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## How Many People on a Fire Truck

One of the most contentious discussions regarding fire suppression operations is the number of full time personnel that should be assigned to a specific fire company. While much of this rhetoric seems to center back upon the creation of the 1710 standard, the reality is that the number of people actually on a fire apparatus is linked more the ability of a community to pay for the personnel than it is any other single factor. Not uncommonly when fire departments transition from being a volunteer department to a combination department their initial staffing on engine companies is lower simply because they lack tax revenue to support them.

However this is not the point. In dealing with urbanized fire protection services, there are very distinct consequences of staffing levels that need to be articulated, evaluated and utilized when making a decision regarding fire station placement and staffing that is based upon economics. The purpose of this article is to articulate that rationale.

One of the arguments that are raised with regarded to fire protection staffing is that fire departments do not have a constant rate of utilization. The concern expressed in this case is that a fire department has a lot of down time waiting for an emergency. In one sense this is true and in another it is totally untrue.

A fire department is not paid by the fire. It is paid for providing protection. Fire protection is like an insurance policy, not a pizza delivery system. Any fire department that is only responding to fires and not engaged in training, fire prevention, prefire planning and a host of other activities is not fulfilling its obligation to the community. If you limit the number of firefighters on a piece of fire apparatus to two because they do not have a lot of emergencies, begs the question of what happens when they do have an emergency.

The only place in which two-person fire trucks has even a fighting chance of being successful is when it is matched with a combination system that results in an instantaneous response and a large amount of reinforcement by reserves. A secondary scenario might be those firefighting organizations that respond as two piece companies together, i.e., a fire truck and ambulance. Even this particular staffing configuration has deficiencies, because of the reality that the ambulance and the engine company may often be separated from one another due to distribution of emergency call workload.

It has been stated in U.S. Fire Administration statistics that the average fire department staffing in this country is three. That is probably true in most suburban fire departments. It is not true for many small cities. Following the utilization of standard staffing formulas, having three people actually on duty requires the hiring of 9.9 individuals in order to provide 24/7/365 a year coverage. This means that



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the decision to put three people on per day is 9.9 times the annual average salary of one person. It is my belief that this is an economic consideration that forms the basis for why most fire departments are only operating with 3 personnel. Simply stated that is the level of service that most suburban fire departments with relatively low density of housing and relatively moderate commercial risk find economically viable.

The consequence of running three people is that it is impossible for that three person company to exercise all of the options that maybe called upon for a company officer to perform in the first five minutes of arrival at a scene. In essence the two in and two out rule that has been created by OSHA states that unless human life is definitely endangered then a three person company doesn't have any reason to be on the inside of a burning building. This particular phenomena places a great deal of pressure upon the first due company officer to make an instantaneous decision as to whether or not he/she is risking the lives of the firefighters by ordering them to enter a building in which there is an IDLH present.

Not uncommonly, three person companies are supported by other three person company's which means that in order for the two in two out rule to be invoked the second due company must be on the scene within a reasonable timeframe. In an analysis of what actually happens on a fire, during critical task analysis, in the event an IDLH does exist it, takes time for firefighters to don breathing apparatus, engage in pumping operations and deploy hose lines to make entry anyway. The argument could be made that two three person companies that they are functioning together within 8 minutes on the fireground are likely to be able to make entry.

However, that doesn't resolve other problems such as RIC or RIT. It requires the remainder of the first alarm assignment must be on scene within a reasonable period of time or firefighter safety is in danger.

Which then leads to the discussion of why four people are desirable; but that is not all. It raises the issue of how can a single station fire department operate within these criterion. The primary aspect of a four person company is that it is autonomous with regard to the first five minutes on the fire scene. While RIC and RIT will not be invoked having a four person fire company removes any doubt as to whether or not the company officer has the authority to direct operations into the interior.

