ADVANCED WARNING OPERATIONS COURSE (AWOC)

- FY13 OBJECTIVES

Core Track

IC Core 1: Optimizing Learning

Lesson 1: Optimizing Learning

Learning Objectives

1. Identify the key factors to maximize learning and transfer of learning in AWOC.
2. Identify the ways learning in AWOC is facilitated.
3. Identify how your learning in AWOC will be evaluated.

IC Core 2: Situational Awareness and Decision Making in a Warning Environment

Lesson 1: The Warning Process and the Role of Intuition

Learning Objective

1. Identify conditions favoring analytical and intuitive decision making styles.

Lesson 2: Individual SA

Learning Objectives

1. Identify definitions, examples and failures of the three levels of SA.
2. Identify factors that can impact getting and maintaining individual SA.

Performance Objectives

1. Using specific data examples, identify the three levels of SA and how they are contributing to your warning decisions, while working:

a) WES simulations, and

b) Warning events.

2. As part of post-event analysis, determine the role that SA (good or bad) at the three levels played in the warning decisions that were made.

Lesson 3: Team SA

Learning Objective

1. Identify factors that can impact getting and maintaining team SA.

Performance Objectives

1. Using specific data examples, identify the three levels of SA and how they are contributing to your warning decisions, while working:

a) WES simulations, and

b) Warning events.

2. As part of post-event analysis, determine the role that SA (good or bad) at the three levels played in the warning decisions that were made.

Lesson 4: SA Demons: The Enemies of Situation Awareness

Learning Objective

1. Identify the SA demons and how they can inhibit SA.

Performance Objective

1. As part of post-event analysis, determine the role that SA (good or bad) at the

three levels played in the warning decisions that were made.

Lesson 5: Maintaining Situation Awareness by Managing the Unexpected

Learning Objectives

1. Identify the two practices that can help facilitate a prompt response to unexpected events.
2. Identify the attributes of the operating environment of a Highly Reliable Organization.
3. Identify the 5 characteristics of a Highly Reliable Organization.
4. State the impact of overconfidence on responding to the unexpected.

IC Core 3: Expertise and Effective Office Warning Strategies

Lesson 1: Expertise

Learning Objectives

1. Identify the differences between routine experts, adaptive experts, and novices.
2. Identify the characteristics of an adaptive expert.
3. Describe how interactions with automation can hinder expertise.
4. Identify ways in which expertise is developed.

Lesson 2: Cognitive Task Analysis of Expert Warning Forecasters

Learning Objectives

1. Define a cognitive task analysis
2. Identify the results of the NWS CTA on expert warning forecasters

Lesson 3: Learning from Post-Mortems

Learning Objectives

1. Identify the potential benefits of a post-mortem analysis
2. Identify characteristics of ineffective post- mortems
3. Identify the value of having a post-mortem database
4. State what is meant by human error
5. State the impact of the hindsight and outcome biases on performing post-mortems
6. Explain the value and meaning of a root cause analysis

Performance Objectives

1. Using the examples provided, do a simple Root Cause Analysis on the 2 events described.
2. Using root cause structure, perform an analysis on one particular warning or forecast decision you made or were involved in.

IC Core 4: Conveying Warnings and Public Response

Lesson 1: Mitigating Potential Errors in Spotter Reports

Learning Objectives

1. Identify the sources of storm reports (i.e., how they are received and from whom) as well as their strengths and weaknesses
2. Identify common storm reports errors and how they occur
3. Identify the mitigation steps discussed to reduce potential errors in warning operations

Performance Objective

1. Demonstrate the ability to mitigate erroneous spotter reports in warning operations

Lesson 2: The Warning Response Process

Learning Objectives

1. Identify the common process between a person hearing the initial warning and responding.
2. Identify the most common sources of warning information.
3. Identify methods forecasters can use to impact the actions of warning recipients.

Lesson 3: Effective Warnings

Performance Objective

1. Demonstrate the ability to apply the five characteristics of an effective warning:

- Specificity
- Consistency
- Certainty
- Clarity
- Accuracy

Learning Objectives

1. According to NWS Instruction 10-511, be able to identify specifications of WFO Severe Weather Products
2. Be able to name five characteristics of an effective warning.
3. Be able to identify effectively worded warning phrases.

Lesson 4: Social Science Aspects of Post Mortems

Learning Objectives

1. Identify examples of social science disciplines and their applications in post mortems
2. Identify relevant social science questions to be addressed in post mortems

3. Identify ways that social scientists gather information

AWOC Core Track Crisis Communications Module 1: Crisis Communication Cycle & Stories of Decision Support

Lesson: Crisis Communication Cycle & Stories of Decision Support

Learning Objectives

1. Identify and explain the components of the crisis communication lifecycle.
2. Recognize the components of successful communication in a crisis.
3. Recognize the importance of establishing relationships before events.

AWOC Core Track Crisis Communication Module 2: Tools for Improving Risk Management Support to Stakeholders

Learning Objective

1. Use at least one tool, to engage with one or more stakeholder groups to gain a better understanding of their decision support needs.

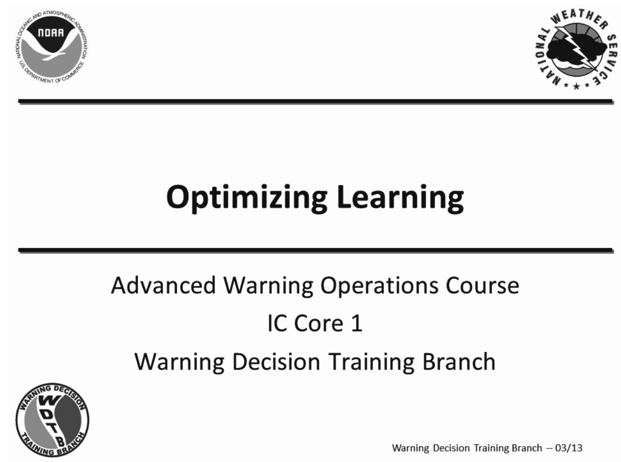
Welcome to AWOC Core!

Each of the following handouts is numbered individually for each lesson, beginning at page one.

1. Optimizing Learning

Instructor Notes: Hello, my name is Brad Grant of WDTB. This Instructional Component is designed to teach you how to maximize the learning process in AWOC. The lesson is the first lesson in the Core Track but the learning principles contained within can be applied to your participation in AWOC Severe Track as well.

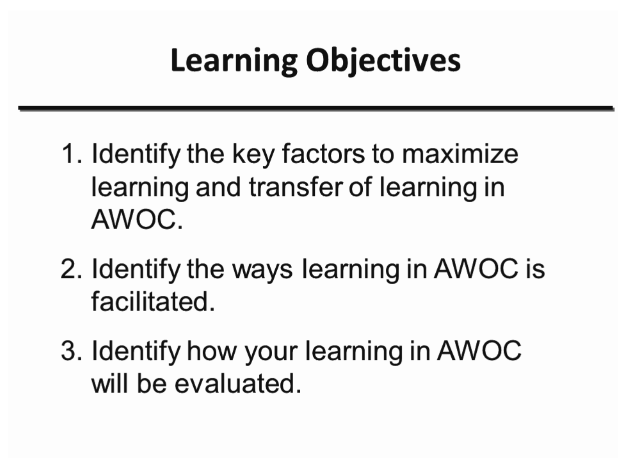
Student Notes:



2. Learning Objectives

Instructor Notes: The learning objectives for AWOC Core 1 Lesson 1 are displayed on this slide. The goal of the lesson is to provide learners with a description of the ways learning are most successful and in particular, the various ways learning and transfer in AWOC are made easiest through facilitation and evaluation.

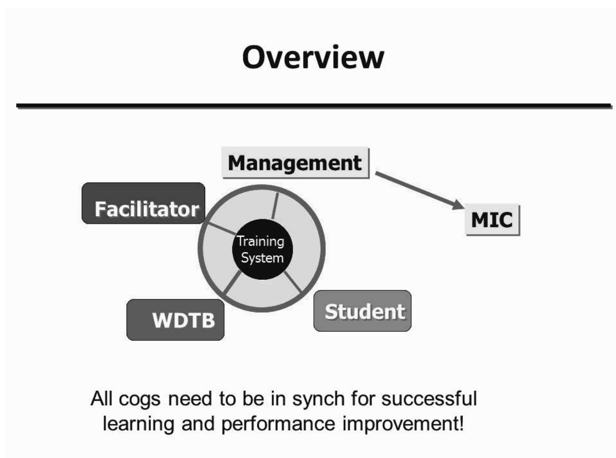
Student Notes:



3. Overview

Instructor Notes: This lesson will take about 18 minutes and will discuss factors for effective transfer of learning into performance. For effective transfer of learning in AWOC, it is essential that certain factors be in place. A successful learning venture is optimized through a process of partnerships, with a primary focus on the learner and how that learning is to be transferred to job performance. Otherwise, the knowledge and skills will not transfer. In this lesson, I will describe the various factors and specific roles of each party shown here connected to the training system. All cogs need to be in synch for successful learning and performance improvement! Since we use a blended approach in the AWOC , it is important to see how actions can be used to maximize learning in an operational shift-like environment. For example, web based modules can be taken self-paced, but instructor-led modules are to be taken live with your WDTB instructors, and simulations conducted with your SOO (or DOH). Thus, each mode affords different actions to maximize the knowledge and skills to be gained from each respective activity. We'll discuss how simulations are to be used the most effectively in the course.

Student Notes:



4. What are the Factors for Effective Transfer of Learning to Performance?

Instructor Notes: These factors have been determined from research by Broad and Newstrom (1992) and Broad (2005). For effective performance, it requires much more than knowledge and skills. All six of the factors in the table shown here are necessary to support full performance. For a specific performance requirement such as NWS forecasters making accurate and timely warning decisions, there are three main stakeholder groups: 1. Instructors (which are the WDTB training designers and facilitators) 2. Students (these are the learners/performers), and 3. Managers (which entail local supervisors all the up the management chain to senior executives). The red circle shows which stakeholder group is responsible for making sure each factor is in place. Note that Managers are primarily responsible for 4 out of the 6 factors. We are going to elaborate on each of the factors and look at roles and responsibilities of each group. Let's start with Instructors and their roles first.

Student Notes:

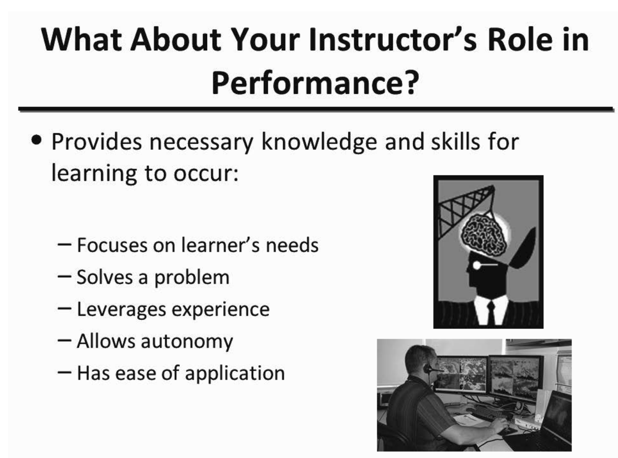
What are the Factors for Effective Transfer of Learning to Performance?

Factors	Instructors	Students	Managers
Clear performance specifications	I	S	M
Necessary support	I	S	M
Clear consequences	I	S	M
Prompt feedback	I	S	M
Individual capability	I	S	M
Necessary skills and knowledge	I	S	M

5. What About Your Instructor's Role in Performance?

Instructor Notes: The instructor's role in performance is multifaceted but the essential goal is to provide the necessary knowledge and skills in order for learning to occur. The focus must be on the learner's needs not on the facilitator's or the organization's needs. If learning solves a problem or avoids one, the mind will be more ready to receive the knowledge. Also, if the learning holds potential advancement and/or external expectations, or accomplishes a personal goal, then it can motivate a person to learn. Experience is also a critical part of learning as when it is considered, it makes learning outcomes much more effective (this is also one of the reasons simulations are so valuable). Also, adults learn best when the training is designed with built-in autonomy, that is, they take charge of their learning. They need opportunities to participate and contribute to the learning activity (not just be lectured to). Most examples of good training courses include many elements of learner autonomy. Group or individual work in which they decide on structure, format, and application is usually effective. For example, it can be a good idea to complete a simulation with a cohort. Finally, if there is credibility of the new skills and we have designed practicality with ease of application into the instruction, it accommodates the best transfer of learning into operational warning job tasks. So, WDTB provides the knowledge and skills that you, the learner, can best use. We focus on the job tasks of the warning forecaster and all the skills required to make effective warning decisions. A successful learning transfer factor is when the training must provide a benefit. Since no forecasters are perfect, there is a real need for job improvement for this training. But you must want to learn. More on the role of the learner in a minute. There are more factors to discuss that optimize learning originating from the instructor's side.

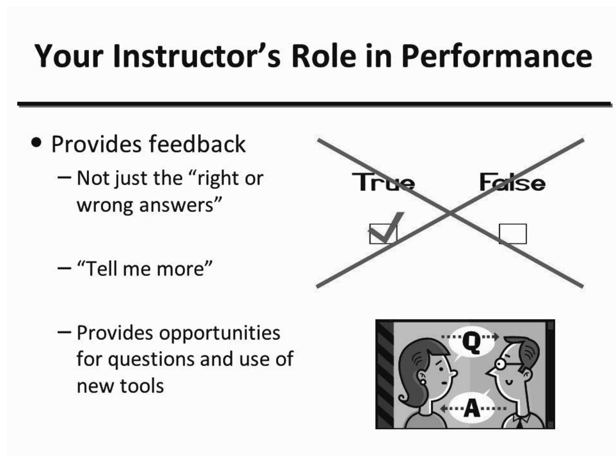
Student Notes:



6. Your Instructor's Role in Performance

Instructor Notes: Feedback is most effective when it's prompt and immediately provided after a student has taken a module in the course. While there are assessments and quizzes which serve as learning interactions in each module, it is important to supply explanation for why the answers are the ones shown and especially, how the concepts can be applied. Since we can only hold a limited amount of information in our working memory, for the training concepts in AWOC to be transferred to long-term memory, it is critical to take the opportunity to have discussions with the instructor and especially the local facilitator on what has been learned. This is a type of feedback that typically has stronger and deeper retention. Seeing the application of the learning objectives through the viewpoint of an other forecasters will shed light and broaden your understanding of how the concept may be manifested with other examples.

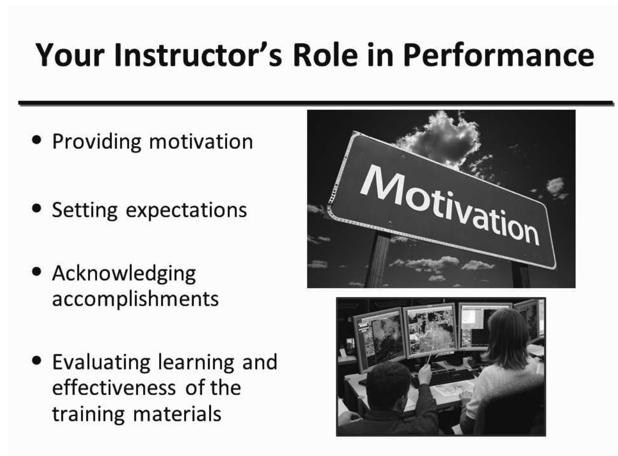
Student Notes:



7. Your Instructor's Role in Performance

Instructor Notes: Motivation, not cheerleading, is the goal of these actions. Motivation should be used to demonstrate to the learner why they should put forward the effort. So, good motivation leads students to achieve an expectation of the learning effort needed. The effort should pay off with a better understanding of the job tasks, which can lead to better decision making and performance results. As learning occurs, instructors and local facilitators need to be observing behavior changes. This evaluation process can occur on many levels. We'll talk a bit about some of the factors that go into simulations as they are a critical part of the AWOC training.

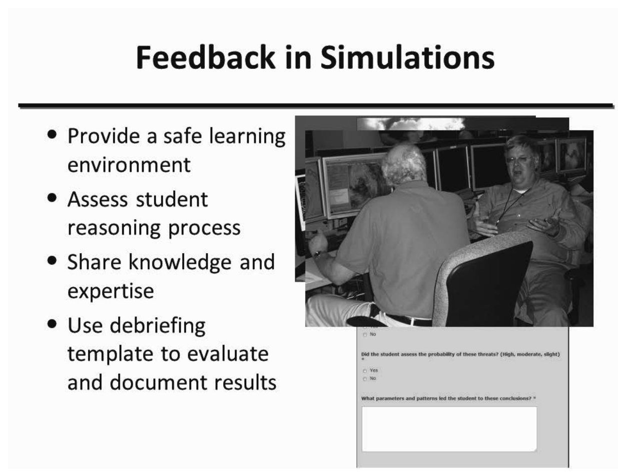
Student Notes:



8. Feedback in Simulations

Instructor Notes: One of the most important responsibilities for the instructor is to provide feedback. Simulations in AWOC are intended to be accomplished with a local facilitator. Here are some specific actions for the facilitator in conducting simulations. Provide a safe learning environment. What does that mean? Well, in any learning environment it is very important for the learner to know everything is fair game. Think of the best learning you've been able to experience in your life. It has more than likely been in a situation in which it was okay to ask questions and make mistakes. In those environments, students feel free to ask long standing questions about stuff you were “suppose to have learned' but never really grasped. Next, make sure you assess the student's reasoning process – ask them why they made a certain decision. Use the opportunity to share knowledge and expertise. There is a prepared debriefing template which should be used to record and evaluate student performance during the simulation.

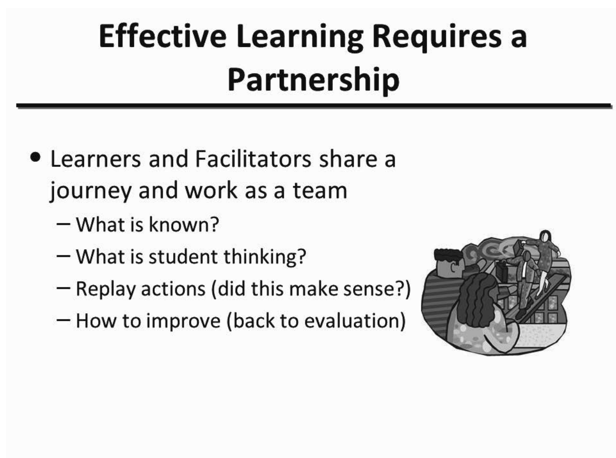
Student Notes:



9. Effective Learning Requires a Partnership

Instructor Notes: Research has shown that some of the most effective learning is accomplished with one-on-one training where the trainer and trainee work together as a team. The trainer’s job is to guide and interject when appropriate. The instructor should be checking to make sure that the trainee is all set with logistical and technical requirements and is fully aware of what is required before the training begins. The instructors should also make some assessment as to what the trainee is “thinking” during decision making points in the simulation. This is not easy to do but can be helped by discussion or by using post-event evaluation tools. Finally the trainer should look at the actions and see if they make sense based on what the trainee has shared so far. Does the trainee know what he/she lacks from the use of science, technology, and /or policies ? What improvements can be made based on the actions? Working as a team can help establish an action plan for improvement.

Student Notes:



10. What are the Factors for Effective Transfer of Learning to Performance?

Instructor Notes: We next will look at the role of students, which are the primary learners and performers in the training process. Students are responsible for the two factors circled in red: individual capability, and a role doubly shared by the Instructor stakeholder group, necessary knowledge and skills. In terms of this factor, the student's role is the actual learning required to perform. The role of you as a student is of a professional , since you are getting paid for your job. This is contrasted against some of your previous roles as a student, say for example, as a college student.

Student Notes:

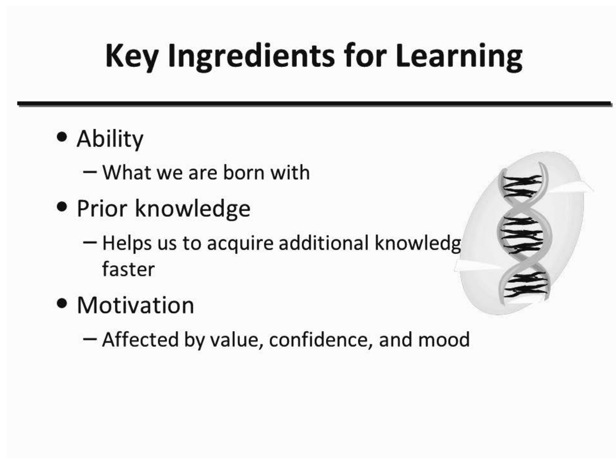
What are the Factors for Effective Transfer of Learning to Performance?

Factors	Instructors	Students	Managers
Clear performance specifications	I	S	M
Necessary support	I	S	M
Clear consequences	I	S	M
Prompt feedback	I	S	M
Individual capability	I	S	M
Necessary skills and knowledge	I	S	M

11. Key Ingredients for Learning

Instructor Notes: Cognitive psychology research suggests that three major factors influence how much and how well we learn: ability, prior knowledge, and motivation. General ability to learn varies depending on our genes, but it can be built up, like muscles. Prior knowledge is important as we build upon what we already know and have used. Motivation is also important. Training activities can be developed as a compensation for what the learner lacks. The greater the abilities, prior knowledge, and motivation the learner possess, the less required from the other groups, especially facilitators. We need to recognize these ingredients and seek support accordingly. We can adapt for differences or deficiencies in each of these ingredients.

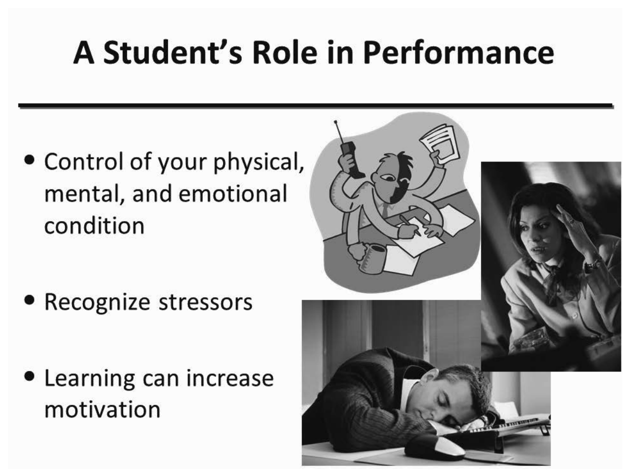
Student Notes:



12. A Student’s Role in Performance

Instructor Notes: Since most adults come in with a pre-disposition to learning in general, instructors are aiming to design the course in a way so that the learners can succeed. And since we know that learning is a partnership, it cannot succeed without the student's accomplishing their share of the responsibilities that go into the partnership. As a student, your individual capacity for learning and performance begins with your physical, mental, and emotional capacity. Some of these things are out of our control, but some aren't. We all have the capacity to learn but often we get bogged down with lots of issues. For example, we might be dealing with poor health, or dealing with the common problem of multiple demands on our time. Fatigue at work might be due to a lack of a particular vitamin or a mineral deficiency, or just lack of sleep. Wellness affects our job performance so we must do our best to try to stay healthy. Frustrations, conflicts, and pressures all are big stressors in the workplace. By recognizing stress, we can better adapt to it and try to deal with it. Increased stress can lead to lack of performance and overall motivation at work which will certainly impact our ability to learn, because we eventually don't care and have no drive. So, one thing that can have a positive influence on our individual capacity in performance is learning and we know that it is tied to motivation. So, let's look at three factors which affect motivation in learning.

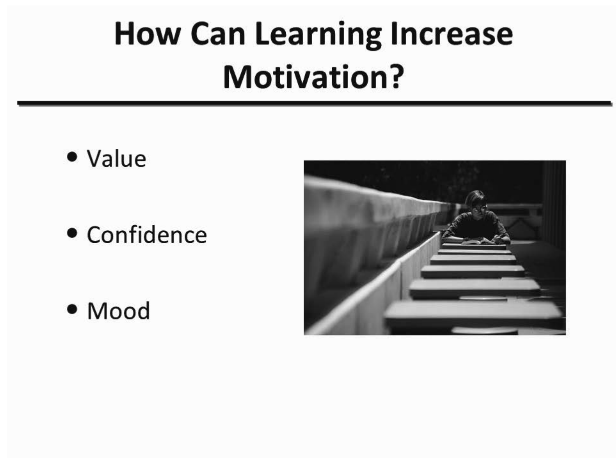
Student Notes:



13. How Can Learning Increase Motivation?

Instructor Notes: We all have seen the power of high motivation – the desire to achieve something. We also have seen the reverse: those who don't care, have no drive, are stressed out, those who seem to lack interest in learning rarely achieved proficiency in new knowledge or skills. We know motivation is important but what are the factors that affect it? Research suggests that there are three general factors that motivate people to learn: Value, confidence and mood.

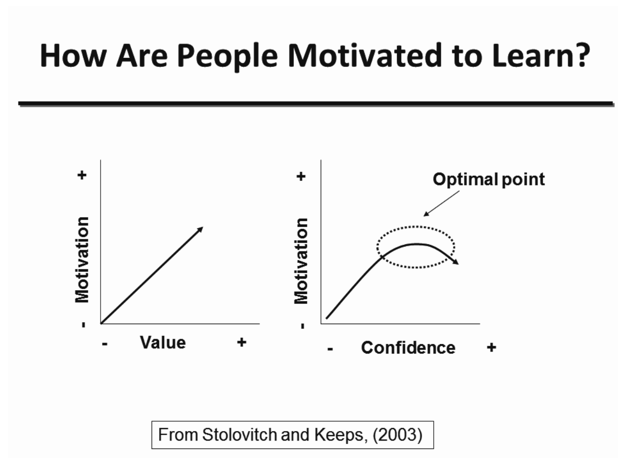
Student Notes:



14. How Are People Motivated to Learn?

Instructor Notes: The graph illustrates how value is directly related to motivation. The right-hand graph shows that that if the learner feels "this is so easy, I don't even need to try", then motivation plummets. The optimal point of motivation is where the learner has enough confidence to feel he/she can succeed, but not so much that the incentive to learn declines. Most of us are motivated by challenges (the high point on the curve) and security ("if I work at it I know I can succeed"). Motivation is also directly related to mood (graph not shown). A positive learning/work environment tends to improve a person's mood and hence, his or her motivation. But, a frivolous or manic mood might have unpredictable effects on motivation.

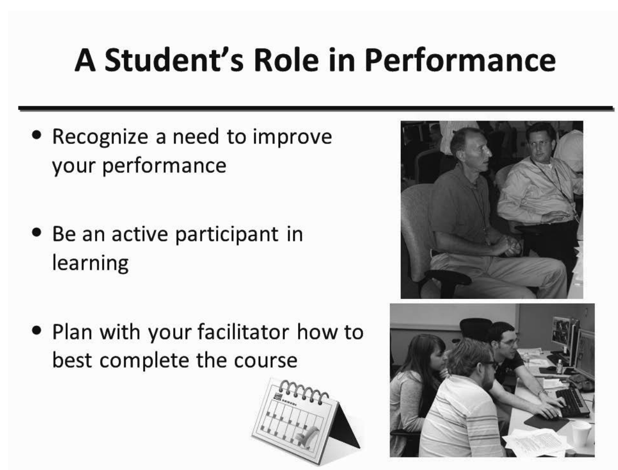
Student Notes:



15. A Student's Role in Performance

Instructor Notes: So, individual capacity for learning and performance begins with the physical, mental, and emotional capacity. This is tied to motivation which is a powerful attitude attained by personal growth and our working environment. Let's not forget experience is a factor too which can be remediated by good facilitation. For example, one might see severe weather examples in the training from places that are totally different from their local CWA, such as a high-end QLCS. They might think, "we don't ever get those type of events here" ; "How can I possibly learn something relevant here?" Well, that is a good question, but by working with the local facilitator, one can find learning potential and the application to job performance for any activity. So, there are some other specific factors in a student's role for learning. For example, how about a recognized need to improve your own performance? This is symbolized as a hand extended asking for help. Once this mindset is established, the student must become an active participant in the training process, not a passive receiver of information but a stakeholder in his/her own progress. Instructions are provided in the Orientation Session which describe the role of a participant. Before learning occurs, the focus is on how to complete the course. During training, the student should work with co-workers and local management on scheduling and attendance commitments. Plan with your facilitator on how to best complete the course. It's important to complete training requirements on time including all online modules, instructor-led sessions, simulations, and evaluations.

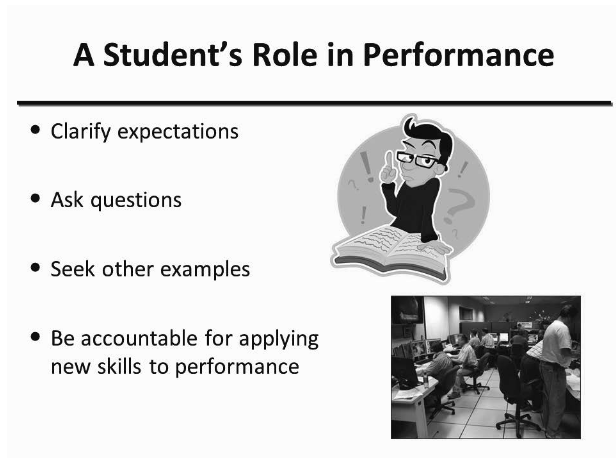
Student Notes:



16. A Student's Role in Performance

Instructor Notes: Students should clarify expectations (i.e., make sure to know the goals for the training sessions) and what should the focus should be during the simulations. They should ask questions and seek help when needed. Have the SOO help explain AWOC concepts because it will be easy to lose track of the big picture. Seek other examples to gain a better picture of the concepts. And finally, be accountable for applying new skills and even develop a personal action plan to correct weak areas. The student is the only one who will ultimately gain or suffer as a result of this learning.

Student Notes:



17. Now, What is Your Manager's Role in Performance?

Instructor Notes: It may be surprising but your manager is chiefly responsible for ensuring 4 out of the 6 factors for transferring learning to performance are in place. These include clear performance specifications , necessary support, clear consequences , and prompt feedback.

Student Notes:

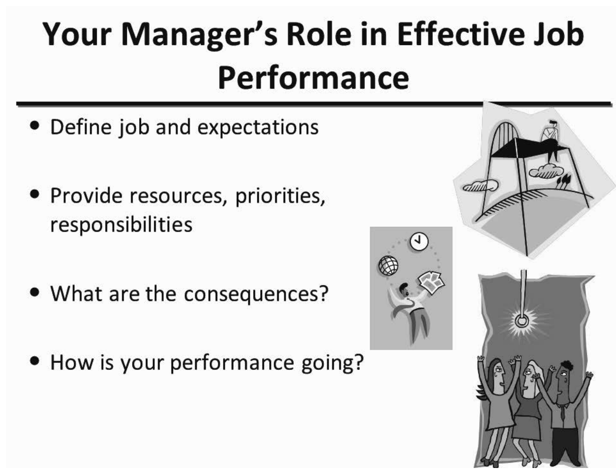
Now, What is Your Manager's Role in Performance?

Factors	Instructors	Students	Managers
Clear performance specifications	I	S	M
Necessary support	I	S	M
Clear consequences	I	S	M
Prompt feedback	I	S	M
Individual capability	I	S	M
Necessary skills and knowledge	I	S	M

18. Your Manager's Role in Effective Job Performance

Instructor Notes: A manager's role in effective job performance starts with defining the job expectations (however high they may be!). They define the job task procedures, outputs, and standards (for example, how the tasks should be accomplished). Necessary support means management should provide resources, priorities, responsibility, authority, and time (such as dedicated training time). Clear consequences for completing the training can be reinforcement, incentives, or rewards. Incentives are usually huge motivational factors in the work world and training incentives can be applied. Finally, a Manager's role (in conjunction with the instructor's) is to provide prompt feedback especially in regard to how well performance matches expectations.

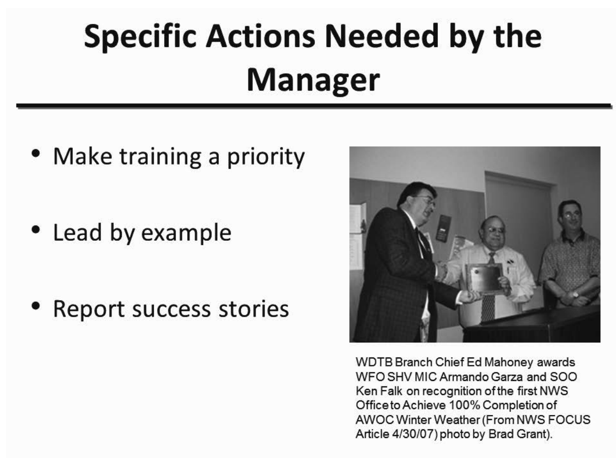
Student Notes:



19. Specific Actions Needed by the Manager

Instructor Notes: Some specific actions needed by the manager (or management staff) are: Make training a top priority Lead by example, and Report success stories. A great example illustrating these concepts came from the management and staff of WFO Shreveport. They reported to WDTB that there were three key elements used to effectively implement the AWOC Winter Track training in their office (and become the first office in the NWS to complete this required training): Instill complete management support Instill a "partnering learning environment", and Have inter-office competition. The Science and Operations Officer (SOO) Ken Falk reported that the "support from the Meteorologist-In-Charge (MIC) in establishing clear priorities such as allowing each forecaster to receive dedicated training time to complete the course and monitoring the progress of each participant" were critical actions in achieving the goal. "The entire staff got behind the effort to complete the course before the start of the fall severe weather season and we encouraged folks to complete the training in pairs, to help the learning and application process", stated MIC, Armando Garza.

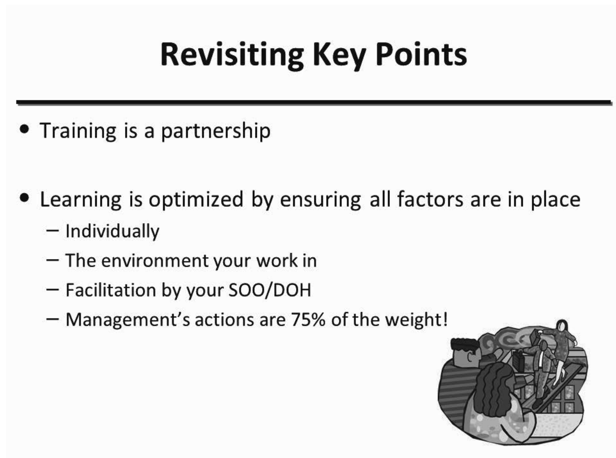
Student Notes:



20. Revisiting Key Points

Instructor Notes: In summary, training is a partnership. Learning is optimized by ensuring all factors are in place and all parties do their parts. This includes your personal actions and attitudes as a professional, the environmental factors we work in, facilitation by your SOO/DOH and management's actions, which hold a huge 75% of the total weight! Don't forget, learning that focuses on job performance improvement requires these actions. Otherwise, the learning will be largely unsuccessful.

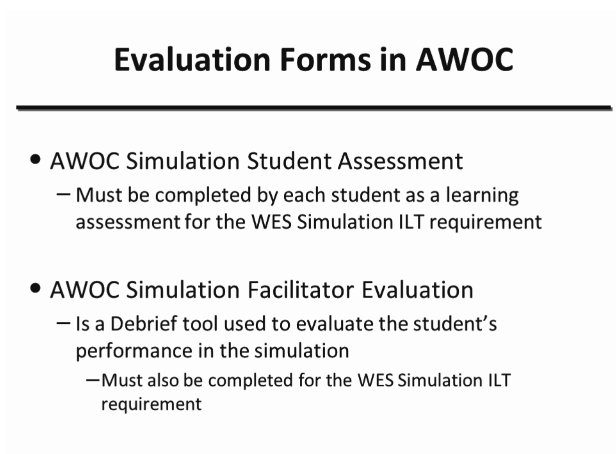
Student Notes:



21. Evaluation Forms in AWOC

Instructor Notes: These are some of the evaluation forms used in AWOC. Click on the attachment to view/print these documents. They are also available on the LMS and in the Simulation Guide.

Student Notes:



22. Contact Information

Instructor Notes:

Student Notes:

Contact Information

- For Questions on this lesson
  - bradford.n.grant@noaa.gov
    - 405-325-2997
  - liz.quoetone@noaa.gov
    - 405-325-2986
  - WDTB help email lists/NWS chat
    - awoccore_list@wdtb.noaa.gov
    - wdtbchat@conference.nwschat.weather.gov
      - for Pidgen or any other Jabber client

23. References

Instructor Notes:

Student Notes:

References

Clarke, R.C., 1998: Building Expertise: cognitive methods for training and performance improvement. International Society for Performance Improvement, Washington D.C.

Hahn, Bianka B. , D.W. Klinger, Klein Associates. Advanced Warning Operations: Collaborative Development of Expertise Workshop (Work funded by OCWWS, Warning Decision Training Branch) 2004.

Hodges, T. K., 2002: Linking Learning to Performance: A practical guide to measuring learning and on-the-job application. Butterworth-Heinemann, Boston, MA.

Hopkins, K. D., 1998: Educational and Psychological Measurement and Evaluation. Allyn and Bacon,Boston, MA.

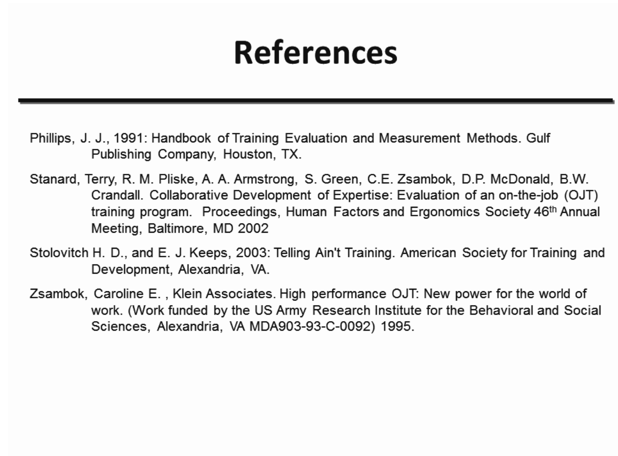
Kirkpatrick, D. L., 1994: Evaluating training programs: the four levels. Berrett-Koehler, San Francisco, CA. (note: Kirkpatrick first published his four-level approach on the evaluation of training in a series of articles appearing in the journal known as the American Society of Training Directors in November-December of 1959 and January-February 1960.)

McCain, D. V., and D. D. Tobey, 2004: Facilitation Basics. American Society for Training and Development, Alexandria, VA.

24. References

Instructor Notes:

Student Notes:



1. Situation Awareness and Decision Making in a Warning Environment

Instructor Notes: Welcome to IC Core 2, Situation Awareness and Decision Making in a Warning Environment!

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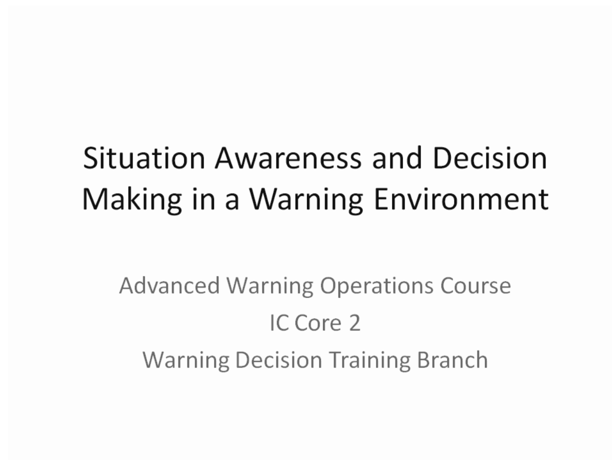
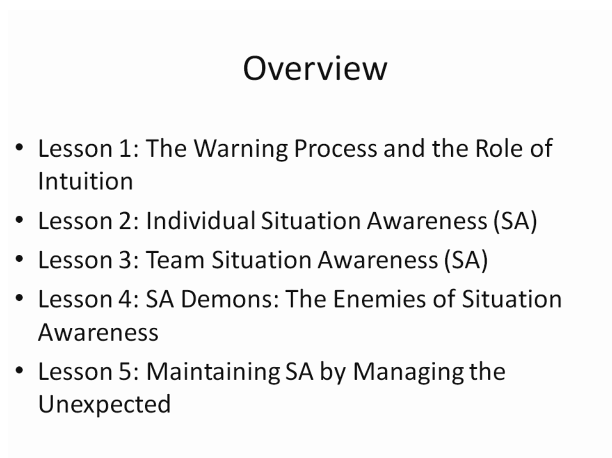


2. Overview

Instructor Notes: Situation Awareness and Decision Making in a Warning Environment is divided into 5 lessons, each of which is a separate on-line module. There is one exam for all 5 lessons of IC Core 2.

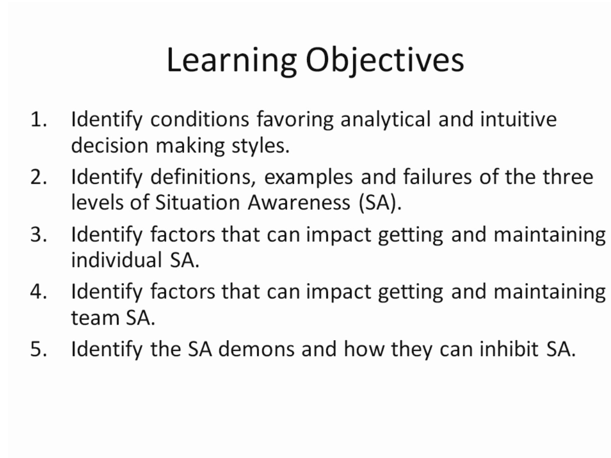
Student Notes:



3. Learning Objectives

Instructor Notes: Here are the Learning Objectives for IC Core 2. The objectives that apply to each lesson will be repeated at the beginning of each lesson. The Learning Objectives will be tested when you take the on-line exam for IC Core 2.

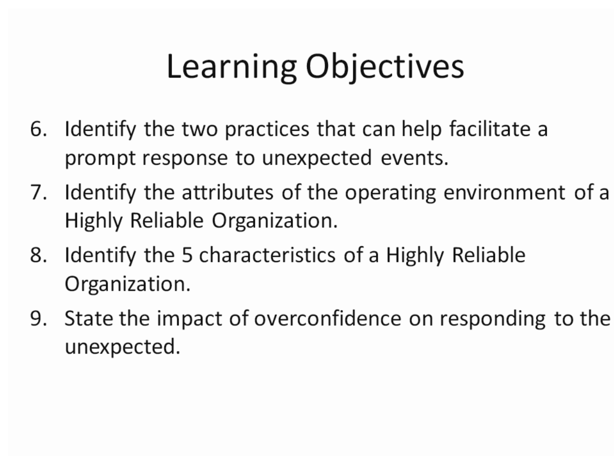
Student Notes:



4. Learning Objectives

Instructor Notes: Here are the remaining Learning Objectives for IC Core 2. The objectives that apply to each lesson will be repeated at the beginning of each lesson and will be tested using a single on-line exam for IC Core 2.

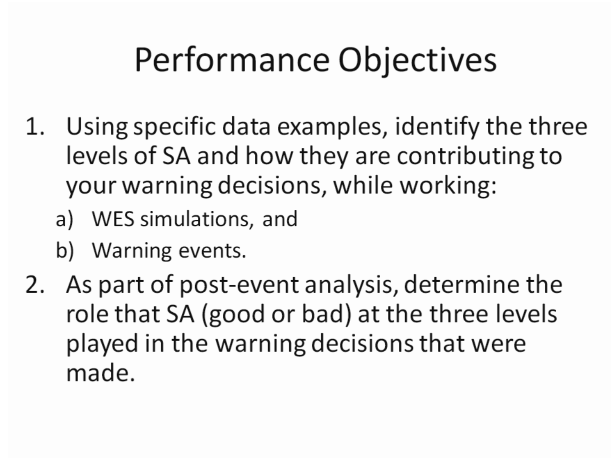
Student Notes:



5. Performance Objectives

Instructor Notes: The Performance Objectives for IC Core 2 apply during this course as well as after completion. Though they are not tested formally, questions related to these Performance Objectives will be posed during the course simulations.

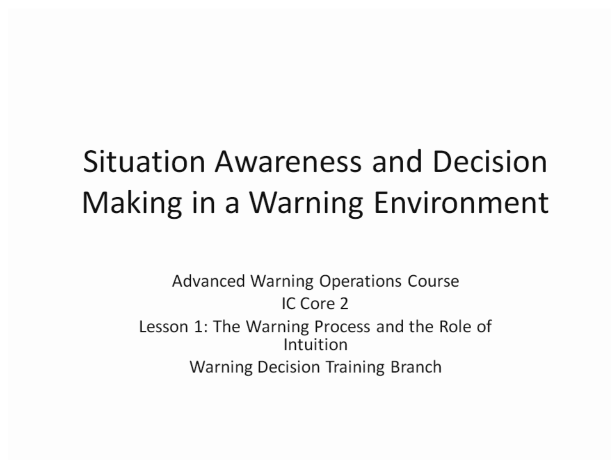
Student Notes:



6. Situation Awareness and Decision Making in a Warning Environment

Instructor Notes: Lesson 1 will focus on the elements of the Warning Process, which includes both meteorological and non-meteorological factors. There is also a section on analytical and intuitive decision making, and the role of intuition in the warning “domain”.

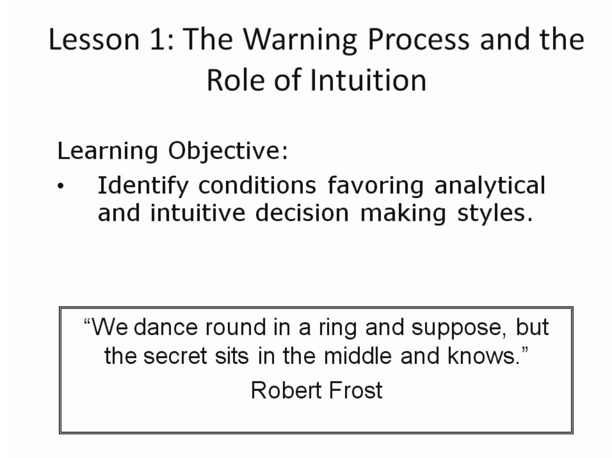
Student Notes:



7. Lesson 1: The Warning Process and the Role of Intuition

Instructor Notes: Lesson 1: The Warning Process The Learning Objective associated with this lesson addresses analytical and intuitive decision making.

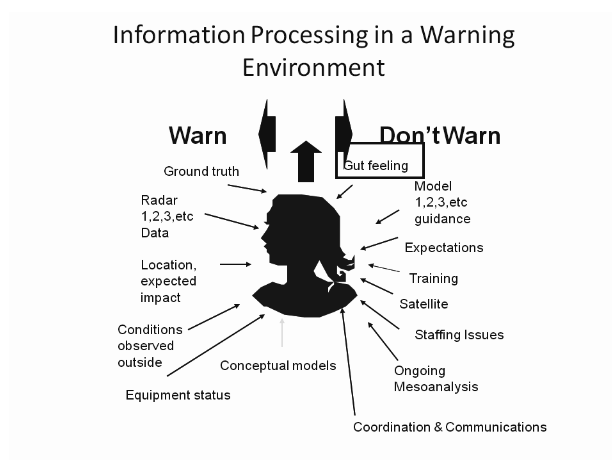
Student Notes:



8. Information Processing in a Warning Environment

Instructor Notes: There are so many different types of information that must be processed to make a warning decision. Using each of these data sources effectively is difficult, since the strengths and limitations of each data set must be well understood. Also, the update times of the various data sources vary, which requires mental tracking. This lesson will take a particular look at the contribution of "gut feeling", which is your intuition.

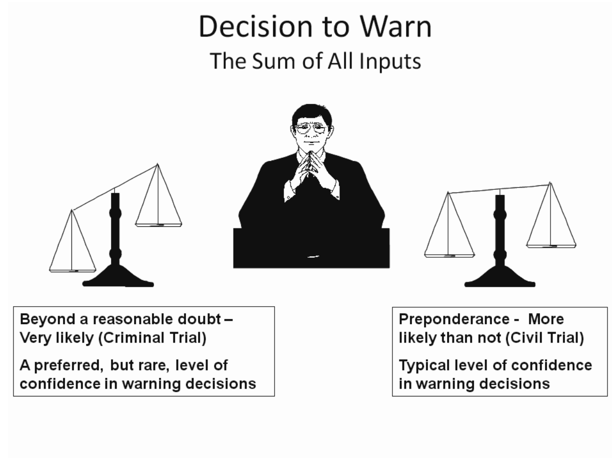
Student Notes:



9. Decision to Warn, The Sum of All Inputs

Instructor Notes: "Beyond a reasonable doubt" is a level of certainty that is very rare in warning decisions. We would like to operate at that level, but most often, a warning is issued because the "preponderance of the evidence" supports it. If you find yourself delaying making a warning decision by waiting for a higher level of certainty, think about this concept. Perhaps you are waiting for a level of certainty that is not going to exist.

Student Notes:



10. The Warning Process

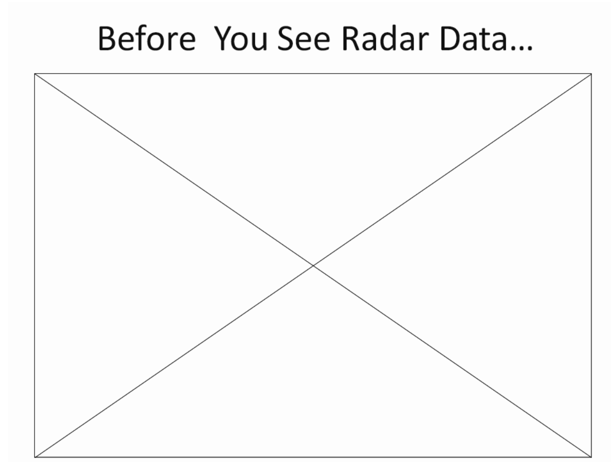
Instructor Notes: Among these elements of the warning process, we will first focus on Anticipation. Anticipation is based on your threat assessment, which is hopefully an ongoing process. Threat assessment and monitoring the mesoscale environment creates your expectations. Those expectations affect the data cues that you will be looking for. An example would be an expectation of large hail leading you to look for hail spikes in the radar base data.

Student Notes:

11. Before You See Radar Data…

Instructor Notes: This animation depicts the "tipping of the scales" of a warning decision before looking at radar data. The climatology, synoptic, and mesoscale factors all affect the warning decision. In this case, the scales are moderately tipped in favor of a warning. You can replay the movie if you wish.

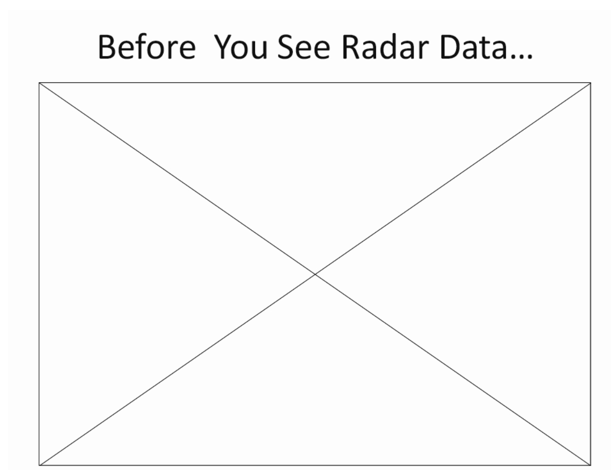
Student Notes:



12. Before You See Radar Data…

Instructor Notes: This animation depicts a different “tipping of the scales” of a warning decision, where the scales are strongly tipped in favor of a warning. Consider looking at the same radar data given the conditions of the previous slide vs. the conditions of this slide. How might your expectations impact your decision to warn? Or impact how intensely you may interrogate radar data looking for signatures?

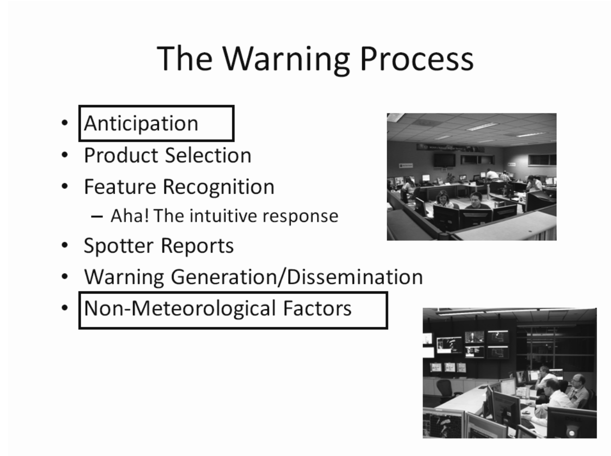
Student Notes:



13. The Warning Process

Instructor Notes: There are many challenges here: choosing products appropriate for the anticipated threat, recognizing a significant feature when you see it, knowing which spotter reports to rely on, and conveying the threat through language in products issued. Then there are numerous factors that have nothing to do with meteorology…

Student Notes:



14. Non-Meteorological Factors

Instructor Notes: Your work environment is known as a “domain” by those who study decision making. The WFO domain is a particularly complex one, especially during a warning event. There are things that can be done to mitigate some of the potential chaos, which will be presented later in Core 2 and in other parts of the AWOC Core track.

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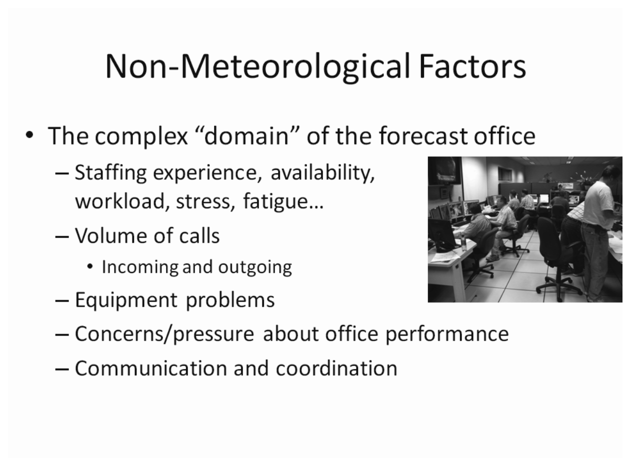
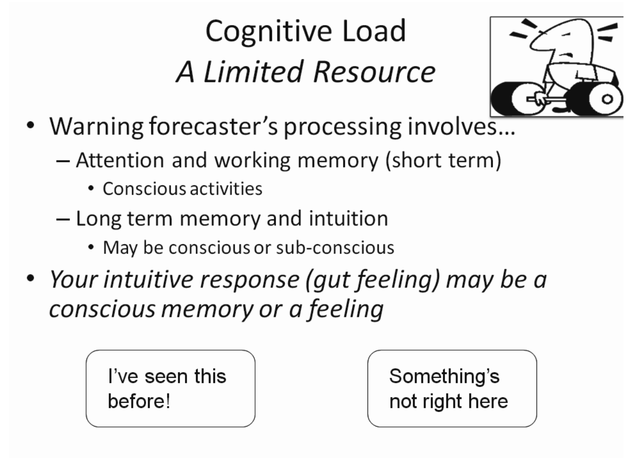


15. Cognitive Load, A Limited Resource

Instructor Notes: The total mental activity for working a task is called cognitive load. This involves cognitive work done at the conscious and sub-conscious level. These concepts will be explored later in IC Core 2. The key thing to remember is that no matter how skilled a human may be, cognitive activities are in total a limited resource. Intuition is an important part of cognitive load and will be discussed in the next few slides. One of the ways to learn to use intuition effectively is to understand that it may be experienced as either a conscious thought or an emotion (gut feeling).

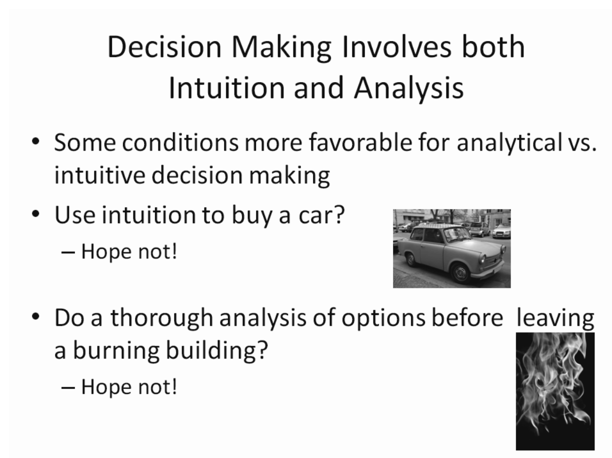
Student Notes:



16. Decision Making Involves both Intuition and Analysis

Instructor Notes: Our decisions are always processed with some combination of analysis and intuition….this is not an either/or relationship. Some environments are more favorable to the different decision making approaches. For examples, buying a car is (hopefully) going to be largely an analytical decision, while deciding to get out of a burning building is (hopefully) largely an intuitive decision.

Student Notes:



17. Analytical Decision Making

Instructor Notes: The process of analytical decision making has the following steps. We begin by identifying the available options. Then the pros and cons of each option are evaluated. Based on the those pros and cons, the best option is determined.

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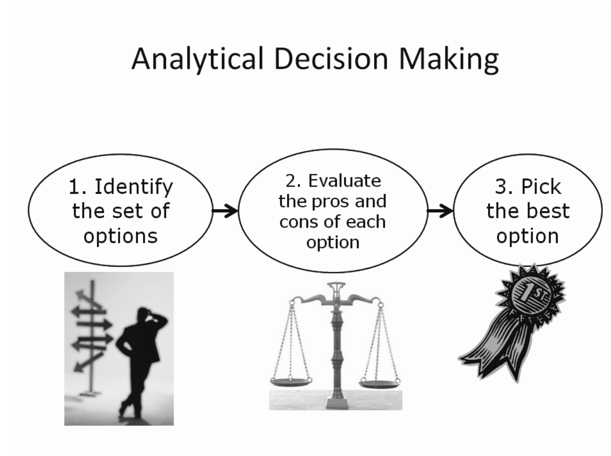
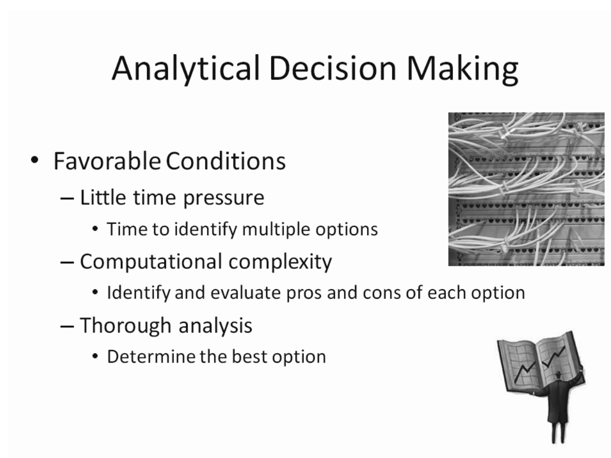


18. Analytical Decision Making

Instructor Notes: Given the analytical process, the most favorable conditions start with environments that do not have significant time pressure. There is time to identify multiple options. Identifying and evaluating the pros and cons of each option is the next step, which also requires time and computations, sometimes rather complex ones. A thorough analysis process results in finding the best option.

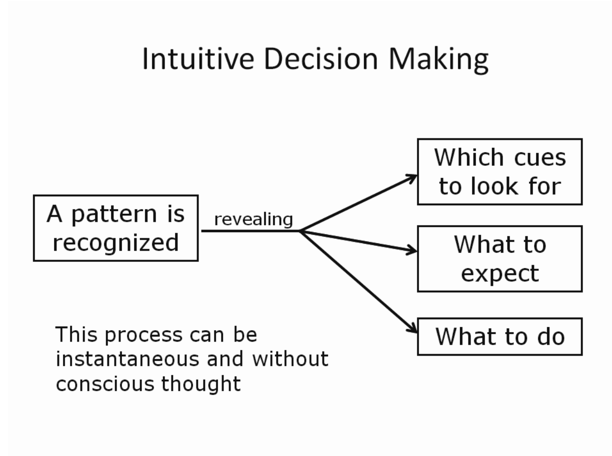
Student Notes:



19. Intuitive Decision Making

Instructor Notes: Intuitive decision is usually triggered by pattern recognition of some sort. The data cue that triggers your intuition reveals the next steps to take, such as which additional data to look for, formulating your expectations and how to respond. This process is usually a conscious one. As you gain more expertise, it can also be nearly instantaneous and the next steps occur without conscious thought (at least initially!).

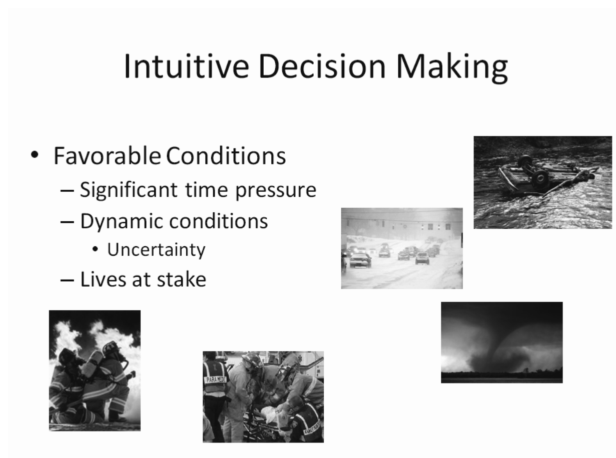
Student Notes:



20. Intuitive Decision Making

Instructor Notes: The favorable conditions for intuitive decision making are much different. There is significant time pressure in these environments. Things are happening quickly and there is a lot of uncertainty…it is a dynamic situation. Frequently, lives are at stake.

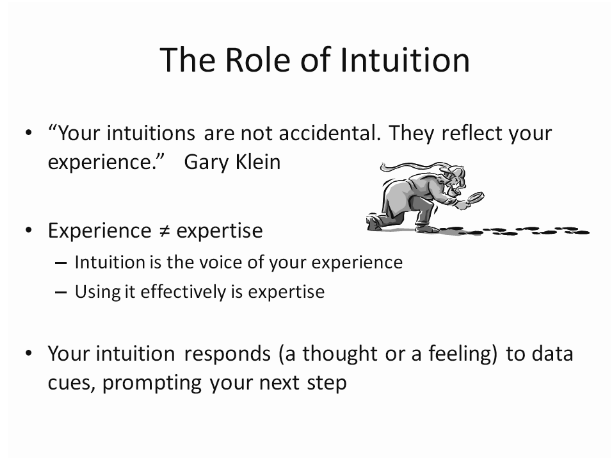
Student Notes:



21. The Role of Intuition

Instructor Notes: Gary Klein is a psychologist who has studied decision makers in their environments. He has written about the importance of the use of intuition among experts in dynamic environments. Intuition comes from experience, but that is not the same as expertise. Intuition is your experience speaking to you, but using it effectively involves expertise. An intuitive response may be a conscious thought or just a feeling. Experts have learned to respect that response and use it as a prompt to take the next step.

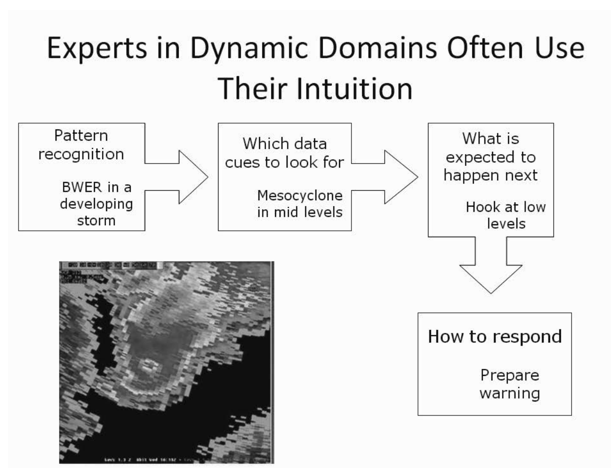
Student Notes:



22. Experts in Dynamic Domains Often Use Their Intuition

Instructor Notes: The expert warning forecaster has many things in common with experts in other dynamic domains that use both their intuition and their analysis to make decisions. Recognizing a significant pattern can occur consciously (aha! I know what this is and I know what to do) or sub-consciously (a feeling that this is significant). There may be additional data cues to look for and decisions to make. The point here is that the intuitive response can be the beginning of a process that leads to a warning decision.

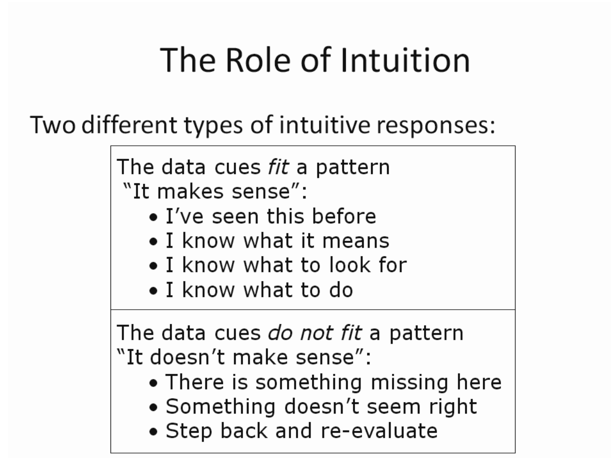
Student Notes:



23. The Role of Intuition

Instructor Notes: The "aha" intuitive response happens when the data do fit a known pattern…"it makes sense". The remaining steps follow quickly. If additional information is needed, you know what you are looking for. You also know what you are going to do. The other possibility is that the data do not fit a pattern…"it doesn't make sense". This often involves stepping back and doing some re-evaluating. In each case, the expert knows what to do following the intuitive response.

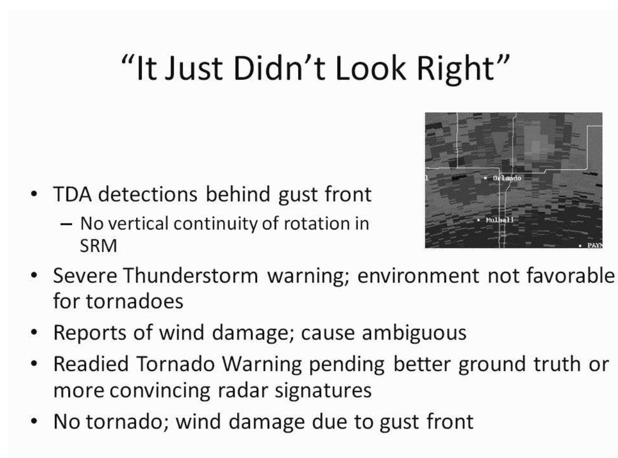
Student Notes:



24. "It Just Didn't Look Right"

Instructor Notes: In this event, the forecaster was concerned about the algorithm detections, but the signatures in the radar base data conflicted with the TDA results and the environment was not favorable for tornadoes. The sense that something wasn't right led him to seek additional data cues and maintain the warning status as Severe Thunderstorm.

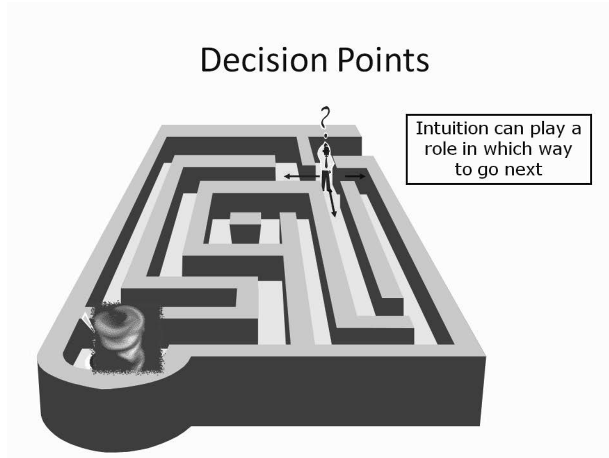
Student Notes:



25. Decision Points

Instructor Notes: The decision making for a warning event can be represented by a maze. The intuitive response often leads to the next step…with additional data cues to look for or perhaps going directly to issuing a warning. When examining your warning decision making, consider the role of intuition.

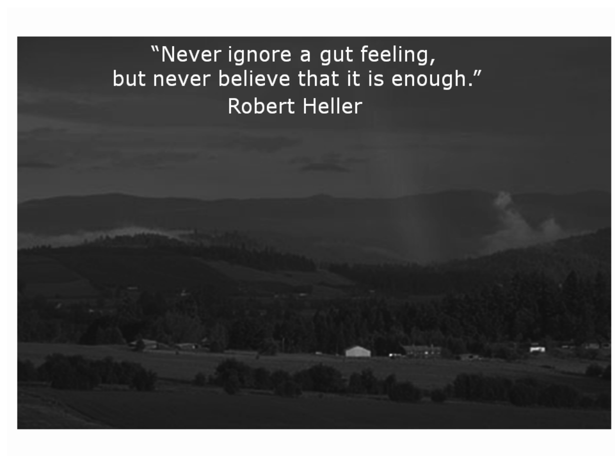
Student Notes:



26. Final Quote

Instructor Notes: Intuition can be a powerful tool, but it is not the only tool. It is just a part of the process of analyzing the radar base data, assessing the near storm environment and assimilating reports.

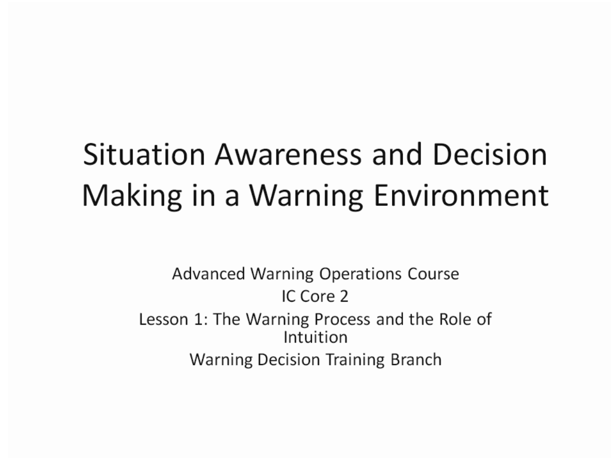
Student Notes:



27. Situation Awareness and Decision Making in a Warning Environment

Instructor Notes: This concludes Lesson 1: The Warning Process and the Role of Intuition. There are four remaining lessons for IC Core 2.

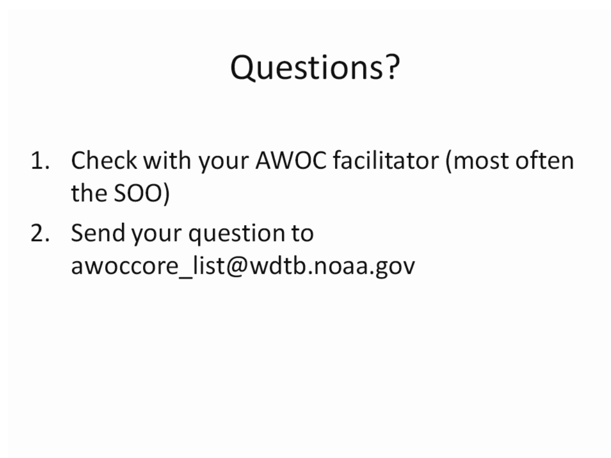
Student Notes:



28. Questions?

Instructor Notes: If you have questions about the material from IC Core 2, first check with your AWOC facilitator (most likely your SOO). If your AWOC facilitator cannot answer your question, please send an email to awoccore_list@wdtb.noaa.gov.

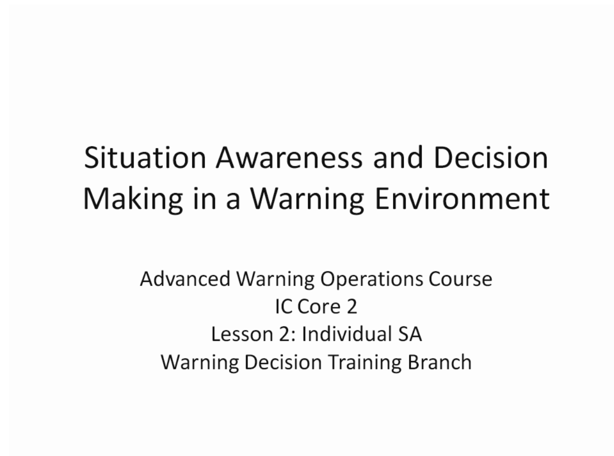
Student Notes:



1. Situation Awareness and Decision Making in a Warning Environment

Instructor Notes: Lesson 2 will focus on the Situation Awareness (SA) of an individual. This lesson will take a look at the three different levels of SA, as well as examples of failures at each level.

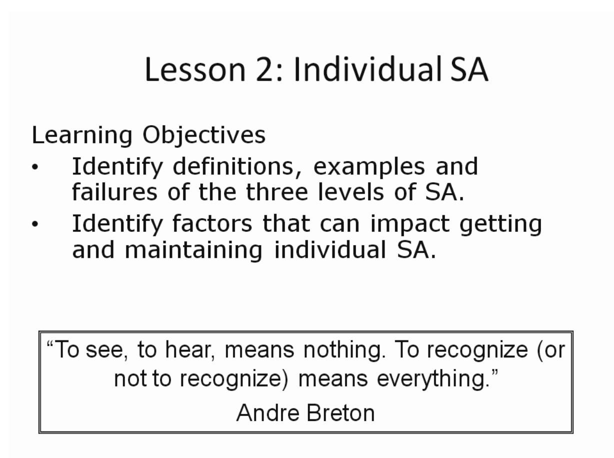
Student Notes:



2. Lesson 2: Individual SA

Instructor Notes: The Learning Objectives for Lesson 2 apply to the definitions, examples, and failures of each of the three levels of SA. The objectives also address factors that can impact getting and maintaining SA. The Learning Objectives will be tested when you take the on-line exam for IC Core 2.

Student Notes:



3. Lesson 2: Individual SA

Instructor Notes: The Performance Objectives for Lesson 2 apply during this course as well as after completion. Though they are not tested formally, questions related to these Performance Objectives will be posed during the course simulations. Developing SA in the "domain" of the warning environment is a skill that evolves over time and is an important asset in making sound warning decisions.

Student Notes:

Lesson 2: Individual SA

Performance Objectives

1. Using specific data examples, identify the three levels of SA and how they are contributing to your warning decisions, while working:
   a) WES simulations, and
   b) Warning events.
2. As part of post-event analysis, determine the role that SA (good or bad) at the three levels played in the warning decisions that were made.

4. Situation Awareness: The Ability to Maintain the Big Picture

Instructor Notes: Looks like one of the individuals is lacking SA in this domain…

Student Notes:

Situation Awareness: The Ability to Maintain the Big Picture

5. SA Helps You Anticipate

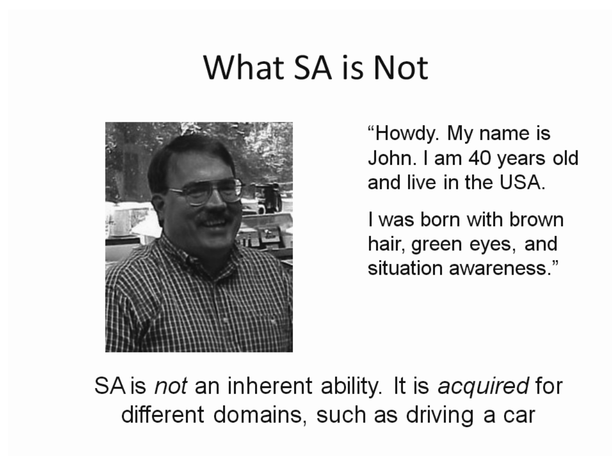
Instructor Notes: SA supports your expectations. It also supports the process of shifting expectations during an event.

Student Notes:

6. What SA is Not

Instructor Notes: SA is not something that you are born with. The ability to acquire SA is learned, and SA must be acquired for each domain. You already have SA in many domains in your life…for example, driving a car.

Student Notes:



7. SA Research Has Been Ongoing in Many Domains

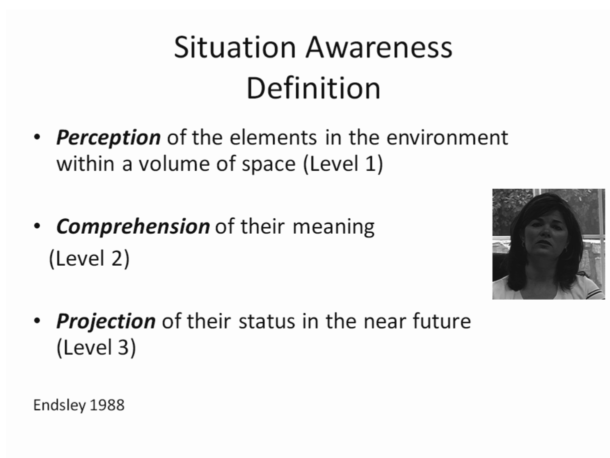
Instructor Notes: SA has been studied for many years in other domains. Here are examples of research papers from NASA, the FAA and others. There are many things in the NWS warning environment that are common to the military, aviation, emergency medicine, nuclear power, and other domains. All require decision making in high stress environments with significant uncertainty, time pressure and lives are often at stake.

Student Notes:

8. Situation Awareness, Definition

Instructor Notes: There are three levels of SA, as defined by Mica Endsley. Each level will be examined separately. Notice that none of these definitions involves making a decision! SA forms the framework for making decisions.

