# ASSURED AUTONOMY FOR DISASTER MANAGEMENT

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**(Robin) Murphy's Law of Autonomy: a deployment of robotic systems will fall short of the target level of autonomy**

*Woods, Tittle, Feil, Roesler IEEE TSMC-C 2004*

Champlain Towers Collapse, Surfside, FL



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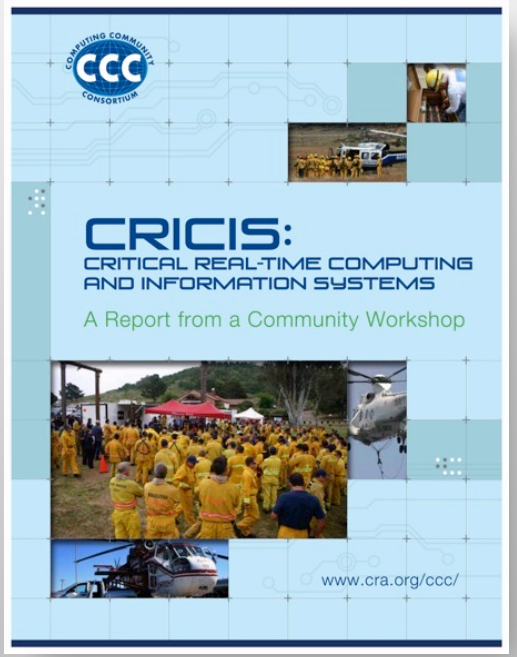
# Disaster Environments are Extreme

- **Unexpected environments and environmental interactions at the design boundaries**
  - *Which simulations tend to miss*
    - Sensors and wireless behavior is hard to simulate
    - Simulations favor task rehearsal for the "expected unexpected"
      - People fail to imagine or handle >3 variables or >6 transitions/steps in a sequence *(Klein 1999)*
    - Neglect impact on overall work processes



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# Extreme Environments Are Hard

- **Unexpected environments and environmental interactions at the design boundaries**
  - *Which simulations tend to miss*
    - Sensors and wireless behavior is hard to simulate
    - Simulations favor task rehearsal for the "expected unexpected"
      - People fail to imagine or handle >3 variables or >6 transitions/steps in a sequence *(Klein 1999)*
    - Neglect impact on overall work processes
  - ***Which probabilistic methods minimize***


https://liveindex.org/26133/2016/07/what-exactly-is-a-black-swan-event/



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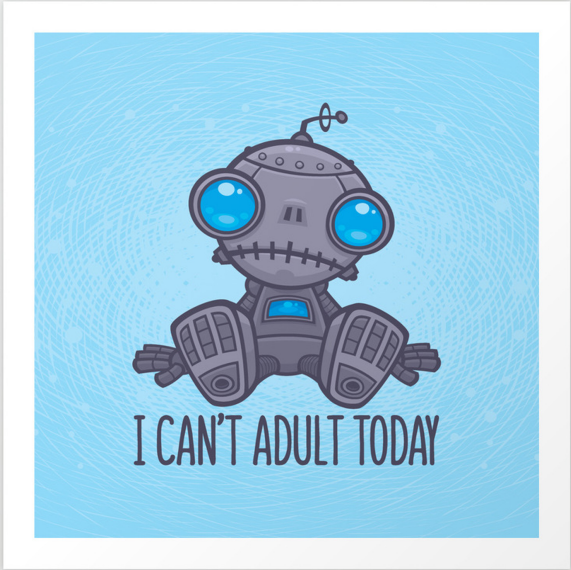
# Extreme Environments Are Hard on People

- Unexpected environments and environmental interactions at the design boundaries
- **Humans can't seamlessly take over if robot fails**
  - Heightened cognitive demands
  - High operational tempo
  - Human out-of-the-loop (OOTL) control hand-off problem




https://society6.com/product/i-cant-adult-today-sad-robot_print



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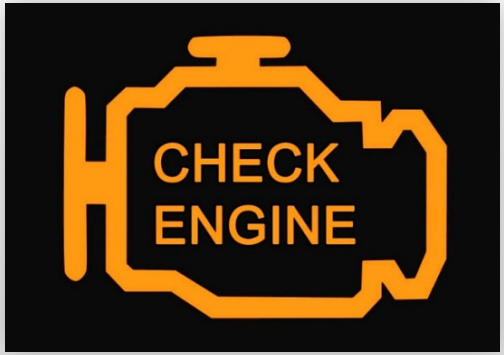
# Disasters Require Focus

- Unexpected environments and environmental interactions at the design boundaries
- **Humans can't seamlessly take over if robot fails**
- **Users don't care about explanations from explainable AI unless requested and succinctly help with decision making**




https://carwarninglights.net/warning-light/check-engine-light/

*Now? Next 10 minutes? Next 30 miles? Slow down and don't try to pass other cars and go up hills?*



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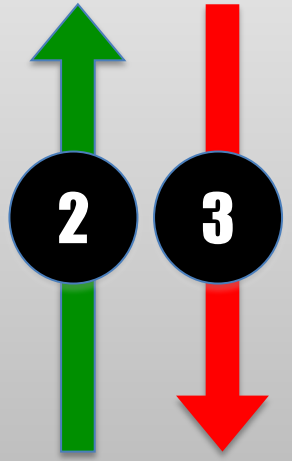
# How Do Responders Decide to Use AI Technology?

1 **Demand Pull**, not innovation push

**High Suitability**
assured operation for the expected and expected unexpected- both in terms of V&V and *work processes (extra work or support staff, wireless, training)*




**Low Risk**
Clear understanding of the worst that can happen and work-arounds



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# (More) Assured Autonomy Research Priorities

- More focus on effective **design and test methods that incorporate external factors** (e.g., complex environment and work processes)
- More work on **evidential reasoning**, not simple Bayesian probability, especially as to mission success
- New methods for **cognitive work domain analysis** for formative applications in order to project vulnerabilities and head off the Substitution Myth



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