

The background image shows a large-scale disaster scene, likely a collapsed bridge or highway overpass. Debris, including twisted metal, concrete, and rubble, is scattered across the ground. Several rescue workers in dark uniforms and reflective gear are visible, working amidst the wreckage. A large, rusted metal beam is prominent on the left side of the frame. The overall scene is one of destruction and emergency response.

# Robots to the Rescue!

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*Special thanks to NSF, ONR, ARL, DARPA, SAIC, SPAWAR San Diego, CRA, Lockheed Martin,  
Jenny Burke, Matt Long, Bob McKee, Cliff Nass, Kevin Pratt, Eric Steimle, Sam Stover, David  
Woods*

# Rescue Robots...

- Don't replace people, they do things that people and dogs can't do
- Don't eliminate jobs, they create them
- Don't raise questions of ethical use, it is an ethical imperative to use them
- *Won't succeed if it has to rely on the invisible hand of capitalism*





# Ground, Aerial, Marine Vehicles



# Definitions

- **Formative vs. Normative**

- Search and rescue is **formative** because the robots do things people have not done
- Bomb squad robots are **normative** because they *duplicate* what people already do

- **Horizon Effect**

- If I just do a little bit more, I'll be perfect...



# Urban Search and Rescue



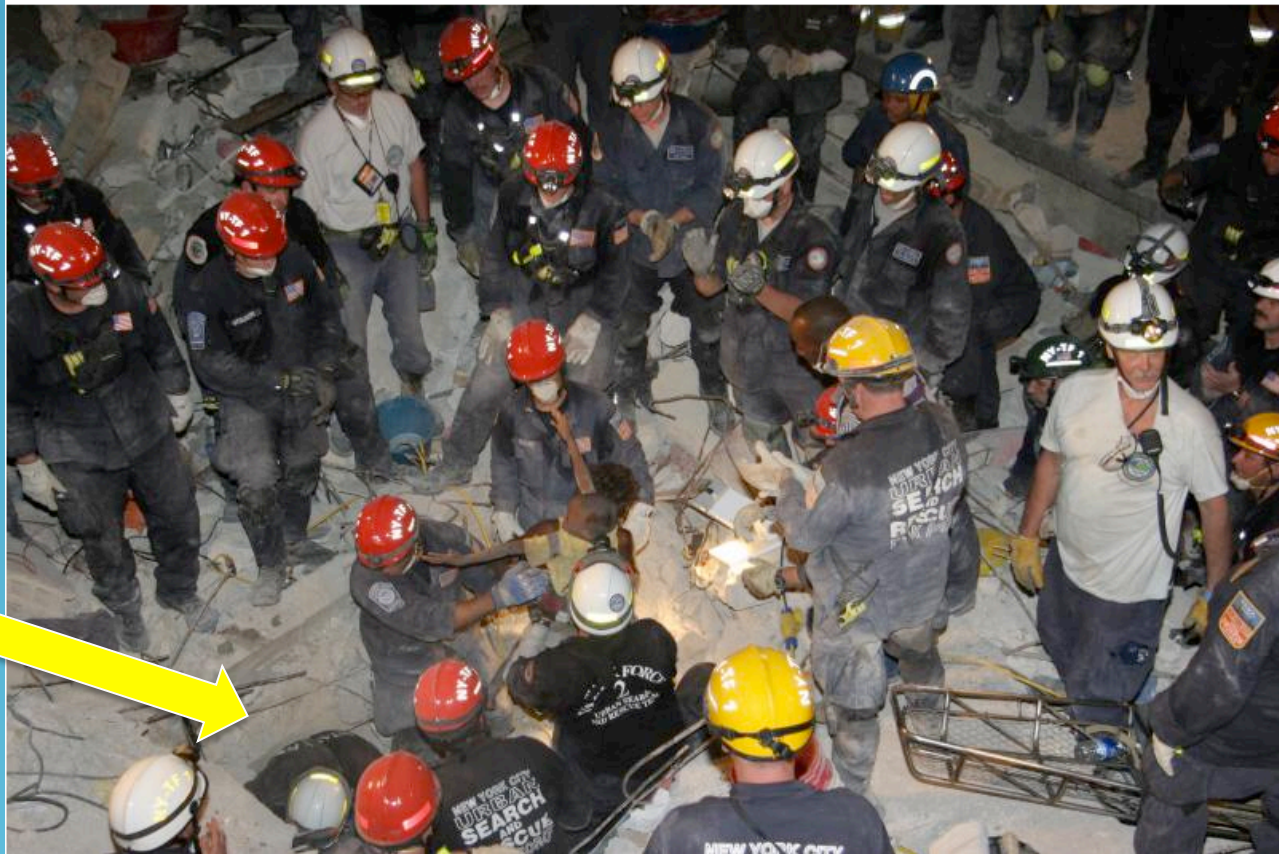
# Current Practice

- **Mortality curve is about 48 hours**
- **80% survivors are surface/ lightly trapped**
- **20% are trapped or entombed**
  - Takes 12-18 hours to find (20-40ft range)
  - Takes a team of 10 people 4-10 hours to extract
  - Medical attention only in last 20 minutes or so





# Haiti: NY-TF1 with 82 people found 6 survivors in 8 days



Void



# Rescue Robot Deployments

Rescue Robots At Responses					
	Urban	Underground Mine	Forest Fire	Wilderness	CBRNE
2001	World Trade Center	Jim Walter #5 AL			
2002					
2003					
2004	LaConchita mudslides Hurricane Charley				
2005	Hurricane Katrina Hurricane Rita				
2006		Sago WV			
2007	Berkman Plaza II	Midas NV Crandall Canyon UT	California		
2008	Hurricane Ike				
2009	Cologne Germany				
2010	Haiti*	Xinjiang China Upper Big Branch WV		Malibu**	

\*self-deployed                      On-Site but not used                      \*\* FAA violation