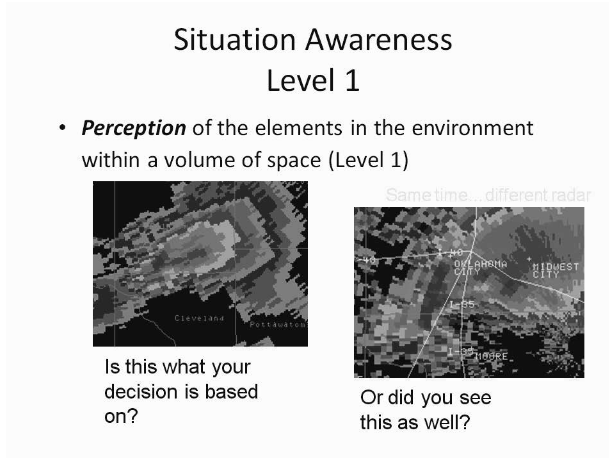
Student Notes:



9. Situation Awareness, Level 1

Instructor Notes: Level 1 SA involves simply seeing the relevant data in the domain. Since there is such an enormous volume of data available in the warning environment, success with level 1 SA requires looking at what is most appropriate. However, the most pertinent data may be unavailable, masked by system design or it may require a great deal of effort to find.

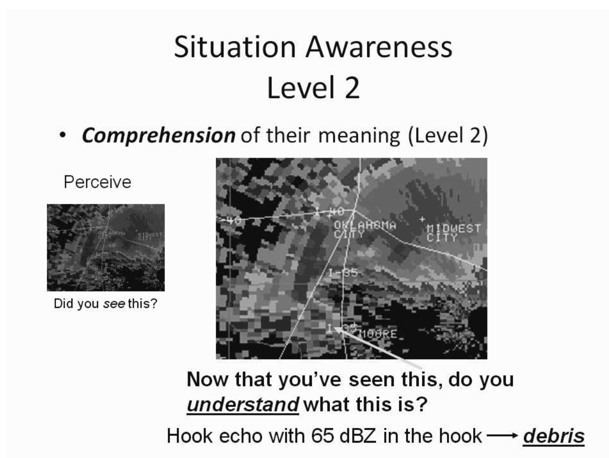
Student Notes:



10. Situation Awareness, Level 2

Instructor Notes: Level 2 SA involves your ability to comprehend the data and recognize patterns. In this example, you may understand the significance of a hook echo (and were able to see it in the data – level 1). The added significance of the high dBZ value in the tip of the hook is also (hopefully) comprehended. The radar beam is reflecting back from debris which has been lofted into the circulation.

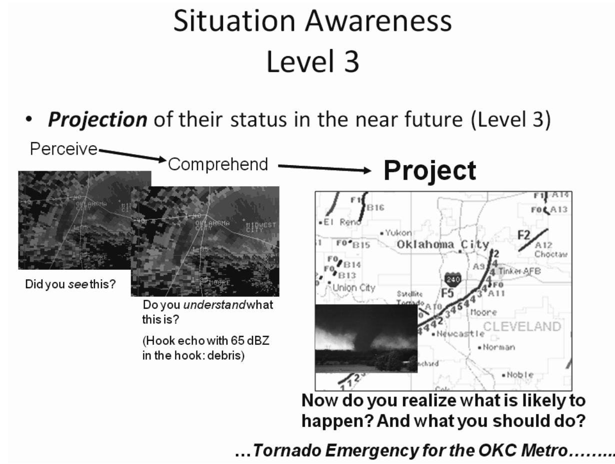
Student Notes:



11. Situation Awareness, Level 3

Instructor Notes: Level 3 SA involves mentally projecting this feature forward in time and understanding the associated consequences. With level 3 achieved, the decision on what to do next is usually straightforward. Note that attaining the three levels of SA is not the same as making a decision.

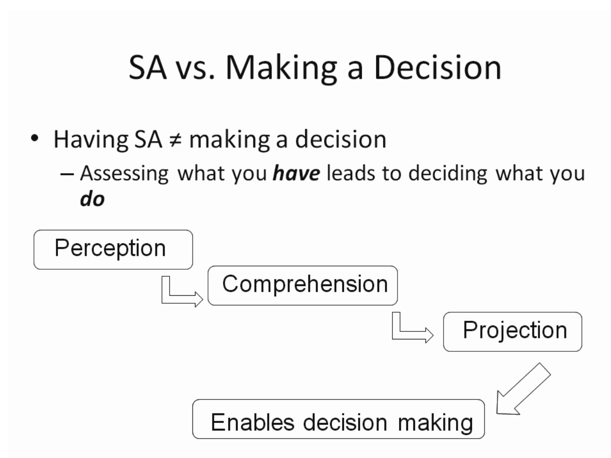
Student Notes:



12. SA vs. Making a Decision

Instructor Notes: Though there are three levels of SA, none of these levels involves making a decision. Once all three levels of SA are achieved, the decision directly follows. SA provides the framework for making a decision.

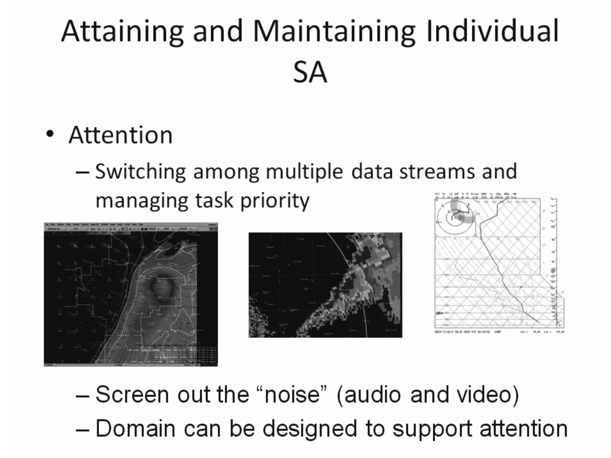
Student Notes:



13. Attaining and Maintaining Individual SA

Instructor Notes: SA can be enhanced if the domain is designed to support human attention, which is a limited resource. Our attention manages multiple data streams, as well as their relative priority. Attention must also function to screen out information that is not relevant. Irrelevant information is essentially noise, whether it is visual or audible. It is important that the domain (systems and people) does not overly tax human attention, and appropriate design can support attention.

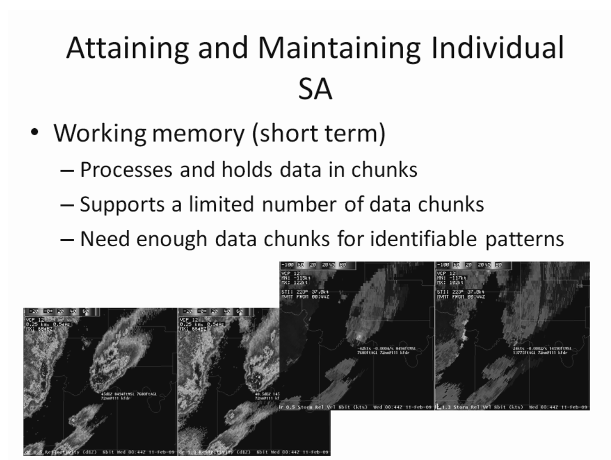
Student Notes:



14. Attaining and Maintaining Individual SA

Instructor Notes: Another limited resource is working memory, where the data chunks found by our attention are stored. Working memory can support a limited number of these data chunks. We need enough of these data chunks to identify patterns in the data. Pattern recognition is critical for comprehension of the data. Hopefully, your working memory has enough chunks of relevant data to recognize relevant patterns!

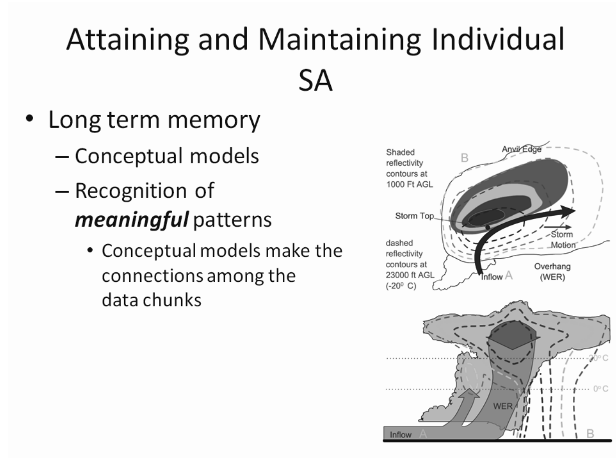
Student Notes:



15. Attaining and Maintaining Individual SA

Instructor Notes: You don't go around all the time thinking about HP supercells, but patterns associated with them reside in long term memory. This is where a number of conceptual models for severe weather would be stored. The conceptual model provides the necessary connections among the chunks of data in working memory. Accessing a conceptual model from long term memory during an event may not be conscious, but that feeling of "I've seen this before" means something!

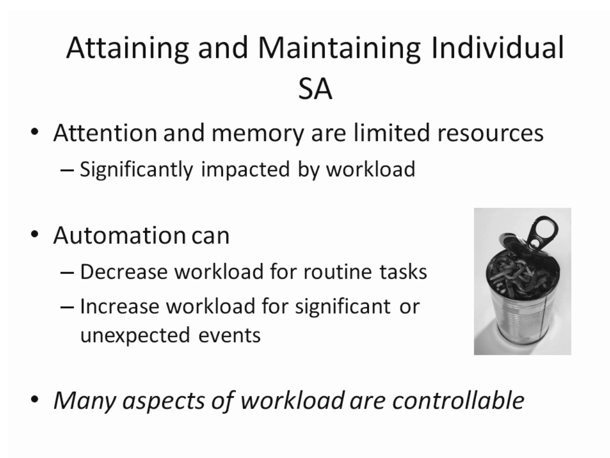
Student Notes:



16. Attaining and Maintaining Individual SA

Instructor Notes: Workload has a significant impact on SA, and it can be made manageable. Automation has increased so much in many domains. It can decrease workload for routine tasks, However, it can increase workload for significant or unexpected events. You'll be hearing a lot about unexpected events in the AWOC Core track modules. The good news is that many aspects of workload are controllable.

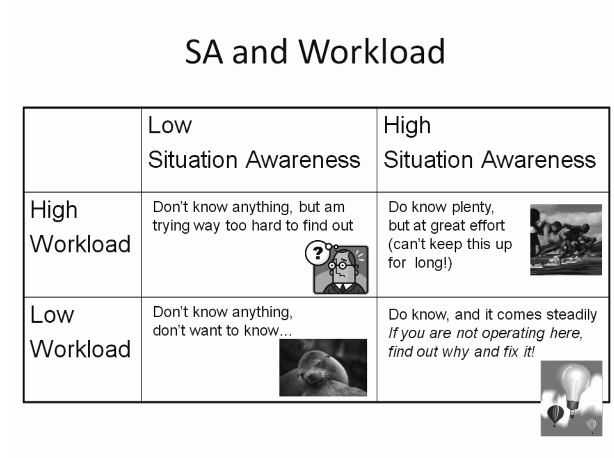
Student Notes:



17. SA and Workload

Instructor Notes: We'll start with low SA and high workload. This means you don't know what's going on and you're working too hard to find out. In aviation, this is known as "flying behind the plane". The next possibility is that you have high SA, but you are working too hard to maintain it. This is dangerous because it is not sustainable! How about low SA and low workload? You don't know what's going on and you aren't trying to find out. Maybe you're in "that doesn't happen here" mode? The goal is to maintain high SA with a low workload . This doesn't mean that you are bored, but that the information flow is manageable. If you aren't operating in the high SA, low workload area, find out why and fix it! More about how to do that later.

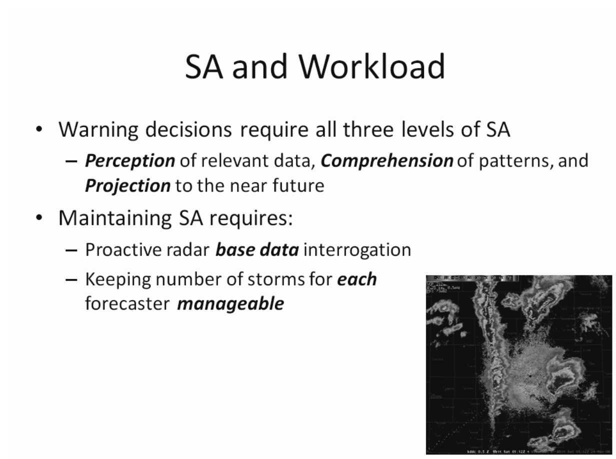
Student Notes:



18. SA and Workload

Instructor Notes: Why is workload so important? Appropriate storm interrogation requires proactive analysis of the radar base data. Sectorizing can ensure that each warning forecaster has a manageable number of storms to interrogate.

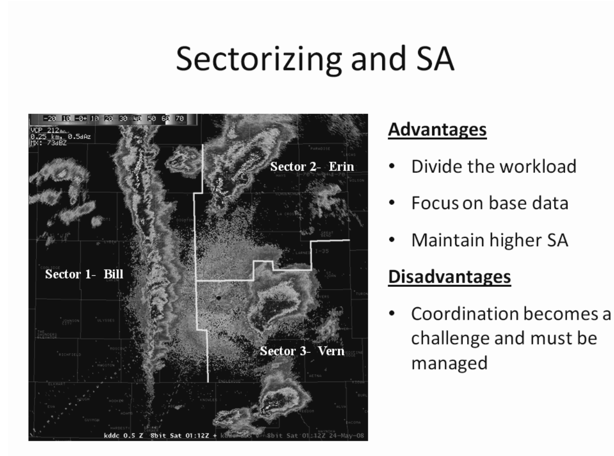
Student Notes:



19. Sectorizing and SA

Instructor Notes: Sectorizing can have great benefits. In this example, there are three sectors, based on geography. The workload is divided such that each individual can maintain higher SA. The challenge with sectorizing is the need for an overall coordinator, providing oversight and "event level" SA. Storms may need to be passed from one sector to the next or sectors redefined. A designated warning coordinator can oversee this process and ensure that the event overall is managed.

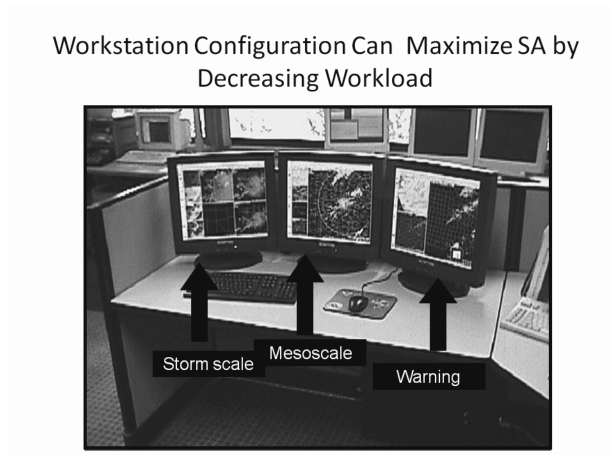
Student Notes:



20. Workstation Configuration

Instructor Notes: Workstations can also be configured to support your SA. There are many possible configurations. In this example, two monitors are set up for storm scale and mesoscale analysis, respectively. The third monitor is set up to process warnings.

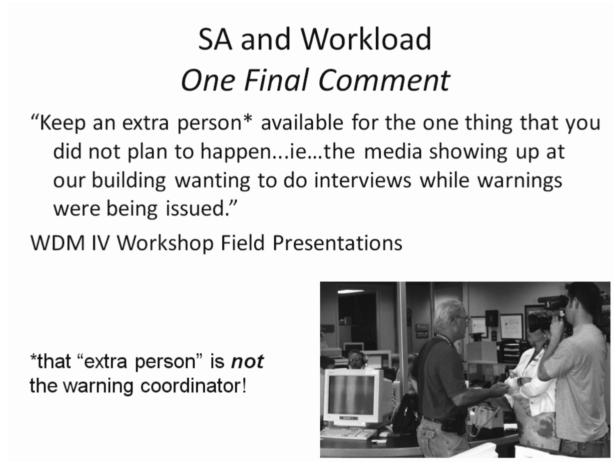
Student Notes:



21. SA and Workload, One Final Comment

Instructor Notes: A recommendation from one of the WDM IV workshop field presenters! During a largely successful event, one thing that wasn't expected was a visit from the media. Having an extra person available for the unknowns can make a huge difference, and keeping that extra person available is the coordinator's decision. Though the warning coordinator may be able to do short interviews, his/her SA may be lost if too much time is spent away from maintaining the big picture.

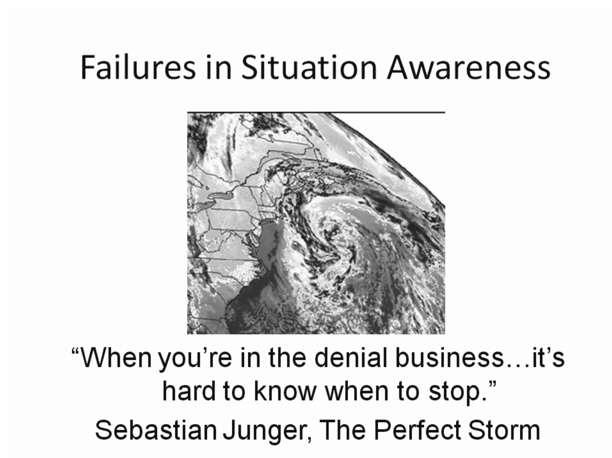
Student Notes:



22. Failures in Situation Awareness

Instructor Notes: There are many different ways that each of the three levels of SA might fail. Denial is only one of the possibilities, but it was a factor in the loss of the Andrea Gail.

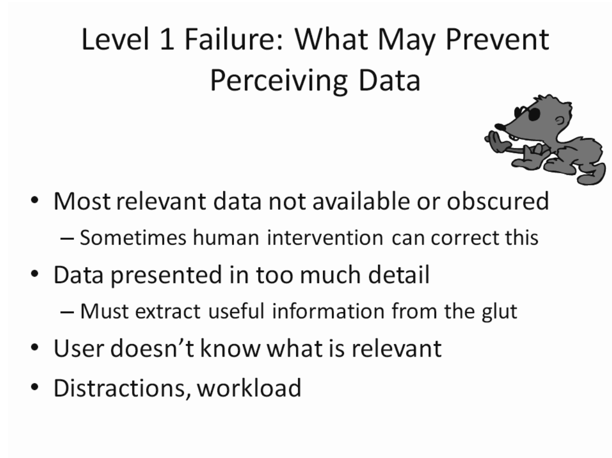
Student Notes:



23. Level 1 Failure: What May Prevent Perceiving Data

Instructor Notes: Level 1 SA is all about seeing the most relevant data. An important example for warning operations would be the masking of radar data by range folding. This problem can often be mitigated by changing the VCP, or editing the Doppler PRF, but workload may get in the way. Sometimes relevant data gets overlooked because it is embedded in too much irrelevant data. An example might be loading multiple AWIPS procedures that aren't really personalized for you. Inexperience may mean that you don't yet know what is the most relevant. Distractions and a high workload can negatively impact any of these contributors.

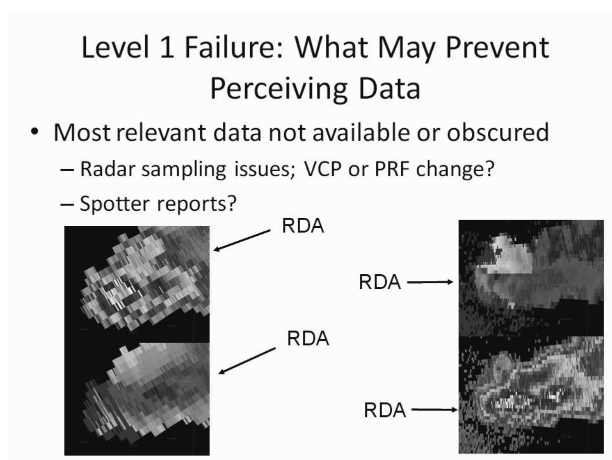
Student Notes:



24. Level 1 Failure: What May Prevent Perceiving Data

Instructor Notes: In this example, there is a storm viewed from two different radars, but there are data quality problems with the velocity products. From one viewing angle (left side of slide) part of the storm is embedded in range folding, while the other viewing angle (right side of slide) has a velocity dealiasing failure. These data uncertainties can cause a level 1 SA failure with respect to the radar data. Hopefully, alternatives exist, such as changing the VCP or the PRF, or having good spotter information.

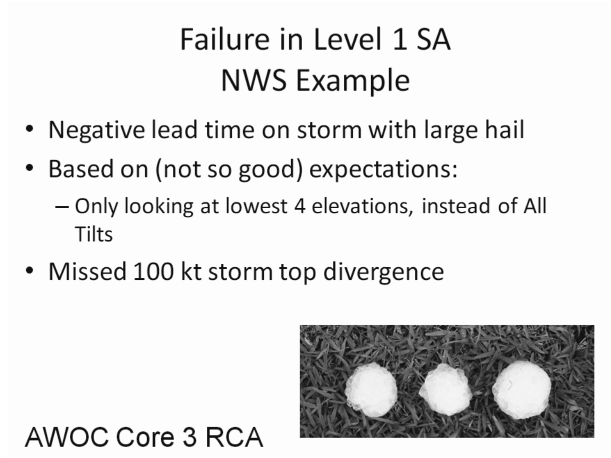
Student Notes:



25. Failure in Level 1 SA, NWS Example

Instructor Notes: Here's an NWS example of a level 1 failure, drawn from a Root Cause Analysis exercise, which you will get to do as part of Core 3. This event was a missed hail event. The most relevant data was at the mid and high levels, but it was missed because they were only looking at the lowest four elevations. This "failure to seek" was based on a poor mental model, which drove expectations, which drove the data choices. More about the impacts of poor mental models later….

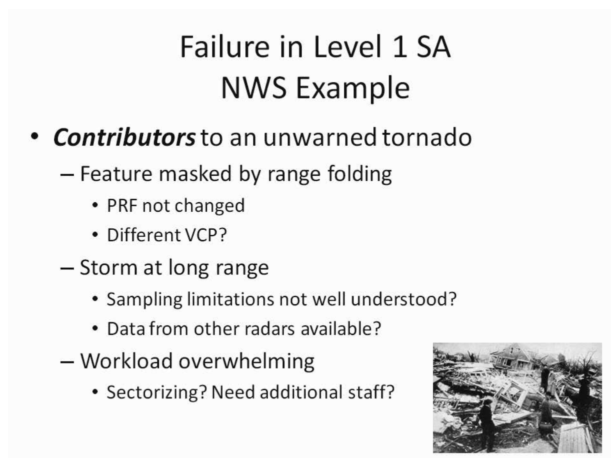
Student Notes:



26. Failure in Level 1 SA, NWS Example

Instructor Notes: Other NWS examples presented in IC Core 2 are drawn from service assessments or presentations from field representatives at WDTB workshops. In this case, a tornado developed from a storm that was in an area of range folding. Perhaps the staff was unfamiliar with the procedure to change the PRF, weren't sure about an alternate VCP or just didn't have time to do either. Since the storm was at long range, perhaps looking at an adjacent radar would have been helpful. The workload was overwhelming, likely contributing a great deal to the lost perception of the significance of this storm. Additional staff and/or sectorization may have mitigated the workload impact.

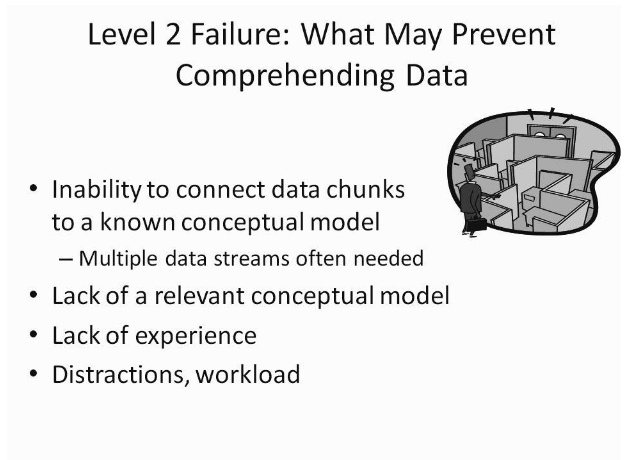
Student Notes:



27. Level 2 Failure: What May Prevent Comprehending Data

Instructor Notes: In the warning environment, level 2 SA requires comprehension of multiple data streams (radar images, spotter reports, near storm environment data) to support the pattern recognition and build the connection to the conceptual model. If the relevant data are seen but not understood, level 2 SA with respect to a conceptual model may be lost. Lack of experience can limit comprehension, even if the data are readily available. Distractions and a workload that is too high can also compromise level 2 SA.

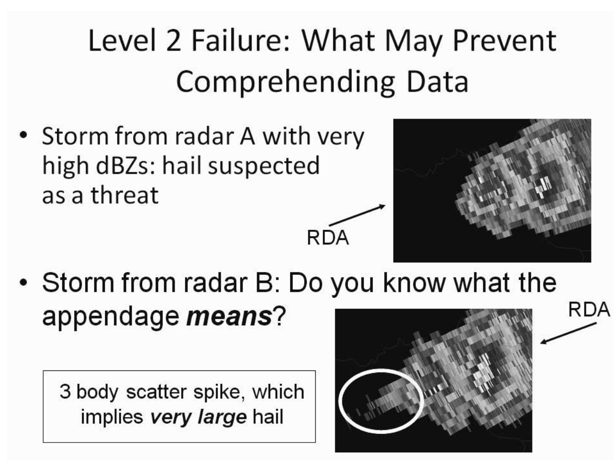
Student Notes:



28. Level 2 Failure: What May Prevent Comprehending Data

Instructor Notes: In this example, the view from radar A depicts a storm with very high dBZs in its core, which would make hail a suspected threat. However, the view of the same storm from an adjacent radar reveals a 3 body scatter spike. If you understand what that means, your level 2 SA on this storm now includes the likelihood of very large hail. The 3 body scatter spike adds significant additional information, if you understand what it means.

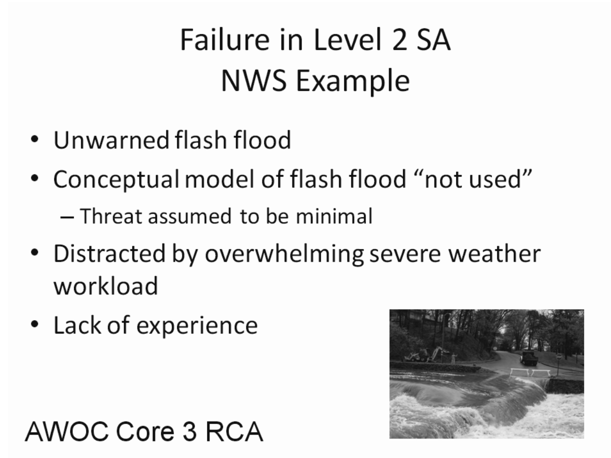
Student Notes:



29. Failure in Level 2 SA, NWS Example

Instructor Notes: In this NWS example from an AWOC RCA, the conceptual model of a flash flood was “not used”. Since the threat was thought to be minimal, the data chunks were not being put together. The other contributors were an overwhelming workload and a lack of experience.

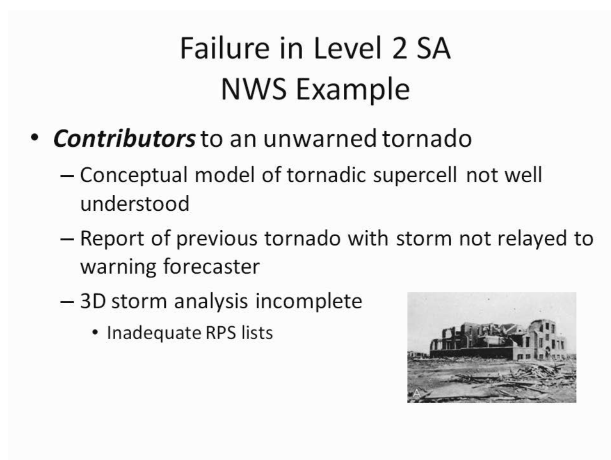
Student Notes:



30. Failure in Level 2 SA, NWS Example

Instructor Notes: In this event, a storm had previously produced a tornado, but a delayed report of the tornado was not relayed to the warning forecaster in real time. Additionally, the ability of the warning forecaster to interrogate the storm was compromised by inadequate RPS lists. The conceptual model of this tornadic supercell might have been better understood if the tornado report was passed on and the storm had been more thoroughly interrrogated.

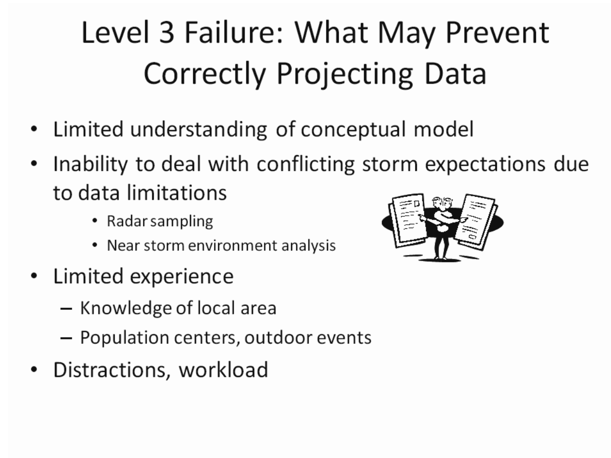
Student Notes:



31. Level 3 Failure: What May Prevent Correctly Projecting Data

Instructor Notes: Level 3 SA requires a thorough understanding of conceptual models, sufficient to predict future threats. So lack of experience or lack of a relevant conceptual model (or both) greatly impact level 3 SA. The data streams used in warning decisions all have strengths and limitations, which must be understood. A storm’s expected future behavior may be incorrect or inconclusive due to data limitations. The combination of limitations from radar and near storm environment may result in projections that are in conflict or in error. The storm’s impact must also be projected, such as passing through populated areas or crowded outdoor events.

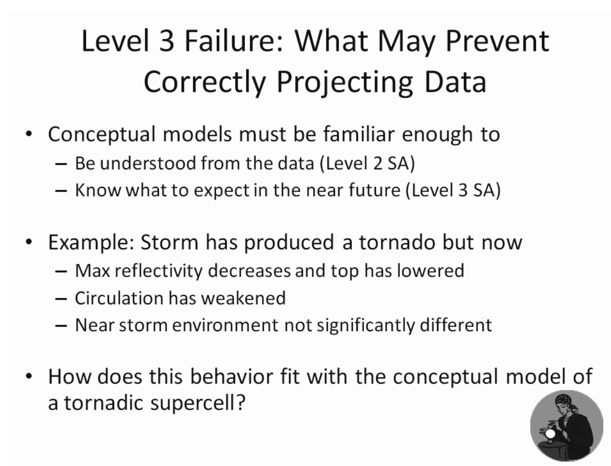
Student Notes:



32. Level 3 Failure: What May Prevent Correctly Projecting Data

Instructor Notes: Conceptual models must be familiar for both Level 2 and 3 SA. In this example, a storm has previously produced a tornado. Now the radar data shows a lowering top, lower max reflectivity and a weakening circulation. The near storm environment is not significantly different, so the question to ask is how does this behavior fit the model of a tornadic supercell?

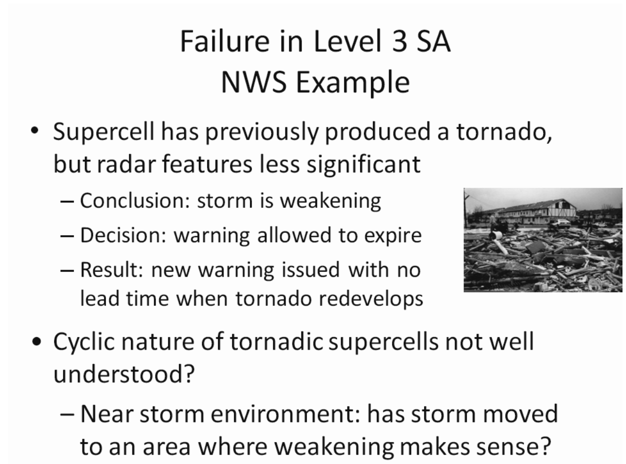
Student Notes:



33. Failure in Level 3 SA, NWS Example

Instructor Notes: In this example, the radar features were assumed to mean that the storm was weakening and the warning was allowed to expire. The cyclic nature of tornadic supercells was not sufficiently understood, thus not projected. This level 3 failure resulted in a reactive tornado warning with little lead time.

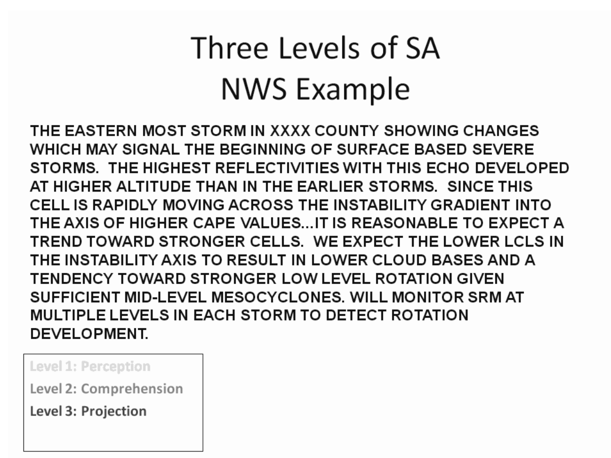
Student Notes:



34. Three Levels of SA, NWS Example

Instructor Notes: As an exercise, take a look at this excerpt from a regional weather discussion. Identify the different levels of SA represented in the phrases. Statements of perceived data represent level 1. Statements of the meaning of the data represent level 2, and statements projecting the consequences of that meaning represent level 3.

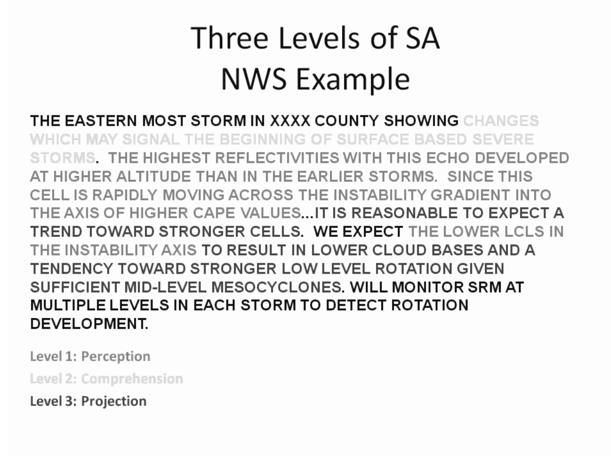
Student Notes:



35. Three Levels of SA, NWS Example

Instructor Notes:

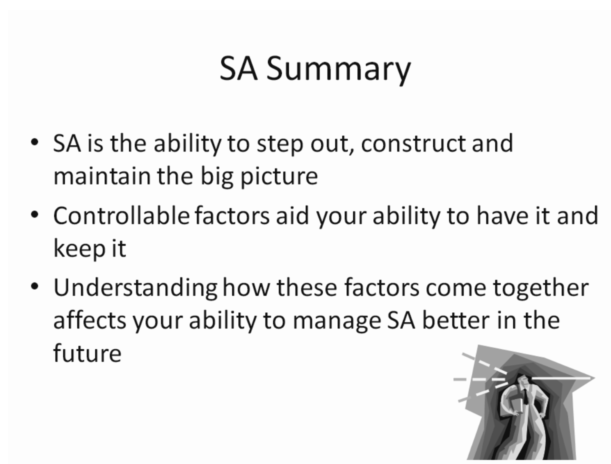
Student Notes:



36. SA Summary

Instructor Notes: In summary, SA is the ability to build and maintain the big picture, which supports your ability to make sound warning decisions. There are several controllable factors, such as workload, which can support your ability to have good SA. Developing the ability to have good SA in the warning environment in the future is dependent on understanding how these controllable factors come together.

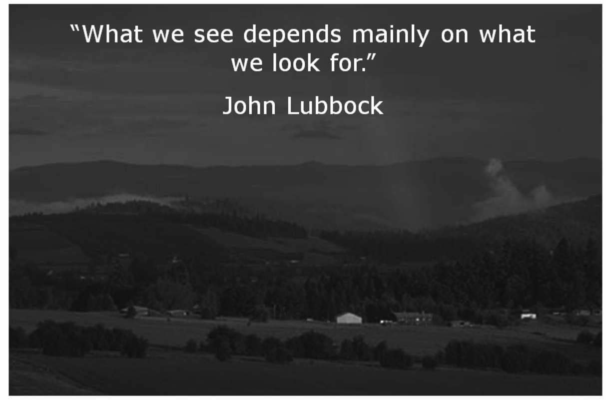
Student Notes:



37. Final Quote

Instructor Notes: John Lubbock reminds us that what we perceive is often limited to what we are looking for.

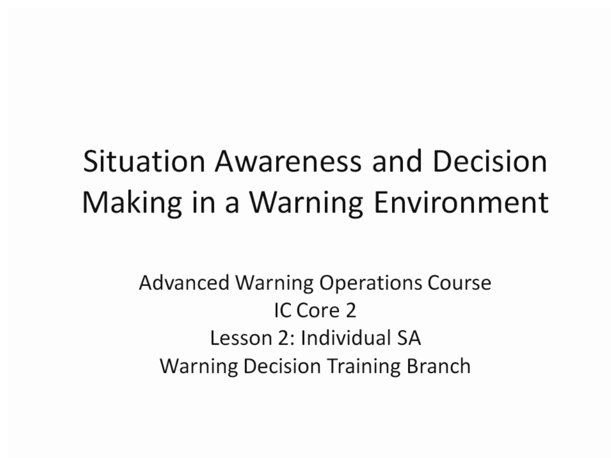
Student Notes:



38. Situation Awareness and Decision Making in a Warning Environment

Instructor Notes: This concludes Lesson 2: Individual SA. There are three remaining lessons for IC Core 2.

Student Notes:



39. Questions?

Instructor Notes: If you have questions about the material from IC Core 2, first check with your AWOC facilitator (most likely your SOO). If your AWOC facilitator cannot answer your question, please send an email to awoccore_list@wdtb.noaa.gov.

Student Notes:

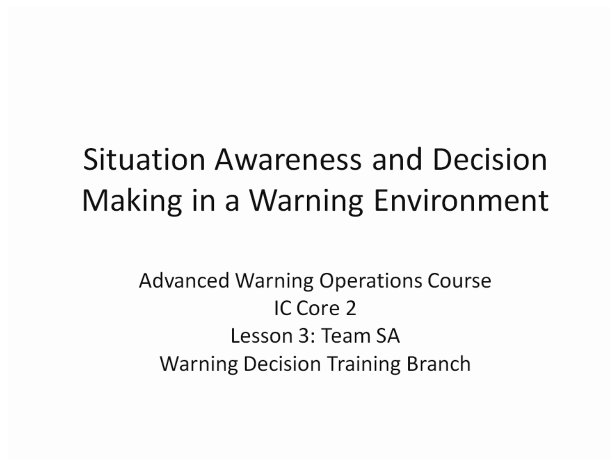
Questions?

1. Check with your AWOC facilitator (most often the SOO)
2. Send your question to awoccore_list@wdtb.noaa.gov

1. Situation Awareness and Decision Making in a Warning Environment

Instructor Notes: Lesson 3 will focus on the Situation Awareness (SA) of teams. The "teams" in this lesson are not limited to the forecast office staff. For example, another team would be the entire group comprised of the forecast office, the media, and emergency managers, who are all part of the warning effort.

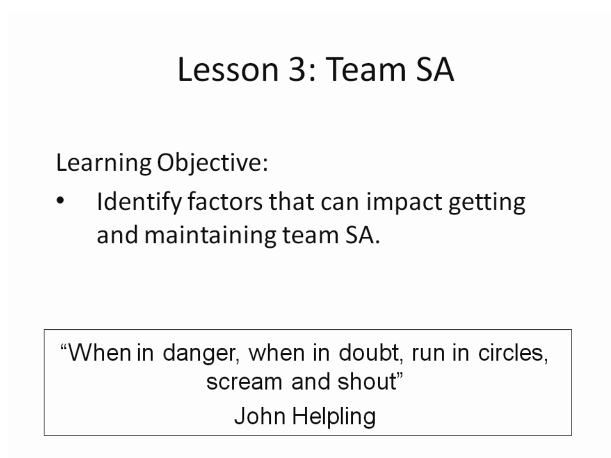
Student Notes:



2. Lesson 3: Team SA

Instructor Notes: The Learning Objective for Lesson 3 applies to factors that affect getting and maintaining team SA. The Learning Objectives will be tested when you take the on-line exam for IC Core 2.

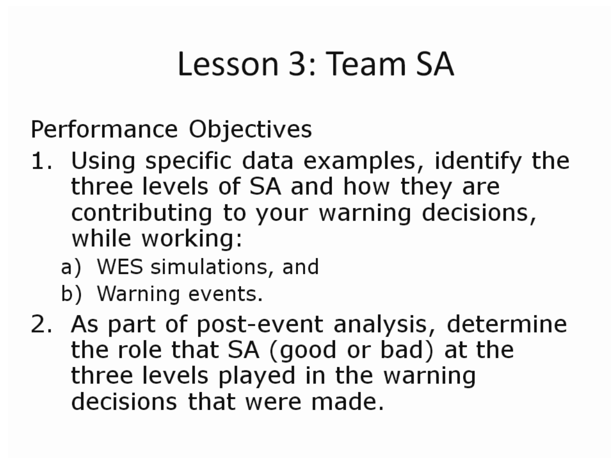
Student Notes:



3. Lesson 3: Team SA

Instructor Notes: The Performance Objectives for Lesson 3 apply during this course as well as after completion. Though they are not tested formally, questions related to these Performance Objectives will be posed during the course simulations. Developing SA in the “domain” of the warning environment is a skill that evolves over time and is an important asset in making sound warning decisions.

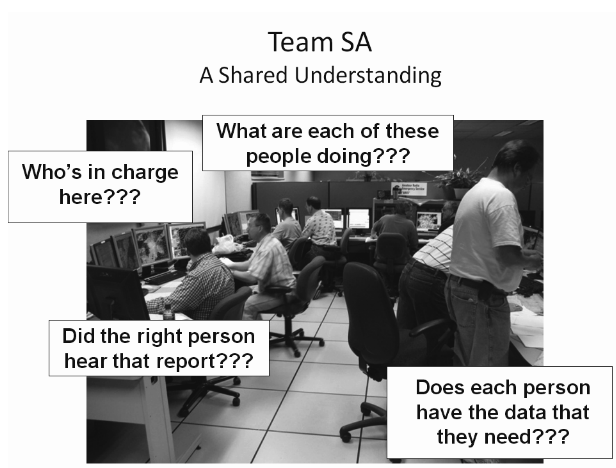
Student Notes:



4. Team SA, A Shared Understanding

Instructor Notes: This photo was taken at a forecast office during a significant warning event. There are eight people working in this one area and others working elsewhere. The potential for communications chaos is very high and there are a number of important questions to consider about managing this environment.

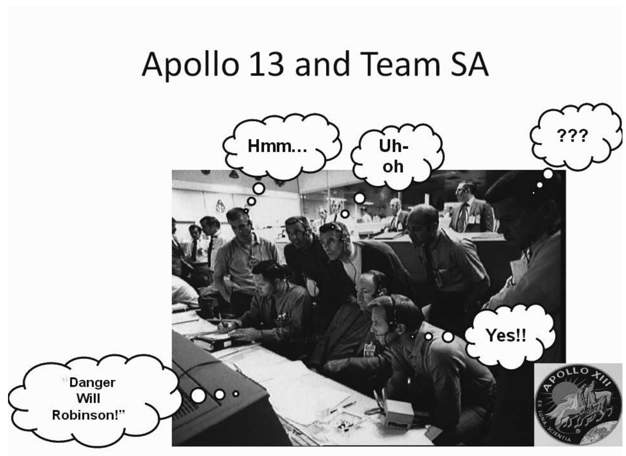
Student Notes:



5. Apollo 13 and Team SA

Instructor Notes: The Apollo 13 mission is an interesting example of a shift in team SA. This large team of controllers had to build their SA sufficiently to shift the goal from mission completion to getting the astronauts back alive. Imagine the reluctance to abandon the mission, but lengthy resistance would have caused delays that might have prevented the return of the astronauts.

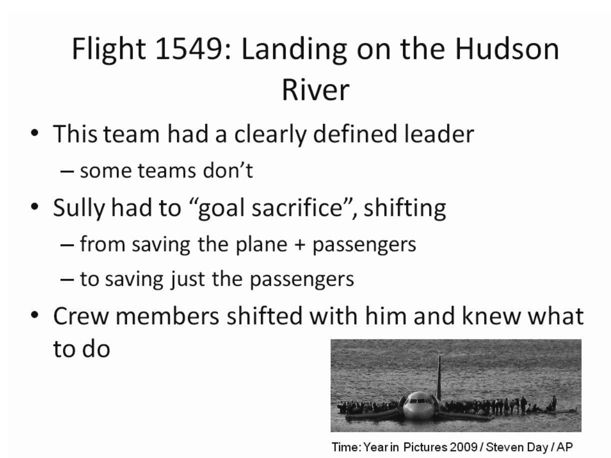
Student Notes:



6. Flight 1549: Landing on the Hudson River

Instructor Notes: A recent example of a significant shift in team SA is the successful landing of Flight 1549 on the Hudson river in January of 2009. Captain Sully had to sacrifice the goal of saving both the plane and passengers in order to change his goal to simply saving the passengers. Once that shift occurred, the crew shifted with him and knew what to do.

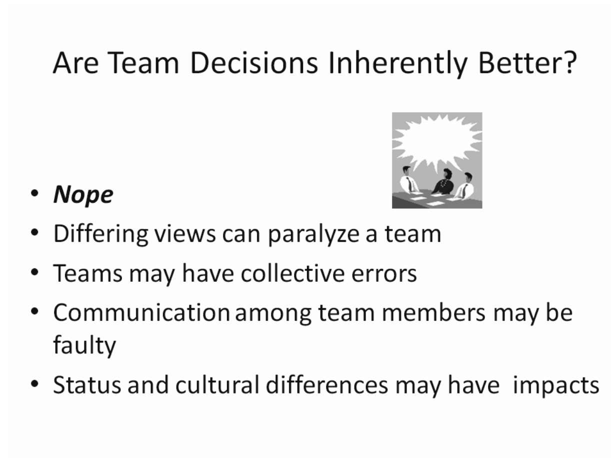
Student Notes:



7. Are Team Decisions Inherently Better?

Instructor Notes: Team SA has its own challenges. Team decisions are not necessarily better. There are a number of things that can derail team SA, such as inability to resolve conflicts, poor communication, status and cultural differences.

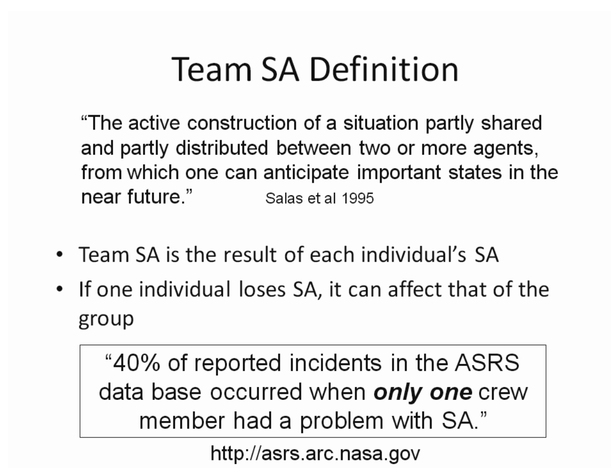
Student Notes:



8. Team SA Definition

Instructor Notes: The definition of team SA addresses the construction of SA for each individual, with information shared among team members, building team SA. The quote from ASRS shows that the impact is significant when only one member of a team loses their SA. ASRS is the Aviation Safety Reporting System, a web site provided by NASA where pilots and crew members can report incidents anonymously. This database is also used by human factors researchers.

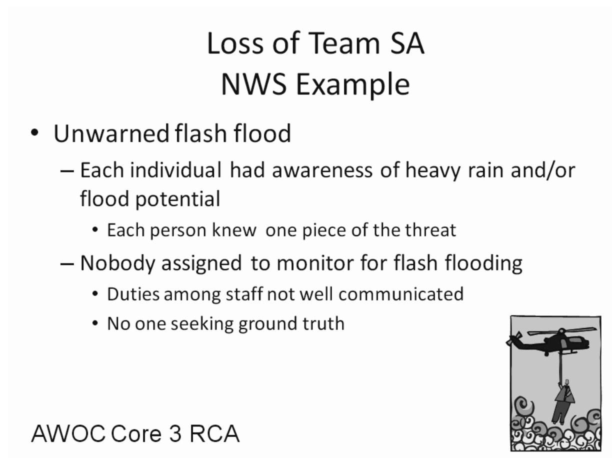
Student Notes:



9. Loss of Team SA, NWS Example

Instructor Notes: Here's a case of an unwarned flash flood. Each of the individuals had some knowledge, but it was not communicated. One person had been monitoring for flash flooding earlier, changed to another task, but did not delegate to someone else. Members of the team noted the heavy rain at different times, but nothing further was done. Most importantly, no one was formally assigned the task.

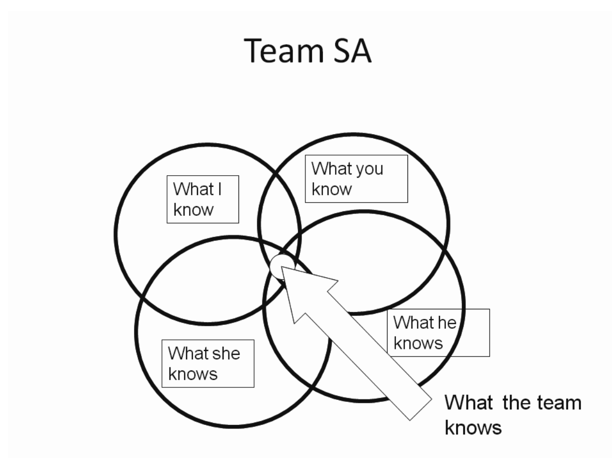
Student Notes:



10. Team SA

Instructor Notes: The subset of information that all team members need to know can be quite small. Each team member will likely have a vast amount of individual knowledge, but only a portion of it needs to be shared. In the previous example, just keeping track of who is monitoring for flash flooding may have been sufficient for "what the team knows" and might have been enough for a warning.

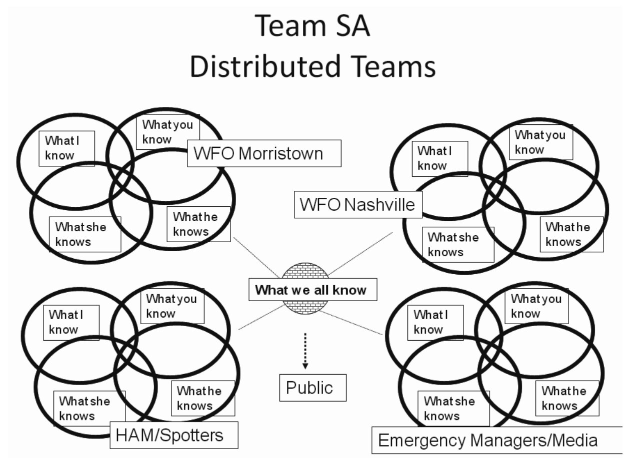
Student Notes:



11. Team SA, Distributed Teams

Instructor Notes: The warning process involves many teams, both internal and external to the NWS office. In addition to the NWS offices, HAMs/spotters, Emergency Managers, and the media are all members of the distributed team involved in the warning process. The better the communications among these groups, as well as a clear understanding of roles and responsibilities, the better the chance for good decision making and public service during severe weather events.

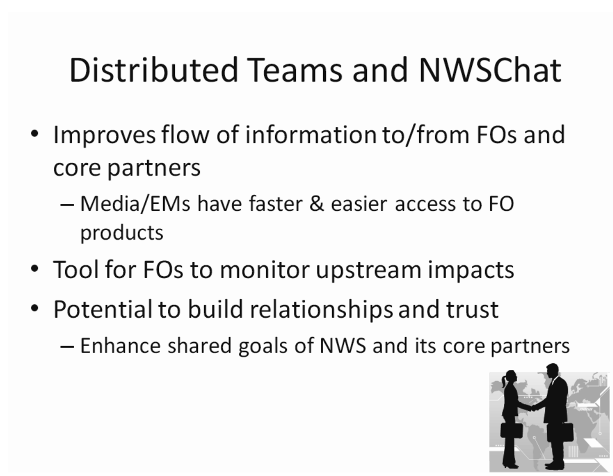
Student Notes:



12. Distributed Teams and NWSChat

Instructor Notes: NWSChat has a unique role in the distributed teams of the warning process. It improves the flow of information between the NWS and its core partners. It allows FOs to monitor upstream impacts. Most importantly, it has the potential to build relationships and trust. The goals of the NWS and its core partners are ultimately the same, and NWSChat supports the sharing of these goals.

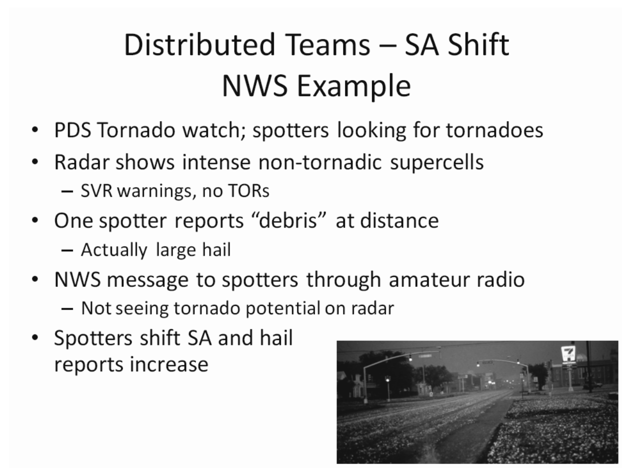
Student Notes:



13. Distributed Teams – SA Shift, NWS Example

Instructor Notes: In this example, the fact that a PDS Tornado Watch had been issued had shifted the SA of the spotters toward rotation and tornadoes. Radar was indicating intense supercells, but rotation signatures on radar were minimal. No tornado warnings were issued, only severe thunderstorm. The forecast office was expecting hail reports and not getting them until a spotter reported "debris" at a distance. The NWS used amateur radio to communicate to the spotters that the tornado potential was low at that time and that hail seemed to be the threat. Not long after, hail reports began coming in as the spotters shifted their SA.

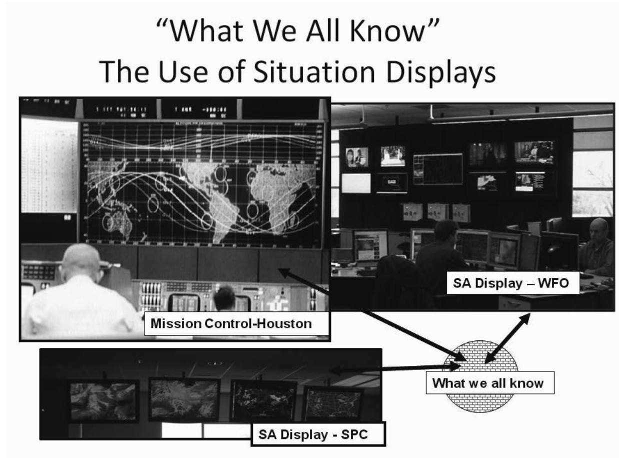
Student Notes:



14. "What We All Know" The Use of Situation Displays

Instructor Notes: SA displays have been used in other domains for many years and new technologies support more robust designs. Mission Control in Houston may be the best known example of a large SA display. Many forecast offices have SA displays to support warning operations.

Student Notes:



15. Team SA and Leadership

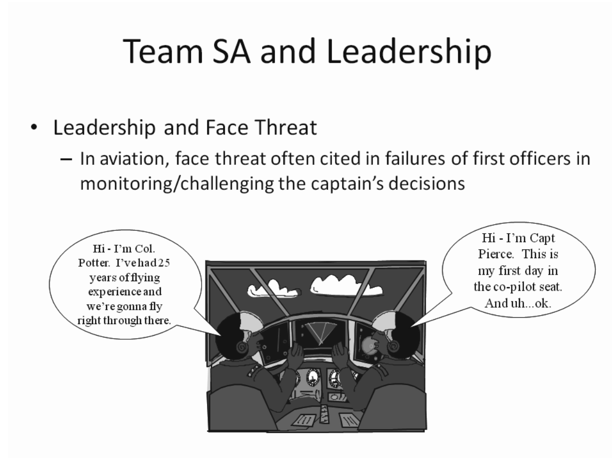
Instructor Notes: Leadership can strongly affect team SA and performance…favorably or unfavorably! Leadership is most important in creating an environment where roles and responsibilities are well defined, understood and the role of each individual is valued and respected. Leadership sets the tone for communications among staff members. Good leadership can also minimize "face threat", which is a sometimes dangerous hindrance to communication. At all times, the most junior member of the staff should feel comfortable pointing out potential errors to the most senior member of the staff. If not, there's a chance that critical information may not be communicated.

Student Notes:

16. Team SA and Leadership

Instructor Notes: "Face Threat" inhibits communication, sometimes tragically. Self-awareness on the part of senior person is just as important as assertiveness on the part of the journeyman. Good leadership provides an environment where communication between superiors and subordinates flows freely.

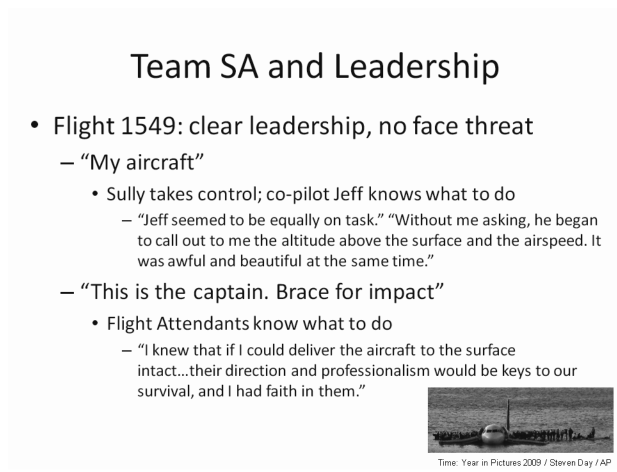
Student Notes:



17. Team SA and Leadership

Instructor Notes: The successful landing and evacuation of Flight 1549 was achieved due to the leadership of Captain Sully, which included his ability to communicate only what was needed to the crew. He also had confidence in their ability to do what they had been trained to do. His verbal and non-verbal communication conveyed that confidence.

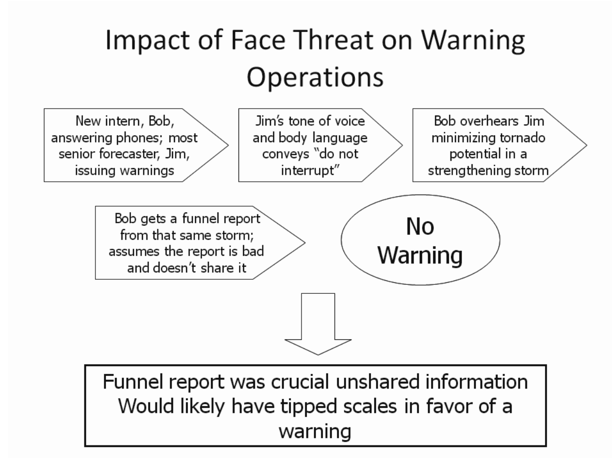
Student Notes:



18. Impact of Face Threat on Warning Operations

Instructor Notes: This situation is based on a real event. "Bob" is the new intern, answering the phones. "Jim" is the lead forecaster, but his verbal and non-verbal messages deliver the message that he doesn't want to be bothered and that a strengthening storm isn't likely to produce a tornado. When Bob gets a report of a funnel, he is reluctant to share it (can you blame him?) and decides it must be invalid. The result is an unwarned tornado.

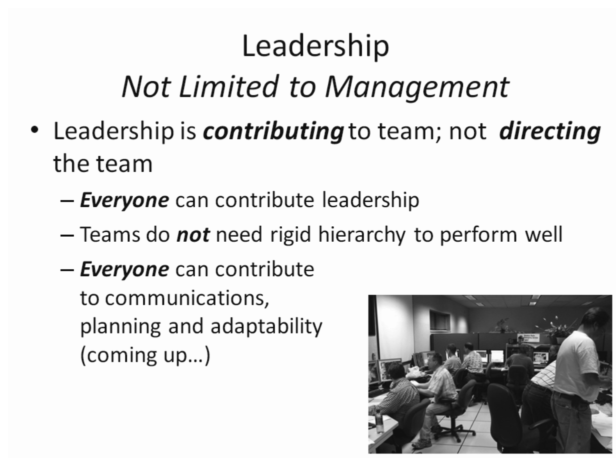
Student Notes:



19. Leadership, Not Limited to Management

Instructor Notes: This type of leadership is not limited to management. It is about contributing to the team rather than directing the team and everyone has the potential to do that. A rigid hierarchy is not needed to allow a team to perform well, with each individual contributing to the communications, planning, etc.

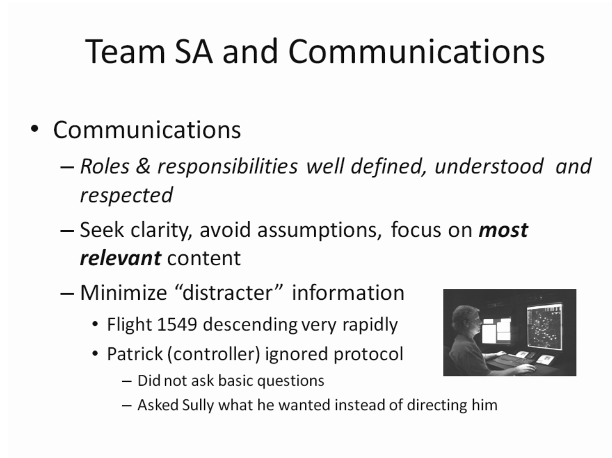
Student Notes:



20. Team SA and Communications

Instructor Notes: Even in the absence of face threat, communications can suffer. Once again, roles and responsibilities need to be well defined and understood by all. Assumptions need to be avoided, so ask questions as needed for clarity. Do not share irrelevant information, which will vary from event to event.

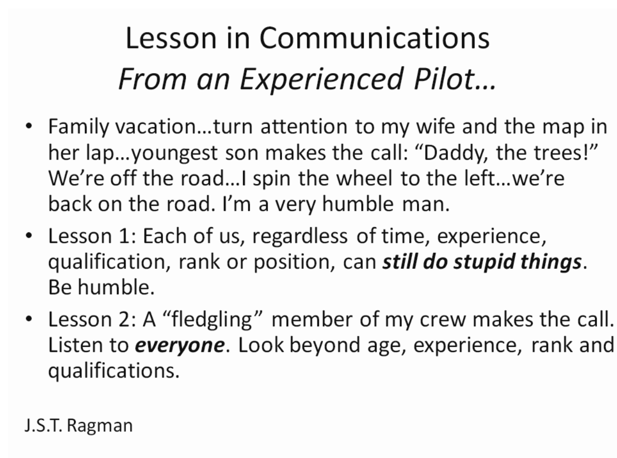
Student Notes:



21. Lesson in Communications From an Experienced Pilot…

Instructor Notes: This example is a personal story from an experienced commercial pilot, Air Force Reserve Guard unit commander, and trainer. His message is to always be on guard for error and to always listen to everyone on your crew.

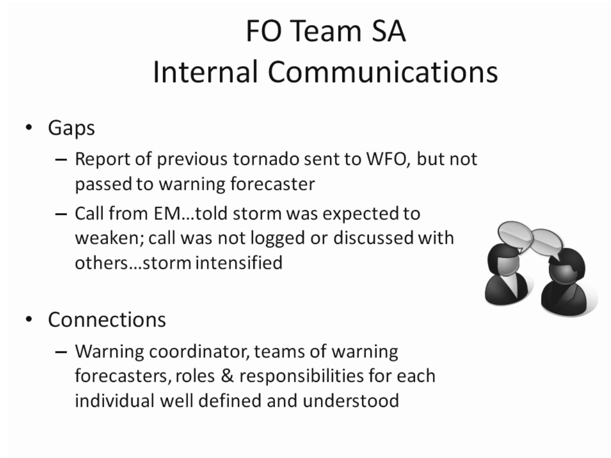
Student Notes:



22. FO Team SA Internal Communications

Instructor Notes: Here are examples of internal communications within a forecast office, both good and bad. The gaps are examples of crucial pieces of information that were not passed to the right person…the warning forecaster needs to know in real time if a particular storm has previously produced a tornado. Another gap is one staff member telling an EM that a storm is expected to weaken and not sharing this conversation with the warning forecaster who was working that storm. An example of good connections is the presence of a warning coordinator and all staff members having clearly defined roles and responsibilities.

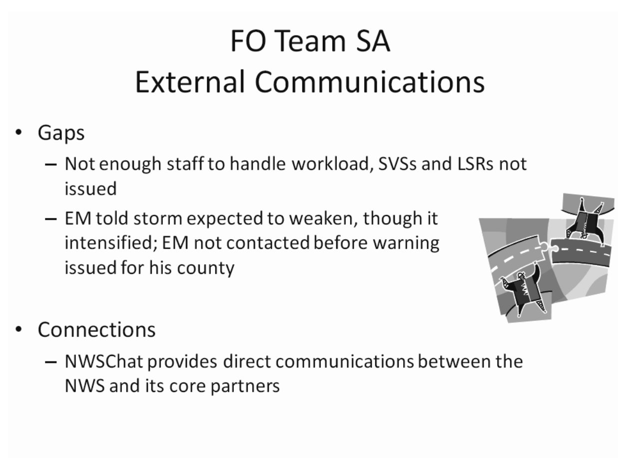
Student Notes:



23. FO Team SA External Communications

Instructor Notes: Here are examples of external communications, both good and bad, between the forecast office and the media and emergency managers (EMs). One of the gaps results from not having adequate staff for the event, resulting in no SVSs or LSRs being issued. These products provide a valuable service to the media and EMs, and hampered the performance of these external partners. In another case, an EM talked to a WFO staff member and was told that a storm is expected to weaken. When the storm intensified and a warning was issued for that county, the EM was not notified in advance. Good external communications involve direct connections between the NWS and core partners. Use of strong language in warnings and statements helps to convey a particularly high threat.

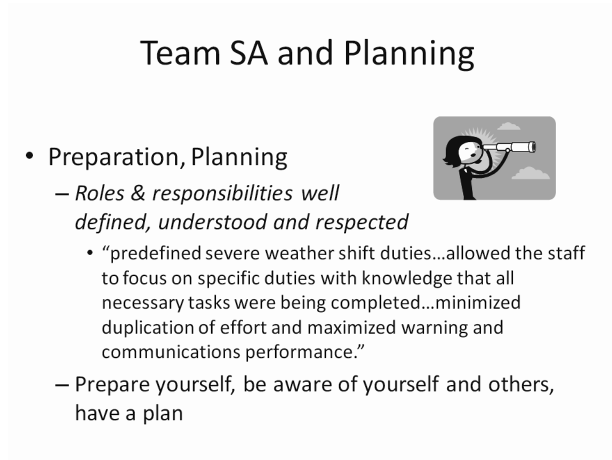
Student Notes:



24. Team SA and Planning

Instructor Notes: Pre-planning can make a significant difference during warning operations. Successful office performance often results from well defined responsibilities for each individual, as well as a coordinator to oversee workload and to deal with the inevitable surprises. The quote is from a service assessment of a widespread but successful event. Each staff member was better able to focus on their particular duties because they knew that all necessary operations were accounted for.

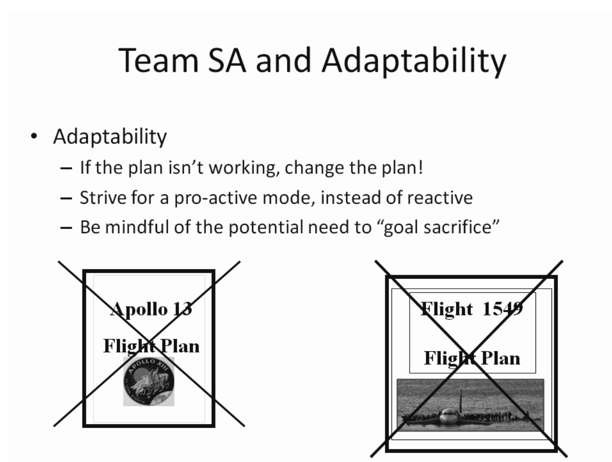
Student Notes:



25. Team SA and Adaptability

Instructor Notes: There is no single "plan" for severe weather operations. Since the warning environment is so dynamic, adaptability is essential. It may be necessary to call in more staff, adjust warning sectors, and adjust roles and responsibilities, as needed. Adaptability allows for a more proactive approach to warning operations, instead of reactive.

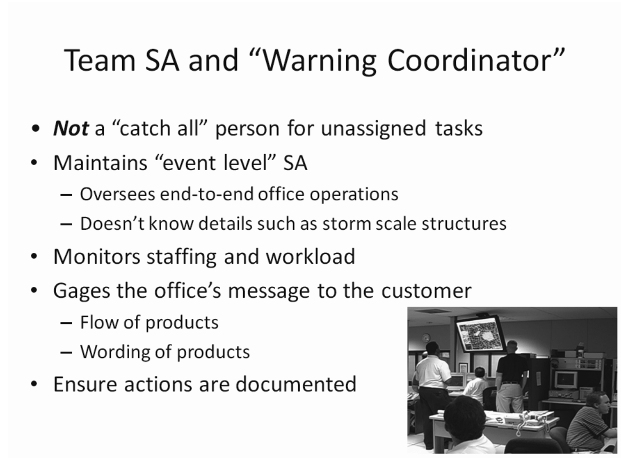
Student Notes:



26. Team SA and "Warning Coordinator"

Instructor Notes: The warning coordinator has to maintain his or her own SA, which is "event level". The warning coordinator does not know details such as storm scale structures, which is the focus of the warning forecaster's individual SA. The warning coordinator manages team SA by monitoring staffing and workload, as well as monitoring the office’s overall message to the customer.

Student Notes:



27. Team SA Summary

Instructor Notes: In summary, team SA requires team members to maintain their individual SA and contribute to the group SA. There are several controllable factors, such as well defined roles and responsibilities, effective communications, planning, adaptability, and managing staff workload.

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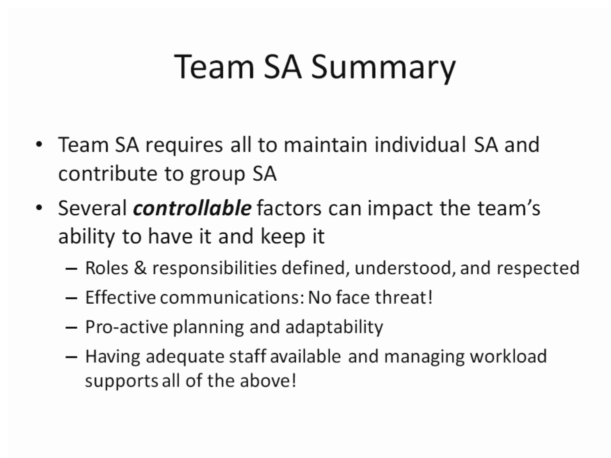
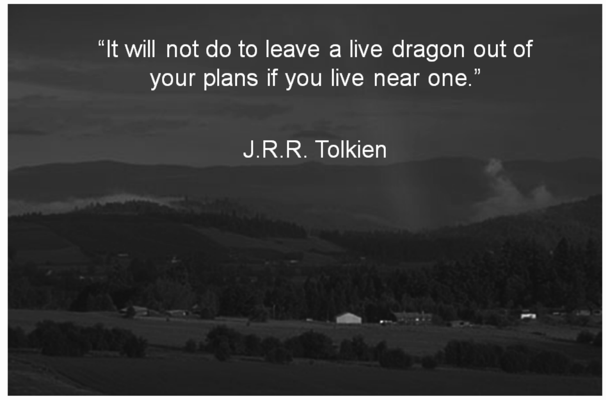


28. Final Quote

Instructor Notes: A final word from J.R.R. Tolkien. Since we have a live dragon living nearby, it’s best to plan for it!

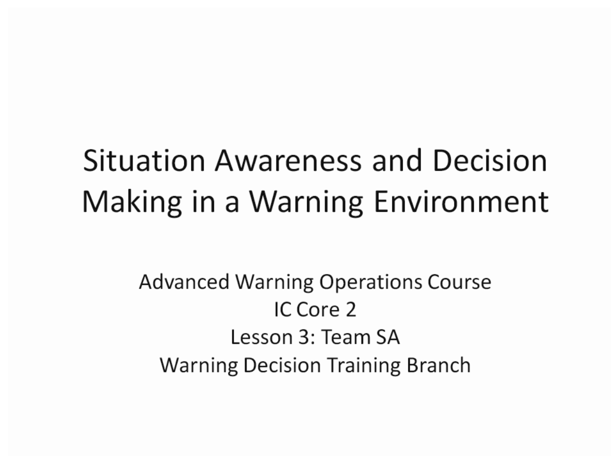
Student Notes:



29. Situation Awareness and Decision Making in a Warning Environment

Instructor Notes: This concludes Lesson 3: Team SA. There are two remaining lessons for AWOC Core 2.

Student Notes:



30. Questions?

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Student Notes:

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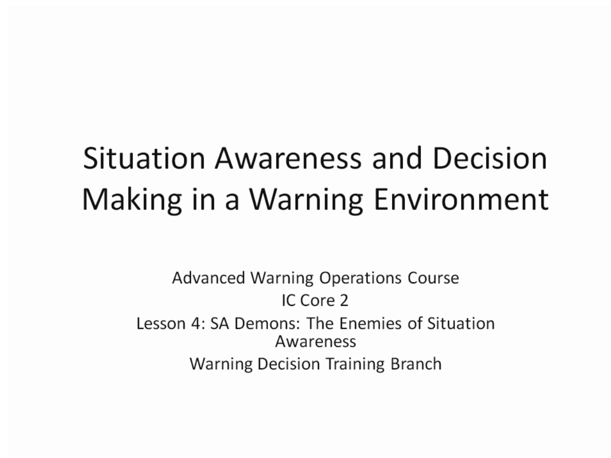
2. Send your question to awoccore_list@wdtb.noaa.gov

1. Situation Awareness and Decision Making in a Warning Environment

Instructor Notes: Lesson 4 will focus on the SA Demons, which are the enemies of Situation Awareness.

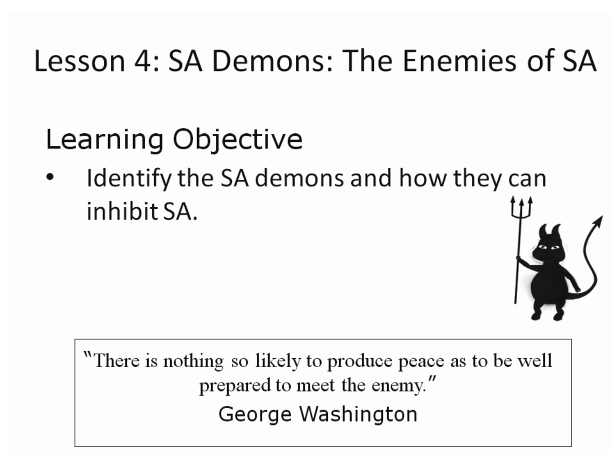
Student Notes:



2. Lesson 4: SA Demons: The Enemies of SA

Instructor Notes: The Learning Objective for Lesson 4 applies to the SA demons, identifying them as well as how they can inhibit SA.

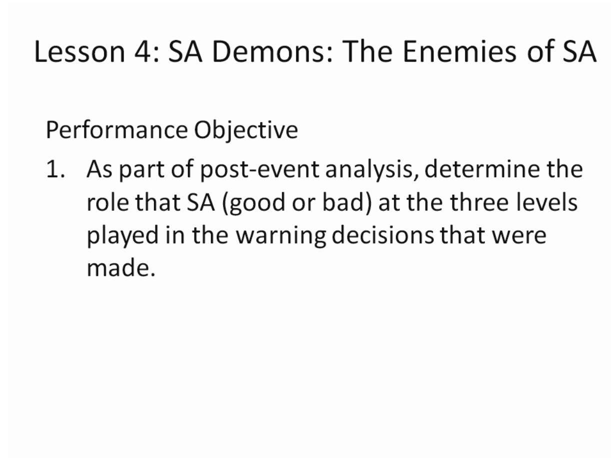
Student Notes:



3. Lesson 4: SA Demons: The Enemies of SA

Instructor Notes: The Performance Objective for Lesson 4 applies to post event analysis during this course as well as after completion. Though they are not tested formally, understanding SA demons and their impact as part of post event analysis will improve your ability to build and maintain good SA in future events.

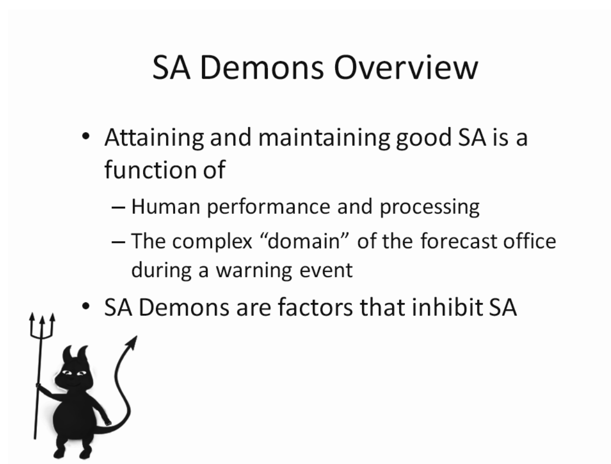
Student Notes:



4. SA Demons Overview

Instructor Notes: Summarizing the previous lessons of Core 2, getting and maintaining good SA is dependent on how humans perform in the complex domain of the warning environment. SA Demons are elements to look for in this environment.