Utilizing critical task analysis again by creating a four person engine company the apparatus operator has the ability to engage in pumping operations, the company officer has the opportunity to establish an incident command and two firefighters properly trained and properly equipped have the possibility of making entry into a structure fire without any concerns or violation of the law. However, that doesn't mean that making that entry is logical or for that matter even allowed.



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In essence, if an IDLH exists and the fire has not gone to flashover in the room of origin, two firefighters entering a building under these conditions are still potentially at risk. A review of line of duty deaths (LODD) clearly indicates that firefighters' making an entry prior to flashover does not eliminate the risk of it occurring within minutes or seconds. To the contrary if they do not take a hose line with the, merely begin a searching operation, especially above the fire there is a remote possibility that premature entry lacking the availability of a RIC team makes a 4 person company, that is unsupported as as vulnerable to injury or fatality as any other.

Once again utilizing the staffing formula for the number of people required to be hired on a full time equivalency in order to keep four persons on duty the department must hire 13.2 firefighters. Utilizing the same formula of looking at annual salary and benefits multiplied times 13.2 creates economic portraits that must be satisfied in order to sustain a 4 person operation.

While a lot of discussion has been conducted over the idea of whether it is a good idea to put 3 or 4 people on a company the bottom line is that you can't do it unless you can afford it. Some communities won't do even if they can afford it. One of the most important considerations of for the funding of the staffing level is not the number of minutes to the deployment of the company to arrival on scene, but rather the density of the population that is within a reasonable travel distance from that single fire station to pay for the service. In other words, a lot of people living in a relatively small area can afford a higher level of protection than a small number of people living in a widely dispersed area.

Unfortunately most fire departments are focused entirely on response time and are not giving any consideration to the per capita cost of what it takes to sustain that level of service. This places the department sometimes in conflict with land use policies.

A good example might be a very wealthy community that for purposes of determining the lifestyle in the community makes a decision that no property can be developed if it is on less than one or two acres of land. Using up one acre for a home that houses a number of family members of 2.9 thereby creates the following phenomenon. A square mile contains about 640 acres. Therefore, if the land use requires that there only is one home on every acre the maximum number of people in a square mile is going to be approximately  $640 \times 2.9 = 1,856$ .

If you look at this backwards and now start to regard travel distance from a single fire station this now means that for a distance of 1.5 miles in all directions from that fire station you are only going to create an approximate population of  $7.7 \times 1,856$  or 14,291 people.

If these same citizens are only paying about \$50.00 per capita in supporting the fire department, the community can only afford about \$714, 550 of fire protection. That is less than most departments that



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are full time need to adequately staff the station. Increase the per capita to 100.00 and you get 1.4 million dollars. That's more like it!

Now if you go back and look at the tax base for your community and determine what the per capita contribution is, it becomes clear that an area that has a land use limitation must have a higher per capita contribution in order to sustain its level of staffing.

If those same parties choose to keep their property taxes low and there is no sales tax revenue to compensate for that then a 2 person company is likely to be the consequence. In those areas that have 3 or 4 person companies there is probably a constant struggle between the taxpaying public and the needs and desires of the fire department to sustain that staffing level.

In essence then the debate over the number of people going in a fire station is not all about response time. It is about economics.

Land use practices that encourage higher density concentration are now considered to be appropriate public policy. Where the uncontrolled urban sprawl that has been experienced in the United States over the last fifty years is finally reaching a point where public policy makers are realizing that it has a consequence on service levels. The so called new urbanism is placing emphasis on new land use strategies. These have included the resurrection of the concept of mixed occupancy uses which allow for both commercial and residential occupancies in a reasonably similar area.

This particular trend has not been reflected in industrial growth. Industrial development is still considered to be incompatible with single family occupancies. However, land use policies are not uncommon with regard to allowing multi-family in industrial zones.

The same map that we applied earlier with regard to evaluating tax revenue still applies to industrial land. One square mile of industrial land may generate two forms of taxes. These are property tax and sales tax. Depending upon the assessed valuation of the industrial property and the volume of sales tax every square mile that is protected by a single engine company will create an incremental level of service.

