

2013 FIREFIGHTER  
INJURIES REPORT

WHEN FIRE  
IS A WEAPON

CALIFORNIA'S HOME FIRE  
SPRINKLER SUCCESS

2013 LARGE-LOSS  
FIRES REPORT

# JOURNAL nfpa

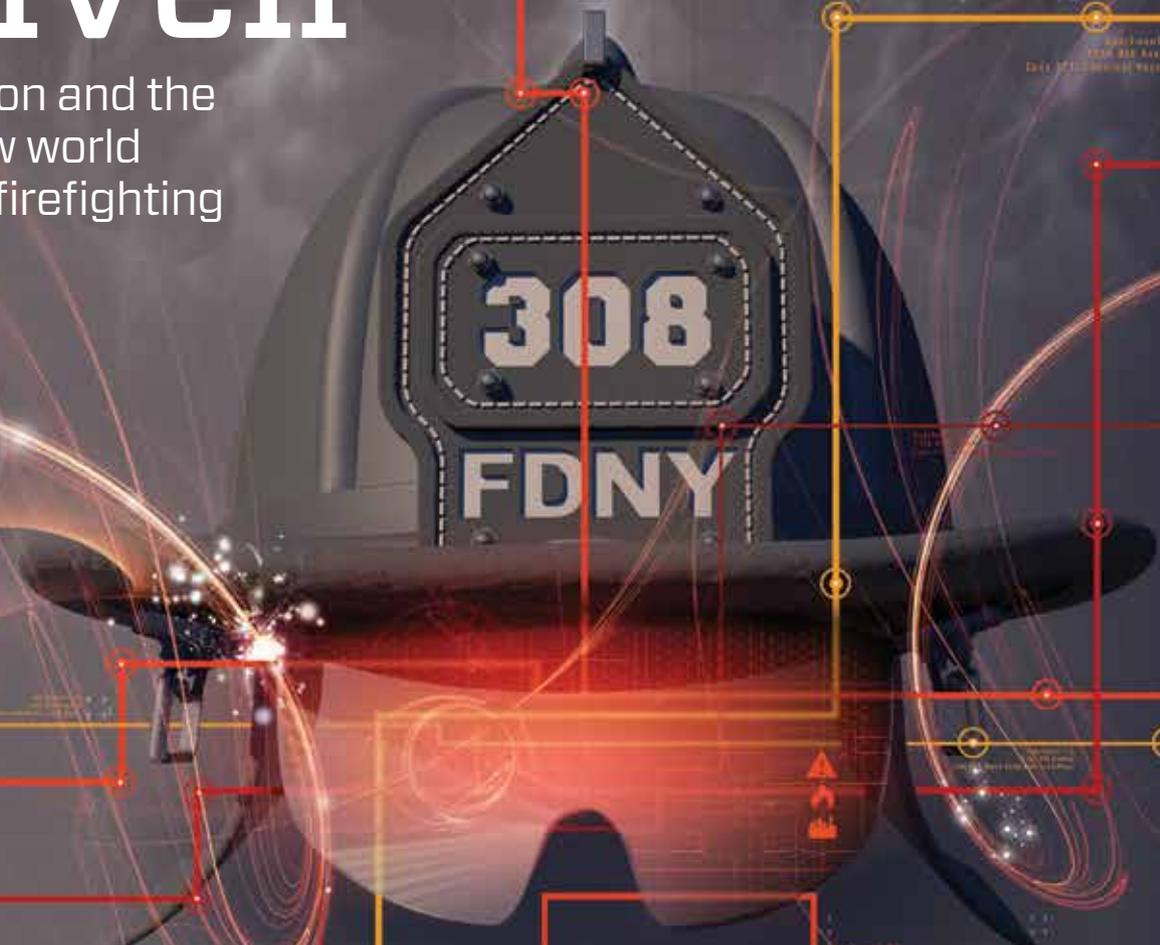
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**+** SPRINKLER ADVOCATES  
ON THE FRONT LINES

# Data Driven

Information and the  
brave new world  
of smart firefighting



OFFICIAL MAGAZINE OF THE NATIONAL FIRE PROTECTION ASSOCIATION

[nfpa.org/datadriven](https://www.nfpa.org/datadriven)

Read more about "Developing a Research Roadmap for Smart Firefighting," a project by the National Institute of Standards and Technology and the Fire Protection Research Foundation.

#### WIRED + BEYOND

Some of the most important data utilized by firefighters details the characteristics of buildings. The emerging area of smart firefighting is looking at ways to enrich that information through the collection and analysis of vastly greater quantities of data.

# IN PURSUIT OF SMART

As the amount of data produced increases exponentially, the fire service considers innovative ways to harness the power of information to help it save lives, reduce property loss, and protect firefighters—a brave new world of “smart firefighting”

The Engine 308 firehouse in South Queens is the kind of place where visitors receive a firm handshake and a strong cup of coffee upon arrival. Upstairs, Eugene Ditaranto’s office is equally old-school. The walls are clad in 1970s-era wood paneling, and Ditaranto, chief of Battalion 51 for the New York City Fire Department (FDNY), has tacked up clipboards and maps of his district. A couple dozen binders are arrayed in a bookshelf against the far wall, and the surface of the chief’s simple wooden desk is covered neatly in stacks of papers, folders and Post-it notes. Every few minutes the landline phone rings over the chattering buzz of two window AC units.

