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Big Data and Fire Protection Systems

FINAL Proceedings BY:

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EXECUTIVE SUMMARY

These are the proceedings of a workshop held on 2 March 2016 in San Antonio, Texas to address "Big Data and Fire Protection Systems." The goal of this workshop was to identify and prioritize the opportunities for big data to inform decision making for ITM (Inspection, Testing and Maintenance) used for built-in fire protection systems.

The on-going reliability of built-in fire protection systems is related to inspection, testing and maintenance (ITM) of these systems. This is addressed by multiple NFPA codes and standards, including NFPA 4, *Standard for Integrated Fire Protection and Life Safety System Testing*, NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, NFPA 72, *National Fire Alarm and Signaling Code*, and NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*. Requirements for ITM have evolved over time, but often do not have a solid scientific basis.

A new activity at NFPA that directly relates to this topic is the proposed development of a Data Analytics Sandbox. NFPA is uniquely positioned to coordinate the next generation of data and data analytics in support of the built environment and safety infrastructure. Going forward, the NFPA Data Analytics Sandbox is anticipated as serving as an important collective resource, and serving as a next generation test bed in support of our rapidly evolving world of cyber physical systems and the internet of everything. The collection and coordination of ITM data, which will ultimately support the technical activities addressed by NFPA 4, 25, 72, 2001, etc., is considered a prime candidate activity for the NFPA Data Analytics Sandbox.

This workshop has gathered applicable stakeholder input and clarified certain information through roundtable discussions. Using Breakout Groups and through a series of structured questions, this information includes discussing how data can inform ITM decisions, identifying the key data needed and potential sources of data, and clarifying how NFPA can help. Key findings from this effort support five concept categories of recommendations: (1) *general*; *(2) data collection methods*; *(3) documentation*; *(4) stakeholder benefits/concerns*; and *(5) standardization*. Specifically, these include the following:

(1) General

- **Prioritize Occupancy Focus**: For start-up efforts, first focus on certain specific occupancies such as commercial properties.
- **Support Legislative Initiatives**: Identify, clarify and support legislatively-oriented initiatives that promote the sharing of data for the public good (e.g., the State of Georgia is working on data sharing legislation).
- **NFPA's Attributes**: NFPA, as a trusted 3rd party, is an ideal organization to serve as a central data collector.
- **Stakeholder Value Added**: NFPA can develop a clear consensus of the most important data based on stakeholder needs and explain to stakeholders the value of their own data collection.
- **Code Requirement Validation**: Analysis of collected data will verify whether or not recent code updates are successful or unsuccessful.

(2) Data Collection Methods

- **Novel Collection Methods**: Consider novel approaches such as indoor drone inspection.
- **Promote Automated Approaches**: Automate the data collection process to improve efficiency and effectiveness (e.g., automated impairment detection program to flag impaired systems).

- **Enable External Data Sets**: Enable external unrelated data sets that can provide value-added to the overall pool of data (e.g., external real estate permitting data is presently available).
- **Data and Data Analytics Focus:** Focus on data and data analytics, and avoid any mandates of software, hardware, or similar details.
- **Positive Data Usage**: Data is often only collected if there is a negative issue, but there is also positive data available that shows the systems are functioning properly.
- **Enable User Friendly Data Collection**: Explore the aspect of user friendly data collection methods such as using mobile apps.

(3) Documentation

- **Prioritize Essential Data**: Focus on data that is essential, and do not collect unnecessary data.
- **Focus on Data Needs**: Make sure the needed data drives the data collection process and not the forms and/or format.
- **Support Confidentiality Agreements**: Address confidentiality agreements between inspectors and property owners/manufacturers as a means of obtaining data that would otherwise be unavailable.
- **Manage Evolution**: Set performance characteristics, and allow the format to naturally evolve based on usage.
- **Establish Common Terminology**: Develop standard terminology to address the language and terminology differences between different regions or companies.

(4) Stakeholder Benefits/Concerns

- **Establish Data Safeguards**: Provide safeguards for user access so that all data and data analytics is used securely and wisely (e.g., by AHJs, end-users, researchers, etc.).
- **Address Data Breach Implications**: Consider liability implications due to data breaches (e.g., consider parallel case studies).
- **Identify Unrealized Data Analytics**: Demonstrate value-added for end-users by enabling analytics they would otherwise not have, including for their own proprietary data.
- **Promote User Benefits**: Continually emphasize end user benefits and value added.
- **Address Ultimate End-User Needs**: Identify and summarize end user problems to guide data analytic efforts (e.g., using collected thermostat data to develop residential profiles for addressing smoke detector performance in extreme temperatures)

(5) Standardization

- **Utilize Existing Standards**: Consider using existing standards that address the processing and handling of confidential data (e.g., existing ISO or IEEE standards on data confidentiality)
- **Clarify Data Types**: Distinguish between mandated data collection vs. voluntary.
- **Promote Automated Data Collection**: Promote automated data collection vs. manual data collection (e.g., establish minimum standardized data stream, with flexible data format)
- **Standardize Common Baseline Data**: Standardized baseline cross-sectional common data that is necessary for all ITM systems (e.g., limited location information, system age, commissioning details, etc.).
- **Support Risk Based Data Analytics**: Create code requirements customized for specific risks rather than system types. Systems vary based on occupancy type but there will always be a level of risk (which can be determined by analyzing collected data).

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The Fire Protection Research Foundation plans, manages, and communicates research on a broad range of fire safety issues in collaboration with scientists and laboratories around the world. The Foundation is an affiliate of the NFPA.

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About the National Fire Protection Association (NFPA)

Founded in 1896, NFPA is a global, nonprofit organization devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards. The association delivers information and knowledge through more than 300 consensus codes and standards, research, training, education, outreach and advocacy; and by partnering with others who share an interest in furthering the NFPA mission. All NFPA codes and standards can be viewed online for free. NFPA's membership totals more than 65,000 individuals around the world.

Keywords: Inspection, Testing, Maintenance, ITM, Data, Big Data, Fire Pumps

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1) BACKGROUND AND OVERVIEW

The on-going reliability of built-in fire protection systems is related to inspection, testing and maintenance (ITM) of these systems. This is addressed by multiple NFPA codes and standards, including NFPA 4, *Standard for Integrated Fire Protection and Life Safety System Testing*, NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, NFPA 72, *National Fire Alarm and Signaling Code*, and NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*. Of particular note, some of these standards are now proposing inclusion of specific data collection information, such as a new Annex F addressing "Connectivity and Data Collection" for the upcoming 2017 edition of NFPA 25.

Requirements for ITM have evolved over time, but often do not have a solid scientific basis. These are often historical requirements that are not based on ITM data or on observed deficiencies. Recent efforts to address this topic have included a previous Foundation Workshop on "Applying Reliability Based Decision Making to ITM Frequency" (2012). This involved discussion of approaches to determining ITM frequency for a given fire protection system or equipment based on reliability concepts.

Another Foundation activity around this topic was a report on Fire Pump Field Data Collection and Analysis (2012). The research objective of this study was to provide credible and statistically valid fire pump performance data that substantiates testing frequencies and protocols. This was completed by reviewing the landscape of existing field data, establishing data collection needs, and developing a framework for how the data can be used in a credible manner. This effectively provides a useful case study focused on fire pumps and its involvement with data for ITM purposes.

In addition, a workshop at SupDet 2015 on the topic of general research needs around the topic of ITM identified several areas where data is needed to answer key questions such as the optimal frequency for certain tests and the relationship between ITM activities and failures.

All of these previous activities identified additional work that needed to be done to evaluate reliability and correlate reliability with code requirements. A key issue is standardizing data collection so that the data can be effectively analyzed. This includes standardizing the data collection format, submission process, data security parameters, and data analysis procedures. A standardized framework is needed for the efficient collection, storage, and analysis of ITM data.

A new activity at NFPA that directly relates to this topic is the proposed development of a Data Analytics Sandbox. NFPA is uniquely positioned to coordinate the next generation of data and data analytics in support of the built environment and safety infrastructure. Going forward, the NFPA Data Analytics Sandbox is anticipated as serving as an important collective resource, and serving as a next generation test bed in support of our rapidly evolving world of cyber physical systems and the internet of everything. The collection and coordination of ITM data, which will ultimately support the technical activities addressed by NFPA 4, 25, 72, 2001, etc., is considered a prime candidate activity for the NFPA Data Analytics Sandbox.

This prior background activity has resulted in a need to further address this topic, and accordingly this latest half-day workshop has been held on 2 March 2016 in San Antonio, Texas to address "Big Data and Fire Protection Systems." The goal of this workshop is to identify and prioritize the opportunities for big

data to inform decision making for ITM (Inspection, Testing and Maintenance) used for built-in fire protection systems. These are the proceedings of this workshop.

This workshop seeks to gather the applicable stakeholder input and clarify certain information through roundtable discussions. Using Breakout Groups and through a series of structured questions, this information includes discussing how data can inform ITM decisions, identifying the key data needed and potential sources of data, and clarifying how NFPA can help. Specifically this includes:

- Identify All Applicable Stakeholders
- Confirm Critical Data Elements (using focus on Case study of Fire Pumps)
- Identify Potential Sources of Available Retrospective Data for the following:
  - ITM Results
  - Failure Outcomes
- Identify Key Barriers for Sharing the Following Types of Data (i.e., playing in the sandbox):
  - Existing Retrospective Data
  - Future Prospective Data.
  - Benefits to Sharing Data
- Prioritize the Key Barriers for Sharing Data
- Identify/Prioritize Benefits for Sharing Data
- Summarize Recommendations for Universal Data Platform (i.e., sandbox)

The agenda for the workshop is illustrated in Table 1: Workshop Agenda. Following welcoming remarks, this is structured to provide a baseline overview of this topic area, followed by breakout group discussions, and concluded with a plenary session addressing summary observations.

Table 1: Workshop Agenda

1:00 pm	Welcome and Workshop Overview	Amanda Kimball, Foundation
1:10 pm	Opening Remarks on ITM and Big Data	Casey Grant, Foundation
1:30 pm	Presentation: Big Data Analytics and Decision Making	Nathaniel Lin, NFPA
2:00 pm	Case Study Presentation: Update of Fire Pump ITM Data Coordination	Gayle Pennel, Aon Fire Protection Engineering
2:30 pm	*Break*	
2:40 pm	Breakout Groups (groups of 10-15 each) – Address Break-out Group Questions that focus on: • Discussing how data can inform ITM decisions; • identifying the key data needed and potential sources of data; and • clarifying how NFPA can help.	Workshop Attendees
4:20 pm	Breakout Group Reports and Plenary Discussion	Workshop Attendees
5:00 pm	Workshop Wrap-up and Summary Observations	Casey Grant and Amanda Kimball

2) CLARIFYING THE BASELINE

The baseline for this topic was provided by the following three presentations: first by Casey Grant titled "Workshop on Big Data and Fire Protection Systems"; second by Nathaniel Lin titled "Big Data Analytics and Decision Making"; and third by Gayle Pennel titled "Going Forward from the Fire Pump Field Data Collection and Analysis Project". These are illustrated in Figures 1 through 12.

