

## Risk Management: Identification, Assessment, Mitigation, Models

In assessing risks, all possible combinations of events may be taken into account. Major disasters are rarely caused by any one factor. They arise from the unforeseeable coming together of several diverse events, each one necessary but singly insufficient.

Read the article by Crouchy: “Risk Management—A Helicopter View” .

**FIGURE 1-1**

**The Risk Management Process**



Risk is the possibility of an unexpected loss or cost

Magnitude of the risk must be determined

Risk Strategies

- Minimize downside risk:  
    Avoid, Transfer, Diversification, Mitigate
- Keep risk:  
    Accept
- Exploit upside risk:  
    Adapt

## Risk Management-Definitions and Comments from Article

**Risk Management Process:** Risks and uncertainty are inherent in life. Risk management is a conscious process to identify and select the appropriate level of uncertainty and employ strategies to attempt to bracket the levels of uncertainty.

**Risk:** Costs or Consequences will appear in an unexpected way and reduce our resources for other activities. The potential for volatility can be disruptive.

**Risk Factors:** Identification of factors that seem likely to cause the volatility in our results. There may be a number of risk factors. The relative importance of each factor can be assessed

**Risk Mitigation Strategies:** Depending upon the individual risk factor, different strategies (avoid, transfer, mitigate, keep) can be employed.



**One rule of thumb for immediate personal use:**

**Weigh Upside Potential vs. Downside Risk**

# Measuring Risk Exposures—Hurricane Damage

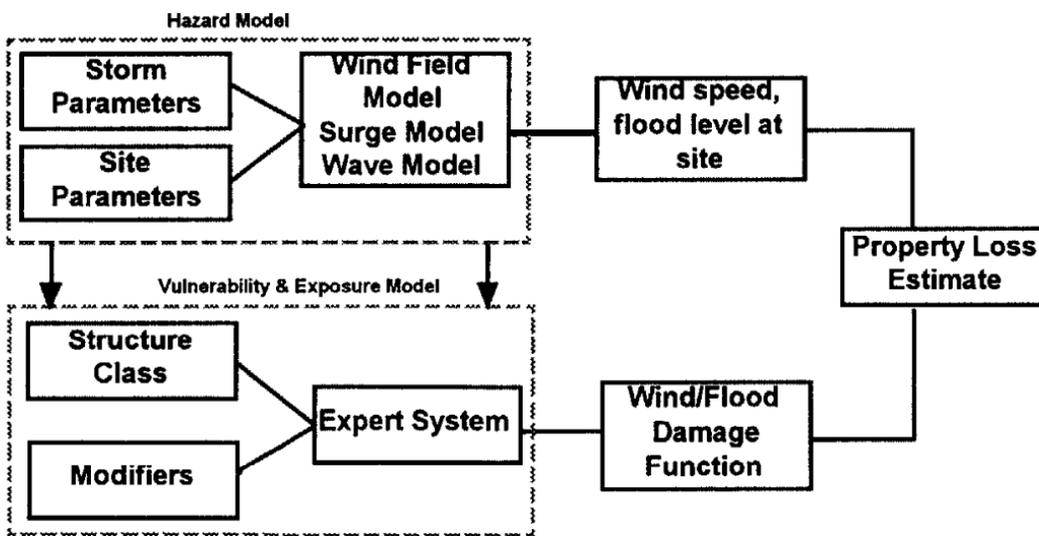
## How to Best Use Engineering Risk Analysis Models and Geographical Information Systems to

### Assess Financial Risk From Hurricanes

By Auguste Boissonnade and Peter Ulrich

<http://www.casualtyactuaries.com/pubs/dpp/dpp95/95dpp179.pdf>

The Basic Probabilistic Model Probabilistic hurricane risk models typically consist of four main components- a hazard model, a vulnerability model, an exposure model, and a financial model (See Figure 1). The hazard model calculates the probability of occurrence of different intensities of hurricane perils at a site or group of sites. These are fed into a vulnerability model and exposure model which calculate the corresponding damage level for particular construction types, building characteristics, and occupancy types. The resulting dollar loss amount is then allocated through the financial model to the insured and various insuring participants.



**Figure 1**

### Hurricane Model Schematic Flow Chart

Typical probabilistic hurricane risk models develop a series of simulated storms that reproduce the range of possible meteorological events which may affect any hurricane-prone regions. This process can be broken down into four major steps.

STEP 1 - Development of a database of simulated hurricanes.

This database should cover the range of theoretical possible hurricanes, and associate a probability of occurrence with each simulated hurricane.