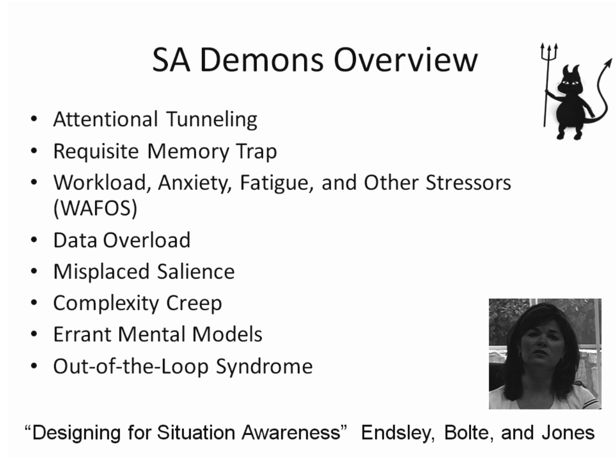
Student Notes:



5. SA Demons Overview

Instructor Notes: There are eight different SA demons, each of which will be defined and examples provided. The concept of SA demons comes from a book by Mica Endsley, "Designing for Situation Awareness".

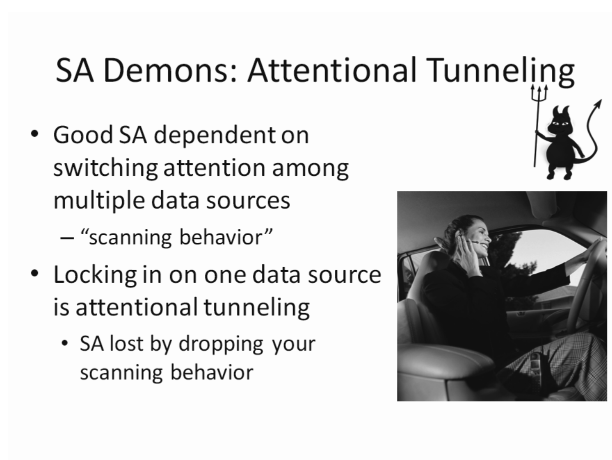
Student Notes:



6. SA Demons: Attentional Tunneling

Instructor Notes: In most domains, good SA requires regularly switching your attention among multiple data streams, also known as scanning behavior. In highly dynamic domains like warning operations, the number of data sources is very high and their relative importance changes. Attentional tunneling is becoming overly fixed on certain data sources to the exclusion of others, which means losing your scanning behavior. A sometimes tragic example from everyday life is making calls on a cell phone while driving. Losing your SA on the driving task for even a few moments can sometimes have terrible consequences.

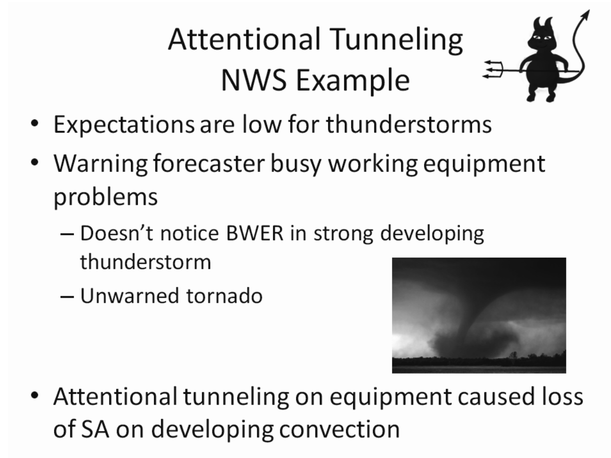
Student Notes:



7. Attentional Tunneling, NWS Example

Instructor Notes: In this example, the day's expectations were for a low probability of thunderstorms. Thunderstorms did develop in the midst of some equipment problems. The warning forecaster was part of the group working the problem. Since his attention was tunneled toward the equipment, he missed a BWER in a particularly strong thunderstorm. The storm did produce a damaging tornado.

Student Notes:



8. SA Demons: Requisite Memory Trap

Instructor Notes: Working or short term memory is the part of our cognitive load that "caches" chunks of data. Good SA (level 2) is dependent on holding sufficient data chunks to apply a conceptual model. Research has shown that working memory can be better developed, but is still a limited resource. Technology that is designed in a way that requires significant memory just for operating the system erodes working memory.

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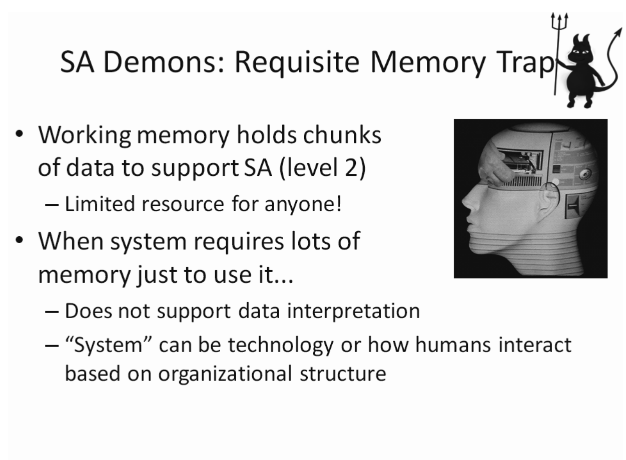
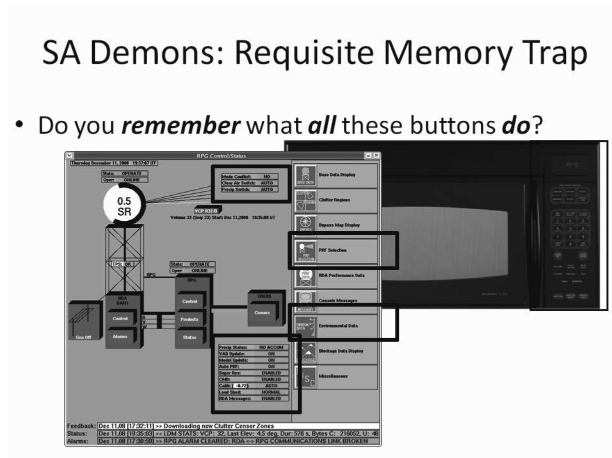


9. SA Demons: Requisite Memory Trap

Instructor Notes: Systems that require "getting out the manual" for operations beyond the baseline are common in everyday life. Most microwave ovens have a myriad of features that aren't used because the design requires too much memory. With the WSR-88D, there are many tasks that will optimize radar performance, but are difficult to do during warning operations.

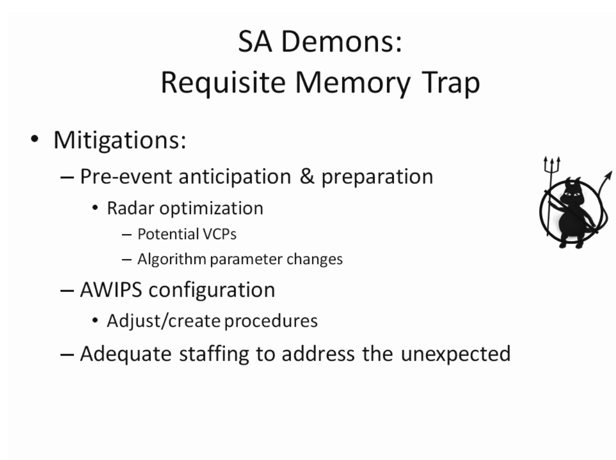
Student Notes:



10. SA Demons: Requisite Memory Trap

Instructor Notes: Anticipation of events and setting parameters before the event begins can partially mitigate this demon. This is particularly important for tasks that require too much memory to be done on the fly. Examples include adjustments to AWIPS procedures, RPS lists, considering potential VCPs, and radar algorithm parameter changes, such as the Z-R relationship.

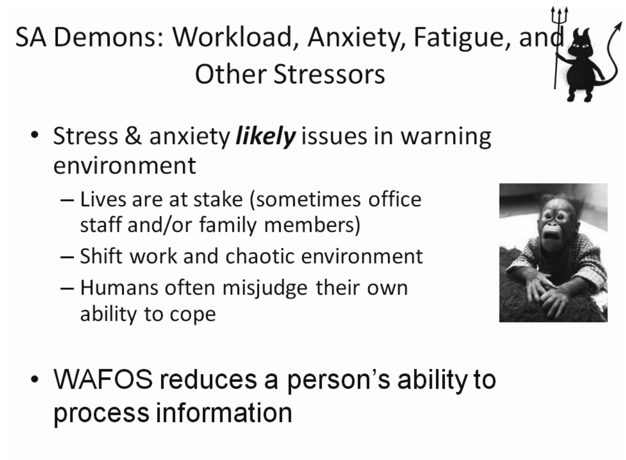
Student Notes:



11. SA Demons: Workload, Anxiety, Fatigue, and Other Stressors

Instructor Notes: Workload, Anxiety, Fatigue, and Other Stressors (WAFOS) are human conditions common to dynamic domains. WAFOS is likely to be a significant issue in warning operations and should be monitored and adjusted as best possible. Humans usually assume that they can “keep on going” despite stressful circumstances. The warning coordinator can often identify someone who needs a break well before the individual would know. For example, during a historic tornado event, one of the warning forecasters, “Joe”, was working a supercell with a large tornado that passed through his neighborhood. Phone communications were down and Joe could not reach his family. Joe did not ask if he could leave to check on his family…the warning coordinator told him to go. It took awhile for Joe to find out, but his family survived despite significant structural damage.

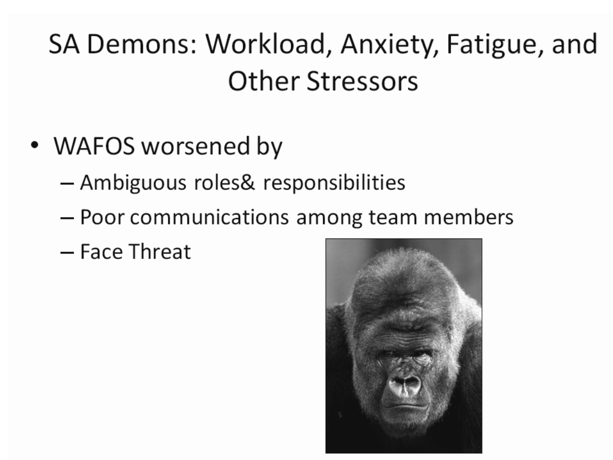
Student Notes:



12. SA Demons: Workload, Anxiety, Fatigue, and Other Stressors

Instructor Notes: There are non-meteorological factors that affect WAFOS as well, taxing attention and working memory. Ambiguous roles and responsibilities and poor communication among team members will worsen the “distraction” that WAFOS provides. Face threat is a particularly damaging hindrance to team communication, and all staff must be aware of the potential for face threat to get in the way.

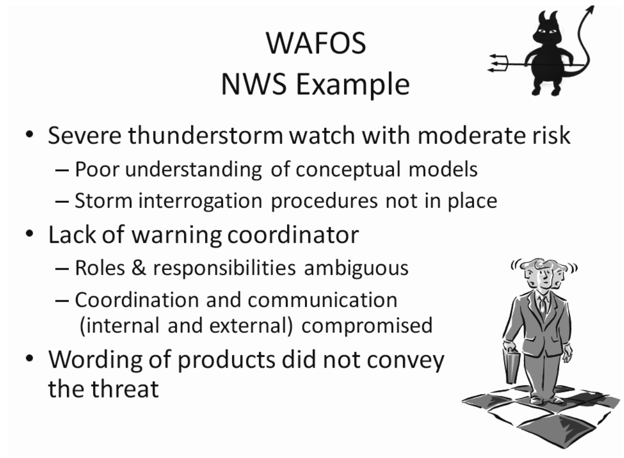
Student Notes:



13. WAFOS, NWS Example

Instructor Notes: This example resulted in significant hail and wind damage in some unwarned counties. A number of factors came together to raise the WAFOS to the point of hindering storm recognition, internal and external communications and conveying the severity of the threat.

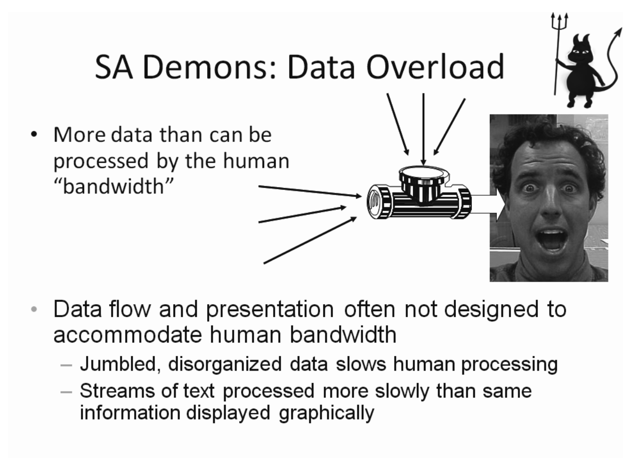
Student Notes:



14. SA Demons: Data Overload

Instructor Notes: Data Overload is a frequently cited problem in our culture. In warning operations, it can significantly inhibit good SA. Humans have a limited bandwidth, yet systems (technology and communications) are often not designed to accommodate this limitation.

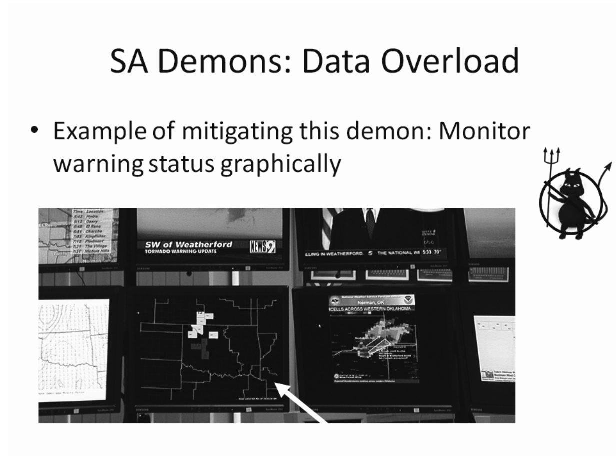
Student Notes:



15. SA Demons: Data Overload

Instructor Notes: One example of mitigating this demon is to graphically display current warnings and the number of minutes remaining for each warning. In this example, it is part of an overall situation awareness display.

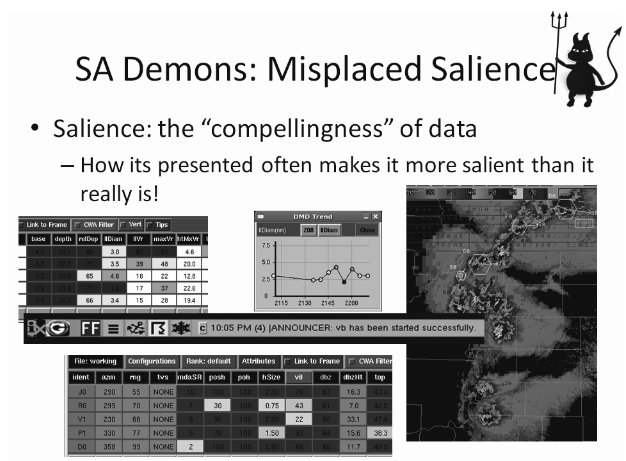
Student Notes:



16. SA Demons: Misplaced Salience

Instructor Notes: You are probably all too familiar with red boxes and banners and the associated audio alarms. It is often left to the operator to investigate and determine which of these alarms is actually relevant. Misplaced salience with these alarms is a typical example.

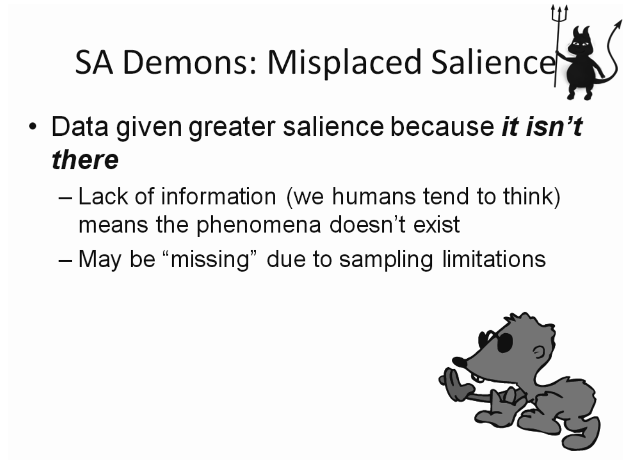
Student Notes:



17. SA Demons: Misplaced Salience

Instructor Notes: A more subtle example is misplaced salience on the lack of information. We humans tend to assume that the absence of information means that the phenomena doesn't exist. For example, a lack of spotter reports from a storm is often interpreted to mean that the storm isn't producing hail or strong winds.

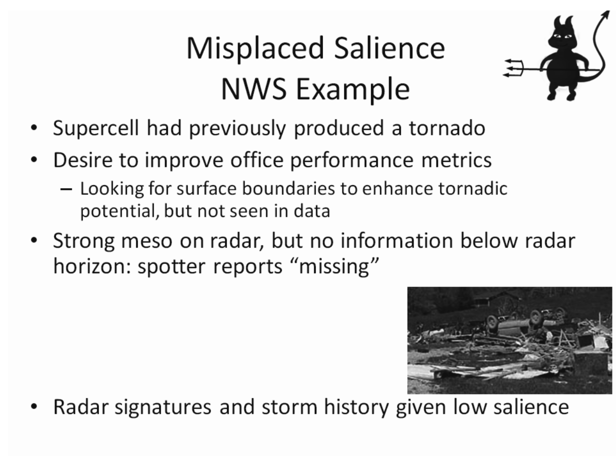
Student Notes:



18. Misplaced Salience, NWS Example

Instructor Notes: In this example, there was a supercell that had previously produced a tornado. The office staff wanted to improve their warning statistics, and were looking hard for clues from the environmental data. Surface boundaries were not seen in the data and assumed not to be there, reducing the tornadic potential. Though the radar showed a strong mesocyclone, spotter reports were not available, which was interpreted to mean that the storm was not tornadic. In both cases, the lack of data was interpreted to mean that the phenomena was not there. The radar signatures and storm history were given too little salience, and the storm produced an unwarned tornado.

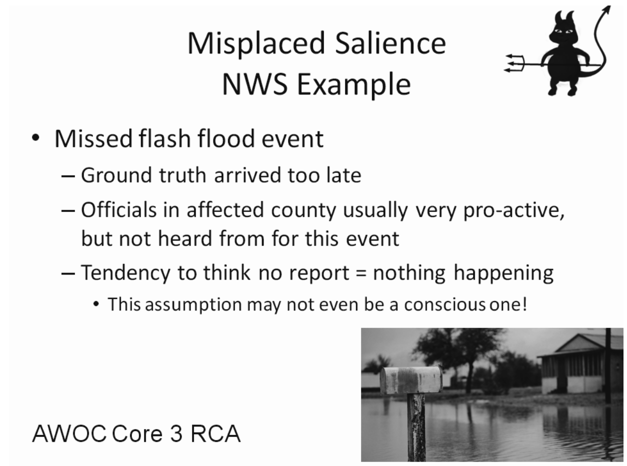
Student Notes:



19. Misplaced Salience, NWS Example

Instructor Notes: This was a case of a missed flash flood, mainly due to the lack of ground truth. This occurred in a county where the officials are usually very pro-active, but not this time.

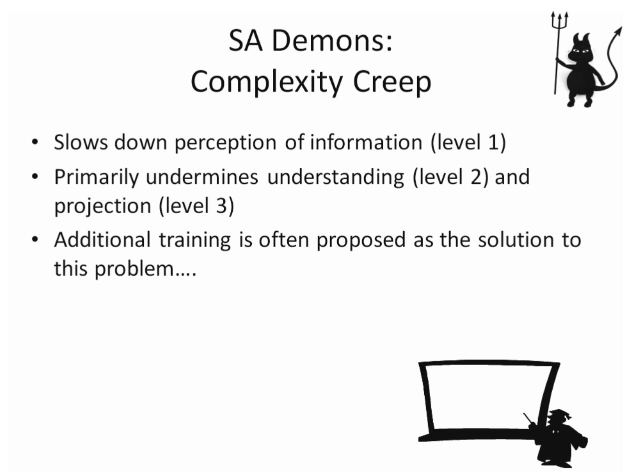
Student Notes:



20. SA Demons: Complexity Creep

Instructor Notes: Complexity creep is a long term problem with many science and technology driven organizations and has an impact on all three levels of SA. Training is typically proposed as the solution to this problem, though often by those who aren't going to produce the training or those who will complete it!

Student Notes:



21. SA Demons: Complexity Creep

Instructor Notes: Complexity creep is a common trend in technology-based organizations. Here are a couple of trends in the NWS in the past several decades.

Student Notes:

22. SA Demons: Errant Mental Models

Instructor Notes: Errant mental models can have an impact in different ways. Though the appropriate conceptual model may have been anticipated, an incomplete understanding of that model may hinder comprehension and projection (level 2 and 3 SA). If the wrong model is anticipated, the data may be incorrectly interpreted. Humans have a tendency to explain away cues in the data that conflict with the mental model that they have selected. An extreme example is an underlying assumption that “tornadoes don’t happen here”. The following slides have a couple of examples of conflicting data that is “explained away”.

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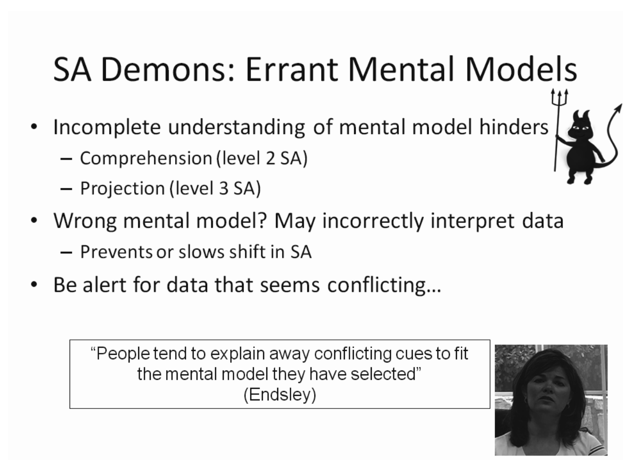
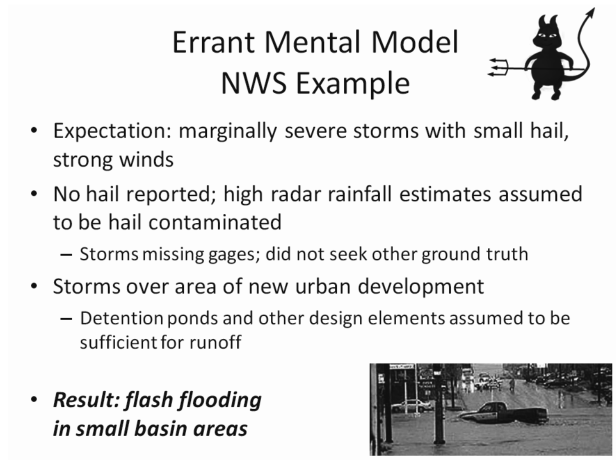


23. Errant Mental Model, NWS Example

Instructor Notes: In this example, the primary threat expected is small hail and strong winds. No hail is reported, yet high radar rainfall estimates are assumed to be hail contaminated. There's not much gage data, but no-one sought additional ground truth. The storms were over an area of new urban development and detention ponds were expected to be sufficient for runoff. The mental model of hail and winds was used to explain away the potentially important cues of high radar rainfall estimates over areas of new urban development.

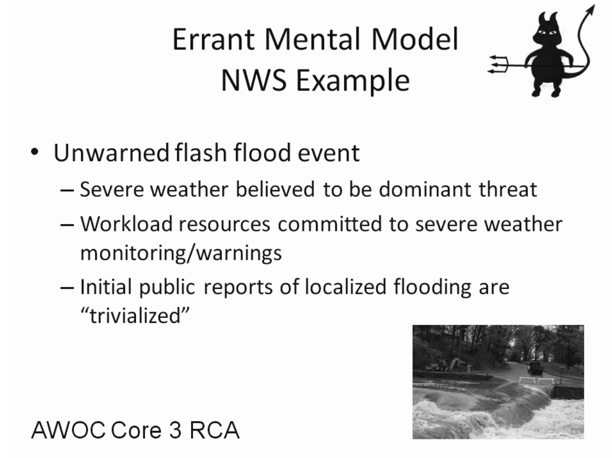
Student Notes:



24. Errant Mental Model, NWS Example

Instructor Notes: This unwarned flash flood event came from an AWOC Core 3 RCA. The mental model of the team was based on the expectation of severe weather, but not flash flooding. The workload was distributed to address the severe weather threat and the team was very focused on that task. Unfortunately, public reports of localized flooding were “trivialized”. This is an example of the human tendency to “explain away conflicting cues”, when what is really needed is a shift in the mental model.

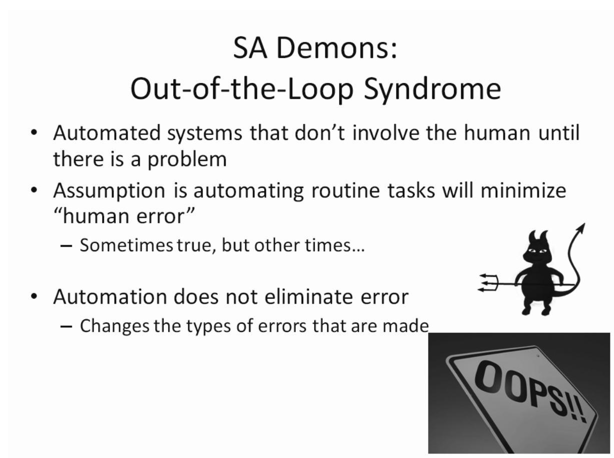
Student Notes:



25. SA Demons: Out-of-the-Loop Syndrome

Instructor Notes: In many domains, much of the "routine" work that humans do forms the foundation of their skills. Automation of routine tasks is sometimes a good thing, but there is risk. In some cases, an attempt to minimize human error has sometimes resulted in automating as much as possible of the routine tasks, leaving the human to intervene only when there is a problem. This approach can result in a loss of the skills that are built and maintained by doing the routine tasks. It also may not allow the human enough time to respond, even when they know what to do.

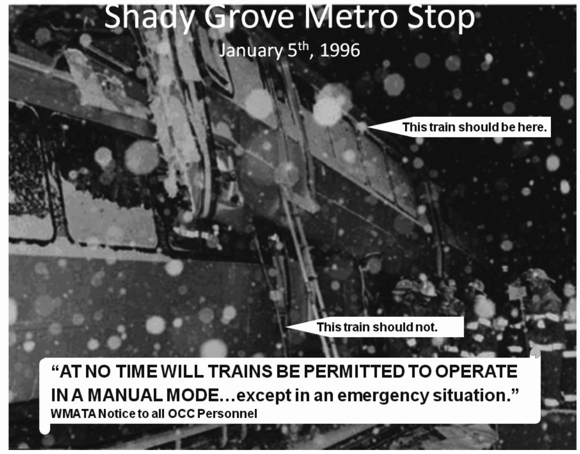
Student Notes:



26. Shady Grove Metro Stop, January 5th, 1996

Instructor Notes: Under the assumption that letting the computers run the trains would minimize wear on parts, train operators were not allowed to run the trains manually, unless there was an emergency. This policy impairs an operator's ability to assess a problem, react quickly, and be sufficiently skilled to react effectively. Automation resulted in a train traveling too fast for the snowy conditions. The operator was unable to react quickly enough to avoid this accident, which unfortunately killed him.

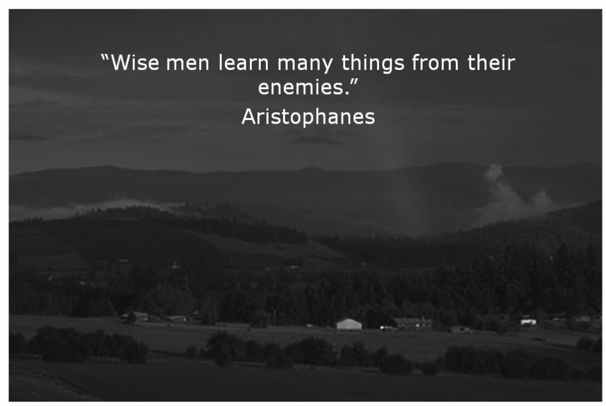
Student Notes:



27. Final Quote

Instructor Notes: Aristophanes says it best…

Student Notes:



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29. References for IC Core 2

Instructor Notes:

Student Notes:

References for IC Core 2

Toward a Theory of Situation Awareness in Dynamic Systems; M. Endsley, 1995, Human Factors and Ergonomics Society

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30. References

Instructor Notes:

Student Notes:

References

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1998 Railroad Accident Report Collision of Washington Metropolitan Area Transit Authority Train T-111 with Standing Train at Shady Grove Passenger Station, Gaithersburg, Maryland January 6, 1996, NTSB

Sources of Power: How People Make Decisions, G. Klein; MIT Press

Intuition at Work, G. Klein; Doubleday

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31. References

Instructor Notes:

Student Notes:

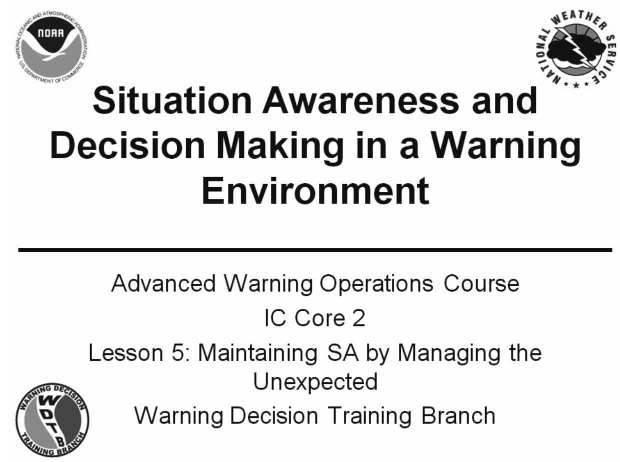
References

- Highest Duty, My Search for What Really Matters; C. Sullenberger, J. Zaslow; HarperCollins

1. Situation Awareness and Decision Making in a Warning Environment

Instructor Notes: This lesson will look at how we can maintain situation awareness at one of the most challenging of times – when the unexpected happens.

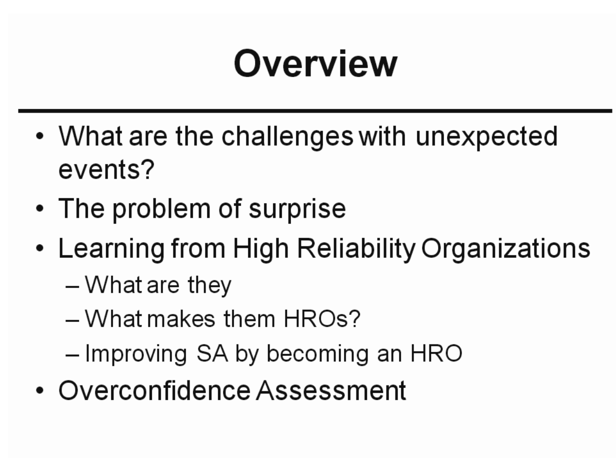
Student Notes:



2. Overview

Instructor Notes: One of the most difficult times for us to maintain situation awareness is when we are faced with an unfolding event that is not what we were expecting. This is associated with an element of surprise which for many can be uncomfortable. You have gone from a sense of understanding what is about to happen to being blindsided. This problem of surprise can manifest itself in many ways, which we will look at. Other disciplines are faced with some of the same issues. A subset of these disciplines are referred to as High Reliability Organizations. We'll look at what that means and how these organizations function in a way to help mitigate the unexpected. Finally, we'll take a look at how overconfidence plays a role in your ability to respond to unexpected events.

Student Notes:



3. Objectives

Instructor Notes: Here are the specific objectives we will address in this module: Identify the two practices that can help facilitate a prompt response to unexpected events. Identify the attributes of the operating environment of a Highly Reliable Organization. Identify the 5 characteristics of a Highly Reliable Organization. State the impact of overconfidence on responding to the unexpected.

Student Notes:

Objectives

1. Identify the two practices that can help facilitate a prompt response to unexpected events.
2. Identify the attributes of the operating environment of a Highly Reliable Organization.
3. Identify the 5 characteristics of a Highly Reliable Organization.
4. State the impact of overconfidence on responding to the unexpected.

4. Challenges with the UnexpectedImpact on SA

Instructor Notes: Here is why we can have such a challenge when something unexpected happens. As we formulate our understanding regarding what is likely to unfold, we’ve developed the 3 levels of SA (assess, comprehend, project). When the unexpected happens we first have to notice (update level 1), then we have to understand what that means (level 2). The next step is to take corrective action based on what we see as the likely outcome (level 3). That is assuming that we know what action to take and that we take it in a timely fashion.

Student Notes:

Challenges with the Unexpected
Impact on SA

- Must update expectations
  - *Update SA (assess, comprehend)*
  - *Does this fit any Conceptual Model?*
- Must be willing to take action
  - *Update SA(comprehend, project)*
  - *Do you know what action to take?*
  - *Are you equipped to take that action?*
  - *Do you have to convince others?*
- Narrow window for effective action

5. Challenges with the UnexpectedWhat experts say

Instructor Notes: The Cognitive Task Analysis the NWS undertook with expert warning forecasters cited rare events as one of the biggest challenges. This might mean a rare even in general or an event that is rare in your location. This is one of the reasons forecasters can benefit for routine simulations as a way to experience something that is not routinely provided for you in the course of your job. Sometimes you have a rare event that you are able to anticipate…at least to some degree. Much more challenging is a rare event that is not in your list of possibilities. Finally, you might face a rare event that you certainly know about, but you certainly didn't expect it today. All of these bring challenges in training, expectation, and implimentation.

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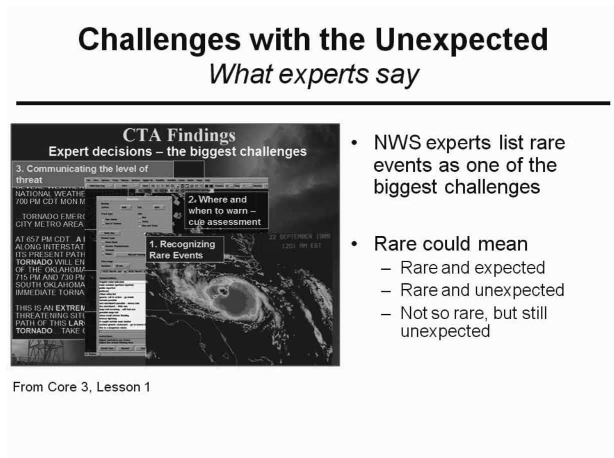

6. Slide 6

Instructor Notes: Here is an example of how a lack of expectation can have an impact on an outcome. This chart represents data from Root Cause Analysis done by students as part of AWOC Core 3. This process attempts to reveal factors, and their relationships, which contribute, in this case, to missed tornado events. In the best estimate of the people involved in these 146 missed tornado events, the fact that the event was "Not Anticipated" appeared 99 times. In the cases with these missed tornado events, the fact that the event was not expected contributed to a slow or non-response by the decision maker.

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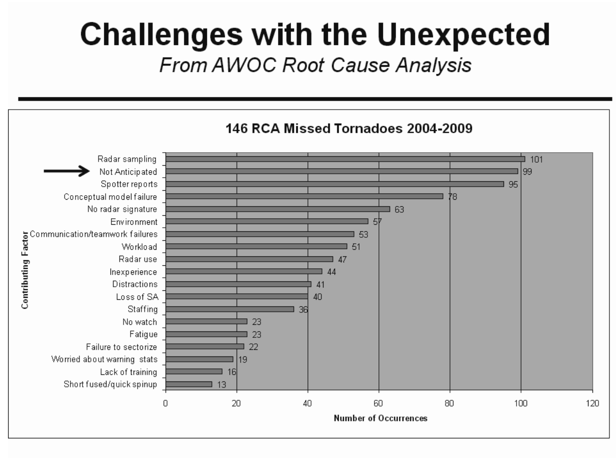

7. So what's wrong with being surprised?

Instructor Notes: There is a reason we are resistant to surprise. It immediately puts us in unfamiliar territory where we may not know what the proper response is. This can be associated with a feeling of "unpleasantness" that we quickly want to dismiss. For some, that may mean resistance to letting go of what they thought they knew (the current forecast) or going into denial by explaining away data to the contrary. If you are the forecaster, in this example, who has put out a forecast of benign weather, what do you do when significant storm quickly develops and begins doing damage? If you can't let go of your expectations (which are now erroneous) it can cause you to lose precious minutes in formulating a response.

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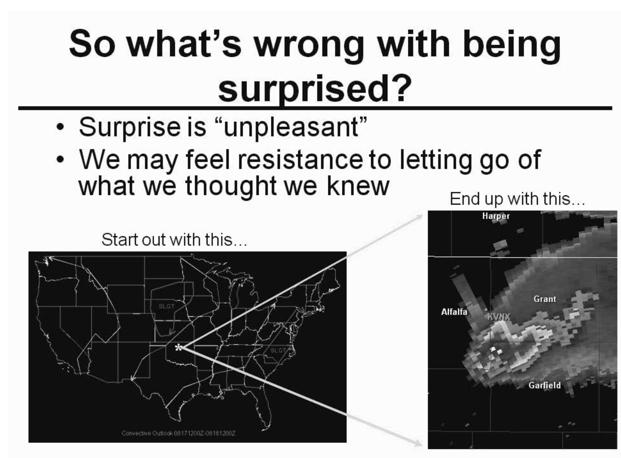
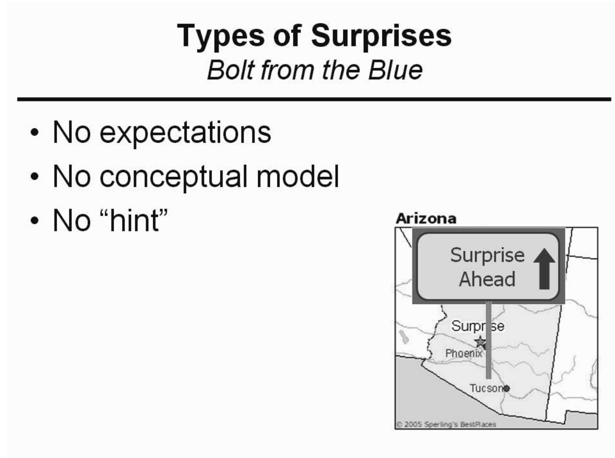


8. Types of SurprisesBolt from the Blue

Instructor Notes: There are all kinds of surprises. With the "Bolt from the Blue", the event unfolding was not in your experience, training, or maybe even your imagination. In the world of weather, this might mean that what is happening is not to be found (yet) in the literature. In other words, there is no conceptual model for what is unfolding and therefore, what actions one might need to take. Nature may be providing hints, but you don't recognize them.

Student Notes:



9. Types of SurprisesBolt from the Blue

Instructor Notes: One example of a "bolt from the blue" might be the events of 9/11. At 8am on that day, the United States was considered in a "State of Deep Peace" with "No threats assessed against our country." The belief at the time implied that if there were to be a threat, it would come from across the ocean, hence radars were on the coast pointed outward. There was not a conceptual model which outlined what was about to happen. Yet, within an hour of the events starting to unfold, a complete ground stop had been ordered (that had never happened before), and permissions were granted for Air Force fighter jets to shoot down a commercial US airplane. Unthinkable the day before! In this case, we saw the birth of a new conceptual model that future learners will have the benefit of knowing about.

Student Notes:

10. Slide 10

Instructor Notes: Other types of surprises are a little more subtle. Perhaps this is a day when you feel confident about what is going to happen and in what order, but your assessment of “when” turns out to be wrong. A perfect forecast of rain changing to snow with 1-3 inches accumulating is all for naught when the rain changes to snow not at 8pm as expected, but at 4pm at the start of rush hour. Event is the same but the start time is a little different and the impacts, in this case, just increased from moderate to significant.

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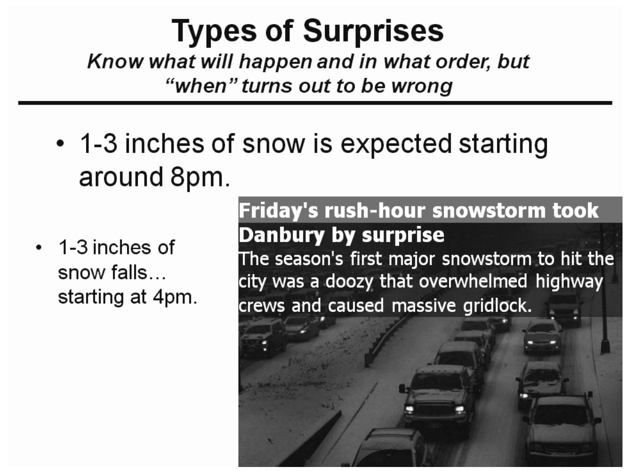

11. Slide 11

Instructor Notes: Or in this case where you are expecting the event, but the duration of it is a surprise. A couple hours of freezing drizzle at 10 pm might not do too much. But your expectation that temperatures would warm slightly causing the freezing part to cease and desist, does not seem to be happening. Hour after hour, you are still expecting temperatures to warm, but they never do. Next thing you know that tree outside your window starts losing branches with accumulating ice. Your minor impact event, with some traffic implications for a couple hours, has gradually become a major ice storm with traffic and power implications. All for a couple of degrees. In this case, the event unfolded very gradually, which can mean you have more time to respond, but may make it harder to realize it’s happening.

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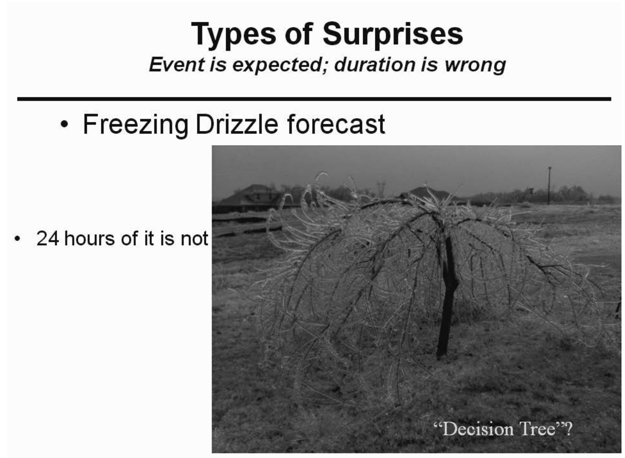

12. Slide 12

Instructor Notes: For events that you actually are expecting, you can still get caught off guard when they turn into something extreme. On this day, a High Risk of severe weather was expected with hail likely and some isolated tornadoes. Sounds like a typical severe weather day in the Plains. What wasn't expected was an event of historical magnitude which would capture national attention, and impact communities and staff for years to come. Actions that went with the high end event (not expected with a 'typical' event) included capturing data real-time, planning for the onslaught of national media, reworking the schedule.

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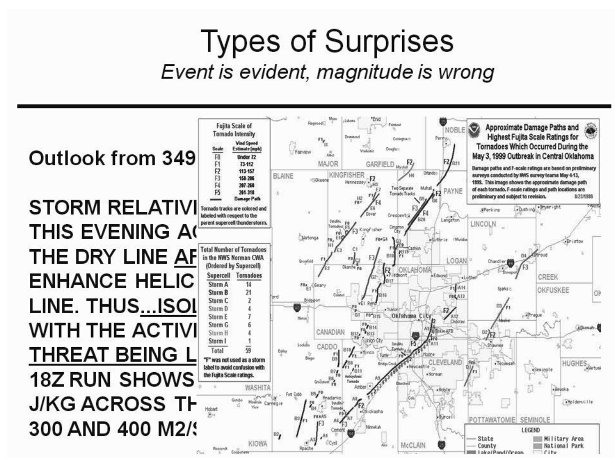

13. Types of SurprisesIt's possible; but not today; at least not here; at my house.

Instructor Notes: Surprises may also happen with our public users. And it may be a surprise to us that it's a surprise to them. In this case, forecasters are on top of the event. But at the receiving end, the user is still surprised by what is unfolding as is revealed in their stating, “The sirens were going off but I knew we didn’t have that bad of tornadoes in February.” Social scientists can do more to help us shed light on how best to communicate rare events to a public that is already fighting an uphill battle in thinking they personally are ever at risk.

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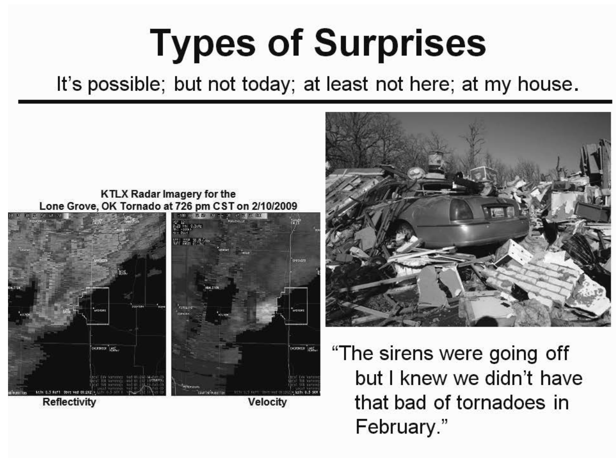
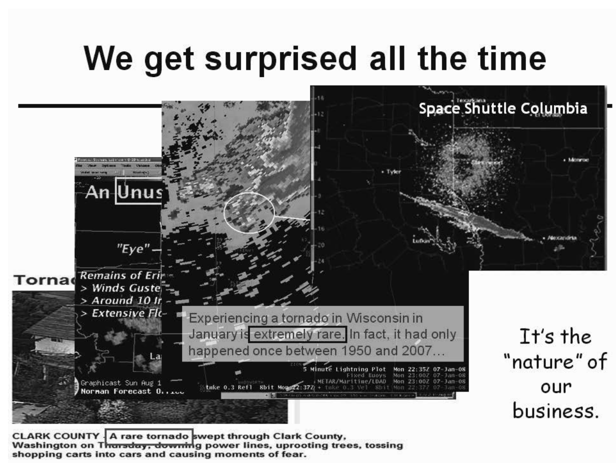


14. We get surprised all the time

Instructor Notes: In reality, the business of forecasting weather is fraught with unexpected events. Whether it’s a tornado in the Pacific Northwest, tropical storm intensifying in the plains, a tornado with snow cover in the upper midwest, or the demise of the space shuttle, we should learn to expect the unexpected. It’s the nature of our business.

Student Notes:



15. ExpectationsCan be a way to combat surprises

Instructor Notes: Forming expectations can be way to combat surprises. Having expectations that turn out to be valid can shorten the time it takes to respond with the correct actions. In surveys done with NWS forecasters, having a good understanding of the environment, which is important in forming valid expectations, is the number one key to a successful warning event. In contrast, having expectations that turn out to be invalid can lengthen the time it takes to undergo proper action. This is because we tend to assume all our expectations are valid and all are decisions are correct. Because of that, there is the tendency to only accept cues that support our belief, and explain away, minimize, or ignore cues to the contrary. This is referred to as confirmation bias. It's what can happen once we make up our mind, whether it is about the forecast, our political choices, or our favorite sports team. All of that denial uses up valuable time which should be put to updating our SA and as a result, our actions.

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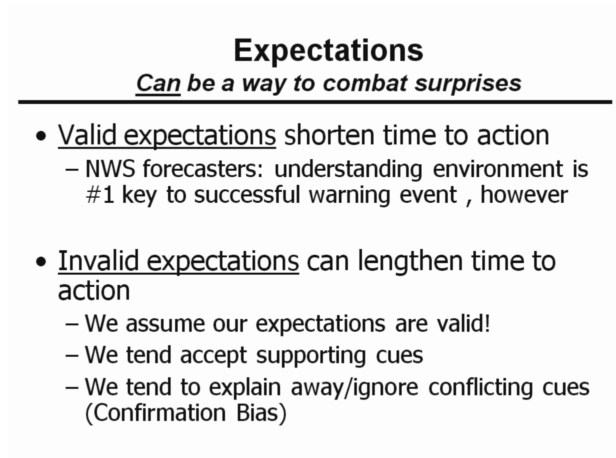
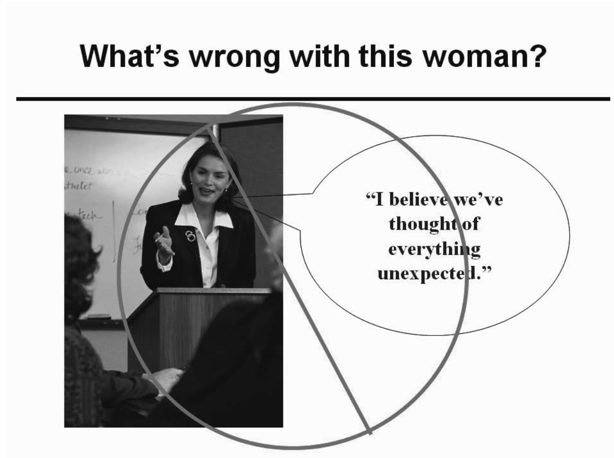


16. What's wrong with this woman?

Instructor Notes: This young woman is in charge of a big meeting about to get underway. She's briefing all the organizers. "I believe we've thought of everything unexpected," she proudly states. So what's wrong with her statement? There's nothing wrong with imagining what could surprise you and being ready for it. That's actually a good use of your time. Her problem appeared when she decided they had all possibilities covered. Once you do that, you stop looking for evidence to the contrary. You get complacent. She's no longer being proactive, she's going into an overconfidence abyss. And she's taking everyone else with her. She must be stopped!

Student Notes:



17. How are you able to respond to surprises?

Instructor Notes: There are a couple of things you can do to help yourself notice and then respond to the unexpected. The first, and perhaps the most difficult, is changing your mindset. It's important to be aware of confirmation bias and constantly be on guard against it. When you allow for a range of possibilities, not just the one you've settled on, you are halfway there. Next you must be physically able to detect cues that may tell you something different is afoot. Let's say a family member may need a ride to work from you, although chances are low. You say, "OK – just call me." Then you don't ensure you have our cell phone. You've altered the mindset, but you haven't made yourself available to the data. You need access to the data, and then you have to have a car to take the proper action! In order to have a chance at responding to unexpected events, you need to do both of these. This is what Highly Reliable Organizations do.

Student Notes:

How are you able to respond to surprises?

1. Mental - Overcome Mindset
   – Allow other possibilities to exist
2. Physical - Position Yourself
   – Be able to detect cues when they sprout
   – Be empowered to act on them when you see them

This is what Highly Reliable Organizations do!

18. Highly Reliable Organizations (HROs)

Instructor Notes: Highly Reliable Organizations (HROs) are far from perfect. They are defined by how they co-exist with all the variables in their environment. First, they work in an environment that is complex, unstable, and to varying degrees, unknowable and unpredictable. This is not because they are lazy, but rather due to the nature of their environment. Next, because of this they have at any point in time, an incomplete understanding of their own “system”. A very important thing occurs when they accept these facts. It allows for the possibility of something unexpected. This then helps them have a mitigation plan (because then know it will be needed at some point). If they can’t mitigate the event, they then will attempt to contain it (damage control). In spite of all this, sometimes all will fail. In that case, they will focus on resilience. The ability to be resilient is critical to learning and moving forward.

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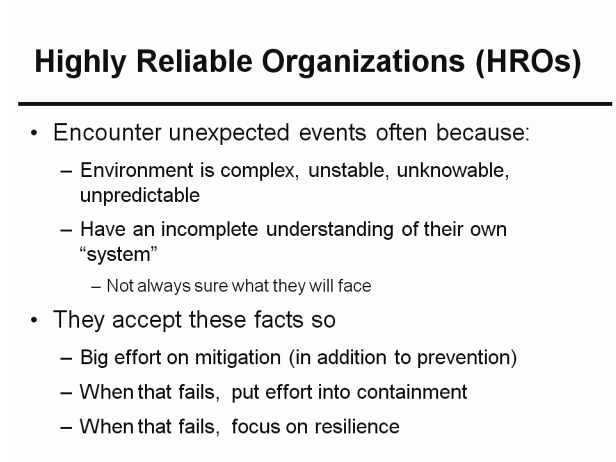

19. Some HRO Environments

Instructor Notes: With this in mind, here are potentially some examples of organizations that can function as Highly Reliable Organizations. They all represent domains that are complex, uncertain, and every changing. What is needed now is how individuals respond within those domains.

Student Notes:

20. Characteristics of HROs

Instructor Notes: Based on work done by Weick and Sutcliff, here are some of the attributes that can determine if you are a highly reliable organization. They are Preoccupied with Failure They practice a Sensitivity to Operations They have a Commitment to Resilience They exhibit a Deference to Expertise Proper use of Mindfulness/Mindlessness We'll talk a little about what is meant by each of these.

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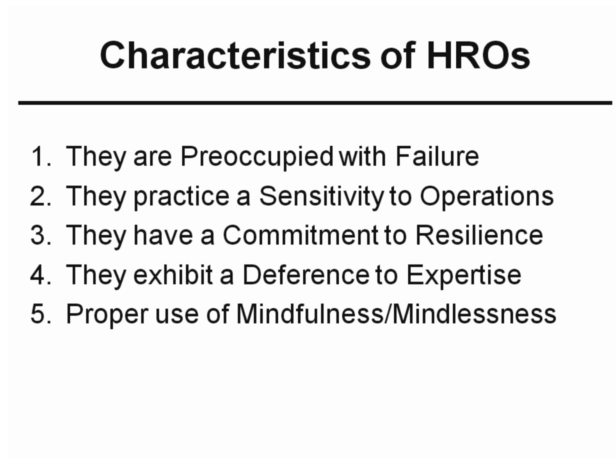

21. 1. They are Preoccupied with Failure

Instructor Notes: HROs are preoccupied with failure. While this sounds like something negative, it's a characteristic that keeps them grounded. Success (especially recent success) can make an individual or organization complacent. The minute we decide we have it all figured out, we stop look for places to improve. One of the ways to improve is the freedom to acknowledge errors. That is actually the first step in improving. Instead of someone who make an error being chastised, they are looked at as being willing to help the organization as a whole improve. There is not a stigma attached. They also know the difference between being lucky and being good. We've all made the right decision for the wrong reason. We can either pat ourselves on the back and think "Wow! I'm good!", or think, "That was close!", and do nothing. Or we can say, "We were lucky this time; next time that may not be the case." As this SOO, quoted after experiencing a very successful event, admonished the staff, "We're still just one missed event away from a warning disaster."

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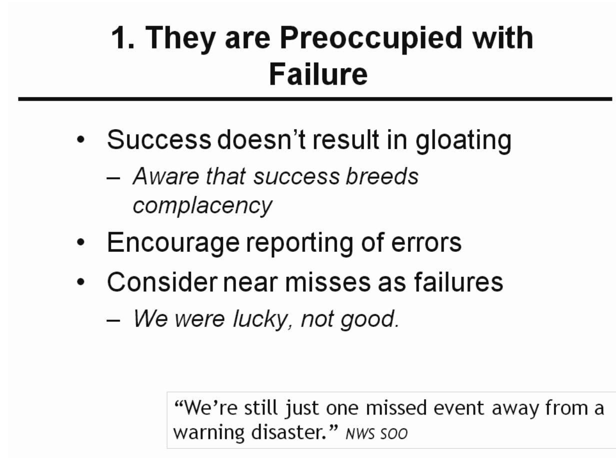

22. Preoccupation with FailurePre-Mortem*

Instructor Notes: One way a preoccupation with failure can produce benefits is by practicing a "pre-mortem". This technique developed by Klein Associates uses mental simulation to identify key vulnerabilities in a plan. It's a way to first admit your expectations might be imperfect, and then identify and be on the lookout for information which illustrates that. Imagine a pre-mortem years ago that PC developers might have done musing about why this invention might fail. Watching for and or mitigating things on this list will help you be more successful. A pre-mortem of sorts which is based on your expectations will help you identify the indicators that you might see if your expectations are going south.

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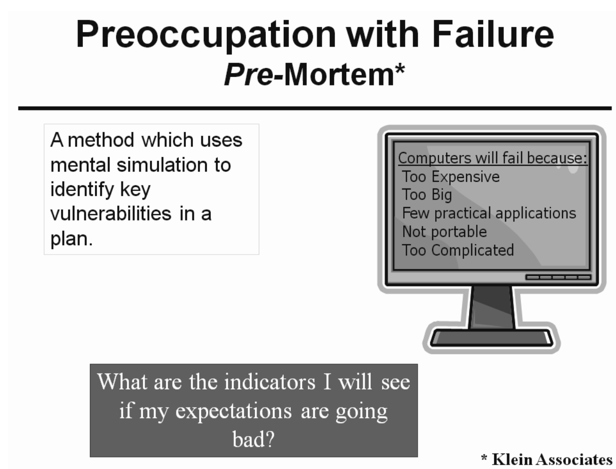

23. Preoccupation with FailureMaking improvements

Instructor Notes: Another strategy you can employ is that of a Devils' Inquisitor. This is not the same as a devils advocate who plays an argumentative role, but more like a partner who is on the lookout for problems. When someone has the role, questioning is no longer threatening. Pointing out inconsistencies is not an accusation of inadequacy. He or she can help the group look for evidence that is outside their “bounds of awareness”, because that’s what you want them to do. This helps to mitigate the so called “Group Think” process where everyone goes down the same flawed road together. A devil’s inquisitor works when all opinions are valued, even those from the novice. This role can be assigned to one person, or if you’re really good, can be assigned to all.

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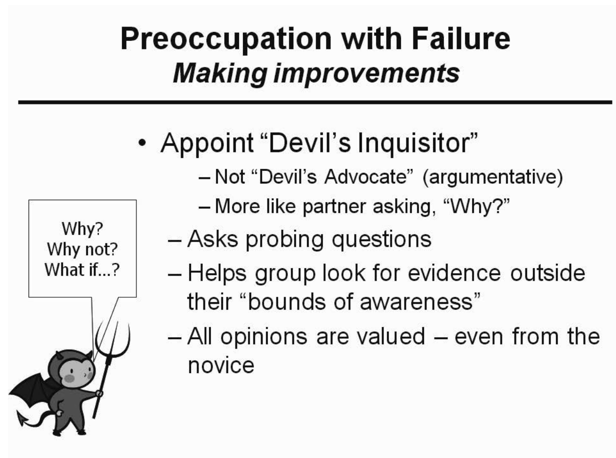
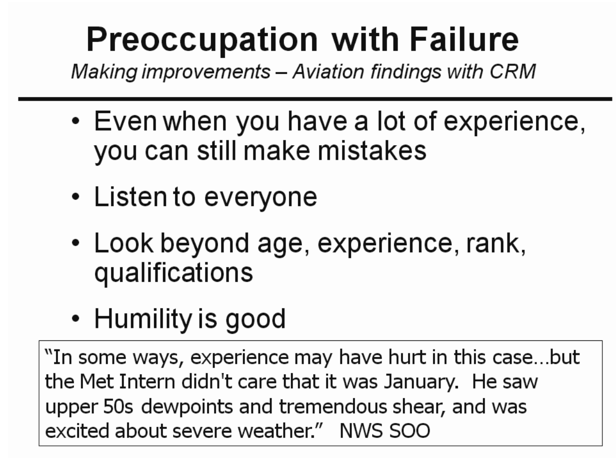


24. Slide 24

Instructor Notes: Another way to make improvements can be borrowed from aviation protocol which now includes Crew Resource Management (CRM) findings. With CRM, the crew works together, with the assumption that any member of the crew, not just the pilot, can offer valued insight. This acknowledges that even those with lots of experience can make mistakes. Anyone can have a perspective that can offer valuable information. This can come in spite of age, experience, rank or qualifications. Someone outside looking in may see things that would be explained had they more information or experience. But sometimes they might offer a splash of cold water to wake you up to possibilities. Ultimately, humility is what enables this to work. In the words of this SOO, “In some ways, experience may have hurt in this case…but the Met Intern didn't care that it was January. He saw upper 50s dewpoints and tremendous shear, and was excited about severe weather.”

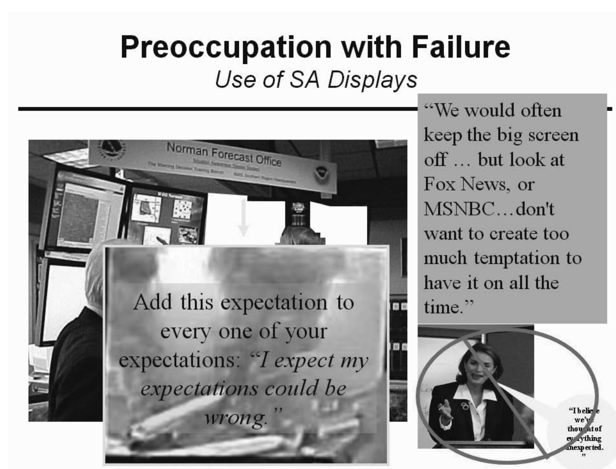
Student Notes:



25. Preoccupation with FailureUse of SA Displays

Instructor Notes: The way you configure your SA display can offer a way to head failure off. Perhaps you only have certain things on display when your are expecting certain kinds of weather. If in this case, you weren't expecting weather so you turned off the TV feeds to keep down "distractions", you would have missed the news story showing a train derailment due to river flooding at a compromised bridge. The resulting toxic spill into the river will shortly be something you are involved when you ultimately get notified of this event. Populating your SA Display in such a way that you can catch surprises, or things you are not expecting, is one way to physically set yourself up for success. You've done that by adding this expectation to every one of your expectations: "I expect my expectations could be wrong." It's one way to make sure this woman doesn't show up!

Student Notes:



26. 2. They have a Sensitivity to Operations

Instructor Notes: A sensitivity to operations means an organization prioritizes and responds to factors that are affecting operations. You are on the lookout for "latent conditions", or those conditions that are sitting around every day waiting to combine with other factors to result in a disaster. Root Cause Analysis helps to reveal these latent conditions (more about both of these in Core 3, Lesson 3: Learning from Post Mortems). Some examples of latent conditions that might need addressing before they show up to negatively impact an event include: not wearing seatbelts, budget cuts, a culture of silence, personnel turn over, belief systems, and personality conflicts.

Student Notes:

2. They have a Sensitivity to Operations

Important to Identify Latent Conditions that may have impacts

- Budget Cuts
- Culture of Silence
- Personnel Turn Over
- Belief Systems (tornadoes don't happen here)
- Personality Conflicts

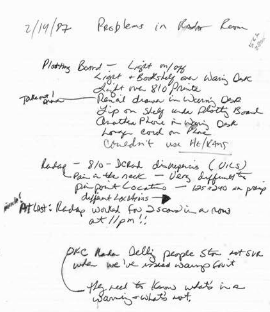
27. Sensitivity to OperationsMaking improvements

Instructor Notes: When sensitivity to operations is a priority, management immerses in real-time information. They treat operations as gold by assuring they have it gets undivided and thorough attention. Taking steps to support operational SA is critical. This chicken scratch example is the result of management requesting help to understand what worked and want didn't during a severe weather event the day before. While crude, the resulting list of things which impeded operations provided valuable information to the management team which allowed them to address each concern within 24 hours of the event. That is showing a sensitivity to operations.

Student Notes:

Sensitivity to Operations
Making improvements

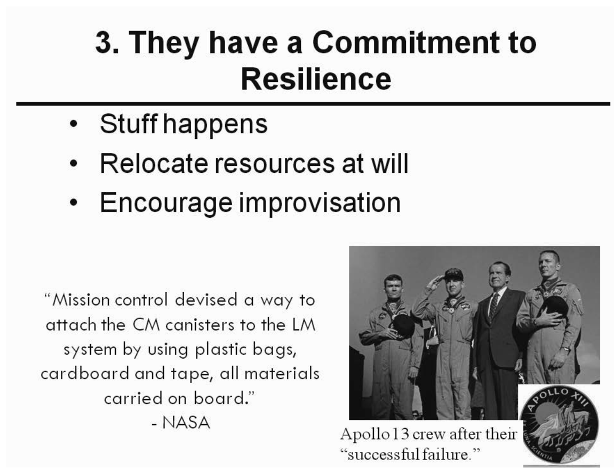
- Management immerses in real-time information
- Operations are gold
  - Operations get undivided and widespread attention
  - Support Operational SA



28. 3. They have a Commitment to Resilience

Instructor Notes: Next , HROs will have a Commitment to Resilience. This is critical because, as stated before, the world of formulating weather expectations is imperfect. Stuff happens. Knowing that and accepting that, you can be willing to quickly relocate resources to where they are needed most. In addition,the ability to creatively improvise can mean the difference between failure and success. Think of how important that was with the flight of Apollo 13 as they tried to figure out amongst other things, how to make a square peg fit into a round hole.

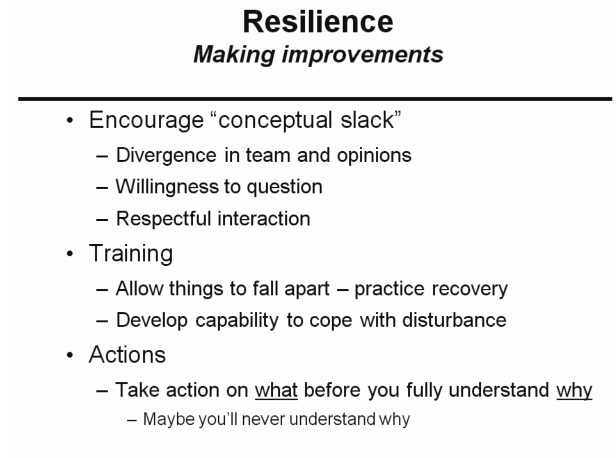
Student Notes:



29. ResilienceMaking improvements

Instructor Notes: In practice, one can improve resilience by encouraging 'conceptual slack'. That means you have a culture and environment which allows teams to express opinions openly. Questioning is acceptable and that is because there is respect in the interaction. You don't have to agree, but you do have to respect. In training, resilience can be beefed up by allowing the training environment to be imperfect. If things fail, practice recovery. Insert problems and surprises into the situation. It can allow one to strengthen their ability to cope with disturbances. Finally, be prepared to take action on what is happening before you understand why. While it would help to know why things are going south, it should not be a prerequsite for taking action. You may not ever fully understand what went wrong and why, but you can take action to mitigate the impacts.

Student Notes:



30. 4. They practice a Deference to Expertise

Instructor Notes: HROs will practice a Deference to Expertise. This means they respect expertise, wherever it is found. They understand the value of the system, but are willing to bypass it when necessary. Instead of the senior person being the source of all answers, the question essentially migrates around looking for the expertise.

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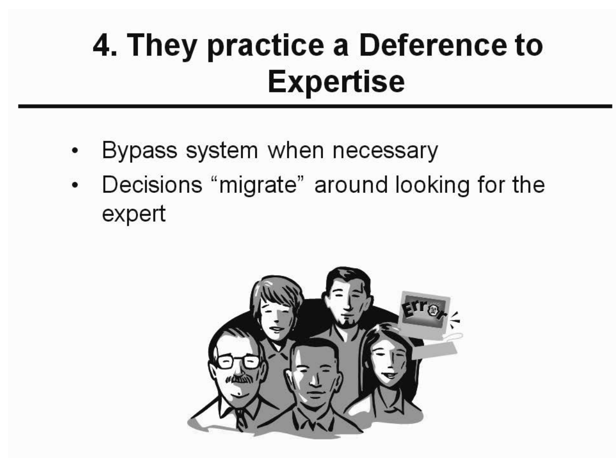

31. Deference to ExpertiseMaking improvements

Instructor Notes: One way to accomplish this is to practice "coordinate" leadership. This means that anyone can be the leader in the area in which they have the expertise. This might mean the MIC defers to the FIC during the severe weather shift, who for a particular problem, defers to the intern who had just been trained on this piece of soft-ware. This may seem obvious to some, however, this is not a given in everyone's cultural experience. The quote from this MIC indicates the office philosophy when the staff is empowered to use their judgment and experience to the best of their ability. Of course, the MIC will need to back that up!

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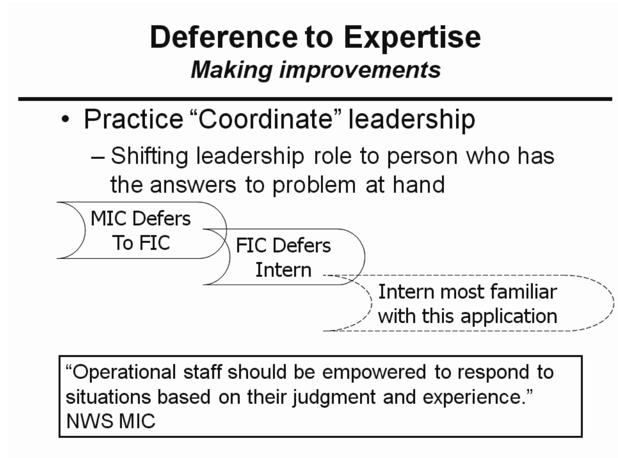
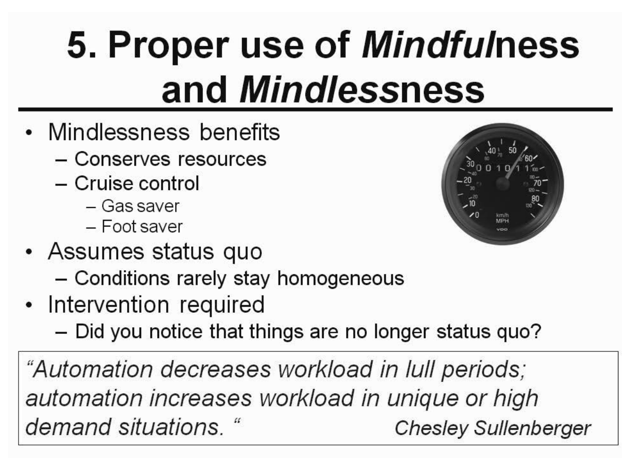


32. 5. Proper use of Mindfulness and Mindlessness

Instructor Notes: Mindlessness sounds like a bad thing, but it has its place. To do routine activities without having to spend time thinking about them conserves resources. One example you probably do a lot is using cruise control in your car. It saves gas and allows your foot to rest. This works so longs as status quo conditions exist. The challenge will be when the status quo is busted. For cruise control, you come across debris in the road, or an unexpected detour, or freezing drizzle starts to fall. Conditions are no longer homogeneous. At that point you are required to intervene. If you haven't noticed that things have changed, or haven't been involved in the process until change occurs, you may have a hard time knowing what intervention is required. As Capt. Sullenberger can attest, while the automation helps in lull periods, it requires more out of you in unique or high demand situations. This is because there is often a lot more to monitor, sort through, and make sense of when something unusual is unfolding.

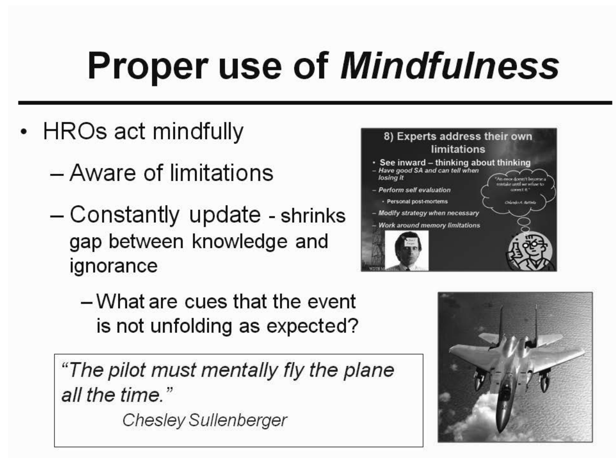
Student Notes:



33. Proper use of Mindfulness

Instructor Notes: HROs know when to be mindful. They start by being aware of their limitations. This is a trait of experts universally (discussed in Core 3). One of the ways to do this is to constantly update your understanding. By doing this you may be more able to recognize surprising cues closer to when they occur. To quote Capt. Sullenberger, “The pilot must mentally fly the plane all the time.” This means you are engaged and vigilant even when you’re on auto pilot.

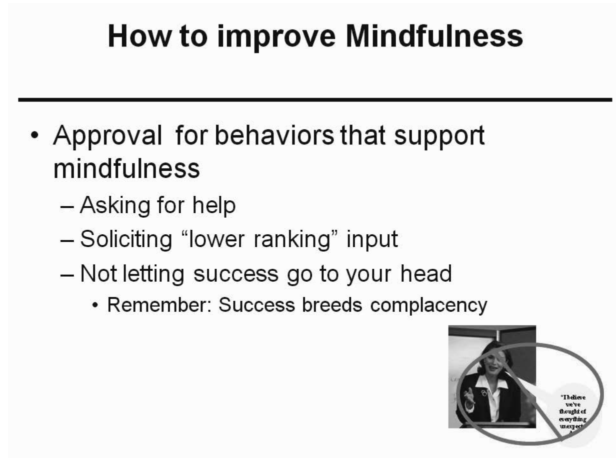
Student Notes:



34. How to improve Mindfulness

Instructor Notes: One of the ways to promote mindfulness is with feedback on behaviors which are applauded and those which are not. One of the biggest boulders to overcome for some people is to ask for help. This can lead to being understaffed, overworked, loss of SA and the consequences which result. Recognize when you or the team are falling behind and ask for help. Management needs to support that decision as the right decision, not a sign of weakness. Next, we can get by sometimes when we operate on our own without the input of others. Eventually though, it will likely come back to haunt us. Supporting an attitude of including viewpoints and questions, even when they are from new or inexperienced voices, is a practice that will promote mindfulness. This practice takes more than words in order to provide an environment in which all can speak up. It takes action and follow Finally, when we start to let success go to are heads, we are in trouble. Eventually we might think, hey, I am really really good at this, in fact, maybe I’m perfect! Then who shows up again? She does! In any event we do well, there is always some area in which we can improve.

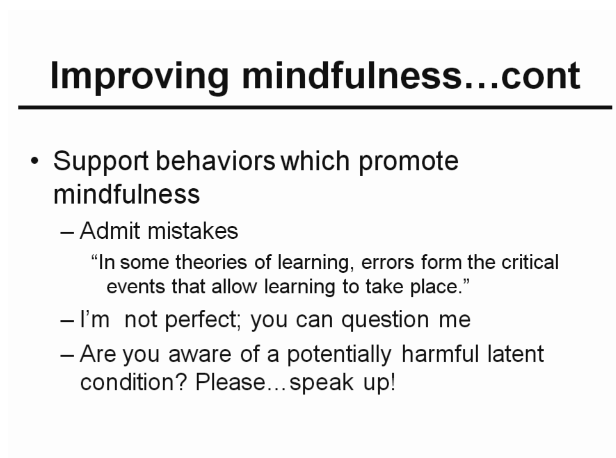
Student Notes:



35. Improving mindfulness…cont

Instructor Notes: One of the best ways to support behaviors which promote mindfulness is in modeling the behavior. So often people are afraid to admit mistakes. We are human, we operate in an imperfect environment – mistakes and misjudgments will be made. When someone at the top admits mistakes, it makes others feel free to do so. Some theories of learning indicate that errors from critical events are what allow learning to take place. Knowing we are not perfect opens the door for others to question without offending. It essentially wipes out face threat. By asking anyone who is aware of a potentially harmful latent condition to speak up, we can all feel like we are on one team and essentially have each other's backs.

Student Notes:



36. Slide 36

Instructor Notes: The last way we'll discuss in improving mindfulness is in addressing overconfidence. There is nothing wrong with being confident, that is what allows us to move forward. It is when we are overconfident that we have problems. Problems which arrive from overconfidence are that it may keep you from: Collecting key information (since you already know it all) Learning from mistakes, since you won't make them often (or make them again) Most people over estimate what they know, in trivia as well as in their own field. To illustrate this point, we will do a little self test on Overconfidence.

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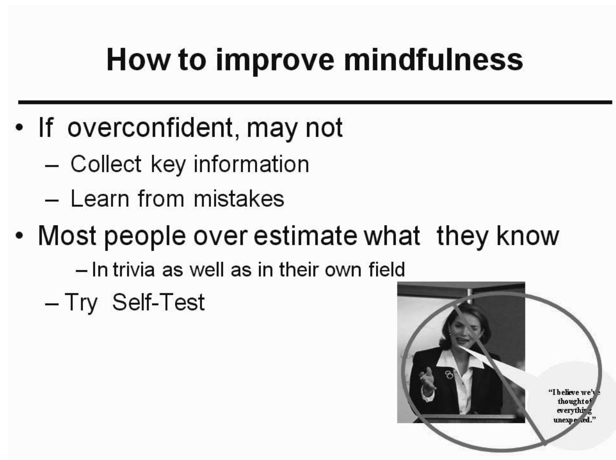
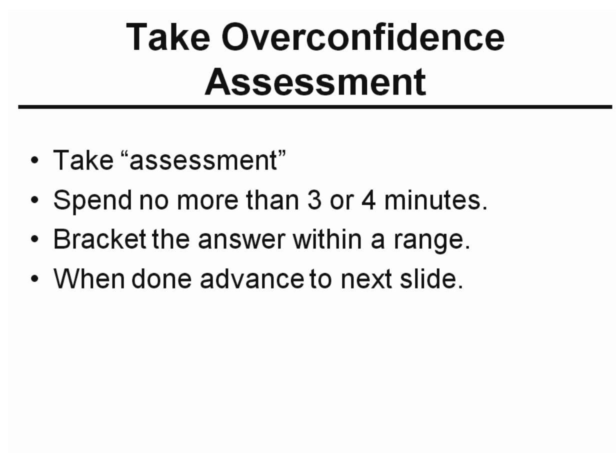


37. Take Overconfidence Assessment

Instructor Notes: At this point, stop and take no more than 3 or 4 minutes to go through the overconfidence assessment. Your goal is not to "know" the answer, because odds are you don't. Try to bracket the answer with a range of values. If you make the interval too narrow, you are overestimating what you know. Too large, and you are underestimating. When you look at your completed assessment, you should be 90% confident that the correct answer lies within the range you chose. When finished, go on to next slide.