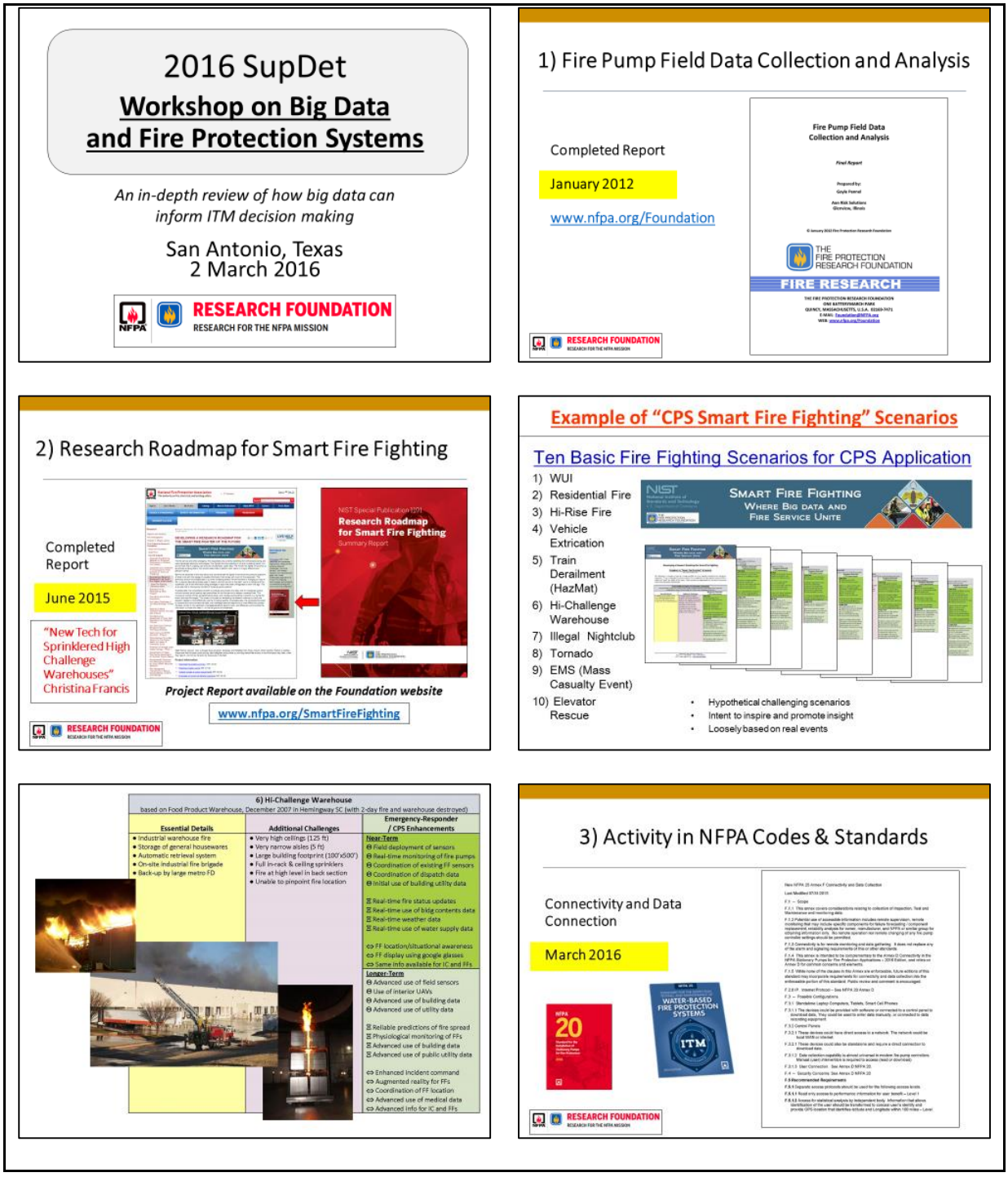


Figure 1: Presentation by Casey Grant (1/2)

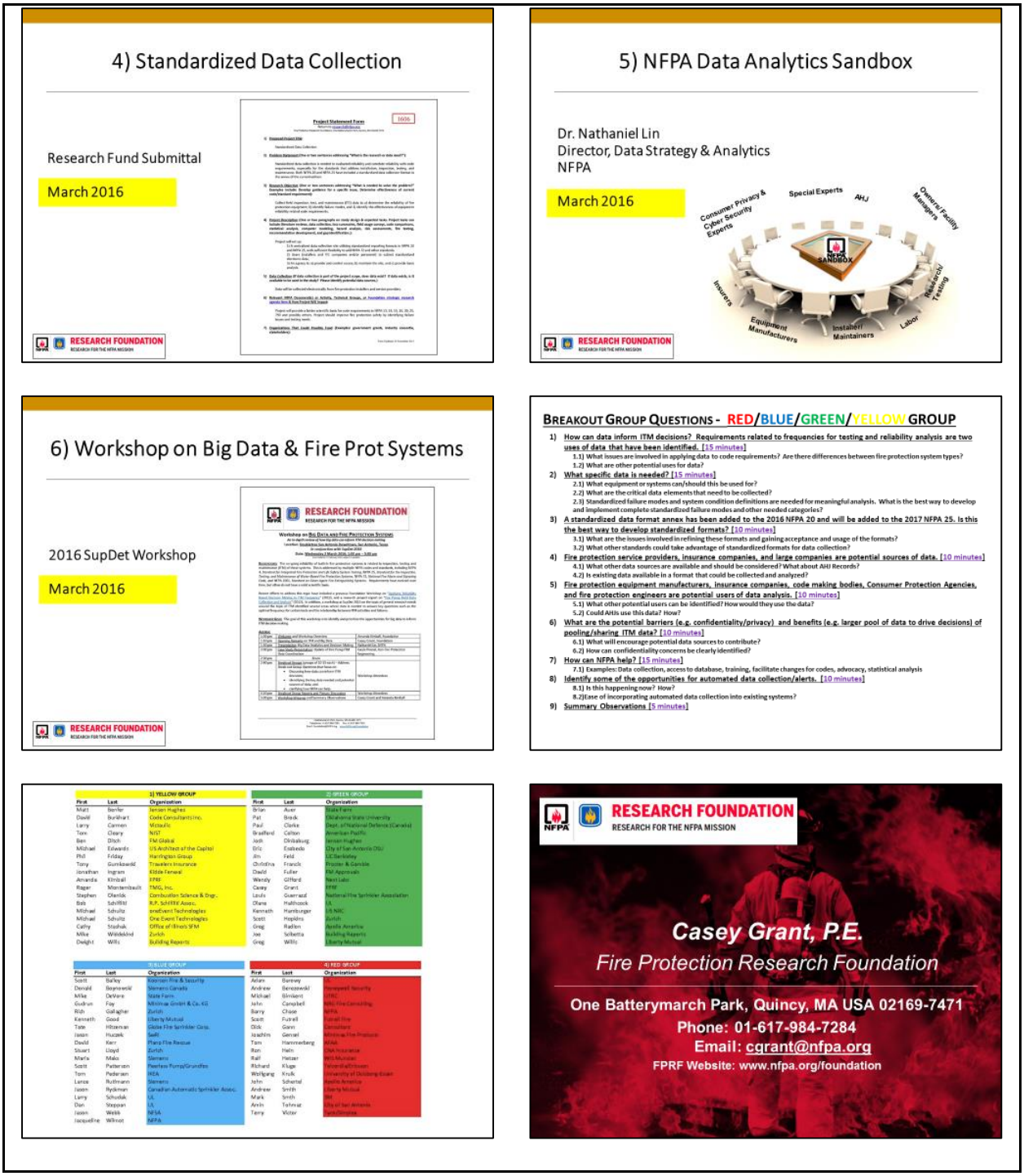


Figure 2: Presentation by Casey Grant (2/2)

