EVENT NOTES

OBJECTIVES:

- Bring together leaders in academia and industry related to global safety concerns
- Identify new frontiers in public safety, especially as they relate to emerging science and technologies; educational and industry needs; and policy implications
- Honor H.W. Emmons Distinguished Lecture Award Recipient: Prof. Weicheng Fan
- Look for ways to leverage the expertise and facilities available at WPI and CGPS partner institutions to drive research, education, outreach, and strategic alliances in the advancement of global public safety concerns

ATTENDEES PRESENT:

Table 1: Laurie Leshin, Weicheng Fan, Lou Gritzo, Mike Lavoie, Michael Moore, Linda Looft, Jose Torero, Albert Simeoni

Table 2: Wole Soboyejo, Bin Yang, Dirk Steyn, Casey Grant, Xinming Huang, Milosh Puchovsky, Carlo Pinciroli

Table 3: Steve Schwartz, Bo Meng, Hui Zhang, Qiu Canghu, Eric Nette, Danielle Cote, Natalie Farny, Ali Rangwala

Table 4: Martin Dyer, Dan Gottuk, Zachary Magnone, Wayne Moore, Robert Solomon, Hongyan Zhou, Karen Bean, Jing Xiao

Table 5: Tom Connell, Shifei Shen, Yi Wang, Andrew White, Shi Yanyan, Xin Zheng, Eric Young, Thea Marcoux
Table 6: Tom Yang, Victoria Valentine, Robert Avakian III, Yi Liu, Linda Looft, Xinming Huang, Songbai Ji, Pratap Rao, Doug Petkie

Table 7: Zhang Gengyuan, Wang Guangyong, Hong Huang, Zhao Lihong, Chen Yizhou, Maohua Zhong, Jianyu Liang

Table 8: Javad Hashempour, Nima Rahbar, Khalid Saeed, Chris Scarpino, Yan Wang, Yu Zhong

Table 9: Mark Macaulay, Jeannine Coburn, Rob Krueger, Paul Mathisen, Pratap Rao, Kent Rissmiller, Wally Towner

Table 10: David Wroth, John McNeill, Shichao Liu, Gbeton Somasse, Patricia Stapleton

PANEL DISCUSSION POINTS:

**Emerging Technologies**

**Dirk Steyn**

➢ Recent advancements in fire truck technologies: electronic stability control; sophisticated pump systems; control systems for aerial devices; air bags, crash-avoidance systems

➢ New technology categories:

  o Internet of things: connected products, vehicles, apparatus; new trucks have cellular data access; can do predictive analytics with data collected (speed, location) and provide warnings via Waze app

  o Electric drive trains – constant, high torque, quiet, low heat; but need energy storage (battery) systems, need to consider that fire trucks are in service 24/7; need backup system

  o Autonomous Driving - looking at using LIDAR technologies

  o Wildland Fires – more prevalent and intense; looking to use technology to help fight wildland fires and escape these conditions
Emerging Technologies
Xinming Huang

➢ Background in ECE, processing, chip design, research on self-driving cars

➢ We have a self-driving car at WPI; using LIDAR, cameras, radars, powerful graphic processor unit in the trunk; has been driven on the highway

➢ LIDAR is one of the many sensors we’re working with; good for low light; sensitive to height, structures & obstacles; challenge is processing so much information so you can use it to make real-time decisions; customized hardware/software; deep-learning technology

Emerging Science
Eric Young

➢ Want to explore how engineered biology can be designed and used to address current public safety concerns and future threats

➢ Molecular biology
  o Can make new organisms and use them for our purposes; DNA sequencing technologies
  o Create DNA molecules & insert them to perform a program we designed them to do
  o Produced 10 molecules in 90 days

➢ Examples:
  o Engineered Chestnut trees that are resistant to fungus
  o Engineered organisms that can diagnose diseases (assess microbiome environment)
  o Biological molecules that are sensitive to contaminants in the water supply

