main reformations can be summarized by

- Requirements for establishing goals for the services provided.
- Increased emphasize on fire prevention.
- Elucidation on the responsibilities to privates (home owners etc.).
- Reduced governmental control and increased scope for local solutions.

In addition, the proposition brings a holistic view on risks, risk management, preparedness, operations and analysis of operations. It puts the Swedish fire and rescue service in a position where it is possible to find a way out from a more traditional approach for the providing of fire cover, in favor of adopting more unconventional solutions to fire and rescue problems.

3. Perspective on fire cover

Fire cover includes providing the public with reasonable levels of protection against fire or other accidents. The question arises what "reasonable" is and how to measure such a reasonable level of protection. Various attempts to solve this problem have been made over the years, in Sweden as well as in other countries.

In the 1960's and the 1970's, the Swedish National Inspectorate of Fire Services developed a proposition for a model for providing fire cover [30], [31], [32]. The model was based on the actual conditions in a number of municipalities, and it considered frequency and severity of residential fires as well as the extent of industrialization and other hazardous activities. In addition, it included guidelines for qualifications of fire fighting personnel, including commanding officers. Representative task forces in relation to five representative building classes were assumed. The proposition included a numerical model for determining preparedness, as the ratio between number of personnel and its time to action. Figure 1 shows a comparison between the model and the actual conditions (data from 1996) [33]. Although not adopted, the proposition has had an impact on the manning of the Swedish fire and rescue service.

A project that has been ongoing for a few years in Jönköping in Sweden, aims at developing methodology for providing fire cover based on management by objectives [34]. In the suggested methodology, an overriding objective, such as "*residents shall have a safe environment and the risk of fire as well as other accidents shall decrease continuously*", is broken down to objectives for e.g. individual procedures performed by the fire and rescue service. The objectives for such procedures are linked to the performance of so called tactical units and this performance is based on numerical strength (number of personnel), time to action, correct resources (technology) and appropriate competence for each identified risk.

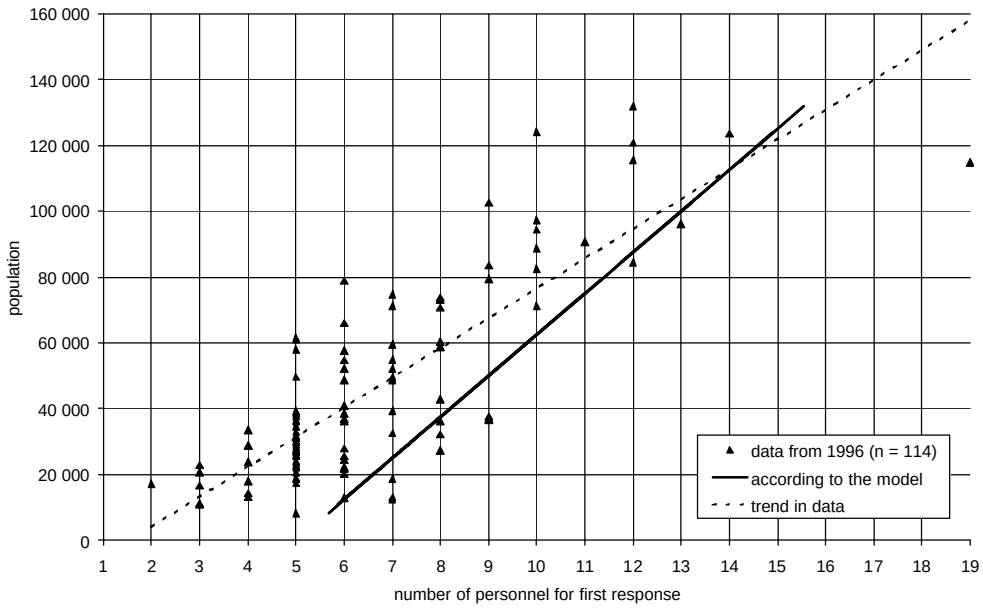

Figure 1. A comparison between a prior suggested model for fire cover and actual conditions, based on Swedish data from 1996 [33].

According to these models, there are basically only two parameters that influence the performance of the fire and rescue service as well as fire cover; number of personnel and time to action. This view on the fire and rescue services is static and it doesn't consider the actual conditions on the fire ground or the inherent dynamics in an operation, i.e. it only looks at the problem of "reasonable" from a historical point of view. Unfortunately, this assumption on the importance of number of personnel and time to action characterize the Swedish fire and rescue service completely. Based on number of personnel and time to action, we try to solve the problem of fire cover, by use of statistical, economical or logistical methods, or combinations of such methods.