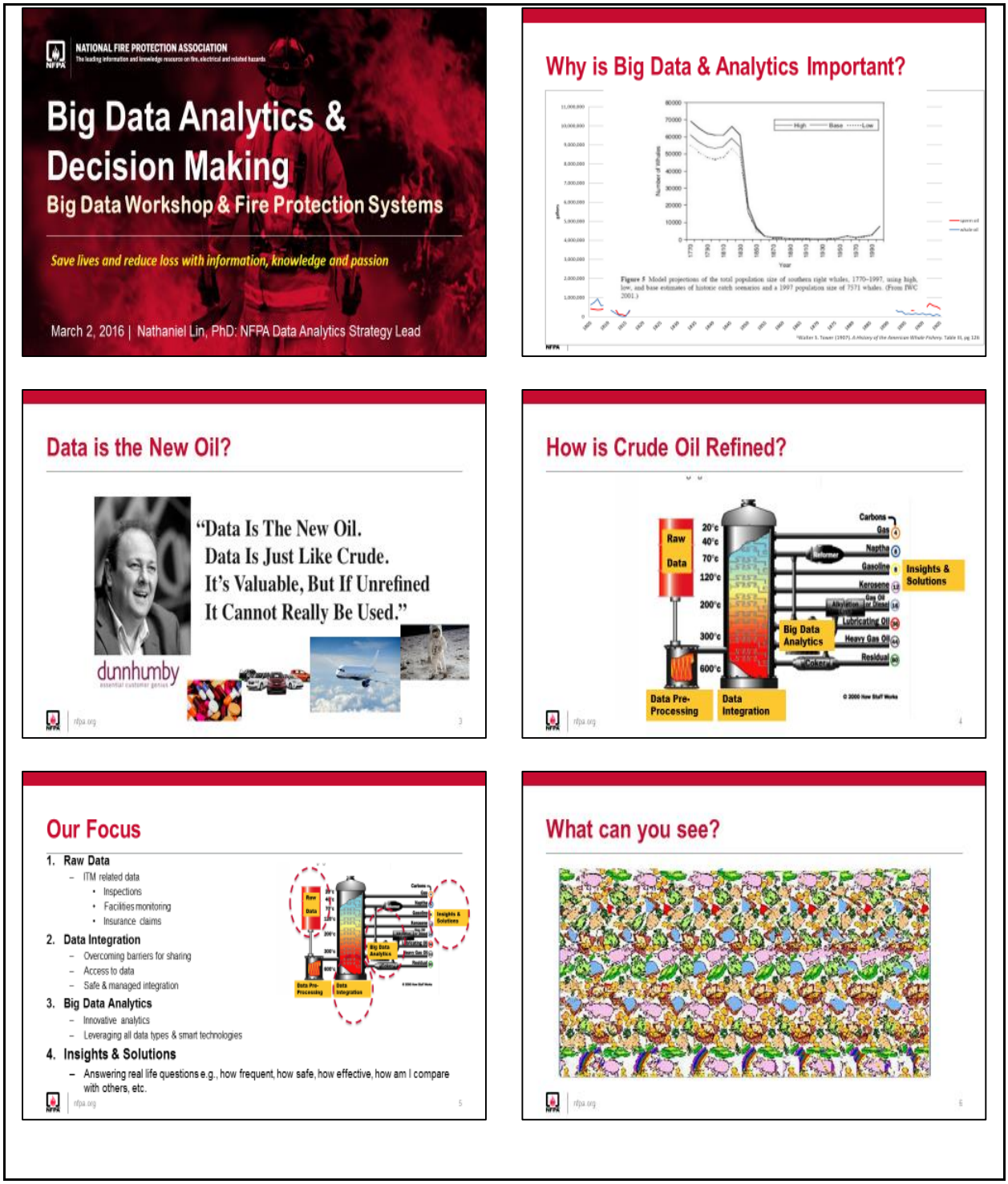
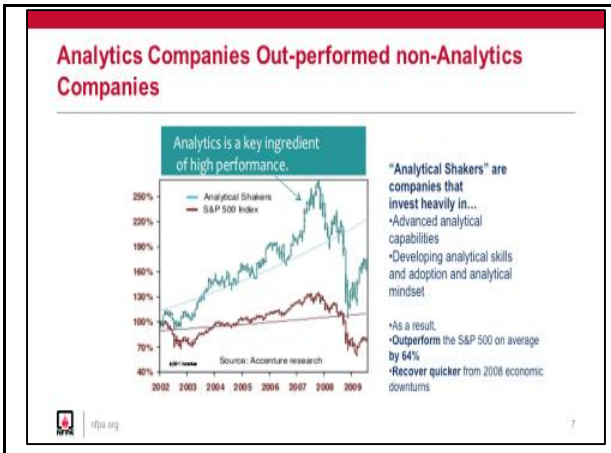
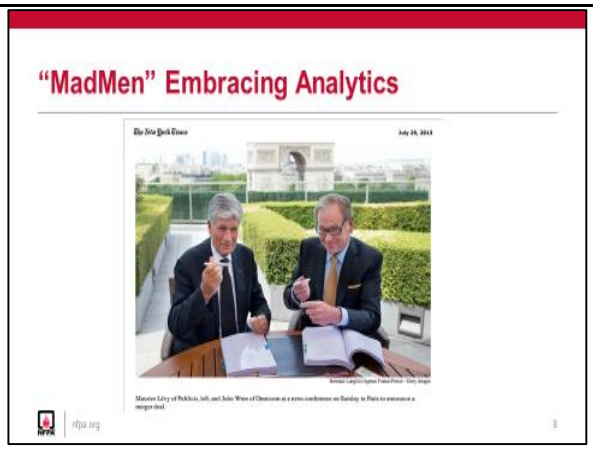
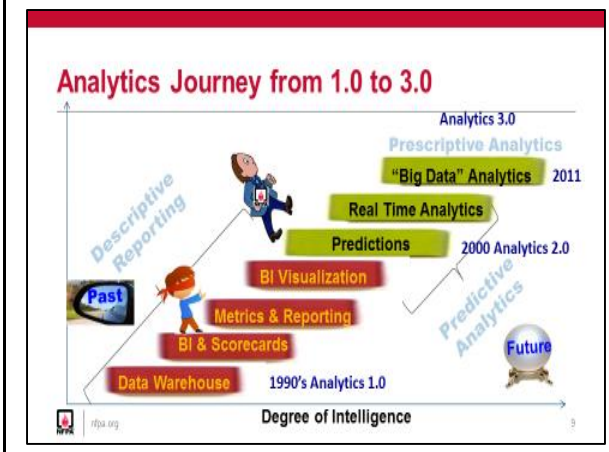
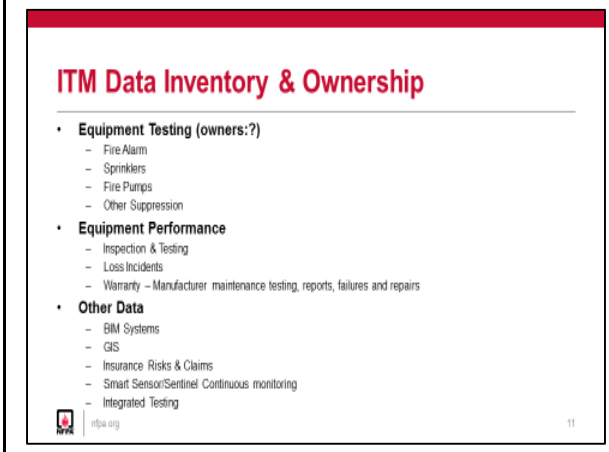


Figure 3: Presentation by Nathaniel Lin (1/3)









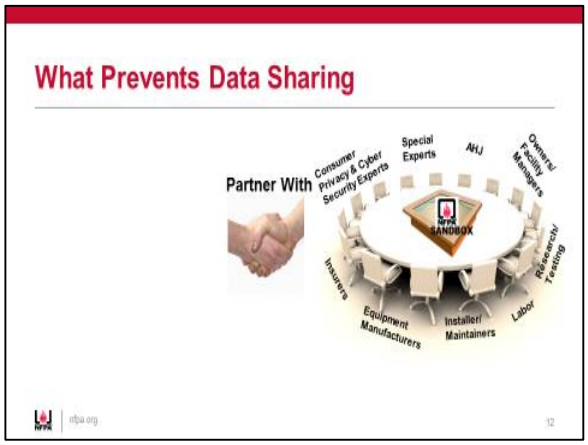


Figure 4: Presentation by Nathaniel Lin (2/3)

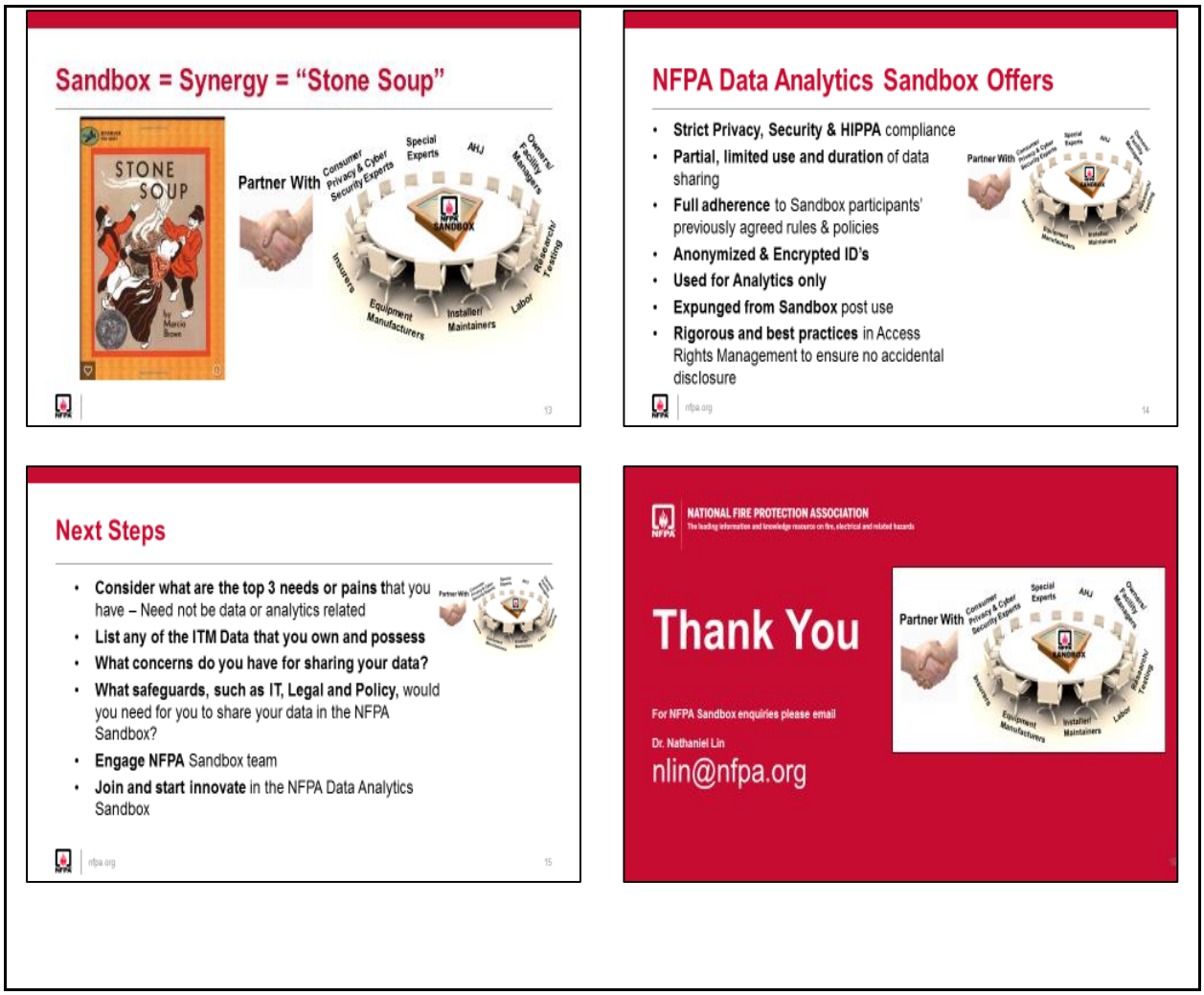


Figure 5: Presentation by Nathaniel Lin (3/3)

Going Forward from the Fire Pump Field Data Collection and Analysis Project

Gayle Pennel, P.E. - *Aon Fire Protection Engineering*

Original Project Funded and managed through

The *Fire Protection Research Foundation*

Aon Fire Protection Engineering Corporation

Project Conducted and Funded Through The *Fire Protection Research Foundation*

Report Entitled *Fire Pump Field Data Collection and Analysis*

Available for download at www.nfpa.org/foundation

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Hindrances in Developing Performance Based Codes and Standards and Reliability Analysis for Fire Protection Systems

- Lack of reliable performance information
- Lack of centralized data collection
- Lack of data reporting standardization

Characteristics of Normally Active Systems

- Normally active systems perform their designed function(s) under normal conditions
- Wear and tear on active components, equipment, and systems occur normally as they are used.
- Failures occur during normal operation
- Reliability based on normal operation
- Failures must be corrected for continued operation

Characteristics of Most Fire Protection (Normally Standby)

- Normally in standby mode
- Operate in abnormal (emergency) conditions
- Most failures develop from inactivity and age
- Most failures not apparent until system is operated
- Regular testing needed to verify condition
- Failures may not interfere with normal operations

Moving to Performance Basis

- As a result of recent technology changes, it is now possible to collect and correlate performance data during normal operation, inspection, testing, and maintenance of systems.
- Fire pumps selected for the a pilot project because they have a pressing need for reliability analysis, especially to provide a basis for the test frequency in NFPA 25.
- Use fire pumps as a basis to develop the collection and analysis techniques that can be expanded to other areas of fire protection.

Figure 6: Presentation by Gayle Pennel (1/7)

Project Research Questions

- What is the appropriate test frequency for non-flow testing of electric and diesel fire pumps?
- How well and how frequently the tests provide evidence of existing or developing problems?
- What unknown or inadequately defined issues can be improved with systematic data collection, i.e. better balance between requirements and reliability?
  - Unforeseen failure modes that may occur with new technology, product redesign, and manufacturing changes.

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Initial Considerations

- Data available manually is too time consuming to process.
- Some data acquisition may be possible from available records.
- Other data may require standardization and long term data collection.
- **Data collection should be seamlessly integrated with Inspection, Test and Maintenance procedures with minimum or no added cost.**

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Research Objectives

A. Collect and correlate existing fire pump performance data to determine
  - **Short Term and Long Term** How well and how frequently the tests provide evidence of existing or developing problems.
  - **Short Term and Long Term** The reliability of fire pumps, i.e. what is the expected impairment time for fire pumps.
  - **Long Term** The effect of test frequency on the reliability of fire pumps, i.e. what is the expected impairment time for fire pumps tested weekly, monthly, and yearly.
  - **Long Term** Failure Modes and Frequency of Failure Modes, and the down time with each failure mode.
  - **Short Term** Use the calculated expected downtime and reliability for weekly and monthly test frequencies to evaluate the non-flow test frequency requirement in NFPA 25.