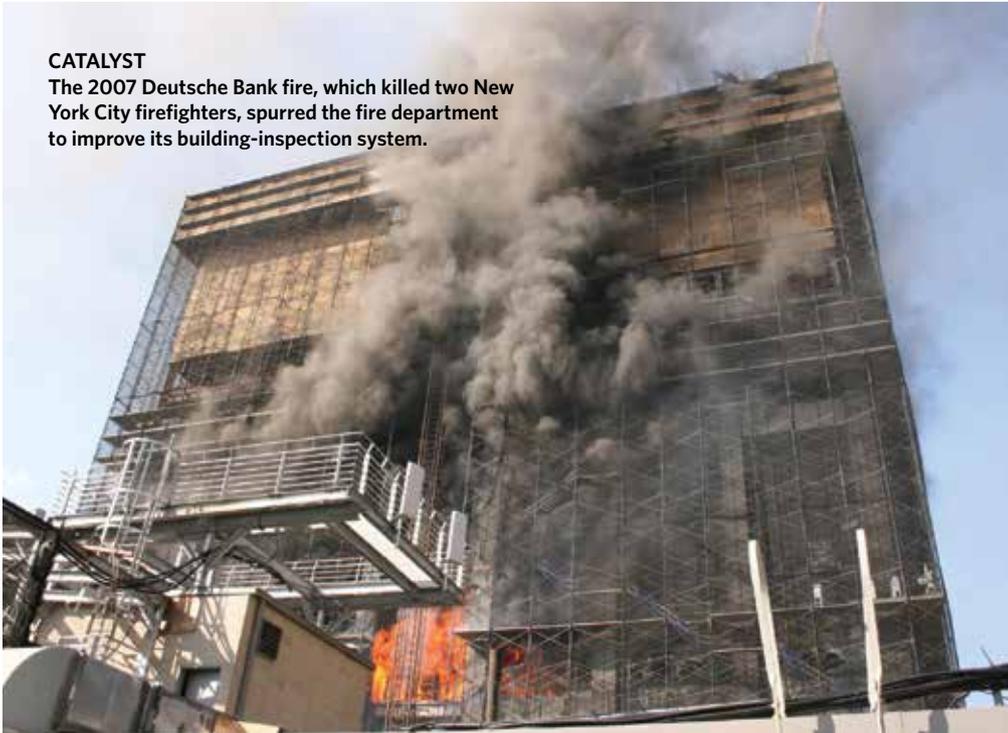
Even in this modest space, Chief Ditaranto is only a few keyboard clicks away from one of the most technologically sophisticated tools ever developed by the fire service. He fires up his Dell computer, and in moments his screen displays every chief’s dream: a list of the buildings in his district that are at highest risk of experiencing a fire that day. The program is called the Risked-Based Inspection System, or RBIS, and at its heart is an innovative data-analytics algorithm called FireCast. >>

By Jesse Roman

Illustrations by Sean Rodwell

## CATALYST

The 2007 Deutsche Bank fire, which killed two New York City firefighters, spurred the fire department to improve its building-inspection system.



will use the FireCast 3.0 algorithm to analyze three years' worth of data for every building in the city. Using the variables and each neighborhood's unique fire history, FireCast 3.0 will perform a complex statistical analysis and assign every building FDNY inspects with a fire risk score. The buildings with the highest risk score will be placed near the top of a building-inspection to-do list, assigned daily to each of New York's 341 fire companies. FireCast also considers buildings that the fire department is legally required to inspect on a set schedule—schools, buildings under construction,

For more than a year, FDNY has used FireCast 2.0, which sorts data from five city agencies into as many as 60 fire risk factors, which in turn are

used to create prioritized lists of all buildings inspected by the FDNY. Fire department officials credit the technology for easing workloads, simplifying an incredibly complex task and, most importantly, getting New York fire-

tremendous number of lives that we can't quantify," said Ditaranto, who helped develop and now oversees the RBIS system. "If we go into a building and see something and correct it, we can't know if we're preventing a fire three weeks down the road—there's no way to predict that. But I think there are probably several cases where the action we took did help prevent a fire."

The RBIS tool is about to become much more powerful. Early next year, FDNY will launch the FireCast 3.0 algorithm, which will sort data, collected from 17 city agencies along with the city's 311 non-emergency phone reporting system, into as many as 7,500 distinct and weighted fire risk factors—everything from building specifications and occupancies to past trash violations and noise complaints.

Every night, powerful computers at FDNY's sleek modern headquarters in downtown Brooklyn

and condemned buildings, for example—and adds those to the top of the list. The entire computational process will take about 90 minutes.

The RBIS system is perhaps the best example of what has become known as "smart firefighting"—using data to both inform and streamline the processes firefighters use when responding to a fire or other emergency. In a world increasingly saturated with information—where seemingly everything is "smart," from phones to the electrical grid—the fire service, too, is beginning to harness the vast amount of data and gadgets now available to help it save lives, protect firefighters, and reduce property loss.