STEP 2 - Development of a hurricane hazard model.

Utilizing the database of simulated hurricanes developed in STEP 1, the hazard model calculates the intensity of associated perils (generally wind and surge) from the simulated hurricanes at a desired location (e.g. the address of the property to be insured) or a group of locations.

STEP 3 - Development of a vulnerability model

The vulnerability model calculates the damage to a given structure and its contents, as well as the time related loss utilizing the hazard results at the desired location of the structure developed in STEP 2. –

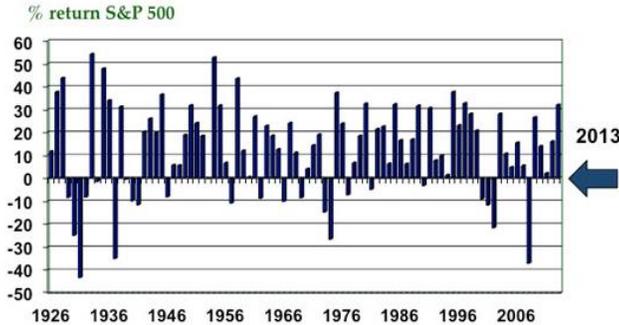
STEP 4 - Development of a financial model to calculate losses to a structure or a group of structures.

# Risk Management Strategy--Example

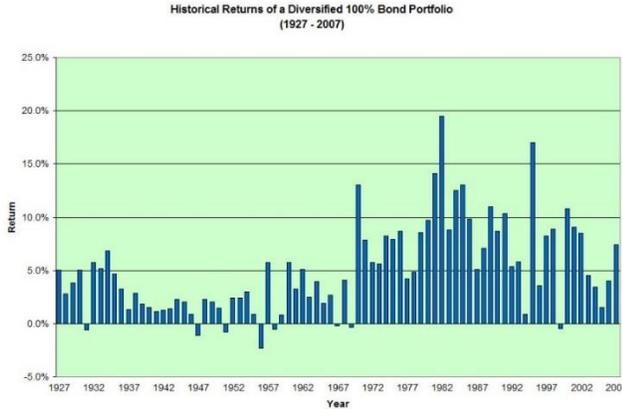
Investment Risk is minimized by diversification

Portfolio with 100% Stocks

**Annual Stock Market Returns Since 1926**  
 2008 Was 2<sup>nd</sup> Worst Year on Record,  
 But Market Has Recovered

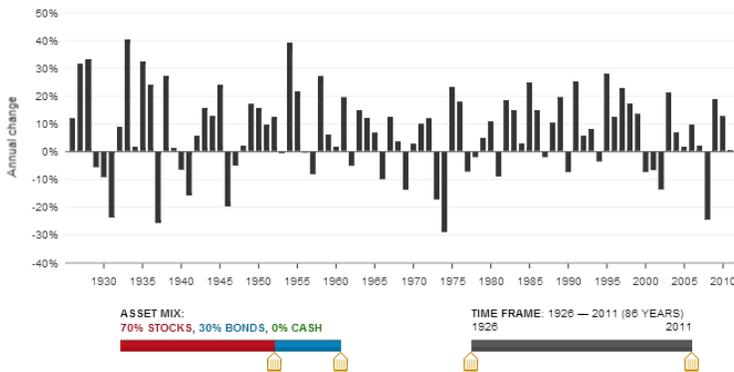


Portfolio with 100% Bonds

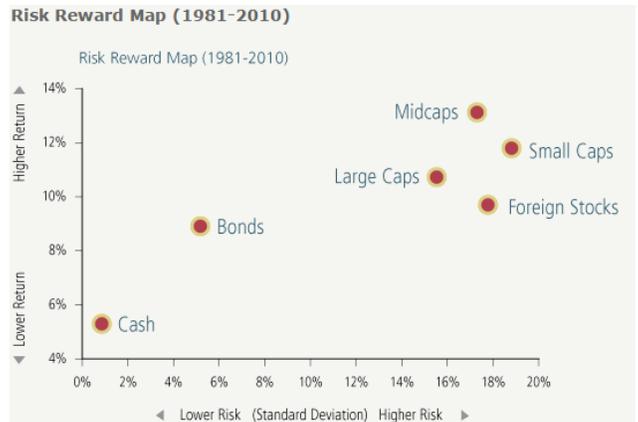


<http://www.cbsnews.com/news/stock-market-double-double-a-reason-for-optimism-2014/>; <http://www.crackerjackgreenback.com/investing/a-closer-look-at-a-diversified-100-bond-0-stock-portfolio/>

Portfolio with 70% Stocks/30% Bonds



Risk/Reward Map



<http://www.crackerjackgreenback.com/category/investing/page/2/>

[http://www.jhrollover.com/article\\_asset\\_allocation.shtml](http://www.jhrollover.com/article_asset_allocation.shtml)

Examine these graphics using the principles previously discussed.