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Research Objectives (continued)

B. Long Term Facilitate early identification of currently unknown or inadequately defined issues including (but not limited to)
  - Limited service controller reliability;
  - Variable speed pressure limiting pumps reliability (pressure relief valves on variable speed fire pumps because of a lack of experience); and,
  - Unforeseen failure modes that may occur with new technology, product redesign, and manufacturing change

C. Long Term Develop a standardized and statistically valid fire pump data collection framework that will accept on-going data submittals to generate a continually updated data compilation, whose analysis will substantiate the requirements for periodic testing and maintenance.

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Fire Pump Test

- Performance test required yearly – requires water flowing through the pump
- Non-Flow test required weekly for diesel fire pumps, and some electric pump but monthly for most electric fire pump (changed from weekly in the 2011 edition of NFPA some electric pumps changed to weekly in 2014)

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Initial Data Collection

- Performance testing requires analysis and many test company use electronic input which can be used to provide data collection without additional cost to the owner
- Non-flow testing may be a check mark on a form, however
- Test frequency for non-flow testing a priority

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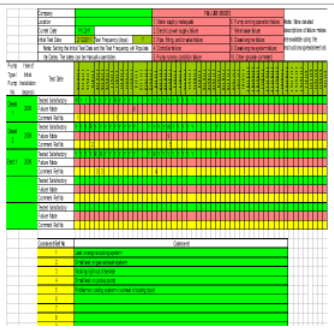
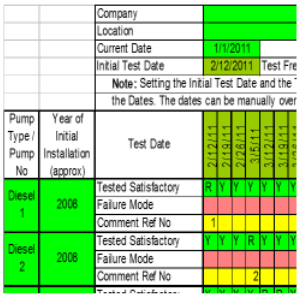
Figure 7: Presentation by Gayle Pennel (2/7)

Non-Flow Data Collection



Non-Flow Data Collection



Pass / Fail / Repair

- Tested Satisfactory This is a dropdown field that allows (**Y**)es, (**F**)ail, (**R**)epair needed but completed test, or blank answers.
- "**Y**" indicates the fire pump started automatically and was capable of delivering water at the needed pressure for the duration of the test.
- "**F**" indicates the pump did not start automatically or appeared incapable of delivering water at the needed pressure for the duration of the test.
- "**R**" indicates the fire pump is in need of repairs, but started automatically and was capable of delivering water at the needed pressure for the duration of the test.

Failure Modes

1. Water supply inadequate
2. Electric power supply failure
3. Pipe, fitting, and/or valve failure
4. Controller failure
5. Pump running condition failure
6. Pump running operation failure
7. Relief valve failure
8. Diesel engine failure
9. Diesel engine system failure
10. Other (provide comment)

Standard Performance Input

Standard Performance Input

Analysis - Desired

95% confidence level for

- Mean time between failures with different testing frequencies
- Expected impairment time with different testing frequencies

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Accomplished

Provided a rational basis (reliability) for evaluating non-flow test frequency.

	Weekly Test	Monthly Test
Electric	99.4%	97.3%
Diesel	99.0%	96.0%

– However, the code committee must still decide what reliability is significant, i.e. are weekly tests justified to increase the reliability from 97.3% to 99.4%

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What was partially completed?

- Developed standardized data collection framework and forms for fire pumps.
- A close examination of the data indicate differences in interpretation when the framework and forms are used.
- Additional description and training appear to be necessary to achieve better consistency, i.e. consistent understanding of failure and other categories.

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What was not accomplished?

- Did not establish the relationship between pump test frequency and the mean time to failure
- Additional work needed to set up Web Site and start data collection

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Lessons Learned / Extension To Other Data Needs

- Testing results must be well defined. Data collection formats should be uniform. Even if well defined may need training for data submitters to obtain reporting consistency.
- Need standarized failure modes for analysis
- Identify potential data submitters early.
- Need data submitters solicitation program. This should include direct solicitation by NFPA and announcement of the data collection process in fire protection related publications.

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Recommendations From Project

- Complete a data collection web site.
- Develop a solicitation program for users. This should include direct solicitation by NFPA and announcement of the data collection process in fire protection related publications.
- Made the data collection and analysis permanent.
- Develop data collection and data base formats for pressure regulating devices, backflow prevention devices, dry pipe valves, and quick opening devices.

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Figure 9: Presentation by Gayle Pennel (4/7)

Project Recommendation for Future

- Web site to
  - Distribute standardized electronic test non-flow and performance pump test forms
  - Collect test data
  - On going data analysis
- Develop standardized test forms, and data collection and analysis for other needs (pressure reducing valves, pressure transducers, dry pipe and deluge valves, accelerators, backflow prevention devices, etc.)

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Web Site Functional Requirements

- Allow the Web Master User to post and update Standardized Test Forms to the web site
- Allow users to sign up by providing basic information and a password.
- Allow users to download Apps with Standardized Inspection, Test and Maintenance Forms (or spreadsheets) from the web site to their computer.
- Allow users to upload test information (Using the downloaded Apps or other standardized software with Standardized Inspection Test and Maintenance Forms) from their computer to the web site.
- Allow the Web Master to retrieve those files.

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Web Site Page 1

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Acknowledgements:

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Tom Work, Dow Corning (MI)
Terry Victor, Tyco/SimplexGrinnell (MD)

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Figure 10: Presentation by Gayle Pennel (5/7)

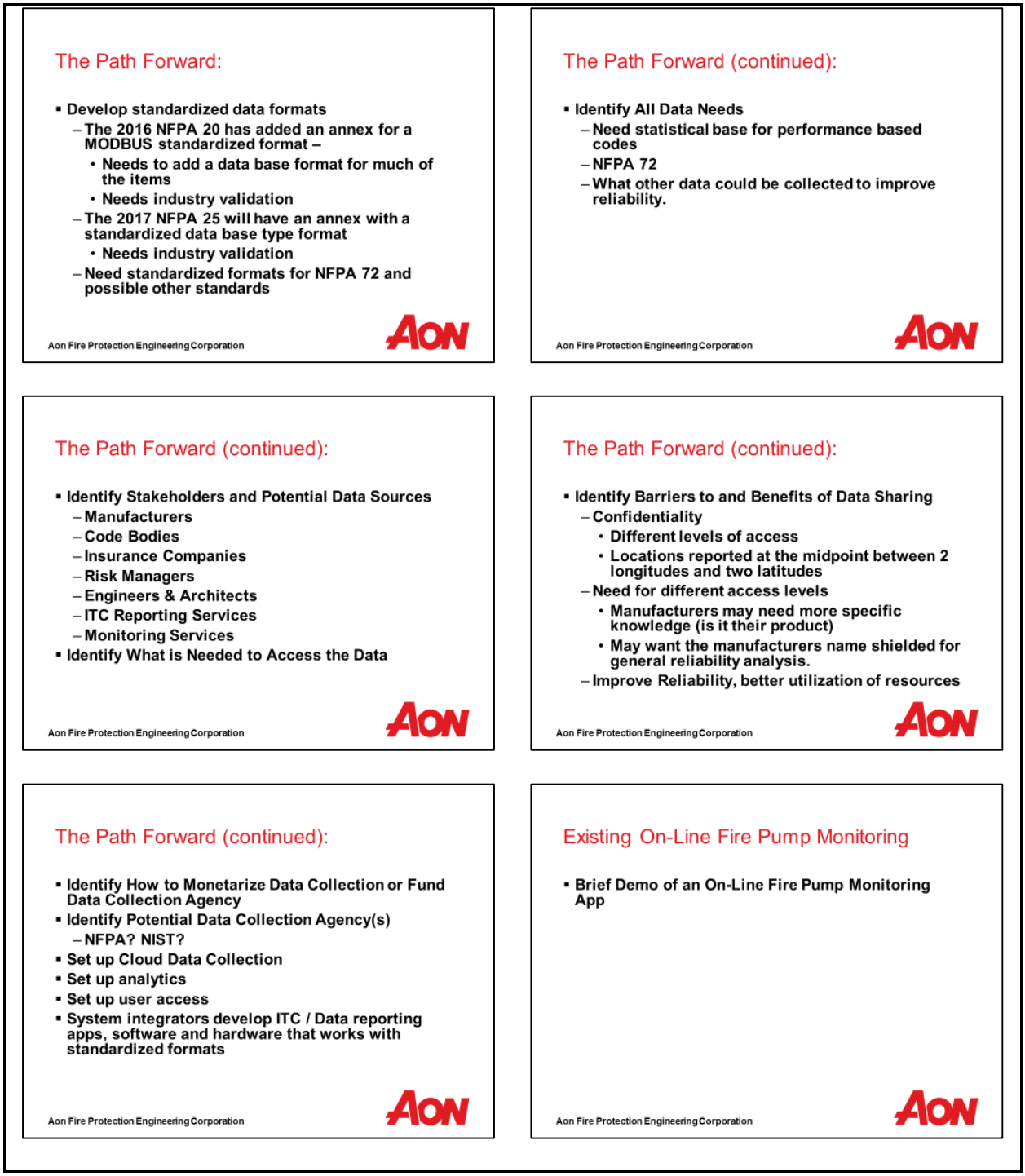

Figure 11: Presentation by Gayle Pennel (6/7)

Figure 12: Presentation by Gayle Pennel (7/7)

3) BREAKOUT GROUPS

Following introductory remarks and baseline presentations, breakout group discussions were conducted to clarify the collective consensus perspective on a series of key questions. The questions are summarized in Figure 13: Questions for Breakout Groups.

QUESTIONS FOR BREAKOUT GROUPS (SUBJECT TO UPDATE):

1. **How can data inform ITM decisions? Requirements related to frequencies for testing and reliability analysis are two uses of data that have been identified. [15 minutes]**
   - **1.1. What issues are involved in applying data to code requirements? Are there differences between fire protection system types?**
   - **1.2. What are other potential uses for data?**
2. **What specific data is needed? [15 minutes]**
   - **2.1. What equipment or systems can/should this be used for?**
   - **2.2. What are the critical data elements that need to be collected?**
   - **2.3. Standardized failure modes and system condition definitions are needed for meaningful analysis. What is the best way to develop and implement complete standardized failure modes and other needed categories?**
3. **A standardized data format annex has been added to the 2016 NFPA 20 and will be added to the 2017 NFPA 25. Is this the best way to develop standardized formats? [10 minutes]**
   - **3.1. What are the issues involved in refining these formats and gaining acceptance and usage of the formats?**
   - **3.2. What other standards could take advantage of standardized formats for data collection?**
4. **Fire protection service providers, insurance companies, and large companies are potential sources of data. [10 minutes]**
   - **4.1. What other data sources are available and should be considered?**
   - **4.2. Is existing data available in a format that could be collected and analyzed?**
5. **Fire protection equipment manufacturers, insurance companies, code making bodies, Consumer Protection Agencies, and fire protection engineers are potential users of data analysis. [10 minutes]**
   - **5.1. What other potential users can be identified? How would they use the data?**
6. **What are the potential barriers (e.g. confidentiality/privacy) and benefits (e.g. larger pool of data to drive decisions) of pooling/sharing ITM data? [10 minutes]**
   - **6.1. What will encourage potential data sources to contribute?**
   - **6.2. How can confidentiality concerns be clearly identified?**
7. **How can NFPA help? [15 minutes]**
   - **7.1. Examples: Data collection, access to database, training, facilitate changes for codes, advocacy, statistical analysis**
8. **Identify some of the opportunities for automated data collection/alerts. [10 minutes]**
   - **8.1. Is this happening now? How?**
   - **8.2. Ease of incorporating automated data collection into existing systems?**
9. **Summary Observations [5 minutes]**

Figure 13: Questions for Breakout Groups

Attendees were assigned to one of four separate breakout groups. The breakout groups were designated by color as follows: Yellow, Green, Blue and Red. The assignment of each attendee is indicated in Figure 14: Breakout Groups, which represents an attempt to provide a diverse balance of stakeholders in each respective breakout group. Each group worked separately on the set of questions and reported back at the plenary session at the end of the workshop.