Statistical analysis of the fire and rescue service includes collecting and comparing data such as frequencies of various accidents, demographical patterns, building types, and infrastructures. However, statistics only shows history. It doesn't reflect planned or recently initiated activities, such as increased efforts/funding for fire preventive actions. Statistics taken from areas where similar preventive actions already have been introduced may of course be used, but in cases where such actions are novel, this is not possible. In addition, statistical data may tell us what a situation looks like upon the arrival of the fire service and what it looks like when the operation is completed. But it doesn't give us the full picture of the events on a fire scene.

The ambition of engineers is to design advanced systems that maximize safety. However, someone has to pay the price for the safety and, in the case with the fire and rescue service, safety is paid for by taxes. In recent years, focus has come upon economical aspects on safety, the keeping of preparedness and on actions taken during fire fighting and rescue operations. However, such work generally considers economic aspects of fire safety from national economical points of view only [35]. Aspects such as those of human safety and the flexibility of the safety system are not being dealt with explicitly when looking at the problem from an economical point of view [36]. In addition, statement of accounts shows great variations between municipalities, making it hard to determine what is a "reasonable" level of fire cover. As an example, the cost for providing fire cover varies from 330 SEK (approximately 33 USD) [37] to 637 SEK (approximately 63 USD) [38] per capita and year (data from 2000).

Logistics includes finding the timely most effective way for allocating resources. The objective of analyzing the fire and rescue service from a logistics point of view may be to find the most effective geographical or timely coverage of fire apparatus and fire stations. Methods for treating the problem are well known and available. A general problem on this subject, is known as the "traveling salesman problem": given a finite number of cities along with the cost of travel between each pair of them, find

the cheapest way of visiting all the cities and returning to your starting point. However, logistics focuses on number of personnel and time to action, although these parameters only contribute to a small part on the outcome of fire and rescue operations. As an illustration, assume that 20 less competent and unfit fire fighters arrive at a fire scene within 3 minutes. Is this situation better or worse than having 10 highly competent and fit fire fighters to arrive within 6 minutes?

Statistical, economical and logistical methods don't treat competence, skill or actual performance by the fire and rescue service efficiently. Such methods of looking at fire cover only strengthen the traditions within the system, traditions that we often consider as a burden. Determining fire cover should of course be based on in-depth analysis of the fire and rescue service. But such analysis must be based on actual problems on the fire ground, and caution should be made so that the inherent dynamics of fire fighting operations are correctly treated.

4. Performance of the fire and rescue services

An area that has not been in the focus of any research activities to any greater extent is the actual performance of the fire and rescue service. Despite a lack in the basic understanding of how our investments in resources for solving fire and rescue problems actually interact with such problems, we try to seek answer to questions such as [39],

- How many fire stations should be maintained?
- Where should stations be located?
- What types of apparatus should be purchased?
- How many staff should be retained to operate this apparatus?
- How should this staff be scheduled and deployed?

The theory on individual procedures used by the fire and rescue service, such as suppression or ventilation, is well known. However, in most cases combinations of procedures are used and theoretical conceptions for such combinations are lacking. Recently, research has been initiated in order to investigate such combinations of procedures [40]. This work shows that physical modeling of combinations of procedures is complex and in many cases time consuming and it lays down the importance of treating the inherent dynamics correct, in modeling as well as on the fire ground. The research is still in its initial stage, but the potential for further advancement of knowledge on the performance of the fire and rescue services is large.

However, investigating the performance of the fire and rescue service is only a small portion of the problem that needs to be addressed. A more extensive analysis must be made, including the actual need that people have during accidents and incidents.

5. People in distress

Naturally, people who are in distress call for help. If there is a fire, the fire and rescue services are called for. If there is a cardiac arrest, we call for an ambulance or a doctor. And if we are faced by a criminal we need law enforces to help us out.

In 1992, the Swedish Rescue Services Agency initiated a project in the municipality of Torsby, aiming at testing and investigating the response of the fire and rescue service to medical calls, including cardiac arrests, unconsciousness, respiratory distress and accidents such as collapses and car accidents [41]. It should be noted that the project was carried out in a thinly populated area, characterized by decreasing population density, increasing mean age, high unemployment, lack of public transportation and large distances to municipal services such as schools and medical care. The hypothesis was that by having the fire and rescue service to respond to medical calls and performing an initial medical treatment, this would lower death rate. In addition, due to a shorter time to action by the fire and rescue service than by a professional emergency service, it was assumed that people living in this thinly populated area would get a better feeling of security. The results showed a positive effect in almost 30% of turnouts by the fire and rescue service to medical calls, and that people generally got an increased feeling of safety.