Find specific examples of the effects of diversification for both positive and negative outcomes.

Note the effect of diversification on the volatility (range) of the returns. Qualitatively state the risk/reward tradeoff in narrative form.



# Managing Risk: Reason's Human Factors Analysis and Classification Model (Swiss Cheese Model)

## Safety Reasons Model

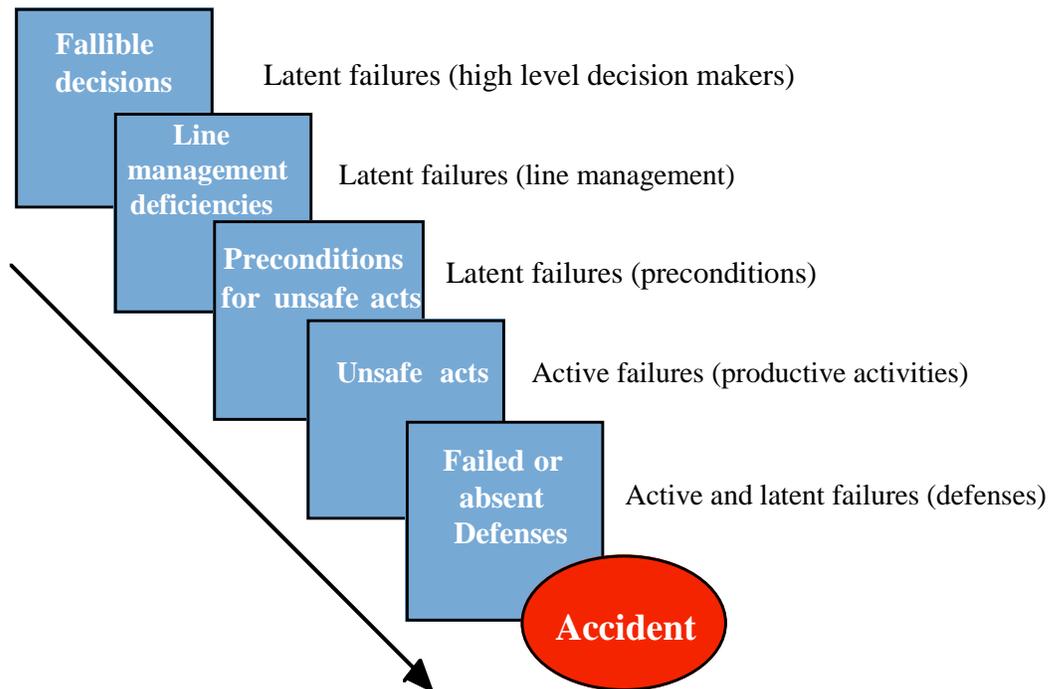
### Resident Pathogen Metaphor

PILOTS ASSOCIATION PAPER Thursday 15 September 2002,  
RICHARD M ROBINSON , Director, Risk & Reliability Associates Pty Ltd

Reason [7] has suggested a pathogen metaphor to emphasize the significance of causal factors present in the system before an accident sequence begins:

"All man-made systems contain potentially destructive agencies, like the pathogens within the human body. At any one time, each complex system will have within it a certain number of latent failures, whose effects are not immediately apparent but that can serve both to promote unsafe acts and to weaken its defense mechanisms. For the most part, they are tolerated, detected and corrected, or kept in check by protective measures (the auto-immune system). But every now and again, a set of external circumstances -- called here local triggers -- arises that combines with these resident pathogens in subtle and often unlikely ways to thwart the system's defenses and to bring about its catastrophic breakdown."

James Reason's (1993) pathogen model of how things go wrong in physical systems is described in the figure below. The idea is that latent failures in technical systems are analogous to resident pathogens in the human body, which combine with local triggering factors, for example, life stresses or toxic chemicals, to overcome the immune system and produce disease. Accidents in defended systems do not arise from single causes. Rather, they occur as a result of the adverse conjunction of several factors, each necessary but none sufficient to breach the defenses alone. And, as in the case of the human body, no technical system can ever be entirely free of pathogens.