# USA Leads in Deployments

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# USA Regulations Are More Restrictive than Rest of World

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# Robots On-Site But Not Used

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# Why On-Site But Not Used?

## Industry

- Not engineered for unique environment
- Not engineered for adaptability



# Only 1 Fire Rescue Team in USA Owns Rescue Robots!

- NJ-TF1, a state team
- None of the 28 FEMA Teams
  - NIST is finishing standards, but no funding for purchases



# Very Few Models (8)

- CRASAR
  - National Science Foundation R4 cache: Inuktun VGTV & Extremes, AirRobot, AEOS USV
  - ***Roboticists Without Borders Program***
- MSHA, NIOSH
  - Remotec Wolverine, iRobot Packbot, Sarcos snake,\* Sandia Gemini\*
- SPAWAR San Diego Small Robot Pool
  - Inuktun Extremes, iRobot Packbot, Foster-Miller Talon
- NJ-TF1
  - Inuktun Extremes





# Why Aren't More Types and Caches?

## Industry

- Not engineered for unique environment
- Not engineered for adaptability

## Government

- Regulations stymie use
- No funds for purchasing
- Low volume, low profit



# Chicken or Egg Problem

*Imperfect because FORMATIVE*

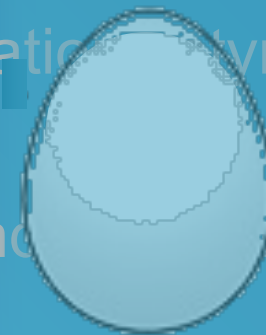
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*Stalled acquisition due to HORIZON EFFECT*



# Make Some Omelets!



- Change regulations
- Strengthen and hold accountable inter-agency transparency

***Doesn't  
Require  
Money!***





# Make Some Omelets!



- Create acquisition plan and funding that rewards rapid innovation
- Institutionalize “continuous beta” in devices and program management and post the data

**\$20-50M for  
30+ FEMA,  
State Teams**



# Make Some Omelets!



- Increase funding for Regional Clusters/  
Proof of Concept Centers/Centers of  
Excellence



# Make Some Omelets!



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  - *Texas Regional Robotics Cluster Initiative  
on Emergency Response, led by National  
Instruments, CRASAR, AUVSI*

**Huevos  
Rancheros  
Anyone?**





# Robots to the Rescue: The Economy

- A \$3.7B industry with a 20% annual growth rate
  - Assumes follows the bomb squad/law enforcement market, currently at ~\$200 million in 2009, anticipated to reach \$3.7 billion by 2016\*
- *And that's just ground robots!*



# Robots to the Rescue: Us



- Lives saved
- Lives without long-term disabilities
- Faster recovery