The point is that people, who are in distress, irrespective if there is a fire, cardiac arrests or crimes of violence, are not interested in the color of the vehicle responding. They take no notice in if the helper is a fire fighter, an emergency medical technician or a police officer, as long as it is a person in authority,

preferably wearing a uniform of any kind. They are only interested in getting professional help to sort out the situation they are facing..

6. Fire cover or "safety cover"?

This section is deliberately written more freely and its scientific character may be called in question. However, it is based on the illustrations above. The intention is mainly to encourage a more flexible thinking when looking at providing fire cover and the performance of the fire and rescue service.

When looking at fire cover and related issues, we tend to focus on fires and on actions taken by the fire and rescue service when responding to fires. However, the fire and rescue service respond to other accidents than fires as well, accidents such as traffic accidents and drowning accidents. In addition, when an accident occurs, irrespective if it is a fire or a traffic accident, other organizations respond as well. Such organizations include medical service and law enforcers.

It is reasonable to assume that the medical service as well as law enforcers discuss and analyze how to provide reasonable levels of help to the general public, in a similar way as we do within the fire and rescue service. Then, it is also reasonable to assume that these organizations look at the problem from their respective point of view.

Instead, let us perform a coordinated analysis of the situation and make a shift in focus, from "fire cover" to "safety cover". Then, the basic question becomes,

> *What needs do the public have when various types of accidents or incidents occur and with what kind of help can society contribute in such situations?*

By looking at the problem from this point of view, the results may be e.g. that to meet the needs by the general public it is necessary to create a combination of competences. Then, a task force may consist of the competences equivalent to fire fighters, paramedics and police officers. All of them should have a similar basic competence, but each individual should have his or hers specialty. Such solutions might be especially suitable in thinly populated areas, where it often is hard to get help within a "reasonable" amount of time.

Such task forces would be put together based on weighted analyses of type and frequency of accidents and incidents. Close to major traffic routes such task forces may be put together based on expected accidents on such traffic routes. In areas with high rates of criminality these task forces should have a larger capability of law enforcement. Investments in preventive measures should be reflected in the composition of task forces and by a focus on "safety cover" it is assumed to be easier to have a closer connection between the composition of task forces and investments in preventive measures. The composition of task forces should easily recognize the reduction of frequencies and any changes in types of accidents and incidents in an area through preventive measures.

Also, the technical development should be reflected through "safety cover". As an example, police forces in many countries are introducing non-lethal weapons, i.e. weapons intended to incapacitate perpetrators or to destroy opponents weapon without causing grave injuries. Another well-known problem in Sweden are those large, heavy and consequently slow vehicles used by the fire and rescue services. By looking at the problem from a "safety cover"-point of view, in some areas it would be suitable to invest in smaller, lighter, faster and more versatile vehicles, useful for fast access to accident sites and in areas where availability is a problem.

With an increasing competence within the fire and rescue service, including academic skills of officers as well as fire fighters, improved training of officers and fire fighters, and increased research activities, it should be possible to make a shift in focus. Basically, the fire and rescue service should be considered as an integral part of society and not as an option that steps in when malfunctions in the form of accidents and incidents occurs. The point is to create a holistic view on safety to the public and to approach the problem of providing fire cover from a broader perspective.

7. Conclusions

This paper suggests a shift in focus, where "fire cover" should make a shift towards "safety cover". This safety should include a wide perspective on accidents and incidents, from fires and traffic accidents to medical conditions and crimes of violence.

Applications of this approach includes a shift in composition of fire and rescue teams; differentiated composition of fire and rescue teams, including a variety of competence; allocation of such

differentiated fire and rescue teams; new, different and differentiated vehicles; alternative actions, methods and procedures for dealing with accidents; and developed command and control functions.

The analysis of the societies means for providing relief in any situation should be based on the help needed and on the actual outcome and performance of the collaboration between functions, functions today represented by the performance of the fire and rescue service, medical service and law enforces. Most important is that the general public, who is in the need of help, is in the center of the suggested approach.

We have the technology for it; we just have to let go of the tradition.

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Personal profile

Stefan Svensson is currently working as a research and development engineer at the Swedish Rescue Services Agency (SRSA). He started his career as a fire fighter in the Swedish Air Force, received a bachelor degree in fire science in 1989 and a licentiate in engineering degree in fire science in 1998 (equivalent to a master degree with distinction or higher). Currently involved in finalizing a Ph.D.-work, his research is mainly focused towards command and control of fire fighting operations.. The work examines the operational core of fire fighting operations and it focuses on control through the initiation, coordination and execution of various procedures on the fire ground. During his employment at SRSA, he has performed a number of large- and small-scale fire tests, mainly on fire ventilation and on manually applied high and low pressure water sprays. The employment also includes training of fire fighters and fire officers. During short periods, he has also been working as a fire fighter as well as a commanding officer in the Swedish fire and rescue service.