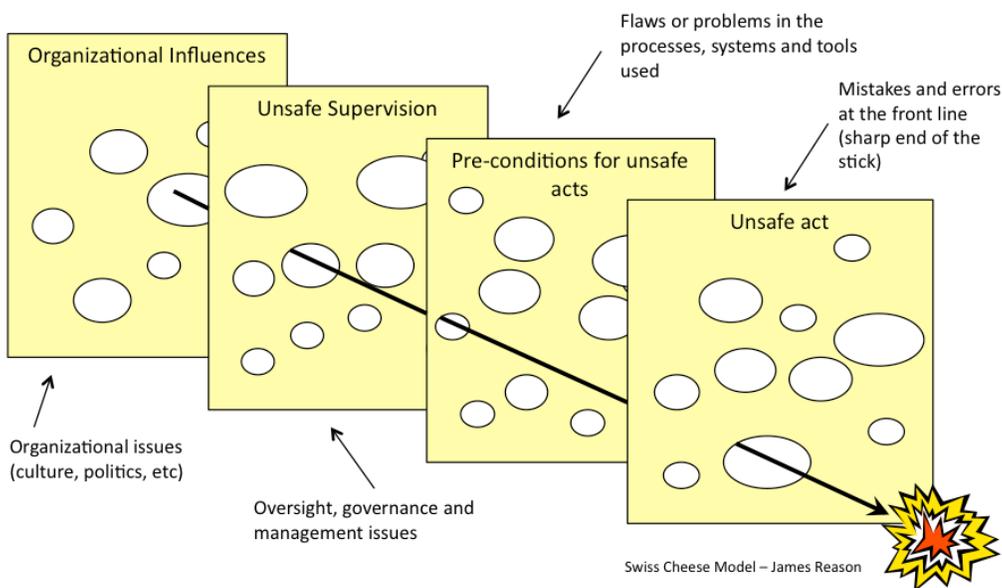


**"Reason" Resident Pathogen Metaphor Model**

Such a view leads to a number of views about accident causation:

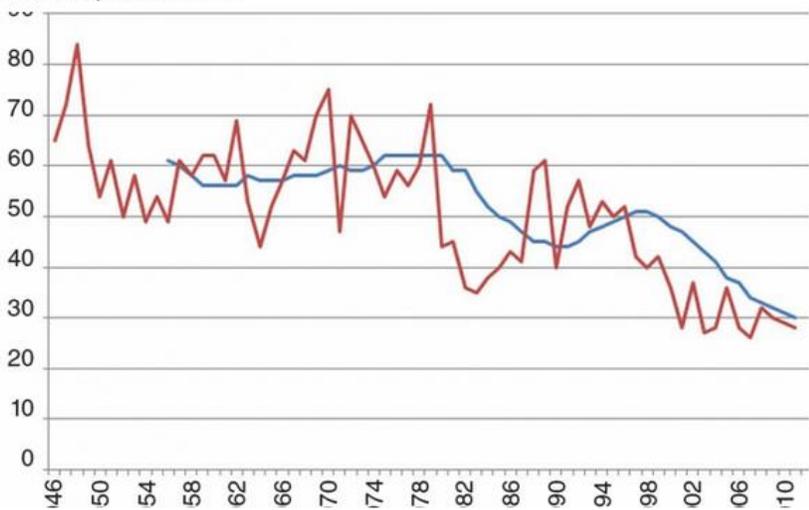
- a) Accident likelihood is a function of the number of pathogens within the system.
- b) The more complex and opaque the system, the more pathogens it will contain.
- c) Simpler, less well defended systems need fewer pathogens to bring about an accident.
- d) The higher a person's position within the decision making structure of a system, the greater the opportunity to spawn pathogens.
- e) Local triggers are hard to anticipate.
- f) Resident pathogens can be identified pro-actively.
- g) Neutralizing pathogens (latent failures) are likely to have more and wider ranging safety benefits than those directed at minimizing active failures.
- h) The establishment of diagnostic organizational signs will give general indications of the health of the high-hazard technical system.