➢ Need to be able to detect them when they’re released into the environment

➢ May be able to use them to detect other engineered organisms
Industry Needs
Mark Macaulay

➢ Concern about critical energy infrastructure
➢ Power outages that affect 10k+ households/facilities have tripled in last 20 yrs
➢ 50% of outages caused by weather; 25% by vandalism; cyber security is also a concern
➢ Energy resilience is a critical foundation for fire, water and food safety
➢ Combined heat and power technology offers options for building resilience
➢ Microgrids offer resiliency to life-saving institutions like hospitals and nursing homes

Education Needs
Jose Torero

➢ In the context of technology, there are drivers which push positive technological advancements and there are constraints which prevent the mis-use or abuse of those technologies
➢ The last three decades we have over-emphasized drivers while ignoring constraints
➢ Complexity and relaxed regulations create ambiguity in delivering constraints
➢ Complexity and ambiguity require greater competency; technology can easily be mis-used
➢ Creates enormous gap of incompetence by users
➢ Education is important – enables us to understand where the issues are and prioritize them
➢ Need to relate to other disciplines and translate knowledge into other spaces
➢ Without education, we put enormous effort into problems that don’t matter; mis-direct resources, mis-inform decision-makers; leads to conflict fueled by incompetency
➢ Want to create a critical mass of people who are educated in these spaces
➢ This creates an environment that fosters improved public safety
Policy Implications
Michael Moore

➢ Policy makers can’t be experts on every issue so collaboration is important
➢ After 9-11 we learned how important it is for local, state and federal gov’t to collaborate
➢ Government is often reactive but should be more proactive about public safety threats
➢ Some threats like cyber security affect multiple sectors which have different protocols; the Governor recently added a state committee to look at cyber security protocols in all sectors
➢ MA is looking at creating a commission of industry experts to inform law makers
➢ Any new laws passed also have to be in accordance with individuals’ rights

Perspectives from China
Hui Zhang

➢ We tend to think of technology as always being good but it creates a lot of problems for emergency response
➢ Mass events management can be a challenge
➢ Mass communication can result in traffic jams; emergency personnel cannot get to scene
➢ Cyber security is also an issue
➢ Need to educate people to help them integrate the system
➢ Need to make communities more resilient
➢ Planning workshop next year to focus on this
Audience Questions for Panelists

1. Would electric drive trains address cancer concerns for fire departments? (Casey Grant)
   - Need to consider possible mis-use of technology as well as its benefits; not so much about developing new technology as about applying it – legal, resource issues are significant barriers for the applications to move forward (Jose Torero)
   - When legislation is being developed, need to consider issues like economic development, civil rights, etc. (Michael Moore)
   - Yes, electric drive trains might play a role in reducing firefighter exposure to chemicals and contaminants which are a concern since firefighters are known to have higher rates of cancer than the general public. Already we are focusing on preventing the collection of contaminants and improving air quality in the truck cab by using HEPA filters and seat covers that are easier to clean. (Dirk Steyn)

2. For Mark Macaulay: Regarding the statistics regarding power outages, do these include terrorism? Smart City Architecture? (Robert Solomon)
   - Yes, it’s included but not a large part of the numbers. Can get more specific data to share. (Mark Macaulay)
   - Smart cities are data-driven. So users have to evolve to be data centric as well as the public itself - not just emergency services. (Jose Torero)
   - It’s tough to take the raw data. Need to take information and turn it into knowledge to control it properly. We’re getting better but aren’t there yet. New technologies will help. (Mark Macaulay)

3. Regarding Eric Young’s remark that the limitation of knowledge is a constraint, at the Grenfeld Tower incident, the British architects talked about prescriptive codes with performance driven requirements. They said we need more prescriptive requirements. So is limitation of knowledge enough or do we need a policy to decide whose knowledge we’re going to rely upon? (Russ Fleming)
• Knowledge itself is a matter of public policy. (Paraphrased:) We were not able to create an alternative to cover the gap. It should have been driven by public policy. (Jose Torero)