1) YELLOW GROUP

First	Last	Organization
Matt	Benfer	Jensen Hughes
David	Burkhart	Code Consultants Inc.
Larry	Carmen	Victaulic
Tom	Cleary	NIST
Ben	Ditch	FM Global
Michael	Edwards	US Architect of the Capitol
Phil	Friday	Harrington Group
Tony	Gumkowski	Travelers Insurance
Jonathan	Ingram	Kidde Fenwal
Amanda	Kimball	FPRF
Roger	Montembault	TMG, Inc.
Stephen	Olenick	Combustion Science & Engr.
Bob	Schifiliti	R.P. Schifiliti Assoc.
Michael	Schultz	oneEvent Technologies
Michael	Schultz	One Event Technologies
Cathy	Stashak	Office of Illinois SFM
Mike	Widdekind	Zurich
Dwight	Wills	Building Reports

2) GREEN GROUP

First	Last	Organization
Brian	Auer	State Farm
Pat	Brock	Oklahoma State University
Paul	Clarke	Dept. of National Defence (Canada)
Bradford	Colton	American Pacific
Josh	Dinbaburg	Jensen Hughes
Eric	Esobedo	City of San Antonio DSU
Jim	Feld	UC Berkleley
Christina	Francis	Procter & Gamble
David	Fuller	FM Approvals
Wendy	Gifford	Nest Labs
Casey	Grant	FPRF
Louis	Guerrazzi	National Fire Sprinkler Association
Diane	Haithcock	UL
Kenneth	Hamburger	US NRC
Scott	Hopkins	Zurich
Greg	Radion	Apollo America
Joe	Scibetta	Building Reports
Greg	Willis	Liberty Mutual

3) BLUE GROUP

First	Last	Organization
Scott	Bailey	Koorsen Fire & Security
Donald	Boynowski	Siemens Canada
Mike	DeVore	State Farm
Gudrun	Fay	Minimax GmbH & Co. KG
Rich	Gallagher	Zurich
Kenneth	Good	Liberty Mutual
Tate	Hitzeman	Globe Fire Sprinkler Corp.
Jason	Huczek	SwRI
David	Kerr	Plano Fire Rescue
Stuart	Lloyd	Zurich
Maria	Maks	Siemens
Scott	Patterson	Peerless Pump/Grundfos
Tom	Pedersen	IKEA
Lance	Rutimann	Siemens
Jason	Ryckman	Canadian Automatic Sprinkler Assoc.
Larry	Schudak	UL
Dan	Steppan	UL
Jason	Webb	NFSA
Jacqueline	Wilmot	NFPA

4) RED GROUP

First	Last	Organization
Adam	Barowy	UL
Andrew	Berezowski	Honeywell Security
Michael	Birnkent	UTRC
John	Campbell	NRG Fire Consulting
Barry	Chase	NFPA
Scott	Futrell	Futrell Fire
Dick	Gann	Consultant
Joachim	Gensel	Minimax Fire Products
Tom	Hammerberg	AFAA
Ron	Hein	CNA Insurance
Ralf	Hetzer	WIS Munster
Richard	Kluge	Telcordia/Ericsson
Wolfgang	Kruik	University of Duisborg-Essen
John	Schertel	Apollo America
Andrew	Smith	Liberty Mutual
Mark	Smth	3M
Amin	Tohmaz	City of San Antonio
Terry	Victor	Tyco/Simplex

Figure 14: Breakout Groups

The separate results of each Breakout Group, as reported during the concluding Plenary Session are included in Figures 15 through 22, in the following sequence: Yellow Group; Green Group, Blue Group; and Red Group.

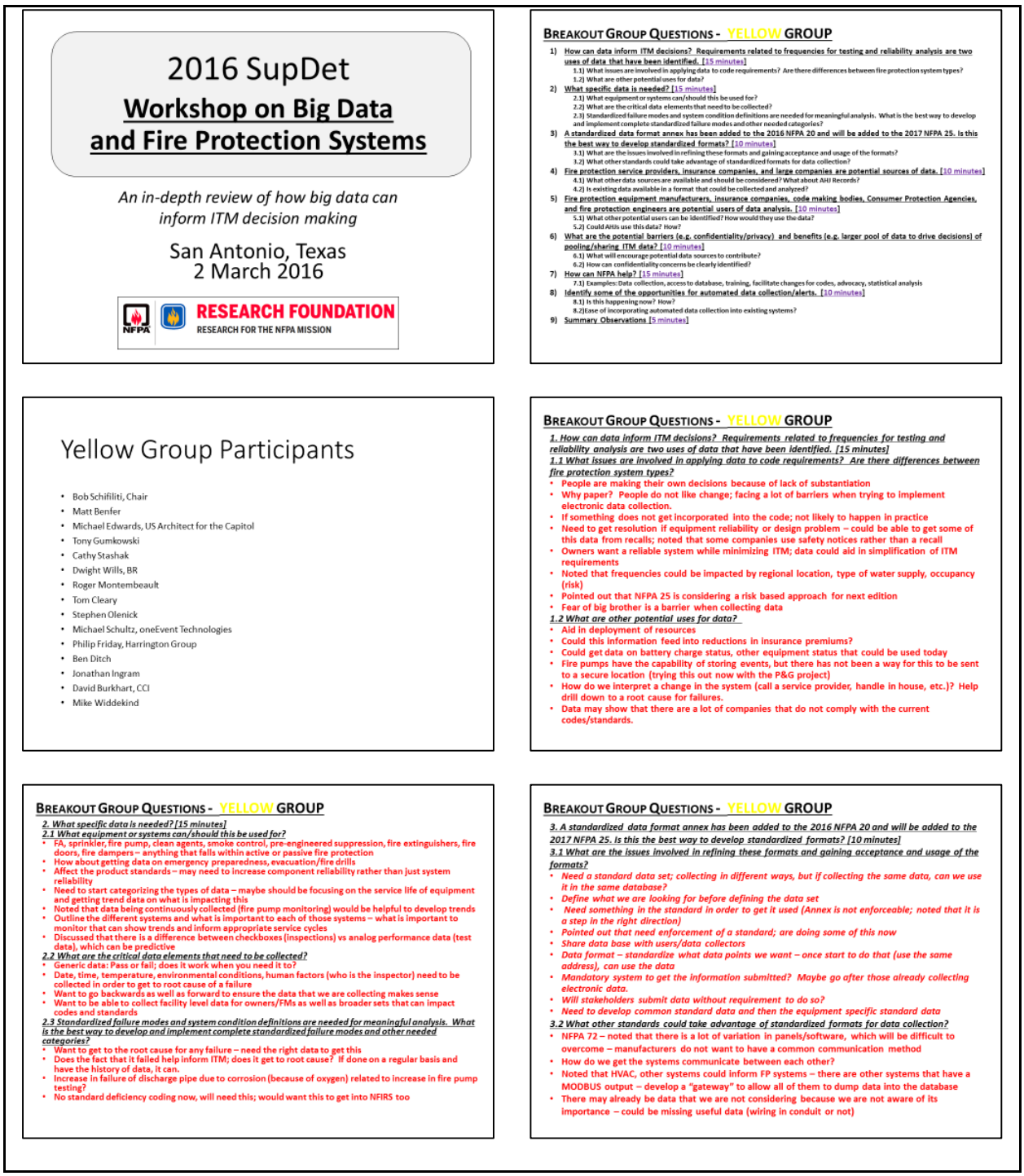

Figure 15: Breakout Group Answers - Yellow Group (1/2)

BREAKOUT GROUP QUESTIONS - YELLOW GROUP

4. Fire protection service providers, insurance companies, and large companies are potential sources of data. [10 minutes]

4.1 What other data sources are available and should be considered? What about AHJ Records?

- AHJs/fire departments – own the data? Should be public knowledge
- Service company owns the data that they collected (not owner)
- Third party reporting can aggregate the data (can make this anonymous) - BR.com and others could be interested in providing data
- Information from fire incident reports
- Consultants doing healthcare inspections
- Building owners doing self-inspections
- OSHA
- Risk managers (internal)
- Data from commissioning
- Building departments – permit information
- Census data – issue of it being obsolete as soon as collected

4.2 Is existing data available in a format that could be collected and analyzed?

- Companies collecting permit information from building departments (realty trac)

BREAKOUT GROUP QUESTIONS - YELLOW GROUP

5. Fire protection equipment manufacturers, insurance companies, code making bodies, Consumer Protection Agencies, and fire protection engineers are potential users of data analysis. [10 minutes]

5.1 What other potential users can be identified? How would they use the data?

- Building owners – to inform test/inspection frequencies
- Use to market the success of sprinkler/fire alarm/etc. systems (education)
- Do insurers benefit from the data? Agreed that yes, they do use and benefit from the data and can impact the rates. Pointed out that there are different types of insurers. A lot of data gets lost because end users do not always report back to the insurers. FD could collect some of this and fill in the gaps.
- Noted that big data shows trends and not necessarily specific data around a single system
- There is interest from the general public as well
- NFPA could benefit in getting the codes and standards being implemented more widely
- Collect trend data on fires from FD information – could get trends on industry segments (NFPA could report on these trends)
- ISO

5.2 Could AHJs use this data? How?

- Municipalities – to inform staffing levels and fees (sales tool)
- Inform risk based approaches to building inspections – spend the time where you need it most

BREAKOUT GROUP QUESTIONS - YELLOW GROUP

6. What are the potential barriers (e.g. confidentiality/privacy) and benefits (e.g. larger pool of data to drive decisions) of pooling/sharing ITM data? [10 minutes]

- Big Brother
- Ok with inspection reports being shared, but real time data is a whole other world – too much risk during transmitting data – security of data is more important in some cases than others (nuclear plants, status of an emergency alert system in a building could be used by the wrong people)
- Several examples of areas where this is happening now (home automation, etc.)
- Private organizations vs government having data – have recourse when using a private organization
- Who develops the software? Preference for private companies developing software and then sending the same data to NFPA.

6.1 What will encourage potential data sources to contribute?

- Need to have a clear statement to what data is for and what it is not for!
- Only contributors get access to results

6.2 How can confidentiality concerns be clearly identified?

- MODBUS already has scrubbed data, but can give information on type of detector/device, etc., but no location
- How to scrub inspection reports from company and other identifying information?
- Need some identifying information – zip code level? Leave it to the data experts to figure out how to scrub data.