### a) Aviation: Human Factors Analysis and Classification System (HFACS)



### Recent Period Safest for Airlines in Modern History

by Ian Goold - January 5, 2012, 12:28 PM

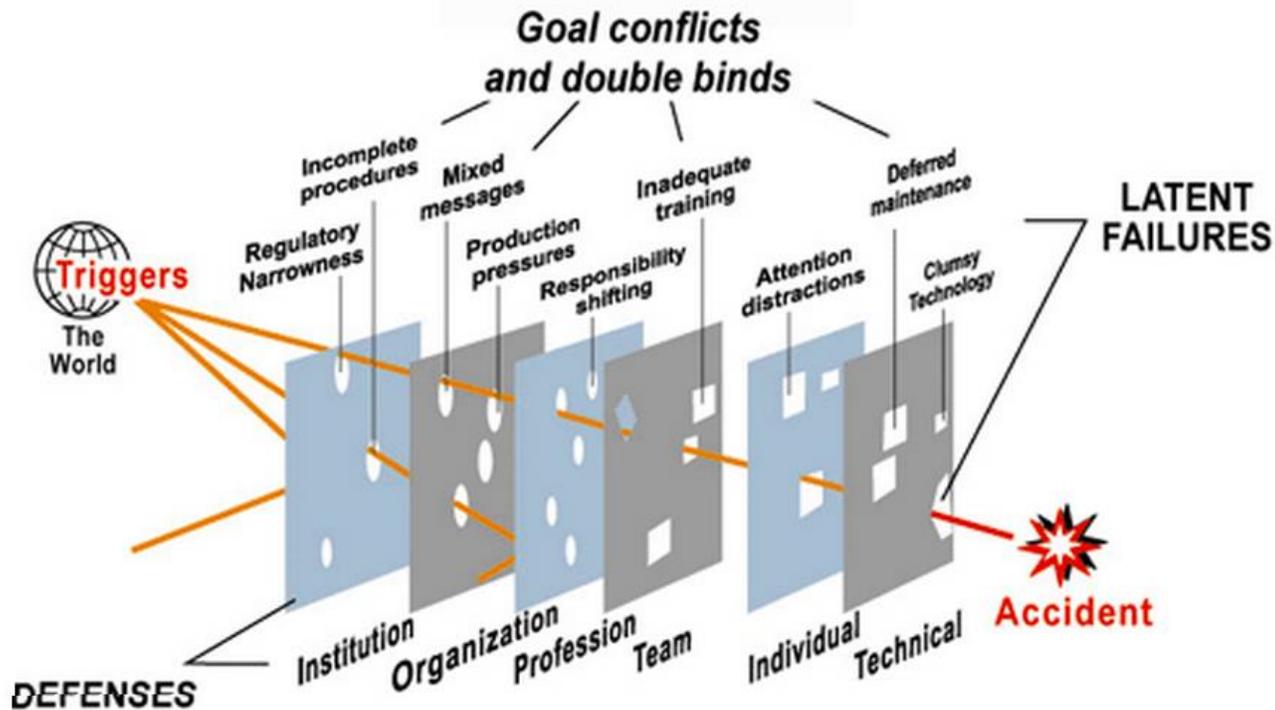


Fatal Accidents per year (moving ten year average is smooth line)

## b) Healthcare

This model was developed for aviation safety. More recently, the model has been used to reduce the frequency of accidents in hospitals. An example of a more detailed diagram is shown below.

### The Latent Failure Model of Complex System Failure



Modified from Reason, 1991

[http://www.patientsafetydesign.org/index\\_files/Page346.htm](http://www.patientsafetydesign.org/index_files/Page346.htm)

**Narrative:**

**Reason's Risk Management Process has three components**

**People:** Model is exemplified by the traditional occupational safety approach. The main emphasis are upon individual unsafe acts and personal injury accidents. It is usually policed by safety departments. The most widely used counter measures are 'fear appeal', unsafe act auditing, new procedures, training and selection.

**Engineering:** Model is system based and quantified where possible. Counter measures are engineered into the system using devices such as Hazards Analysis. Measures include quantified individual risk and societal risk.

**Organizational:** Model is allied to crisis management. Human error is a consequence and not a cause. Countermeasures aim at an 'informed culture'.

## Risk Assessment—Bias in Assigning Risk Factors

There is a tendency in our planning to confuse the unfamiliar with the improbable. The contingency that we have not considered looks strange; what looks strange is thought improbable; what is improbable need not be considered seriously (T. Schelling, Foreword in Pearl Harbor, R Wohlstetter)

### **Uncontrollable vs. Controllable:**

When preventing the risk is in someone else's hands (government's or industry's), citizens feel helpless to change the situation and are less accepting of it the citizen can prevent or reduce the risk (using household chemicals properly) the risk is more acceptable.

### **Immoral vs. Moral:**

Pollution is viewed as an evil. Therefore, some people consider it unethical for governments and industries to decide that a risk is acceptable on the basis of cost/benefit analysis or because there is a low incidence of harm.