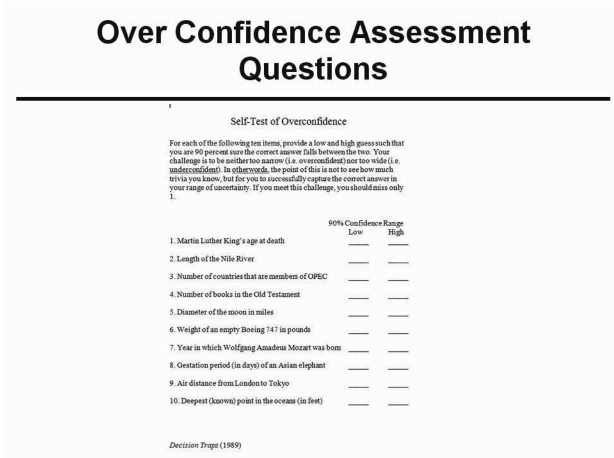
Student Notes:



38. Over Confidence AssessmentQuestions

Instructor Notes: The answers aren't in this handout, but you'll find them in the presentation. Note: if you feel the need to go off and research these before filling our you're answers, you kind of missing the point! So don't do it!

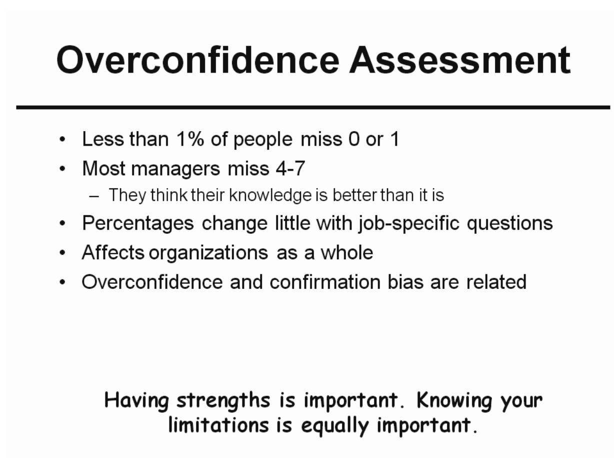
Student Notes:



39. Overconfidence Assessment

Instructor Notes: This pop quiz was NOT to see how much trivia you know, but to see if you are aware of the "bounds of your knowledge". Less than 1% of all people miss 0 or 1. Most managers miss between 4 and 7. That is, they think their knowledge is better than it is. Amazingly, percentages change little with job-specific questions. This type of overconfidence affects organizations as a whole when 1) people don't seek information because they think they already know, which leads to 2) decisions being made with less than optimum knowledge. This applies to decisions at all levels of an organization, and frankly, in all aspects of your life. When this overconfidence is strong, it contributes to the confirmation bias, where we once again, notice information that matches our beliefs and ignore or minimize the rest. The lesson of this is that which helps experts be experts and HROs become HROs: Having strengths is important. Admitting you have limitations and knowing them is equally important.

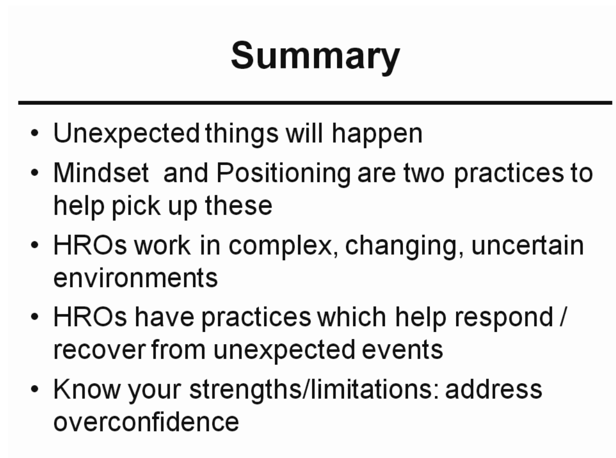
Student Notes:



40. Summary

Instructor Notes: To summarize the key things which will help you respond to unexpected events: Admit unexpected things will happen Knowing this, the two practices that will help you are to have the proper mindset of acceptance and then position yourself to pick up on the queues of an unfolding unexpected event Highly Reliable Organizations work in very complex changing, uncertain environments. They practice characteristics which help them respond and recover from unexpected events. These characteristics include Preoccupation with Failure Sensitivity to Operations Commitment to Resilience Deference to Expertise Proper use of Mindfulness/Mindlessness Knowing your strengths and limitations will help you address the problems of overconfidence and seek additional help and information when needed.

Student Notes:



41. One more surpriseIt’s possible; never actually expect it

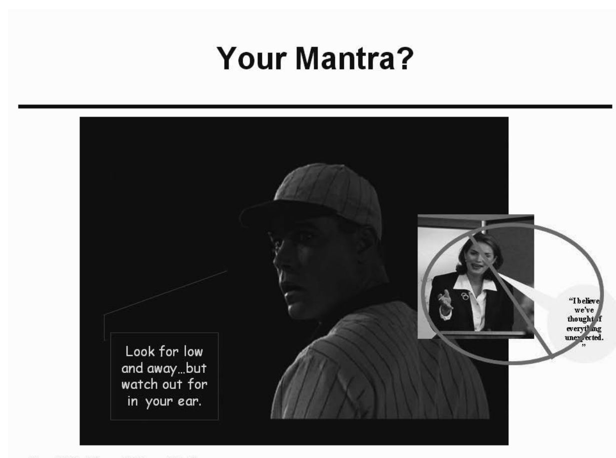
Instructor Notes: Here’s one last look at how a particular surprise was handled in real time. It’s the kind of surprise that is in the realm of possibility, but you never really expect it.

Student Notes:

42. Your Mantra?

Instructor Notes: What should your mantra be? If you've ever seen the moving Field of Dreams, you'll recall Shoeless Joe Jackson's advice to the rookie Moonlight Graham as he stepped up to take his 3rd pitch, not knowing what to expect. Joe's advice, "Look for low and away…but watch out for in your ear." In other words, have expectations, just watch out for nature's curve ball! It's the best way to get rid of this woman for good!

Student Notes:



43. For Additional Help

Instructor Notes: For additional help check with your AWOC facilitator or send your questions to awoccore_list@wdtb.noaa.gov. When you are ready, go to the LMS and take the test for AWOC Core 2, Lessons 1-5.

Student Notes:

For Additional Help

1. Check with your AWOC facilitator (most often the SOO)
2. Send your question to awoccore_list@wdtb.noaa.gov

44. Resources/References

Instructor Notes:

Student Notes:

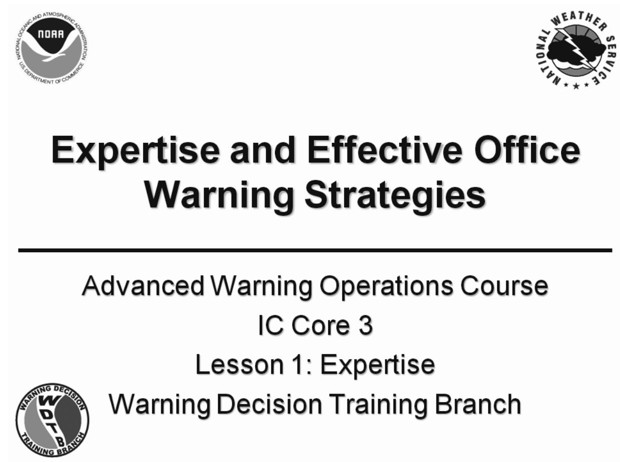
Resources/References

- Managing the Unexpected. Karl E. Weick, Kathleen M. Sutcliff
- Intuition at Work. Gary Klein
- Decisions Without Blinders. Max H. Bazerman and Dolly Chugh. Harvard Business Review January 2006
- We Learn from our Mistakes – Don't We? Addie Johnson. Ergonomics in Design Spring 2004
- 1st Air Force Headquarters (Briefing on 9/11). C-SPAN 11/30/2001
- AWOC RCAs 2005-2010
- WDM1 Survey Results 1997-98
- Managing the Risks or Organizational Accidents. Ken Hammond
- Highest Duty. Capt. Chesley Sullenberger
- Human Error. James Reason
- Decision Traps: Ten Barriers to Decision-making and How to Overcome Them. J. Edward Russo and Paul J.H. Shoemaker
- Who is Watching You? "J.T. Ragman" Flying Safety June 1999
- Defensive Driving. Wait, make that Defensive Flying. "J.T. Ragman" Flying Safety May 2002
- Anatomy of an Effective Warning: Event anticipation, data integration, feature recognition. Quoetone and Huckabee. WAF January 1995 Dallas, TX.
- Warning Decision Making: The Relative Roles of Conceptual Models, Technology, Strategy, and Forecaster Expertise on May 3rd, 1999, Andra, Quoetone, Bunting, 2002: Weather and Forecasting: Vol. 17, No. 3
- Cognitive Task Analysis of the Warning Forecaster Position. Klein et al,

1. Expertise and Effective Office Warning Strategies

Instructor Notes: IC Core 3 will begin with a discussion of Expertise. It will be important to understand what we mean by this term in order to appreciate its value throughout the remainder of this IC.

Student Notes:



2. Lesson 1:Expertise

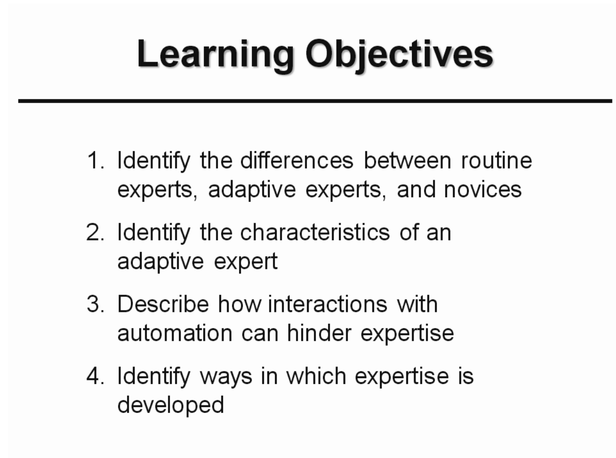
Instructor Notes: See if you can recognize who these folks are. They all have something in common in that each is associated with a level of expert knowledge or performance in their domain. Whether your area is medicine, baseball, world affairs, pushing the aviation envelope, mitigating human suffering, or issuing warnings, there is a process by which you develop that skill.

Student Notes:

3. Learning Objectives

Instructor Notes: The learning objectives for this lesson are testable. They are: 1) Identify the difference between routine and adaptive experts and novices. 2) Identify the characteristics of an adaptive expert. 3) Describe how interactions with automation can hinder expertise. 4) Identify ways in which expertise is developed.

Student Notes:



4. ExpertiseOverview

Instructor Notes: During the next 30 minutes, we'll discuss at least some definitions of what constitutes an expert. We'll demonstrate why that expertise is so valuable to an organization. Automation is neither good nor bad. It just is. They way in which it is designed or the way it is applied in operations however can either foster or inhibit the development of expertise. Finally we'll look at what you can do to develop expertise in the area of warning operations. As we go through this talk, think of people you know in your domain, or in other domains with which you interact, and see where you think they fall in these descriptions.

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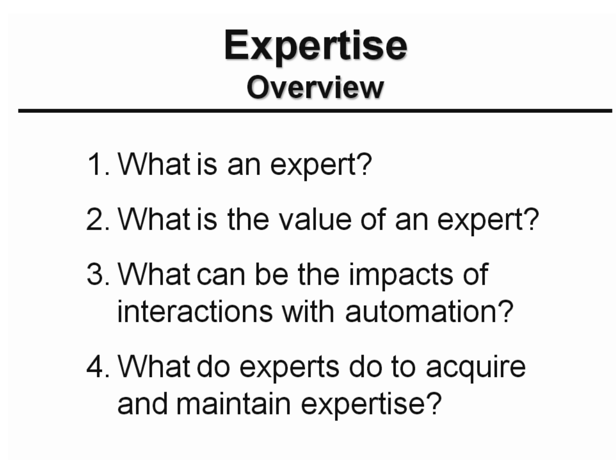

5. What is an Expert?

Instructor Notes: We all are novices at many things. I personally am a novice at judging how much air in a tire is too much (since when are tires not suppose to be “round” anymore?). Novices tend to live in the moment. They don’t easily make connections and the options they produce for action are limited. Next we have a routine expert. These people are great. They can swoop in and fix what’s wrong instantly; they can quote regulations. They only run into trouble when the situation takes on a unique appearance; looks out of the ordinary. Then their very strict processes don’t provide unique answers. What we are going to discuss for the remainder of this session is the adaptive expert. Their understanding goes deep. You probably really feel good working a stressful event in the company of this type of expert.

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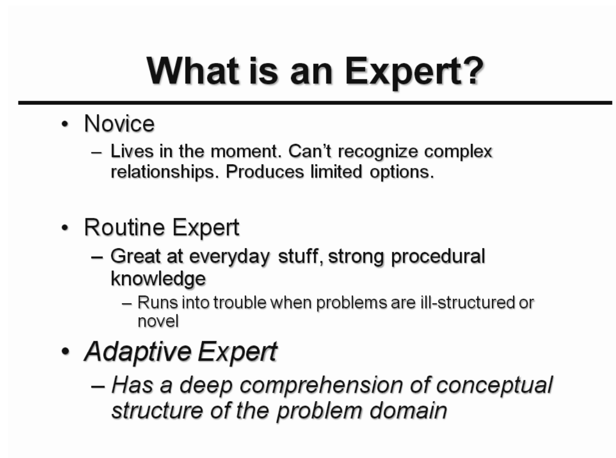

6. Experience vs Expertise

Instructor Notes: First we should stress that experience alone does not guarantee one develops expertise. This guy is fast but is he really good? Perhaps he’s good at being fast but that’s about it. This person in a forecast office may always get the products out on time but their content leaves something to be desired. What you do with each experience is more important in developing expertise than just having that experience.

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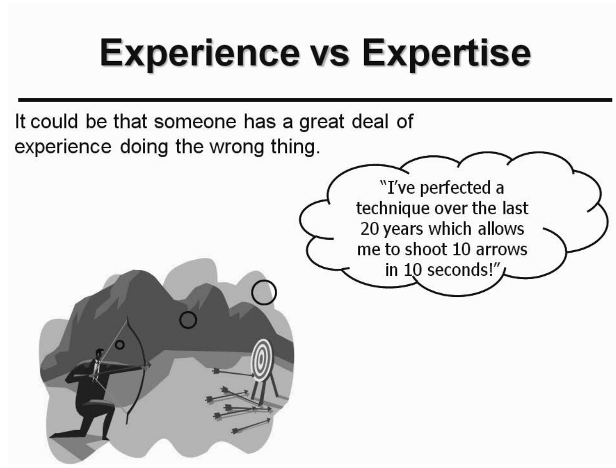
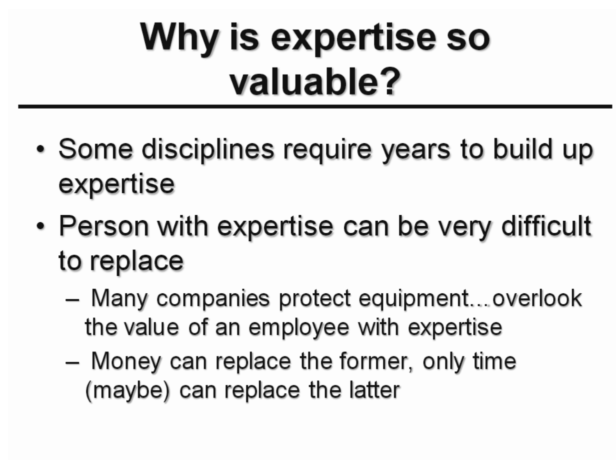


7. Why is expertise so valuable?

Instructor Notes: Why do we care about expertise? One reason is that it often takes time to grow and it can therefore be difficult to replace. Many organizations have made the mistake of saving money (in the short run) but investing in equipment but not in investing in the development of their employees.

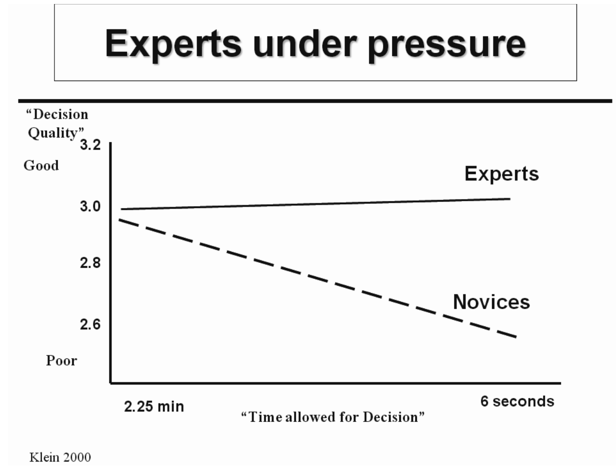
Student Notes:



8. Experts under pressure

Instructor Notes: Experts really shine when the pressure gets turned up. This study showed that the quality of decisions (as seen on the y axis), tends to remain the same as the time for that decision (on the x axis) is shortened…at least for the experts. The nov-ice on the other hand succumbs to pressure and the quality of their decision making deteriorates.

Student Notes:



9. What do experts do so well that others don't?

Instructor Notes: So what do experts do so well that others don't? We'll take a look at each of these characteristics. Keep in mind how you might rate yourself using this criteria.

Student Notes:

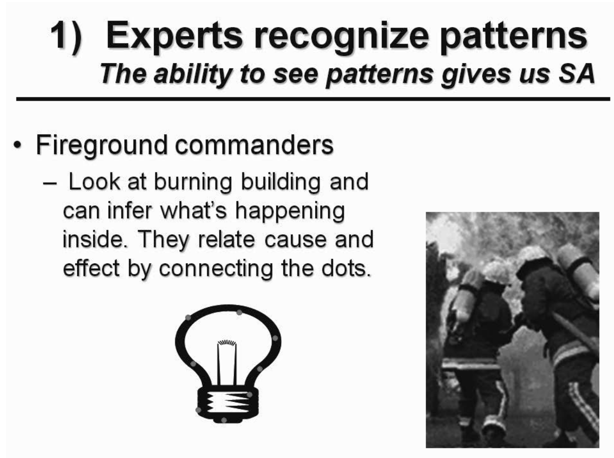
What do experts do so well that others don't?

1. Recognize patterns
2. Detect anomalies
3. Keep the big picture (SA)
4. Understand the way things work
5. Observe opportunities, able to improvise
6. Relate past, present, and future events
7. Pick up on very subtle differences
8. Address their own limitations

10. Experts recognize patternsThe ability to see patterns gives us SA

Instructor Notes: Experts recognize patterns. With loads of data dumped on us continually, seeing a pattern, and seeing it quickly, is what can make all the difference. For fireground commanders, it's behavior of smoke in a burning building. It's connecting what looks like unrelated information to form a picture of what's happening. For a warning forecaster it's putting together a spotter report with a radar signature that tells you there's a high likelihood for a tornado. This relating cause and effect helps the development of SA.

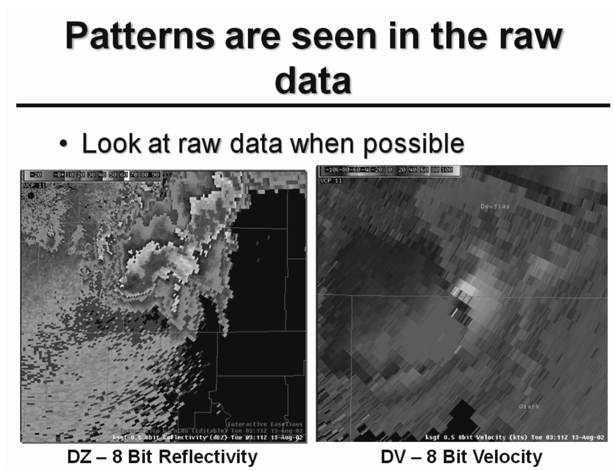
Student Notes:



11. Patterns are seen in the raw data

Instructor Notes: Most experts in the warning environment recognize those patterns using base data. That may mean hi-res velocity and reflectivity data, or mesonet observations, or upper air analysis, or live TV video. They get to the data which has gone through the least amount of processing.

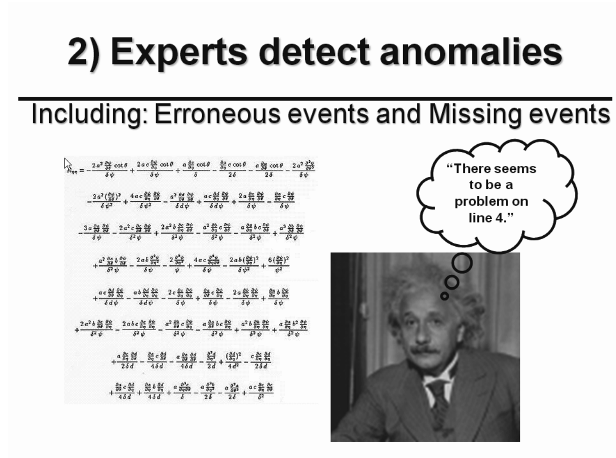
Student Notes:



12. 2) Experts detect anomalies

Instructor Notes: One of the hardest things to do is detect things which are "just not right" or things which are missing. Albert sees the problem here, but I don't. He should, he wrote this equation. For warning operations, it might be a messed up surface observation which is impacting local analysis. Or it might be the lack of acknowledgement from a TV station regarding a warning you just issued (maybe it didn't go out?).

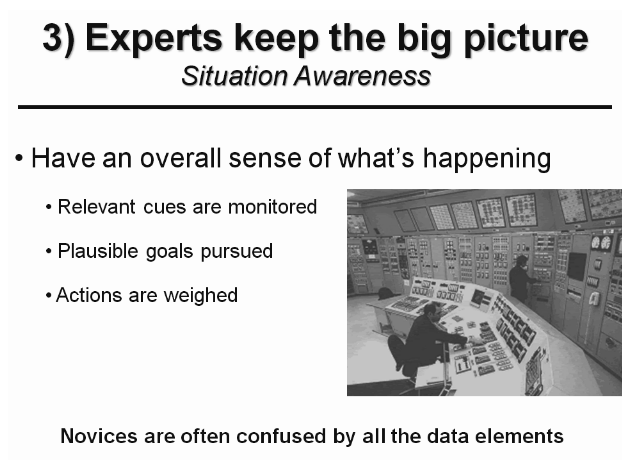
Student Notes:



13. 3) Experts keep the big picture

Instructor Notes: Experts often keep good SA. They tend to focus their energy on the important cues and filter out the rest. How do they know what’s important? More on that later. They are able to weigh options and judge consequences of each. By contrast, the novice may actually suffer “paralysis by analysis”. It’s the never ending “one more volume scan” syndrome in which the novice hopes all uncertainty will vanish and the decision will be obvious. Experts are able to make decisions even when the picture is somewhat fuzzy (which it usually is).

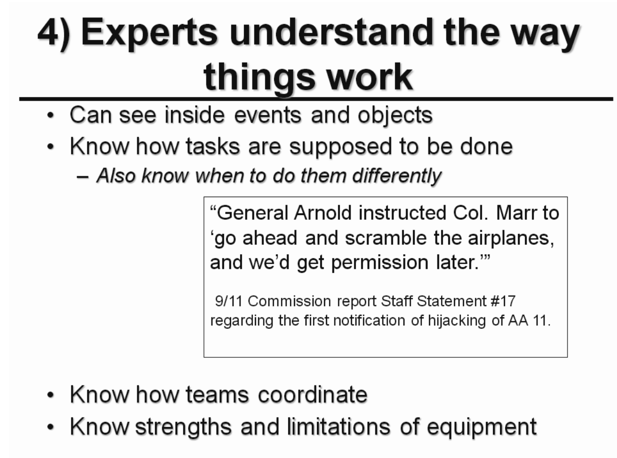
Student Notes:



14. 4) Experts understand the way things work

Instructor Notes: Experts are aware of how and why things and processes are designed. This includes the need for communication and coordination. They have a good sense when to trust equipment and when not. They know when to go with a known practice, and when to deviate. In the 9/11 Commission report, the General violated “protocol” because he believed it was called for in this case.

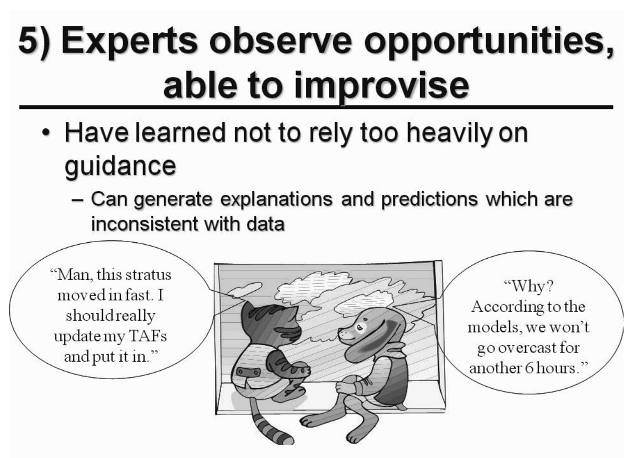
Student Notes:



15. 5) Experts observe opportunities, able to improvise

Instructor Notes: When data sources conflict, experts are often able to resolve the differences. Their deeper level of understanding also allows them see when expectations are not being met before it's too late. This helps them more readily "let go" of a previous expectation when it is clearly no longer valid. While the discussion here is regarding the earlier than expected stratus deck, it may also involve a strong rotational signature developing on a day where "no severe weather" is expected.

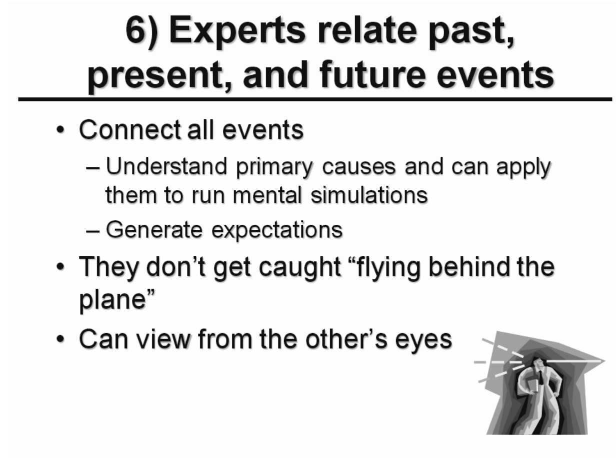
Student Notes:



16. 6) Experts relate past, present, and future events

Instructor Notes: Experts quickly, and usually without being aware of it, make the connections between what has occurred, what is occurring, and therefore what is most likely in the future. They mentally simulate possibilities and outcomes and take action based on the result which gives the first good workable solution. They tend to look at a problem from more than one angle, allowing them to see more than one possible explanation for what is occurring.

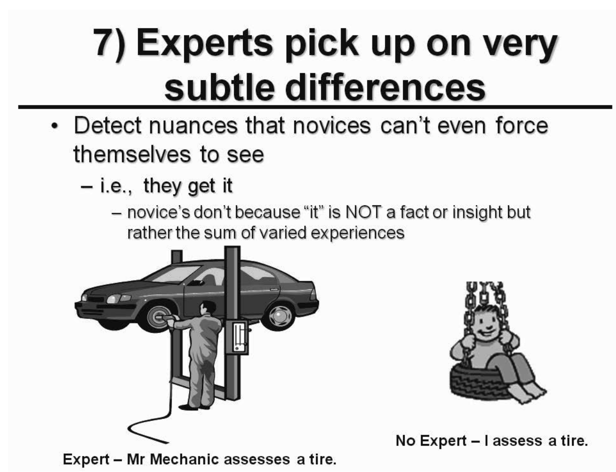
Student Notes:



17. 7) Experts pick up on very subtle differences

Instructor Notes: Experts can pick up on subtle differences. The sum of their experiences has come together in a way to make this easier. Novices have not been assessing the same things and have not developed the same sensitivity.

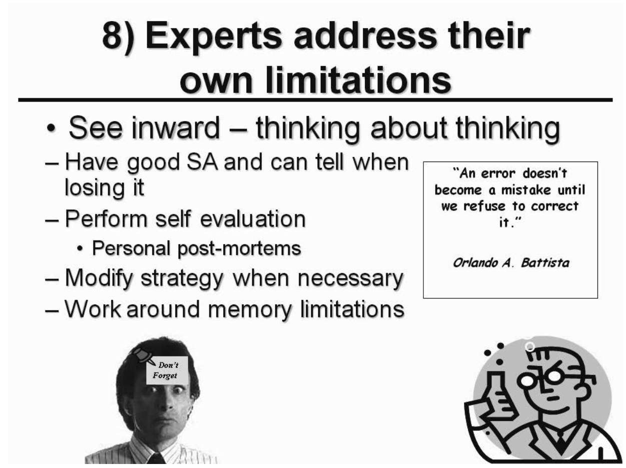
Student Notes:



18. 8) Experts address their own limitations

Instructor Notes: Nobody's perfect, including experts. What allows someone to gain expertise is knowing this fact and constantly making an effort fill in the knowledge gaps. We all make mistakes. We grow in our expertise if we understand why and how a mistake was made. Experts will accept their limitations and work around them. They will be uncomfortable with a situation that doesn't work out as expected and will look at the reasons why. This knowledge will then be available to them the next time they are faced with a complex decision. This is how they get the most out of every experience.

Student Notes:



19. When and why you want experts

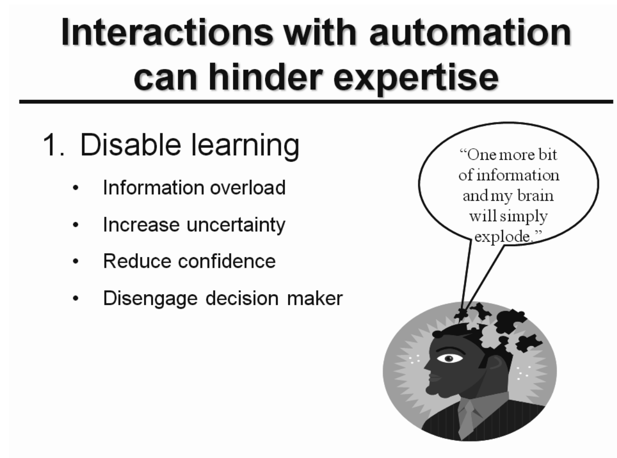
Instructor Notes: Experts are especially beneficial when a crisis erupts and, as is often the case, resolving it means dealing with fast paced decisions in an environment where data is not necessarily all pointing at the same answer. In this case from an NTSB file, one of the most important things this expert pilot did was ask for help when the workload became overwhelming. The group never did resolve the cause of the crisis, but still managed to work through the uncertainty and overcome the consequences of the initial problem before a catastrophe resulted.

Student Notes:

20. Interactions with automation can hinder expertise

Instructor Notes: So we have looked at the characteristics of an expert, let's look at what can keep them from using that expertise, or what can hinder the novice from attaining it. When automation is inserted into the process without considering the user, it has the potential to "disable learning". If the automation has the characteristics listed here, it can have an affect on learning and application in real time. No doubt you have felt the impact of all these things at one time or another. Simply adding more and more information is not always the answer. Is it better to have 2 sources which suggest 2 possibilities or 10 sources which suggest 10 possibilities? Neither! On the other hand, more and better information which helps us reduce uncertainty and increase confidence in our understanding of the threats is another story.

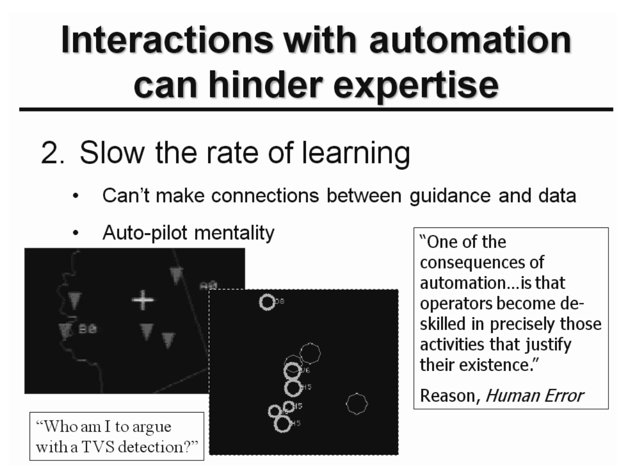
Student Notes:



21. Interactions with automation can hinder expertise

Instructor Notes: When the automation does not provide a means for the user to evaluate its validity, it can actually reduce the decision makers confidence it what they believe is happening, and may even cause them to disengage. This quote from James Reason is pretty telling. When we get to the point of saying we can't argue with the automation, we are implying we are no longer needed in this process. And with perfect automation that may be true. Until then, we need to be able to add value to the decision by using our expertise and incorporating the automation properly.

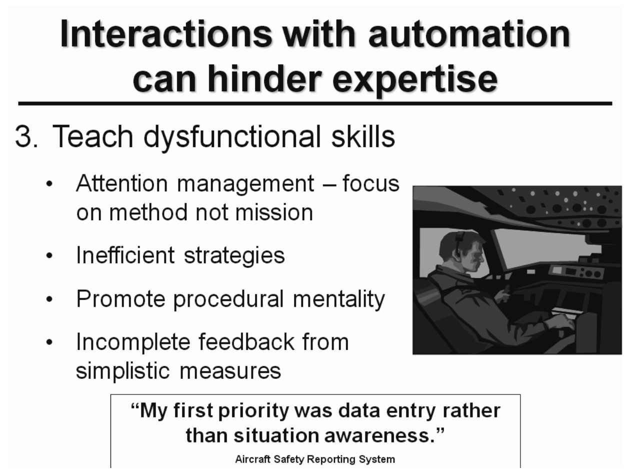
Student Notes:



22. Interactions with automation can hinder expertise

Instructor Notes: Sometimes automation can be so labor and attention intensive that we lose track of the process we are trying to accomplish. We don't get to tap into our expertise. The pilot quoted here is lost in the process of working the automation, so much so that he's losing SA. Another problem can arise if the feedback you get indicating whether you succeeded or not is not really representative of your skill, or one's idea of what success really means. Remember our guy who could shoot 10 arrows in 10 seconds? That was easy to measure but did it really measure what was important? Unfortunately, that simplistic measurement can get fed back into the system and ultimately be what we end up training for…in the previous case, not accuracy but speed.

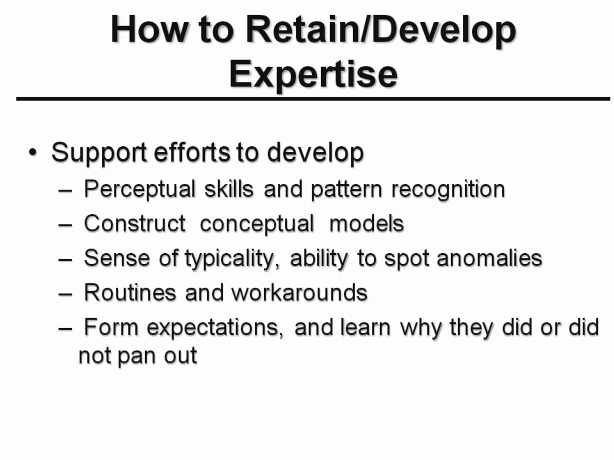
Student Notes:



23. How to Retain/Develop Expertise

Instructor Notes: So what do we do? The process by which we assess, understand, and evaluate our decisions is very important. Automation, operations, and training which support the efforts to develop skills in pattern recognition and aid in constructing conceptual models are important. These efforts should also focus on making unusual and rare occurrences more recognizable. Routines are important…they save time. New routines need to be developed when skills or software or mission change. The routine you may have had 15 years ago (not you youngin's) has had to change considerably, as will the one you likely use 5 years from now. One of the best practices you can do is challenge your expectations, both during and after an event. Look at why they are not working out, or did not come to pass.

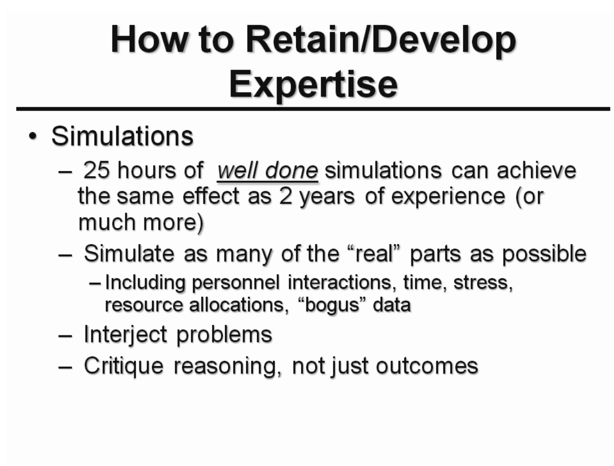
Student Notes:



24. How to Retain/Develop Expertise

Instructor Notes: One of the best ways to develop expertise is in simulations. Just as having experience doesn't guarantee you have expertise, going through a simulation won't either. It has to be pointed toward some goal which can be rather simple (get very comfortable with WARNGEN) or more complex (recognize MARC signatures). One thing that is common to all simulations is the process of evaluating reasoning, not just outcomes.

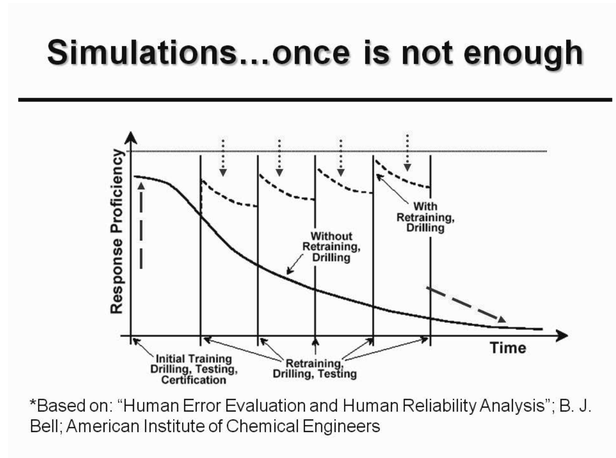
Student Notes:



25. Simulations…once is not enough

Instructor Notes: This study revealed how proficiency was impacted by initial training (dashed arrow) and how it went to pot with time. Like watering a seed when you plant it, and then neglecting it and expecting it to grow without any further nourishment. However, with continued refresher training (dotted arrows), proficiency remains at a much higher level and can even improve. This is especially important when the event for which you're training is relatively rare (nature doesn't routinely offer chances to keep up skills otherwise).

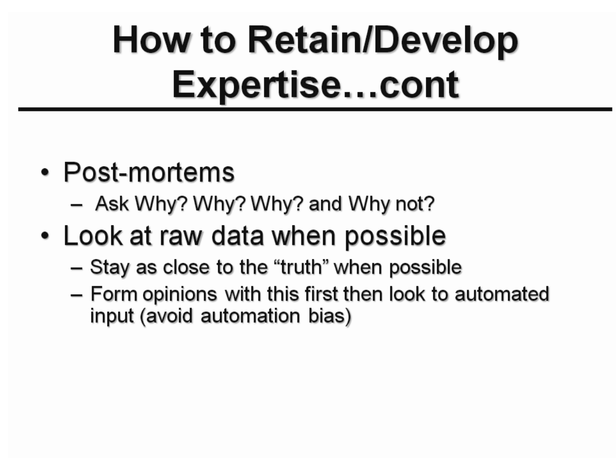
Student Notes:



26. How to Retain/Develop Expertise…cont

Instructor Notes: Asking "why?' is a great practice. It's how most of us learned at a very young age (hopefully, the answer you get when asking that question after a warning event is still not "because I said so."). Post-mortems are key to advancing knowledge and critical thinking. Looking at the raw data, something the Air Force refers to as "owning the data" also helps cement understanding and assists in solidifying conceptual models. Forming opinions based on objective analysis, and then looking at automated guidance helps avoid what researchers call the "automation bias". Studies have shown that decision makers are more likely to come to the "automated" solution if they look at the automated solution BEFORE forming their own opinion. In that case, they are less likely to resolve differences in what the automation says versus what their original opinion might have been.

Student Notes:



27. Summary

Instructor Notes: A summary of the meaning and value of expertise.

Student Notes:

Summary

1. Experts are those that have a deep comprehension of the situation
2. They are extremely valuable to an organization, especially when problems are unique and constrained by time.
3. Automation, if not developed or integrated correctly, can hamper one's ability to gain or apply expertise.
4. Experiencing simulations, doing personal post-mortems, and resolving "why", are ways in which you can gain expertise.

28. Questions?

Instructor Notes:

Student Notes:

Questions?

1. Check with your AWOC facilitator (most often the SOO)
2. Send your questions to awoccore_list@wdtb.noaa.gov

29. References

Instructor Notes:

Student Notes:

References

Aviation Safety Network, http://aviation-safety.net/index.shtml

Hammond, Kenneth R. (1996) *Human Judgment and Social Policy*. New York: Oxford University Press.

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Reason, J. (1990) *Human Error*. New York: Cambridge University Press.

Wood, David D., Johannesen, L., Cook, R., Sarter, N., *Behind Human Error: Cognitive Systems, Computers and Hindsight* (SOAR December 1994, from the Crew Systems Ergonomics Information Analysis Center). Wright-Patterson AFB, Columbus OH.

1. Expertise and Effective Office Warning Strategies

Instructor Notes: Continuing through the Expertise and Effective Office Warning Strategies instructional component, we will now look at a Cognitive Task Analysis of the warning process.

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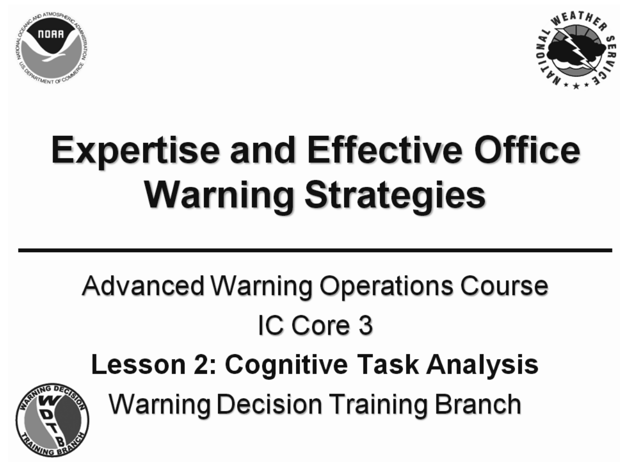

2. Lesson 2:Cognitive Task Analysis of expert warning forecasters

Instructor Notes: This lesson will share result of a CTA which was recently conducted using NWS expert warning forecasters.

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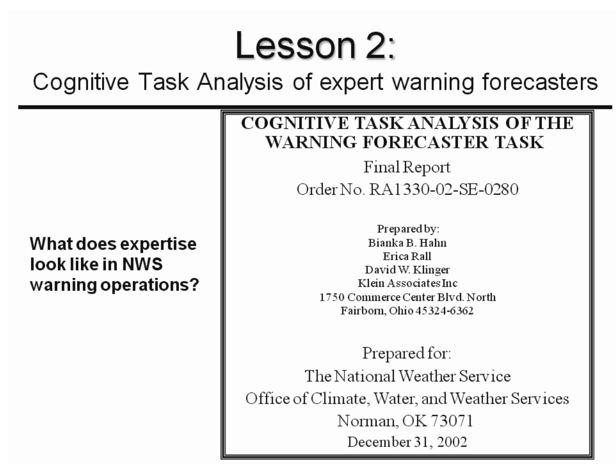

3. Overview

Instructor Notes: We'll discuss what we mean by the term Cognitive Task Analysis, or CTA, and the process by which it was conducted. We will also look at the findings from this study. These findings help us get a good picture of what an expert does and thinks as he or she encounters a severe weather event.

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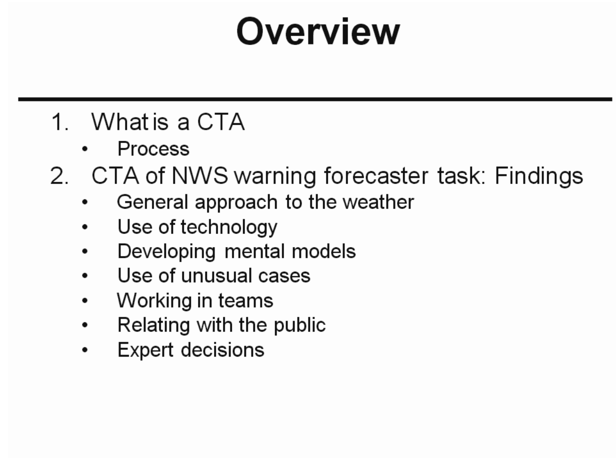

4. Learning Objectives

Instructor Notes: The learning objectives, which are testable, involve defining a CTA, and identifying the results of this particular CTA.

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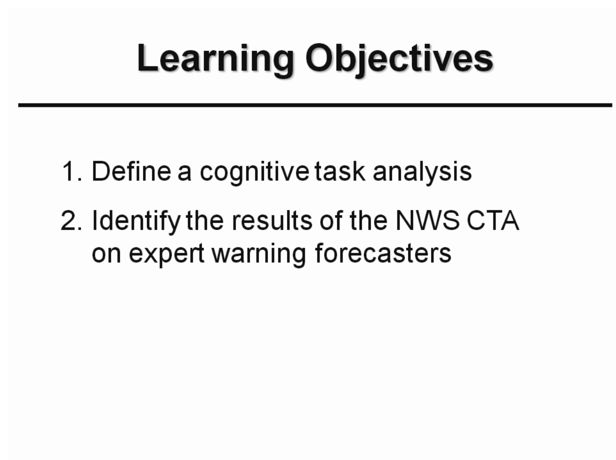

5. What is a CTA?

Instructor Notes: Did you ever work with someone who was about to retire and think, “Man we need to clone him before he leaves!”. Well a CTA tries to see what the characteristics of that “clone” might involve, at least in the area of interest. In this context, a CTA is defined as a study of the mental processes needed to perform a task proficiently. While a “task analysis” looks at the job tasks which are done to accomplish a goal, the CTA focuses on the thinking processes and reasoning of the person doing the task. Not just what they do, but how they come to the decisions they come to. A CTA can be done on anyone, but if you are attempting to capture and grow expertise, it is important to do this with those who are considered experts. Findings from a CTA can help design research needs and guide training efforts in the direction of fostering, in our case, warning expertise. The results can also be used to direct hardware and software design to assist the expert in using their expertise, instead of working against them.

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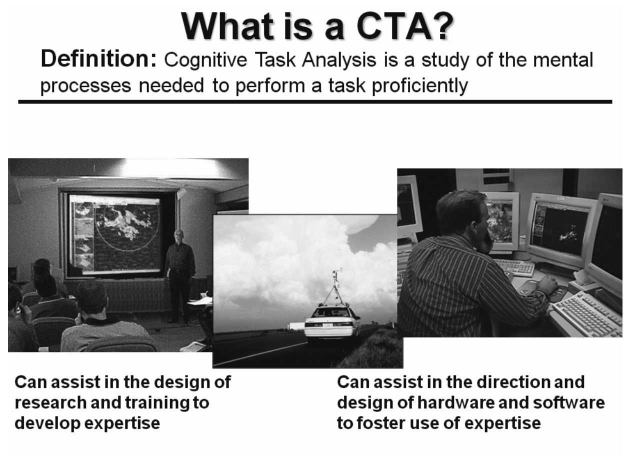

6. CTA Process

Instructor Notes: For the NWS CTA, Klein Associates, an organization which does human factors research with other high-stress, pressured domains (Army command and control, Aircraft carrier flight control) was commissioned to conduct a CTA on NWS warning forecasters. They interviewed 6 recognized warning forecast experts, each of which had between 12 and 20 years of experience in offices which covered all aspects of weather across the U.S. In addition, one novice was interviewed, the results of which were used as a control. The process involved interviews of actual events worked by each of the experts, rather than hypothetical situations. In other words, the CTA was focused around what these experts did, not what they might do. Many of you looking at this are probably considered experts, or know someone who is. The findings here will likely NOT be any surprise to you and in fact may describe you!

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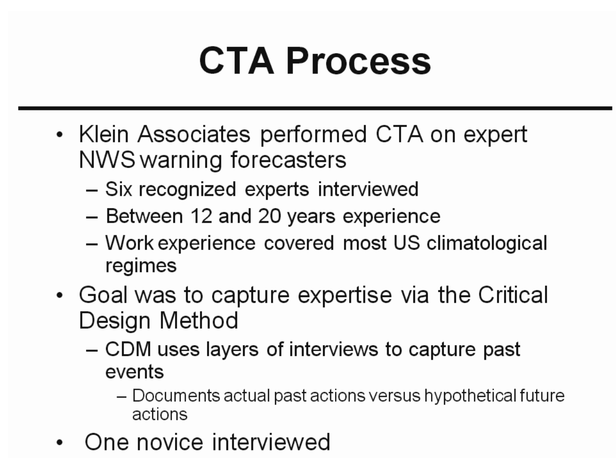

7. CTA Findings

Instructor Notes: The CTA produced several findings. First was the way that the experts approached weather in general. None considered weather an “8 to 5” job. They were on a lower level of “watch” when off duty but on watch nonetheless. What this means is that they are constantly in a learning, observing mode. The field of weather affords that opportunity more so than other domains. Experts will take advantage of this. By the time they go on duty, they’ve already formulated some expectations about what is in store for them that day. However, experts will frequently reassess expectations which helps prevent them from locking in on their initial assessment.

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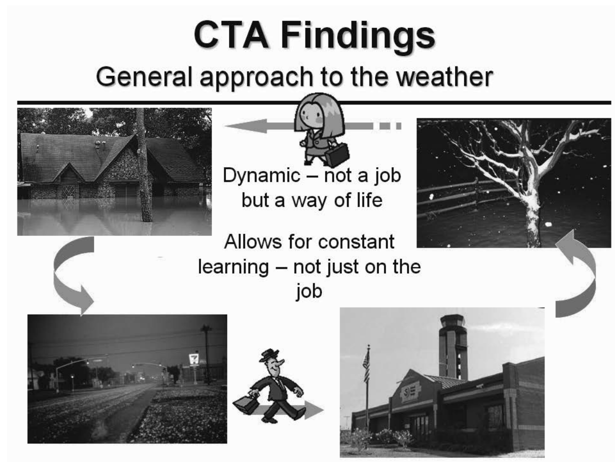

8. Slide 8

Instructor Notes: The second finding involved the use of technology. As you all know, the warning environment is technologically rich, and getting richer every day! This requires experts to have a strong understanding of the domain in which they are immersed and a constant effort to properly use the technology to the best outcome.

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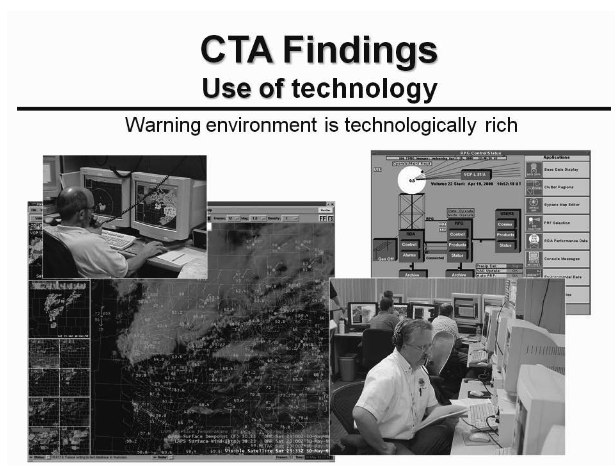

9. The scientific warning process

Instructor Notes: One of the ways experts do this is with a grounded warning process. This process is built around detailed and frequent base data analysis, the assimilation of ground truth, and considerations for the impacts of a representative mesoscale analysis. These things help illuminate conceptual models which help bring order and expectation out of the mountains of available data. The warning decision comes from this process, with the use of algorithms as a safety net to help catch things that slip through the cracks. The experts were aware however that this safety net has "holes" and therefore to rely on algorithms as a "first line of defense" is dangerous.

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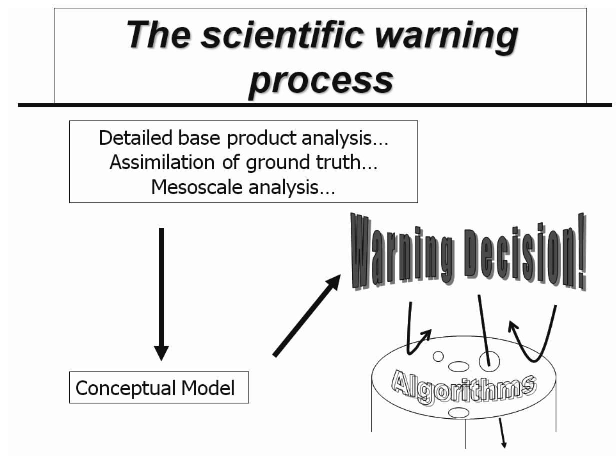

10. Experts put a high value on Base Data

Instructor Notes: All the experts interviewed here put a high value on base data analysis. They have developed numerous procedures and methodologies to make this analysis as quick and easy as possible. Their reasoning primarily comes from the base data being the closest data one has to the "truth", with each step of processing thereafter having the potential of introducing additional levels of uncertainty. Since these experts are very aware of conceptual models, they are able to use the base data to recognize and validate those models. The challenges of base data analysis for these experts is the workload it places on individuals. However, most placed a high priority of ensuring staffing to support this effort.

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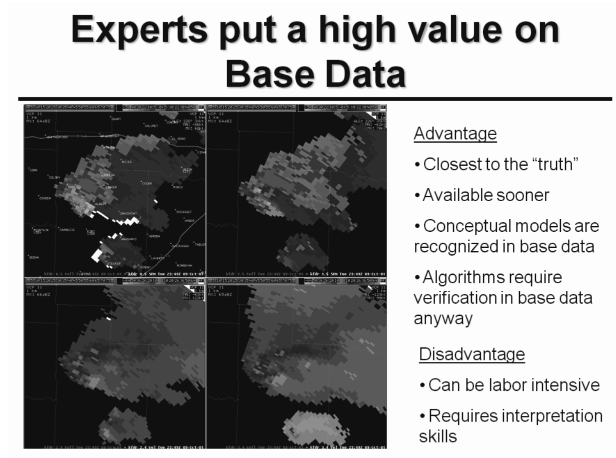

11. Use of Decision Aides

Instructor Notes: Decision aides, which may or may not use the output of algorithms, were also used to support expert warning forecasters. The experts found value in those outputs which were easily traceable to their base data inputs. This ability allowed them to develop confidence and reduce uncertainty. Outputs which added value above and beyond what was readily detectable in the base data were used more often. However, outputs which were difficult to verify or validate were considerably less likely to be used. On the other hand, novices are more likely to use decision aids without questioning their validity.

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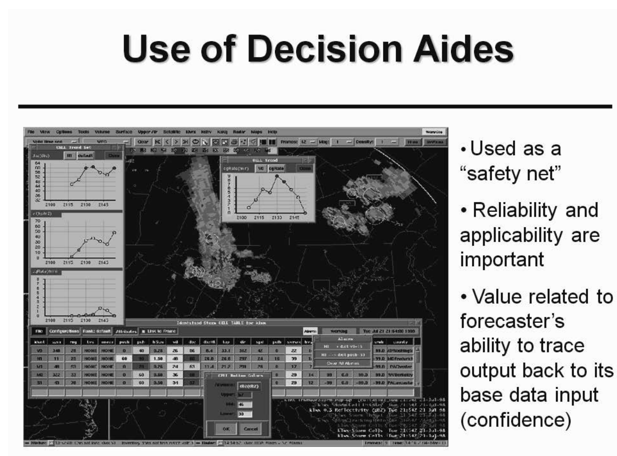

12. Basis for Warning Decision

Instructor Notes: For the expert warning forecasters, all data gets weighed against all other data, and in the context in which it is received. All data sources rarely point to an "obvious" answer. In addition, no one piece of data (except on extremely rare occasions) is ever enough to base a decision upon. The expertise comes in deciding on which side of the scale inputs reside and how much weight each carries with it. The context in which the event is occurring is always being considered.

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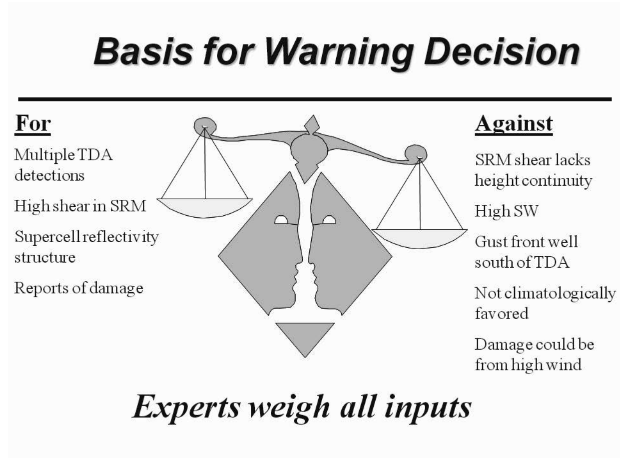

13. Slide 13

Instructor Notes: The CTA found that expert warning forecasters are very familiar with mental and conceptual models. This begins taking shape during the expectation phase before echoes appear on the radar screen. It was important for these forecasters to not get locked in on any particular threat, but rather consider a range of threat possibilities, each with an associated likelihood. This helps focus effort on the biggest threats and ensure resources are arranged to support that effort. At the same time, it was necessary to prevent tunnel vision ("flash flooding is not a threat today") which can contribute to the likelihood of low probability or rare events going undiagnosed. In addition, the experts were aware that oftentimes the signatures will not fit the "textbook" classics, but that they can still be good enough.

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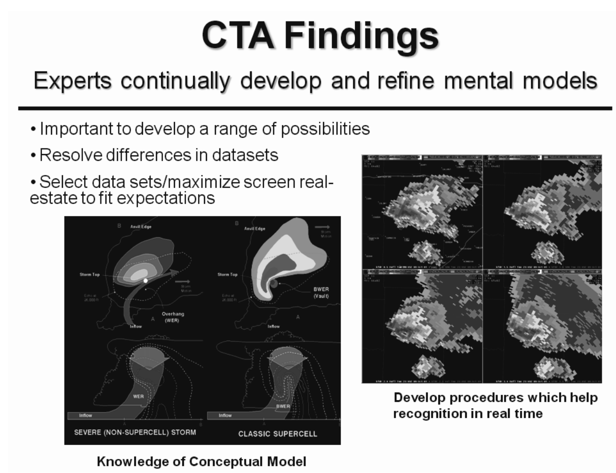

14. Slide 14

Instructor Notes: The experts were very prone to looking at numerous events in hind-sight. This included events from other areas, even other countries, and events which, even though they were not common to their particular locale, were in the realm of possibilities. The benefit of doing this was to expand exposure and possibilities, as well as develop critical thinking skills. They viewed simulations as a challenge and sought to get the most out of any event they experienced.

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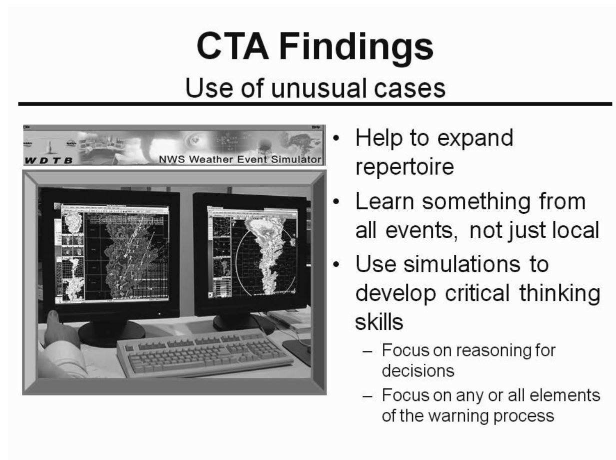

15. Slide 15

Instructor Notes: The teamwork focus of the experts interviewed was a common theme. They considered success and failures as belonging to the office and the NWS, not just the person composing the warning. Each team member has a responsibility for communication and coordination as well as situation awareness. They valued the role of each member of the team, regardless of their experience level. The experts endorsed the use of a warning coordinator to help ensure nothing gets overlooked and that the message the office is sending is understood be each team member.

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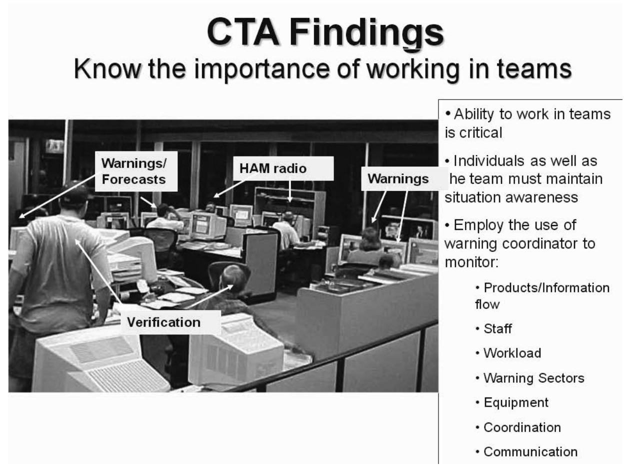

16. Slide 16

Instructor Notes: The experts viewed issuing warnings as a social action which was based on a scientific decision. They were very focused on their relationship with the public and public vulnerabilities at any point in time. They did not view their job as just issuing a warning, but rather making attempts to elicit the best public response to ensure safety. A focus on a constant and consistent communication of the threat, both from sources within the office and with outside partners, was a critical piece of the job.

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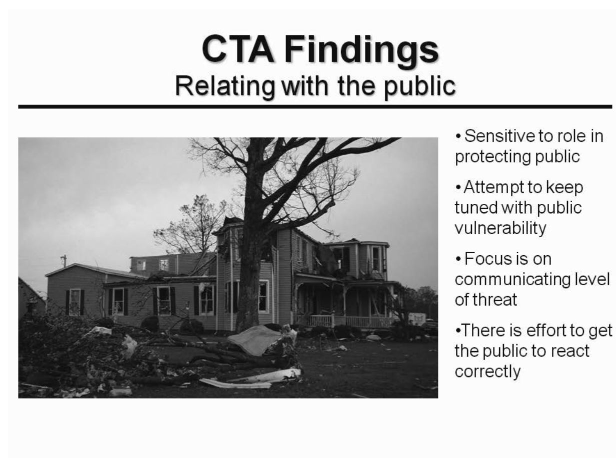

17. Slide 17

Instructor Notes: The biggest and most important challenge that the forecasters interviewed found in their jobs was the ability to rise to the occasion when the “big event” presented itself. It was believed that this was where the NWS needed to meet and even exceed all expectations. They tended to look at all events as having that potential, knowing that it is often not known ahead of time which event will be the one that defines your reputation or that of your office or the agency. Their belief was that seeing and properly reacting to these catastrophic events as they are unfolding (correctly assessing the relevant cues) is the biggest challenge one is faced with in the forecast and warning environment. The importance of categorizing the threat once it is realized in words which convey not only its magnitude but its certainty was thought to be imperative.

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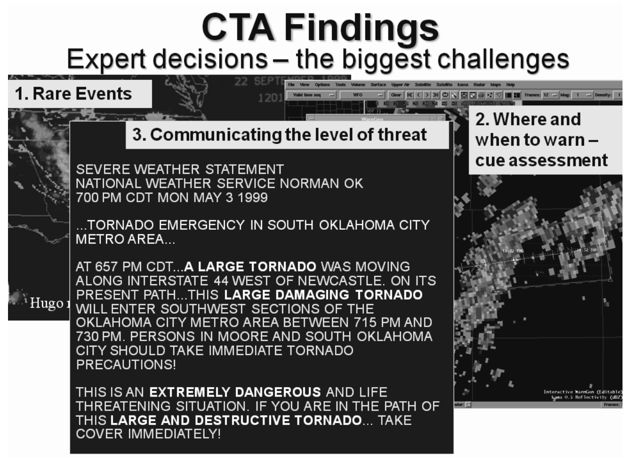

18. Summary

Instructor Notes:

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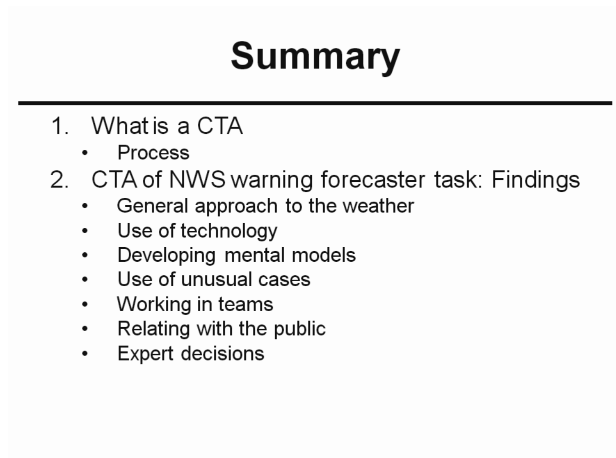

19. Questions?

Instructor Notes:

Student Notes:

Questions?

1. Check with your AWOC facilitator (most often the SOO)
2. Send your questions to awoccore_list@wdtb.noaa.gov

20. References

Instructor Notes:

Student Notes:

References

Hahn, B.B., Rall, E.,Klinger, D.W.,(2003). Cognitive task analysis of the warning forecaster task (Report # RA1330-02-SE-0280 for the NWS/OCWWS, Norman, OK). Fairborn, OH: Klein Associates, Inc.

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Klein, G. A., & Hoffman, R. (1993). Seeing the invisible: Perceptual/cognitive aspects of expertise. In M. Rabinowitz (Ed.), Cognitive science foundations of instruction (pp. 203-226). Mahwah, NJ: Lawrence Erlbaum Associates.

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Pliske, R. M., Klinger, D., Hutton, R., Crandall, B., Knight, B., & Klein, G. (1997). *Understanding skilled weather forecasting: Implications for training and the design of forecasting tools* (Technical Report No. AL/HR-CR-1997-0003 for the Air Force Material Command, Armstrong Laboratory, Human Resources Directorate Brooks AFB, TX). Fairborn, OH: Klein Associates Inc.

1. Expertise and Effective Office Warning Strategies

Instructor Notes: Lesson 3 of IC Core 3 deals with the use of post-mortems as a means to gain expertise as well as a means of gaining insight into to warning operations and decision-making, both for the individual and for the agency.

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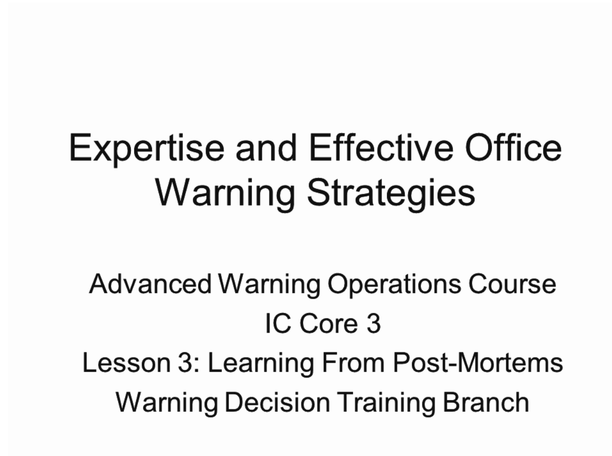

2. Lesson 3:Learning from Post-Mortems

Instructor Notes: Most often when you work an event which has a bad outcome, you have a desire not to go through that again. By the same token, an event which flows smoothly can offer just as much insight as to effective strategies. Post-mortems should be considered for both situations. The Fed-Ex plane which caught fire on approach to Memphis is an example of an event one would not like to see repeated.

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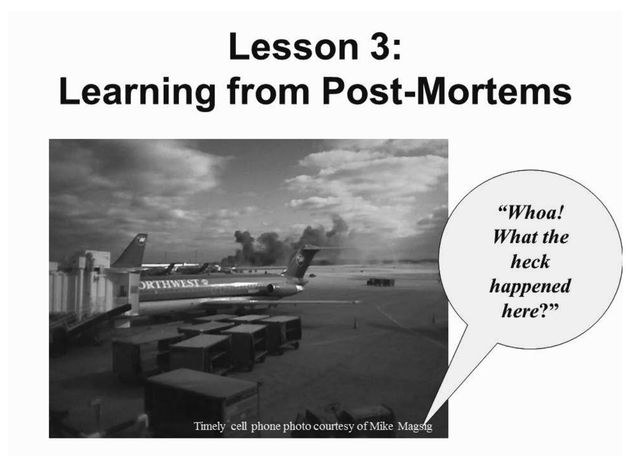
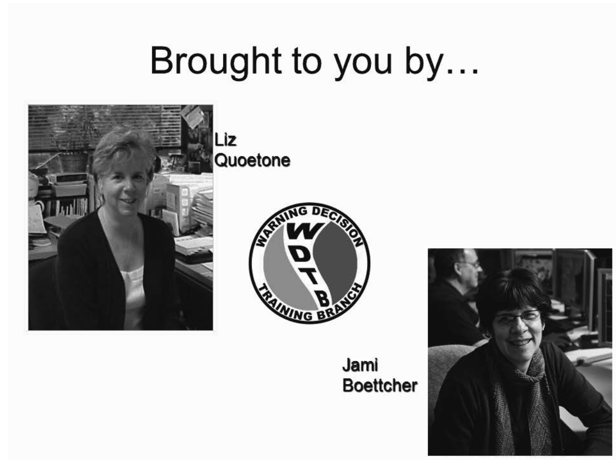


3. Brought to you by…

Instructor Notes:

Student Notes:



4. Learning Objectives

Instructor Notes: The learning objectives for this lesson are testable and have to do with the benefits of a post-mortem and why you would want to do one in the first place. However, just going through the motions doesn't mean you will reap all the benefits. The post-mortem must avoid certain pitfalls. In addition, having a database constructed of post-mortems from numerous events and offices can reveal systemic issues (both good and bad). We will look at the term "human error" and discuss its meaning and relevance. We will also discuss some of the challenges with assessing decision making in real-time, while already knowing the outcome (outcome and hindsight biases). Finally we'll discuss a means of going in deeper by using a root cause analysis approach.

Student Notes:

Learning Objectives

1. Identify the potential benefits of a post-mortem analysis
2. Identify characteristics of ineffective post-mortems
3. Identify the value of having a post-mortem database
4. State what is meant by human error
5. State the impact of the hindsight and outcome biases on performing post-mortems
6. Explain the value and meaning of a root cause analysis

5. Performance Objectives

Instructor Notes: This lesson will also include two performance objectives in the form of exercises. The first will be do root cause analysis on a couple of small case studies. The second will be to use the root cause method to look at one warning or forecast decision in which you were actually involved.

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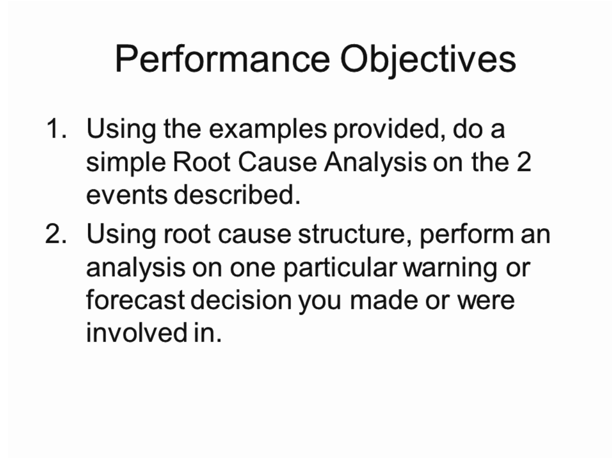

6. What you don't want to read in tomorrow's paper…

Instructor Notes: Anyone who's worked a significant weather event has seen headlines the next day which may or may not reflect the service provided, but nonetheless are extremely troublesome. In some cases, the office would have been hard pressed to get a better outcome. In others, actions before and during the event show room for improvement. An honest post-mortem will help us know where improvement can be made, whether it is in understanding the science, better technology, or human factors related issues.

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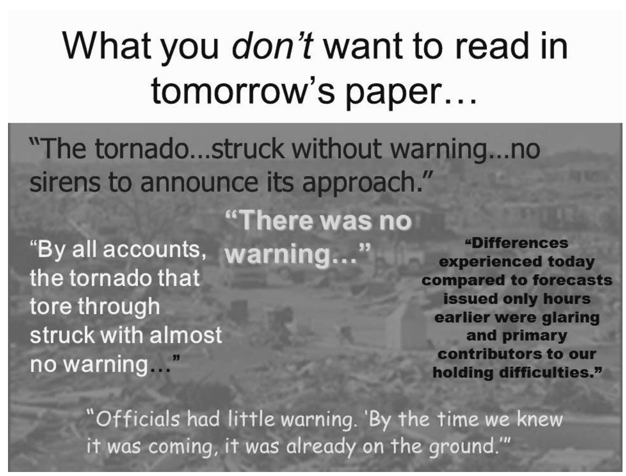

7. Finding out what happenedWhat do other disciplines do?

Instructor Notes: As you see here, many domains conduct post-mortems using many different strategies and formats.

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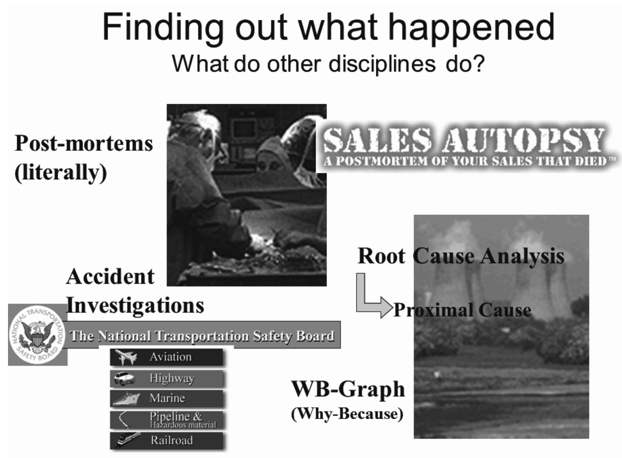

8. Post-Mortem - definition

Instructor Notes: The official definition of a post-mortem is an examination of an event that has just ended. No mention of whether that event had a good or bad outcome. Post-mortems can not only tell us about the past but can help point us in the direction of needed research, technology, policy, or procedures.

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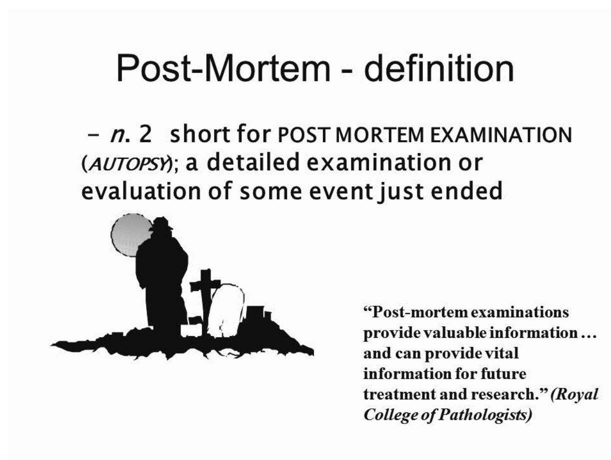

9. Value of Post-mortems:a. Tie to expertise

Instructor Notes: One of the most important benefits of a post-mortem is that it ties with the development of expertise. This slide from lesson 1 shows that this is one of the crucial methods that experts use to develop and maintain their expertise. It has not always been a formal look at an event, but enough so that the cause, effect, and actions are understood, and therefore, can provide feedback about current needs or future actions.

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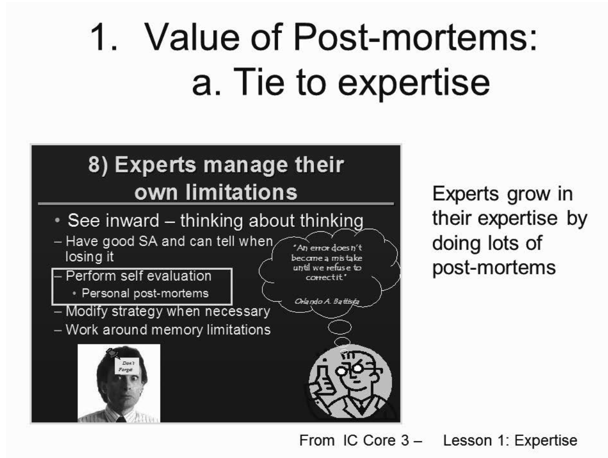

10. Slide 10

Instructor Notes: A good post-mortem will include many perspectives. In the old legend depicted here, each person had a hold of a different part of the elephant, and each then described an elephant based on the part they had in their hand. "An elephant is like a rope", said the guy holding the tail. "An elephant is like a snake", said the guy with the trunk. In reality, the elephant was like none of these individually, but all of these collectively. Your perspective of what happened in an event may be totally different than that of the gal working the other desk. Together, your perspectives give a more complete picture of what really happened.

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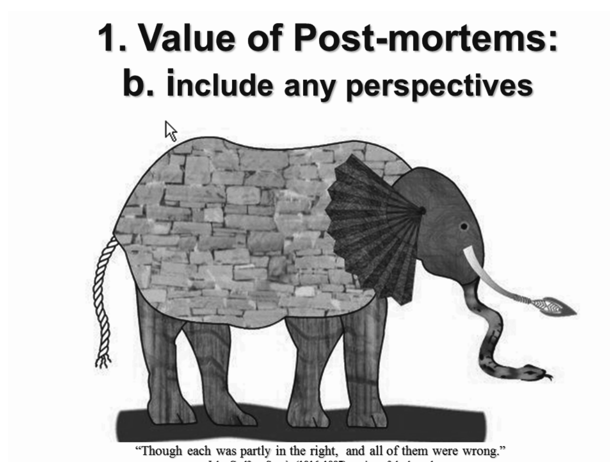

11. Traditional post-mortems have not been multi-disciplinary

Instructor Notes: Unfortunately, traditional post-mortems have usually only included the perspective of one domain, which results in a solution originating in that domain. A post-mortem which involves research, operations, and something representing the users will take more effort but may be the key to solving outstanding issues. This quote from Dr. Mileti represents a desire to expand the problem solvers. A more recent effort at integrating many perspectives in problem solving comes from the WAS*IS initiative which led to the SSWIM Program, started by Dr. Eve Gruntfest. This approach integrates social science into meteorological research and practice when looking for solutions to problems.