BREAKOUT GROUP QUESTIONS - YELLOW GROUP

7. How can NFPA help? [15 minutes]

7.1 Examples: Data collection, access to database, training, facilitate changes for codes, advocacy, statistical analysis

- Develop clear guidelines
- Providing guidance to state and local government to help us collect data and to institute requirements that make sense
- Provide data portal; clear picture of what doing with the data (and status); need access to the analysis
- Need a clear roadmap
- Foster partnerships – selling to the stakeholders how they could benefit
- Do not necessarily need a 100% mandate – if get data on a percentage of fire pumps, etc., it is still very useful and can tell us a lot
- Develop guidance on how to create partnerships on data sources and data users
- Facilitate optimization of the codes

BREAKOUT GROUP QUESTIONS - YELLOW GROUP

8. Identify some of the opportunities for automated data collection/alerts. [10 minutes]

8.1 Is this happening now? How?

- Identified some of this during previous discussion
- Security monitoring
- Derivative information (NEST)
- Building automation data

8.2 Ease of incorporating automated data collection into existing systems?

BREAKOUT GROUP QUESTIONS - RED/BLUE/GREEN/YELLOW GROUP

9. Summary Observations [5 minutes]

- Bullet 1
- Bullet 2
- Bullet 3
- Bullet 4
- Bullet 5
- Bullet 6

Figure 16: Breakout Group Answers - Yellow Group (2/2)

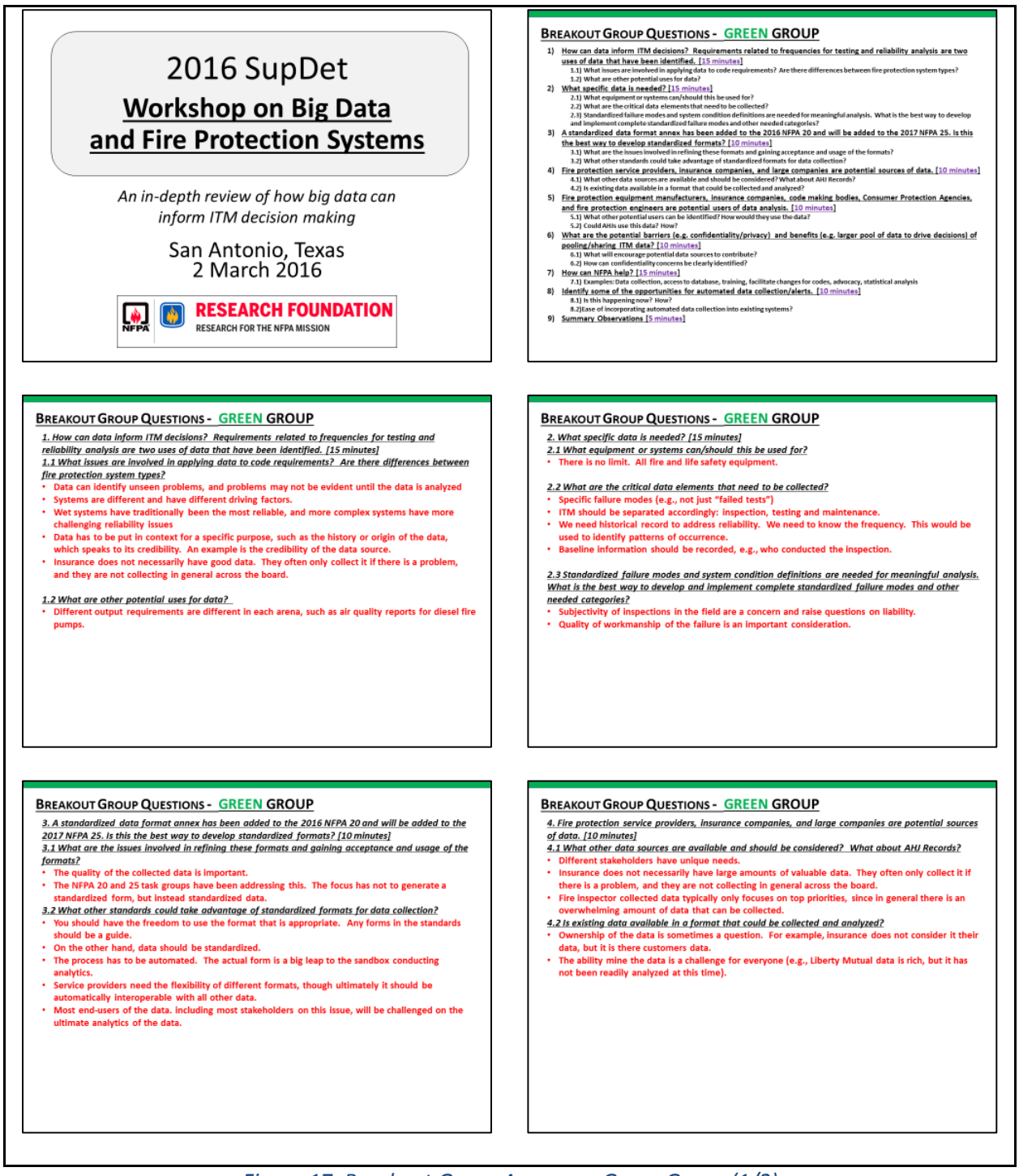

Figure 17: Breakout Group Answers - Green Group (1/2)

BREAKOUT GROUP QUESTIONS - GREEN GROUP

5. Fire protection equipment manufacturers, insurance companies, code making bodies, Consumer Protection Agencies, and fire protection engineers are potential users of data analysis. [10 minutes]
5.1 What other potential users can be identified? How would they use the data?

- There is a lot of uses for the data analysis outputs.
- There are multiple spin-off uses, such as air quality reports, environmental agencies, property owners, product certification issues, etc.
- System designers could enhance design, such as materials used in a particular design.
- Promoting the optimum technology for the specific application will be improved.

5.2 Could AHJs use this data? How?

- Absolutely. AHJs would certainly use the data analysis.

BREAKOUT GROUP QUESTIONS - GREEN GROUP

6. What are the potential barriers (e.g. confidentiality/privacy) and benefits (e.g. larger pool of data to drive decisions) of pooling/sharing ITM data? [10 minutes]
6.1 What will encourage potential data sources to contribute?

- If you don't contribute, you should not be able to benefit from the analysis.
- There are a lot of ways to mine the data.
- Consider using a tiers of who has access to the data for future analytics based on their level of contribution.
- There needs to be incentive for data contributors.
- As a barrier, here is always a possibility that a group is withholding data, and this could skew overall data results.
- An incentive to share data is to have analysis on your data that would be beneficial, such as lower insurance rates (e.g., progressive insurance model).
- Fully automate the data collection effort (e.g., not like NFIRS). This is critical. We need "Smart Reporting"

6.2 How can confidentiality concerns be clearly identified?

- Confidentiality can be built in today.
- This introduces a new level of liability if the system fails (e.g., security breeches).
- Often confidentiality is non-negotionable, such as with certain insurance data.

BREAKOUT GROUP QUESTIONS - GREEN GROUP

7. How can NFPA help? [15 minutes]
7.1 Examples: Data collection, access to database, training, facilitate changes for codes, advocacy, statistical analysis

- Two ways it has value: (1) Life and property, and (2) save money and resources
- NFPA is a credible independent trustworthy third party.
- For ITM, we need to establish justification for the frequencies that ultimately get translated into the codes and standards.
- Finding frequencies that are to something other than code (e.g., quarterly versus monthly) is a challenge, in terms of finding the data and contributing the data.
- For NFPA, we need help specifying the data that needs to be collected. This is more important than any form.
- For NFPA, we need help setting the priorities. Keep in focused. We need to limit the collection of superfluous.
- The FPRF should pursue a specific project, consistent with the recent Research Fund submittal.

BREAKOUT GROUP QUESTIONS - GREEN GROUP

8. Identify some of the opportunities for automated data collection/alerts. [10 minutes]
8.1 Is this happening now? How?

- The internet of things is putting sensors into everything.
- Sensors are being put into virtually everything. For example, some sensor technology today does not require its own power supplies and can be (and is) being installed into everything.
- In other applications, some inspections are currently being done by drones (e.g., nuclear).
- There needs to be incentive for manufacturers to install sensor technology up-front, and show how they can ultimately have value added.

8.2 Ease of incorporating automated data collection into existing systems?

- Retrofit of existing buildings is almost always now done with wireless. There is no other economically feasible way to do it.
- Keep it simple and straight-forward as possible.
- Demonstrate to end users the value added for sensor retrofit, and the money they save.

BREAKOUT GROUP QUESTIONS - GREEN GROUP

9. Summary Observations [5 minutes]

- Be careful on using spin control for the release of final analyzed data. Some will interpret very high reliability numbers as we could lesson the requirements, while others will argue more reliability is needed (e.g., protection of life).
- This is a huge responsibility. If its wrong the implication is possible loss of life.
- Data is being gathered now. But NFPA is in a unique role to be a central facilitator of collected data.
- Fire is a statistical problem at its very core. Data is needed.
- The withholding of data, and having incomplete data sets, will always be a question.
- We have different occupancies, and the ideal is to have code requirements much more customized for the specific risk. ITM can be much more customized, and therefore be more effective and efficient.

Figure 18: Breakout Group Answers - Green Group (2/2)