The concept appears on the verge of taking off. Earlier this year, the Fire Protection Research Foundation, in partnership with the National Institute of Standards and Technology (NIST), embarked on an ambitious 18-month research

## DATA BOOM

From the dawn of civilization to 2003, the amount of data generated by humans totaled about 5 exabytes— $5 \times 10^{18}$  bytes.

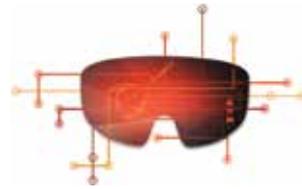
In 2012, the world produced about 5 exabytes of data every two days.

In 2013, 5 exabytes were produced every 10 minutes.

Source: Google

fighters into some of the city's most fire-prone buildings, some of which haven't been inspected in years.

"Fire prevention ultimately saves a



project aimed at identifying opportunities to create and develop new smart-firefighting tools. As part of the project, teams of fire experts, scientists, and data and technology experts are creating a comprehensive “roadmap” for the future study of smart firefighting, encompassing topics from data analytics and sensors to mobile applications and interoperability. The roadmap project should be completed by the spring of 2015.

“The world is changing very rapidly, and so is the fire service,” said Edward Baggott, FDNY’s assistant chief of operations and one of the developers of FireCast and the Risk Based Inspection System. “RBIS is helping the citizens of New York, but it is also beneficial to the firefighters because we are learning some things out in the field that are critical—it’s a win/win. I believe we are just in the infancy of this.”

#### Addressing shortcomings

To see how far FDNY has come, all you have to do is look at where it was just seven years ago.

On August 18, 2007, engulfed in a roiling cloud of thick smoke, New York City firefighters Robert Beddia, Joseph Graffagnino, and James Martin ascended a stairwell of the condemned Deutsche Bank building in downtown Manhattan, trying to reach firefighters they thought might be trapped on the 15th floor. The high-rise office building, located just steps from Ground Zero, was badly damaged in the September 11 terrorist attacks and was undergoing abatement and demolition. A fire broke out just before 4 p.m. on the 17th floor when a worker carelessly disposed of a cigarette.

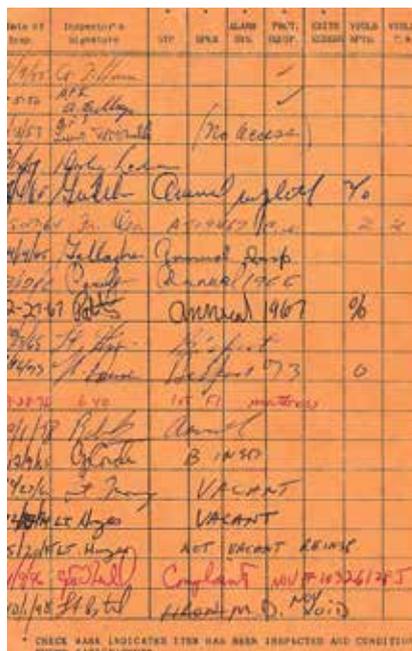
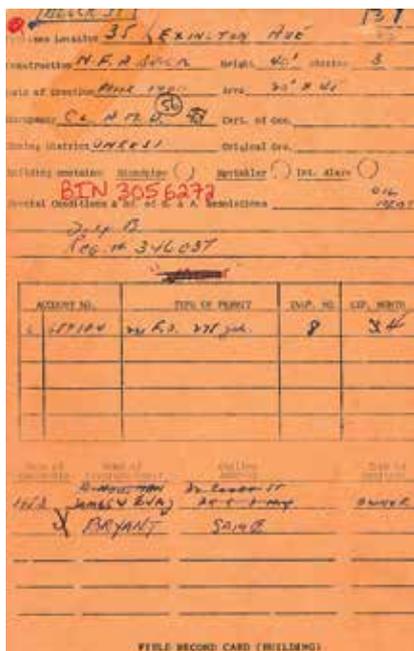
When firefighters arrived, they discovered that construction crews,

in their haste to demolish the building, had months earlier severed a 42-foot section of standpipe meant to feed water to the top floors during a fire. As a result, firefighters struggled to run hose up from street level. Firefighter Martin later testified at a criminal trial against three construction supervisors at the site that he, Beddia, and Graffagnino had been in the building 40 minutes before the water arrived, their oxygen tanks becoming dangerously depleted.

Between the 14th and 15th floors, Graffagnino and Beddia ran out of air, but escape proved difficult, in part because portions of the stairwells had been improperly sealed as part of the abatement effort at the building, a city investigation found. Martin, the last of the three to enter the building, had oxygen remaining and tried to help the other two before making the difficult decision to leave them and find help. Graffagnino and Beddia later died of smoke inhalation.

Records showed that the fire department had not inspected the building in five months, even though city rules required a visual inspection of the standpipes of a building undergoing demolition every 15 days. Meanwhile, the city’s Department of Buildings had conducted inspections, but failed to discover the broken standpipe or share any of its inspection information with FDNY. “We deeply regret the failures of our agencies to inspect and detect the conditions that contributed to the deaths of Firefighters Beddia and Graffagnino,” the city acknowledged in a statement after the fire. The project’s three construction supervisors were charged with manslaughter but were acquitted.

