

Situational Awareness

1 Introduction

Everything and everyone has its limitations. We know that the turnout gear of a firefighter weighs about 25 kg. We also know that firefighters are capable of dragging a victim out of a burning building. No one, however, expects a firefighter to drag out 10 victims at once. That is just too heavy a load. Everyone knows this, everyone accepts this.

Firefighters not only have physical limitations. There are mental limitations as well. And those are just as real as the physical ones. However, a lot of people are not aware of these mental limitations. For instance, in stress situations, human beings will be able to remember 5 things at the most. When additional pieces of information are dumped onto such a person, other parts will be forgotten. And these things just might be important ones. During a fire ground operation, a lot of information is being passed around at a high pace. Missing certain information can happen very easily in those circumstances.

The image of the (company) officer that is registering all available information, saving it for future reference and processing it when needed, is not consistent with reality. This image does not take into account the mental limitations we all have.

This article is about situational awareness and the different factors that by definition, cause that situational awareness to be limited.

2 Dr. Richard Gasaway

Last October, dr. Rich Gasaway was visiting Belgium. He was here on invitation of major Bert Bruggemans, fire chief of the fire department of Antwerp. Dr. Gasaway is the authority on situational awareness. He has worked for over 30 years in the US fire service. He started his career as a firefighter and retired as a fire chief in a small city. At the end of his career, he started studying line-of-duty-deaths (LODD's) in the fire service. He asked himself why so many people lost their lives while, in hindsight, there were very "clear causes" to the accidents. How could it be that these experienced firefighters missed the crucial information? *How did they not see it coming?* These questions for him were the beginning of a PhD study: a research into the situational awareness of firefighters and the different factors that hinder a good perception of the surroundings.

In Antwerp, he did a lecture on situational awareness. In this article, I will attempt to share with you a number of important findings of that day. Aside from that, this article is a plea for a chapter on situational awareness to be included in the Belgian firefighter training program.



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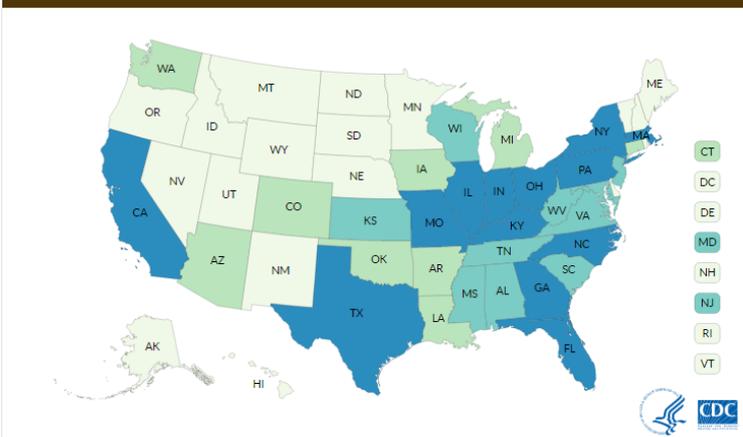
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Number of NIOSH Fire Fighter Fatality Investigations

- 1-5
- 6-10
- 11-15
- >15

figure 1 The main search screen of the NIOSH firefighter fatality program gives access to hundreds of reports of fatal accidents involving firefighters. (www.cdc.gov)

3 Situational Awareness

Gasaway defines situational awareness as *the possibility to perceive and understand what is happening around us in relation to time passing by. The goal is then to be able to predict certain events in the future, in time, to avoid bad outcomes.*

There are three key components in this definition:

1. Perceive
2. Understand
3. Predict

3.1 Perceive

During a fire ground operation, perception is happening continuously. However, there is a difference between reality and the perception of reality. Perception is influenced by all kinds of different factors. This causes perception to differ from reality. And this is a first way how things can go wrong on the fire ground. **Perception can differ immensely from reality.**

The factors that cause this discrepancy, are defined by dr. Gasaway as *barriers to good situational awareness.*

Dr. Gasaway has identified about a hundred of such barriers. A few of these will be discussed in this article: mind drift, short term memory overload, confabulation, distraction and task fixation. There are however, many more other.

3.2 Understand

It is important that everyone is aware of the fact that people interpret the same reality in different ways. Different people can look at the same thing, and still see something different. This can be due to several reasons:

1. Different people are looking at something from a different perspective and thus each will see a different side or angle.
2. Each of us has a personal frame of reference. People can see the exact same thing and give a different meaning to it.