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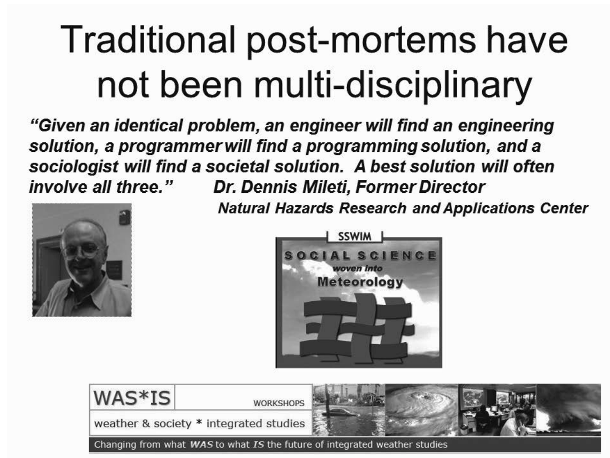

12. Slide 12

Instructor Notes: A post-mortem can offer insight for any level of an organization. For the individual, he or she can see in what areas they are strong and in what areas they need help, whether it be practice with a new software tool, additional understanding in the science, or a better comprehension of how the operational strategies employed by the office are meant to be. Local management can see what is working and what is actually impinging on forecasters ability to do the job, including office policies (official and unofficial), roles and responsibilities or way in which workload is distributed. The agency can see if the same issues are occurring at several sites and look at policies and procedures which are contributing to these issues.

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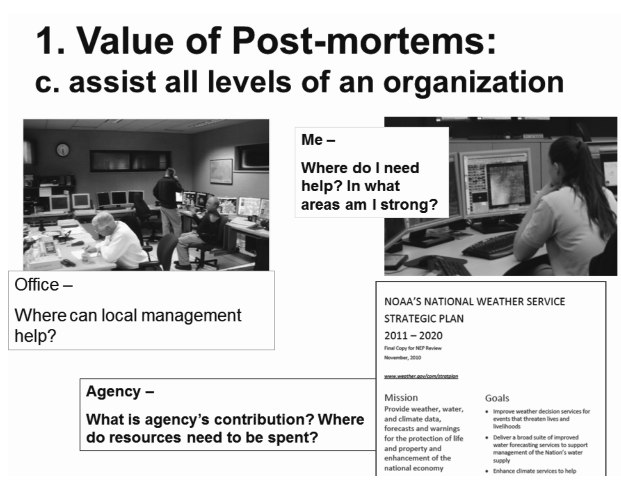
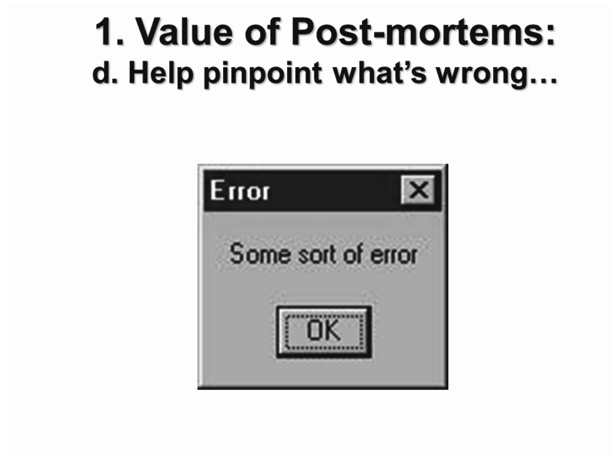


13. Slide 13

Instructor Notes: There is nothing worse than having a negative experience and then going on to the next event without knowing why it was so negative. If you can't figure out what went wrong, how will you be able do learn and perhaps prevent it in the future? "Tornado struck without warning" is not enough information, just like "some sort of error" is not enough information.

Student Notes:



14. Value of Post-mortems: …and leave alone what's right. Implementing a fix without understanding the problem

Instructor Notes: A consequence of not understanding the problem is an increased likelihood of repeating it. A consequence of misunderstanding the problem can be implementing solutions which are irrelevant. In this case, an increasing number of runway incursions was attributed to pilots not being able to see the markings on the runway. So the solution was to paint wider markings. When the mishaps continued to occur, a second and more thorough look found out that runway markings weren't the issue at all. Implementing a solution before understanding the problem in this case was a waste of time and money, and more importantly, didn't help prevent future mishaps.

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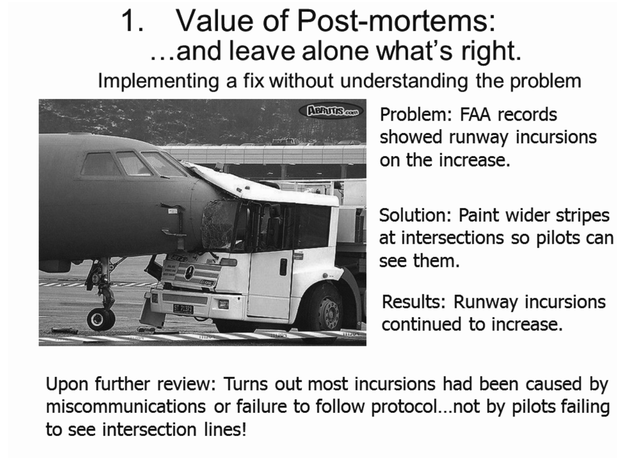

15. Value of a post-mortem…Not the blame game!

Instructor Notes: One of the BIG obstacles to doing post-mortems is the perception that the effort is designed to place blame. If that is true, then most of those involved will expend their energies to ensure the amount of blame they take on is minimal. And who could "blame" them? Research has shown, and your experience probably tells you, that once people suspect the process is all about punishing the "guilty", then the process is hosed. Part of that may stem from historic efforts which only look at cases where the outcome was bad. It's a compelling reason to look at all cases. Another problem has been in the failure to recognize that there are numerous contributors to outcomes, good and bad, at all levels. To affect real change, we must consider all levels, and consider how the entire process came together during the event.

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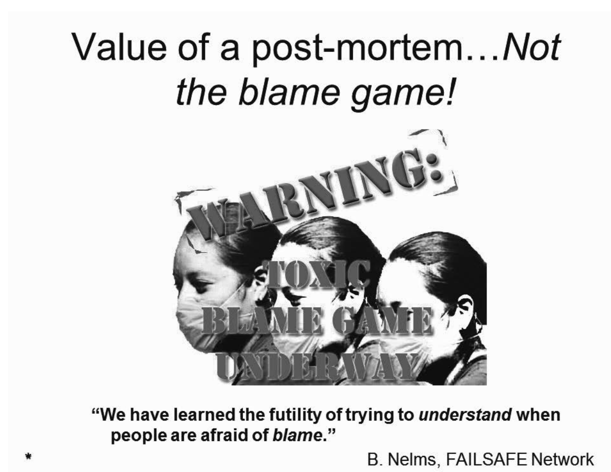
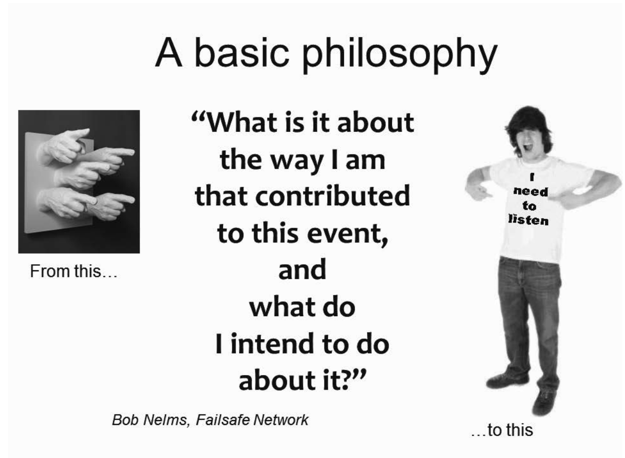


16. A basic philosophy

Instructor Notes: The need to fingerpoint and place blame on someone who can take the fall is counterproductive. Much more beneficial is to see how each of us contributed to some outcome in our own way.

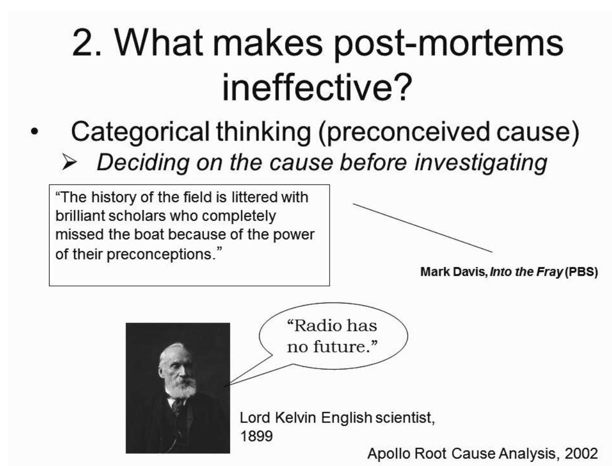
Student Notes:



17. 2. What makes post-mortems ineffective?

Instructor Notes: When we go into an event with a strong perception as to the cause, it can result in missing important information. Sort of like when you decide that tornadoes aren't going to happen today and you therefore never check for velocity couplets. It's like having blinders on. The more open minded you can be when reviewing an event, the more likely you are to discover things you hadn't anticipated. As Mr. Davis says, the power of one's preconceptions can cause us to totally miss the boat. No doubt Lord Kelvin would like to have had the opportunity to take this statement back!

Student Notes:



18. 2. What makes post-mortems ineffective

Instructor Notes: The one who goes into an event with a "favored solution" in mind will no doubt find what they are looking for…somehow. There can be all kinds of reasons for this approach, most of which are left for your imagination, but the end result can be that real and meaningful cause and effect are left out, and therefore not addressed in the solution. The article from Moorhead et al in Human Relations points to the dangers. Finally, it's important to not just get facts but get "stories". Some of the most important information can be gleaned when people recount events. One of the things that gets left out with just the facts is how pieces of information fit together…their causal relationships.

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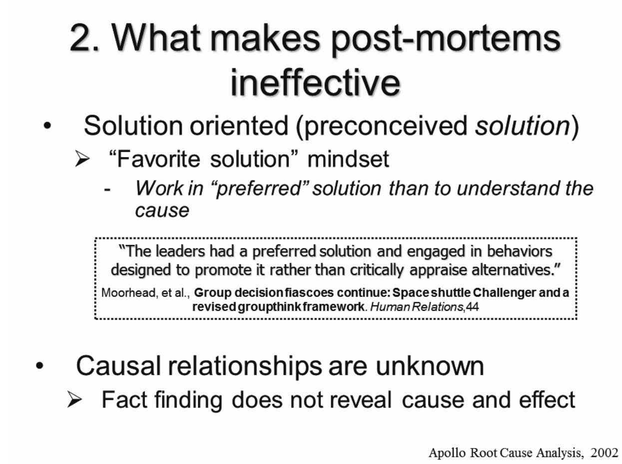

19. What we learn depends on how we conduct the post-mortems

Instructor Notes: The bottom line is that what you get out of a post-mortem depends on your attitude going in and the process by which you conduct it. In the final report regarding the Columbia Accident, it was noted that with both the Challenger and Columbia, problems were accepted without a full understanding of the risks associated with those problems. Some had mistaken being very lucky for being very good.

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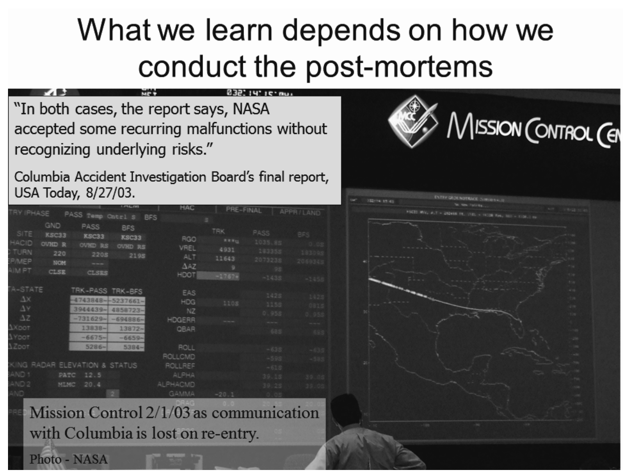

20. 3. Challenges in performing post-mortems

Instructor Notes: So let's look at some of the challenges we face when doing a post-mortem. They involve how we measure success in the first place, how we define and account for human error, and the effect of biases. Col Scott probably said it best when he said, "What you see depends on where you sit." This is certainly the case as an event unfolds (whether 9/11 or a significant weather event), as well as in looking at an event after the fact.

Student Notes:

3. Challenges in performing post-mortems

a. Measuring success

b. Human error

c. Hindsight bias

d. Outcome bias

"What you see depends on where you sit."

Col. Alan Scott (ret) First Air Force, regarding the events as they unfolded on 9/11

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21. a. Measuring success Which Office Performed Better?

Instructor Notes: Let's look at how success may have been measured for these offices. The statistics are fairly close with Office A showing slightly better numbers. Based on these measures of success, which office did a better job? Which office would you rather be? Is there more information you would like to know before you decide this? If so, what are some of the questions you'd like to have answered?

Student Notes:

a. Measuring success

Which Office Performed Better?

	Office A	Office B
POD	80	70
FAR	70	80
Ave. Lead Time	10	10
Total Fatalities	2	2

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22. To learn, you must go deeper

Instructor Notes: If you do seek more information, you are on the right track. These numbers tell some of the story but not the whole story. Other issues were involved.

Student Notes:

To learn, you must go deeper

	Office A	Office B
POD	80	70
FAR	70	80
Ave. Lead Time	10	10
Total Fatalities	2	2

In the eyes of the customer….Office B was a hero. Office A got nothing but grief. Why?

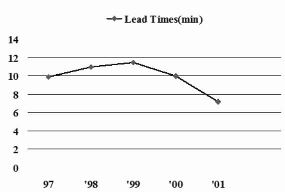
There was more to the story than just these statistics (there usually is).

23. What doesn't this graph tell us about individual events?

Instructor Notes: Here are just some of the details which might be useful when trying to decide what performance was really like. Answering these questions may help us know if the event was handled well or if there is room for improvement, and if so where? These and other questions you and your co-workers might have should be included in a routine part of a post-mortem.

Student Notes:

What doesn't this graph tell us about individual events?



- What was F-scale of each?
- What was time of day?
- What was range of each?
  - How did radar(s) sample?
  - How well did other sensors sample?
- How well was event anticipated?
  - Were there environmental clues?
- How well did staff work together?
- What was experience level of staff?
- What was maximum expected lead time in "best case scenario"?

If we can't answer these questions, how do we know what to leave alone and what to fix?

24. b. The human aspect

Instructor Notes: Human error has been implicated in 60-80% of incidents/accidents in complex, high technology systems. These systems include aviation, nuclear power, oil, medical, rail, and marine transport industries. Weather forecasting also occurs in a complex environment. Although the overall rate of many industrial and transportation accidents has declined steadily during the past 20 years, reductions in human error-related accidents have not paralleled those related to mechanical/environmental factors. The tendency after seeing this is to think that humans are becoming more and more of the problem. Is that really what is happening? What are some other explanations?

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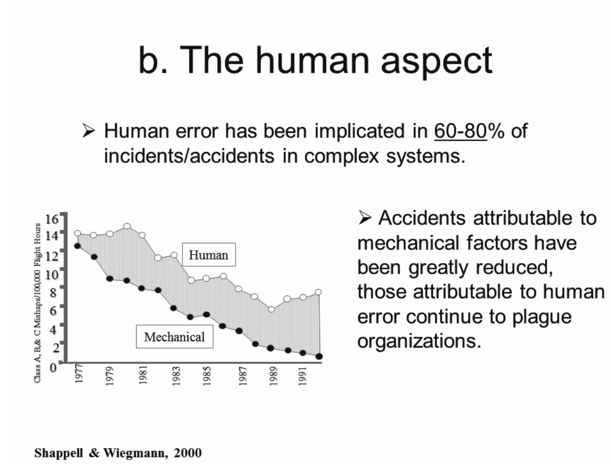

25. Some possible explanations

Instructor Notes: In Shappell and Wiegmann's studies, it is revealed that as technology continues to expand in scope and coverage, the need to include the human user in the design is not always (or even often) considered. Technology which does not consider how a human operates, especially an expert, is not going to have good results when fielded. It is also a possibility that the person using the technology will have an overconfidence in its ability to perform a function. This may result from never having seen the technology "fail" (perhaps too few cases), or from not having much expertise in the area (must rely on technology as I don't know any better). Finally, it is likely that we are not getting routine feedback on the human-system interactions. That feedback is not only necessary during design but after implementation.

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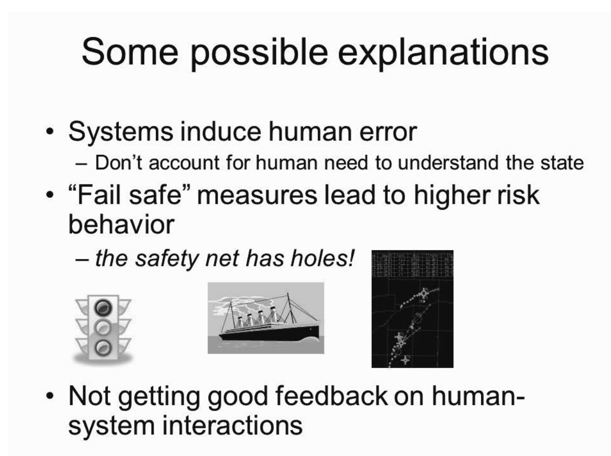

26. What is human error?Complex systems and human error

Instructor Notes: There are lots of definitions of "human error" all of which seem to point to the action taking place at the "sharp end of the stick". This is where the practitioner takes everything which has gone into the process up to this point and makes a yes/no, warn/no warn, shoot/don't shoot etc., decision. While that may be the easiest thing to do, it is extremely simplistic and does not account for all the components present in a complex system. Bill Corcoran who studies events and their causes for a living, points out that the behavior of the human practioner is not the start of everything, but rather the result.

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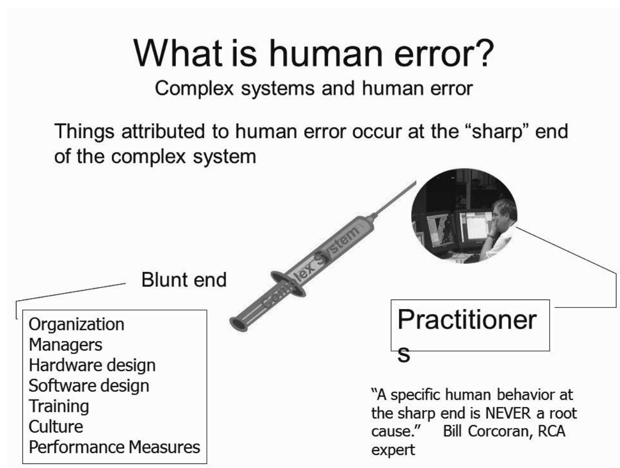

27. What is the danger when using the term "human error"?

Instructor Notes: Far from being a compelling diagnosis, citing human error has often been used to direct blame. In reality, it is not an objective assessment and may actually keep an investigation from going any further. A "Heads will roll!" mentality. There is something in assigning "human error" which implies that nothing is really wrong, except the person making the decision.

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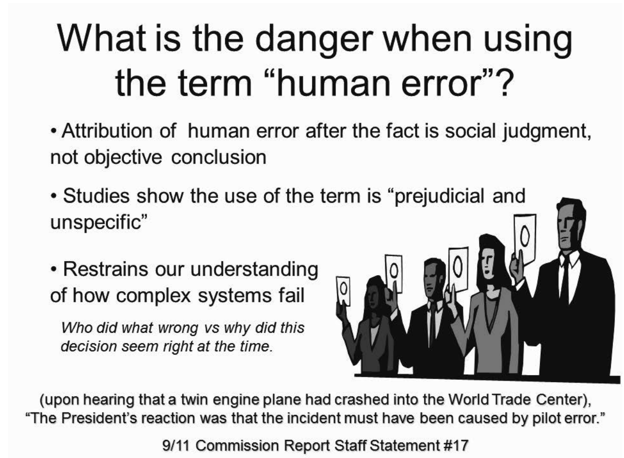

28. Addressing the Problem

Instructor Notes: So to address the problem one can take a couple of stances. Decide the human is really the problem and ramp up the automation to replace them. This might have one set of implications when the task is wrapping bon-bons in candy wrappers, but an entirely different implication when the human in the loop is there to add expertise and employ critical thinking. Another solution might be to look at the way the human and automation interact and view "errors" as a form of information about that interaction.

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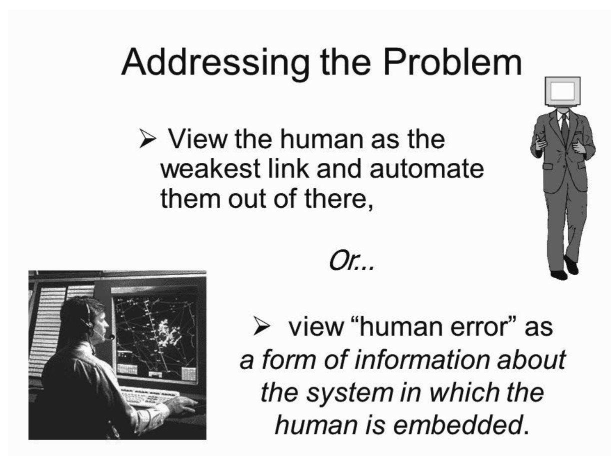

29. c. Hindsight biasA tendency to exaggerate what could have been anticipated in foresight

Instructor Notes: What are some other dangers when doing post-mortems? Have you ever seen a bad outcome and wonder "just what was the guy thinking?" or thought "Any-body should have been able to see that!" Well that may be how you feel, and it may even be true, but apparently it didn't happen in this case and the question is "why"? To really understand how we got from a to b, it is important to leave behind what you know happened, and put yourself in the position of the decision maker and see what they saw at that time. This helps avoid the “hindsight bias” which is a tendency to exaggerate what could have been anticipated in foresight. We see lots of issues regarding this in the 9/11 discussions. Look at the options which were available to the decision maker at the time and see how they got to where they went. That’s where the real understanding of the process and the potential solutions lie. If you only set yourself at the end of the event and look backwards, you won’t have the same view. The best way to work a maze is by starting at the end and going back to the beginning…there is only one way to go and it is obvious. But that tells you nothing about how it was possible for the events to unfold as they did.

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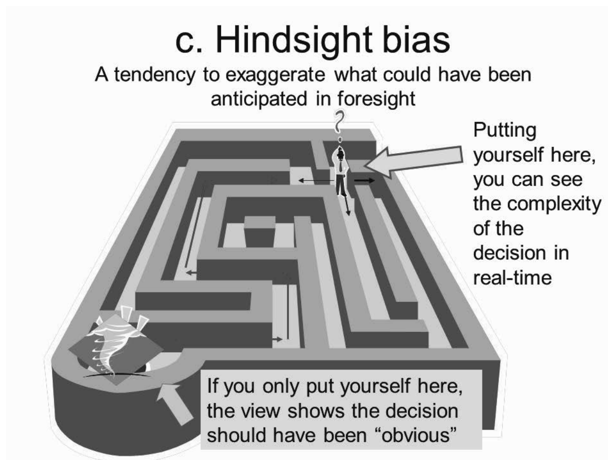

30. d. Outcome bias Judging the decision process by its outcome

Instructor Notes: Another bias to be aware of is the “outcome bias”. In this instance we tend to judge the process by the outcome. Good outcome…must have been good process. Bad outcome…must have been bad process. Not necessarily. In the first example, a tornado warning was issued and no verification was received. Was it a good or bad decision process based on what you see here? Although verification stats show a check in the FAR column, do you feel the warning justified based. Strong rotation at more than one slice at a location with a pendant and inflow notch are certainly in the tornado potential category. Maybe no one was there to witness it, or maybe it just didn’t happen. Knowing the limitations of the science and technology as well a need for adequate lead time, perhaps this was the best decision. In the second example, no warning was issued and nothing was reported. Was it a good or bad decision process based on what you see here? True it went down in the books as a good non-warning decision but that could have been attributable to other things, not to mention one of which was nobody in the vicinity. While you might could argue the tornado potential with this, are there indicators that at least large hail is occurring?

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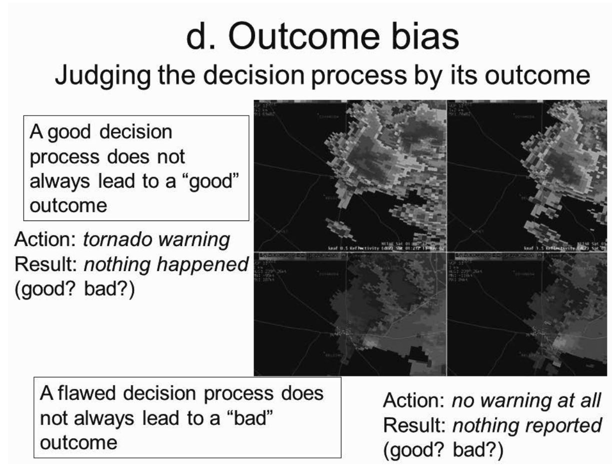

31. Getting past the outcome bias How about evaluating the process?

Instructor Notes: So it is important to do the best we can with what we have and what we understand. Ultimately when assessing the process, you want it to be sound and based in a good understanding of the science and technology with consideration to the context of the event itself including the public you serve. You'd want the action repeatable. The process is in our control, but the outcome is not. Dr. Hammond captures the dilemma when he discusses the effects of irreducible uncertainty. At any moment in time there is some degree of uncertainty and if you are not able to reduce it by adding data or adding understanding, you must make decisions based on the information available at the time, imperfect as it can be.

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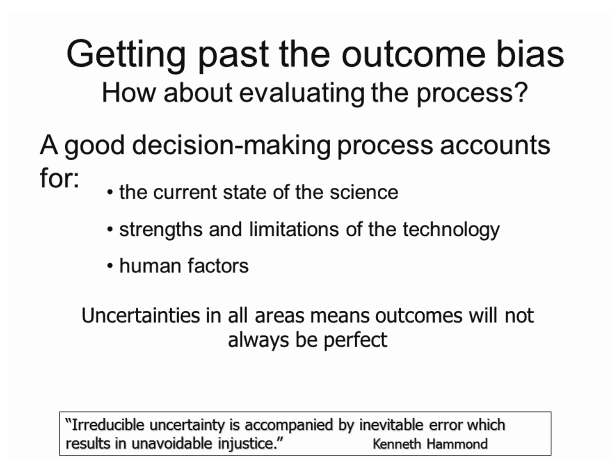

32. Overcoming biasesTo affect outcomes, evaluate the process

Instructor Notes: One set of questions you might ask of yourself after an event is whether or not you would do the same thing next time? Maybe ask some co-workers or someone you'd consider an expert. If all agree, then you probably have a good process and the issues may have resided in the uncertainties of the data sets or technology we have. Or it could have been a conscious decision to err on the side of caution due to an unacceptable risk you perceived for those in the path. If others might have done something else, look at their reasoning and discuss. Maybe you haven't thought of all aspects, or maybe they haven't thought of yours. Regardless, it's an opportunity to grow in knowledge and advance your critical thinking skills.

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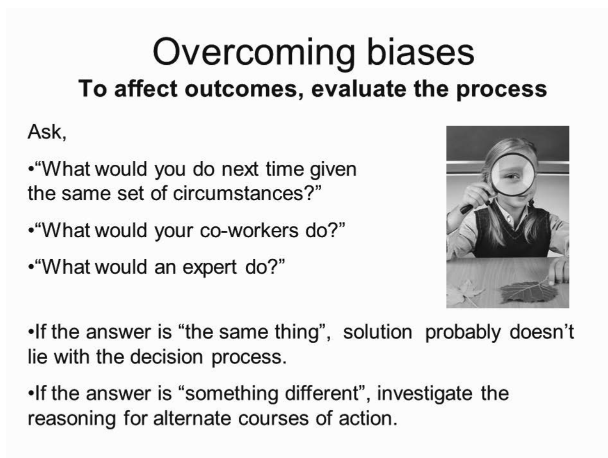

33. Slide 33

Instructor Notes: Another example can be gleaned from the final report on the Columbia mishap. This takes into account the "latent" conditions which are in place at the time of the incident. Latent conditions can go unaddressed for long periods of time for numerous reasons, but one of the more common is the effort it takes to resolve, especially if nothing "bad" has resulted so far. Numerous latent conditions, many still in place after the Challenger investigation, were cited as contributors to the Columbia accident. Ultimately you want to identify these "holes" or absent defenses and plug them up before they contribute to a larger disaster.

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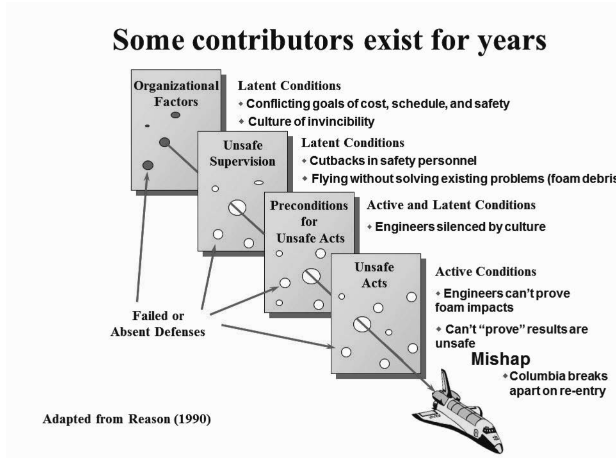

34. Slide 34

Instructor Notes: How about in warning operations? There may be organizational issues in place either nationally or locally every day which are not in and of themselves bad. However when put with other contributors, they can facilitate a bad outcome. In this example, the "slices of swiss cheese" are organizational factors, technology, science, and human factors with the "holes" in each representing factors or in some cases contributors to the outcome.

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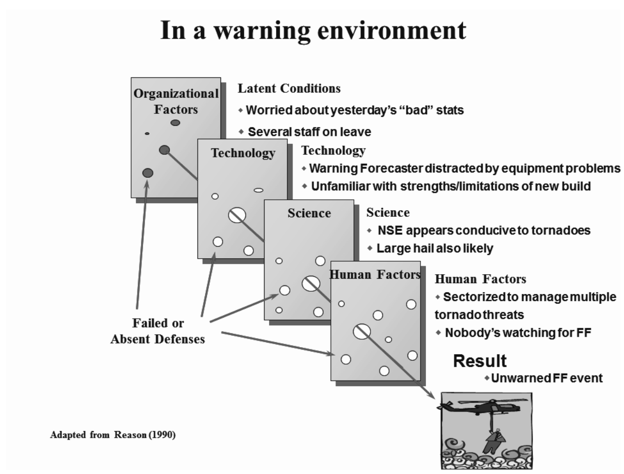

35. 4. A post-mortem databaseA database can tell us several things

Instructor Notes: Next we want to look at another motivation for doing post-mortems which is producing a database. When we no longer have just a few in depth assessments, but rather a large population of events, much can be revealed. We can see if most contributors to bad outcomes all fall in the same area, or if they vary by office or region or time of year. We can compare meaningful statistics over time to see if more or less outcomes are being affected by technology-based contributors, or if workload for instance, is becoming more and more of a factor. We can answer those questions about sampling issues or time of day and see if there is a relationship between these occurrences and our ability to get lead time.

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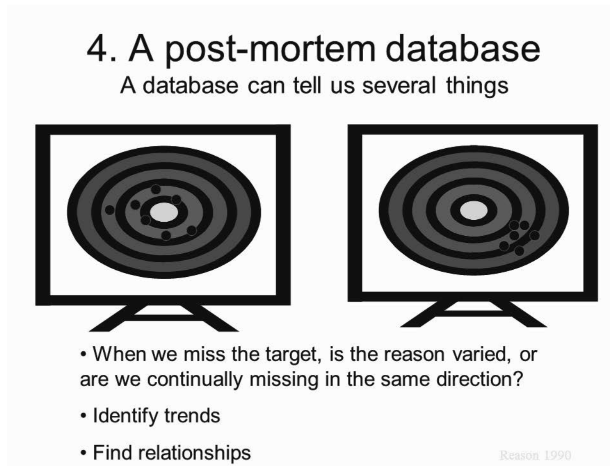

36. Insight from a post-mortem database

Instructor Notes: Here is an example of a database of Nuclear Power Plant operations in 1983. By having a database, it was readily apparent what categories were showing up in what numbers. Human performance (and hopefully we now have a better understanding what we mean by that) was the leading category. Design deficiencies followed that. This can be helpful (after digging a little deeper of course) when trying to adjust problem solving resources.

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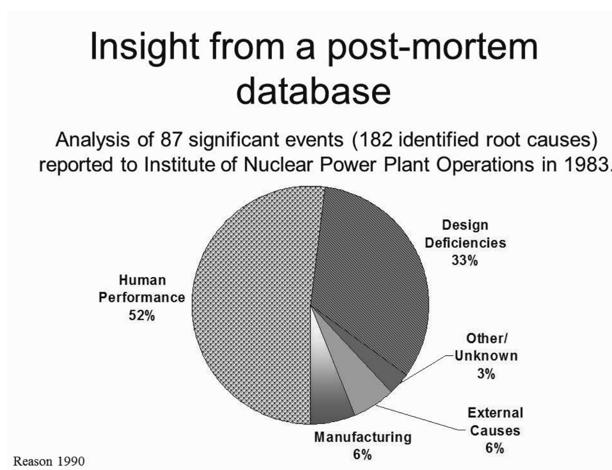

37. Example of a post-mortem database Aircraft Safety Reporting System (ASRS)

Instructor Notes: Another example of the use and construction of a database can be seen in the Aircraft Safety Reporting System (ASRS). This came about when it was felt that valuable information and critical lessons were being lost because flight crews had no avenue to express concerns (below the NTSB investigation level) without fear of retribution. This website is used for flight crews who want to anonymously report safety issues which occur during the course of a flight. None of these would be under the guise of a full-blown NTSB investigation, but most have resulted in a near miss of some disaster. The information flow via this vehicle is two-way. The arrows indicate both where a report can be generated, and where database information can be extracted. In this example we see a list of categories under which the issues reported fall into. In particular we will look at the “Crew Resource Management (CRM)” Issues.

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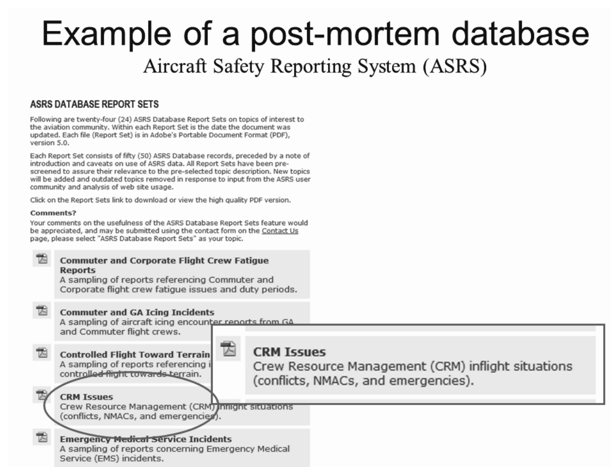
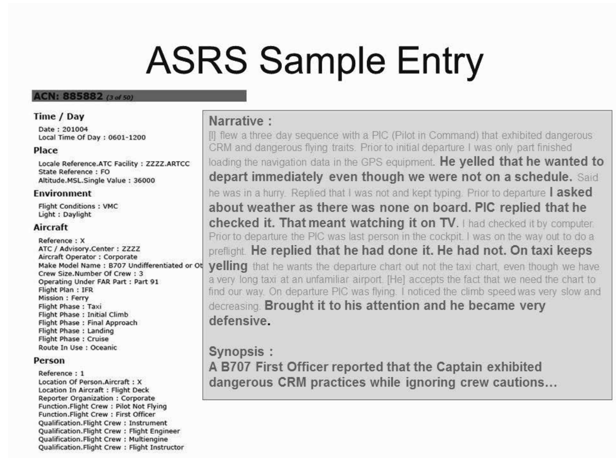


38. ASRS Sample Entry

Instructor Notes: By selecting on this we see several entries, one of which we have displayed. We see the “just the facts ma’am” type of stuff on the left (all of which has been stripped of pilot/plane identification), and the narrative which accompanied this on the right. You can see why this incident report has fallen into the crew interaction category and how big of a potential disaster this person felt they had. There is a boatload of information in this which if we waited for the actual disaster to occur before studying, we might not have seen before the next time it occurred and did result in disaster. Think of times where you’ve had near misses, the “right thing for the wrong reason” type of situation and imagine how beneficial it would be to study that type of situation as well.

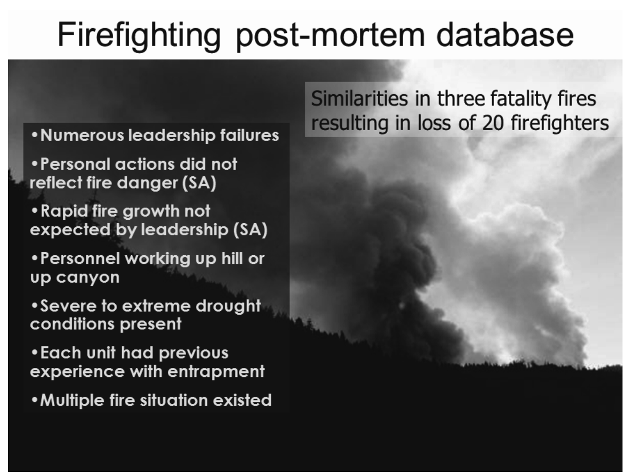
Student Notes:



39. Firefighting post-mortem database

Instructor Notes: Here is a look at a limited number of wildfires, in particular those which resulted in fatalities amongst firefighters. In this case, we see what all the events had in common. All revealed because a database of incidents were looked at. By the way, your experiences in the warning environment may have something in common with those facing decision makers in the fire fighting world.

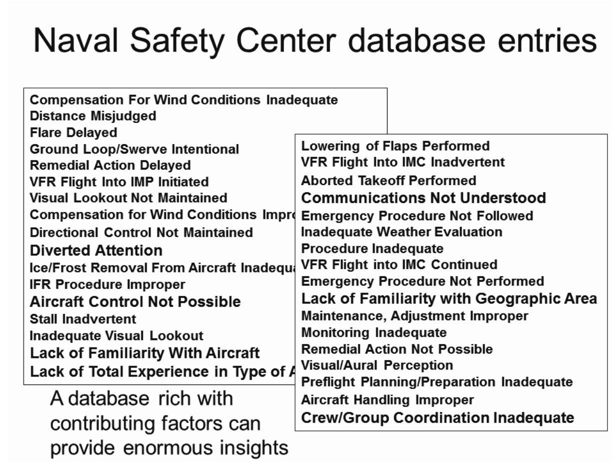
Student Notes:



40. Naval Safety Center database entries

Instructor Notes: Another database, this time the Naval safety Center database. This information must first be illuminated, via a post-mortem type of process, before it can be gathered and used for local and agency purposes. Once again, while many of these entries are domain specific, many could apply to any domain.

Student Notes:



41. NWS ExampleWhat factors contributed to 50 missed hail events?

Instructor Notes: An example closer to home shows how we are beginning to use an NWS database to see what factors have contributed to certain events. In this example, Root Cause Analysis done by AWOC students (something you'll be doing soon!) shows that in 50 missed hail events, numerous factors contributed. In this case, communication and teamwork failures showed up as a contributor 34 times in these 50 missed events.

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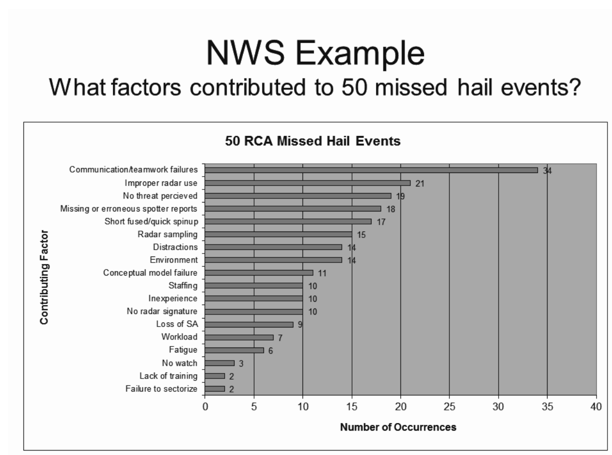

42. 5. Methods of performing effective post-mortems

Instructor Notes: In this last section we'll look at post-mortems which are done in the NWS and suggest some additional possibilities. There currently is a variety of ways in which we examine events, varying considerably by region and by office. Next we'll look at a method of going in deeper to particular forecast or warning decisions.

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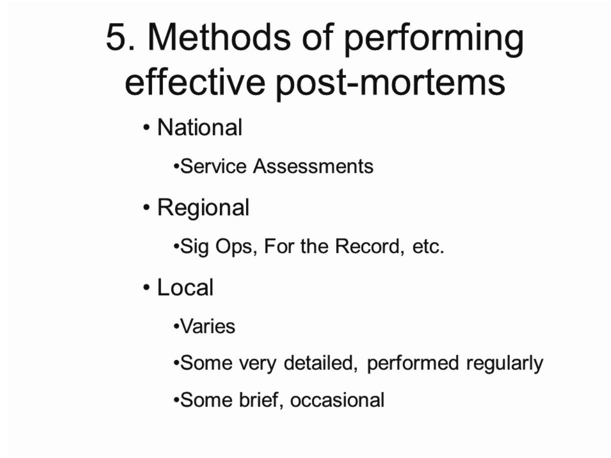
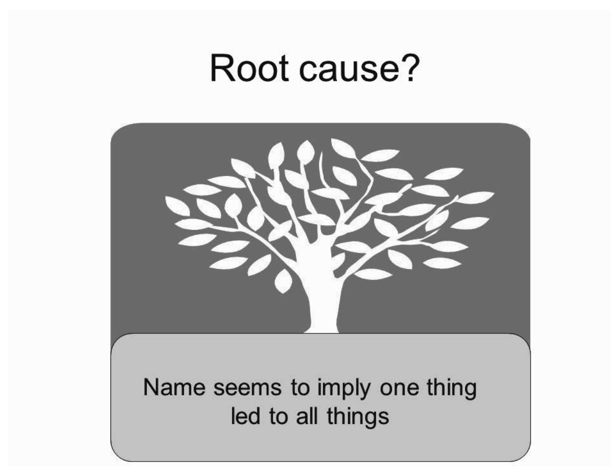


43. Root cause?

Instructor Notes: That further investigation might take the form of a root cause analysis. While the term “root cause” implies there’s one thing at the bottom of it all, it really is not the case. In fact, nothing could be further from the truth. Every “cause” has causes of its own.

Student Notes:



44. Root cause?

Instructor Notes: When doing a root cause process, one uncovers numerous “roots” each with numerous “offshoots” which have all contributed to an outcome. While the definition of Root Cause Analysis is wide and varied, depending on where you ask, the one listed here seems to fit our needs.

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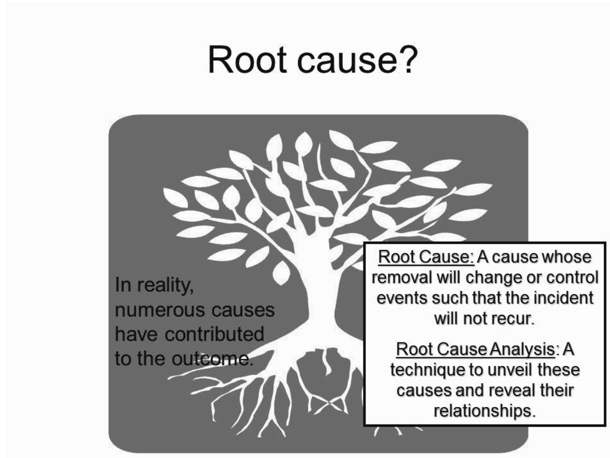
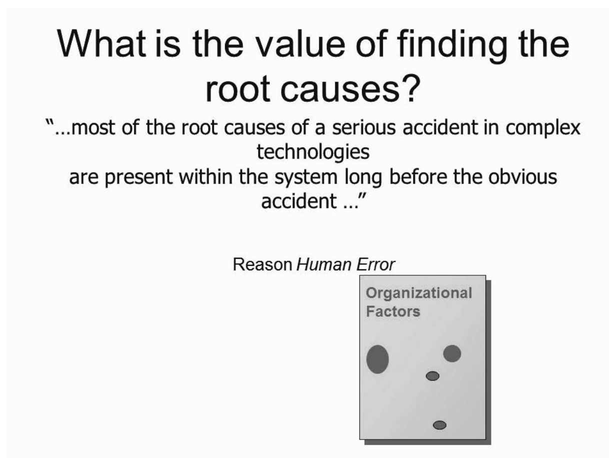


45. What is the value of finding the root causes?

Instructor Notes: So why find the root causes? Just as with the "swiss cheese" model of "latent" factors, the root causes of most incidents are present long before the thing happened. For example, organizational factors don't instantly appear at the time of an incident or a disaster, they pare present long before.

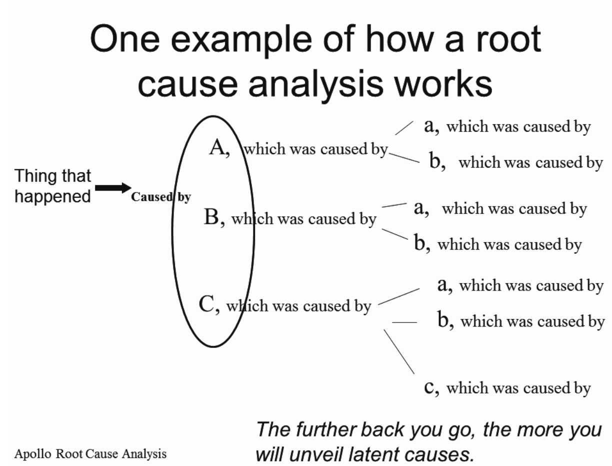
Student Notes:



46. One example of how a root cause analysis works

Instructor Notes: The ways in which you can do a root cause seem to be numerous. Lots of schools of thought exist on how and when these should come about. There are a host of vendors and sites which offer root cause training. Some require travel, while others can be done on line. If you are interested, some resources which point to further training can be found at the end of this presentation. One example is presented here but this is certainly not the only way, or maybe even the best way to do the process. But it is one we'll use in our simplistic example. For this analysis, the "thing that happened" (either good or bad) is what you start with. You ask "why" did this happen or state, "this was caused by" and then get at least 2 contributors to that, listed here as A,B,and C. In this method, A, B, and C must all have occurred together. If you take A away, no problem. If you take C away, no problem. All must have occurred together. Then each of these has a list of contributors, and so on. This process will end when: You get enough information to work solutions You run out of time The “branch” your going down is cost or time prohibitive or out of your control We’ll look at some actual examples shortly.

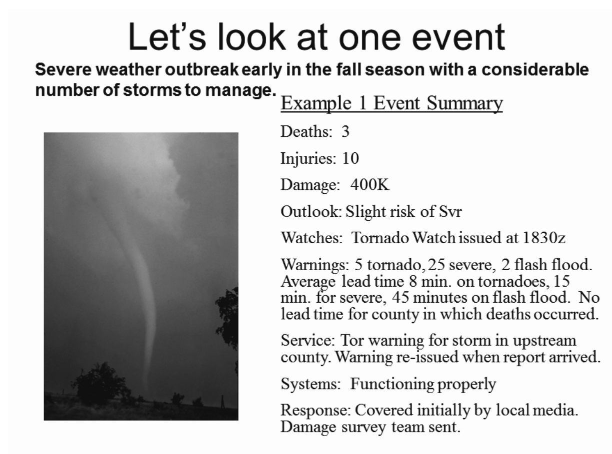
Student Notes:



47. Let’s look at one event

Instructor Notes: For comparison’s sake, here’s an event which had a negative outcome. This is how it might look in a write-up which captures the facts of the event. In this case, there was no tornado warning for a county in which deaths occurred. We’ll do a RCA on that particular event.

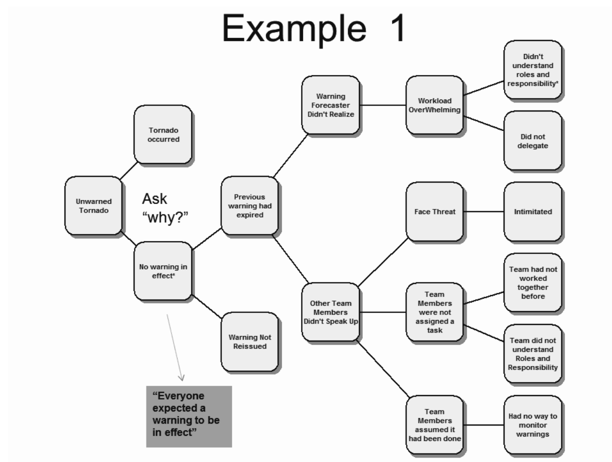
Student Notes:



48. Example 1

Instructor Notes: So we start with the “unwarned tornado”. The two things which had to occur together for this to be an issue are: Tornado occurred AND no warning in effect. Change either of those and your outcome is different. As some information on the side, we see that there was an expectation by the team in this event that a warning was needed. Hmmm…so why didn't it happen? Of the two causes, "tornado occurred" and "No warning in effect", we will choose to focus on the "no warning in effect branch". If this was a science based focus, we might choose to go down the "tornado occurred" branch and see what clues the science holds (especially useful when there was no expectation of tornado possibility), no doubt leading to some research. With each factor…we ask "why?" in order to determine what comes next. You can see the various contributors to the question as to why no warning was in effect. Included here are inputs from all team members which ultimately point to several factors, some technological, and several involving communication and roles and responsibilities. It is easy to see how this warning fell through the cracks with this in place.

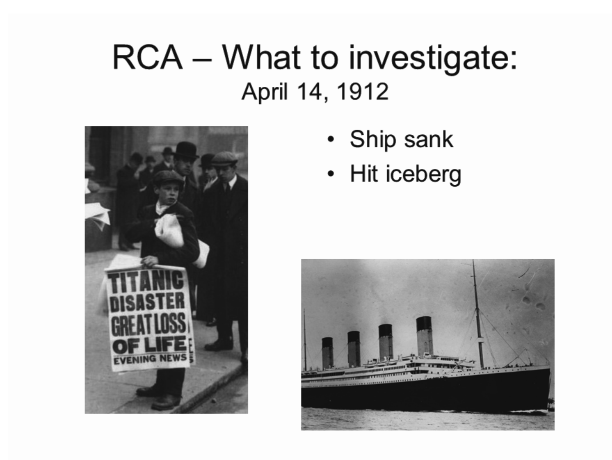
Student Notes:



49. RCA – What to investigate:April 14, 1912

Instructor Notes: Sometime you have to stop and see what exactly it is you want to investigate. Do you want to know why the ship sank?

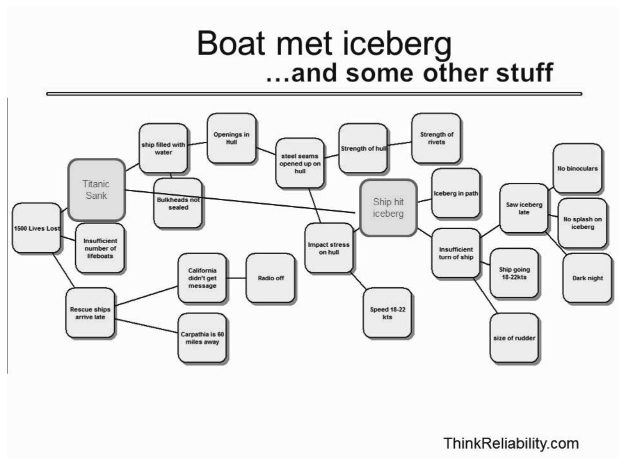
Student Notes:



50. Boat met iceberg

Instructor Notes: The answer to that is as simple or as complex as you like. Obviously, the more detail you can discover, the more opportunities you have to intervene. You may also want to, at least in this case, ask why people died. Certainly ships have sunk where no one died. That would open up your RCA to account for many other facets. Changing any factor you see listed in an RCA would change the outcome. The more detailed your RCA is, the more opportunities you have to see what interventions are the most doable.

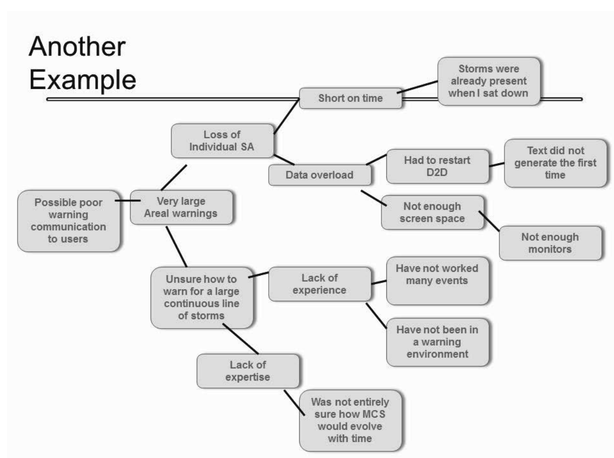
Student Notes:



51. Slide 51

Instructor Notes: Here's another example. Remember to ask "Why?" or state "This was caused by…" before going on to the next box.

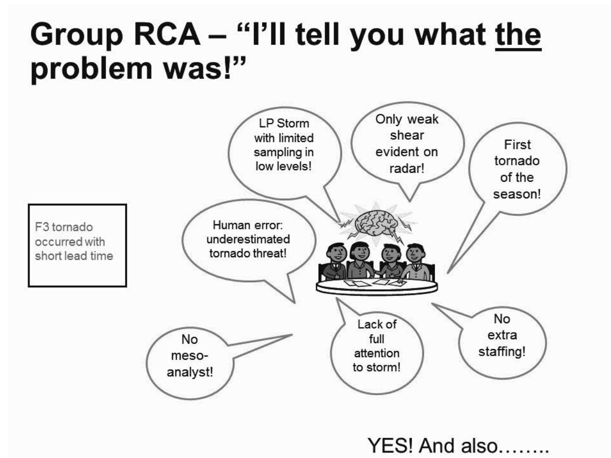
Student Notes:



52. Slide 52

Instructor Notes: Everyone will have a perception about what "the problem is". In most cases, their perception is right, just incomplete. Much like the earlier example of the description of the elephant. The purpose of the RCA is to validate these perceptions with evidence and then locate them in the proper chain of events.

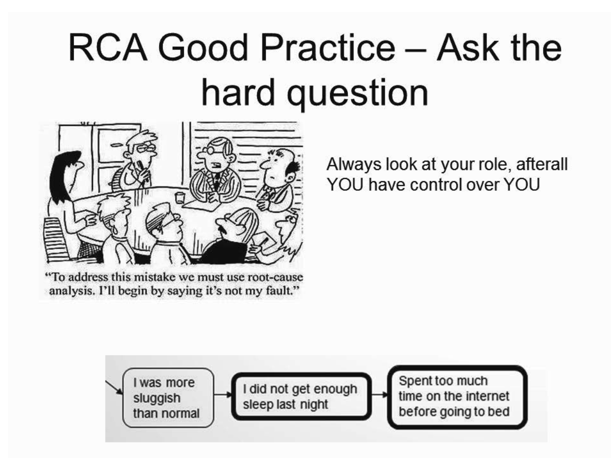
Student Notes:



53. RCA Good Practice – Ask the hard question

Instructor Notes: One of the most challenging yet beneficial practices in doing root cause analysis is to take a close look at our own actions. While it's tempting to limit your sights on what everyone else did wrong, it is far more revealing and more productive to look at what you could have done differently, afterall, you can change your behavior far more easily than you can change others. In this example, the RCA author tied a delay in product issuances to their own behavior the day before.

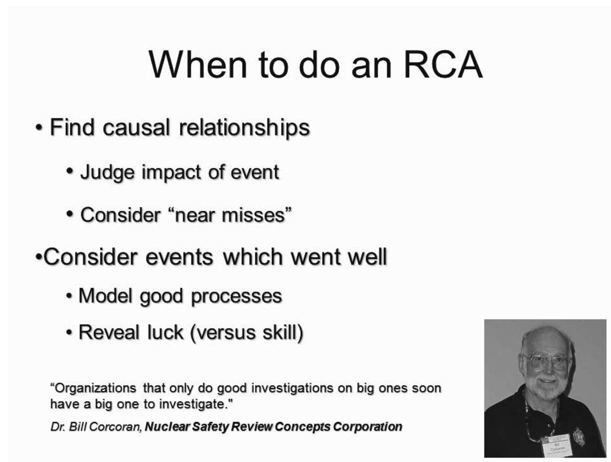
Student Notes:



54. When to do an RCA

Instructor Notes: When should you do a root cause analysis? More schools of thought on that, whether it be event driven, or a function of resources, etc. It will take some time. Maybe your office, or you personally, want to develop some guidelines. Generally, use it any time you want to find casual relationships. Not just the facts, but how everything fit together. Pick one warning outcome or decision. Look at events that went well, and also look at “near misses”. As Corcoran states, if all you look at is big events, you will soon have another big one to investigate.

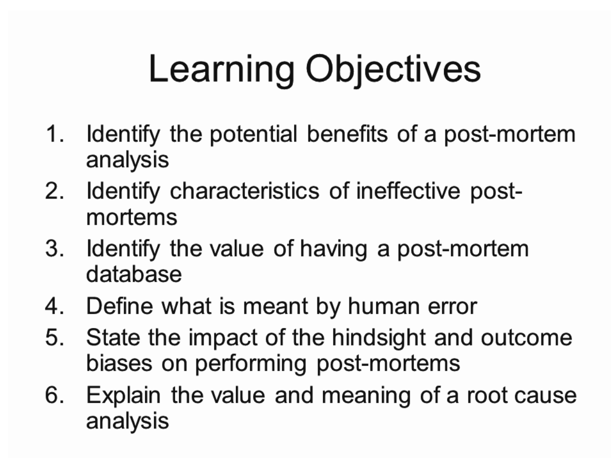
Student Notes:



55. Learning Objectives

Instructor Notes: We’ve restated the objectives here.

Student Notes:



56. Performance Objectives

Instructor Notes: The performance objectives will take the form of exercises which are outlined on the following slides.

Student Notes:

Performance Objectives

1. Using the examples provided, do a simple Root Cause Analysis on the events described.
2. Using root cause structure, perform an analysis on one particular warning or forecast decision you made or were involved in.

57. 6. AWOC CORE 3Assignment 1

Instructor Notes: Try your hand at this easy RCA. Fred is on midnight shifts. His last one is tonight. During the day, instead of sleeping, Fred went to a fishing tournament at a lake 150 miles away. Fred loves fishing. Because Fred never checks the oil in his car, car trouble on the way home delayed his arrival back to 11pm. Fred then laid down for "just a few minutes" setting his alarm for 11:30pm. A storm knocked out power and Fred's alarm clock didn't go off. He woke up when the his office called at 12:15am to see where he was. Hint: Start with "Fred is Late to Work" When finished, upload your file to the LMS to receive one possible solution to this.

Student Notes:

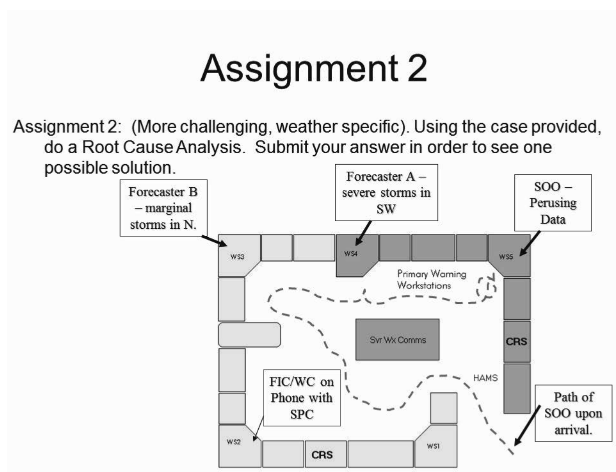
6. AWOC CORE 3
Assignment 1

Assignment 1: (Easy and Generic) Using the case provided, do a simple Root Cause Analysis. Submit your answer through the LMS in order to see one possible solution.

58. Assignment 2

Instructor Notes: Do a Root Cause Analysis on the following event: A low end to moderate severe weather event is in progress at WFO WOW. The Forecaster –in-Charge acting as the Warning Coordinator (WC) has sectorized warning operations to give Forecaster A several storms in the Southwest part of the CWA. Forecaster A is experienced but tends to work in isolation. The WC tells Forecaster B to monitor a small cluster of storms over the Northern part of the CWA. These are not severe but may produce some marginal hail and flash flooding. Forecaster B, who has just completed 88D training is relatively new to the office. The WC mentions that they might need some help if things continue to develop. He then calls SPC for a discussion regarding expectations. Meanwhile, the SOO drops by the office to check the weather before he heads out of town. He passes by the WC, makes eye contact, sees he's on the phone and walks on. The SOO then saunters by everyone else, noticing they have their hands full so he sits at an open workstation and peruses the data. He spends time interrogating the radar data including a newly developed storm over the Southeast part of the CWA (he doesn't realize it's newly developed). This new storm intensifies. The SOO comments out loud at how impressive it now looks. Forecaster A says "Uh-huh." Forecaster B thinks it looks severe and audibly concurs. Forecaster B is glad the SOO has come in to help but is wondering why the SOO isn't issuing a warning. Being new to severe weather and the office, Forecaster B assumes the SOO knows best. The SOO assumes there's a warning out but can't find evidence of it. Forecaster A is busy fighting with WarnGen. The WC gets off the phone in time to get a report of golfball hail associated with the new storm which has no warning on it. All four forecasters look at each other with dismay. Hint: Start with "Unwarned hail event" When finished, upload your file to the LMS to receive one possible solution to this.

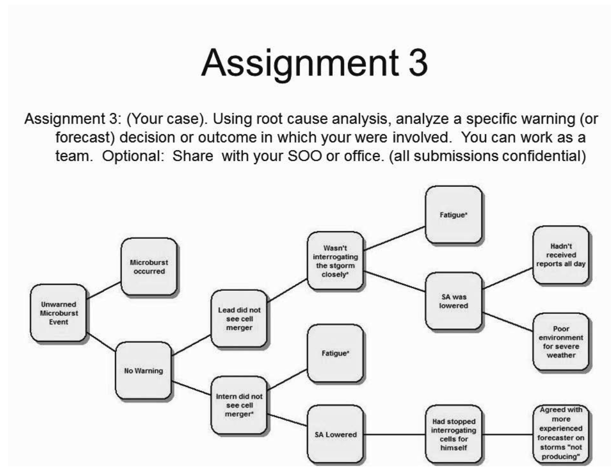
Student Notes:



59. Assignment 3

Instructor Notes: In this assignment, you are asked to do a RCA on some warning event or decision. Missed event, event you hit, good lead time, negative lead time, false alarm, scope not anticipated, etc.

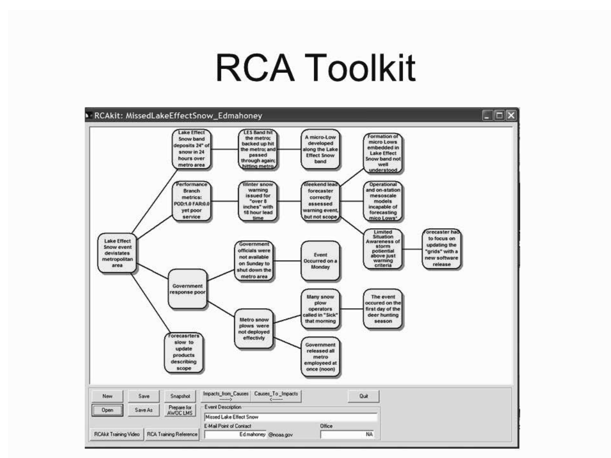
Student Notes:



60. RCA Toolkit

Instructor Notes: You'll be using an online RCA Toolkit in order to submit your RCAs. We'll have a special website for you to go to in order to enter the data on your RCA. We'll provide you the link and instruction on how to do this in your teletraining session.

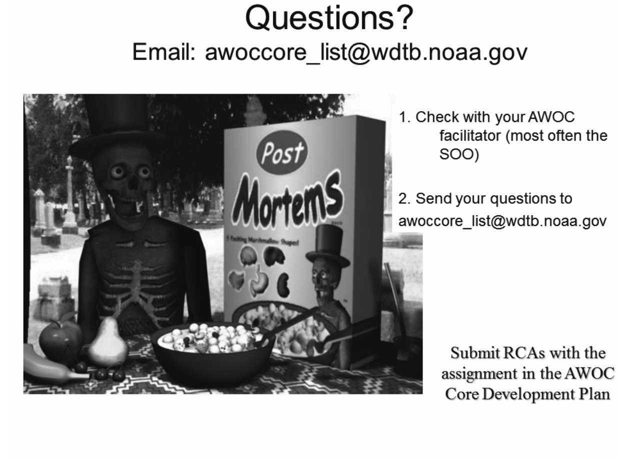
Student Notes:



61. Questions?Email: awoccore_list@wdtb.noaa.gov

Instructor Notes:

Student Notes:



62. Slide 62

Instructor Notes: Finally, when doing post-mortems it's important to keep in mind that most people are doing there best. No one intends to work an event that has a bad outcome. We are all part of the same agency (especially as far as the public sees) and what any office does reflects on me, whether it be a local office or an office at region or headquarters. We are all part of the same team and we can either support each other in that or not. This quote from Shappell and Wiegmann illustrates the belief in an aviation environment.

Student Notes:

63. References

Instructor Notes:

Student Notes:

References

Aviation Safety Reporting System, http://asrs.arc.nasa.gov/

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Gano, Dean L. (1999) *Apollo Root Cause Analysis*. Yakima Wa: Apollonian Publications

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Shappell, S., D. Wiegmann. (2000a). The Human factors Analysis and Classification System (HFACS). (Report Number DOT/FAA/AM-00/7). Washington DC: Federal Aviation Administration.

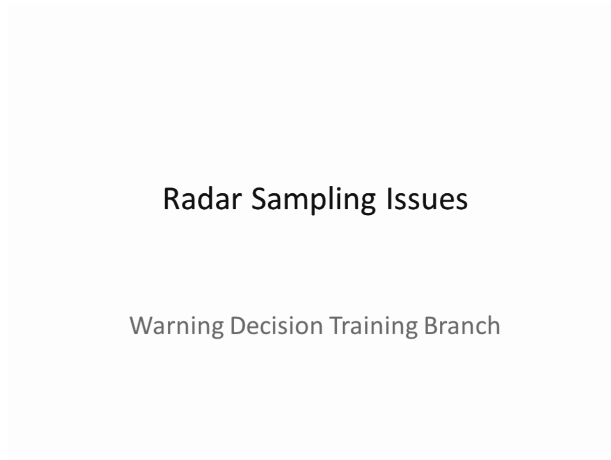
Shappell, S., D. Wiegmann. A Human Factors Approach to Accident Analysis and Prevention, Workshop, 45th Conference on Human Factors and Ergonomics Society, Minneapolis, 2001

Wood, David D., Johannesen, L., Cook, R., Sarter, N., *Behind Human Error: Cognitive Systems, Computers and Hindsight* (SOAR December 1994, from the Crew Systems Ergonomics Information Analysis Center). Wright-Patterson AFB, Columbus OH.

1. Radar Sampling Issues

Instructor Notes:

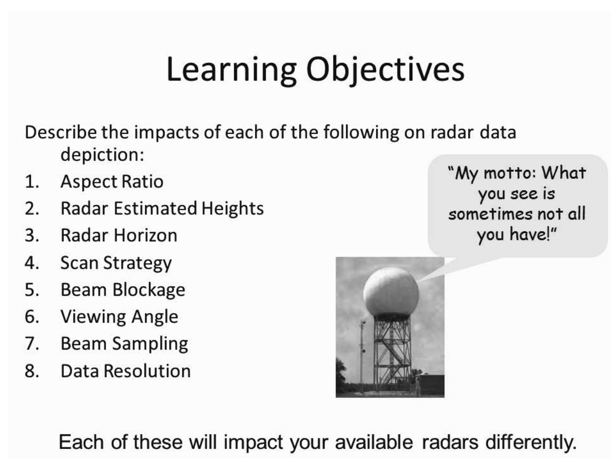
Student Notes:



2. Learning Objectives

Instructor Notes: It may be challenging to remain aware of the fact that radar is not a perfect sampling tool. The considerations listed here will impact (to varying degrees) the quality and quantity of the radar data depicted on your display. Unfortunately, most of these impacts are not always apparent by simply looking at the data. You (the user) must do the work of keeping these in mind and assessing as best you can when the data you are depicting are not telling the whole story, which in reality, is all the time!

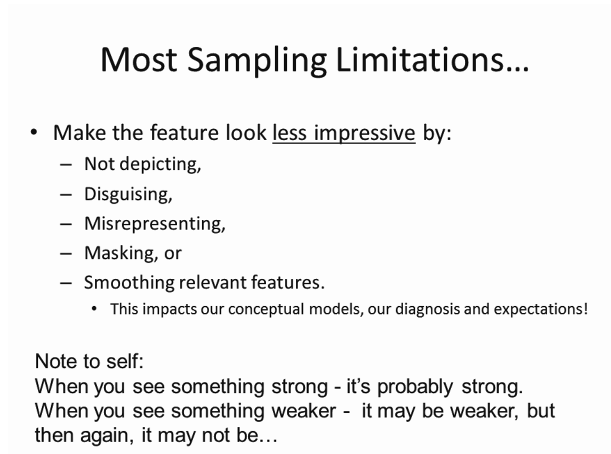
Student Notes:



3. Most Sampling Limitations…

Instructor Notes: With a few exceptions, most sampling limitations make storms features appear weaker or broader or located somewhere else. A prudent assumption would be that what is really there is at least as strong or stronger than what you see.

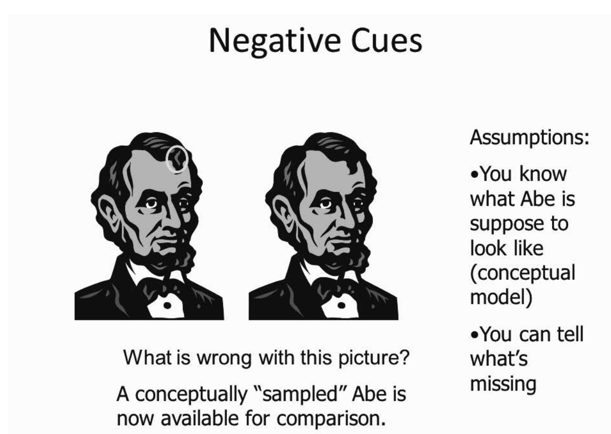
Student Notes:



4. Negative Cues

Instructor Notes: Sometimes recognizing sampling limitations can be like trying to imagine the difference between what you see and what you would see under the best conditions. In other words, you know what you should be seeing, and you recognize that for whatever reasons, you are not seeing it. In our example here, we look at a picture of Abe Lincoln. If we know what Abe should look like under the best conditions, we can hopefully recognize what's missing in this depiction. We have a mental picture (the newly arriving image on the left) of what he should look like so we noticed that the highlight (yellow circle) was missing. This recognition is hard enough to do with the conceptual and compromised images next to each other! Imagine trying to notice something that's missing when you only have the compromised image to see. This is what you are trying to do with radar data all the time: recognize what's missing. This absent data is an example of a "negative cue".

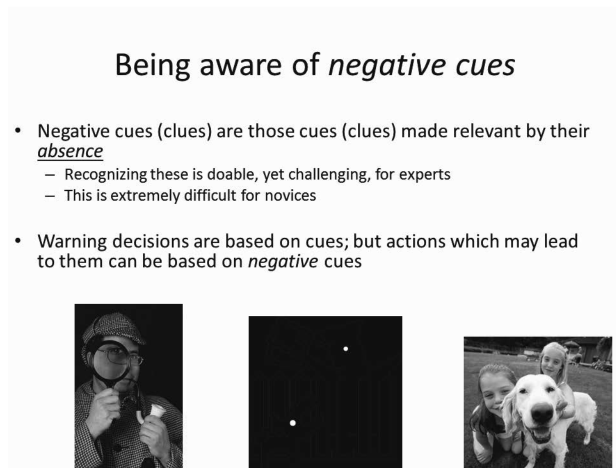
Student Notes:



5. Being aware of negative cues

Instructor Notes: A negative cue: Like when a bunch of adults are talking, with their kids playing in the next room. Someone then asks, “Why is it so quiet in there?!” The lack of noise coming from the next room is a significant ‘negative cue’ which causes you to investigate further. Sherlock Holmes solved a crime with a negative cue. The lack of a dog barking during the time of a neighborhood crime inferred to him that the criminal was known in the neighborhood. The missing sound of a dog barking was a negative cue.

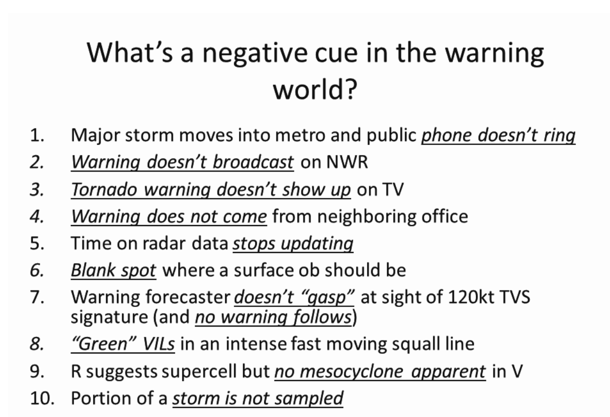
Student Notes:



6. What's a negative cue in the warning world?

Instructor Notes: Let's look at some negative cues in the warning world. When a storm moves into a major metro area (1), would you normally expect your public line to ring, and would you notice if it didn't? What would be some possible explanations? Items 2 and 3 fall in the "if a warning is issued and nobody knows about it is it still issued?" category. How would you notice? What might be the cause(s)? For 4, it might be that no warning was issued, or it went the road of #2 and 3. For 5, you might know about cases where warnings have been withheld because the "storm's just not intensifying", while other warnings have been re-issued for storms that appear nearly "stationary"….all because the data were not updating. It has happened. Do you always pay attention to the time on products? How about the "blank spot" (6) where a surface ob should be? Or that blank position on the ob where the precip type should be? For 7, it gets a little tricky when you try to make sure something doesn't make it through the cracks in your team effort at severe weather warnings. A rare and dramatic looking radar image would most surely cause someone (the warning forecaster?) to holler, "Wow look at this!" or some such, wouldn't it? What if that didn't happen, and the warning you might think would come, doesn't? Did they see it? Did they recognize it? Did they generate a warning and forget to send? Did the storm develop in a "dead area" between assigned sectors? The last three are directly related to imperfect depictions of radar data. In 8, low (green VILs) can be a result of sampling errors which happen when the storms move quickly during the time it takes for a volume scan. For 9, does "no mesocyclone apparent" mean one isn't there? Nope. At further ranges this could be especially a problem with aspect ratio. Further the mesocyclone can appear to shrink or even disappear at certain stages of tornadic development. For 10, impacts of beam width, range, and gaps in elevation angles can cause the business end of a storm to be totally overlooked by the radar. These negative cues require you to know what's "normal" and proactively check-in to see when normal is not happening, and then investigate why.

Student Notes:



7. Question 1 on cues

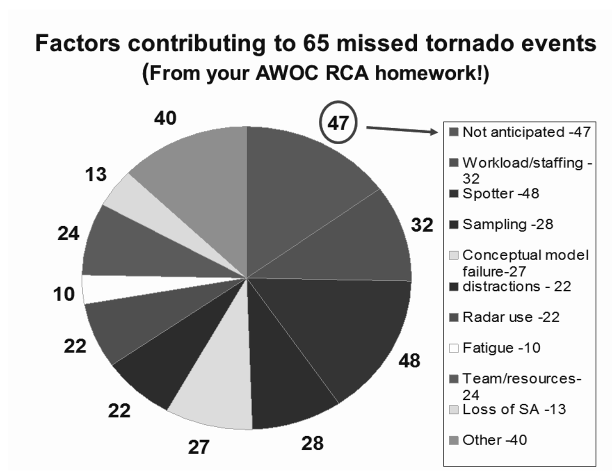
Instructor Notes:

Student Notes:

8. RCA Contributors

Instructor Notes: Here are some factors which contributed to 65 missed tornado events. This comes from Root Cause Analysis studies done for AWOC (See Core 3, Lesson 3). For example, in 47 of the 65 events, a contributing factor was that the event was "not anticipated." Let's look at the impact of Sampling and Radar use on the next slide.