“Post 9/11, the focus was on rebuilding the department and preparing for terrorism—building inspection was not one of our top-



Until the launch of the Risk-Based Inspection System in 2013, the FDNY’s building-inspection system was based on an antiquated card-catalogue method that had been in place for decades. “Building inspection was not one of our top-level priorities” post-9/11, one fire official said.

## COLLECT, ANALYZE, ACT. REPEAT.

How the  
data side  
of FDNY's  
Risk-Based  
Inspection  
System, or  
RBIS, works

For the updated RBIS, which will launch in early 2015, 17 different city agencies, along with the city's 311 non-emergency phone reporting system...

NYPD

FDNY

HPD

DPR

DFTA

DCA

DOB

DOE

DOF

DOITT

DOHMH

EDC

TLC

DOT

DEP

DHS

DSNY

See key on  
facing page »

311

... will contribute vast amounts of building and neighborhood data...

### A few examples:

Building type, such as commercial, residential, garage, office space, storage facility, or factory; year the structure was built; whether or not the building is sprinklered (full, partial, or none); and many more.

Data will also be supplied via a wide range of 311 complaint types, including reports of plumbing/water leaks; defective elevators or dangerous elevator conditions, such as an open or unguarded shaft; building structure stability issues; smoking violations; presence of chemical vapors, gases, or odors; non-functioning smoke detectors; poor indoor air quality or ventilation issues; and many more.

...into the city's data repository. That information will then be analyzed by...

**In April 2013**, New York City creates a citywide data-sharing platform that allows agencies and even the general public to view and manipulate the vast amount of data collected by city agencies. The city also creates the Mayor's Office of Data Analytics, dubbed New York's "civic intelligence center."

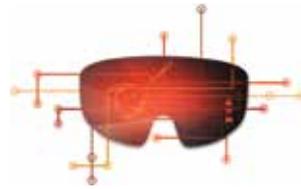
level priorities," Baggott said during a recent interview at FDNY's Brooklyn headquarters. "Deutsche Bank showed us that we definitely had shortcomings."

FDNY is responsible for inspecting 330,000 city buildings, encompassing all commercial buildings and any other buildings with common areas, such as apartment complexes. (The Empire State Building, with its 2.7 million square feet of space, counts as a single building.) For years, the department relied on an antiquated card catalogue method for keeping

track of inspections. Each building in the city was assigned a card with basic information like occupancy, square footage, construction materials, and year built. It was up to the company commander to keep track of the cards and assign each a letter, A through E, which determined how often the building was to be inspected. None of the records were digitized, and there was no way to keep track of critical information, or even when a building was last inspected, without going to the local firehouse and looking

through the card catalogue.

"We told the company commanders that they needed to determine, out of the thousands of buildings in their company's administrative district, which buildings they should go to every year, every two years, every three, etc.," Ditaranto said. "With all the other responsibilities they have, it was an impossible task. There was a good chance that things would fall through the cracks." The haphazard nature of the system, Baggott said, meant that many of the cards were missing or destroyed and not on file.



...FireCast 3.0, a special algorithm developed by the Analytics Unit of the New York City Fire Department (FDNY).

As part of the city's effort to harness the power of data, in March 2013 FDNY launches FireCast 1.0, a rudimentary data-driven tool to improve FDNY building inspections. FDNY's newly formed Analytics Unit launches an upgraded version, FireCast 2.0, just a few months later, which is able to sort the data collected from five city agencies into 60 fire risk factors. A new, vastly more powerful version, FireCast 3.0, is scheduled to launch in early 2015 and will be capable of sorting the data dynamically into 7,500 distinct and weighted fire risk factors.

Firecast 3.0 will generate a fire risk score for every building inspected by the FDNY, along with a prioritized daily building inspection schedule for every fire company in the city.

Firefighters at each of New York City's 341 fire companies can log on to the fire department's RBIS to see their company's daily inspection schedule, listed in order of priority. Information also includes building inspection type (demolition, alteration, school, risk-based inspection, etc.), building address, the building's structural fire incident count, date of last inspection, inspection due date, and inspection notes.

Firefighters conduct building inspections, note and address potential fire hazards, and collect critical information to feed back into the RBIS/FireCast cycle.

Post-inspection, firefighters can upload newly collected building information onto the RBIS site. Information can include the location of standpipes and alarm panels; building specifications; new violations; changes in occupancies; changes to fire suppression systems; unusual hazards or means of egress; and much more.

Inspectors can also add key information to FDNY's Critical Information Dispatch System—a short report on critical building information that firefighters can access in the truck en route to a fire.



**NEW YORK CITY AGENCY KEY** NYPD, New York City Police Department; HPD, Housing Preservation and Development; DFTA, Department for the Aging; DOB, Department of Buildings; DOF, Department of Finance; DOHMH, Department of Health and Mental Hygiene; TLC, Taxi and Limousine Commission; DEP, Department of Environmental Protection; DSNY, Department of Sanitation of New York; DHS, Department of Homeless Services; DOT, Department of Transportation; EDC, Economic Development Corporation; DoITT, Department of Information Technology; DOE, Department of Education; DCA, Department of Consumer Affairs; DPR, Department of Parks and Recreation; FDNY, Fire Department of New York.

