



Formula for Success

This article was originally published when Kevin Baum was Assistant Fire Chief with the Austin Fire Department, and is being reproduced here in its original form.

Do FIRE AND LIFE-SAFETY INSPECTIONS make a difference? As fire-safety professionals, we assume that an ongoing inspection program produces a positive result in the fire and life-safety performance of structures in our cities, but can we prove it?

The Austin, Texas, Fire Department (AFD) has grappled with this question ever since we began conducting in-service inspections more than 20 years ago. On average, we conduct more than 28,000 fire and life-safety inspections annually, 12,000 of which fire crews perform in the field. This is a substantial commitment of time and resources to a function that we "think" makes a difference.

While we're bound by ordinance to conduct technical certificate-of-occupancy inspections of all new construction, our commitment to in-service inspections of existing structures has always been voluntary. As a result, our approach lacked methodology; and the program rapidly became a numbers game.

By the mid-1990s, we rarely identified any significant hazard through the maintenance-inspection effort. We realized then that the in-service inspection program was floundering and that we'd have to rethink the entire project if we were going to be able to measure its success.

We began by trying to define what makes an inspection effective. Even the most ambitious fire and life-safety inspection program can't prevent all fires, but it can control their magnitude. Say that an inspector notes during a maintenance inspection that a building's sprinklers have been painted over and that the sprinklers are subsequently repaired. A fire may still occur in the building, but it will be much smaller than it would have been had the inspector not noticed the damaged sprinklers.

Understanding Risk

As we dug into the problem, we noted that our approach to choosing the structures for which we'd conduct in-service inspections was inconsistent, emphasizing quantity rather than quality. This led us to reevaluate our



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occupancy types, focusing on them in a logical fashion so we could coherently justify our choices and measure our results statistically.

To evaluate occupancy types, we first had to define their risk levels. To do this, we had to develop a consistent model of risk we could apply to historical incident data and sort using NFIRS coding. This would provide a relative-risk indicator by property type and, we hoped, a clear picture of Austin's fire problem.

Fundamental to any concept of risk are the frequency with which events occur and their consequences. After a fair amount of debate, we decided that a building's fire risk could be represented by the number of fires it suffered over time, multiplied by the number of casualties these fires caused, plus the amount of dollar loss they generated. As a mathematic formula, this concept of relative risk looks like this:

$$R=F*C$$

Where "R" is the risk of fire; "F" is the frequency, or number, of fires; times "C," the consequence of the fires, or the number of casualties plus the dollar loss.

Each time we ran the model, we calculated the consequences by property use. For example, the total number of fires in one and two-family residences for the reporting period-usually a year-was multiplied by the number of fatalities in that property type as a percent of overall fire fatalities in all property types, plus the total dollar loss in that property type as a percent of total fire-related dollar loss in all properties.

This model produced some interesting results. We've known for years, based on national studies, that more people die in fires in their one and two-family homes than in any other type of occupancy. The Austin fire experience is consistent with national trends. Unfortunately, the AFD doesn't have the authority to inspect one and two-family homes. However, we do have the authority to inspect multifamily dwellings, which the model codes view as commercial enterprises, and multifamily dwellings are the number-two high-risk occupancy in Austin. Here was a clear a road map for our inspection efforts.

Based on these data, we redirected the entire focus of the in-service inspection program to multifamily occupancies. Today, the AFD inspects more than 10,000 apartment buildings each year, and we inspect every such occupancy within the city limits over the course of two years.

Measuring Inspection Effectiveness

Since fire and life-safety inspections are designed to manage a hostile fire once it ignites, not prevent ignition, anyone attempting to measure the effectiveness of an inspection, empirically or otherwise, must first recognize that a hostile fire in an inspected property isn't just acceptable, it's expected, even inescapable. The trick is to develop a model that determines whether inspection efforts affect the magnitude, not occurrence, of these events over time.