### **Unfamiliar vs. Familiar:**

An unfamiliar risk, such as an industrial process that produces an unpronounceable chemical, is a much less acceptable risk than something more familiar, such as taking a medication.

### **Dreadful vs. Not Dreadful:**

A risk that could cause a much-feared or dreaded disease (like cancer) is seen as more dangerous than a risk that could cause a less-feared disease.

### **Uncertain vs. Certain:**

Some people become uneasy when scientists are not certain about the risk posed by a hazard, such as its exact effect, severity, or prevalence.

### **Catastrophic vs. Common:**

A risk resulting in a large-scale disastrous event (plane crash, nuclear reactor meltdown) is more dreaded than a risk affecting individuals (auto accidents, radon gas in homes).

### **Memorable vs. Ordinary:**

Potential risks similar to those in a well-known event, such as the nuclear leak at Three Mile Island or the release of toxic gases in Bhopal, are viewed as much more dangerous than the risk of some unheard-of or little-known event.

### **Unfair vs. Fair:**

People become outraged if they feel they are being wrongfully exposed (for example, in an environmental justice issue where there is exposure to a risk that people in a neighboring community or a different economic bracket are not being exposed to, or in a situation where there is exposure to a risk with no benefit). In contrast, people will accept the risk of exposure to something like medical X-rays because they perceive a benefit that equals or outweighs the risk.

### **Untrustworthy vs. Trustworthy:**

People become outraged if they have no confidence in the institution that is the source of the risk (such as an untrustworthy company or agency). In contrast, they tend to accept risk from what they view as a reliable source.

Sources: Kamrin, Michael; Dolores J. Katz; and Martha L. Walter. *Reporting on Risk: A Journalist's Handbook on Environmental Risk Assessment*. Ann Arbor, MI: Michigan Sea Grant Program and The Foundation for American Communications, 1995.

National Research Council. *Improving Risk Communication*. Washington, DC: National Academy Press, 1989.

Slovic, Paul; Baruch Fischhoff; and Sarah Lichtenstein. "Facts and Fears: Understanding Perceived Risk." In Richard C. Schwing and

## Risk Assessment Problems

1. During a fire drill, it is observed that some students exit through the main door, rather than the designated side entrance. The main door was intended to be clear so that the first responders can enter the building quickly. Make a Reason's diagram which illustrates the different levels of responsibility for this error.
2. The NYC Bike Sharing program has put many more riders on the street. One student was hit by a car on Houston Street. Analyze the different levels of risk for this situation.
3. There was an account in the news about the story of three fishermen who survived 9 months adrift at sea in a 29 foot boat. (NY Times 8/26/06 A3). Background—The boat and crew were on a shark-fishing trip, which typically lasts from 3 days to a week. These trips follow the fish and there is no radio for land contact. There was concern at the outset that enough provisions (food, water, fuel) had been laid in for the trip. At sea, the crew lost their shark-fishing tackle. During the search for the equipment, they ran out of fuel. Winds pushed them out to sea where a current caught them and carried the boat 5000 miles west from Mexico to the Marshall Islands. There, the survivors were rescued by a fishing boat.

This event was a consequence of a series of breakdowns or coincidences. Express these in a diagram that follows Reason's model. Label each level of hierarchy and assign the events associated with each filter

4. (E3 S13)An elderly patient is taken to the emergency room by his wife after the patient cut himself. The patient was treated by a physician immediately by stitching the wound and prescribing antibiotics to reduce the risk of infection. A medical history was not taken. The pharmacist dispenses the prescription drug to the nurse without comment, who then administers it to the patient. Unfortunately, the patient is allergic to antibiotics and goes into cardiac arrest.

Modify Reason's method of risk assessment hierarchies and assign each of the preconditions to the appropriate category. Analyze the diagram and make a table listing Risk Factors and Mitigation Strategies for each risk factor.

5. Evaluate your own bias by estimating the relative risks of bicycling, auto travel, and air travel. Find a data table to check your perception against the experience..