Fixing the broken inspection system was daunting. The department's goal is to complete inspections of 10 percent of its buildings each year, but with some companies dispatched to as many as 5,000 fire calls annually, even that goal presented a huge challenge. "We had to ask ourselves what we could do to improve how we target which buildings we go to, because we certainly can't get to all 330,000," said Jeff Roth, an assistant commissioner at FDNY and leader of the four-person FDNY analytics unit in charge of developing and maintaining the

FireCast algorithm. "But how do we make that determination?"

Long-discussed changes at city hall were set into motion in the aftermath of the Deutsche Bank fire, Roth said. The Department of Buildings and the Department of Environmental Protection were ordered to begin automatically sharing all new building and inspection information they gathered with FDNY. More significantly, in April 2013, then-New York mayor Michael Bloomberg signed an executive order creating a citywide

data-sharing platform that allowed agencies and even the general public to view and manipulate the vast amount of data collected by city agencies. The order also created the Mayor's Office of Data Analytics, dubbed New York City's "civic intelligence center."

The city's turn toward using data in innovative ways was happening as FDNY continued the process of revamping its building inspection policies. "It was a natural progression for us," Roth said of the decision to develop a data-driven fire inspec-

tion model. “We realized we had to prioritize inspections based on something, and we suddenly had all of this untapped data. So we thought, ‘How can we use this?’”

The department began modestly by digitizing all of the information on its old building inspection card system. It then conducted focus groups with officers to determine what critical information on the cards might be the biggest predictors of fire. From this process, FireCast 1.0, which Roth described as an “anecdotally driven” fire predictor without much statistical basis, was launched in March 2013. “It was anecdotal because our access to data was limited at the time,” Roth said. “It was the best we could do, but it was a crucial first step.”

Realizing the limitations of this initial effort, FDNY contacted the city’s

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**“This data might have the potential to change laws and regulations—if we see a trend, maybe we can rectify the rules before we have a major incident.”**

new data analytics office and enlisted its help in developing a new, more data-driven model. In June 2013, the mayor’s data team handed the project off to a newly assembled FDNY Analytics Unit, which completed and launched FireCast 2.0—“the first step toward a real statistical model,” according to Ryan Zirngibl, the lead data scientist for the FireCast system, and one of the four original FDNY Analytics Unit members.

#### **Fine-tuning the machine**

According to Zirngibl, the central concept of the FireCast algorithm is to find the characteristics of buildings that have had fires and compare them to the characteristics of buildings that haven’t. “What’s the difference between two buildings that look

exactly the same, except for one building had a fire incident? What is it we’re not seeing about these buildings?” Zirngibl said. “You want to find those descriptors that exist in one of those worlds but not the other, and there are a few different statistical tests that we use to help determine which factors are of interest to us.”

Once the FireCast algorithm figures out what factors are correlated with fire, and to what degree, it evaluates the massive cache of data stored in New York City’s new data-sharing platform to determine which buildings have fire-predictive characteristics and assign each building a fire risk score. “FireCast emulates the intuition of a seasoned fire officer, someone who’s been in the neighborhood for years

and really knows the buildings,” Roth explained. “Many of these old timers I’ve spoken to aren’t really surprised by some of the FireCast findings I’m

surprised by, which I thought was hugely impressive.”

While FireCast 2.0 has been a leap forward, developers say FireCast 3.0 will be an improvement in every conceivable way. Aside from the vast amount of data the new model can manipulate, and the boost in the number of fire-predictive risk factors from 60 to 7,500, version 3.0 is also a much finer-tuned machine. Where the first two versions of FireCast lumped the entire city into one data set, version 3.0 separately analyzes each of the city’s 49 battalion districts, creating building fire-risk scores based on the unique fire history and characteristics of individual neighborhoods.

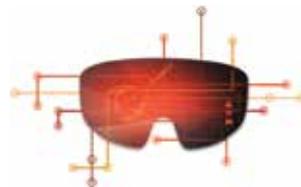
Fire officials hope this dynamic

quality will result in a more sensitive—and more effective—inspection tool. For instance, if the algorithm determines that a trash violation is a predictor of fire in the 3rd Battalion District in the Bronx, a building that was issued a trash violation there on Tuesday will have a higher fire-risk score on Wednesday. However, in Battalion 51 in Queens, a trash violation may not be a fire indicator based on the local fire history, so a violation there would not impact a building’s risk score—but that could change. If the next day a Queens building with a history of trash violations experiences a fire event, the algorithm will automatically sift the data again and may determine that trash violations are now statistically significant and include them in the next day’s fire-risk model.

To capture the role of human behavior in assessing fire risk, FireCast 3.0 also includes data from the city’s vast 311 non-emergency phone reporting system. Of the 2.6 million 311 complaints that are processed annually, 1.4 million are building related. The majority of those complaints—categorized into more than 6,000 different types—are related to buildings that FDNY inspects, which gives FireCast 3.0 a huge and constantly updating stream of fresh data points to process each night.