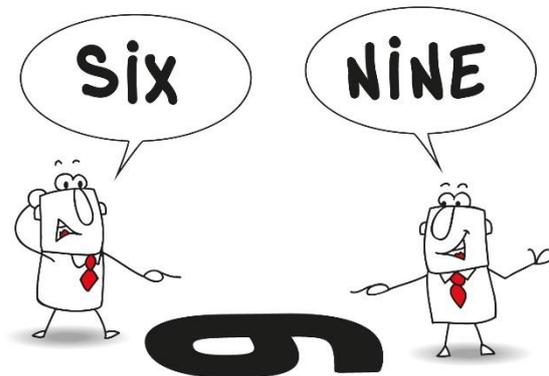


figure 2 Two people can be looking at the same image from different angles and therefore come to opposite conclusions.
(Image: Shutterstock)

Both knowledge and experience are required to process perception into understanding of the situation. This is why currently the fire service is investing heavily into knowledge of fire behavior, reading the fire, ... The more knowledgeable and experienced a person is, the more he or she will be capable of interpreting perceptions. This has to do with the fact that he or she will know more, but also with the fact that due to experience he or she will be able to understand more quickly what is going on.

When a junior company officer of a fire house that doesn't have many fire calls, arrives on a fire as shown in figure 3, he will quickly size up the situation. Probably he will be under some form of stress. His attention will be drawn to the venting flames. Maybe he will feel the heat of the flames on his face. He will conclude that a fully developed fire is burning on the ground floor.

If a senior and more experienced company officer with a lot of calls on his track record were to arrive at the same time, several other things will be going through his mind as well. The senior company officer will probably also see the light coming from the top end of the front door. This tells him that fire room and the hallway on the ground floor are somehow connected. This can lead to several possibilities:

- The door between the fire room and hallway is open.
- The door between the fire room and the hallway has been burnt through.

In theory, there is also the possibility that the front door opens up into one big room and there is no hallway. The experienced crew officer knows that this is highly unlikely. If that were the case, then the entire room would be filled with burning gases. The front door would also have flames exiting at the top. The fact that it does not, points to a hallway behind the front door.

Generating this last bit of information requires a lot of knowledge and experience. It requires drawing a conclusion from something that is not there. (There are no flames venting from the top of the front door, so there is a hallway behind the front door.)

Beginners can draw conclusions from things they can see. Advanced or expert people can also draw conclusions from things they do not see.