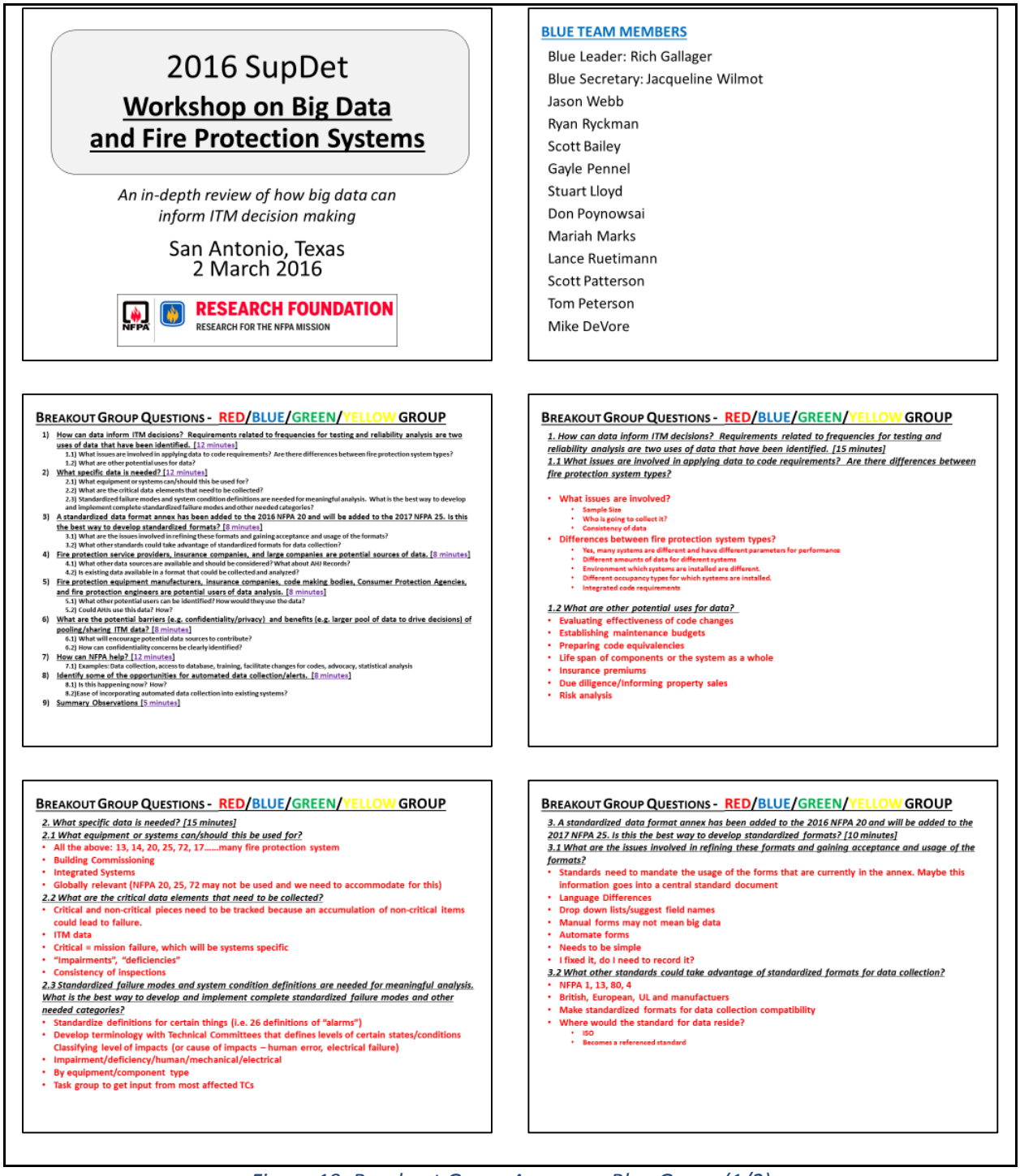

Figure 19: Breakout Group Answers - Blue Group (1/2)

BREAKOUT GROUP QUESTIONS - RED/BLUE/GREEN/YELLOW GROUP

4. Fire protection service providers, insurance companies, and large companies are potential sources of data. [10 minutes]

4.1 What other data sources are available and should be considered? What about AHJ Records?

- Military
- Government
- Third party recording services
- Building reports
- Automated systems
- Supervising/monitoring stations
- Variety of manual forms

4.2 Is existing data available in a format that could be collected and analyzed?

- Supervising/monitoring stations
- Panel event logs
- DCIM
- BAS
- Manual forms

BREAKOUT GROUP QUESTIONS - RED/BLUE/GREEN/YELLOW GROUP

5. Fire protection equipment manufacturers, insurance companies, code making bodies, Consumer Protection Agencies, and fire protection engineers are potential users of data analysis. [10 minutes]

5.1 What other potential users can be identified? How would they use the data?

- Building owners
- Potential buyers
- Building occupants
- Property managers
- Researchers
- Due diligence for events
- Architects

5.2 Could AHJs use this data? How?

- AHJs could mitigate risk (i.e. some occupancies may need to be inspected more than others)
- The more inspections increase the fees, justification for service
- Utilize resources
- Right now, everything is code driven
- Planning
- Provide more information for future for code changes
- Forensics

BREAKOUT GROUP QUESTIONS - RED/BLUE/GREEN/YELLOW GROUP

6. What are the potential barriers (e.g. confidentiality/privacy) and benefits (e.g. larger pool of data to drive decisions) of pooling/sharing ITM data? [10 minutes]

6.1 What will encourage potential data sources to contribute?

- Data protection laws
- Need to be compliant with the law
- Implement code requirements
- Change the law
- Centralized Storage
- Who has access to it?
- Who is making money on this?
- Time and cost to collect data
- Implementing uniformity
- Usability
- Incentives?
- Value proposition for stakeholders
- Who owns the data?
- Contracts
- Inspection software systems/build systems/apps

6.2 How can confidentiality concerns be clearly identified?

- ISO standards (and other resources) on how to manage data security

BREAKOUT GROUP QUESTIONS - RED/BLUE/GREEN/YELLOW GROUP

7. How can NFPA help? [15 minutes]

7.1 Examples: Data collection, access to database, training, facilitate changes for codes, advocacy, statistical analysis

- Demonstrate value to the stakeholders
- Navigate confidentiality issues
- Correlating body for this process
- MOS for data (collection and storage)
- Identify different data collection standards
- Develop standardize contracts for service companies
- Share model contracts

BREAKOUT GROUP QUESTIONS - RED/BLUE/GREEN/YELLOW GROUP

8. Identify some of the opportunities for automated data collection/alerts. [10 minutes]

8.1 Is this happening now? How?

- If the system is monitored, you can get data to some extent
- We all heard about Fire Connect for Fire Pump Monitoring in the course of this SupDet meeting

8.2 Ease of incorporating automated data collection into existing systems?

- It will be difficult
- Standardization of what your monitoring

BREAKOUT GROUP QUESTIONS - RED/BLUE/GREEN/YELLOW GROUP

9. Summary Observations [5 minutes]

- **Road to success may be a shorter path if there is a standardized way of collecting data at the international level**

Figure 20: Breakout Group Answers - Blue Team (2/2)

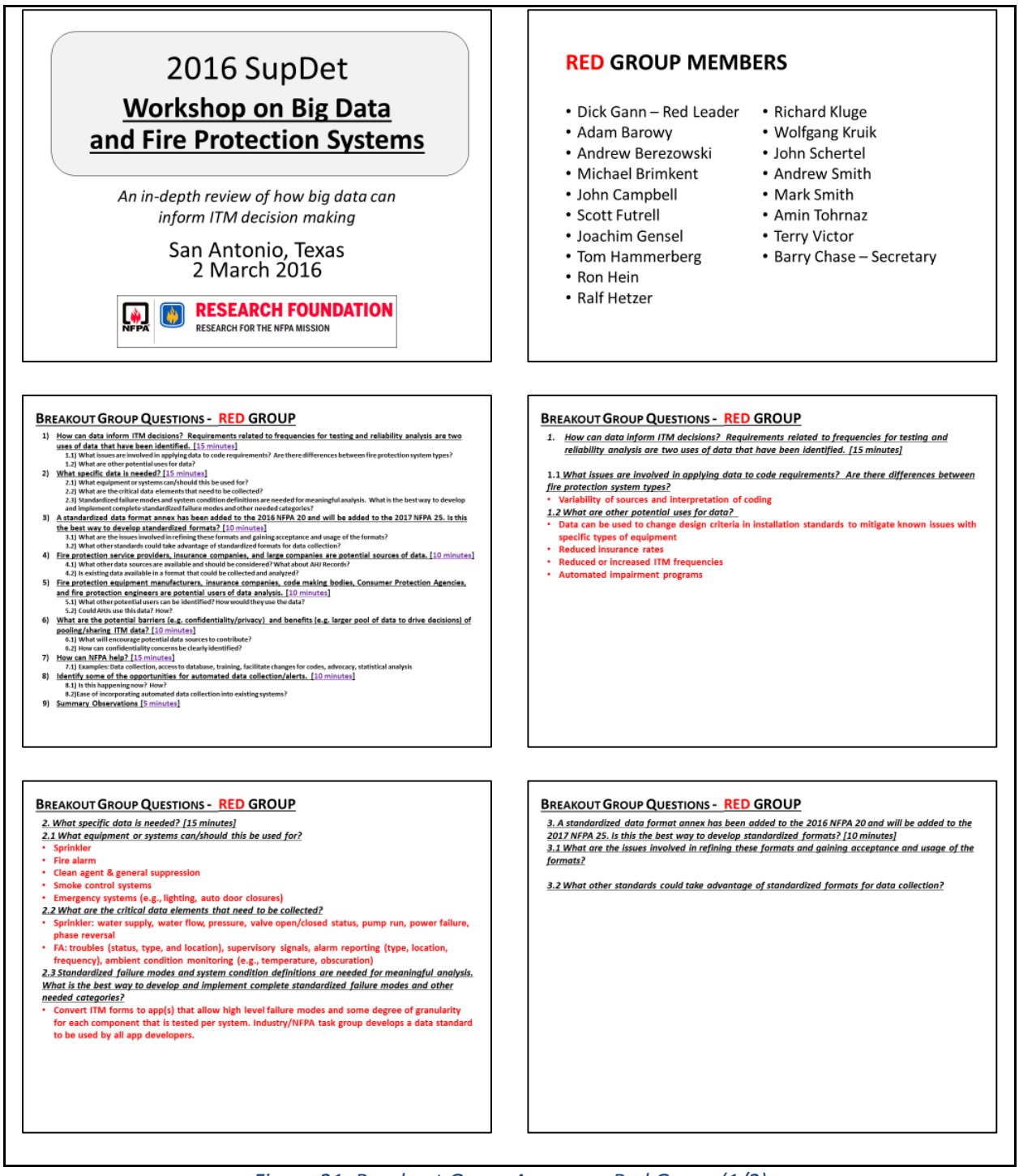

Figure 21: Breakout Group Answers - Red Group (1/2)

BREAKOUT GROUP QUESTIONS - RED GROUP

4. Fire protection service providers, insurance companies, and large companies are potential sources of data. [10 minutes]

4.1 What other data sources are available and should be considered? What about AHJ Records?

- System repair records
- Data from fires/events beyond ITM (losses in asset value)
- Other sources: Monitoring stations / Central stations, Warranty data

4.2 Is existing data available in a format that could be collected and analyzed?

BREAKOUT GROUP QUESTIONS - RED GROUP

5. Fire protection equipment manufacturers, insurance companies, code making bodies, Consumer Protection Agencies, and fire protection engineers are potential users of data analysis. [10 minutes]

5.1 What other potential users can be identified? How would they use the data?

- Inspectors
- Researchers & Product developers
- Building owners
- Public – informed of fire risk/safety
- NAHB - residential

5.2 Could AHJs use this data? How?

BREAKOUT GROUP QUESTIONS - RED GROUP

6. What are the potential barriers (e.g. confidentiality/privacy) and benefits (e.g. larger pool of data to drive decisions) of pooling/sharing ITM data? [10 minutes]

- Fear of sharing customer/distributor information (poaching)
- Legal/litigation barriers to sharing loss data
- Nondisclosure agreements / Privacy agreements
- Benefit is vague until data is available (chicken and egg problem)

6.1 What will encourage potential data sources to contribute?

- Financial or other incentive (e.g. insurance premiums) to report low-consequence events that are not reported now.
- Value of receiving data in return
- Availability of raw, scrubbed data to early adopters (no analysis)

6.2 How can confidentiality concerns be clearly identified?

BREAKOUT GROUP QUESTIONS - RED GROUP

7. How can NFPA help? [15 minutes]

7.1 Examples: Data collection, access to database, training, facilitate changes for codes, advocacy, statistical analysis

BREAKOUT GROUP QUESTIONS - RED GROUP

8. Identify some of the opportunities for automated data collection/alerts. [10 minutes]

8.1 Is this happening now? How?

8.2 Ease of incorporating automated data collection into existing systems?

- Easy to collect, but difficult to share

BREAKOUT GROUP QUESTIONS - RED GROUP

9. Summary Observations [5 minutes]

- Danger of becoming overly focused on satisfying silo data and losing focus on utility of product for application
- Need more participation from building owners

Figure 22: Breakout Group Answers - Red Group (2/2)

4) SUMMARY OBSERVATIONS

This workshop has gathered applicable stakeholder input and clarified certain information through roundtable discussions. Using Breakout Groups and through a series of structured questions, this information includes discussions on how data can inform ITM decisions, identification of key data needed, identification of potential sources of data, and clarification of how NFPA can help for the good of the fire protection community.