In this way the program is constantly refining its process to “detect trends before they are even visible,” Zirngibl said. “This system does that because the data is being updated dynamically.”

The results suggest the system is prioritizing the right buildings. In the 30 days after FireCast 2.0 was deployed, the average number of building violations in the city went up 19 percent. After the first 60 days, the number of violations was still up 10 percent.



## SMART+SMARTER

New ways emergency personnel are using data-based technology

### SCHOOL EMERGENCY RESPONSE ►

#### SAFER Program

##### Frisco, Texas

In 2009, the city of Frisco, Texas, developed an innovative system called Situational Awareness For Emergency Response, or SAFER, which allows first responders to instantly access critical information about each of the school district's 46 schools during an emergency. SAFER, developed by the city's Information Technology Services Department, aggregates information from six databases and video feeds from strategically placed cameras inside each school into one user-friendly interface. The result is that Frisco's first responders—while on the scene, in their vehicles, or at the station—can see real-time video, floor plans, aerial maps, lists of onsite hazardous chemicals, contact information for school administrators, water sources, and other pieces of critical information.

"It's the most advanced tool that I'm aware of," Mack Borchardt, chief of the Frisco Fire Department, said in a release on [ci.frisco.tx.us](http://ci.frisco.tx.us). "It gives us an incredible amount of information instantly, and [firefighters and police officers] have the same view. In the case of the video, a picture is worth a thousand words."

### WILDLAND/URBAN INTERFACE

#### FireWatch Texas

##### College Station and Travis County, Texas

More than 1,000 square miles of forest near College Station, Texas, are being monitored using a new wildfire early-warning camera system. The technology, made by a German company, sells in the U.S. under the name FireWatch America. The cameras, mounted on towers above the tree line, can see smoke plumes of 10 meters by 10 meters, at distances of 10 miles or greater, according to company information. The sensors rotate in 10-degree increments, completing a 360-degree sweep of the area every eight to 12 minutes. During each rotation, sensors in the cameras capture and analyze images, transmit them back to a central command center, and alert authorities if possible fire events



are detected, according to [firewatchamerica.com](http://firewatchamerica.com). The system uses triangulation to pinpoint the exact location of the fire for first responders.

In June, the city council in Austin, Texas, unanimously approved a pilot program to install three of the high-tech cameras on towers around Travis County. Each camera costs \$175,000, plus \$200,000 in annual maintenance, according to published reports. Texas is reportedly the first U.S. state to utilize the cameras, which are being used in 13 countries.

### FIREFIGHTER INFORMATION TOOL

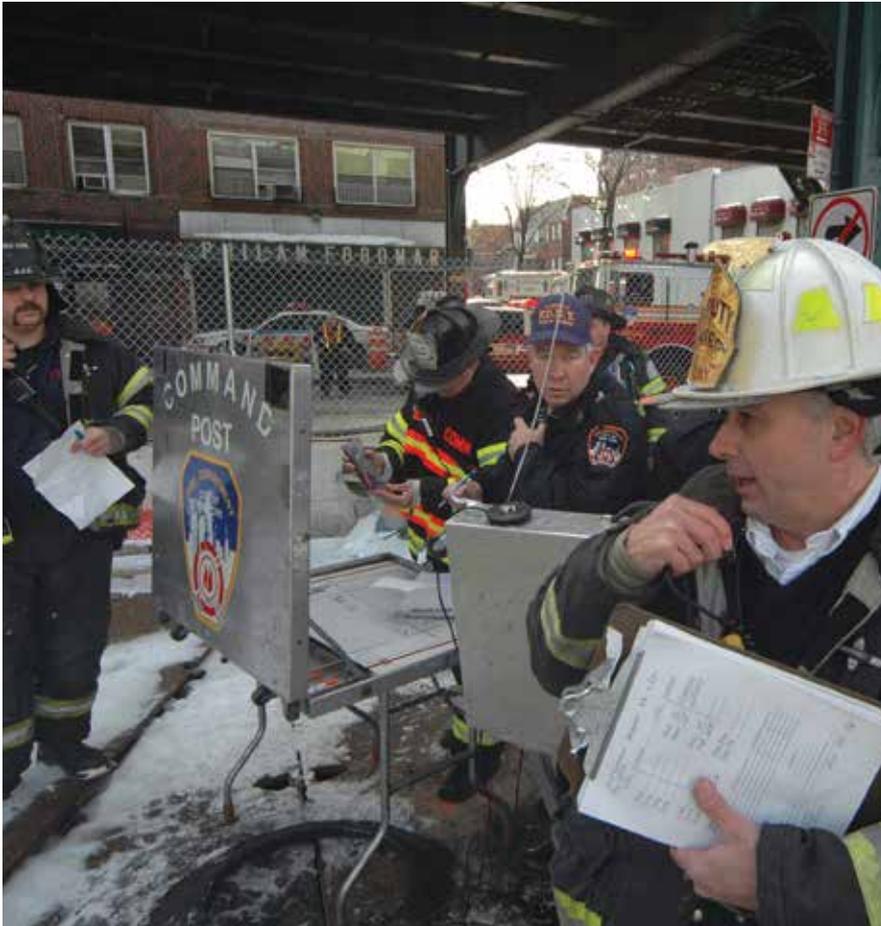
#### Google Glass Project

##### Rocky Mount, North Carolina

Patrick Jackson, a firefighter in Rocky Mount, North Carolina, has designed an app for Google Glass, Google's head-mounted computer—commonly worn as a visor or glasses—that could become a useful hands-free tool for firefighters in the field.