4. What is the role of higher education and research to help with these gaps? How do you see the challenges for us in a way we can have impact? Is what we’re proposing as institutions going to help? Do you see needs for other things that we’re not providing? (Albert Simeoni)

• We’ve over-emphasized the drivers. Universities are churning out entrepreneurs. If you go back 30-40 years, the composition was much more balanced with more professionals capable of seeing the big picture - people who could go from public service into industry. Now we’re totally under critical mass. It’s a fundamental role of government and university administration to be aware there is a need for a shift – more toward social service, not just making money. (Jose Torero)

• As a WPI graduate, I thought the curriculum at WPI does a very good job. My MQP got me my first job. It was the first report they’d ever seen. It helps you think about how you impact society as an engineer. (Mark Macaulay)

• In the past, education was model-based. Now it’s sensor/data based. In order to make decisions from data, we have to learn and then educate the public from project-based experiments. We adopt the new technology then educate our students and the public on how to use the new technology. (Xinming Huang)

• A lot of the issues I’ve heard are applicable to bio-security. The policy area is really lacking. It’s a risk when you have an example like Europe. The regulations they have about genetic engineering hamstring research more than protect the public. They didn’t include a lot of experts in the field. Forming cogent public policy is really important. Technology advances so fast that once you finally make a policy, it’s really out of date. CRISPR gene technology changed everything. How do we govern the use of this new technology when we can’t even imagine how it could be used? (Eric Young)

• More opportunity for us to work together as institutions. Our resources are limited in business. Prototypes we develop need to be reliable and durable. We can work with educational institutions to try out some of this technology (Dirk Steyn)
5. Everyone is talking about how policy impacts them. Public safety is the #1 responsibility of the government. There is no higher responsibility of our government. The MA constitution calls it out twice in the preamble. It seems like whatever side you’re on, we get more and more process, more sub-committees, and little actual progress. So what needs to change? Within the government or within the process so it can facilitate and support rather than hinder and delay the work of everyone on the panel? (Tom Connell)

- There's an initiative called federalism - to do with state rights/sovereignty - where you have a lot of legislation hampered. In MA, we’re very proactive, but sometimes we're hindered by federal pre-emption. That's why things are delayed (federal over-riding authority). In MA we go forward and have initiatives and had things deemed unconstitutional based on fed law. (Michael Moore)

- I completely agree with you that safety is the responsibility of government. We confuse that when we think the response to bad regulation is to deregulate. But the answer to bad regulation is better regulation. By deregulating, the government is handing over the responsibility that belongs to them. (Jose Torero)

- Regulation is part of a political philosophy. It really falls down to the political persuasion of the person involved and whether they think the government should be involved in regulation or not. There was a propane facility in Grafton where the local fire department couldn't step on the property because it was mandated by the surface transportation board which is federally regulated. Often the issue of regulation really falls down to politics. (Michael Moore)

6. What is the biggest problem that you think data science/predictive analytics could help you with in the next 5-10 yrs? (David Wroth)

- Data Science/analytics can solve a lot of problems. Aggregated data can do predictions. With data you can predict something before it actually happens, based on existing data before the event occurs. (Xinming Huang)

- Looking for new way to create data - not just analyze existing data. (Hui Zhang)

- A fundamental breakthrough is capacity for real-time analytics. To predict how fire will evolve, how people will move, super real-time predictions in multiple areas. One thing we need to keep in mind is we're over-emphasizing the creation of that data without having a clue what we're going to do with it. All the effort is going into that side while public policy aspects are being ignored. (Jose Torero)
7. Hui Zhang, it was mentioned the Emergency Management being a new Ministry. What is under the Emergency Management Ministry? (Casey Grant)

- In the beginning, Fire and Police were both under Public Security. Now they’ve formed a new agency so Fire is under the Ministry of Emergency Management and Police is still under Public Security. (Hui Zhang)

**Audience Questions for Keynote Speaker Lou Gritzo**

1. Did you include any global warming statistics in the flood map? (Wayne Moore)

- Yes, we biased our precipitation rates if we saw significant changes (peak precipitation, not overall precipitation rate)
- We’re working on Atlantic coastal storm surge, taking straight line extrapolation for current sea level rises.