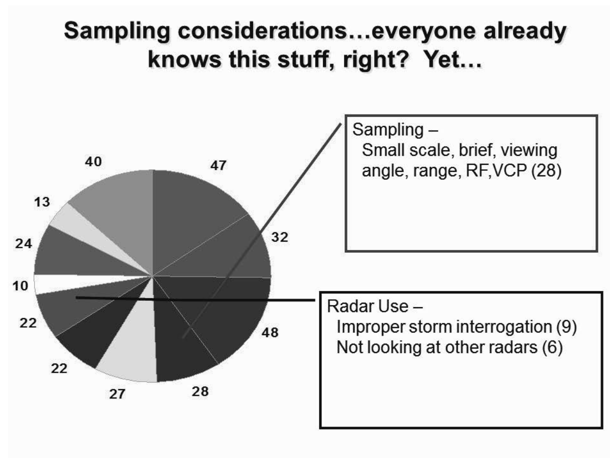
Student Notes:



9. RCA Sampling

Instructor Notes: In 28 of the 65 missed events, sampling limitations such as aspect ratio, viewing angle, range etc. contributed to the forecasters inability to recognize the threat. In 22 of the events, improper use of the radar, which could be failure to look at the relevant products or elevation angles (altitudes) contributed. It might also have been failure to look at other radar views of the storm in question. In these cases, the storm probably looked less threatening to the decision maker than it really was.

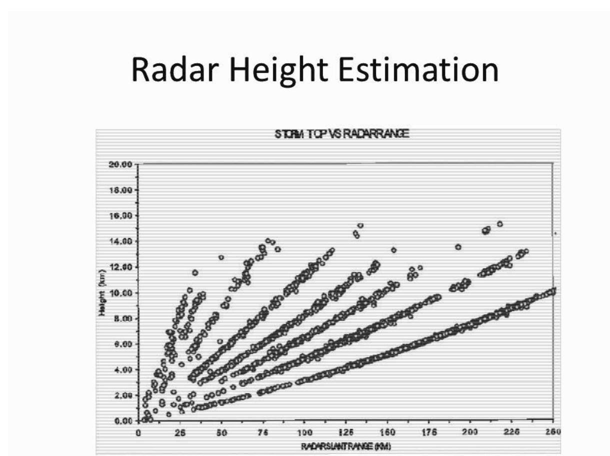
Student Notes:



10. Radar Height Estimation

Instructor Notes: When radars sample the atmosphere, they do so with fixed elevation cuts. These plots represent storm tops which the radar has measured over a period of time. Why do they line up in relatively straight lines? Is that how nature made them? Hardly. You might recall that the only height we have is that of the beam centerline of each elevation cut. Therefore, anything sampled in that beam will be assumed to be close to the height of the beam centerline, which is really what is being depicted here.

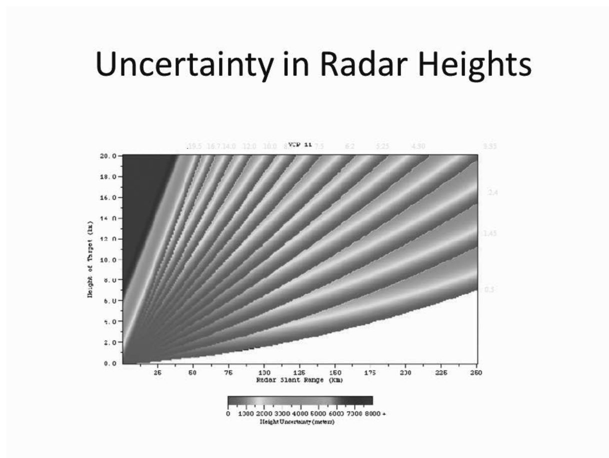
Student Notes:



11. Uncertainty in Radar Heights

Instructor Notes: The uncertainty associated with storm-top height measurement is illustrated here. This shows the uncertainty (in meters) between the WSR-88D determined heights of a target and the actual heights for VCP 11. If the storm top is centered precisely on the beam center line (base of the red shaded region for each elevation angle) then the uncertainty is minimized (or is 0). This same uncertainty is also applicable to all other radar-based height measurements (e.g., height of the maximum reflectivity, echo top, echo base, etc.). For example at the 100-km (54 nm) range from the radar, the uncertainty between the radar-observed storm top and the actual storm top height can be greater than 9kft for tall storms (those above 33kft).

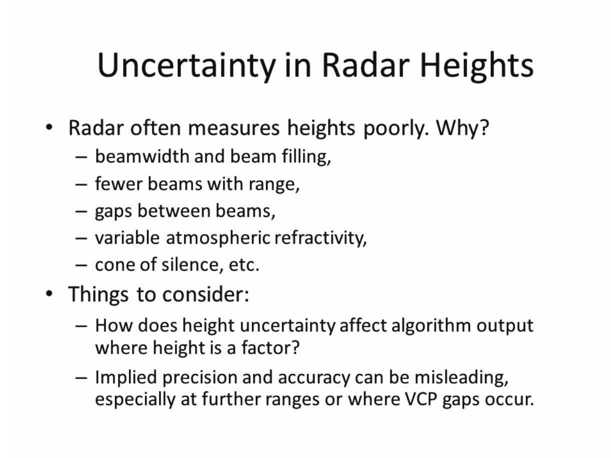
Student Notes:



12. Uncertainty in Radar Heights

Instructor Notes: With all this uncertainty it can be seen that radar is not a precise tool when it comes to measuring heights. Impacts of beamwidth, beam filling, limited samples with range, gaps, atmospheric refractivity, and the cone of silence can depict heights in a poor fashion. When algorithm output (or your use of that output), assumes more precision than exists, problems can occur. This can happen with base data, EET, VIL, VIL Density, estimated height of any reflectivity value, HI, M, TVS, VAD, VWP, etc. When using radar and all its products, the user must keep this limitation in mind and not place an inordinate amount of value on any one piece of data.

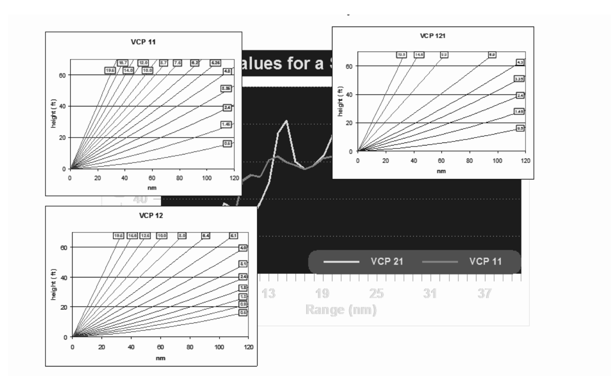
Student Notes:



13. Scan strategy determines which parts of the storm will be sampled…or not

Instructor Notes: Storms will look different purely because of the scan strategy employed. Derived products such as VIL, CZ, ET, and others will all be impacted by the use of different scan strategies. Base data interpretation is also impacted. In general, the more elevation cuts available, the less impact scan strategy will have on the output, and the more meaningful will be the information obtained.

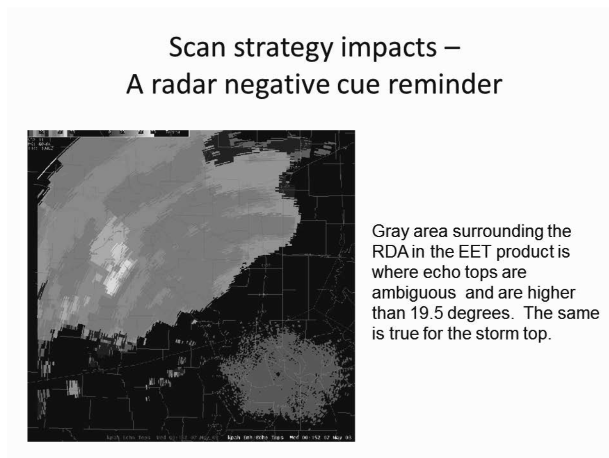
Student Notes:



14. Scan strategy impacts – A radar negative cue reminder

Instructor Notes: Rather than have to remember that data around the radar (and at storm top in this case) is compromised, the product provides that reminder. This "graying" out of data provides an indication that the echo top is ambiguous. It is a reminder that the Echo Tops you would have seen plotted in these areas would not have been trustworthy due to the effects of the cone of silence (a limitation of using scan strategies). In other words, the actual top (greater than 18.3 dBZ) exceeds 19.5 degrees antenna elevation. This is analogous to the areas of uncertain velocities being labeled as "range folded", thereby eliminating the possibility of misinterpretation.

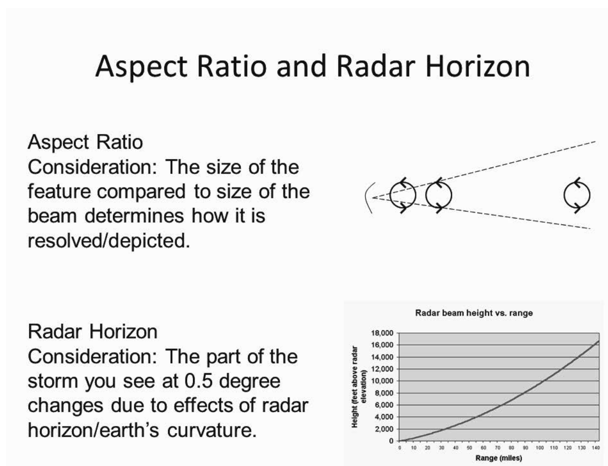
Student Notes:



15. Aspect Ratio and Radar Horizon

Instructor Notes: With aspect ratio, you must know the approximate dimensions of your feature in order to determine the extent of the sampling impacts. Large storm? Mini supercell? In general, the closer and bigger a storm is, the better it is represented on radar. Smaller features are more significantly impacted when they are further away from the radar. In some cases, a feature of interest may be contained entirely in one beam width. With velocity, this will often cause the feature to appear be eliminated altogether. (Note: Rotational velocities of storms at further ranges may be lower than you would expect to be associated with significant rotation). The impacts of radar horizon are too dependent on the type of feature being sampled, You may entirely overshoot what would have been significant cues to threat assessment in some storms, especially lower topped convection. In addition, storms will appear to change with range simply due to the effects of radar horizon. Recall that at close ranges, storms can be sampled at 1kft or less at 0.5 degrees. At far ranges (>100nm) the 0.5 degree cut is sampling between 9kft and 21kft.. Thus a storm moving outward along the 0.5 degree slice will appear to change simply due to the changes in the part of the storm being sampled as well as beamwidth. Again the impact of both of these sampling limitations most often will be that storms appear weaker than they really are.

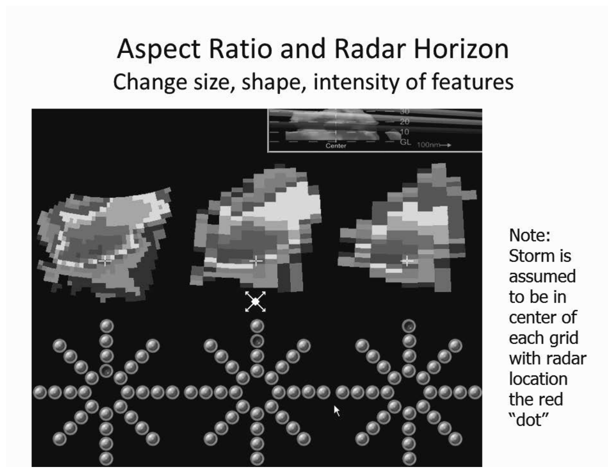
Student Notes:



16. Aspect Ratio and Radar Horizon Change size, shape, intensity of features

Instructor Notes: Three views of the same storm, each changing only by range. The storm is assumed to be at the center of the grid of potential radar positions. Thus, we have a view of the storm from a radar 25 miles to the north (left) and the same storm as view from a radar 75 miles to the north (center). The image on the right is the view from a radar 100 miles north of the storm. The storm's change in appearance is due to both aspect ratio and radar horizon effects. Thus, from left to right, the pixels get bigger (beam is larger) and the height being sampled is higher.

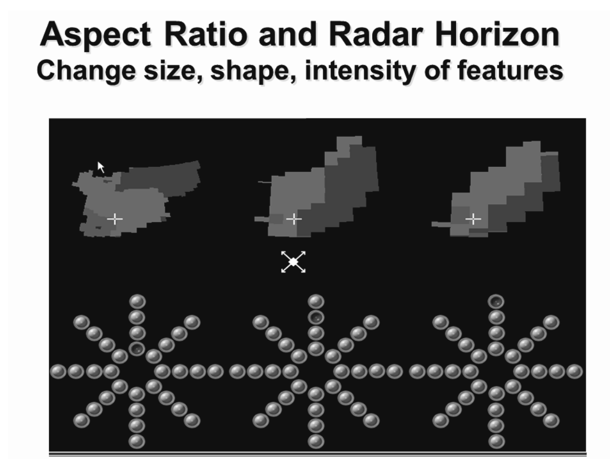
Student Notes:



17. Aspect Ratio/Horizon Velocity

Instructor Notes: Same thing only with velocities. Our beam is getting bigger in the images from left to right and we are sampling different altitudes.

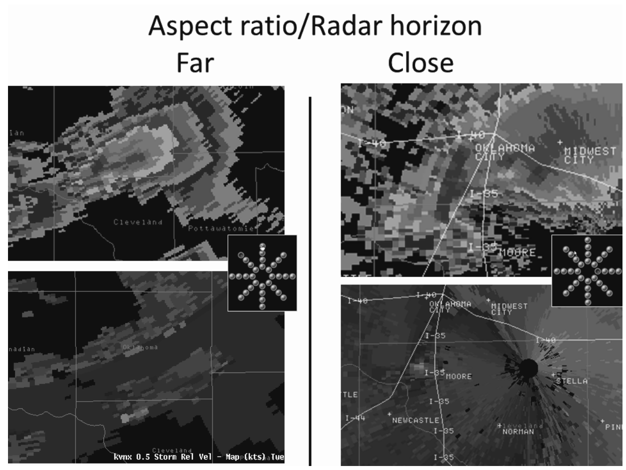
Student Notes:



18. Aspect ratio/Radar horizon Far Close

Instructor Notes: View on the left of both Reflectivity and Storm Relative Velocity is 0.5 degrees, but at 12Kft. View on the right is at 0.5 degrees but at around 1Kft (keeping in mind the height uncertainty). Are you always looking at multiple views from various radars to account for these sampling impacts?

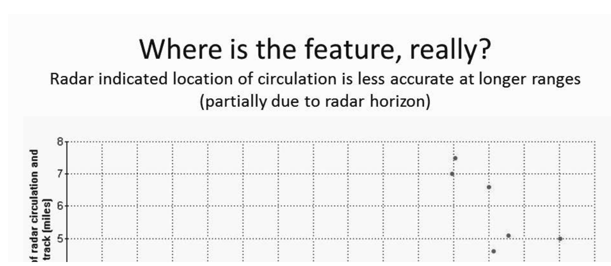
Student Notes:



19. Where is the feature, really? Radar indicated location of circulation is less accurate at longer ranges (partially due to radar horizon)

Instructor Notes: In this image, the difference between the radar indicated circulation center and the damage path is plotted with range. The distance between the indicated feature and the actual feature increases the farther away you are from the radar (i.e. the higher you get above the ground). Many times this will be the case when the circulation tilts with height. This is helpful information when deciding where the actual threat is in a warning, and also in deciding where to go to conduct damage surveys (will likely not be exactly where the center is indicated at further ranges). When wording a warning even though detail is desirable, caution must be exercised in just how much detail should be used in stating specific locations and cities affected.

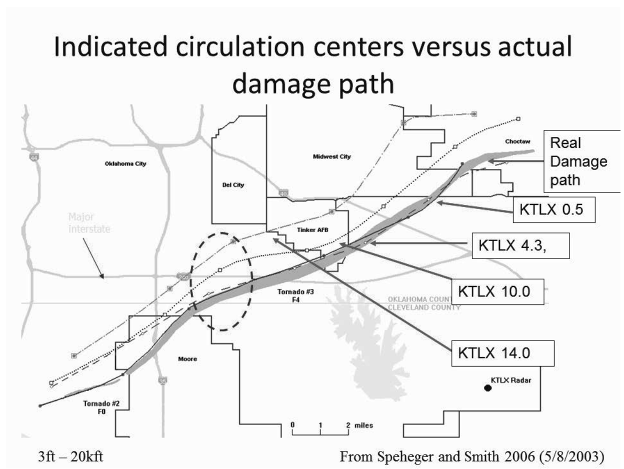
Student Notes:



20. Indicated circulation centers versus actual damage path

Instructor Notes: The location of the circulation center varies at different altitudes (i.e. different elevation slices). This variability would also be what you see if you are looking from different radars, each perhaps sampling the storm at 0.5 degree but at different ranges and therefore different heights. Storm tilt with height is also a major factor. This has an impact when using street level background maps when your depiction is at different altitudes. For example, in the area enclosed by the red dashed line, the tornado is either a couple miles south or a couple miles north of the interstate, depending on the depiction you have in front of you (i.e. which altitude you have sampled). Think about a severe weather statement you are writing at this stage and the tornado location you would use.

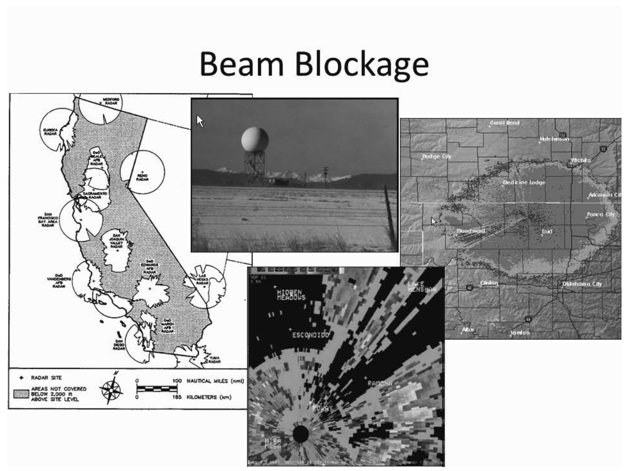
Student Notes:



21. Beam Blockage

Instructor Notes: Pretty obvious that you are susceptible to beam blockage when you see mountains out the window. Still, to what degree the blockage affects your data may be challenging to discern. Other blockage can be caused by nearby buildings, or towers, wind generator farms, or as in the case here (example on the far right), a stand of trees on a ridgeline.

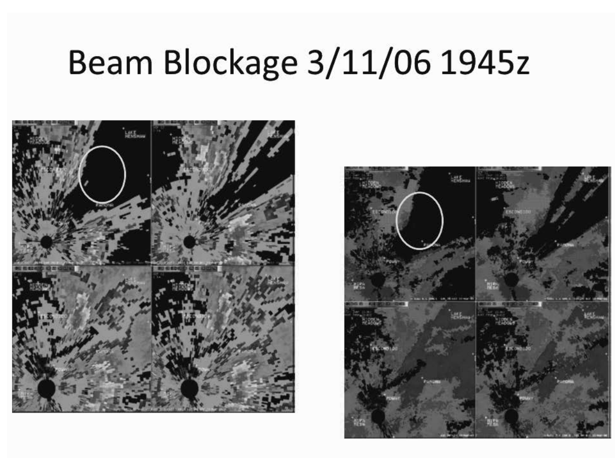
Student Notes:



22. Beam Blockage 3/11/06 1945z

Instructor Notes: Where is the data suspect due to beam blockage in these images? The circles indicate the general area when the beam blockage will have the biggest impact. That blockage will be more significant on the lowest elevation cuts, but will have at least partial impact in the higher cuts. As the storm just northeast of the RDA moves east, it will move into this area. Much of the data will become compromised, especially at the lower 2 cuts. It can be hard to remember these impact are about to insert themselves, and knowing to what degree is an even bigger challenge, especially when not all data is blocked. A tornado is about to occur with this storm.

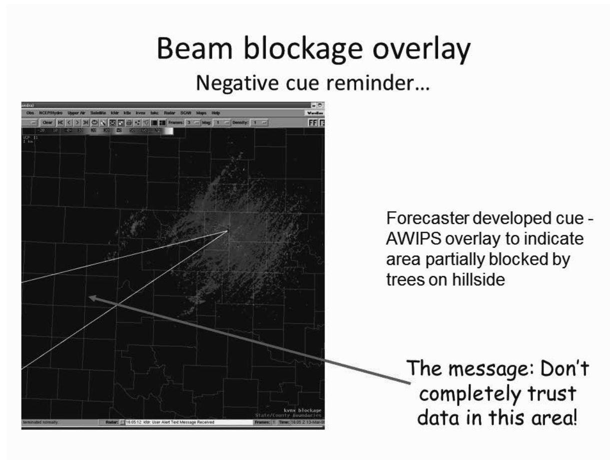
Student Notes:



23. Beam blockage overlay Negative cue reminder…

Instructor Notes: The cue serves to say “don’t trust data in this area”. Close in you have the break in the clear air return to indicate where beam blockage is an issue. Would you be as aware if the radar was sampling data considerably further out?

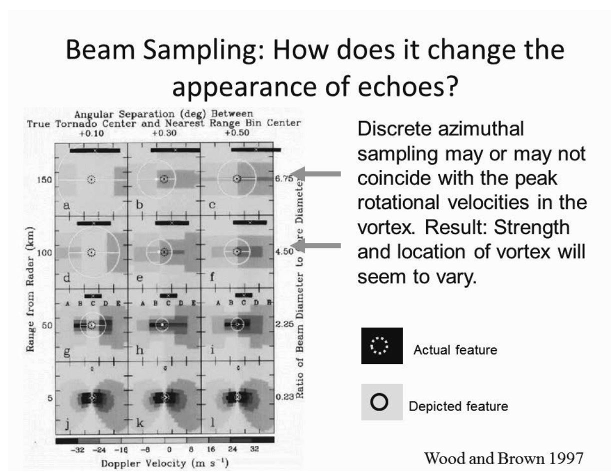
Student Notes:



24. Beam Sampling: How does it change the appearance of echoes?

Instructor Notes: While you can sometimes imply the impacts of some sampling limitations, with beam sampling, it is almost impossible to do so. This is especially true with changes that occur from volume scan to volume scan and slice to slice at constant range. Many a circulation has appeared to weaken via this process causing misinterpretation by the forecaster. In this depiction, each row is at the same range, but the circulation appears differently based on changes in azimuthal sampling, i.e. the location of the beam relative to the actual circulation center. Beam placement is random. At further ranges (top most rows in the graphic) this change is more dramatic because there are fewer (and larger) beams sampling the feature. Look at the row at 100km from the radar. The couplet depicted in this row appears to vary from a weak circulation (left) to a decent mesocyclone (right). Remember the feature is not changing…only the sampling of the feature from volume scan to volume scan (and even elevation slice to slice). Being aware of this sampling impact should cue you to not rely too heavily on computed rotational velocities or shear values, especially if they appear to weaken drastically.

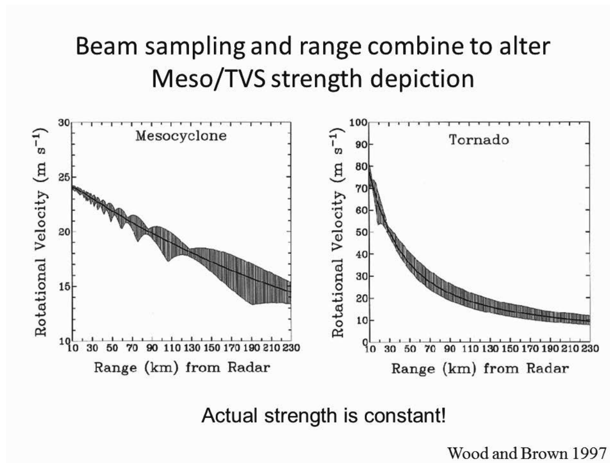
Student Notes:



25. Beam sampling and range combine to alter Meso/ TVS strength depiction

Instructor Notes: This graphic shows how rotational velocities can appear to change (mostly weaken) as the distance to the feature increases. The feature is not changing, just the appearance on radar. All strength changes inside the envelope are due to random changes in sampling.

Student Notes:



26. Question 2 sampling

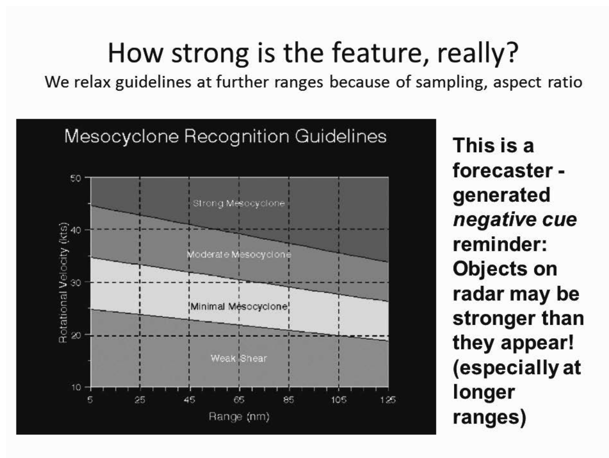
Instructor Notes:

Student Notes:

27. How strong is the feature, really? We relax guidelines at further ranges because of sampling, aspect ratio

Instructor Notes: Here is another tool that the user devised to help remind decision makers of the uncertainty of radar data at farther ranges. But even this tool needs changing as actual circulation size changes (e.g. for mini-supercells).

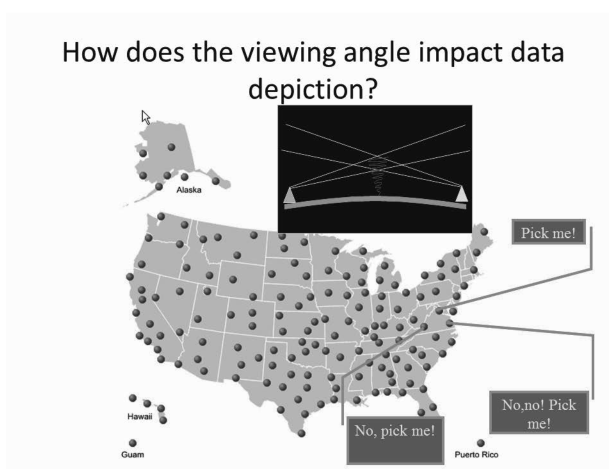
Student Notes:



28. How does the viewing angle impact data depiction?

Instructor Notes: Choosing which radar will give you the best picture can be a challenge. This is especially true when the differences are caused by the radar viewing angle. Normally the radar nearest the feature in question is the best, but not always! Viewing angle impacts may change that radar selection.

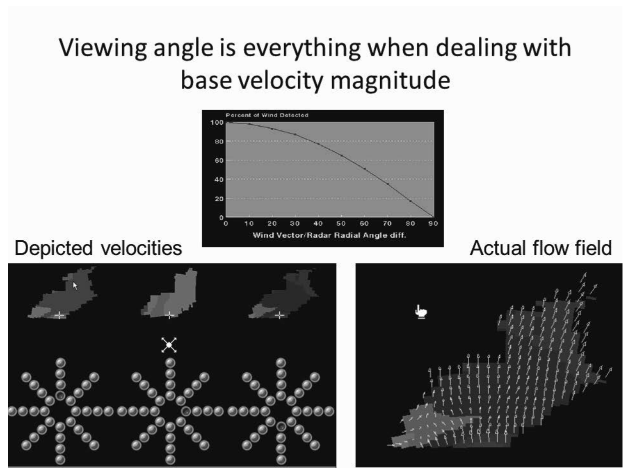
Student Notes:



29. Viewing angle is everything when dealing with base velocity magnitude

Instructor Notes: Recall that if the wind is blowing down the radial, you measure all of it. If it's blowing perpendicular to the radial, you measure none of it. Usually it's somewhere in between. The bottom left image shows the same radial velocity data when viewed from 3 radars, one north of the echo, one east of the echo, and one south of the echo (the echo is assumed to be in the middle of the "grid" of radars). The image on the right shows the actual flow field superimposed on the last depiction.

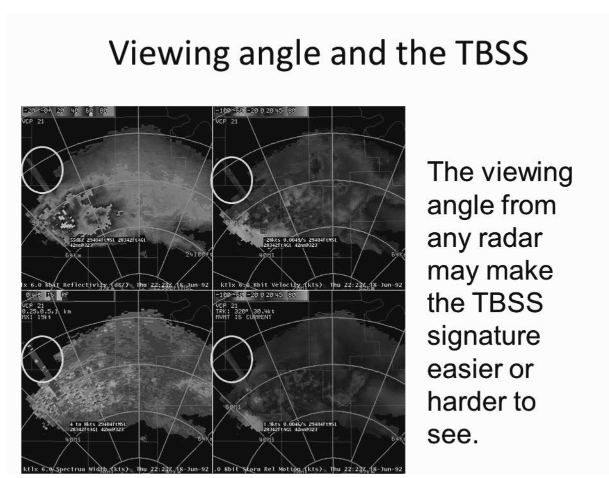
Student Notes:



30. Viewing angle and the TBSS

Instructor Notes: TBSS, caused by the presence of large hail, shows up as weak echo down radial from the high reflectivity core. Weak or negative velocities show up on the base velocity along with very high spectrum widths. Since there is little additional echo on the downrange side of the storm in this example, the TBSS shows up very well with this viewing angle.

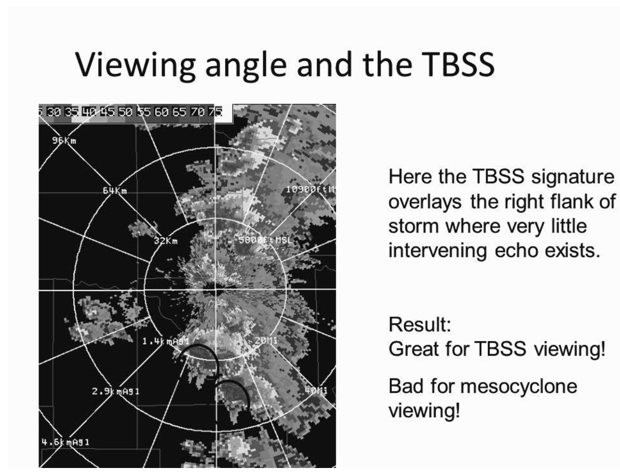
Student Notes:



31. Viewing angle and the TBSS

Instructor Notes: We can still see this TBSS in this example, although not as well as in the last. However, in this case, the weak or slightly negative velocities associated with the TBSS are overlaid on the part of the storm where we would expect mesocyclone signatures. The resulting display will be a mixture of velocities from the two signatures. This will change the appearance of the mesocyclone, and perhaps what you conclude about it. This can even disrupt the velocity field as detected by the radar to the extent that both the forecaster and the algorithm fail to identify the circulation.

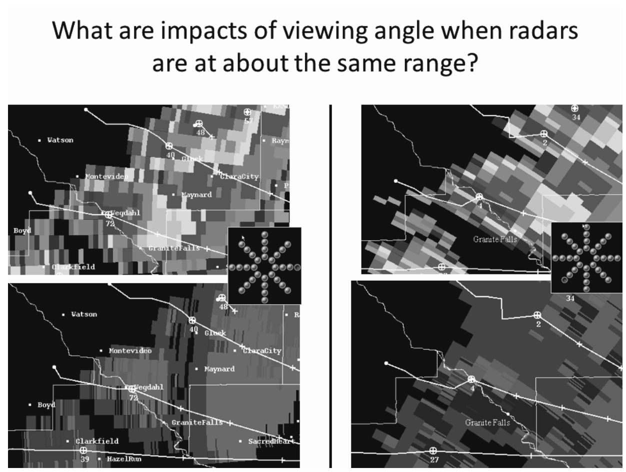
Student Notes:



32. What are impacts of viewing angle when radars are at about the same range?

Instructor Notes: You'd think that radars at the approximate same range would show the same thing, right? Often however this is not the case. The storm here is viewed from a radar 100 miles to the east (left image) and a radar 100 miles to the southwest (right). Differences in the two are caused by several things including the presence and location of RF data (a function of PRF selection, range, and intervening echo). Keep in mind that the circulation is likely not axisymmetric which may be contributing as well. While this illustration concerns mesocyclone recognition, the same impact is present when viewing microbursts or downbursts near the radar.

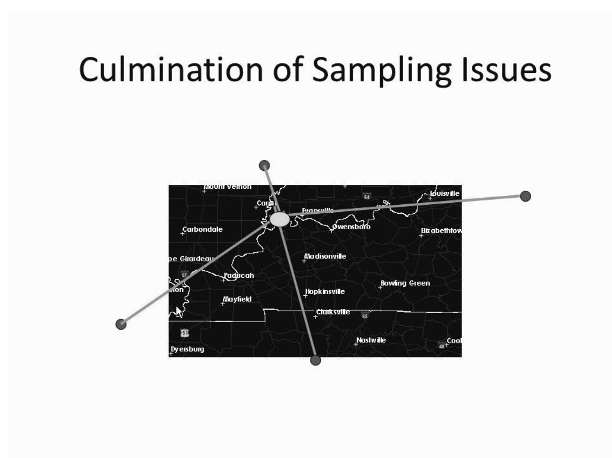
Student Notes:



33. Culmination of Sampling Issues

Instructor Notes: Let's look at one storm as viewed from 4 different radars.

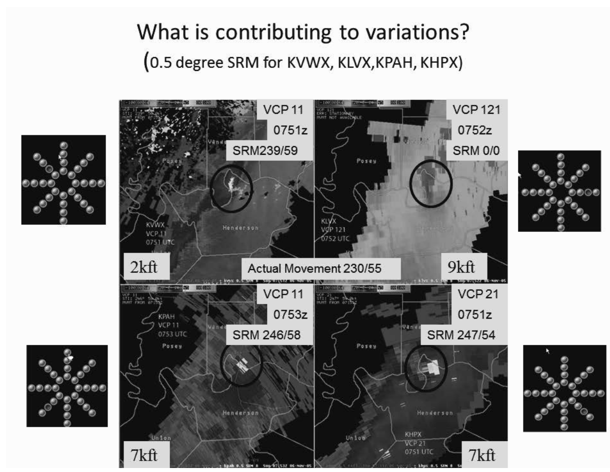
Student Notes:



34. What is contributing to variations?(0.5 degree SRM for KVWX, KLVX,KPAH, KHPX)

Instructor Notes: Each of the velocity images is from a different radar. For reference, the image is assumed to be in the middle of each of the grid of “potential radars”, with each of the grid points representing radar sites at 25, 50 , 75 and 100 nm from the storm. So in the upper left image, the radar viewing the storm is to the northwest about 50 miles looking at the storm to its southeast. You can see that the storm is sampled at about 2Kft. Here are the locations, and sampling altitudes, of the other 3 views. Take a moment and look at these images and ponder if you will why they look different from each other. Some hints as to possible contributors to these differences will be appearing on this image. When you think you know all the impacts, go to the next slide.

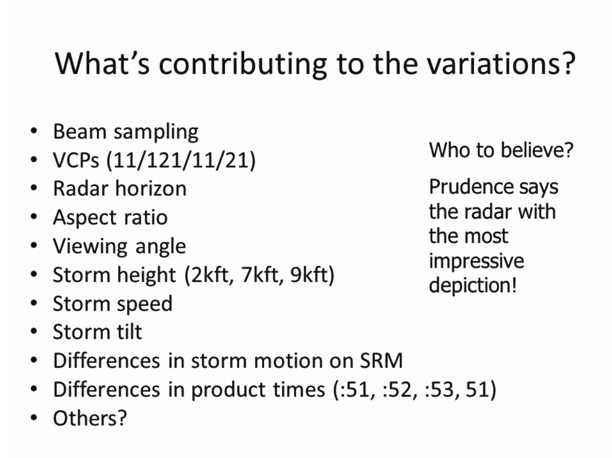
Student Notes:



35. What's contributing to the variations?

Instructor Notes: Here are at least some of the contributors to the variations in the images you see. Each of these impacts will vary with each radar. How do you know which perspective to believe? The variations or limitations listed here will not create, in almost every case, a stronger or more pronounced feature than is actually the case. Therefore, prudence would dictate that you use of the most impressive depiction. In order to do that, you had to make sure you saw all of these views!

Student Notes:



36. Question 3 protocol

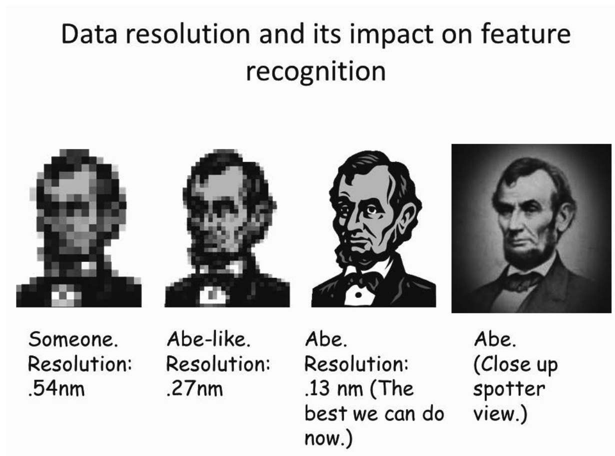
Instructor Notes:

Student Notes:

37. Data resolution and its impact on feature recognition

Instructor Notes: Our ability to resolve features, especially small features, is also a function of the data resolution. With help once again from Abe, we are able to depict how improved data resolution helps us get closer and closer to the real thing. Obviously, we can't resolve the actual feature at this point in time, but we can get close enough to help identify the signature. The next few slides will discuss the changes you can expect to see simply based on the changes in data resolution. Keep in mind that these changes will be further impacted by the sampling limitations already mentioned.

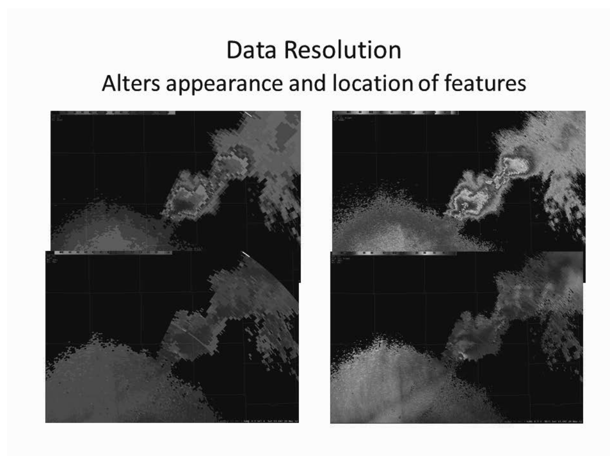
Student Notes:



38. Data Resolution Alters appearance and location of features

Instructor Notes: Base products generally come in different forms. This was done originally to make products smaller for easier transmission through narrow band communications. When using those "legacy" products we find that the data resolution changes and this can alter the appearance or even details in feature shape. Note in the upper left hand corner a legacy reflectivity product called a "4 bit" product. This means that the product is displayed in 16 color data levels. The data is also in the original resolution of 1 degree by 1 km. This data is smoothed and with less detail than in the Super Resolution product seen in the upper right. These two products were made precisely with the same radar, same time, and same elevation angle. But with the magic of signal processing (See DLOC Topic 3) the radar detection is now the equivalent of a higher resolution radar having 256 color data levels and at ½ degree and 250 meter samples. Note there are slight differences in shape and echo coverage and especially in echo intensity. We can actually see that there are values above 60 dBZ when with lower resolution reflectivity strength is in the upper 50s dBZ. Likewise in the lower two images we see the legacy product on the left and the super resolution product on the right. The mesocyclone intensity is greater and size appears somewhat larger. Remember that for now, super resolution R, V, (SRM) and SW products are only available in Batch Cuts.

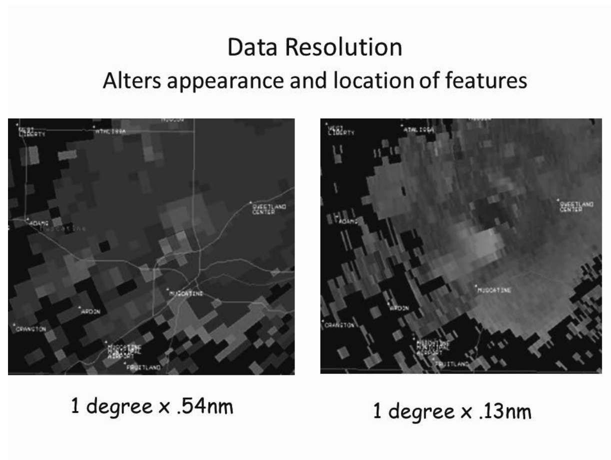
Student Notes:



39. Data Resolution Alters appearance and location of features

Instructor Notes: Higher resolution data accounts for other differences in data depiction. In this case we have the low res versus hi res WSR-88D data. Where you place the center of the circulation is a function of data resolution. In virtually every case the higher resolution product is most desirable.

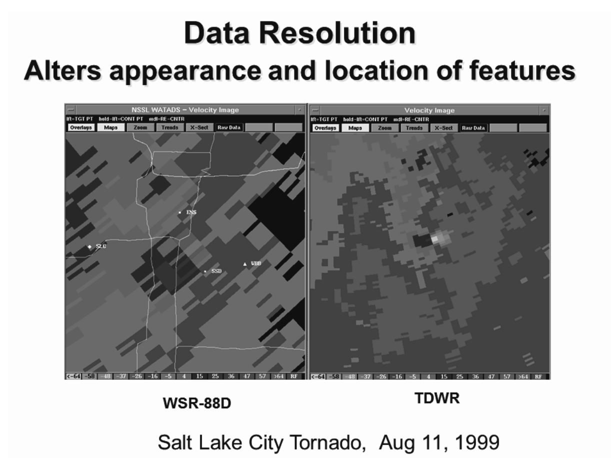
Student Notes:



40. Data Resolution with TDWR

Instructor Notes: In this example, the Salt Lake City WSR-88D is at a greater distance to metropolitan Salt Lake City than the TDWR. The WSR-88D also is located at a higher altitude. Therefore the WSR-88D 0.5 degree beam is higher above the city than the TDWR 0.5 degree elevation beam. This plus the difference in data resolution accounts for a different depiction.

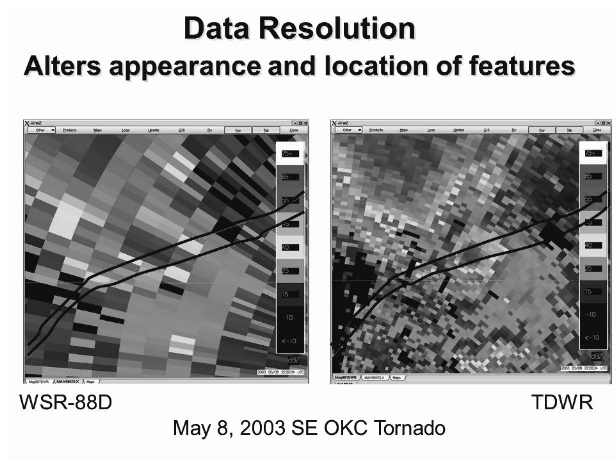
Student Notes:



41. Data resolution and debris ball

Instructor Notes: WSR-88D and TDWR images from May 8, 2003 tornado. The highly reflective “debris ball” is noticeable on both images, but the better resolution of the TDWR allows for much greater detail. Question: Are there challenges with seeing all this detail? In the TDWR depiction, the debris ball is located within the damage path (white lines), where as in the WSR-88D depiction, the debris ball is along and to the north of the path.

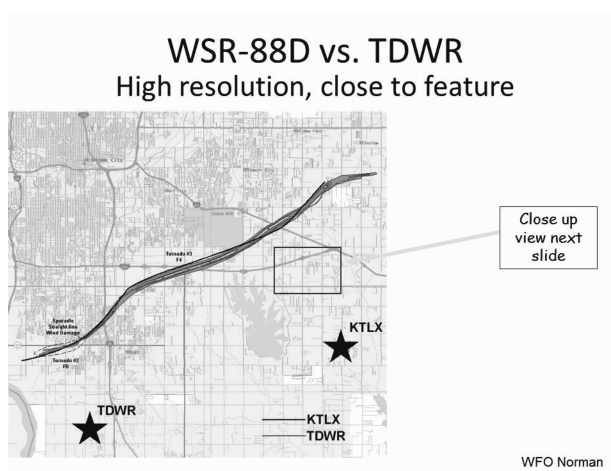
Student Notes:



42. WSR-88D vs. TDWR High resolution, close to feature

Instructor Notes: In this case, both radars are close to the tornado, especially where it is at its strongest. We’ll take a look at the differences we see here from radars at about the same distance, but using different resolutions.

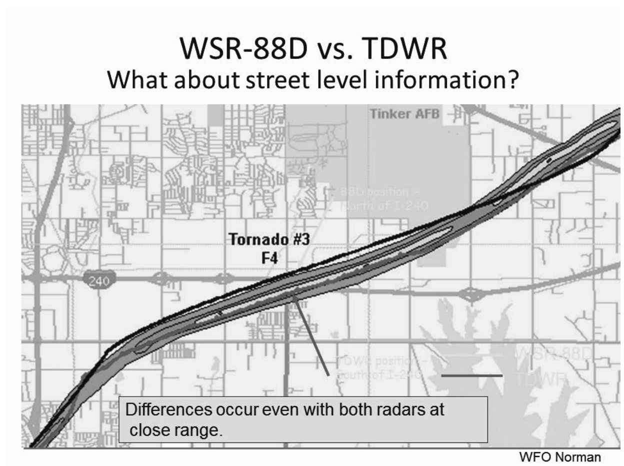
Student Notes:



43. WSR-88D vs. TDWR What about street level information?

Instructor Notes: This image is similar to the one we showed in slide 20. But in this image, instead of having positions that vary because of a depiction of different altitudes by the same radar, these differing positions are due to two different radar views. In this image, the light green is F0 and F1 damage, the light blue is F2 damage, and the yellow is F3 damage. The black line is the circulation center as indicated by the WSR-88D. The red line is the circulation center of the TDWR. Even at these close ranges, there are differences in the TDWR depiction of the circulation center and the WSR-88D depiction. The differences are likely due to variations in radar resolution and slight differences in altitudes sampled, even with both at close range. At one point in time, the 88D has the circulation center north of I-240, while the TDWR has it south of I-240 (the same problem we saw on slide 20 where we were sampling the circulation at different altitudes. This leads to the same dilema: With such variability in the high resolution data close in, how can or should you incorporate street-level information in your statements and warnings?

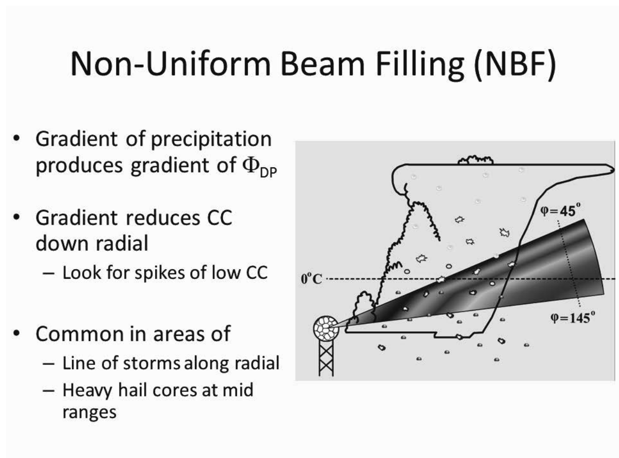
Student Notes:



44. Non-Uniform Beam Filling (NBF)

Instructor Notes: Non-uniform beam filling is common and a fact of radar meteorology. It is always present to some degree. However, with dual pol it is more easily detected and affects more of the variables. NBF affects CC because it is a phase-related phenomenon and low values of CC affect the other dual-pol variables. ZDR and KDP are indirectly affected by significant NBF and these affects propagate down radial such that all dual pol variables along those radials are compromised to some degree. Thus, be careful when using these affected radials.

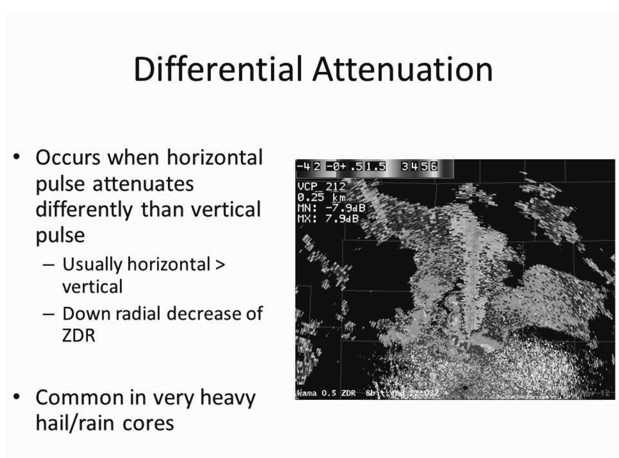
Student Notes:



45. Differential Attenuation

Instructor Notes: Differential attenuation only affects ZDR because it is a power related phenomenon. The affect is to bias ZDR toward zero and can be seen more broadly in this image north of the radar as well as more narrowly northwest of the radar.

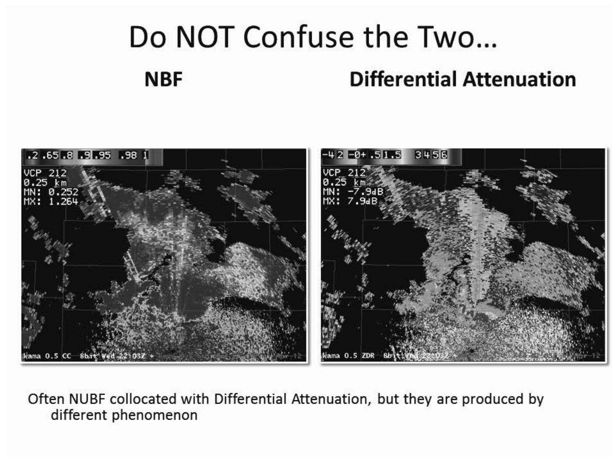
Student Notes:



46. Do NOT Confuse the Two…

Instructor Notes: The two limitations, while different, often do occur simultaneously but can and do occur separately. Note that in these images (CC on left and ZDR on right) the limitations are affecting the same radials. But note the most severely affected are those CC radials to the northwest. But don't confuse DBF and Differential Attenuation since they are different and the "ripple" affects differ.

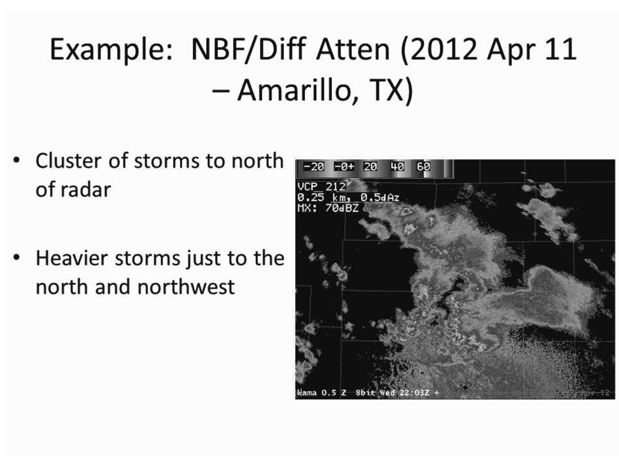
Student Notes:



47. Example: NBF/Diff Atten (2012 Apr 11 – Amarillo, TX)

Instructor Notes: Nearly all of these storms with Z values higher than 60 dBZ (white echo cores) are hail storms. Moreover, those storms nearly due north of the radar are, in part, radially aligned relative to the radar. Both of these conditions (hail, radially aligned echoes) promote these sampling limitations of Differential Attenuation and NBF.

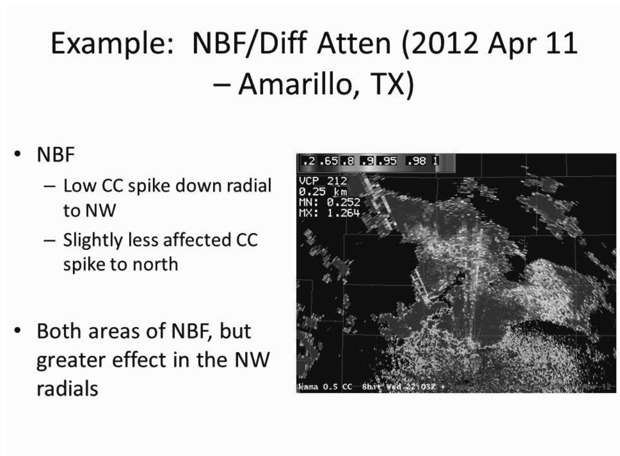
Student Notes:



48. Example: NBF/Diff Atten (2012 Apr 11 – Amarillo, TX)

Instructor Notes: The radials to the northwest in this CC image are very prominent. There the values fall as low as .8 (dark blue) or even lower. Because, when CC values fall below .9, KDP is not computed at all, any regions of heavy rain along these radials are completely obscured and go undetected, at least in KDP data (not shown). Remember that depressed CC values impact all dual pol variables to some degree.

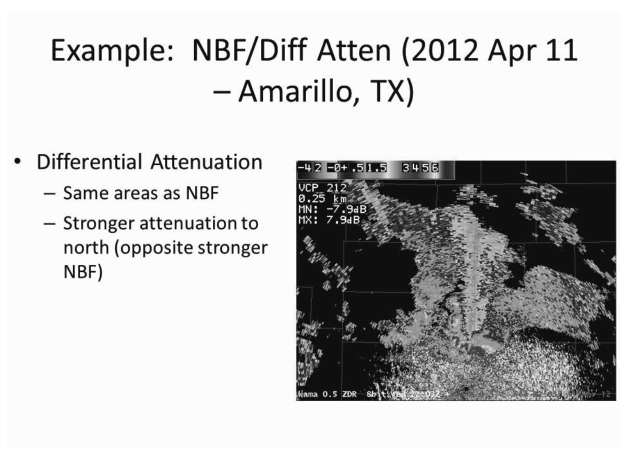
Student Notes:



49. Example: NBF/Diff Atten (2012 Apr 11 – Amarillo, TX)

Instructor Notes: While the CC values in the previous image were most strongly affected by NBF down the affected radials to the northwest, here, those radials oriented nearly due north are the most strongly impacted by Differential Attenuation. When you note that one or the other limitations seems apparent expect that the other will be present even though NBF and Differential Attenuation are not the same phenomena.

Student Notes:



50. Conclusions

Instructor Notes:

Student Notes:

Conclusions

- NBF/Diff Attenuation often appear in same locations
  - Caused by different phenomena
- NBF affects CC directly but it impacts all dual pol variables; Diff Atten affects only ZDR
- Common where storms align along a radial or in strong cores at mid ranges
  - Look for reduced CC/ZDR along a radial

51. Summary

Instructor Notes: To summarize, sampling considerations will always impact the look of the radar data. The question we can not always easily answer is how, and to what degree. That often means we have to be proactive in detecting negative cues which often come in the form of missing data or data which seems good but is actually highly compromised. One way to help minimize the impacts these limitations have on our decisions is to ensure we look at multiple radar views. One of the best way to do this is by having procedures which compare radar views…then all you have to do is remember to use them! Your mission now is to come up with other ways you (or your office) can address these issues operationally.

Student Notes:

Summary

- Sampling considerations always impact the look of radar data
  - The question is how and to what degree?
- This means we have to overcome the subtle negative cues by being proactive with data interrogation.
- Looking at multiple radars may help insure that no one radar's sampling limitations overly skew data interpretation and resulting warning decisions.
- Question for you: What's the best way to incorporate this practice into your storm interrogation methodology?

52. Thanks for your attention!

Instructor Notes:

Student Notes:

Thanks for your attention!

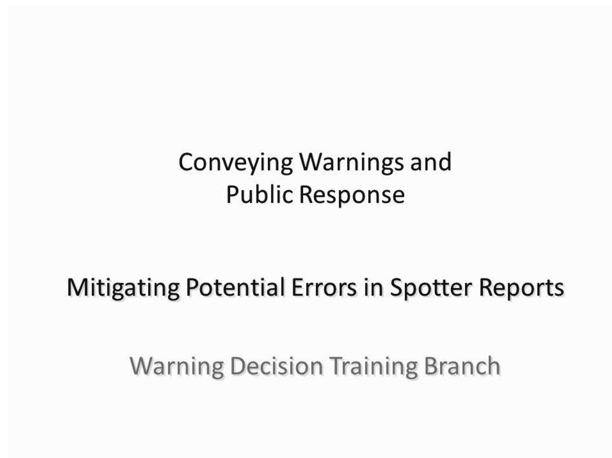
References

- On the Imprecision of Radar Signature Locations and Storm Path Forecasts, Douglas A. Speheger and Richard D. Smith, NOAA/NWS Forecast Office (submitted for publication NWA Digest)
- Effects of Radar Sampling on Single-Doppler Velocity Signatures of Mesocyclones and Tornadoes, Vincent T. Wood, Rodger A. Brown; Weather and Forecasting: Vol. 12, No. 4, pp. 928–938.
- Sources of Power: How People Make Decisions; Gary Klein, 1998
- Uncertainties in WSR-88D Measurements and Their Impacts On Monitoring Thunderstorm Life Cycles, K.W. Howard, J. J. Gourley and R. A. Maddox; Weather and Forecasting: Volume 12, No. 1, pp. 166 -174.
- Cases/data provided by Jim Purpura, MIC San Diego, Pat Spoden, SOO, Paducah, Rich Naistat, SOO Minneapolis, Dave Andra, SOO Norman, Larry Dunn, Former SOO Salt Lake City

1. Introduction

Instructor Notes: Welcome to this short module on mitigating potential errors in spotter reports. This lesson, which lasts approximately 20 minutes, discusses how NWS offices receive spotter reports, the groups of people who submit reports, and some simple ideas on mitigating common errors that can sneak into reports. My name is Andy Wood, and I will be presenting this material.

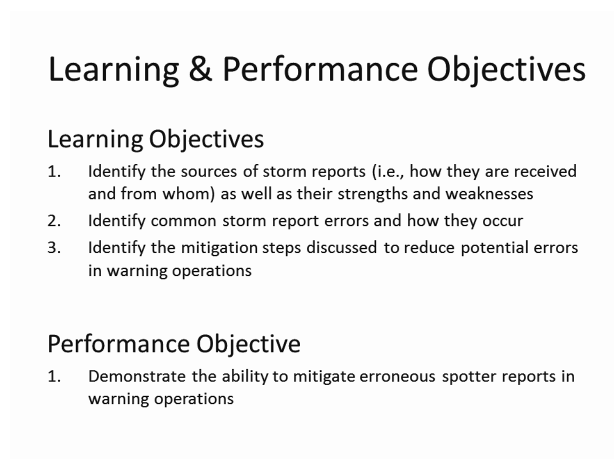
Student Notes:



2. Learning & Performance Objectives

Instructor Notes: There are three learning objectives and one performance objective for this lesson. Please take a few moments to review these objectives before proceeding to the next slide.

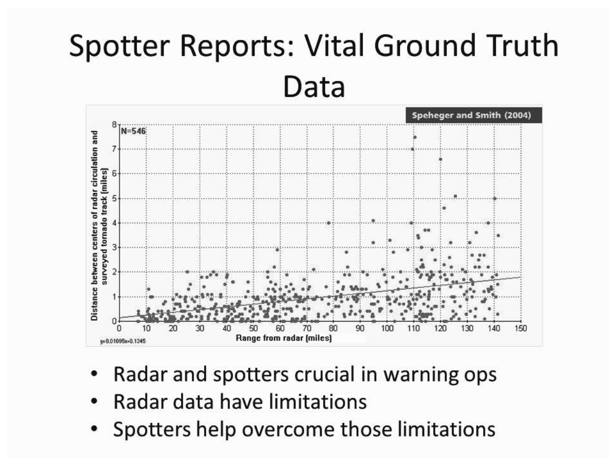
Student Notes:



3. Spotter Reports: Vital Ground Truth Data

Instructor Notes: Anyone even slightly familiar with NWS warning operations knows that spotter reports are important. While all observational data have value, radar data and spotter reports are heavily weighted during warning operations. Radar data, with all of its benefits, do have some significant limitations. For example, the graphic shown is from a study comparing radar circulation locations to tornado damage. The pink line indicates that the further a tornado is from the radar, the greater the error present in the radar observed location (Speheger and Smith, 2004). Spotters are the forecasters eyes and ears in the field and help overcome some of radar data's limitations. On one hand, they provide ground truth data as critical as any mechanical sensor. On the other hand, they are people communicating their observations. To make the most of this vital data, NWS staff must use their meteorological knowledge and people skills to quality control these data just as you would from any other "sensor".

Student Notes:



4. How You Receive Reports Is Important

Instructor Notes: Before we discuss the individuals who provide you with spotter reports, let's talk for a moment about the ways you receive these reports. After all, how you receive the information can be just as important as from whom you receive it. Many reports come into your office through contact initiated from a spotter (or other partner). These reports can come in as a just text via an electronic reporting tool, such as E-spotter, or they can be accompanied by pictures or video (like a TV report). Either way, the information is pushed into the forecast office by the spotter (or partner). While these "push" technologies are an indispensable help for forecasters, these tools don't always provide you with the information you need, or want. When a forecast office has to solicit reports from spotters, it requires more effort to get the information. However, if you "pull" the specific information into the office this way, you are more likely to get the information you are looking for. The more common tools forecasters use to contact spotters and partners (NWSChat, Ham radio, and phones) also have the benefit of being two-way forms of communication. In other words, they are both push and pull tools. When you contact someone in one of these ways, it's easier to have a conversation, ask follow-up questions, and clarify what it is they are observing. During warning operations, you'll ideally want to achieve a balance between the benefits of both "push" and "pull" technologies to receive pertinent storm information in as efficient a manner as possible.

Student Notes:

5. Recent, Significant Technology Changes

Instructor Notes: There are many ways that your office can receive spotter information. Some methods have been around a while, such as TV, phone calls, and Ham Radio. Other methods, such as on-line reporting, is newer, but has quickly become a major information source. NWS forecast offices have used NWSChat as a collaboration tool to exchange mission critical significant weather information for several years now. For some offices, it is the main coordination tool for forecasters to communicate quickly with key partners in the media, public safety, and other emergency response personnel. While NWSChat was not necessarily designed to receive spotter reports, you will inevitably receive some through this medium. Likewise, many NWS forecast offices are using their Facebook and Twitter accounts during significant weather to receive reports. Integration of reports from these social media sites is still relatively new for many offices and requires extra staffing to fully utilize during warning operations. We will discuss the risks and rewards of these information streams a little later. Another relatively new resource is on-line spotter networks. These communities provide on-line access to real-time spotter locations, movement, and information. This information is accessible through a variety of software applications (e.g., GRLevel, Google Earth, and RSS feeds). In some cases, these spotters will stream their storm video live (or nearly live) on-line so that you can see what they are seeing. While this network is most dense in the Central Plains, there are members of this community scattered throughout the lower 48 states.

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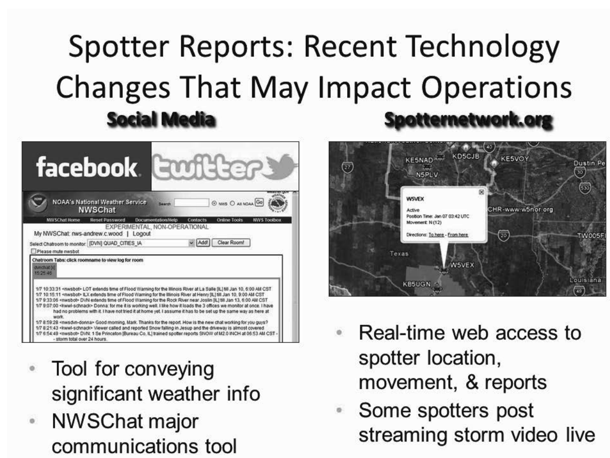

6. Spotter Reports: Network Composition

Instructor Notes: In many ways, the spotters in your county warning area are just like any other surface observing network. Of course, unlike other surface data sources, spotter networks are composed of observers with a variety of experience and skill levels. These different observers fall into four general categories: Local spotters (including emergency managers and public safety personnel) trained by the NWS; Other "experienced" spotters, including storm chasers, researchers, and other weather enthusiasts in the area due to the severe weather potential; Various media (i.e., TV and radio) personnel reporting on severe weather and its impacts; and The general public. On the next slide, you will see a breakdown of the pros and cons of observations provided by these different groups.

Student Notes:

7. Sources of Spotter Reports

Instructor Notes:

Student Notes:

8. Poor Observations

Instructor Notes: We've discussed how you receive reports and the people that provide them. Now let's discuss some of the common sources of errors, starting with poor observations. Poor observations can result from either honest mistakes, a lack weather knowledge, or other reasons. In some cases, these errors result from spotters who don't know what they are looking at, or for, when severe weather is occurring. Not knowing where to look, or what to look for, can result in missing the important details. Other reports are poor because clearly observing the phenomenon is not possible. Remote, rain-wrapped, and nocturnal tornadoes are examples of this problem. Smoke plumes, smoke stacks, or even grain silos in the vicinity of a storm can confuse a spotter about what they are really seeing.

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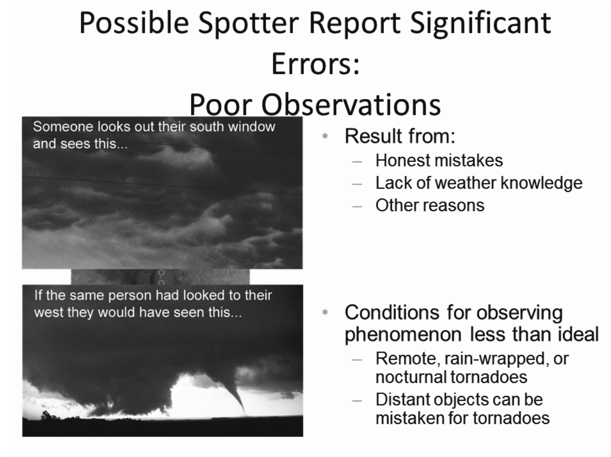

9. Poor Communication

Instructor Notes: Communication problems can also introduce errors into spotter reports. As with poor observations, almost anyone can make these mistakes. The biggest problems result from reports that are relayed through an intermediary. Reports that go through multiple parties before getting to the NWS are only as good as the weakest communicator in the chain. All it takes is one communication failure and the error propagates through to your WFO. It's human nature for us to paraphrase, especially when we are busy and repeating information constantly. Anyone can make this mistake. If you ever played the game "telephone", you know what I'm talking about. Location error is another possible communication problem. When spotters report a location, is that location where they are or where they observed (or think) the phenomenon is occurring? This problem is more likely when a spotter reports weather at a distance (e.g., tornado) and less likely when a spotter reports damage or an in situ measurement (e.g., hail measured with a ruler). However, location errors are still possible in these latter cases. Even when a spotter provides their location and the phenomenon's location, this information can get swapped somewhere down the line. Time errors occur in a similar fashion to location errors. In haste (either the spotters or the forecasters), the occurrence time of delayed reports may occasionally be omitted. In these cases, either the time the call was received or the time of an adjacent report may be recorded instead.

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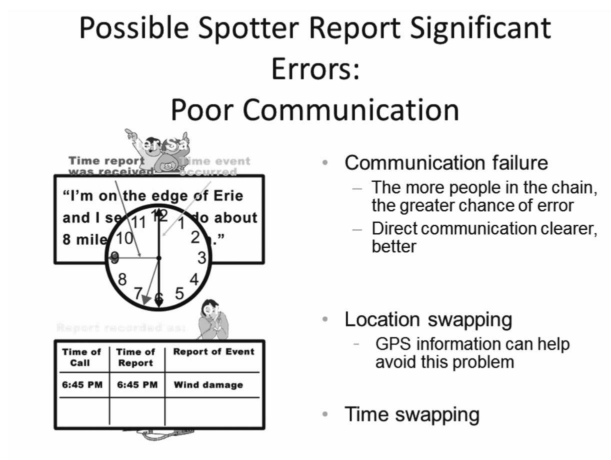

10. How Many Significant Errors Are There?

Instructor Notes: While the errors discussed here are not all-inclusive, they can result in the more common storm report problems. So lets ask the question you are probably thinking at this point: How many spotter reports have significant errors? The honest answer is we don’t know. As a result of conversations with multiple WFOs, the minimum rate of significant reporting errors is somewhere around 10%. However, the research on this subject has been limited. One study, Witt et. al (1998), indicated the number could be as high as 30% in areas of the country that regularly experience severe weather.

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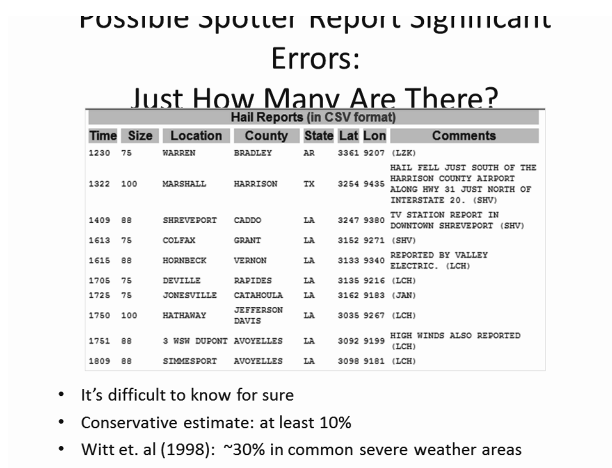


Time	Size	Location	County	State	Lat	Lon	Comments
1230	75	WARREN	BRADLEY	AR	3361	9207	(LZK)
1322	100	MARSHALL	HARRISON	TX	3254	9435	HAIL FELL JUST SOUTH OF THE HARRISON COUNTY AIRPORT ALONG HWY 31 JUST NORTH OF INTERSTATE 20. (SHV)
1409	88	SHREVEPORT	CADDO	LA	3247	9380	TV STATION REPORT IN DOWNTOWN SHREVEPORT (SHV)
1613	75	COLFAX	GRANT	LA	3152	9271	(SHV)
1615	88	HORNBECK	VERNON	LA	3133	9340	REPORTED BY VALLEY ELECTRIC. (LCH)
1705	75	DEVILLE	RAPIDES	LA	3135	9216	(LCH)
1725	75	JONESVILLE	CATAHOULA	LA	3162	9183	(JAN)
1750	100	HATHAWAY	JEFFERSON DAVIS	LA	3035	9267	(LCH)
1751	88	3 WSW DUPONT	AVOYELLES	LA	3092	9199	HIGH WINDS ALSO REPORTED (LCH)
1809	88	SIMMESPORT	AVOYELLES	LA	3098	9181	(LCH)

11. Quiz Question #1

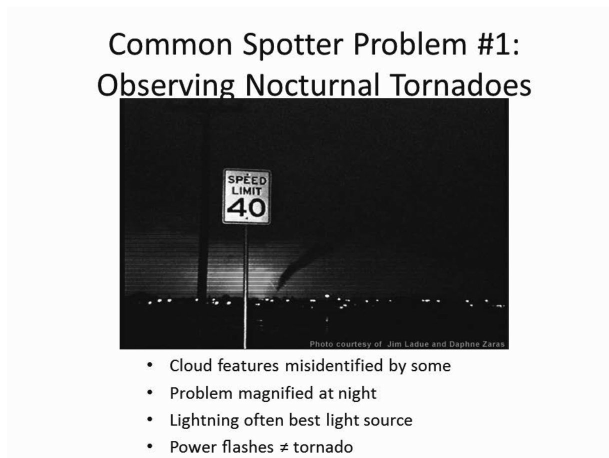
Instructor Notes:

Student Notes:

12. Problem #1: Observing Nocturnal Tornadoes

Instructor Notes: Now let's discuss some common situations where spotter problems may arise. Regardless of a spotter's experience level, it's difficult to identify cloud features at night. Many well-meaning folks have interpreted low-hanging scud cloud as a rapidly rotating wall cloud, funnel, or even a tornado. Educating spotters eliminates these problems during the day, but there's usually not enough light to consistently see the features in nocturnal storms. Many times, the best source of light will be from lightning. Power flash reports can also help identify the location of a tornado. However, some spotters tend to think the power flashes are definitive proof of a tornado. Unfortunately, power flashes, or arcing lines, can occur in strong straight line winds, or even strong inflow winds.

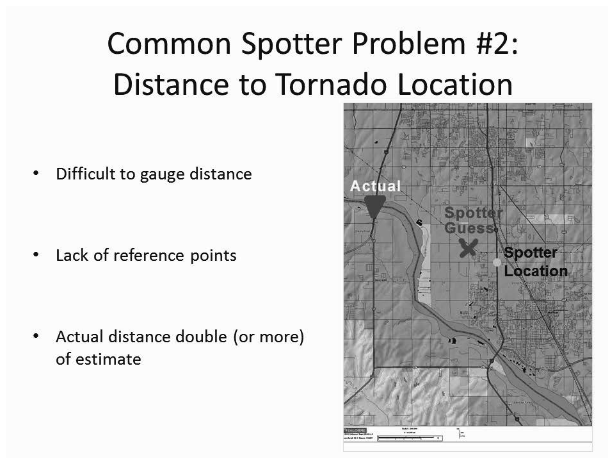
Student Notes:



13. Problem #2: Distance to Tornado Location

Instructor Notes: Regardless of time of day, people have a difficult time gauging their distance from storm features. Even experienced spotters will use some sort of correction of their estimate based on their personal knowledge. Objects at a distance, especially those in the sky, appear closer than they actually are when there are no reference features to provide context. When a spotter provides an estimate of a tornado location several miles from their location, expect the estimate to have some error. In these cases, it can be helpful to know a spotter's location. If you have multiple wall or funnel cloud reports observed from a distance, then the spotter locations (along with the direction they are looking) can help you triangulate the location.

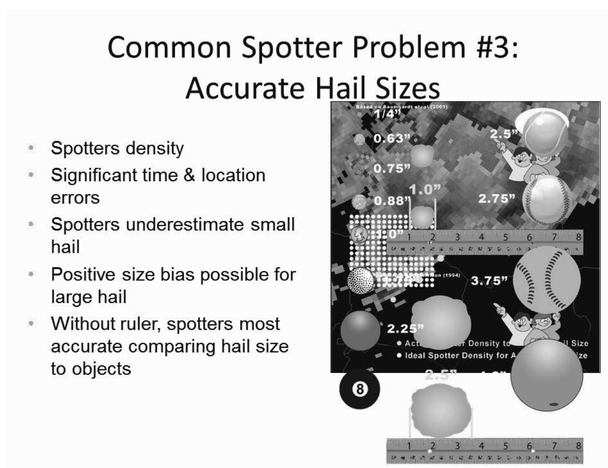
Student Notes:



14. Problem #3: Accurate Hail Sizes

Instructor Notes: Spotter reports of hail size have several potential issues. For starters, your spotter density will usually be less than ideal to accurately measure hail size in a thunderstorm (which is approximately one observer per square mile; Changnon, 1968). Time and location errors for hail can occur frequently, up to one-third of the time in some cases (Witt et al. 1998). Recent efforts, such as the SHAVE project, have attempted to better measure and verify hail sizes in some areas of the country, but it's difficult to know if this error rate has improved significantly over the last decade. Errors related to hail size are often a result of spotters not measuring the stone size with a ruler (or similar measuring tool). Lacking an objective measurement, a study conducted through the NWS LaCrosse, WI office (Baumgardt et al., 2001) found that spotters tend to underestimate the size of hail smaller than golf balls. At larger sizes, the bias is less significant, but the size estimates vary greatly. A study by Herzog and Morrison (1994) found that there may be substantial bias towards larger hail stones in Storm Data. While these conclusions don't agree completely, one can conclude that it's easier to get significant overestimates on large hail vs. small hail. In a follow up study, the NWS LaCrosse, WI office (Baumgardt et al., 2002) found that spotters are more accurate identifying hail size compared to an object (e.g., egg, golf ball) if they don't have a ruler. While this process can cause hail reports to cluster at certain object sizes, including golf ball and baseball (Edwards and Thompson, 1998), the reports are more accurate than trying to estimate the size in inches.

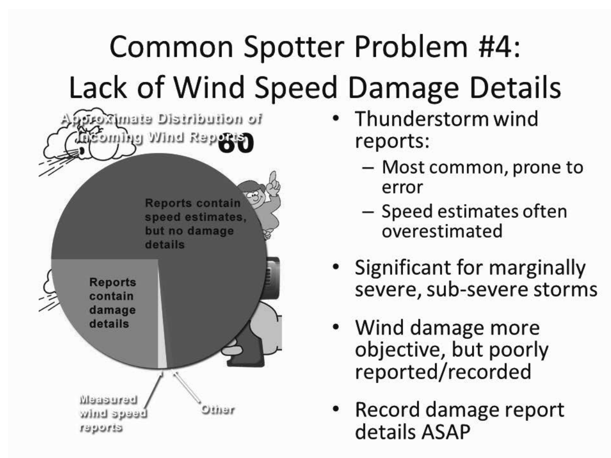
Student Notes:



15. Problem #4: Lack of T-Storm Wind Damage

Instructor Notes: Strong winds from thunderstorms are often the most common severe weather threat reported. Unfortunately, wind speed estimates from these storms are very susceptible to error. While spotters do their best, they tend to overestimate wind speeds (LaDue, 2003). This issue is most significant for storms with marginally severe or sub-severe thunderstorm winds. Unlike speed estimates, damage reports result in an objective impact. Unfortunately, wind damage is either not well reported (or well documented) at WFOs. From a small sample of severe weather events, we found that reports in phone logs generally contained an indication of wind damage in only 1 in 5 reports. Similarly, the climatological record of thunderstorm winds lack detailed records of damage for ¾ of reports (Weiss and Vescio, 1996). While these numbers have likely improved somewhat in recent years, a lack of damage details is still a concern. When damage is reported, it's often tree damage. Using due diligence, you can often determine the level of tree damage in first hand reports. While warning operations are time sensitive situations, do your best to document the details of the report. When working an event with numerous reports, you are likely to forget, or confuse, the details of a specific report in a few minutes.