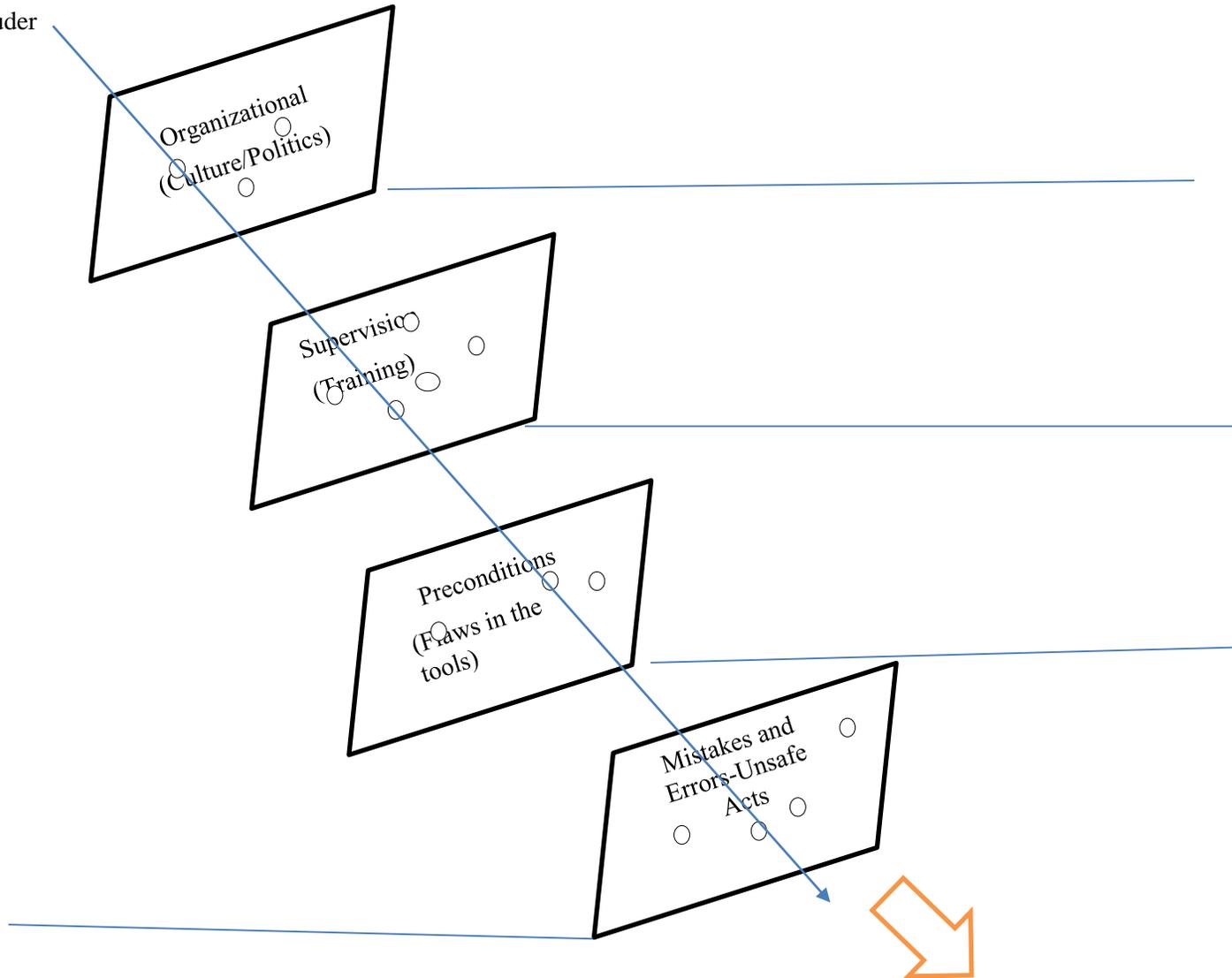
## 6. White House Break-in

In September, 2014, a single intruder climbed the fence at the White House and made his way inside the building without being stopped by the Secret Service. This incident, a most serious breakdown in security, is currently being investigated. The NY Times recently published a summary of the incident report found on the next page.

<http://www.nytimes.com/2014/09/30/us/white-house-intruder-got-farther-than-first-reported-official-says.html?emc=eta1>.

You are given the responsibility to reorganize the security operation around the President. The first task is to understand the event in terms of the Reason's model of Risk Management. Then you will be in a position to make comprehensive set of recommendations to insure the safety of the President. Read the attached article, note all of the breakdowns and match them next to the appropriate category the on the diagram below.

Intruder



## Armed Intruder at White House Got to East Room

A version of this article appeared in print on September 30, 2014, on page A1 of the New York Times. Matt Apuzzo and Charlie Savage contributed reporting.

The hearing is set to focus on a series of security embarrassments over the last several years, including a breach that occurred when a couple crashed a state dinner in 2009, a 2011 incident when bullets struck the White House, scandals involving drinking and prostitution on overseas trips in 2012 and 2013, and 16 separate cases of people scaling the White House fence in the last five years. Ms. Pierson became director in 2013.