2. When you were talking about resiliency, is that directly related to the insurability of the client? (Tom Connell)

- Not as a basis; underwriting is at an account level; will use the sum of risk assessments at the account level to assess the policy for that client. The risk index was motivated by informing risk managers who had supply chain function as well.

3. Where do you see the future of FM Global? Historically you've invested in fire and you're starting to win that fight, those numbers are finally starting to drop. But you can't do that with earthquakes and floods, that are now driving a significant portions of loss. So what does your road map for FM Global look like? (Tom Connell)

- Our natural hazard strategy is to make sure we understand the hazards globally and develop cost-effective approaches.
- For earthquakes, we start with the inside and then go out (structural components, cross-bracing).
- Wind we know fairly well, other than having global wind maps, we have a good history of doing hurricane loss prevention. We’re starting to work on tornado hazards. 80% are EF-0 or 1’s (small level)
- We've looked at geomagnetic storms, asteroid impact, the whole natural hazards thing is understanding the hazards and then developing solutions.
Audience Questions for Keynote Speaker Albert Simeoni

1. Is there a wind tunnel tour in your lab next Wed., 9/26? (Casey Grant)
   - Yes. We’re hosting people from New England and eastern Canada who manage fires so we can do some knowledge transfer with them. We'll host them to our labs and show them some of our research.

2. With your research, do you see some improvements that we can make with the public? (Robert Solomon)
   - Yes, we have a lot of suggestions and research proposed.

3. You mentioned a wide range of things that impact fire safety. What do you think has the most practical impact? (Dan Gottuk)
   - One of the most important is firefighter safety. We can really improve on that. We can help with decisions for systems. The system we use now is 45 years old.
   - The other aspect is providing the information about the question of exposure and codes and standards related to the Wildland Urban Interface. We can design tools that engineers can use and implement to design communities in these areas.

Industry Forum Feedback
Questions for Wole Soboyejo

1. I am a believer that competition is a motivator in Industry and Academia. Similar to the iGEM competition, I've seen global cities team challenges that drive everyone in an organized fashion. It fits with what you're talking about. (Casey Grant)
   - Robotics and biology inspire young people to use new tools to solve problems that we can't solve with old tools. In the process of them engaging in these competitions, they pick up a lot of skills they can use long-term. (Wole Soboyejo)
2. **What do you expect from students?** (Nadia Mofidi, WPI PhD Student)

   - To interact with firefighters and industry and policy makers to the extent that student activities can relate to real-world activities. We want them to have global exposure, not just doing things in Worcester, but in order to have local/global impact, we need to connect students to those opportunities. (Wole Soboyejo)

3. **Two areas emerging in overall design/construction market are the notion of more modular based construction & the issue of 3D printing of components and entire structural assembly that are being put together in the field. What are the challenges for engineers, architects, designers in this?** (Robert Solomon)

   - This is something we are doing at WPI. We have not yet started to work with this in the Center for Global Public Safety but if this is an area of growth that you see for us, our faculty and students are interested in working on this. (Wole Soboyejo)

4. **I've had the opportunity to do a lot of private/public partnerships between industry and academia, including WPI. Your work is great, your people are incredible. You're very unique, your project approach really sets you apart. Often it's all about the professors and researchers doing another research project but how does that carry into the classroom? Seeding this stuff for the next 20-30 years, how can we use today's challenges to engage the young minds? How do you work this kind of forum into your educational opportunities here at WPI?** (Tom Connell)

   - At multiple levels. With our unique way of educating students, we have projects funded by industry to address clearly articulated industry needs. Then students work with a professor as a facilitator. These are crucial points to push our students to work on real-world problems. We do need to look at different paradigms for the education of our students. We need to think about ways we can go beyond that.