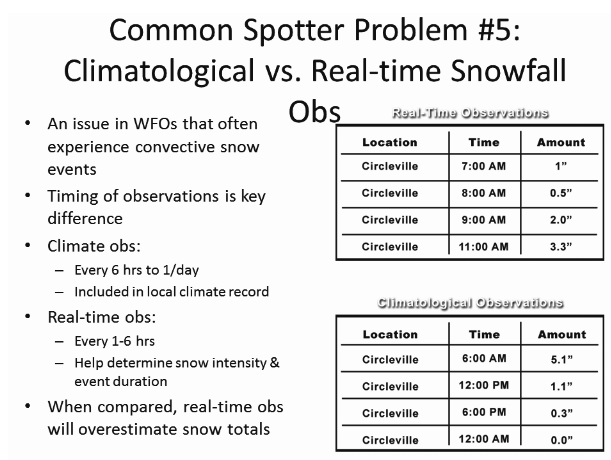
Student Notes:



16. Problem #5: Different Kinds of Snow Obs

Instructor Notes: And now for a problem you might not have thought about being in this lesson. In several forecasts offices, especially those prone to convective snow events with strong intensities, there are two different types of snow measurements that they receive. These snow measurements can be classified as either climatological or real-time. The difference between the two is in the timing of the observations (NOAA, 1997). Climatological snowfall observations, are taken anywhere from once a day to every 6 hours. These reports should include new snowfall, snow depth, and liquid equivalent and are added to the climatological record of snowfall. Real-time snowfall observations are taken more frequently, usually on the order of once every 1-6 hours. Real-time observations provide the warning forecaster more precise information on snow intensity and event duration. Real-time observations, because they are so frequent, don't allow new snow enough time to settle. The resulting measurement will overestimate snow accumulations when they are compared to climatological observations. If you utilize real-time snowfall measurements, you should educate your local media to avoid comparing real-time and climatological snow totals. If significant deviations occur between your official totals and those in media reports, public confusion (and a few angry phone calls) may result.

Student Notes:



17. Quiz Question #2

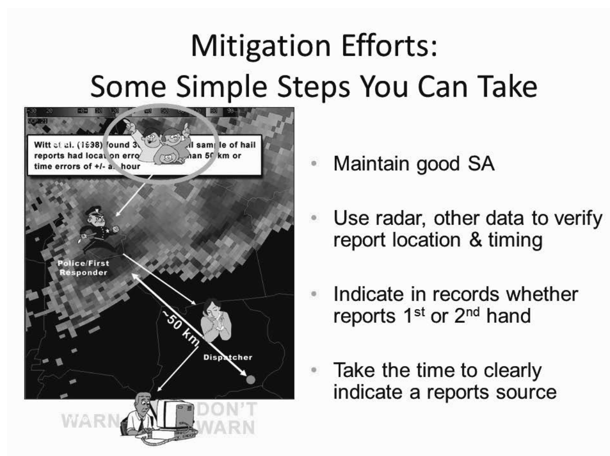
Instructor Notes:

Student Notes:

18. Some Simple Mitigation Steps to Try

Instructor Notes: Now let’s move on to some simple mitigation steps you can take in your office. For starters, maintain good Situation Awareness (SA). You likely cannot quality control every spotter report as it comes into your office. With good SA, most reports with significant problems will be obvious right away. If you suspect a report is suspicious, use radar and other data to match the report to what you are observing. This step can be conducted in real-time, regardless of how the information was received. Location or timing errors can be identified best through this data comparison. During post-event analysis, we recommend you compare all of your reports (not just suspicious ones) to radar data. Whether or not a report seems suspicious, note whether the report is direct from the source or relayed through someone else. During a significant event, even experts at relaying information from others may get confused, mix up information, and misread report locations and times. Knowing which reports are 2nd hand can come in handy at a later time during the event if a question arises. Lastly, indicate clearly a reports source in your office notes. Report quality will vary based on both who made the report and where they live. Where NWS-trained spotters are plentiful, they will report on events 80% of the time or more. In areas where spotters are sparse, the chances are closer to 30% (Baumgardt, 2004). Following these steps will not catch every bad report, but it should help.

Student Notes:



19. Some Questions to Ask Yourself?

Instructor Notes: Here are some other questions to ask yourself (or the spotter): Are they seeing the phenomenon, or are they experiencing the event? Seeing a tornado is one thing, but having your home damaged or destroyed by one is another. Our eyes can be deceived much easier by events at a distance than by more material evidence nearby (such as physical damage). Is there only one report? A single, uncorroborated report is more likely to cause decision-making problems in your office. To put this issue into perspective, one out of six tornadoes reported during the May 3rd tornado outbreak in Oklahoma and Kansas had only a single report (Speheger et al., 2001). While it's nice to have multiple reports of a single event, it's not always possible. Are there any non-meteorological factors at play? Highly populated areas are more likely to have people experience impacts than sparsely populated spots. Good spotter reports in rural areas are very valuable during significant events because there are fewer of them. What time do you have? A report may appear inaccurate because the spotter's time is inaccurate. For fast moving storms, deviations of five minutes or so can be significant. The clocks in our house probably deviate by that much…maybe even more! When comparing reports to radar data, your accuracy is limited to a 4-6 minute window. Some devices, like cell phones, regularly synchronize their time with a standard clock. Comparing these reports to suspicious ones in the same vicinity may help identify poor times in reports.

Student Notes:

20. Using Social Media for Spotter Reports

Instructor Notes: Social media has become a significant tool for NWS forecast offices to collect storm reports during severe and winter weather. These tools can require a level of monitoring that may make their use seem counterproductive at times. The key is to use them wisely. Tweets can come in very handy during an event. The problem is that you can end up with way too many tweets that may or may not be useful. However, if you filter your tweets (say using an application like TweetDeck or HootSuite) so that you focus your attention on tweets from trusted sources, that can help a lot. If you rely on using hashtags to filter tweets, such as #ALTornadoOutbreak, you may run into problems from people who re-tweet others. Facebook is different from Twitter in that it may be more cost effective (at least in terms of staffing) before and after a severe weather event. Facebook, along with Twitter, can help spread the word ahead of time before an impending event. It can generate word of mouth quickly and cause people to mobilize in ways you hadn't imagined. Facebook can also be very helpful after an event. People who are directly impacted by severe or winter weather will often post photos to Facebook about impacts to their life and property. These can be excellent sources of verification, especially since the photo can be tied back to an individual account. Regardless of the social media tool you use, it's still best to get spotter information from the original source. Retweets and post "likes" don't necessarily change the message like in the game of telephone. However, it can be difficult to contact the source of a photo, tweet, or wall post if it has been passed on from person to person. And it's always good to confirm the context of a slam dunk verification photo, even if it seems legitimate.

Student Notes:

21. Summary

Instructor Notes: The quality of information we receive from spotters depends significantly on the observation source. The data source depends on both the person who made the report and how you receive that information. Any single report can be good or poor. Over the long haul, reports should trend toward the generalizations presented here. To assist in your future error mitigation efforts, several common situations were presented as examples. Several simple mitigations steps were provided, including some basic questions to ponder when analyzing spotter reports that you receive. Your office may have some local policies as well to help mitigate impacts of erroneous reports. Now is as good time a time as any to review your local policies to make sure you understand them. After all, poor spotter information is a single destination, but there are many ways to get there.

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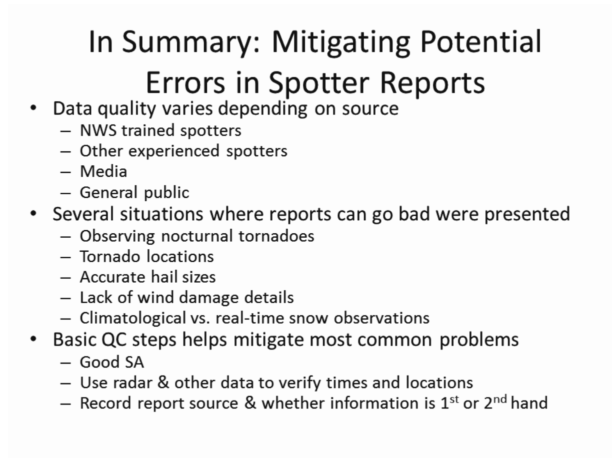

22. Questions???

Instructor Notes: If (after going through this lesson) you have any questions, first ask your SOO. Your SOO is your local facilitator and should be able to help answer many questions. If you need additional info beyond what your SOO provided, send an e-mail to the address on the slide. This e-mail address connects you with all the instructors involved with this IC. Thanks for your time and good luck on the exam!

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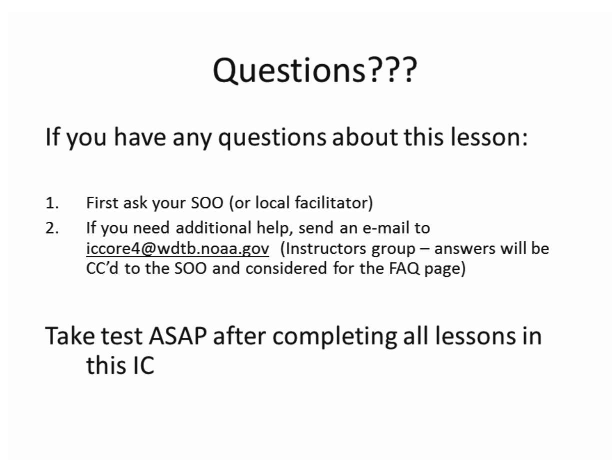

1. Conveying Warnings and Public Response

Instructor Notes: Welcome to this lesson on the warning response process. This lesson, which should last about 20 minutes, addresses the general social-psychological process that people go through from the time a warning is first heard to the time people respond. My name is Dale Morris and I am joined in this lesson by Chris Spannagle.

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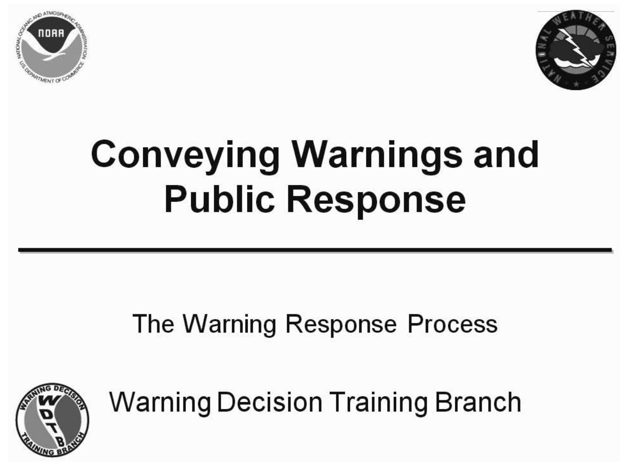

2. What response do you want?

Instructor Notes: What things can a warning forecaster do to get the desired response from the public? A man in the path of an F5 tornado actually crawled into a sewer to escape injury. During this same event, others left safe shelter to go to a highway overpass. Later this same day, patients in a rural hospital were moved into a hallway after communication between the hospital and their local emergency manager. Their rooms eventually were filled with tornado debris, but the patients sustained only minor cuts and scratches. The hospital eventually was condemned and torn down. In Missouri, emergency managers were able to move road crews out of the way of an F4 tornado. What happened in these situations, and what did NWS forecasters do to elicit these responses? Objective metrics like FAR, POD, and Lead Time only partially measure the success of a warning event.

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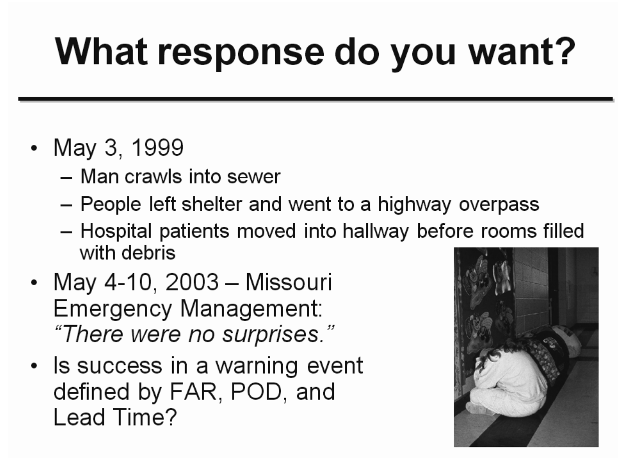

3. Overview

Instructor Notes: Although there is not a lot of research linking warnings and behavioral response, much of the research that does exist shows that there is a process that takes place between hearing the warning and reacting. Programs like WAS*IS, (Weather and Society Integrated Studies) are helping to answer questions related to the end-to-end warning process. New research is trying to get a glimpse into what people were thinking during certain responses to warnings and other environmental stimuli (like deciding to drive through a flooded roadway).Depending on how the warning is crafted, the sender of the warning message can impact the actions of the receiver. Therefore, it is important for forecasters that issue warnings to understand the process people generally go through prior to responding to the warning message.

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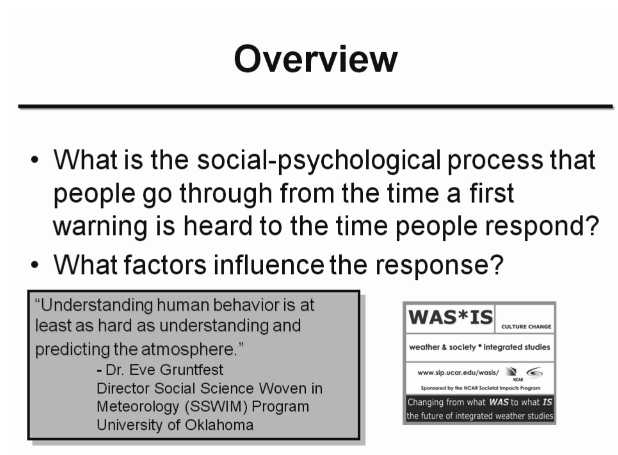


4. Learning Objectives

Instructor Notes: This lesson has three objectives.

Student Notes:

Learning Objectives

1. Identify the common process between a person hearing the initial warning and responding.
2. Identify the most common sources of warning information.
3. Identify methods forecasters can use to impact the actions of warning recipients.

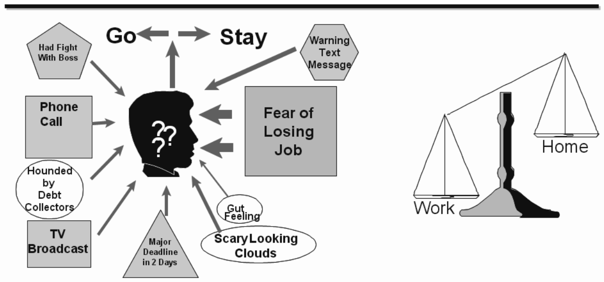
5. Inputs into a Warning Response

Instructor Notes: You may have seen a graphic similar to this relating to how forecasters weigh the sum of all inputs in making a warning decision. In an analogous way, individual people probably weigh various factors when they make decisions. A weather warning may be one piece of information that may be seemingly logically and rationally over-ruled by other competing thoughts and emotions. For instance, consider someone who is at home and is about to leave for work and has received a weather warning message via TV, a telephone call and a text message. However, this person also has had tension on the job because of a looming work deadline and an argument with the boss. Add to that other personal issues like debt collectors or child care or medical expenses, and the pressure to go to work for fear of losing the job may overpower the weather warning. Of course, one important factor that may be excluded from this decision-making process is that the job doesn't matter if the worker dies trying to get to work!

Student Notes:

Inputs into a Warning Response

Do Weather Warnings Outweigh Need To Go To Work?



For someone at a particular time, ignoring a warning to go to work may be a perfectly rational decision.

6. The Warning Response Process

Instructor Notes: People don't just hear a warning and immediately take action. There is a process that takes place between hearing the warning and reacting. That process can take only a few seconds or several minutes. People go through a more or less sequential process in which they consider various aspects of the decision confronting them before acting. The sequence may not be the same for every person, and each stage is not necessary for a response to occur. Importantly, the behavioral outcomes of the public are impacted by both the sender (issuing the warning), the receiver (those hearing the warning), and other intermediate factors.

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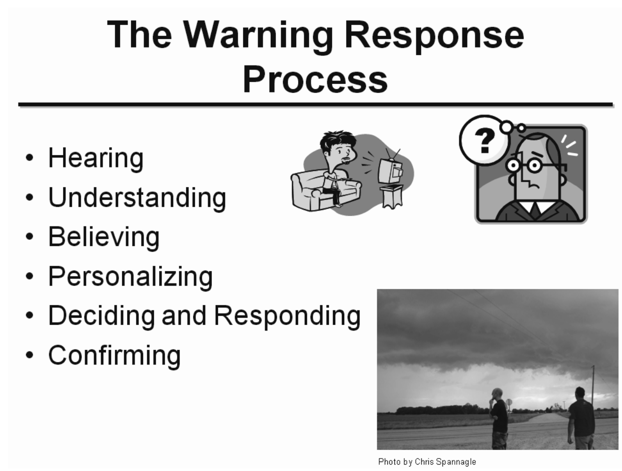

7. Hearing

Instructor Notes: It can't be assumed that just because a warning is broadcast that people will hear it. Most people receive NWS warnings over the television. NWS forecasters must partner closely with the local media to ensure the warnings are transmitted accurately and in a timely fashion. NWS Directive 10-1801 specifically addresses this aspect, encouraging the media to participate in drills to test all aspects of the integrated warning system.

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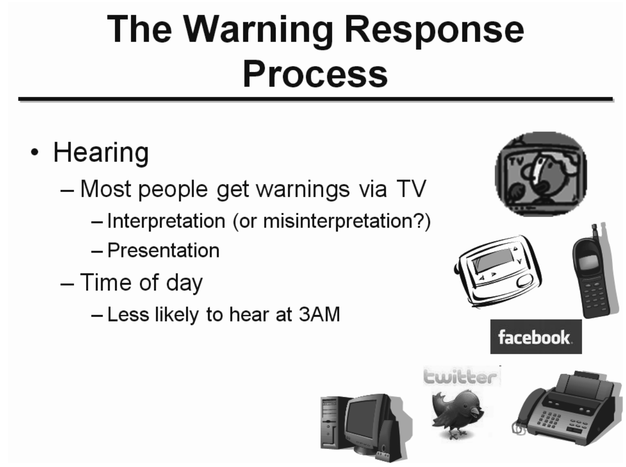

8. Hearing: Community Preparedness

Instructor Notes: The level of community preparedness also plays a large role in the warning response process. NWS offices can and should help to increase community preparedness. In fact, NWS Directive 10-1801 states that "NWS offices should conduct training sessions for hazards community members so they know how to use our services and how to integrate them into their decision processes." Another way to increase community preparedness is through the Storm Ready program. Storm Ready is a program aimed at preparing cities, counties, towns and universities across the nation with the communication and safety tools necessary to save lives and property. This program has several requirements in order to be certified as Storm Ready: Establish a 24-hour warning point and operations center Create a system to monitor local weather conditions Have the ability to receive severe weather forecasts and warnings and alert the public through multiple methods Promote the significance of public readiness through community seminars Develop a formal hazardous weather plan, which includes training severe weather spotters and holding exercises

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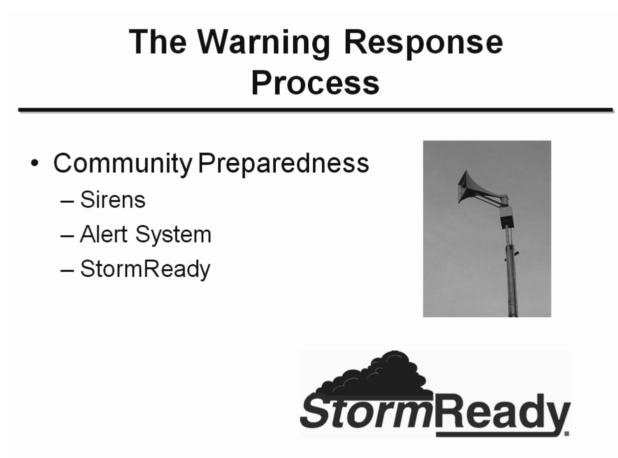

9. Hearing: Sources of Information

Instructor Notes: Recent studies show that TV is both the most common source of warning information and considered to be the most important source of weather information. The top figure shows common sources of weather information obtained from three separate studies which took place between 1997 and 2003. These three studies consisted of a study by Hammer and Schmidlin in 2002 with 190 people affected by the May 3rd 1999 Oklahoma City tornado. Another by Balluz et al. questioned 146 participants affected by tornadoes in Clark and Saline counties in Arkansas on March 1, 1997. A third study, consisted of 129 respondents affected by tornadoes in parts of Kansas, Missouri and Tennessee on May 4th, 2003. The figure clearly shows that television and sirens are by far the most common ways people obtain warning information. The bottom figure shows rankings of what people considered to be the most important source of weather information according to a 2004 study by Hayden et al. which took place in Austin, TX and Denver, CO. This study again shows that TV is considered to be the most important source of weather information, with environmental clues and AM/FM radio ranked second and third.

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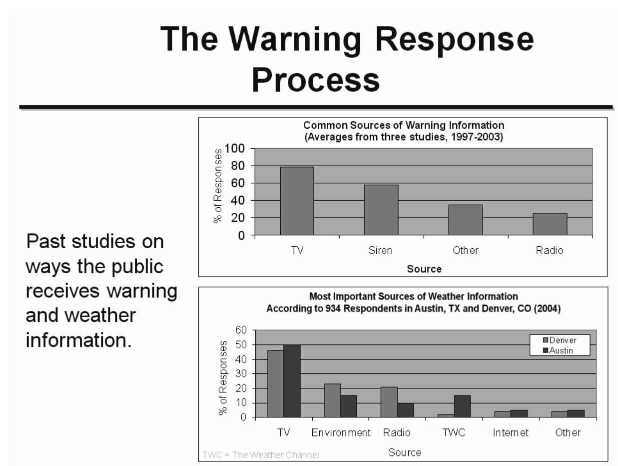
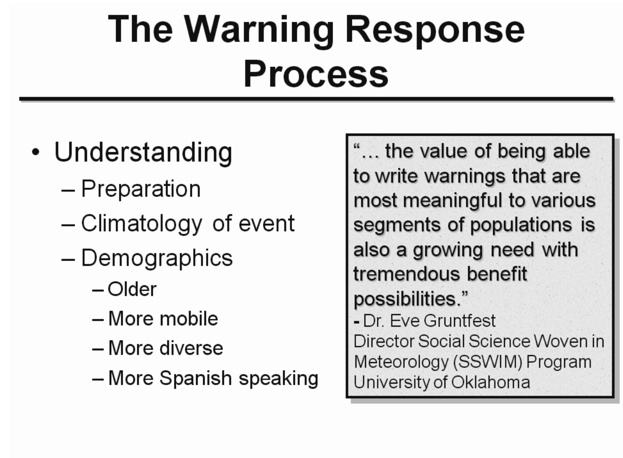


10. Understanding

Instructor Notes: After hearing the warning, the listener must understand the warning. The capability of the public to understand the warning has a lot to do with preparation. It is not just the duty of the Warning Coordination Meteorologist to educate and prepare the public. This is a huge task, the job is never done, and the entire NWS organization needs to help. The public's understanding is also impacted by the climatology of the event. For instance, the public's understanding of a severe thunderstorm warning is better in areas where severe thunderstorms are more common. Finally, it is probably incorrect to think of a single monolithic "public". In fact, there are many publics. Demographics play into understanding. In 2000, one in eight Americans was over age 65. By 2030 one in five Americans will be 65 or older. The increasing Spanish speaking population especially in the South Central and Southwestern U.S. also is an issue in understanding warnings.

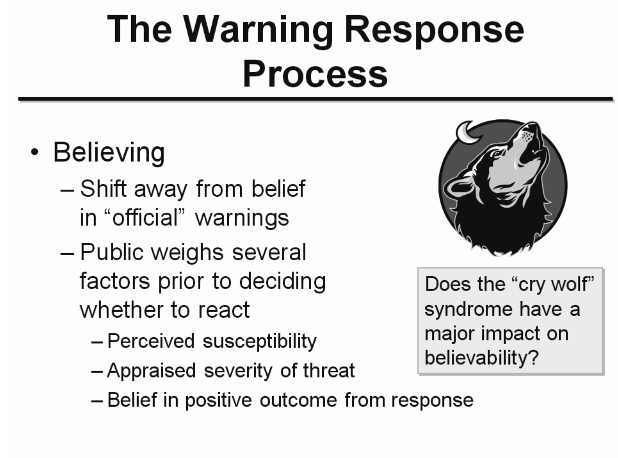
Student Notes:



11. Believing

Instructor Notes: The warning may be heard and understood, but is it believed? Recent findings show that public reliance on "official" warnings from traditional sources may be shifting to more private and informal sources. (Baker 1995; Dow and Cutter, 1998; Drabek, 2001). People use new, previously unavailable sources of information and weigh several factors in their decisions about whether, how, and when to react to hazardous conditions. The classic referenced case is the "cry wolf" syndrome. Most studies have not found evidence of a direct link between previous false alarms and the credibility of warnings. However, one recent study by Simmons and Sutter has found an increased likelihood of fatalities in areas that previously have had a higher incidence of false alarms for tornado warnings. Nevertheless, this is a complicated issue because areas with more warnings probably have more tornadoes and thus more injuries or deaths. In their work, Simmons and Sutter did recognize there is a tradeoff between our detection and warning capabilities and false alarms. For another perspective on the false-alarm issue, a very limited sample of interviews were conducted as part of a recent NWS service assessment. According to the assessment, "Many of those interviewed, including EMs and other public officials, mentioned that they have been under numerous tornado watches and warnings where 'nothing happens.'" Believability can be influenced by many factors associated with the method and contents of the warning. Later portions of this presentation will focus on how the warning forecaster can influence believability.

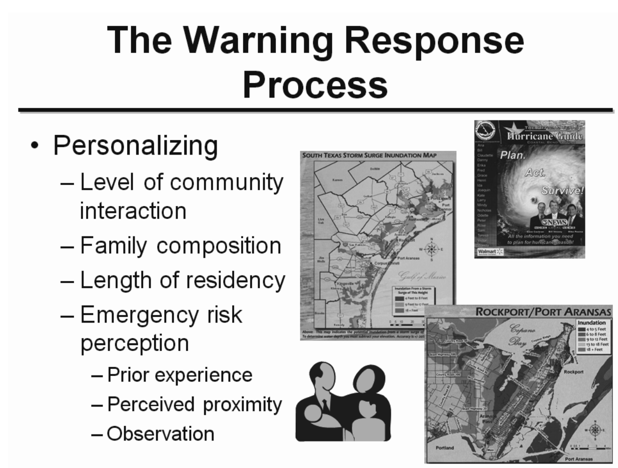
Student Notes:



12. Personalizing

Instructor Notes: People think of warnings in personal terms—what are the risks for themselves and family? The perception of risk is an important step in responding to a warning. If they feel “it can’t happen to me”, they may well ignore a warning. The ability of the public to personalize the threat is to some degree set prior to the warning event. If an area has recently been hit by severe weather, the public will be much more likely to personalize the threat than people in an area that has not been threatened for several years. Through various outreach and public education efforts, the NWS can influence how people perceive risk and their vulnerability to hazardous weather. As one example, all four WFOs that serve the Texas coast (the Lake Charles, Houston, Corpus Christi and Brownsville offices) have partnered with the State of Texas, local media and emergency managers, the American Red Cross, a non-profit organization, and a major retailer to produce and distribute 1.1 million full-color 32 page Hurricane Guides in English and Spanish. One of the sections in the guide includes regional and local storm surge inundation maps which can help local residents assess their vulnerability to storm surge. The next slide contains a video that provides an example from a broadcast media perspective of a viewer personalizing a tornado warning .

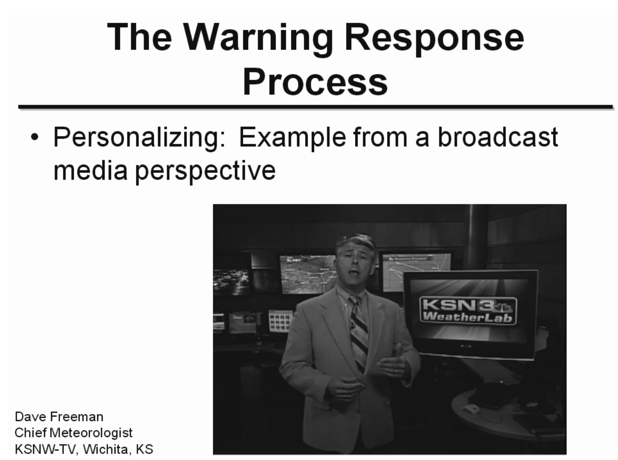
Student Notes:



13. Personalizing Example

Instructor Notes: For some time, the KSN WeatherLab in Wichita was co-located at a children's science center. We were right there doing all of our broadcasting including severe weather coverage in front of the public. So one day, we have a tornado warning for downtown Wichita. The children's museum staff did their job. They executed their safety plans. They got on the PA system and informed everybody they needed to evacuate to the shelters in the other part of the complex. Pretty soon, there's nobody here. We're still doing our coverage. All of a sudden, here comes this dad and his couple of kids just kind of walking around the corner. They sit down in the bleachers and proceed to watch. And I'm talking about the tornado warning and how everybody in downtown Wichita should be in shelter. They're not moving. So I said, "Everyone at Exploration Place should be in shelters, should follow the severe weather safety plan because we have a tornado warning." Nothing. They didn't move. So finally, I actually kind of had to stop my broadcast, and I looked right at this guy, and I said, "Sir, I'm talking to you. There's a tornado warning for downtown Wichita. You need to move to shelter." And this is what I saw. "Ohhh!". And the guy jumps up, grabs his kids, and tears out of there to go to the shelter. Now, I've never forgotten that moment because, in that moment, I was able to actually see the process that is taking place for people at home. I see him kind of going from the "Oh, isn't this interesting" to "Oh my! That's really possibly could be really affecting me, and oh my gosh, I had better do something about it!" And it just reinforces the fact that this is a process and that we have to help people at home get through that process of recognizing that there's a threat, personalizing the threat, and then taking action to protect their families.

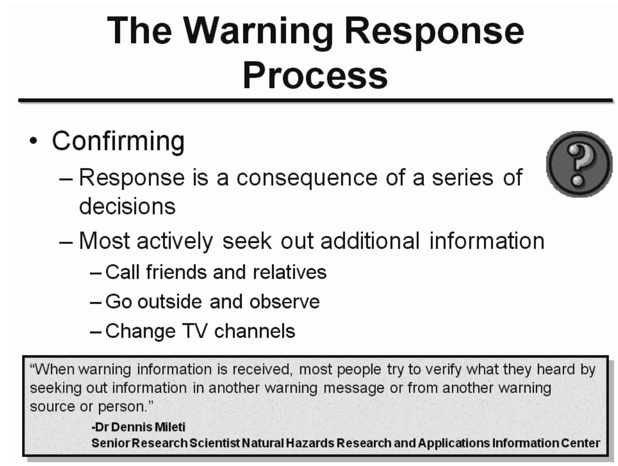
Student Notes:



14. Confirming

Instructor Notes: People are information hungry following the receipt of warnings. This can mean turning the TV to another station, checking with a neighbor, friend or family member, or going outside to look at the sky. There is a need for a continuous flow of information. Even statements that repeat previously available information can help confirm the threat. That confirmation helps people better understand warnings, believe them, personalize the risk, and make response decisions. Because people confirm warnings and receive information from multiple intermediate sources, it is critically important that the continuous flow of information from various media sources as well as various state, local, and federal government officials contains consistent messages.

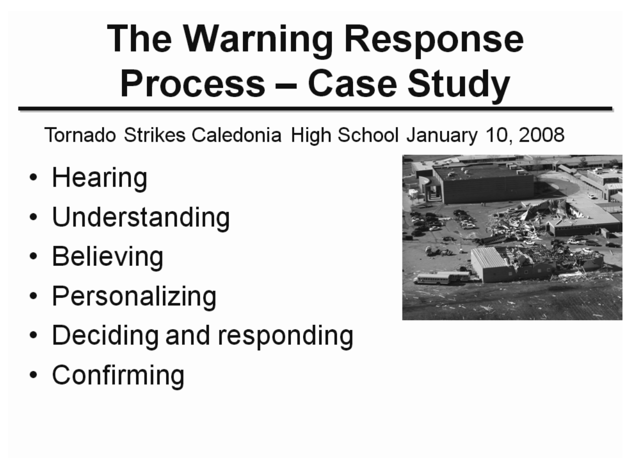
Student Notes:



15. Case Study: Caledonia High School

Instructor Notes: Here is a recent example of a warning response process lifted from the pages of the March 2008 NOAA World Newsletter. Understanding the behavioral aspects of the warning response process can help shape better warnings leading to a better outcome. In this case, an EF3 tornado heavily damaged a school complex in Caledonia, MS, on January 10, 2008, but a timely warning, a NOAA Weather Radio receiver, a prepared principal, and several phone calls from the county EM kept as many as 2140 students and employees from harm.

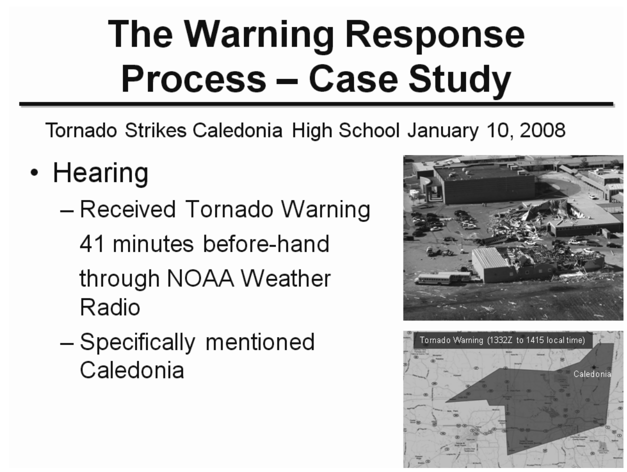
Student Notes:



16. Case Study: Hearing

Instructor Notes: In this case, the hearing aspect was from NOAA Weather Radio and a warning that specifically mentioned the city of Caledonia (shown by the blue star in the warning image). Studies have shown that less than five percent of the population receive warnings from NOAA Weather Radio with most receiving warnings from TV and radio. Most of the nation's workforce do not have access to TV and radio at work. The local office led by the WCM can target workplaces to educate management at those sites of the cost benefit of a weather radio.

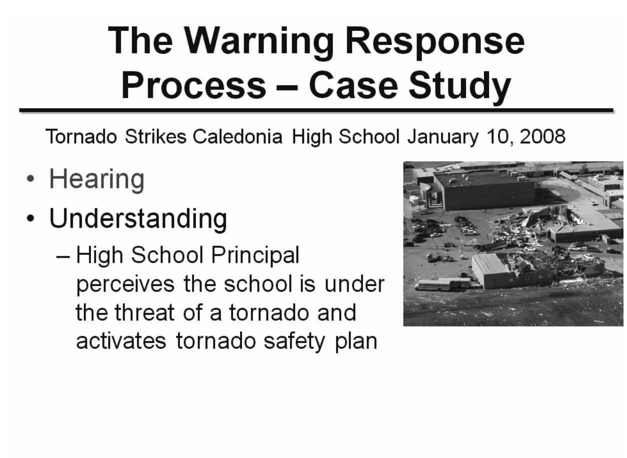
Student Notes:



17. Case Study: Understanding

Instructor Notes: Experience and training made understanding of the warning nearly instantaneous at the Caledonia school complex. A tornado warning activated the schools' tornado safety plan, sending students and employees to their designated shelters.

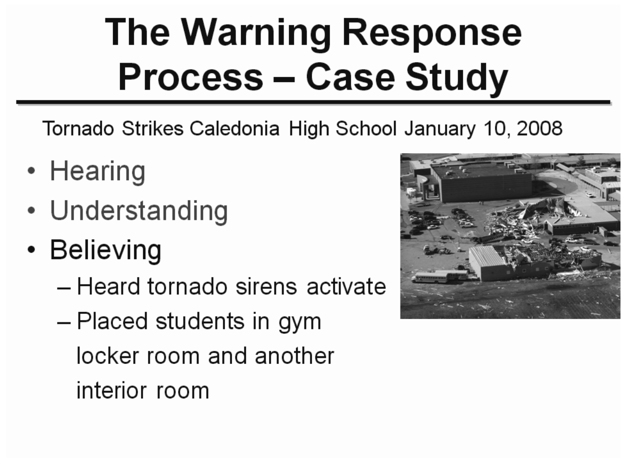
Student Notes:



18. Case Study: Believing

Instructor Notes: In this case, the principal concluded it was time to take shelter within seconds of hearing the Tornado Warning was issued. The strong wording in the tornado warning, stating that the storm was capable of producing strong to violent tornadoes and that this was an extremely dangerous and life threatening situation, also helped to impart the seriousness of the situation and lead the principal to the conclusion that the threat was real.

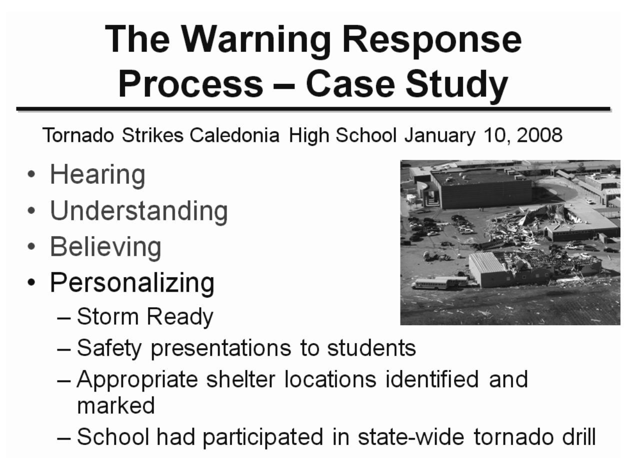
Student Notes:



19. Case Study: Personalizing

Instructor Notes: Caledonia is located in Lowndes County, MS which has been certified as a Storm Ready community. As part of the certification process, the school participated in state-wide tornado drills, severe weather awareness week and received several severe weather safety presentations. These experiences resulted in the development of a strong safety plan, clearly marked shelter locations and receipt of a NOAA Weather Radio.

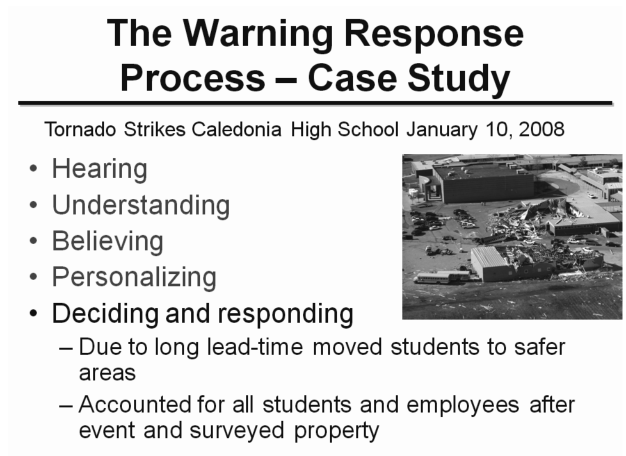
Student Notes:



20. Case Study: Deciding & Responding

Instructor Notes: The decision to seek shelter is not made upon hearing a warning. Studies have shown that a warning must be understood, believed, personalized, and confirmed before a decision is made to respond. In this case, a lead-time of 41 minutes allowed for the principal to move students and employees from nominally safe areas to safer areas of the main building on campus.

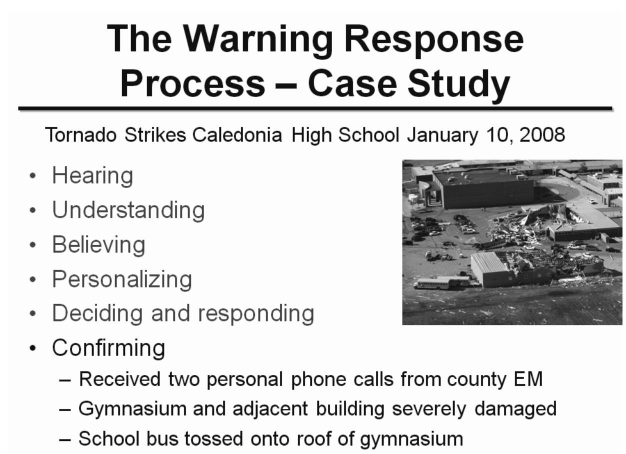
Student Notes:



21. Case Study: Confirming

Instructor Notes: The receipt of the tornado warning through NOAA Weather Radio, sirens and television sent all students and employees to their designated shelters. Two phone calls from the county emergency manager further confirmed the threat and allowed for everyone to be moved to safer shelters. The final confirmation, in this case, was when the tornado struck the school complex.

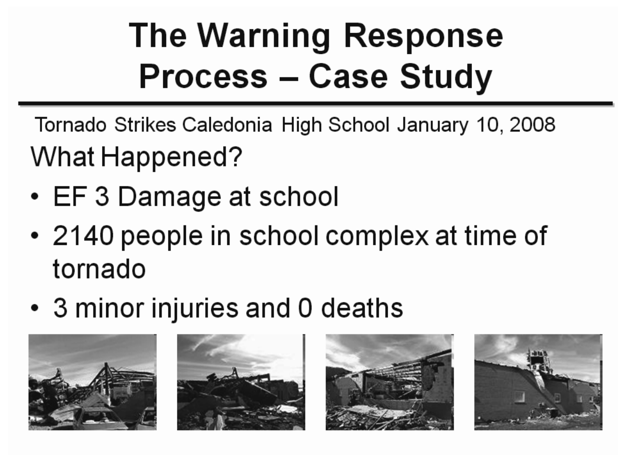
Student Notes:



22. The Warning Response Process – Case Study

Instructor Notes: So what happened with this event? An EF3 tornado struck the city of Caledonia and more specifically the Caledonia High School complex at about 2:13PM CST which is roughly 41 minutes after the first tornado warning was issued. Damage at the school complex consisted of the almost total destruction of a gymnasium in which some students were initially sheltered. A school bus was thrown onto the roof of a Vocational Tech building located adjacent to the gymnasium where other students had initially been sheltered. Cars and other school buses were flipped over and the football press box and concession stands were destroyed. At the time the tornado struck, approximately 2140 students and employees were on the campus: none were killed and there were only three minor injuries. Elsewhere around town, numerous trees were snapped and uprooted, many homes sustained roof damage and/or collapsed walls.

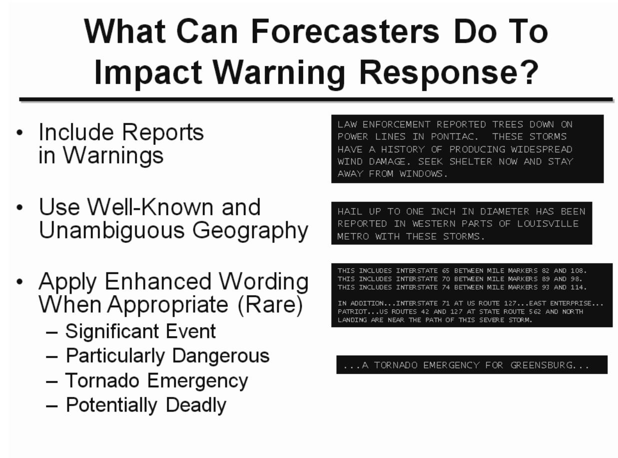
Student Notes:



23. What Can Forecasters Do To Impact Warning Response?

Instructor Notes: What can warning forecasters do to influence the warning response? Including actual and credible reports with the source of the report in the warning text can increase the believability of the warning. Using well known and unambiguous geography helps the personalization process. The automated geographic specification of county sections in storm-based warnings can seem ambiguous and not clear to some residents. For example, individuals may not realize they are in northern Washington County, but they may know they are north of Highway 15. Finally, in rare situations, applying enhanced wording in warnings can draw attention to the most significant of events. For example, specific policy guidance is available in Directive 10-511 about using “tornado emergency”: In exceedingly rare situations, when a severe threat to human life and catastrophic damage from a tornado is imminent or ongoing, the forecaster may insert the headline "...TORNADO EMERGENCY FOR [GEOGRAPHIC AREA]...". Additionally, in such a situation, this headline should only be used when reliable sources confirm a tornado, or there is clear radar evidence of the existence of a damaging tornado such as the observation of debris.

Student Notes:



24. Quiz

Instructor Notes:

Student Notes:

25. Summary

Instructor Notes: In summary, a warning forecaster’s understanding of the behavioral warning response process can result in a positive response by the public. Also, knowing that most people receive warning information through intermediate sources (such as broadcast media or other government officials) means that partnerships should be worked out well in advance of an event to ensure message consistency. Finally, specific wording in warnings and follow-up statements can help people to believe and personalize the warnings.

Student Notes:

Summary
The Warning Response Process

- Hearing
  - Intermediate sources (TV)
- Understanding
- Believing
  - Actual reports
- Personalizing
  - Unambiguous Geography
  - Enhanced Wording
- Deciding and responding
- Confirming

26. End of Lesson

Instructor Notes: You have completed this lesson on The Warning Response Process. For more information you can consult the list of references attached to this presentation. You can access these references by clicking on the “Attachments” button at the top right of this presentation window.Please complete the remaining lesson in this Instructional Component before attempting the test required for completion. The test should be taken as soon as possible after completing all of the lessons. If you have any questions about this lesson, first ask your SOO. Your SOO is your local facilitator. If you need additional help, please send an e-mail to the address listed on the slide. Thank you for your time and good luck on the exam!

Student Notes:

End of Lesson

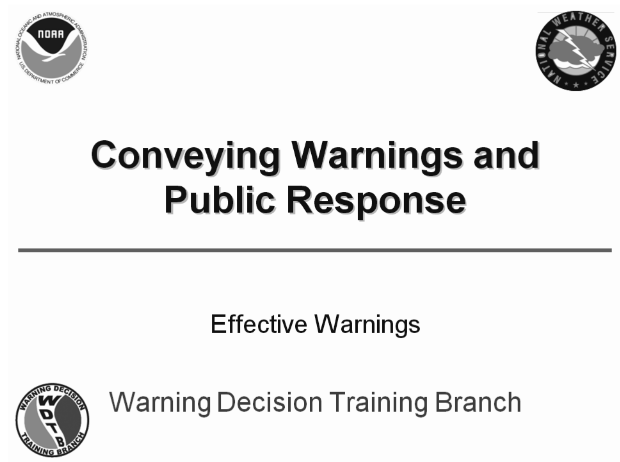
WARNING DECISION WDTB TRAINING BRANCH

Questions about this lesson
“The Warning Response Process”?
E-mail: awoccore_list@wdtb.noaa.gov

1. Conveying Warnings and Public Response

Instructor Notes: Welcome to this lesson on effective warnings. This lesson, which last approximately 20 minutes, focuses on how to issue effective warnings. The lead instructor for this presentation is John Ferree.

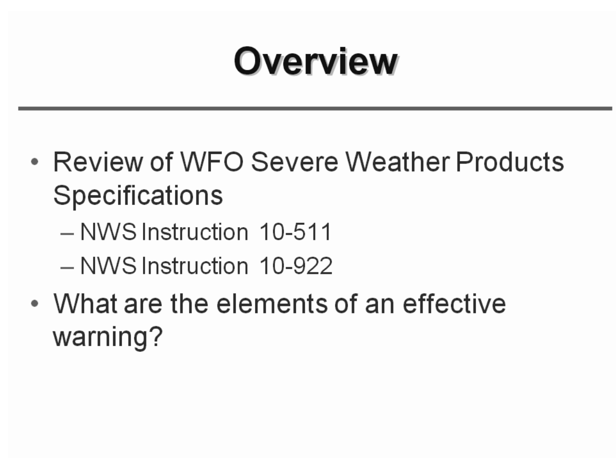
Student Notes:



2. Overview

Instructor Notes: In this lesson we will first review the NWS “official” product specifications. Many of the elements of an effective warning are built into the product specifications. We will then discuss the elements of an effective warning, and discover ways to deliver effective warnings.

Student Notes:



3. Performance Objectives

Instructor Notes: There is one performance objective for this lesson. This performance objectives is a statement of the behaviors that participants will be able to demonstrate both in the simulations and on the job.

Student Notes:

Performance Objectives

1. Demonstrate the ability to apply the five characteristics of an effective warning:
   - Specificity,
   - Consistency,
   - Certainty,
   - Clarity, and
   - Accuracy.

4. Learning Objectives

Instructor Notes: There are only three objectives to this lesson.

Student Notes:

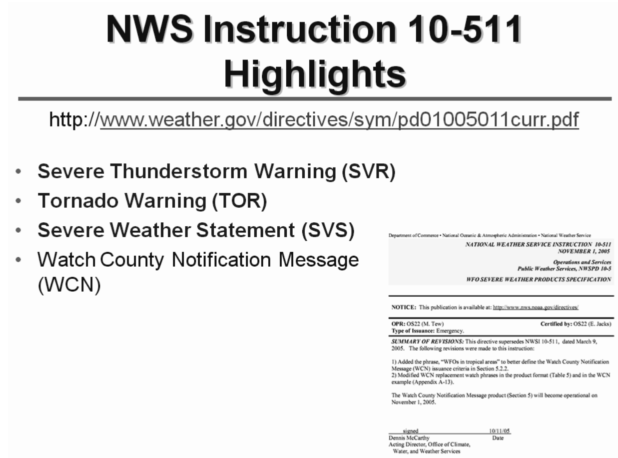
Learning Objectives

1. According to NWS Instruction 10-511, be able to identify specifications of WFO Severe Weather Products.
2. Be able to name five characteristics of an effective warning.
3. Be able to identify effectively worded warning phrases.

5. NWS Instruction 10-511 Highlights

Instructor Notes: A quick review of NWS Instruction 10-511 will be our starting point for a discussion of effective warnings. The focus here is on Severe Thunderstorm Warnings, Tornado Warnings, and Severe Weather Statements. Watch County Notification Message is available in other training sessions (not in AWOC).

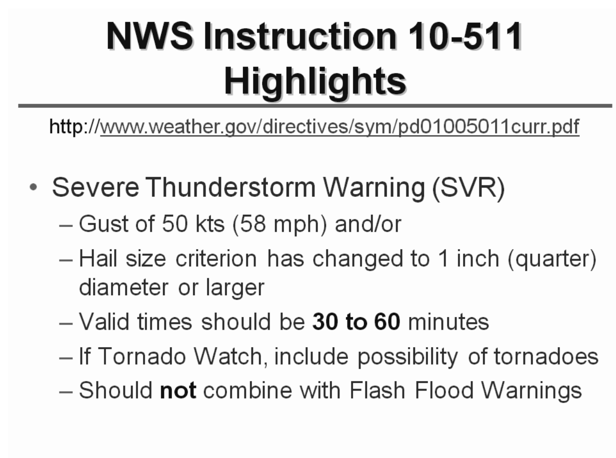
Student Notes:



6. 10-511 Highlights: Severe T-Storm Warnings

Instructor Notes: Some of the highlights from the instruction on Severe Thunderstorm Warnings.

Student Notes:



7. 10-511 Highlights: Tornado Warnings

Instructor Notes: Highlights from the instruction on Tornado Warnings.

Student Notes:

NWS Instruction 10-511 Highlights

http://www.weather.gov/directives/sym/pd01005011curr.pdf
Starting page 7

- Tornado Warning (TOR)
  - Tornado
  - Valid times should be **15 to 45** minutes

8. 10-511 Highlights: SVR & TOR Guidelines

Instructor Notes: Instructions common to both Severe Thunderstorm Warnings and Tornado Warnings.

Student Notes:

NWS Instruction 10-511 Highlights

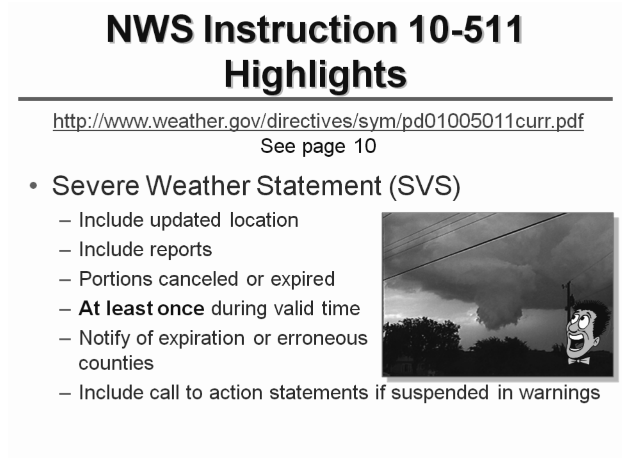
http://www.weather.gov/directives/sym/pd01005011curr.pdf
Starting page 4

- SVR and TOR
  - Should use nine part directions (I.e. northeast, east central, etc.) to identify portions of counties
  - Moves over coastal water -> Special Marine Warning
  - Keep bullets brief
  - Include call to action statements
    - May discontinue during widespread severe weather outbreaks
  - May use mileage markers of major highways as reference points

9. 10-511 Highlights: Severe Weather Statements

Instructor Notes: Highlights from the instruction on Severe Weather Statements.

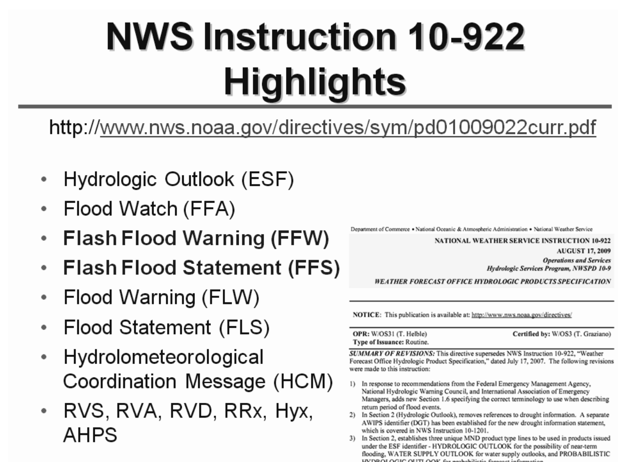
Student Notes:



10. NWS Instruction 10-922 Highlights

Instructor Notes: Flash Flood Warning product specification is in NWS Instruction 10-922. The focus here is on Flash Flood Warnings and Statements. Refer to the instruction (link is in the subtitle) for information on the other WFO Hydrologic Products.

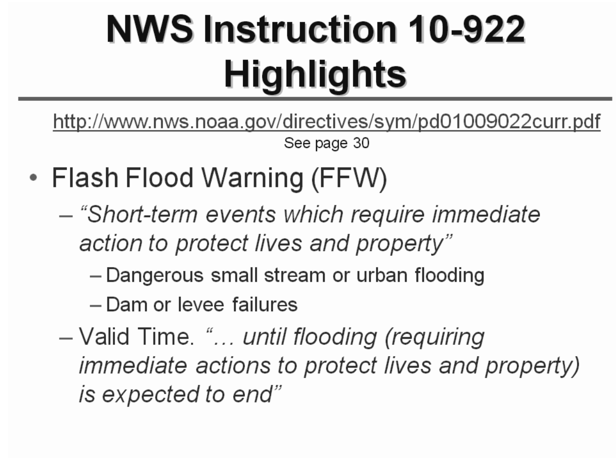
Student Notes:



11. 10-922 Highlights: Flas Flood Warnings

Instructor Notes: A flash flood warning will be issued when: Flash flooding is reported; Precipitation capable of causing flash flooding is indicated by radar, rain gages, and/or satellite; Local flash flood monitoring and prediction tools indicate flash flooding is likely; The effective time of a pre-existing warning changes; The geographical area covered by a pre-existing flash flood warning increases; A dam or levee fails; A sudden failure of a naturally-caused stream obstruction (including debris slide, avalanche, or ice jam) is imminent or occurring; or Small basin hydrologic models indicate flash flooding for specific locations along small streams.

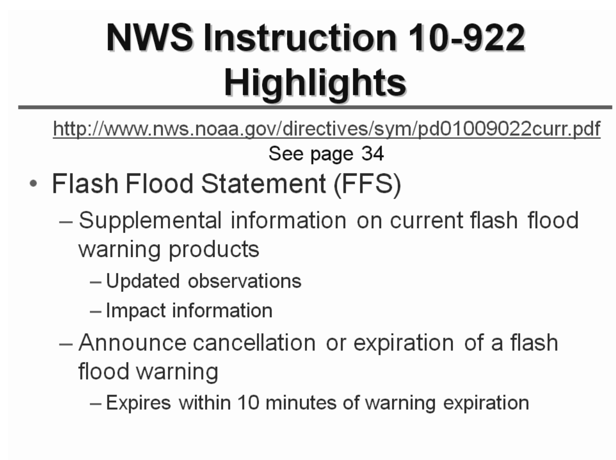
Student Notes:



12. 10-922 Highlights: Flash Flood Statements

Instructor Notes: Flash Flood Statements should include the latest information on the current flash flood warning products. Focus on useful information that will help customers and partners direct mitigation activities where waters continue to present a danger to lives and property.

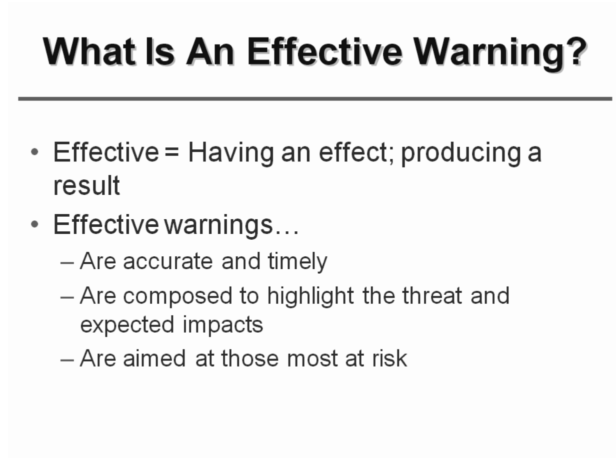
Student Notes:



13. What Is An Effective Warning?

Instructor Notes: First we learned that you as the sender of information can impact public response. We then quickly reviewed the "requirements" for a thunderstorm warning. Now we will look at how you can issue effective warnings.

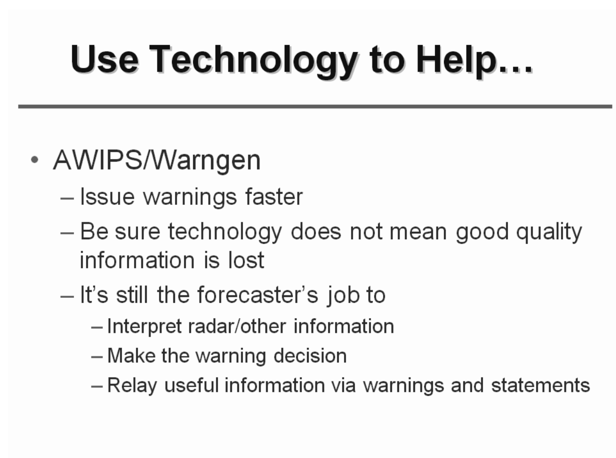
Student Notes:



14. Use Technology to Help…

Instructor Notes: Technology, such as AWIPS and Warngen, can help in the warning process, but the forecaster still has to make the warning decision and issue warnings and statements that meet the needs of the users.

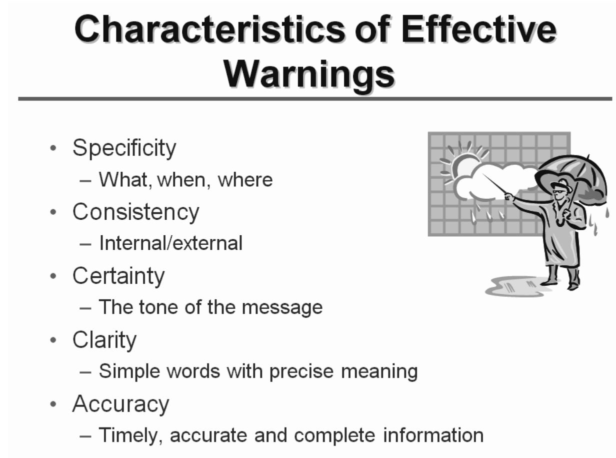
Student Notes:



15. Characteristics of Effective Warnings

Instructor Notes: Recall that the behavioral outcomes of the public in a warning situation are impacted by both the sender (issuing the warning) and receiver (those hearing the warning) factors. Severe weather warnings that include these five characteristics will have the best chance for a positive outcome.

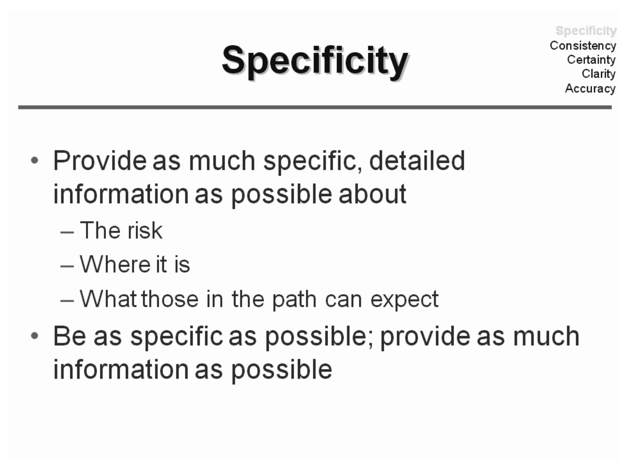
Student Notes:



16. Specificity

Instructor Notes: Although the what, when, and where is a requirement in a severe weather warning, the warning forecaster has latitude in the specificity of the warning. There are many occasions when specificity cannot be high. Include what you know in the warning message, be as specific as possible without exceeding the capabilities of the science and technology. An example of specificity comes from estimating a reasonable forecast of maximum winds in a warning. Some offices have worked with their EM community to blow sirens if expected winds exceed 65kts.

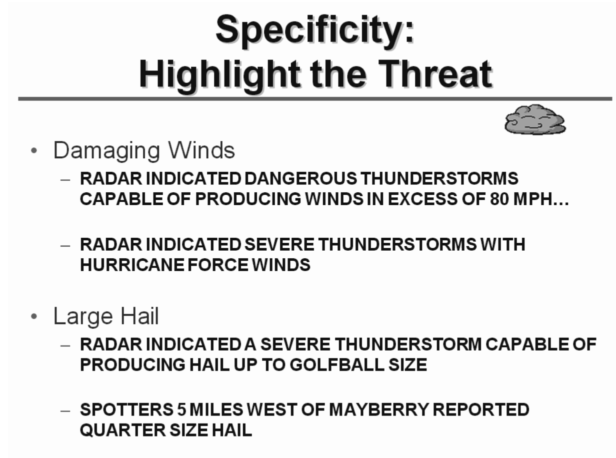
Student Notes:



17. Specificity: Highlight the Threat

Instructor Notes: Be as specific as possible about the threat.

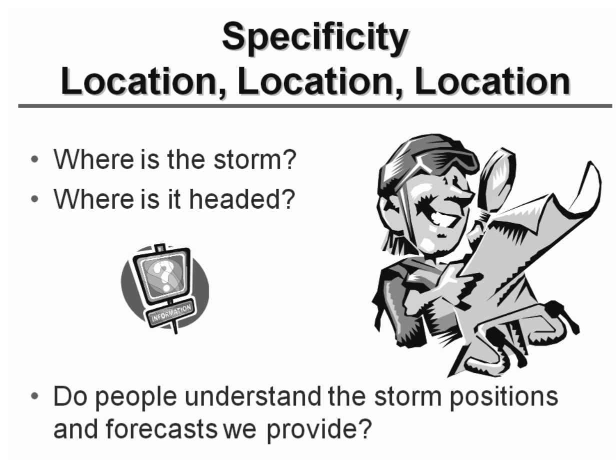
Student Notes:



18. Specificity: Location, Location, Location

Instructor Notes:

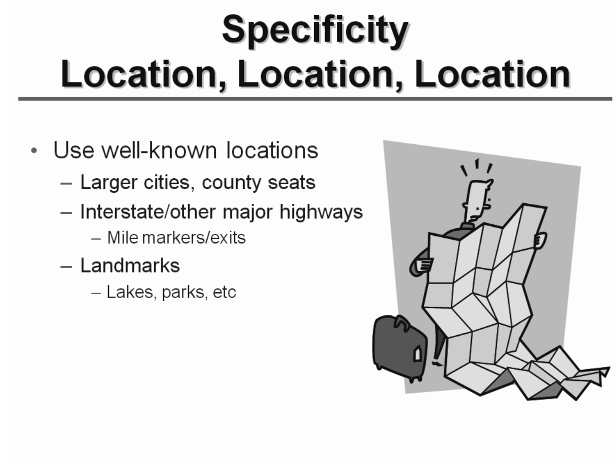
Student Notes:



19. Specificity: Use Well-Known Locations

Instructor Notes:

Student Notes:



20. Specificity: Help Travelers & Geographically Challenged

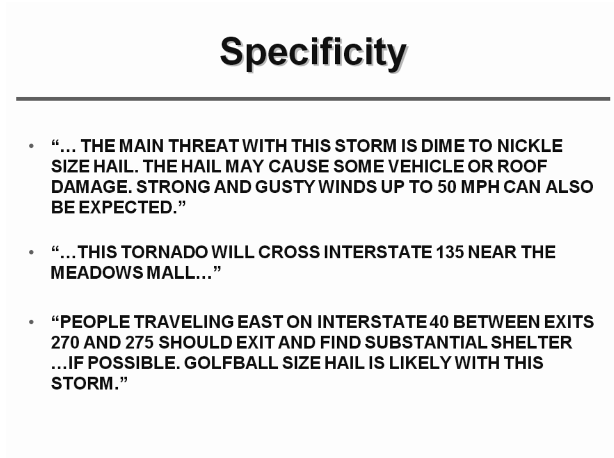
Instructor Notes:

Student Notes:

21. Specificity

Instructor Notes: Here are three example of actual statements in warnings. With each statement, what are potential outcomes? Are these the desired outcomes?

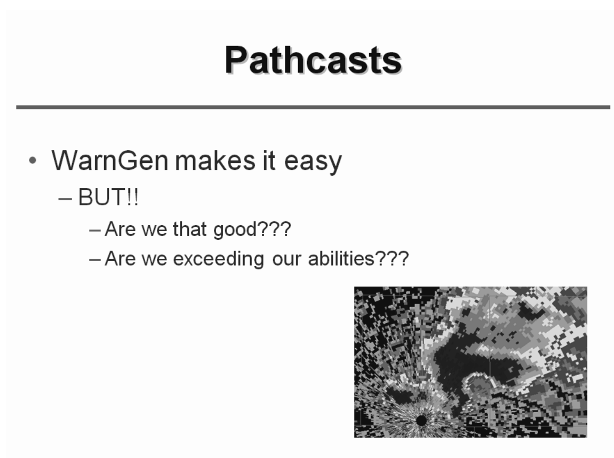
Student Notes:



22. Pathcasts

Instructor Notes: Pathcasts were intended to provide valuable information to users on where the tornado is expected to be during the course of a warning. However, its precision can easily be misused in providing users a false sense of security about where the tornado is expected to be. The science is not that good in forecasting specific locations and times that a tornado will be in the warning polygon.

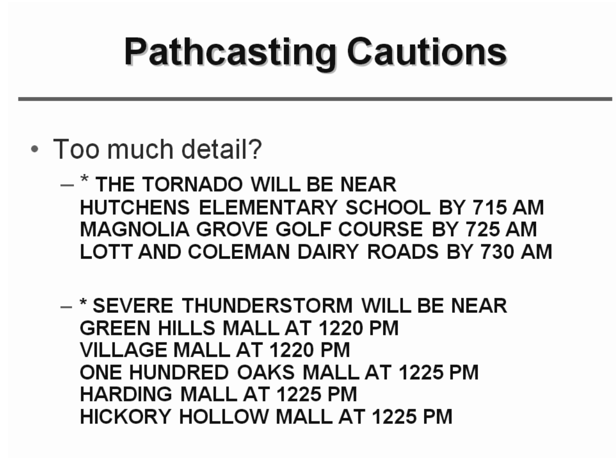
Student Notes:



23. Pathcasting Cautions: Too Much Detail?

Instructor Notes:

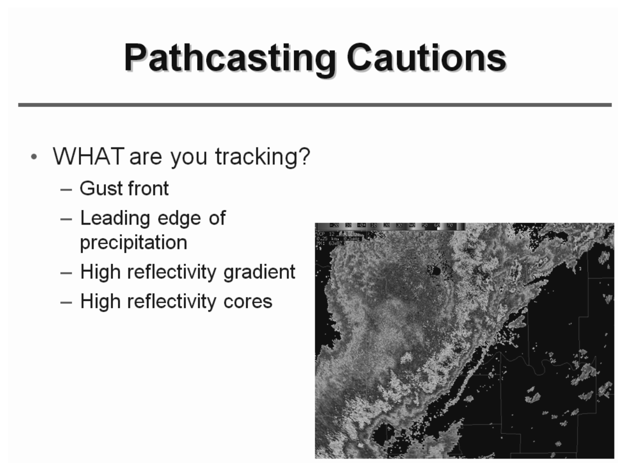
Student Notes:



24. Pathcasting Cautions: What Are You Tracking?

Instructor Notes: WHAT are you tracking? Gust front Leading edge of precipitation High reflectivity gradient High reflectivity cores

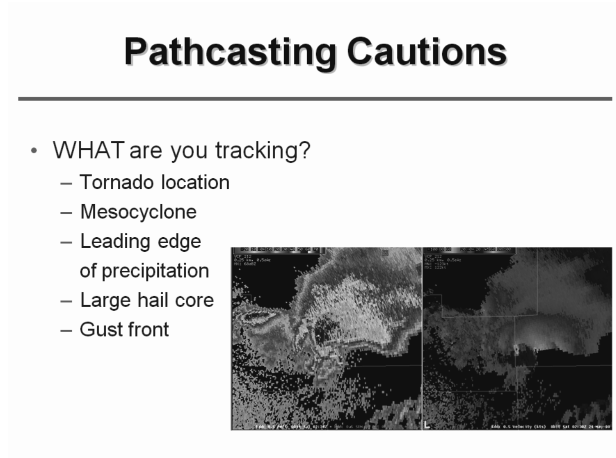
Student Notes:



25. Pathcasting Cautions: What Are You Tracking?

Instructor Notes: Another example is to make sure you track where the best possible location of where the tornado is and not the midlevel mesocyclone

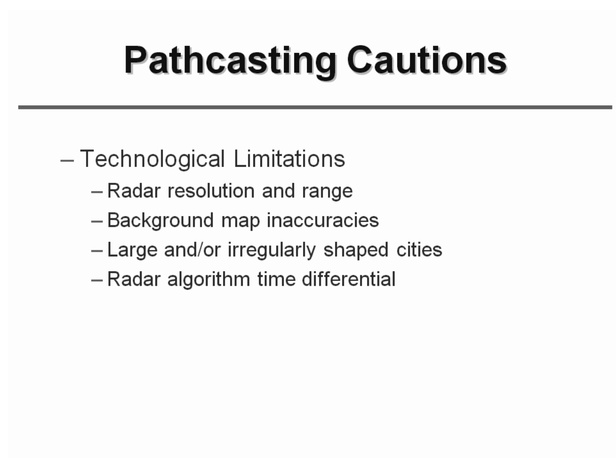
Student Notes:



26. Pathcasting Cautions: Technological Limitations

Instructor Notes: Another caution of pathcasting is to not forget the limitations of your radar. Don't forget that the resolution of the radar and height of the beam increase as you get farther from the radar. There are map background inaccuracies. Cities are depicted as a point but don't forget that they have geographical extent. Algorithms are time-lagged.

Student Notes:



27. Pathcasting Cautions: Meteorological Concerns

Instructor Notes: Meteorological concerns impact pathcasting including Erratic storm motion – speed/direction Storm interactions – splits, mergers Mesocyclone uncertainties Multiple threats from a single storm Tracking tornado arrival time may expose people in the path to large hail, damaging winds, flooding rains

Student Notes:

Pathcasting Cautions

- Meteorological Concerns
  - Erratic storm motion – speed/direction
  - Storm interactions – splits, mergers
  - Mesocyclone uncertainties
  - Multiple threats from a single storm
    - Tracking tornado arrival time may expose people in the path to large hail, damaging winds, flooding rains

28. Pathcast Cautions: An Example

Instructor Notes: Here is an example of why depending on pathcasts can lead to poor service. In this hypothetical example, there is a mesocyclone intensifying from 2212-2217 UTC that prompts you to issue a tornado warning outlined by the yellow polygon. Warngen allows you to track the track of the vortex, and that provides the basis for the general direction of the polygon. Consider towns A and B within the polygon. Notice that town A is directly on the extrapolated track and so it becomes mentioned in the pathcast. Five minutes into the warning, the vortex is close to the pathcast and all seems well. However by 2226 UTC (10 minutes in), the vortex has veered well to the right of your pathcast and is beginning to slow down more than you previously thought. And by 19 minutes into your warning, town B is seeing a tornado on its doorstep despite it not being mentioned in the pathcast. Yet town B is still well inside the tornado warning polygon. These implications are why the Mother's day 2008 tornado outbreak service assessment stressed that pathcasts should not be emphasized because such previous emphasis caused a dangerous over-reliance on pathcasts.

Student Notes:

Pathcast Cautions: An Example

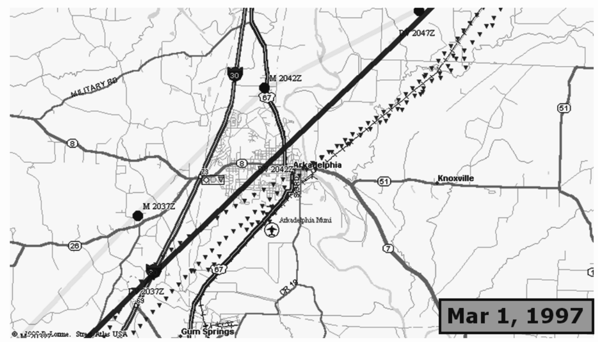
- An hypothetical example
- Town A is in the pathcast

29. The Dangers of False Precision

Instructor Notes: Here is a comparison of tracks from the Mesocyclone algorithm (yellow), TVS algorithm (red), actual tornado (red triangles). The radar circulation signature may be some distance from where the tornado is occurring. This becomes an even greater problem using a linear extrapolation pathcast since the track will usually be non-linear. Reference: Correlation Between Tornado Damage Paths and WSR-88D Signatures, and Resulting Implications for the use of Pathcasts in Tornado Warnings Steven Piltz and Richard Smith: NWS, Tulsa OK

Student Notes:

The Dangers of False Precision



30. Making Pathcasts More Effective (realistic)

Instructor Notes: If you are compelled to use pathcasts, here are some suggestions on pathcasts. Only forecast short distance ahead in initial warning with frequent updates Use range of arrival times based on storm type/threat/motion Simply mention towns in path for the valid period of the warning – more precise updates via the SVS

Student Notes:

Making Pathcasts More Effective (realistic)

- Only forecast short distance ahead in initial warning with frequent updates
- Use range of arrival times based on storm type/threat/motion
- Simply mention towns in path for the valid period of the warning – more precise updates via the SVS

31. awoccore4lesson3resp1

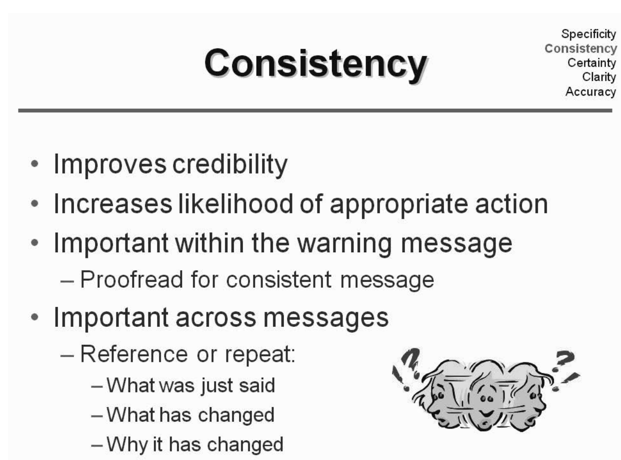
Instructor Notes:

Student Notes:

32. Consistency

Instructor Notes: A consistent message is important in establishing the credibility of the message. Often different warning forecasters are writing warnings and statements, and sometimes neighboring offices will be writing statements about the same storm. Frequent communication within the office and between neighboring offices is necessary to ensure a consistent message. Use of the "Call-To-Action" statements in Warngen can sometime result in an inconsistent message within an individual warning or statement. A quick proofread of the warning prior to issuance can help keep the message consistent. Keep the flow from message to message consistent by referencing or repeating previous statements.

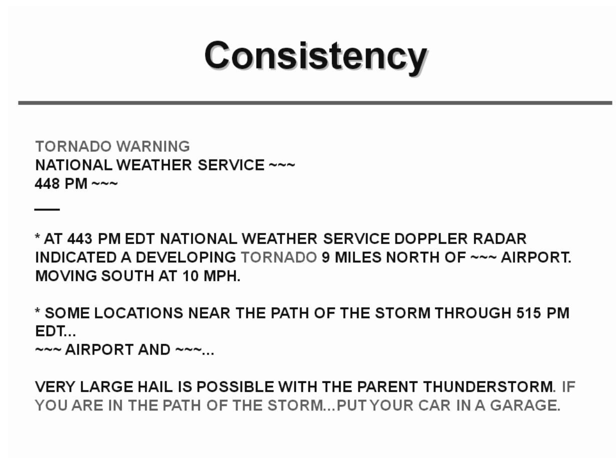
Student Notes:



33. Consistency: Example #1

Instructor Notes: The intent might have been to indicate that the hail is in a different location than the tornado. This problem is the confused public may go outside to put the car in the garage as a tornado hits. Call to action statements that are not consistent with the body of the warning happens more than we would like. Proofreading your warning for consistency of message before issuing may help.