Moreover, one consideration of industrial property these days is that the vast majority of industry and commercial buildings are being fully sprinklered. But, what about the old stuff that wasn't? And, it is not uncommon for the majority of industrial property to have an uncommon balance of frequency in demand of emergency calls. They call very few times, but when they have a serious problem they need help now; not during the next year's budget cycle. It follows in reason that when workers are in the facility and human activity is underway there is a high degree of possibility of injury or events. Not uncommonly the same kinds of communities go relatively benign during late night hours. The exception



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to that rule is in those areas that are pre 1980's that have industrial complexes lacking sprinkler systems. Not uncommonly these areas have some of their largest fire exposure in the early morning hours.

When a fire station is sited on the landscape it needs to be given a designated response area that is reasonable. The tendency in the last couple of years is to continue to try to use a response time criteria that is as limited as possible. The significance of that is that shorter the response time the fewer people that can be protected and the more expensive it becomes for those individual tax payers. For planning purposes response time is not a scientific parameter.

The reason it is not a scientific parameter is simply that response time is a goal not a scientific fact. One only has to look at traffic congestion in some parts of the country to realize that citing fire stations based strictly upon response time could be highly dependent on what time of day that you measure that response time.

The concept of Standards of Cover is to look at performance on the basis of a fractal not on absolutes. Therefore, to superimpose a 4 minute travel time on a fire station is imposing a restriction upon that station that may or may not be reflected in the actual performance of it.

For planning purposes fire stations need to be far enough apart that they can cover all of the developed property within a jurisdiction and close enough together that they can reinforce one another in direct proportion to their staffing levels. In effect, if you have 2 person companies you better have a lot of them very close together if you expect to do anything on a working structural fire. On the other hand, if you have 4 person companies they can be positioned slightly further apart in order for them to be able to be sustainable economically.

This argument often goes obscured in the politics of trying to locate fire stations. A more interesting phenomenon in relating to stations is that old neighborhoods are extremely resentful if you attempt to move a fire station out of the area. However, new neighborhoods often are built without any regard to a new fire facility and yet impose an incremental demand upon the existing services.

Following this line of logic then the concept of transitions, triggers and thresholds has to start with the location of existing fire stations. If the reader will review the triggers and thresholds flowchart you will see that there are a wide variety of scenarios that unfold as incremental development occurs beyond the area of a fire station.

The implications of this triggers and thresholds chart are twofold. In the first place population increases are no reason to build new fire stations. Population that serves the purpose of infill increases density which increases the amount of people to pay for fire protection. And, moreover, an increase in



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population may start raising the unit utilization rate of a specific fire company but it is no reason for a new fire station. Therefore, population is not a trigger.

The primary trigger that forces the construction of new fire stations has to do with distance away from existing ones. If a development is allowed that is further away than 1.5 miles from that fire station it generates the potential for an additional fire station. However, in and of itself a new development may have only a minor impact on their level of demand in the area. A good example would be building a single family dwelling on the edge of a 1.5 mile boarder doesn't have much bearing on demand. However, building an entire housing tract of 250 homes, could range from 1.5 to 1.8 miles away from a fire station could likely create that demand.

From a planning purpose what is important to consider the long range strategy of fire stations is not to stretch fire stations to encompass more and more area until they fail but rather to project where the fire station needs to be located.

In effect, this is where the use of travel distance comes in. By placing a rhomboid on the map and respecting jurisdictional boundaries and/or potential annexation areas fire stations can be projected as development occurs.

As one might suspect this is more of an art than it is a science.

For long range planning purposes it makes more sense to develop fire station projection on a premise that you should have the minimum number of stations that are required to field an effective response force, with the maximum amount of staffing that is sustainable by the tax base. Building a lot of fire stations that are close together and to lack adequate economic considerations to staff them adequately is a recipe for disaster.