   A course I want to do is called *Engineering in the Real World*. It’s not the usual kind of course – it brings in folks from the real world to talk about real problems. We would prepare the students for the process. We hope to enable various industry collaborators to show how engineering is done in different contexts. So students can see the breadth and depth of how engineering is done to create a different kind of classroom. (Wole Soboyejo)
• Great question. Part of that has to do with feedback from the industry. One of my titles is as liaison to engage industry. I try to incorporate those problems into my classes - not just IQP/MQP but also the classroom and independent study project (which can take the place of a course). I’m working on one of these with Zach Magnone right now. Energy storage systems is an example. Right now they present a pretty serious fire hazard. So how do you deal with energy storage systems? I bring that back to my students as a way to engage them in current problems. (Milosh Puchovsky)

• At the graduate level we introduced new courses after discussions with NAFS and identifying needs for education in engineering in the 21st century. It's very important to introduce some concepts. We'll introduce a Great Problems Seminar in fire and another one in water. We’re looking at great problems for society. We'll be reaching out to some of you that are in the room today. We have a very open context. We ask people from industry to come and we provide the basic tools. They pick the topic they like and do a project on that and meet with them 3x/week. It has to be about a great problem. (Albert Simeoni)

5. In regard to autonomous fire fighting vehicles, how much of a difference do you have to make in arrival time to really move the needle in response? Have you done an analysis on where you need to be? (Lou Gritzo)

• Just to be clear, we're not looking at an autonomous self-driving fire truck at all. We're using LIDAR for positioning. That technology is fairly far out. People behave fairly unpredictably on the road when they see lights & sirens. (Dirk Steyn)

• There is some work going on. Raytheon has a small autonomous fire truck. It's a modified military vehicle but it's probably 10-20 yrs out from now (Xinming Huang)

• There may be something in the short term for vehicle to vehicle communication. (David Wroth)

6. How do you feel about progress on these projects? (Steve Schwartz)

• I'm really encouraged on what we've seen in the last 6 mos. (Wole Woboyejo)
7. From my perspective, cancer risk for first responders is big. Research in that area is big, even for inhabitants who are escaping a fire and the effect of building materials. Are there better ways to create building materials that are less carcinogenic? Thinking about some of the earlier forum discussions, the other topic is back to data analytics. How do people at an emergency scene digest data in real-time during that event, not just the after incident analysis of data. As we have more data, how we process that data in the moment is going to be a big topic. (Steve Schwartz)

- Cancer is a very big concern in the fire service. Any exposure to smoke is very bad. I did a study on firefighters about exposure in short and long-term. It's all bad. It's something we have to integrate. (Albert Simeoni)

8. About the idea of how we can use Artificial Intelligence (AI) and machine learning systems to present real-time predictions/analytics. It's an idea we'd like to team with you to do more on. Looking over the horizon, what are safety implications of AI to people? What are implications that will arise because of AI? (David Wroth)

- As Machine learning & AI become more common, to what extent can this Center provide more education for your staff and for members? As we’ve built this Center, we’ve attracted different faculty from different backgrounds. Perhaps there’s a niche for us to also provide some value to you in the form of workforce education programs by our faculty that could enable companies to get some benefit from these capabilities we have in the Center. Would this be of interest to you? Short courses or learning opportunities for your staff? (Wole Soboyejo)

Yes (David Wroth + approx. 10 others with hands raised)

- We’d be interested in more products & technologies being incorporated and trying to apply them in the real world. Running into challenges; being able to make these really challenging complex concepts more educational for the general populace; for engineers becoming FPE engineers; making that information accessible and understandable.

I'm working on a project with Milosh, having students write white papers for application technologies. Hopefully these are good ways to move forward. (Zach Magnone)