The Leaders for each Breakout Group presented the results from their respective Group during the workshop Plenary Session (per previous documentation in these proceedings). This information has been collected, consolidated, and synthesized. This is summarized in Figure 23: Consolidated Summary of Breakout Group Issues and Observations.

Consolidated Summary of Breakout Group Issues and Observations

1. **How can data inform ITM decisions? Requirements related to frequencies for testing and reliability analysis are two uses of data that have been identified. [15 minutes]**
   - **1.1. What issues are involved in applying data to code requirements? Are there differences between fire protection system types?**
     - Frequencies of incidents within the data could be impacted by the regional location, type of water supply, and occupancy of the building. Code requirements would be difficult to apply unilaterally.
     - There are concerns that the sample size of collected data will not be wholly representative of the current conditions of the built environment.
     - Data is often only collected if there is a negative issue, but there is also positive data available that shows the systems are functioning properly.
   - **1.2. What are other potential uses for data?**
     - Evaluating the effectiveness of new code updates. (Data can be collected in areas specific to the recent code changes).
     - Data can show the level of code compliance that company's exhibit.
     - Data can be used to change design criteria in installation standards to address known issues with specific types of equipment.
2. **What specific data is needed? [15 minutes]**
   - **2.1. What equipment or systems can/should this be used for?**
     - Fire alarms, sprinklers, fire pumps, clean agents, smoke control, pre-engineered suppression, fire extinguishers, fire doors, fire dampers, and any other systems considered "active" or "passive" fire protection.
     - There is no limit to what systems/equipment data can be collected for. All fire and life safety equipment will benefit from data collection.
     - Data specific to emergency preparedness and evacuation/fire drills can be useful.
   - **2.2. What are the critical data elements that need to be collected?**
     - Generic data such as pass/fail rates; does the system work when it is critically needed?
     - Specific failure modes for different system types, and their frequency.
     - Data specific to certain fire protection systems. Example – fire sprinklers: water supply, water flow, pressure, valve open/closed status, pump run, power failure, phase reversal, etc.

2.3. Standardized failure modes and system condition definitions are needed for meaningful analysis. What is the best way to develop and implement complete standardized failure modes and other needed categories?

- To start, it will be necessary to determine the root cause of any failure mode.
- Developing terminology with Technical Committees that defines levels of commonly occurring conditions.
- ITM forms can be converted to cell phone/tablet apps which will allow high level failure modes for each component within a system to be identified and examined by those performing testing.

3. A standardized data format annex has been added to the 2016 NFPA 20 and will be added to the 2017 NFPA 25. Is this the best way to develop standardized formats? [10 minutes]

3.1. What are the issues involved in refining these formats and gaining acceptance and usage of the formats?

- These forms being in the Annex mean that they are not required to be used. Unless they are included in the standard then it will be difficult to gain acceptance and usage of the formats.
- There may be language and terminology conflictions between different regions/companies. Standardized terminology needs to be identified.
- Manual fill-in forms may not produce the "big data" that is sought after. Perhaps different formats should be considered.

3.2. What other standards could take advantage of standardized formats for data collection?

- Other NFPA standards (e.g., NFPA 1, NFPA 4, NFPA 13, NFPA 80).
- Other standards (e.g., British Standards (BS), European standards, UL standards, ISO).

4. Fire protection service providers, insurance companies, and large companies are potential sources of data. [10 minutes]

4.1. What other data sources are available and should be considered?

- There is data available regarding system repair records. This could be useful in determining the reliability of certain systems.
- Data from fire events beyond the scope of ITM, for example losses in asset value.
- Other sources: Military and government records, third party recording services, building reports specific to fire protection systems.
- Although AHJs and fire departments own the data, it should be made available as public knowledge.

4.2. Is existing data available in a format that could be collected and analyzed?

- The ability to mine the data is a challenge for everyone. Ex: Liberty Mutual data is rich, but it has not been readily analyzed at this time.
- Supervising and monitoring stations may have data that is ready to be collected.

5. Fire protection equipment manufacturers, insurance companies, code making bodies, Consumer Protection Agencies, and fire protection engineers are potential users of data analysis. [10 minutes]

5.1. What other potential users can be identified? How would they use the data?

- Architects, building owners, property managers, building occupants, and potential buyers/renters can all use the data to perform due diligence checks.
- Insurers can use the data to analyze their insurance rates and change them based on the analysis results.
- NFPA can use the data to show why it is necessary for their codes to be adopted.
- The public can use the data to be informed about fire safety and relative risk.

5.2. Could AHJs use this data? How?

- AHJs could use this data to assist with a risk-based approach to building inspections. They can correlate the data to the current building they are inspecting in order to spend time where it's most needed.
- AHJs could also use the data to develop planning procedures.

6. What are the potential barriers (e.g. confidentiality/privacy) and benefits (e.g. larger pool of data to drive decisions) of pooling/sharing ITM data? [10 minutes]

6.1. What will encourage potential data sources to contribute?

- Barriers include: security concerns while transmitting data, groups may be withholding negative data, and nondisclosure agreements/privacy agreements.
- Creating incentives for those who provide data. For example, providing analysis on each contributor's data which would be beneficial in areas such as insurance rates.
- Uniform data collection will make it easier and more inviting for data sources to contribute.
- Only allowing contributors to access the shared data will make it more worthwhile to provide data.

6.2. How can confidentiality concerns be clearly identified?

- There are ISO standards and other resources on how to manage data security.
- Confidentiality can be built into the data collection process.

7. How can NFPA help? [15 minutes]

7.1. Examples: Data collection, access to database, training, facilitate changes for codes, advocacy, statistical analysis

- Providing guidance to state and local governments to help collect data and institute requirements that make sense.
- Fostering partnerships, i.e. selling the benefits of data collection to the stakeholders.
- NFPA can develop a clear consensus of what data needs to be collected.
- Develop a Manual of Style (MOS) for data collection and storage.

8. Identify some of the opportunities for automated data collection/alerts. [10 minutes]

8.1. Is this happening now? How?

- "Monitored" systems can provide real time data to some extent.
- Sensors are being placed into virtually everything. Some sensor technology does not require its own power supply, therefore making data collection cheap and easy.

8.2. Ease of incorporating automated data collection into existing systems?

- Demonstrate to end users the value added of retrofitting sensors into their systems, and the money they can save by collecting and analyzing their own data.
- Standardization of what is being monitored will make incorporation of automated data a smoother process.

9. Summary Observations [5 minutes]

- The road to success will be a shorter path if there is a standardized way of collecting data at the international level.
- Participation from building owners will be key to collecting useful data.
- Data is currently being gathered now, but NFPA can play a unique role as a central facilitator of collecting data.
- The ideal is to have code requirements customized for specific risk rather than system types due to the wide range of occupancy types (each occupancy requires different systems).

Figure 23: Summary of Top Issues and Key Observations.

A review of all the key themes and pertinent points of information that were raised during the workshop were presented during the concluding plenary session. These have been further distilled here into a set of summary observations. This is primarily based on the plenary presentations and discussions that occurred throughout the Workshop, along with supplemental information where referenced in Workshop discussions. Key findings from this effort support five concept categories of recommendations: (1) *general*; *(2) data collection methods*; *(3) documentation*; *(4) stakeholder benefits/concerns*; and *(5) standardization*. Specifically, these include the following:

(1) General

- **Prioritize Occupancy Focus**: For start-up efforts, first focus on certain specific occupancies such as commercial properties.
- **Support Legislative Initiatives**: Identify, clarify and support legislatively-oriented initiatives that promote the sharing of data for the public good (e.g., the State of Georgia is working on data sharing legislation).
- **NFPA's Attributes**: NFPA, as a trusted 3rd party, is an ideal organization to serve as a central data collector.
- **Stakeholder Value Added**: NFPA can develop a clear consensus of the most important data based on stakeholder needs and explain to stakeholders the value of their own data collection.
- **Code Requirement Validation**: Analysis of collected data will verify whether or not recent code updates are successful or unsuccessful.

(2) Data Collection Methods

- **Novel Collection Methods**: Consider novel approaches such as indoor drone inspection.
- Promote Automated Approaches: Automate the data collection process to improve efficiency and effectiveness (e.g., automated impairment detection program to flag impaired systems).
- **Enable External Data Sets**: Enable external unrelated data sets that can provide value-added to the overall pool of data (e.g., external real estate permitting data is presently available).
- **Data and Data Analytics Focus:** Focus on data and data analytics, and avoid any mandates of software, hardware, or similar details.
- **Positive Data Usage**: Data is often only collected if there is a negative issue, but there is also positive data available that shows the systems are functioning properly.
- **Enable User Friendly Data Collection**: Explore the aspect of user friendly data collection methods such as using mobile apps.

(3) Documentation

- **Prioritize Essential Data**: Focus on data that is essential, and do not collect unnecessary data.
- **Focus on Data Needs**: Make sure the needed data drives the data collection process and not the forms and/or format.
- **Support Confidentiality Agreements**: Address confidentiality agreements between inspectors and property owners/manufacturers as a means of obtaining data that would otherwise be unavailable.
- **Manage Evolution**: Set performance characteristics, and allow the format to naturally evolve based on usage.
- **Establish Common Terminology**: Develop standard terminology to address the language and terminology differences between different regions or companies.

(4) Stakeholder Benefits/Concerns

- **Establish Data Safeguards**: Provide safeguards for user access so that all data and data analytics is used securely and wisely (e.g., by AHJs, end-users, researchers, etc.).

- **Address Data Breach Implications**: Consider liability implications due to data breaches (e.g., consider parallel case studies).
- **Identify Unrealized Data Analytics**: Demonstrate value-added for end-users by enabling analytics they would otherwise not have, including for their own proprietary data.
- **Promote User Benefits**: Continually emphasize end user benefits and value added.
- **Address Ultimate End-User Needs**: Identify and summarize end user problems to guide data analytic efforts (e.g., using collected thermostat data to develop residential profiles for addressing smoke detector performance in extreme temperatures)

(5) Standardization

- **Utilize Existing Standards**: Consider using existing standards that address the processing and handling of confidential data (e.g., existing ISO or IEEE standards on data confidentiality)
- **Clarify Data Types**: Distinguish between mandated data collection vs. voluntary.
- **Promote Automated Data Collection**: Promote automated data collection vs. manual data collection (e.g., establish minimum standardized data stream, with flexible data format)
- **Standardize Common Baseline Data**: Standardized baseline cross-sectional common data that is necessary for all ITM systems (e.g., limited location information, system age, commissioning details, etc.).
- **Support Risk Based Data Analytics**: Create code requirements customized for specific risks rather than system types. Systems vary based on occupancy type but there will always be a level of risk (which can be determined by analyzing collected data).