In 2000, we realized that, if our relative risk formula provided a risk value for each property type, we could follow that value over time for our target occupancies and see whether it dropped, thus suggesting a positive influence. After careful consideration, we developed the following formula:

$$R=F(C) F(D)/P$$

Where "R" is risk, "F(C)" is frequency of fires times the number of casualties, "F (D)" is the frequency of fires times dollar loss in millions divided by "P," is population in thousands.

Frequency in this model is the number of fires in a specific property class for a specific period. Consequence is the same as it is in the relative-risk formula, but we don't calculate percentage of consequence as a value of the overall fire experience in the city. We simply calculate the specific number of casualties and the specific amount of dollar loss, adjusted for inflation, in the population of occupancies in that category.

We further enhanced our previous model by normalizing the data with a population divisor. Austin has experienced incredible economic growth in the last 10 years, and the population has increased in lockstep with the booming economy. By normalizing the data with a population divisor, we effectively account for increases or decreases in at-risk occupancies and occupants.

There are three ways to infer inspection success from these data. Does the risk value decrease over time while the number of fires remains constant or increases? Does the risk value remain constant while the number of fires increases? Or do the risk value and the fire frequency decrease, while the population increases?

As you can see, these data don't penalize based on fire ignitions. Rather, the data propose to measure the magnitude, in terms of casualties and dollar loss, of hostile fires over time in at-risk occupancies, based on our assumption that hostile fires will occur and that effective inspection efforts will produce a decrease in the magnitude of damage they cause over time, as represented by the risk value.

Our information suggests a clear downward trend in the mean risk value for at-risk occupancies in Austin, although the frequency of fire has remained relatively constant and the population has literally exploded. While there are other variables at work here, we can claim that these data provide evidence that the AFD's focus on at-risk occupancies is having a mitigating effect on the magnitude, extent, and scale of hostile fires.



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After the fire

To supplement our statistical model, the AFD introduced a post-incident inspection program in the late 1990s. Today, all fires in at-risk occupancies are inspected literally before the fire is out. A Prevention Division inspector is dispatched to each multifamily residential fire to determine what inspection efforts took place before the event, determine whether identified hazards were corrected, and see if the previous inspection efforts had a measurable impact on the size and spread of the fire.

These findings are immediately communicated to those conducting the inspections, and First-On-Scene Awards are given to the crew and officer of the unit that conducted the successful inspection. Such immediate feedback motivates the troops for future inspections and reinforces the value of the prevention mission in the department and community.

This post-incident inspection program, coupled with the statistical model of risk, enables us to show convincingly that the AFD's inspection efforts have significantly reduced the magnitude and extent of hostile fires in Austin. This is indeed good news.

Lessons learned

It bears repeating that you can't measure the effectiveness of fire and life-safety inspections unless you have something to measure them with. To achieve this, you must first develop a coherent and logical methodology with which to choose the occupancies to be inspected, then foster the skills and expertise necessary to conduct a comprehensive and meaningful inspection. You also need adequate data collection and analysis skills, tools, and processes, as well as systematic statistical and anecdotal measurement formulas and tools. Finally, you need to give inspectors quick feedback on the results of their efforts.

Developing meaningful performance measures for the Austin Fire Department's inspection services has taken quite a while, and we're by no means finished. But it's brought us to a new level of sophistication in performance reporting and program management, which are vital to AFD managers in their ongoing effort to secure funding for important programs. If we can't empirically and convincingly demonstrate that we know what we're doing, why we're doing it, and what the results are, we'll certainly lose the fight for the few public dollars that remain for fire department programs that aren't being directed into post-9-11 initiatives. If other important programs are to survive, we need to be able to demonstrate compelling evidence that they exist for a reason. Sound performance measures will give us that proof.

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Kevin's practical, hands-on experience in performance management gives him the unique experience of having lived what he teaches. A 21-year veteran of government service and the former Assistant Fire Chief and Fire Marshal for the City of Austin Fire Department, Kevin is a recognized leader in performance management. Kevin is known for his efforts in pioneering the implementation of performance measures into programs and services that are difficult to quantify and evaluate statistically, and his efforts were instrumental in his organization winning the Malcolm Baldrige Award for Highest Achievement in Quality, (1999).