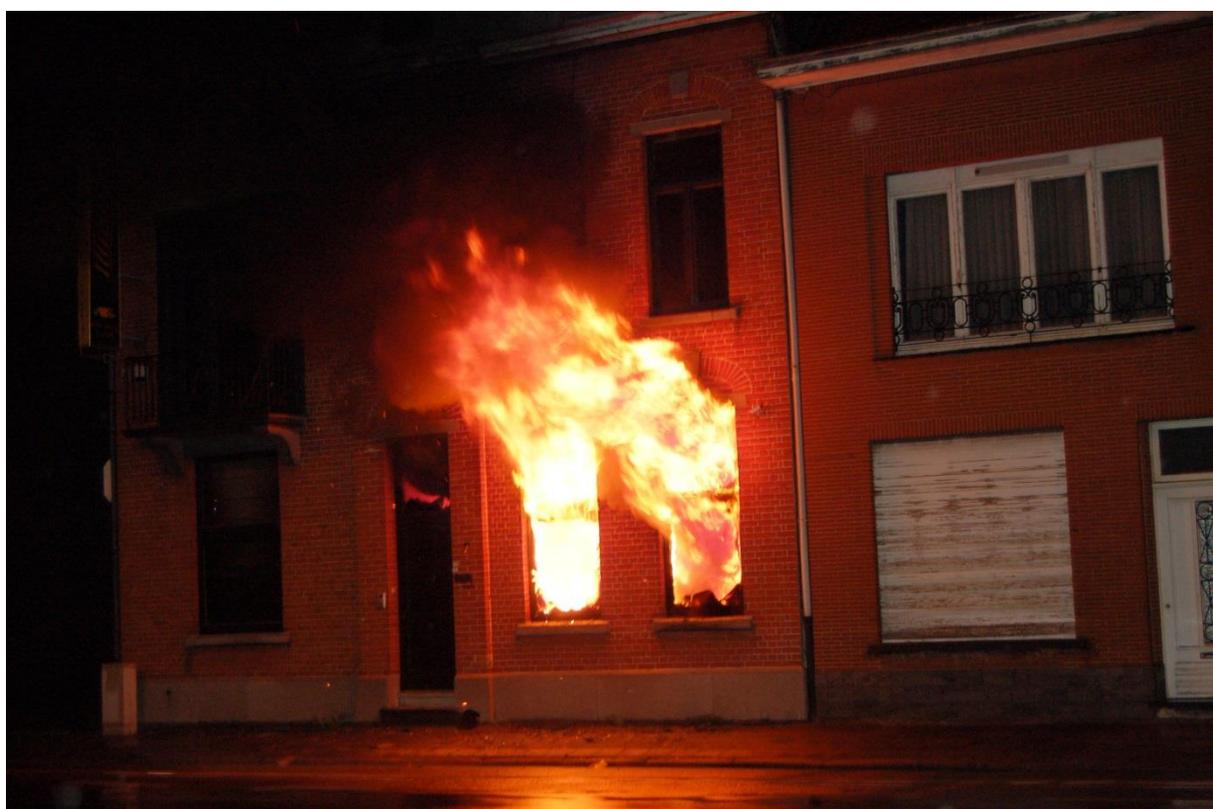


figure 3 fully developed fire on the ground floor of a house. (Photo: Nico Speleers)

3.3 Predict

The next part of our situational awareness is predicting future events. Right after they have arrived on scene, everyone should ask themselves: "How is this fire going to progress?" That way we force ourselves to think on the dynamics of the situation. One outcome for the situation in figure 3 can be the following: *We will knock down the fire with a single 45 mm hose line from the outside and then follow up with an interior attack. This should not take longer than two minutes. The next crews to arrive on scene will have to search the house for victims.*

An assessment of risks versus potential gains will have to be made immediately. Dr. Gasaway distinguishes two *windows of opportunity*:

- The window of opportunity for civilian survivability: the time in which victims can survive in such a situation.

- The window of opportunity for firefighter survivability: the time in which firefighters can survive in such a situation.

Both time periods are finite. Normally the time of victim survivability is a lot shorter than that of firefighters. As long as there is a chance for victim survival, taking certain risks is acceptable.

When a prediction on how the incident will evolve has been made upon arrival on scene, it will become possible to determine after some time whether or not the prediction has come true. *If 5 minutes after the arrival on the fire of figure 3, no improvement is made, the initial prediction is proved to be inaccurate.* Corrections will have to be made. Taking risks will have to be toned down. There may be several reasons why the situation is not going as foreseen:

- Maybe the fire is the work of an arsonist and there is plenty of gasoline to keep the fire burning steadily.
- Maybe the fire has vented through several windows in the back shortly after the arrival of the fire crew. Therefore the heat release rate may be much too high for a single 45 mm line to tackle.
- Maybe there is something wrong with the fire engine and the crew was unable to launch a successful attack on the fire.

Because a prediction was purposely made at the start of the incident, it also becomes easier to determine when things are not going as planned. Adjusting to the actual situation will be possible in order to avoid accidents.

3.4 Intuition

In general practice, fire ground operations are very dynamic. It is impossible by definition, to see everything at the same time. After all, there is more than one side to a building and it is impossible to be looking at all sides simultaneously. Especially for officers, this leads to situations where they are commanding a fire ground operation while not having all available bits and pieces of information.

And because there is so much information, it is also impossible to consciously process all of that information. That is why a large part of information processing is done subconsciously. Commanding officers sometimes feel instinctively, what they should or should not do.