Jackson's app lets firefighters give the computer verbal commands for maps and dispatch information, which is then beamed directly on the Glass device; firefighters see the critical information at the top corner of their vision. Future versions could include building layouts, information on potential building hazards, contact information, and more, Jackson recently told CNN. The Google Glass device can also shoot photos and video, allowing first responders to seamlessly film their response to a fire event or other emergency, which could aid subsequent incident investigations.

Jackson, a self-taught programmer, used a crowd-sourcing fundraising campaign to purchase the Google Glass device and developed the software in his free time. For a video of Jackson's project, visit [youtube.com/watch?v=QPbZy2wrTGk](http://youtube.com/watch?v=QPbZy2wrTGk). —J.R.



## There's a Standard for That

New NFPA documents address issues of data development, storage, and exchange

**WHILE MANY TOUT** the potential of the emerging smart firefighting technologies, there is still a lot of work to do behind the scenes before those technologies become pervasive.

"That's an area where NFPA as a codes and standards developer can help tremendously," said Anthony Hamins, the chief of the Fire Research Division at the National Institute of Standards and Technology, or NIST. "NFPA has a very important role by developing standardized formats, protocols, and data types."

That work is already underway. If there are no objections from the NFPA Standards Council, a new standard, NFPA 950, *Data Development and Exchange for the Fire Service*, will make its print debut this November. Its companion, NFPA 951, *Guide to Building and Utilizing Digital Information*, is slated for release in November 2015.

"I think these NFPA documents are a big deal," said Casey Grant, research director at the Fire Protection Research Foundation. "I think in the next few years we will see these sleepy little

**Ready access to clear, well-organized data is a critical tool for incident commanders and firefighters in the field.**

documents take off, because this is where the world is headed. The technical committee for NFPA 950/951 is really setting some of the basic startup metrics for the whole topic area."

As with any new and rapidly changing industry, a lack of uniformity can

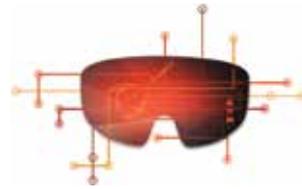
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**"Integrating these different technologies will enable firefighters to get information in real time. It could be like the Tower of Babel if we don't get out ahead of it."**

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create big problems, or at least slow potential advancements. The new documents will address that issue and "provide a standard framework for the development, management, and sharing of data for all-hazards response agencies and organizations," according to Chapter 1 of the proposed NFPA 950 standard.

"There are manufacturers developing radios that give off the users' geo location, devices in clothing that can monitor a firefighter's vitals, locators around buildings that can literally draw the building's layout," said Christopher Farrell, the NFPA staff liaison for NFPA 950 and NFPA 951. "The only thing that is slowing us down is that all the different technologies are written in different languages and on different platforms. Some devices talk to each other easily, some don't. Integrating these different technologies will enable firefighters to get information in real



time. It could be like the Tower of Babel if we don't get out ahead of it."

The first edition of NFPA 950 consists of six short chapters containing relatively basic, but important, information. Topics include requirements for departments to develop data policies, plans for backing up key data, and provisions on how to properly format data entries.

"It's starting with just high-level stuff—the next iteration will have more concentrated material," Farrell said. "We're building a box, and what goes inside that box is yet to be determined. This is a great example of us being ahead of the game."

The push to develop NFPA 950 began in 2008 when a new project request went before the NFPA Standards Council. Once approved, it took a while for Farrell and others to identify potential technical committee members, because the standard "is a whole new area for NFPA," Farrell said. He went to trade shows to meet people who straddle the fire service and technology worlds, he said, because at the moment "they don't know us and we don't know them."

As a result, most of the 20-plus committee members—which include fire department technology experts, consultants, professors, data professionals, and more—have never served on an NFPA committee. Farrell believes, like Grant, that in the not-so-distant future, spots on the NFPA 950 and NFPA 951 technical committees will be coveted. "As the market matures and there is more awareness, we will have a flood of people who will want to be involved, because there will be a lot of money potential in this area," Farrell predicted. "I guarantee a lot of people are going to look at this standard and see the enormous potential." —J.R.

Getting into the right buildings also means being better prepared when fires occur in those structures. Since the deployment of version 2.0, 16.5 percent of citywide structure fires have occurred in buildings that FDNY had inspected within 90 days before the incident. That means that, while the inspections did not prevent the fire, firefighters had up-to-date information on the building layout, the whereabouts of standpipes, alarm panels, hydrants, and other critical information.

It also revealed that FireCast was predicting accurately which buildings are likely to have fire incidents. By comparison, with version 1.0, only 1.9 percent of buildings with structure fire incidents had been inspected within 90 days. FDNY officials predict that, with FireCast 3.0, 25 percent of structure fires in New York City will occur in buildings that FDNY has inspected within the last 90 days, greatly reducing the chances of another Deutsche Bank incident.