According to a law enforcement official briefed on the current investigation, uniformed Secret Service officers at the White House failed to follow several of the agency's protocols. Although the protocols call for an officer to be standing outside the North Portico door, there was no officer there as Mr. Gonzalez made his way up the steps. The officer who was stationed inside the door failed to lock it after an alarm was sounded that someone had jumped over the fence, the official said.

"At all times there is supposed to be someone at the outside and the inside of the door," the official said. "The intruder was running so fast that he gets right past the woman who didn't lock the door. She tries to catch him, and eventually she and another officer tackle the man to the ground, but by that time he was pretty far in."

It has been unheard of in recent decades for an intruder to force his way into the White House, even if only a few steps inside what is supposed to be one of the most secure buildings in the world. Officials in Washington were stunned that Mr. Gonzalez was able to pass by the staircase that leads to the White House family quarters and get as far as the East Room, the ballroom where the cellist Pablo Casals played for President John F. Kennedy and where President Obama announced the death of Osama bin Laden.

Mr. Chaffetz said that Mr. Gonzalez ran from the north front of the White House into the Entrance Hall and then into the 80-foot-long East Room, where he was finally stopped by Secret Service officers at a Green Room entrance near the south side of the mansion. The Obama family was not home at the time.

In addition, Mr. Chaffetz said a system designed to alert agents that a breach of security was in progress apparently did not work as intended, allowing Mr. Gonzalez to surprise the officer at the door. Mr. Chaffetz said that he was told the "crash box" had been silenced or muted at the request of White House ushers, who had complained the boxes were too noisy.

"It's an astounding set of facts," said Representative Gerald E. Connolly of Virginia, a Democratic member of the committee. "It just boggles the imagination and is deeply destabilizing in terms of public confidence in the Secret Service and how it is carrying out its mission."

The new details are strikingly different from what Secret Service officials first said happened on Sept. 19, the day Mr. Gonzalez breached the building. In a statement on Sept. 20, the agency said Mr. Gonzalez "was physically apprehended after entering the White House North Portico doors" — leaving the impression that Secret Service officers tackled Mr. Gonzalez just steps after he opened the door and walked through. Secret Service officials said nothing in their public comments to suggest otherwise.

In its initial briefings, the Secret Service did not inform the Department of Homeland Security, which oversees the agency, that the intruder had made it so far inside the White House, according to an official familiar with the conversations. But the official said that until a final investigation was complete, the department could not confirm or deny the new account.

White House officials also did nothing in the last week to correct the impression that Mr. Gonzalez had been stopped just inside the front door of the building. Josh Earnest, the White House press secretary, was asked repeatedly about the incident in the days after it happened and did not disclose the extent of the breach.

Asked about the new disclosures on Monday, Mr. Earnest referred to comments he made to reporters earlier in the day. Mr. Earnest said that the president retained “full confidence” in Ms. Pierson but that the incident was “an issue that the president is obviously concerned about.”

It is unclear when Mr. Obama learned of how far Mr. Gonzalez had penetrated the White House. West Wing officials previously said Ms. Pierson briefed Mr. Obama about the incident during an Oval Office meeting last week, but they would not say what details she disclosed at the time.

On Tuesday, Ms. Pierson will appear before the House Committee on Oversight and Government Reform, and will hear from lawmakers in both parties who said they would demand explanations for other breaches as well, including recent revelations about a slow and incomplete response by the Secret Service to the incident in 2011, when a man fired seven shots into the south side of the White House.

“Have there been some other serious breaches?” Mr. Chaffetz said. “Absolutely.” He said the 2011 incident was “about as bungled as could possibly be,” but he said lawmakers on the committee have received numerous reports about security breaches that have not yet been made public.

The Washington Post reported that Mr. Obama and Michelle Obama were furious that they had not been made aware of the 2011 incident until days after it happened.

Representative Elijah E. Cummings of Maryland, the senior Democrat on the committee, said he would insist that Ms. Pierson explain why Secret Service officials in charge of protection around the grounds of 1600 Pennsylvania Avenue appear not to have listened to agents on the ground that night in 2011 who believed shots had been fired at the White House. “I want to know what culture allows that to happen in an organization that is supposed to be the most elite protective agency in the world,” Mr. Cummings said.

<http://www.nytimes.com/2014/09/30/us/white-house-intruder-got-farther-than-first-reported-official-says.html?emc=eta1>