Intuition is a very complicated thing. After all, our intuition is not always right. Rich Gasaway told the following tragic tale which happened in the US:

A chief officer was on a difficult fire ground scene in a complex building. The fire was burning fiercely and he had deployed several crews to put it out. A very unpleasant feeling started to form itself, telling him that something was very wrong. However, he could not put his finger on what it was. At that time, the safety officer walked by. The IC discussed his feeling with the man. The safety officer indicated though that everything seemed to be going as planned: an attack crew was tackling the fire. A backup crew was working a second hose line to support the attack crew. A rapid intervention team was standing by



should anything go wrong. The incident command was fully operational as well. There was a clearly defined command post with a drawn out plan of the situation and plenty of people available to handle radio communication. There was someone assigned to keep track of all BA crews. The safety officer had made his round on the fire ground and found nothing wrong. Additional crews were also standing by should any additional tasks arise. Everything seemed to be going by the book. The IC decided to ignore his inexplicable feeling and carry on with the operation. Twenty minutes later, rapid fire progress occurred inside and two firefighters lost their lives.

The officer in charge knew, intuitively, that something was going to go wrong. He just could not explain it. What can we learn from this? Gasaway describes it as follows:

- If you consider yourself an expert in your field
- and you are working in a high-risk situation
- and the situation is constantly changing
- and you are under time pressure
- and you have the feeling that something is going to go wrong
- **Then you would be wise to trust that feeling.**

It is possible that you are processing information subconsciously because there is just too much info to work through on a conscious level. Follow your gut feeling and pull everyone out of the hazard zone until you understand what is actually happening.

The opposite might also happen from time to time. Sometimes you are caught in a feeling of euphoria while in a high-risk situation. Everything seems to be going perfect. In that case, you should not blindly trust your intuition. Actively search for facts to support or disprove your feeling.

4 Types of situational awareness

Dr. Gasaway distinguishes different types of situational awareness:

- Personal situational awareness
- Team situational awareness
- Resource awareness
- Big-picture situational awareness

4.1 Personal situational awareness

Everyone has a certain image of himself. For some that picture is pretty accurate, others over- or underestimate themselves. Each of us has a blind spot. There are certain elements of ourselves, of which we are not aware.



It is important that we have a good personal situational awareness. This means we have to know what our strengths and weaknesses are. How good are our knowledge, our skills, our physical shape? What area needs improvement?

Is the image we have of ourselves correct? Or will we be unpleasantly surprised at a time where we really can't handle additional setbacks?

4.2 Team situational awareness

A team is so much more than just a collection of individuals. Again, there can be an idea of what the team can and cannot do. A team could be the crew of a single engine. How does it take to stretch and charge an attack hose line? Can your team manage to stabilize a situation as depicted in figure 3 within two minutes upon arrival? Or will it take closer to five minutes?

For a chief officer, the team is made up of all the firefighters on the fire ground. The team could therefor be made up of several smaller teams: e.g. two engines, a ladder truck and a water tender. Will this team be able to quickly and efficiently carry out the following tasks?

- Quickly get control of the fire
- Start salvage and overhaul
- Vent the structure
- Search for victims

It is important for an officer to form an idea of the time needed to accomplish all these tasks. If he or she thinks the crews are taking too long to achieve the goals, he or she will have to call for additional crews.

Just as any other situational awareness, the image the officer has of the team can be wrong. So, team situational awareness is very important as well.

4.3 Resource awareness

Resource awareness deals with our image of the equipment we use on the job. *How long can we work with one BA cylinder?* On most fire operations, that isn't really a problem. But for a small number of incidents, it can be important to form an adequate picture of this. Running out of air while still inside, has very serious consequences.

Is the image we have of our equipment correct? Does everyone have the right idea of the maximum extinguishing capacity of a high-pressure line? Or do we have to say there is another barrier to our awareness?

4.4 Shared situational awareness

When operating on the fire ground (or any other major incident), it is important to have a collective idea of the situation. In reality, that collective idea is never perfect because



everyone perceives a certain situation in a different manner: from another angle (physically), from another frame of reference, with other emotions, ...

Still, commanding officers must strive to reach a shared situational awareness. In the past it has been proven many times that when there is a serious accident, the risks on the scene were obvious to some colleagues while other crew members were totally unaware.

There are different ways to enhance shared situational awareness. Sending a CAN report over the radio makes that information available to everyone. SOP's can lead to everyone understanding which actions the team is carrying out and what each individual task herein is. Good commands by commanding (company) officers that are clearly worded, can also help here. If there is time, a commanding officer can even choose to brief his subordinates and provide them with the necessary context and other parts of info that help form a collective image of the fire scene: a brief description of the situation at hand (*What is going on?*), the teams that are already on scene and their tasks (*What are we doing to deal with the problem?*) and finally the task that needs to be done (*What is your job?*).