Ditaranto said the effectiveness and promise of RBIS are the result of its creation by fire officers rather than engineers, technologists, or others. "Fire officers are the ones with the unique perspective and practical knowledge that other professionals do not possess," he said, citing the efforts of officers like Capt. Thomas Gale, Ditaranto's lead operations officer on the RBIS project, to design a system that took into account the safety of civilians as well as firefighters. "We understand risk the best, because we're the ones positioned on the battlefield facing all levels of risk at all times."

More anecdotal evidence that FireCast is working comes from the number of calls to FDNY's Building

Inspection Safety Program (BISP)—essentially a hotline for inspectors in the field who have questions about the city fire code, or encounter challenging or unique situations beyond their level of knowledge. As inspectors were sent to more at-risk buildings, the number of calls seeking help went up. "Since the inspections

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### "What's the difference between two buildings that look exactly the same, except for one building had a fire incident?"

became based on the risk score, all sorts of things have been brought to light: hazardous materials, egress issues, you name it," said Capt. Michael Scheibe, one of the leaders of BISP. "As a result, the level of education [for inspectors in the field] has gone up tremendously. Guys have a much better handle on what to do in situations they come across."

As the system matures, FDNY leaders feel like the system may do much more than just lead firefighters to the riskiest buildings—it might also provide new answers to why and how fires start in New York City. "This data might have the potential to change laws and regulations—if we see a trend, maybe we can rectify the rules before we have a major incident," said Baggott, the FDNY assistant chief of operations. "The fire operations guys look at some of the data and say, 'Really? That leads to fire?' But we have to follow the numbers. If the data leads us that way, it leads us that way."

#### A smart firefighting roadmap

FireCast may be the tip of the spear for smart firefighting, but it's only the beginning.

Last March, an unlikely group of 80 people gathered in Arlington,



Virginia, to discuss what smart firefighting could look like in the future. About half were career firefighters, while the other half were cyber-physicists with backgrounds at places like Google and various agencies of the federal government. The workshop, hosted by the Fire Protection Research Foundation, was held to establish a dialogue between the groups as a first step toward tackling a complex project, titled “Smart Firefighting: Where Big Data and Fire Service Unite” ([nfpa.org/smartfirefighting](http://nfpa.org/smartfirefighting)), aimed at bringing about the future of smart firefighting.

“We’re flooded with incredible amounts of data—sensors are being put in everything you can imagine,” said Casey Grant, research director at the Foundation, which is overseeing the project. “At the same time, our data processing and storage capacities have gone up dramatically. The question is, what do we do with it?”

In the months that have followed that initial meeting, 11 pairs of fire experts and data and technology experts have teamed up to address that question. Each pair of experts has co-written a chapter on subjects ranging from communication technology and delivery methods to sensors, data collections, hardware/software interoperability, analytics, and more. By the beginning of 2015, the group will have produced a comprehensive document that will identify opportunities to improve the fire service through data technology and prioritize areas for future research. “The roadmap will show us the path forward,” said Anthony Hamins, the chief of the fire research division at the engineering laboratories at NIST, which is funding the project.

Through NIST, the federal government is spending millions of dollars on research into so-called cyber-physical systems, or CPS—the integrated system of networks, com-



Smart-firefighting experiments, like this Google Glass project in North Carolina that allows a firefighter to see incident information in his glasses or visor en route to a fire, are data-driven efforts that are opening new possibilities for how the fire service operates.

puters, and sensors that work in tandem with the physical world to create smart systems. NIST’s work to hone smart systems is ongoing in a range of sectors, including manufacturing, transportation, energy, and more. “Cyber-physical systems are a key program area at NIST—a lot of people are working on CPS-related topics,” Hamins said. “We see taking advantage of this emerging technology as very important to ensuring safety and effectiveness of the fire service.”

Firefighting offers particular challenges and opportunities for this technology; as FDNY’s FireCast algorithm demonstrates, the range of applicable data is nearly limitless. For instance, what if a firefighter was able to issue a verbal command to pull up a detailed layout of a building that would appear on his visor? What if incident commanders were able to see real-time fire modeling based on actual conditions as reported from sensors in and around the building?

Grant, who describes the project as one of the most challenging he’s ever worked on, believes the impli-

cations for the fire service are huge. “Some people look at this and say we’re on the cusp of a new era, and I agree with them,” he said. “This is coming on so fast and changing so fast. We’re trying to get ahead of it and figure out where we go next.” Grant said the smart firefighting project could inform new codes and standards, such as NFPA 950, *Data Development and Exchange for the Fire Service*, which is written as a standard, and NFPA 951, *Guide to Building and Utilizing Digital Information*, which could in turn become important tools for navigating the emerging data-rich landscape. [See “There’s a Standard for That,” page 48.]

While he realizes the potential, Hamins downplays notions that the fire service is on the verge of sudden transformation—at least not yet. “It’s hard to predict when this will be pervasive, because there are so many technical challenges,” he said. “There are wonderful opportunities and possibilities, and a lot that needs to be done. But FireCast is an excellent example of where we can go.” 🔥

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