5 Barriers for a good situational awareness

Rich Gasaway identified over a 100 barriers to situational awareness. In his lecture in Antwerp, he talked about 12. This article highlights a few important ones.

5.1 Mind Drift

Everyone who drives a car, has found themselves in a situation where they apparently drove on automatic pilot for a short part of their travel route. While driving, an activity in which hundreds of people lose their lives every year, attention has slipped to something other than the actual driving. The phenomenon is called *mind drift*. Even though it may seem inconceivable, this also happens with activities such as firefighting. From time to time, the attention slips. It goes without saying that this does not contribute to a good situational awareness. However, there is nothing that can be done to counter this. The only thing we can do, is be aware that this happens and thus that our image of the surroundings is by definition incomplete.

5.2 Short term memory overload

In the introduction it has already been stated that on average, during a short time period, a human being can only remember five pieces of information. Our minds work in such a way that only the first five pieces of information are being remembered. This means that after five parts, the short-term memory is full. When a sixth piece of information pops up, one of the previous bits of information will be "overwritten". The person in question will already have forgotten what the first bit was about. This could well have been an important part of information that is crucial for handling the incident properly.

What must be said then of the IC commanding two engines, a ladder truck and a water tender. That's already a total of four units to consider. He or she also has two radio's: one on the frequency of the incident and another one tuned in to the frequency of the dispatching. What if a company officer runs up to the IC to verbally report something while radio traffic is flowing on both radios? The police might also have some questions at that



time. All the while, the IC also has to keep an eye on the situation: perceive, understand and predict.

It is extremely important to recognize that people have limitations when it comes to these situations. These limitations can be mitigated by providing the IC with a driver that handles radio communication with the dispatch. The driver could also play a part in sizing up the incident and could support the IC in that area. Rules can be established that determine when a second chief officer should be called on scene. All of these measures should help prevent the IC from operating beyond his capabilities. Many barriers to situational awareness cannot be avoided. We cannot make people remember 15 pieces of information. We can however, on an organizational level, make sure that there are more people on scene to receive information and that there is support for commanding officers so that none of the crucial info is lost.

5.3 Confabulation

Our mind lies to us. It does not like blind spots in the image we have of reality. Therefore the mind will fill in the gaps we have with data from previous incidents or with what it thinks will fit. This leads to an altered version of the perception that can differ immensely of reality.

5.4 Distraction

Everyone has had it happen that they were on their way to the kitchen to fetch something, only to find out they have completely forgotten what it was once they were there. Still the original reason was very clear at first. On the way over though, something happened to draw attention from the goal. The person got distracted and let his or her attention be drawn toward another subject or activity. However, the attention has not returned to the original task.

On a fire scene, there are countless tasks that may distract the attention. This creates the risk that a commanding officer has just thought up a certain solution and has decided to carry it out, but on the way over he has become distracted. It happens regularly that only much later on the incident, it becomes clear that the particular task still needs to be done. What if this was a critical task?

5.5 Task fixation

Firefighters can be very focused. It is important that they are. They often have to carry out difficult tasks that may mean the difference between life and death. The downside of this is that they are sometimes so focused on their task, that they lose sight of the environment around them.

This causes firefighters to sometimes take unnecessary risks. The fire service as an organization has already taken certain precautions to deal with this problem. The entire guidelines for operating in traffic on public roads, is a way of circumventing the consequences of task fixation. Firefighters that are actively taking part in vehicle extrication, can focus on the victim and the car, while other firefighters are busy managing traffic so it is no longer an additional hazard. Nowadays, everyone would cringe of the thought of doing a victim extrication on the highway without a traffic control vehicle on



scene. Twenty years ago, however, that was considered the normal way of doing things. Back then, firefighters had to keep one eye on the traffic at all time. Luckily that has all changed, for the better. Firefighters are still affected by task fixation on a vehicle extrication incident, but nowadays the consequences are less severe.

6 Closing thoughts

Situational awareness a topic that is virtually nonexistent in the current firefighter training curriculum. However, a good situational awareness is crucial for safe and efficient fire ground operations. It would be wise to include a course on situational awareness in both firefighter and fire officer training. On top of that there needs to be some extra schooling, so that active firefighters can get to know and understand this concept.

7 Bibliography

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