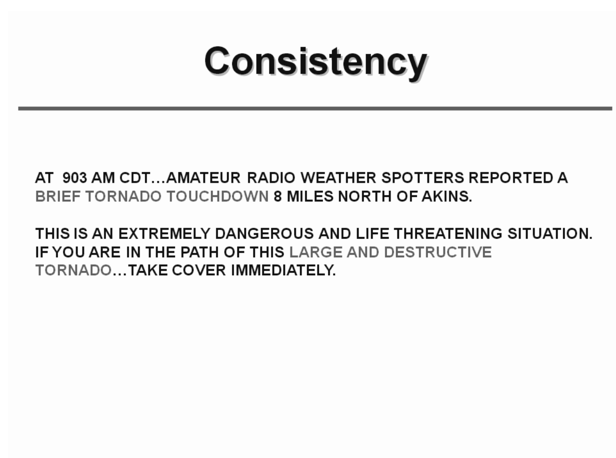
Student Notes:



34. Consistency: Example #2

Instructor Notes: And another example of where call-to-action statements in Warngen can cause problems in consistency of the message.

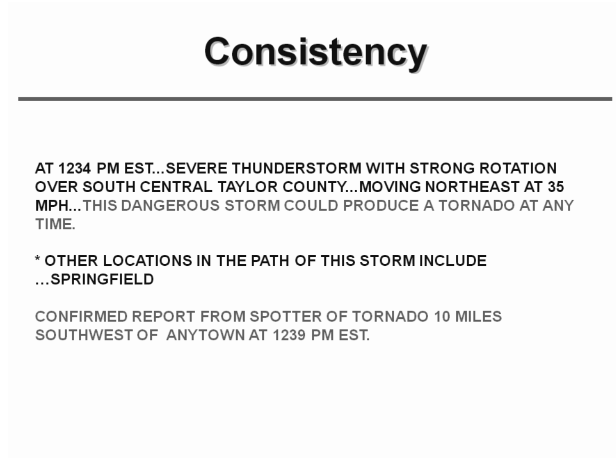
Student Notes:



35. Consistency: Example #3

Instructor Notes: Another example of where call-to-action statements in Warngen can cause problems in consistency of the message.

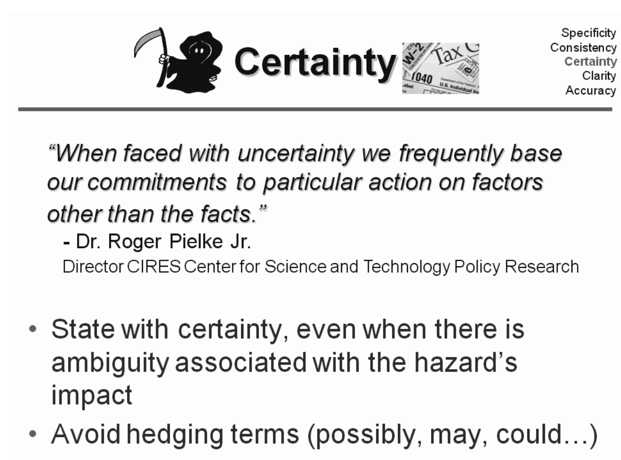
Student Notes:



36. Certainty

Instructor Notes: A warning message should be stated with certainty even in circumstances in which there is ambiguity associated with the hazard's impact. "Hedging" terms tend to spur the listener into "inaction" rather than action. Using terms which indicate action or development can fill the gap in listener's minds between "nothing's happening" to "it's too late now".

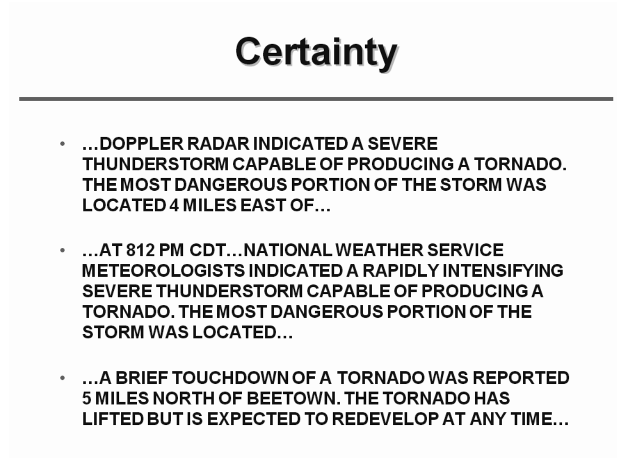
Student Notes:



37. Certainty: Examples

Instructor Notes: Even though the impacts in all of these situations are uncertain, these statements have included a degree of certainty that would tend to spur the listener to action.

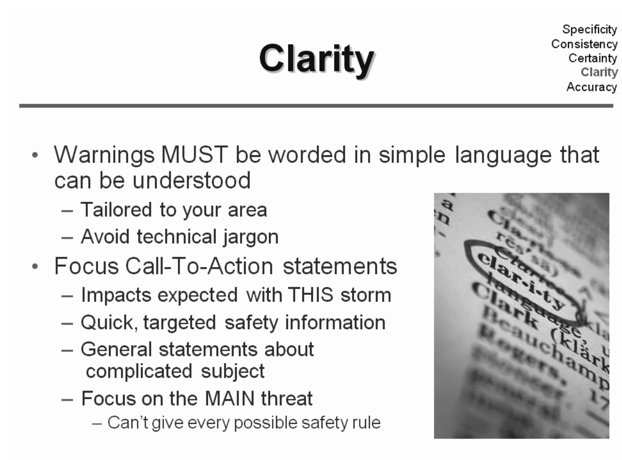
Student Notes:



38. Clarity

Instructor Notes:

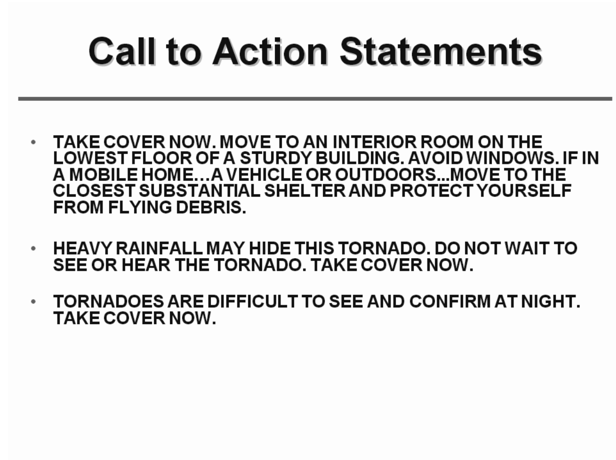
Student Notes:



39. Call to Action Statements (Page 1)

Instructor Notes: Clarity is especially important in “Call To Action” statements. Keep it simple!

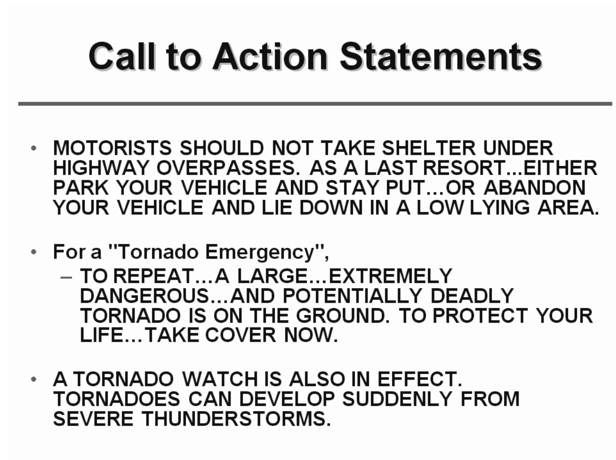
Student Notes:



40. Call to Action Statements (Page 2)

Instructor Notes: More examples of simply worded “Call-To-Action” statements.

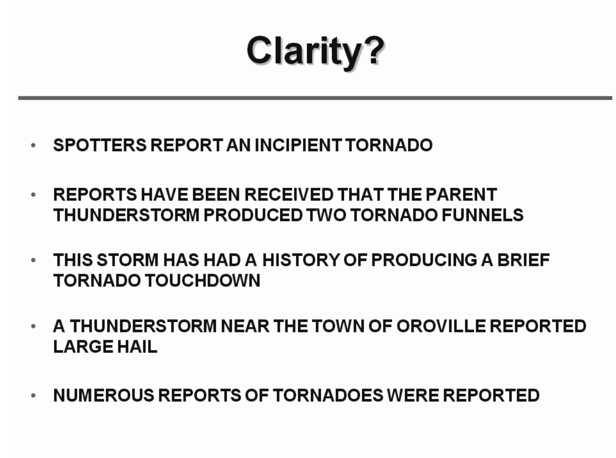
Student Notes:



41. Clarity?

Instructor Notes: What is wrong with each of these statements?

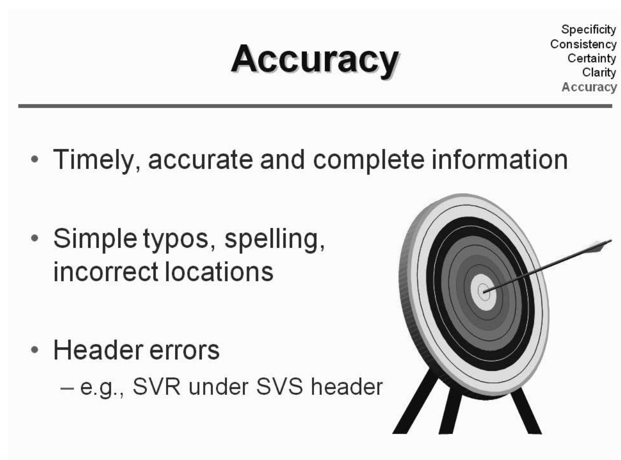
Student Notes:



42. Accuracy

Instructor Notes:

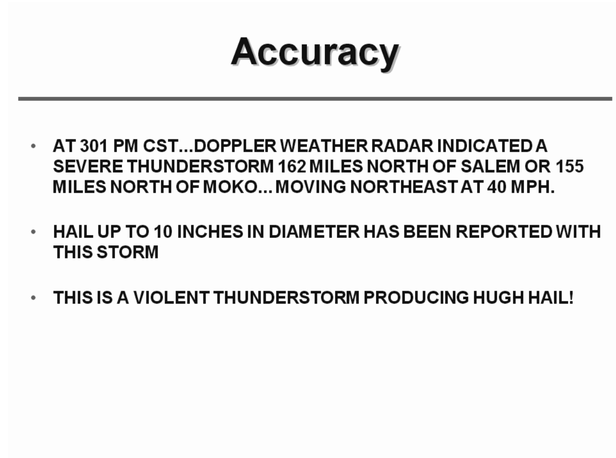
Student Notes:



43. Accuracy: Examples

Instructor Notes:

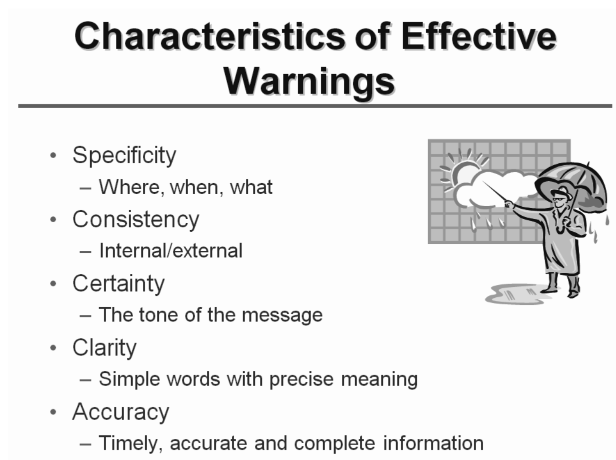
Student Notes:



44. Characteristics of Effective Warnings

Instructor Notes:

Student Notes:



45. AWOC-core4-lesson3-quiz2

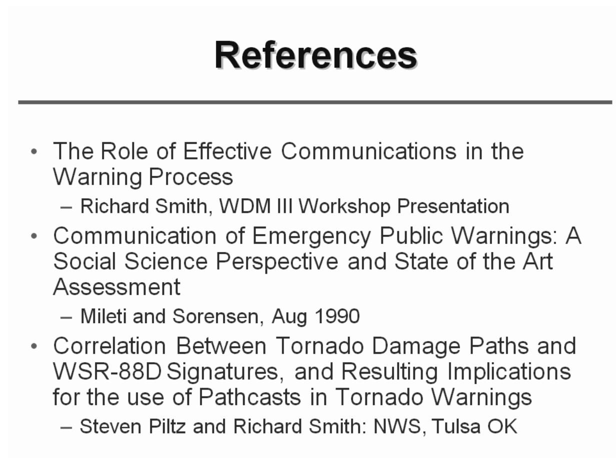
Instructor Notes:

Student Notes:

46. References (Page 1)

Instructor Notes:

Student Notes:



47. References (Page 2)

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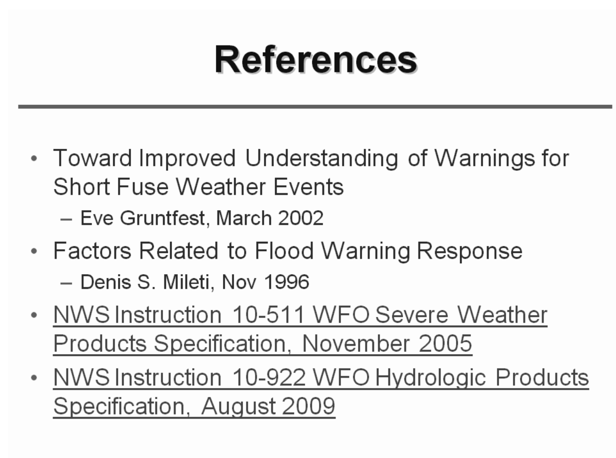


48. End of Lesson

Instructor Notes: You have completed this lesson on Effective Warnings. Please complete the remaining lessons in this Instructional Component before attempting the test required for completion. The test should be taken as soon as possible after completing all of the lessons. If you have any questions about this lesson, first ask your training facilitator. If you need additional help, please send an e-mail to the address listed on the slide. Thank you for your time and good luck on the exam!

Student Notes:

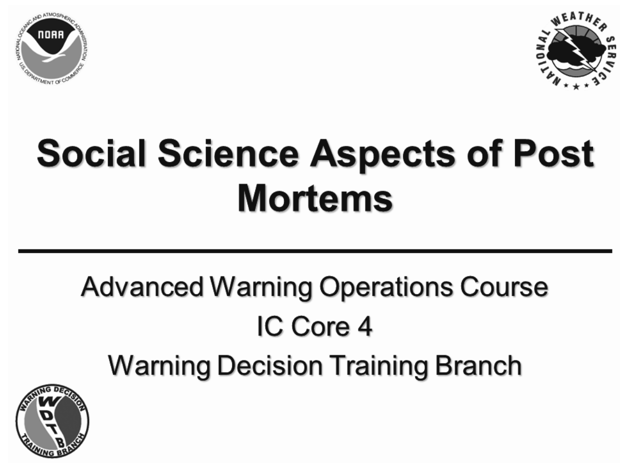
End of Lesson

Questions about this lesson
"Effective Warnings"?
E-mail: awoccore_list@wdtb.noaa.gov

1. Social Science Aspects of Post Mortems

Instructor Notes:

Student Notes:



2. Overview

Instructor Notes: Post mortems offer an opportunity for agency growth and creativity. Many of the social science disciplines can bring a fresh and useful perspective to the review and analysis of event management, partner interaction, agency policy and procedures, and the warning process.

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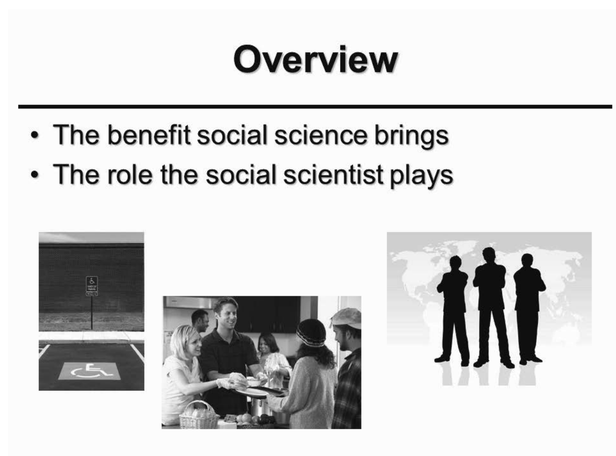

3. Learning Objectives

Instructor Notes: Here are the learning objectives for this module.

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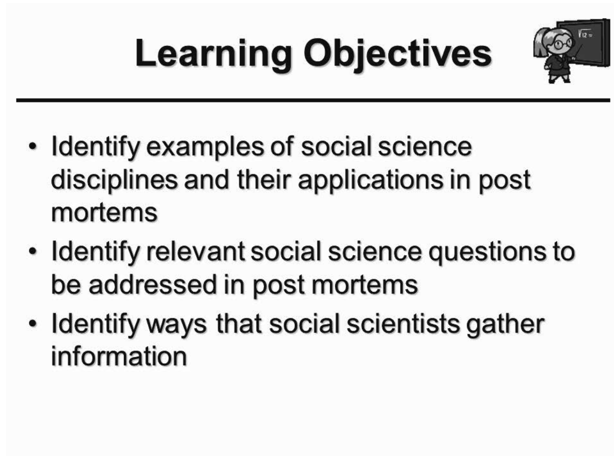

4. How does social science relate to post mortems?

Instructor Notes: If we are to look at the end-to-end warning cycle, it must include the human response. This is the strength that the social scientist brings to the table. Understanding the human response, can inform the entire decision-making process. By bringing social science into the service assessment (a form of a post mortem) process, we can incorporate most facets of the end-to-end warning cycle.

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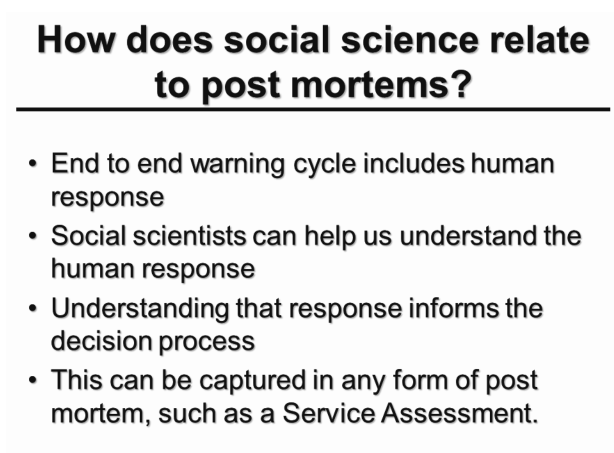

5. What is a Social Scientist?

Instructor Notes: Social science is an umbrella term that refers to many disciplines that study human behavior and interactions. Here are a few examples. "An Anthropologtist might study how the cultural rules of the Amish affect how they receive and interpret weather warnings. A psychologist might look at which personality traits dominate in people who are inclined to take weather related precautionary action. An Economist can see if there is a relationship between people who are risk adverse about insurance and those who are risk adverse about winter weather hazards. A Political Scientist could assess if there is party affiliation can be used to motivate weather preparedness among community groups. A Communicologist might look at how NWS web products are likely to encourage repeat use by a non-technical user. A Geographer would help us understand how are people impacted during long duration severe heat events. And a Sociologist may study how people in a community receive their weather warnings. All of these perspectives are valuable when understanding the entire communication process.

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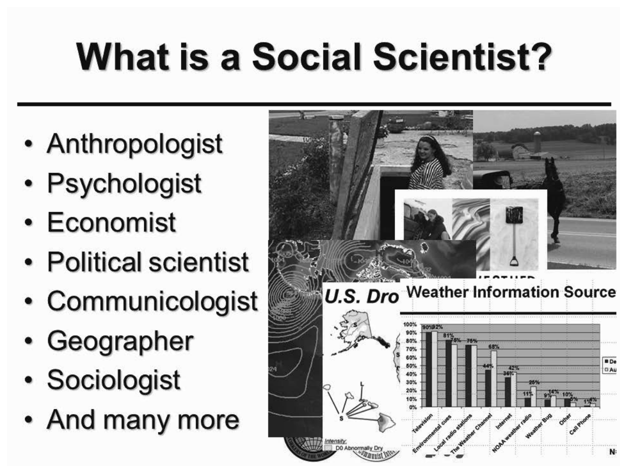

6. What do these have in common?

Instructor Notes: Social scientists ask and answer questions about human experience in a systematic manner. By doing this, they attempt to build both knowledge and create understanding about how human behavior can be influenced and marshaled for the greater and individual good. Social scientists may study individual, organization, or community behavior. No matter what the focus, the intent of the social scientist is to study human action/behavior either at the individual or collective levels. Both the individual and collective levels of analysis are important in a post mortem. Social scientists can help explain how individuals may behave and they can explain how organizations operate, such as how well the weather enterprise operates during a severe weather event or how well processes function, such as how well people receive warnings in the severe weather warning process.

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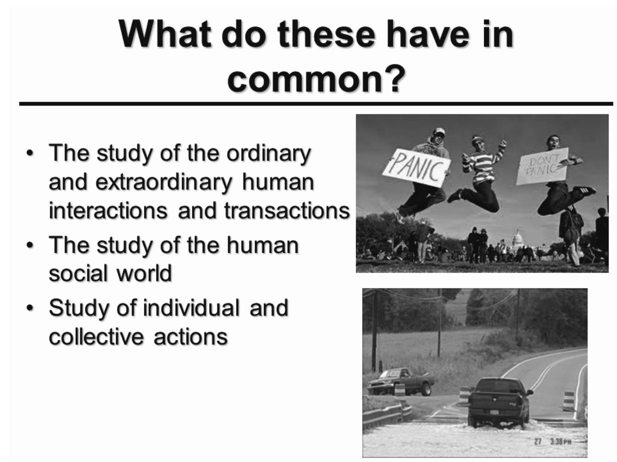

7. Social science aspects of Post Mortems

Instructor Notes: One less obvious aspect of applying social science to the process of conducting post mortems is that the "intra-organizational" analysis can be directed at NOAA/NWS policies and practices. At the community level, the post mortem can look at how the event was handled by the entire weather enterprise and how the public reacted and responded. In some sense, this may be better than focusing only on individual behavior in severe weather events because individual behavior may not be indicative of how well the weather enterprise and the community responded. For example, in the April 27th 2011 tornado events in MS, AL, and GA the weather enterprise questioned how well they did when there were so many fatalities. By studying only individual behavior, one might assume that there were problems in getting the weather warnings to people, but also by studying the weather enterprise, it was clear that the weather enterprise had operated very well and that some people either just ignored weather warnings or some people could not take action, even when they got the warnings.

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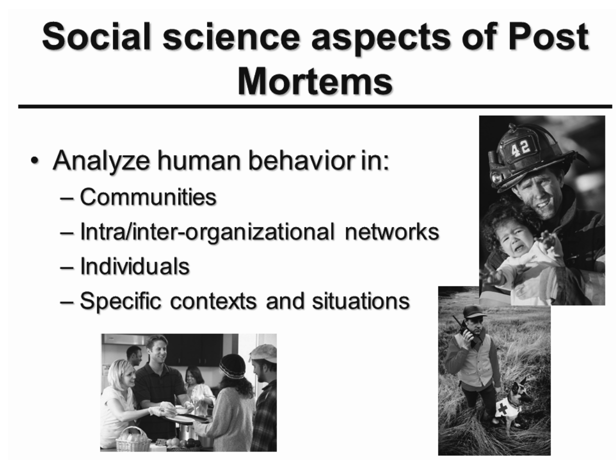

8. Emergency response goal

Instructor Notes: And what role might NOAA/NWS play in this? Not only immediately before, during and after a major weather event, but in the other “down times”? This overall Emergency Response Goal can be assessed by the inclusion of the social science approaches in the post mortems. The social science approaches must collaborate with the approaches of the meteorologists in the post mortem to address this goal as this is the same goal they are assessing in the post mortem.

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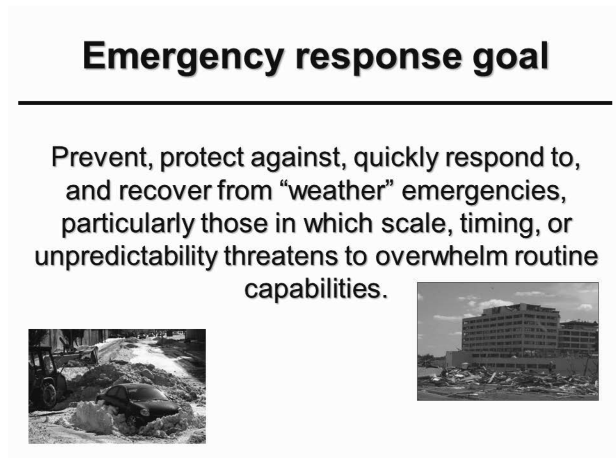

9. Emergency Response Actions

Instructor Notes: These are some of the major processes and practices to be assessed through the post mortem. It’s important to assess how we monitor and investigate in real time as well as how we communicate critical information. We need to develop, practice and improve our response and look at the skills, attitudes, and capabilities that the weather enterprise needs. Finally, we need to look at how we educate the communities.

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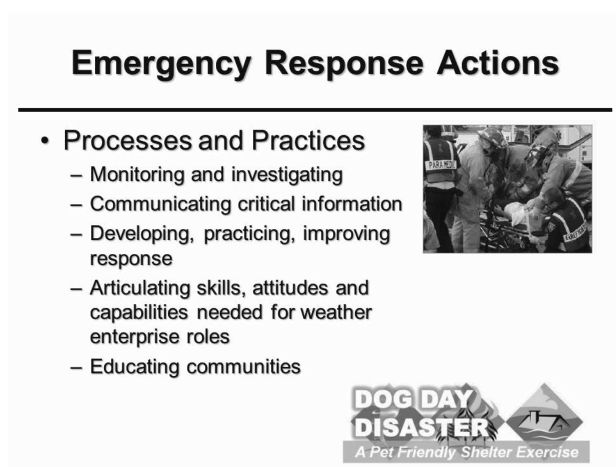

10. Emergency Response Actions …cont

Instructor Notes: These are some additional aspects that can be assessed in the post mortem. What are the infrastructures and resources we need in emergency response? That might mean the labs, centers and offices we use. It also means we look at how we operate and maintain our assets. Are the technologies we use for communication appropriate?

Student Notes:

11. Role of Social Science in Post Mortems/Service Assessments

Instructor Notes: How do individuals, organizations, and communities prepare for severe weather events? What was the baseline before the event being assessed in the post mortem? Some communities may be more or less resilient, have mitigated or failed to mitigate again potential severe weather outcomes, and may be well or ill-prepared for these events. As part of the PM, the social scientists can assess that baseline and determine how well things functioned to report on how resilient the impacted areas were during the event. The results can help to educate the public on how to take better action in the future, direct first responders in their response activities in future events, and help make communities more resilient for future events. It will also help to identify the partner relationships that existed in the weather enterprise at the time of the event and how well those partnerships worked. It will also reveal weak partnerships, strong partnerships, and the need to add additional partners in future events. The analysis will also provide information for future planning for prevention, mitigation, and preparedness.

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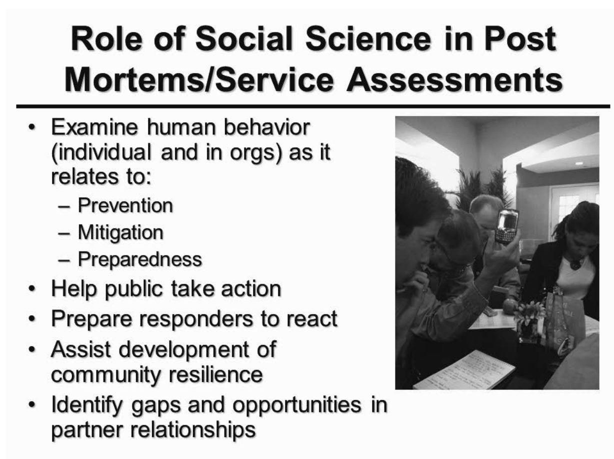

12. Social scientists could ask these questions

Instructor Notes: These are some of the questions that could be asked by the social scientist on the team. The questions should be derived from the mission of the post mortem and then the meteorologists and the social scientists should work together to determine which questions are relevant to the mission. The Post Mortem will be time limited so the development of the questions is essential to make sure that the right questions are posed and assessed as part of the PM. Other questions can be asked/assessed if there is time, but it is critical to focus on a set number of questions.

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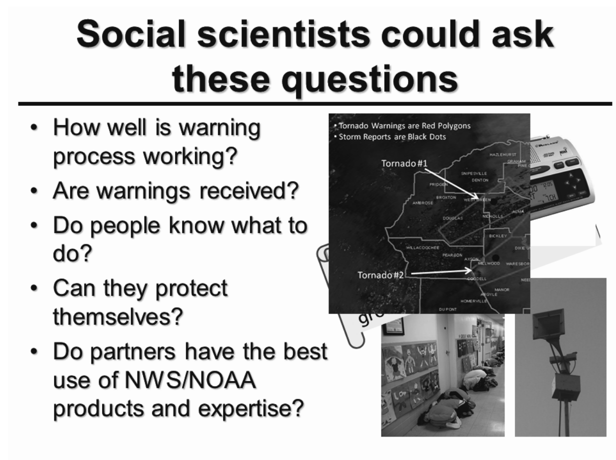

13. Venue for investigationSmall scale

Instructor Notes: A local office can choose to do a local assessment any time. These can be done more often and can look more closely at processes and procedures via a self-evaluation on a routine basis.

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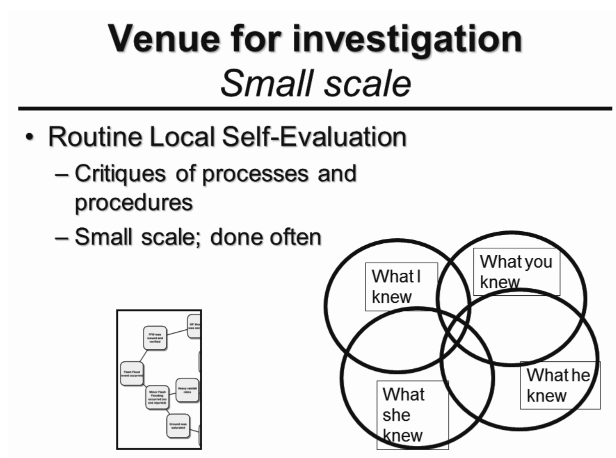

14. Venue for investigationLarger scale

Instructor Notes: Service assessments can be one avenue to investigate an event. They can be thorough and involve lots of participants. Unfortunately because of this, they don't happen very often. Thus there is a small data set generated (when compared to the actual number of events).

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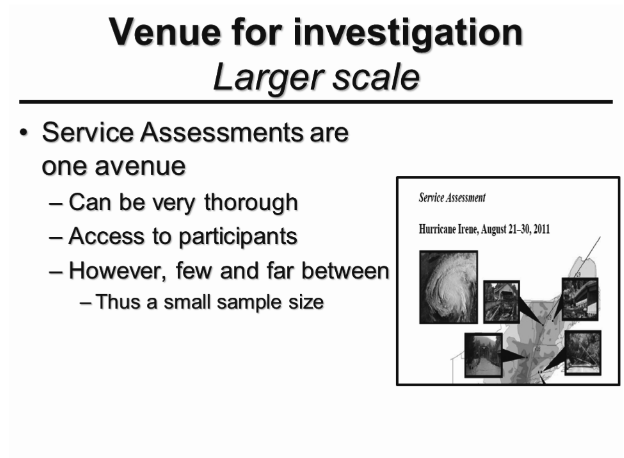

15. Venue for InvestigationService Assessments

Instructor Notes: A service assessment affords the opportunity to take a much larger look at and consideration of all of the players in an event. It can take into account the many aspects of human behavior on several scales. This includes the weather enterprise, the community, the individual, NOAA and NWS, and the coordination that occurs across agencies. We'll look at these and how they might be assessed in a service assessment.

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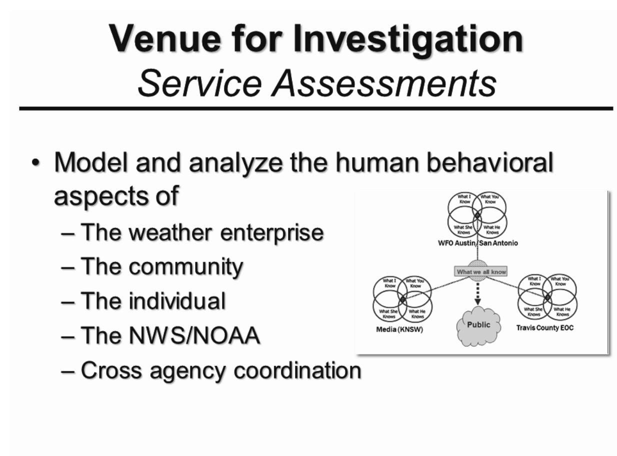

16. Weather EnterpriseWho is this?

Instructor Notes: What do we mean by The Weather Enterprise? The weather enterprise includes all of the partners in the dissemination of weather education, knowledge, forecasts, and warnings, as well as response and recovery from those events. In this case the public is a partner, not a passive receiver. The concept of Weather Ready Nation expands this. The National Weather Service, emergency management, and broadcast meteorologists are the primary partners but they form a network with all of the partners who assist in this process as well as receive and use the information. Partners include all first responders, schools, government, businesses, social service organizations, utilities, as well as all publics who consume this information.

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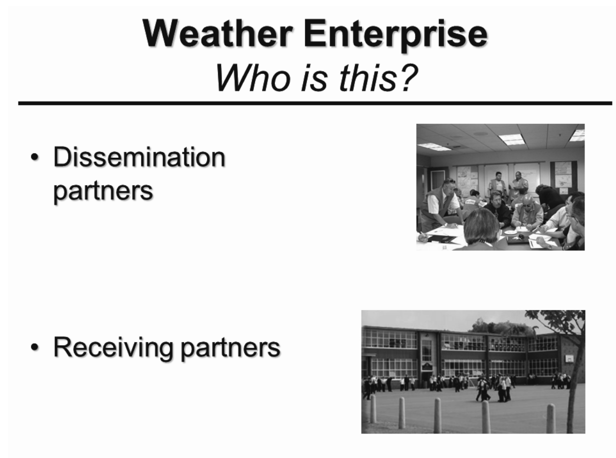
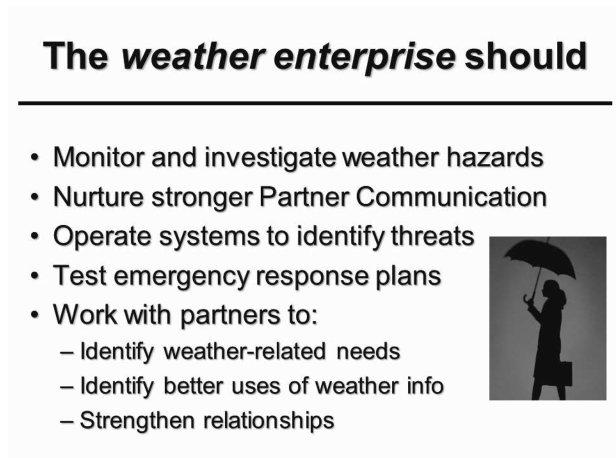


17. The weather enterprise should

Instructor Notes: With a partnership in mind, the weather enterprise should monitor and investigate weather hazards. Each should have a stake in establishing stronger partner communication. They should work to identify threats and test the response to those threats. Together they can better: Identify weather-related needs Identify better uses of weather info Strengthen relationships

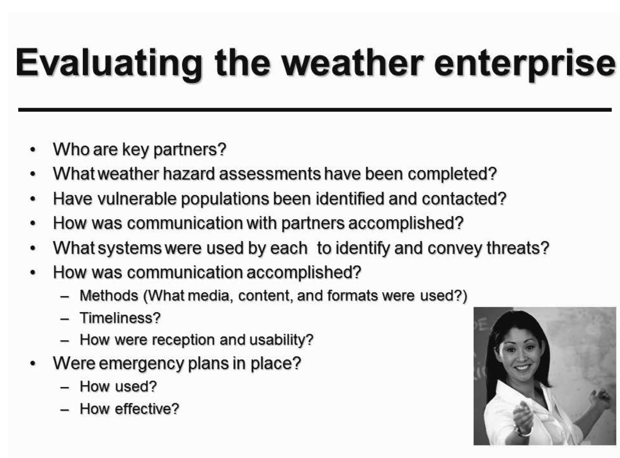
Student Notes:



18. Evaluating the weather enterprise

Instructor Notes: To evaluate the effectiveness of the weather enterprise, the social scientist may ask the follow questions: Who are key partners? What weather hazard assessments have been completed? Have vulnerable populations been identified and contacted? How was communication with partners accomplished? What systems were used by each to identify and convey threats? How was communication accomplished? Methods (What media, content, and formats were used?) Timeliness? How were reception and usability? Were emergency plans in place? How were they used? How effective were they?

Student Notes:



19. The Community's role is to

Instructor Notes: What is a community? It is a system of networks, one of which is the weather enterprise network. All networks in a community operate to connect people and needs as well as to serve as a communication system. It is the planning of all of these networks that make a community more resilient to severe weather events. Any gaps in these partnerships between networks and any communication breakdowns can be a reason for lack of resilience. The PM should assess/evaluate how well these community networks partner with the weather enterprise network and the level of inclusion of relevant partners. Severe weather event planning should be taking place and exercising of these plans should be in place prior to severe weather events. A lack of preplanning and exercising may mean that a community is not prepared to respond properly to severe weather warnings. Here is an example: in the 2012 Derecho storm event, the Kentucky Motor Speedway was in the path of the Derecho. The weather enterprise was connected to the Speedway for emergency planning purposes so that the Speedway could be informed of any severe weather events that might impact their large population venue. They received a direct call from the NWS of the warning and were able to evacuate their field in advance of the impact. Had they not been partnered with the NWS and other planning partners, they might have received the warning too late to have enough time to evacuate and if they had not planned for such a situation, they might not have had the procedures and protocol to conduct that evacuation effectively.

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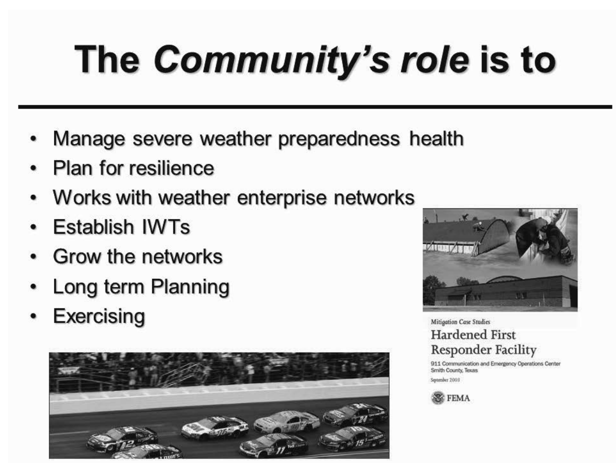

20. Evaluate by asking these questions

Instructor Notes: These are examples of questions that can be used to assess community network and partnership functioning.

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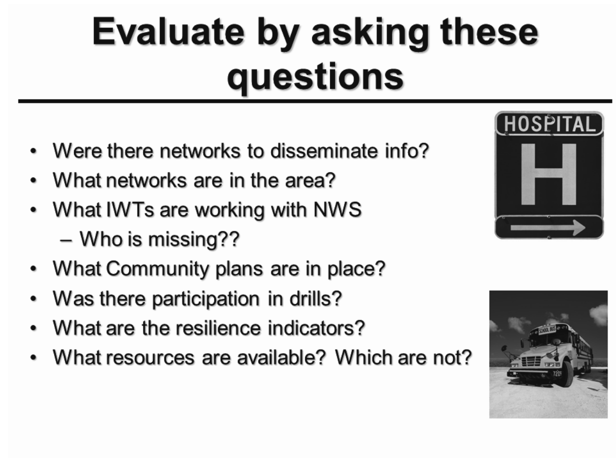

21. The Individual's role

Instructor Notes: Ultimately, it comes down to how well the individual acts in the severe weather event. The social sciences can be used to assess how well the public was educated about severe weather response prior to the event, whether vulnerable populations were unable to mitigate or prevent impact from severe weather, whether the public understood the warnings, and how well prepared people are when they can get the warnings and can take action. Some people are more weather aware and more prepared. Others are less aware and less prepared. Good public education can change this. Asking the public how well they were warned of the weather and what kind of preparedness plans they have is critical. It is also important to know if people in a community are critical nodes of communication that help disseminate weather warnings. For instance, do church leaders, community leaders, neighborhood leaders, school leaders pass warnings on to their communities to speed the process and to add authority to the warnings?

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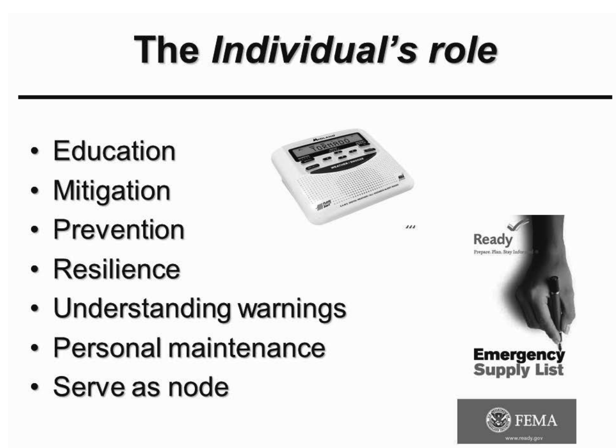

22. Evaluating the Individual by asking…

Instructor Notes: In order to evaluate the community, the social scientist may pursue answers to the following questions. Can public identify education they've received? Did they have safe plans? Did they use them? Were there mitigation efforts? Seasonal or short term? Did they receive warning? Understand? Were they prepared? Did they take action? Did the action work? What would they do next time? Differently? The same?

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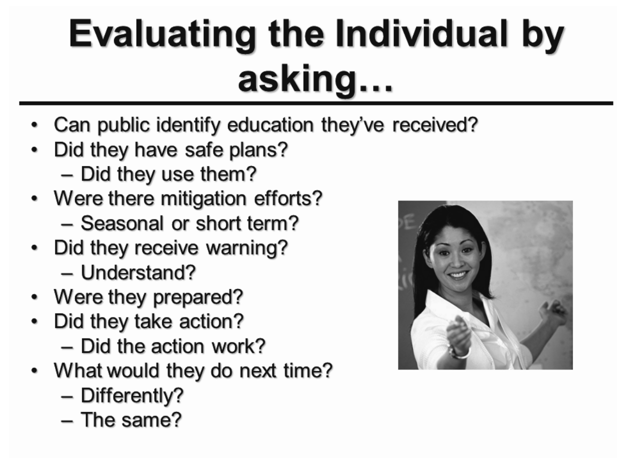

23. Social Science Approaches to data gathering

Instructor Notes: These are some of the approaches that the social scientists can use in the post mortem or service assessment in order to gather data and answer the questions posed elsewhere in this module. The approach used will depend on the questions to be asked and the nature of the population to be studied. Each of these approaches have limitations and the social scientists can provide their knowledge on which approach will work best for the particular PM.

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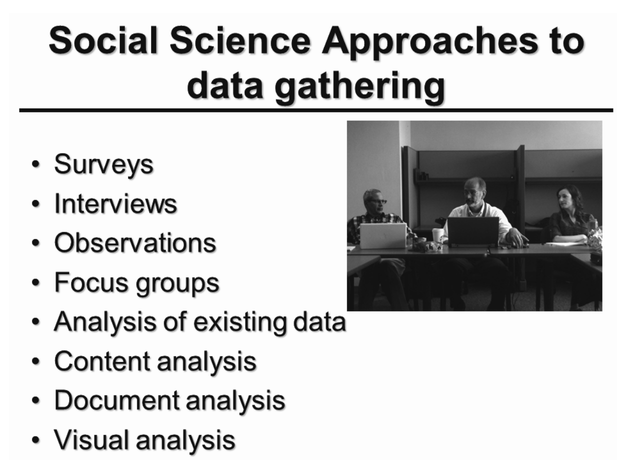

24. Summary

Instructor Notes: A thorough look at any weather event and the response associated with it can benefit from the presence of a social scientist. Social science is a broad term which includes many disciplines that take into account human behavior. Social scientists have several methods for gauging the response of groups and individuals in significant events.

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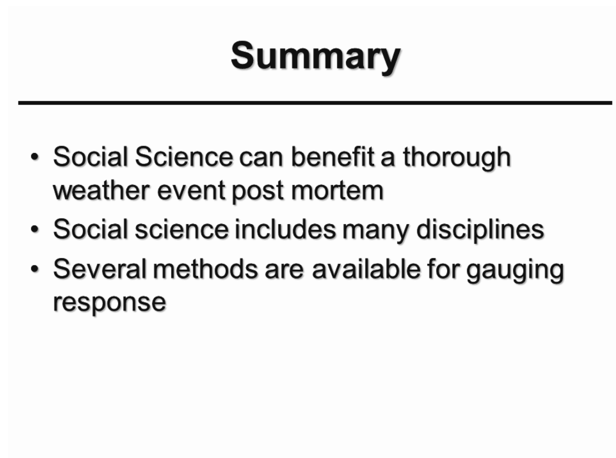

25. Questions?

Instructor Notes: If you have questions about this material, first check with your AWOC facilitator (most likely your SOO). If your AWOC facilitator cannot answer your question, please send an email to awoccore_list@wdtb.noaa.gov. You may also choose to contact the social scientists who developed this material Dr. Susan Jakso: jasko@calu.edu Dr. Laura Myers: drlauramyers@gmail.com Dr. Vankita Brown: Vankita.brown@noaa.gov

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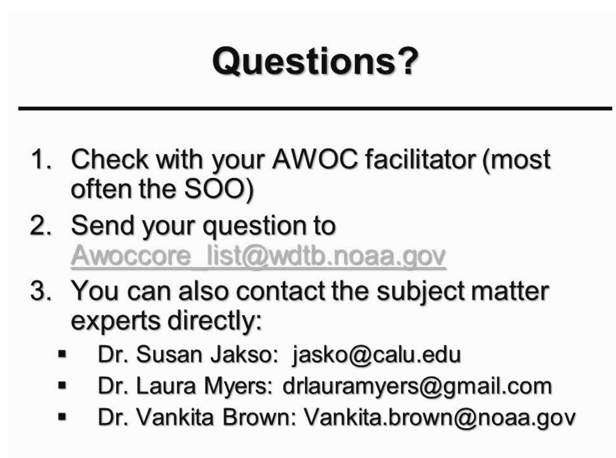

26. References

Instructor Notes:

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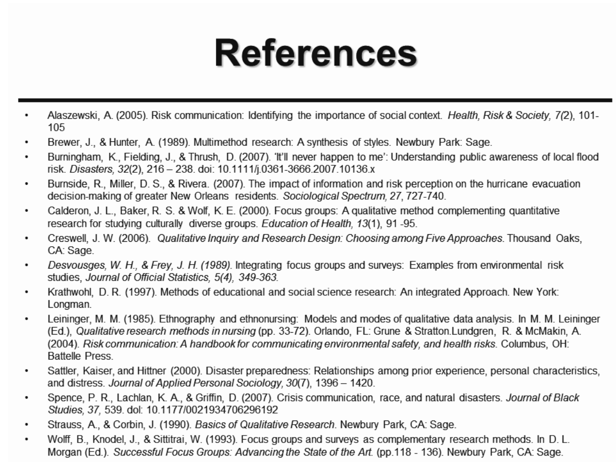
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1. Communicating Risks in High-Impact EventsModule 1: Crisis Communication Cycle & Stories of Decision Support

Instructor Notes: Welcome to Communicating Risks in High-Impact Events. This is Module 1 of a two part course brought to you by the Warning Decision Training Branch. This first Module is composed largely on collections of personal stories and perspectives of individuals involved in recent, high-impact decision support events in the NWS. From these actual accounts we will show the components and complexities of risk communications in high-impact events.

Student Notes:

2. Module Rationale

Instructor Notes: The rationale for this course is based on an analysis of collective recurring recommendations dealing with communication issues over the past twenty-two years of NWS Service Assessments. In the analysis of past recommendations, we observed a pattern of recurrence of certain issues such as communication, collaboration, and coordination. These were either documented problems dealing with internal communication matters, or external communication factors, such as communication with adjacent NWS offices during warnings of storms crossing County Warning Area boundaries, or issues with communicating with core partners. For example, in the Mother's Day Weekend Tornado Service Assessment from May 10, 2008, echoing a finding from the Super Tuesday Service Assessment of the same year, the Team found information exchange with Core partners (like an EM) was a key factor in the effectiveness of rapid communication of risk of high-impact events. The course presented does not expect that the application of the principles presented here will overcome all the challenges of the NWS faced with risk communication of high-impact events. However, it is hoped that the NWS can help mitigate future problems by better understanding the risk communication life cycle and use sound crisis and risk communication planning.

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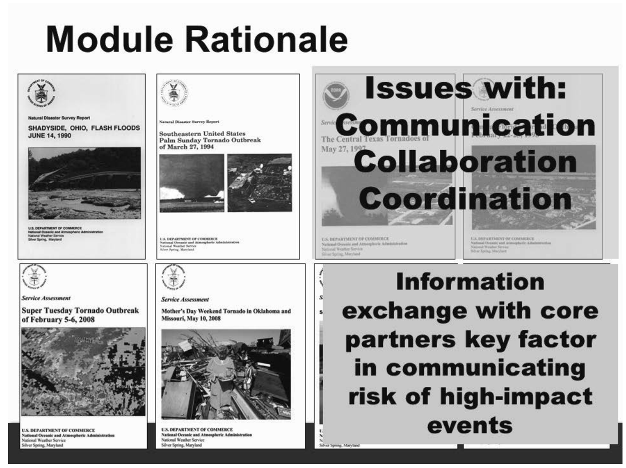

3. Course Design

Instructor Notes: As mentioned, this is Module 1 of the Risk Communications Course. It provides a structure and process for us to learn about the risk communication cycle via four stories from the field. Module 2 is on ways to gather user needs via information-spreading networks. As a part of Module 2, there is an associated office-wide assignment for NWS staff to demonstrate how weather information flows through your local core partners in a risk communication example. If you are taking this Course as part of the AWOC Core Track, you are not required to complete Module 2.

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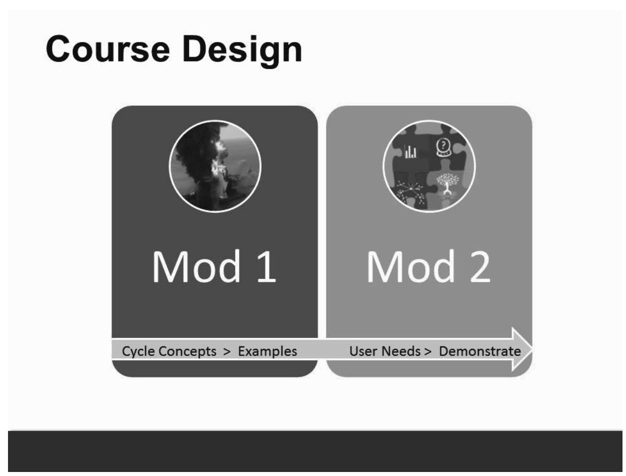
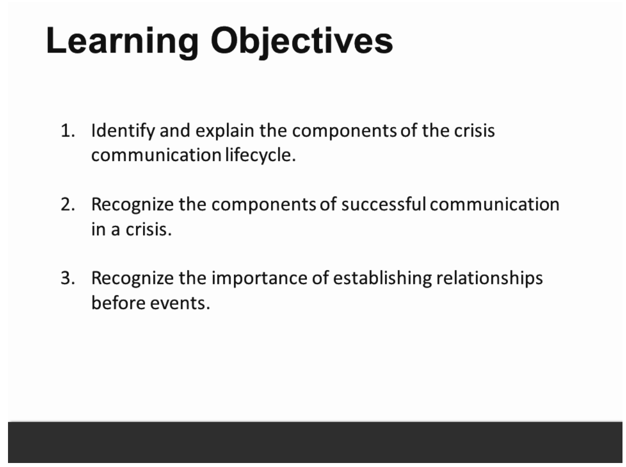


4. Learning Objectives

Instructor Notes: This module has three learning objectives that are designed to help you successfully navigate through a crisis communication cycle. Identify and explain the components of the crisis communication lifecycle. Recognize and use the components of successful communication in a crisis. Recognize the importance of establishing relationships before events. We'll keep going back to these objectives as we go through this lesson.

Student Notes:



5. Why is This So Important?

Instructor Notes: One of the cornerstones of moving the NWS to a Weather-Ready Nation is providing effective Impact-based Decision Support Services (IDSS), which means not only improving the precision of our risk forecasts, but effectively communicating that risk more effectively through proven social science principles. Risk communication is defined as a methodology for effective communication of threats and impact information to others regarding incidents or potential incidents. In risk communication, while there are differences between venues with longer decision support and smaller venues with a shorter-fuse support, in both instances, it is important to start with the goal of assessing the risk profile for each venue. You must find out who knows this information, how dispersed are the incident responders and the associated command structure if it becomes an incident, and if we already have working relationships with them prior to the incident.

Student Notes:

6. Four Stories of Decision SupportServices

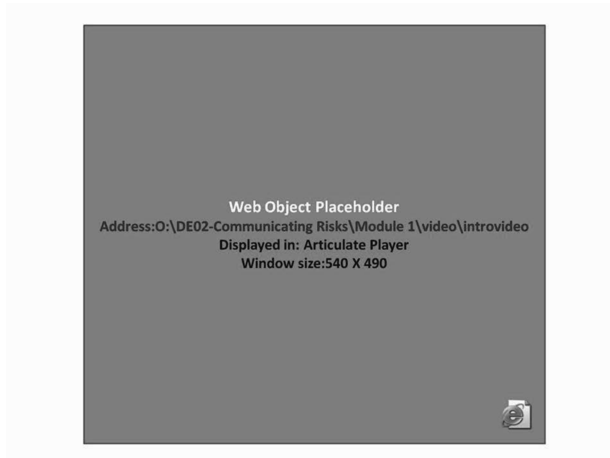
Instructor Notes: We are going to be summarizing four events where the NWS navigated numerous challenges in the disaster cycle to deliver effective Impact-Based Decision Support Services, or IDSS. I will also use the more widely used term DSS in this module. Stories from these events are used to illustrate the concepts of risk communication. These are stories of DSS from well-known large venue events such as the Beale Street Music Festival in Memphis, TN, a Major League Baseball game at Busch Stadium in St. Louis, the Enbridge Oil Spill on the Kalamazoo River in Michigan in July 2010, and probably the most, well-known incident site in the past two years, Deepwater Horizon Oil Spill in the Gulf of Mexico in April 2010. The Enbridge event will be in the form of an interactive quiz where you will have to assess the actions displayed and identify the key components of the risk communication cycle. Before we get into the concepts and stories, let's start off with a short video from Mike Hudson of NWS Central Regional Headquarters, who is one of the principal authors of the NWS Services Roadmap, which lays out the future of NWS and DSS. Mike is going to briefly discuss why it's so important to have a crisis response plan that follows a model like the one we will present in this course.

Student Notes:

7. Message from Mike Hudson

Instructor Notes: Welcome to this module on crisis communications. The National Weather Service has recently embarked on its Weather Ready Nation Initiative. Impact-based decision support services will be a key transition and service provision to our core partners. Often times this decision support will occur during or immediately following a crisis or disaster. I think you'll see key principles of the national incident management system and the incident command system embedded in the lessons that follow. Being familiar with our customers language during an event is critical to our success in providing decision support. Through this module, you'll cover several key objectives: the components of a crisis communication life cycle, the importance of clear, concise communications during a crisis, you'll see how to be an effective communicator through an understanding of crisis and risk psychology,   finally, you'll gain a better understanding of the importance of good relationships before an event occurs.   You'll also see in this module several examples of crisis communications at work during actual decision support missions.   I hope you will enjoy this module and you will find it helpful during your future decision support work.

Student Notes:



8. Introduction to Main Concepts

Instructor Notes: This is a graphic showing the types of communication networks involved in risk communication for the NWS. NOAA communicates a wide load of specific risk information and provides services through its core partners, stakeholders like FEMA, the EMs, NCIMs (National Council of Industrial Meteorologists) , and the media. Then, this communication get funneled down to the general public, who are depicted in this slide example as a person exposed to risks while cleaning up oil hazards on a beach along the Gulf Coast. The public also gets direct risk information from NOAA/NWS, such as forecasts and warnings, but this is a highly personalized channel of risk communication, and is not the focus of this training.

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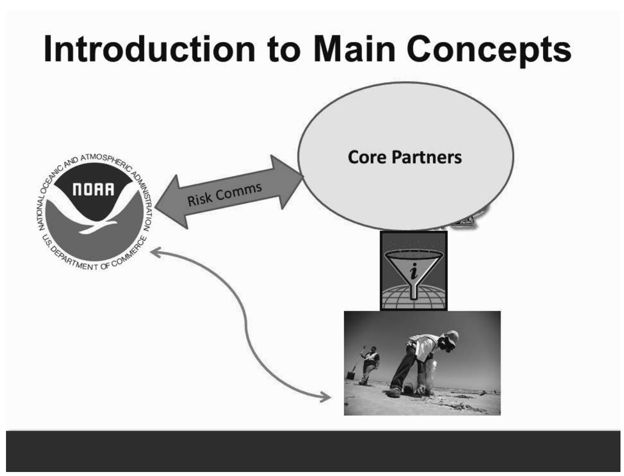
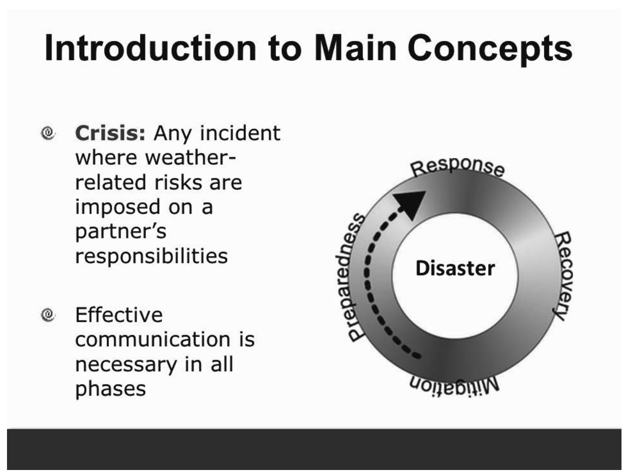


9. Introduction to Main Concepts

Instructor Notes: We all go through a cycle of actions every time there's a disaster (or crisis), so it's vitally important to understand phases within the cycle. A crisis is defined in this course as event that occurs where there are weather-related risks imposed on our partners' decision making responsibilities, either anticipated (planned) or unexpected. The cycle begins and ends with mitigation. This particular disaster lifecycle is something that is familiar to emergency managers. Typically the cycle begins in the mitigation phase then moves to preparedness where you create a plan to respond to the next disaster. When the disaster occurs, the cycle enters the response phase, and then recovery begins as the crisis ends. Afterwards, there's a return to the mitigation phase that helps people evaluate what went right or wrong and planning begins to mitigate the negative outcomes, all in preparation for the next disaster. As you look at the cycle, there are several factors that effect the approach and successful implementation of the cycle. First, effective communication is necessary among all the team players. Likewise, a similar cycle is noted in risk communications. A major goal of understanding the risk communication cycle is mitigation of negative impacts of poor communication and conflicting messages and/or misaligned information with user needs.

Student Notes:



10. Introduction to Main Concepts

Instructor Notes: This module is aimed at crisis communication with whom we call your stakeholders and partners. They have special needs for your information in order to either communicate your products or use weather information to make decisions. They typically know what they need but sometimes they may not know what they need. They also might not know what you are capable of providing. However, both of you share a similar communications landscape, that is, they are the people that typically have significant leverage over large numbers of people (users). Some examples are Emergency Managers (EMs), school principals, facilities managers (e.g., large venues), incident commanders, and the media. Even though media broadcasters do not have direct command authority over the public they serve, their leverage comes from the large influence they have. In this course, we refer to the media in the sense of stakeholders as the broadcasters that partner with you to convey warnings and statements. The other aspect of the media, the news reporting side, is a different relationship for which different strategies apply in crisis communication. This course focuses more on the stakeholder/ partner role the media serves with the NWS.

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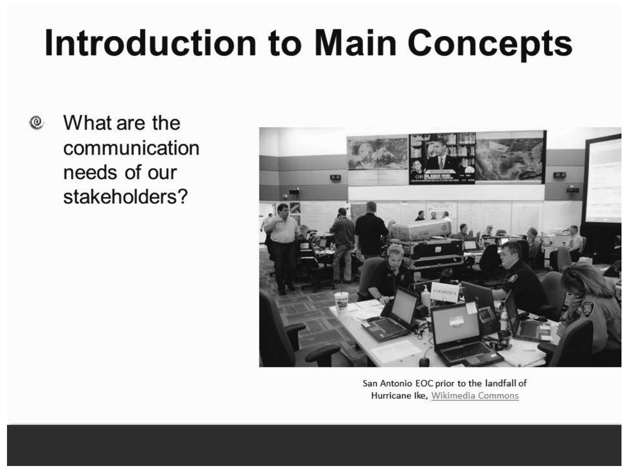


11. Stakeholder Relationships

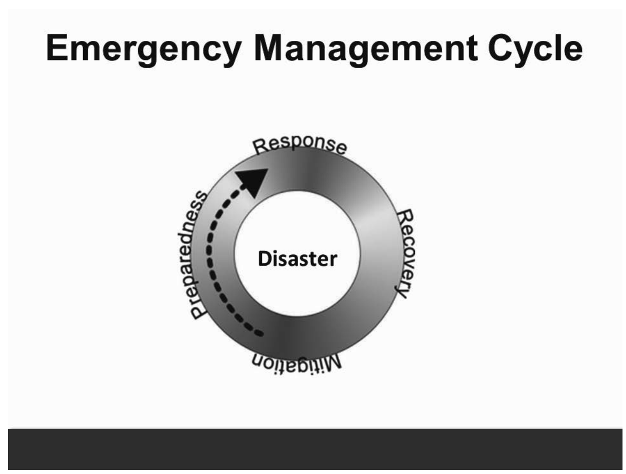
Instructor Notes: The initial relationship you have with your stakeholder is going to be critical in terms of how effective you can convey the message you intend. A relationship that starts out as adversarial may require multiple positive events before they shift their stance toward being advocates. However, a relationship that begins on a positive note and then builds in strength can weather crisis much better by depending on mutual credibility.   To build a positive relationship the most effective way, you would have the following traits: Emphasize trust building characteristics. Yes, the key is to be honest and not promise more than you can provide. Yet you should also demonstrate competence. In addition, seek your stakeholder's feedback whenever possible. Promote your abilities. This does not mean advertising in a commercial sense. Instead, let your stakeholders know what you can do for them once you understand their needs. Understand your stakeholders. You should value their needs, abilities, and culture. Their abilities and culture help define the parameters influencing their ability to handle a crisis. An example would be the amount of lead time a stakeholder needs to be able to efficiently respond to a threat. All of these traits can be greatly helped by effectively carrying through a crisis communication plan according to the cycle once a crisis occurs. Effective planning with your stakeholders helps to build trust for future partners.

Student Notes:

12. Emergency Management Cycle

Instructor Notes: The circular emergency management lifecycle focuses on all phases of disasters which begins and ends with mitigation. There are some general similarities to what we will show in our stories but a lot more details emerge when you analyze and address all the issues with respect to managing risk communication to support ALL of our core NWS stakeholders

Student Notes:



13. Comparing Specific Phases within the Crisis Communication Life Cycle

Instructor Notes: Let’s dig into more details of a modified Risk Communications Model of NWS Stakeholders. There are a lot of similarities to the Crisis cycle shown previously, which is now stretched out horizontally, for comparison. The main distinction in the communication lifecycle phases is that pre-event, the type of communication is risk communication. We can label this as Pre-Crisis in the horizontal-shaped Risk Communication model. During the event itself, the type of communication is more crisis-oriented. Pre-crisis activities are similar to preparedness actions. The response part of the crisis is divided into an initial phase, and a maintenance phase. We maintain the recovery phase and rename to resolution. The mitigation phase gets renamed to evaluation and then the preparedness phase changes its name to pre-crisis.Some crisis are long lasting which demands a different response profile than from a short-lived crisis. The long crisis also may have sub-crisis cycles embedded in the larger one. The nature of the crisis governs how you move through this cycle. Crisis communication models may manifest themselves in different ways depending on the type of event interacting with the hazard. There is a lot to learn about the crisis communication cycle. In order to help, we will go on a journey and listen to four stories of how this cycle plays out in a variety of crises ranging from the short and quick severe storm to a long lasting incident support. Most of the stories showed the great lengths to which the NWS helps their stakeholders by providing excellent support. There were different outcomes, some successful, others not so. No matter what the outcome, there were lessons to be learned for the next time.

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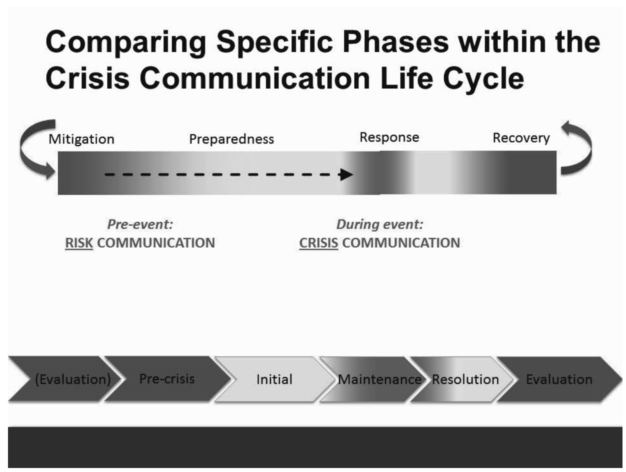

14. Crisis Communication Model

Instructor Notes: The pre-crisis activities in the model involve preparation activities , which can be quite extensive based on the scale of effort required for an event. These activities foster alliances and develop communication channels with desired protocol for support services provided. In most cases, you will have established key partnerships and have established awareness of the NWS with your stakeholders, but the specific individuals that you are communicating with for any given event might have changed. A lot of the questions to the stakeholders in the pre-crisis phase should facilitate exchange of information of their key decision thresholds and the types of weather information needed.

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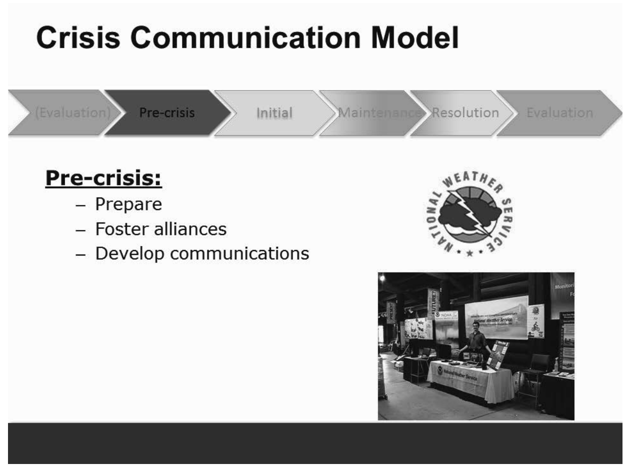

15. Crisis Communication Model

Instructor Notes: Characteristics of the initial phase of the cycle are based on the expectancy of the crisis. Some high impact events that contain substantial risks to exposures may offer more lead time than others. Thus, contact with stakeholders should begin in earnest very early when risks become more probable. Some high-impact events offer little to no lead time, and even some, such as an explosion and subsequent oil spill, occur suddenly and result in an immediate crisis. In addition, the magnitude and scope of the crisis determines the level of mobilization. Thus, the amount of support services and activities in the initial stage of the crisis communication lifecycle are modulated by these variables. You will immediately see the importance of the pre-crisis planning on building a foundation for you to succeed as the crisis unfolds, especially for those events with little or no lead time. For all ranges of the initial stages of a crisis, the crisis communication model can be successfully navigated as long as you follow the spirit of the initial stages of the crisis, such as respond quickly, provide relevant and understandable risk communications, and establish your credibility. We will explore these attributes by seeing how our offices did in the stories.

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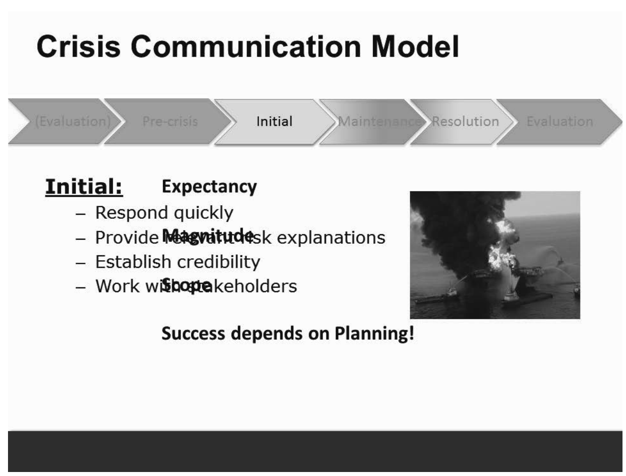
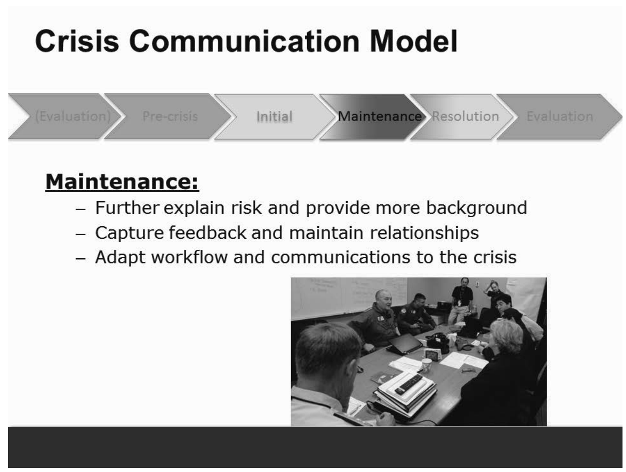


16. Crisis Communication Model

Instructor Notes: Once crisis communication enters the maintenance phase of the cycle, we begin to further explain the risk to our stakeholders and provide more background on the details of the impacts of the weather elements such as exposure risks. As we provide more in-depth services to support decision makers, we value their feedback as this helps to build trust in the service relationship. We adapt the overall workflow and adjust communications based on any new information needed pertaining to the unfolding nature of the crisis. All of the stories presented in the module contain substantial adaptations to the decision support services due to changing weather conditions and exposure profiles.

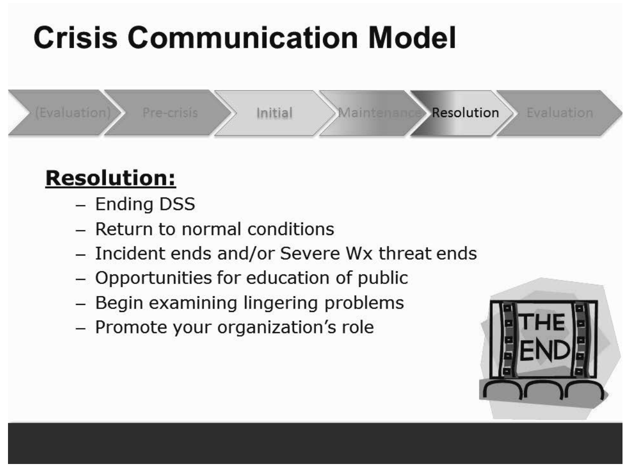
Student Notes:



17. Crisis Communication Model

Instructor Notes: As you gradually cease decision support activities, the crisis communication lifecycle enters a resolution stage. Here is where you learn about ending the incident support and the communication is typically marked by a return to normal conditions. For severe weather operations, normal conditions means the end of the threat and return to normal operating procedures and associated staffing levels. For special support of events like large venues, the resolution will come with the end of the event at the venue itself through an ending of a severe weather threat. For support to a large venue, the resolution is the end of the event itself. For other longer duration DSS activities, it may be harder to enter this stage. The resolution stage does present opportunities for your service organization to educate the public for the future and begin to examine lingering problems. You also will begin to gain support for policy and resources and use this opportunity to promote your organization's role.

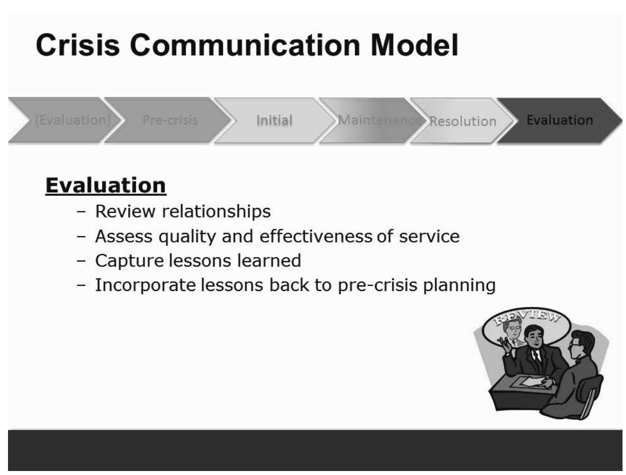
Student Notes:



18. Crisis Communication Model

Instructor Notes: In the evaluation stage, you will review relationships, and assess how well you met your customer's needs for weather information during the incident. You should evaluate the quality and effectiveness of the DSS provided including an evaluation of human and physical resource management. In many longer duration incidents, regional or national service assessments may need to be are conducted. To capture lessons learned, you should conduct a thorough post-mortem to determine actions and information delivered that could be applied to other types of events. Assess if you worked through the event again, what you would do differently. The results of the evaluation phase should flow back into the pre-crisis planning phase.

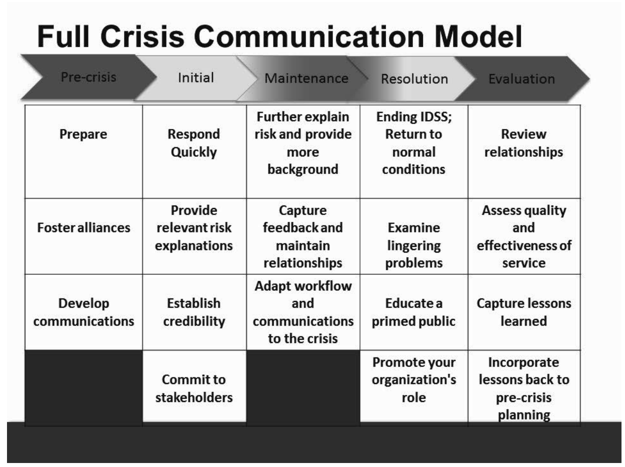
Student Notes:



19. Full Crisis Communication Model

Instructor Notes: Here's the full Crisis Communication Cycle Model and all the primary sub-characteristic components, adapted for our Communicating Risks in High-Impacts Events course. In the stories you'll hear subsequently, we framed questions to that address each of these components.

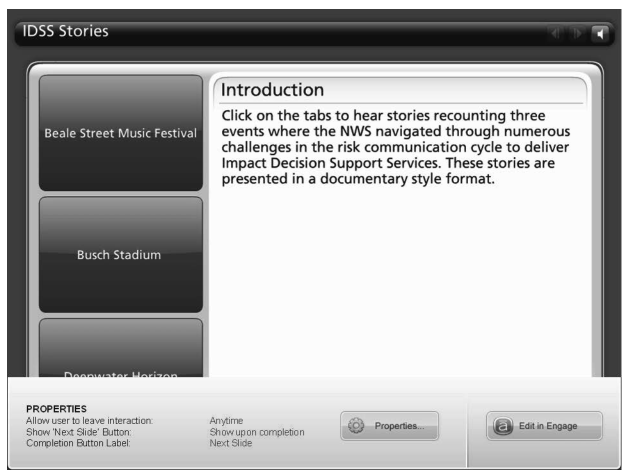
Student Notes:



20. IDSS Stories

Instructor Notes: Click on the tabs to hear stories recounting three events where the NWS navigated through numerous challenges in the crisis communication cycle to deliver Impact Decision Support Services. These stories are presented in a documentary style format. Make sure you go through each story to see the many twists and turns that can occur in the crisis communication life cycle.

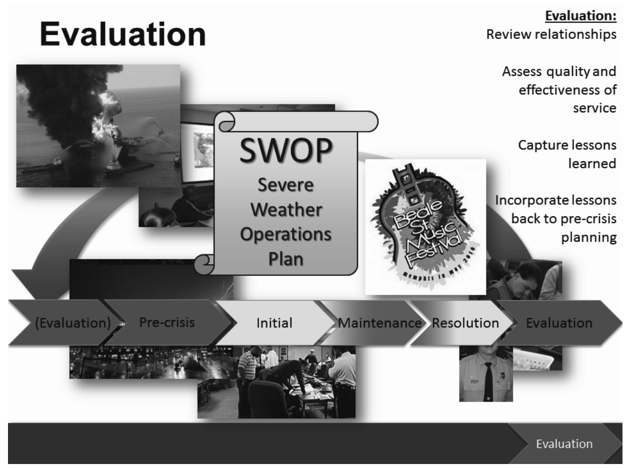
Student Notes:



21. Evaluation

Instructor Notes: Now that you're familiar with the stories, we will take excerpts from them to show you the evaluation stage of the crisis communication cycle. You may find similar themes amongst the stories that may serve you to help plan your crisis communication cycle. Other lessons learned may be unique to the nature of the individual story but still offer lessons of value.In an evaluation stage we want to review our service and relationships with our stakeholders. That is when we assess how well we met their needs for weather information and how well did they know what information they needed. We also want to capture lessons learned. Were there any other events we could apply them? If we could do it all over again, what would we do differently?Then we want to improve our plan using our lessons learned. The questions we already mentioned serve well to planning for the future.Then finally, we want to help close the crisis communication cycle into the pre-crisis phase of the next cycle by practicing the new plan in the pre-crisis planning.

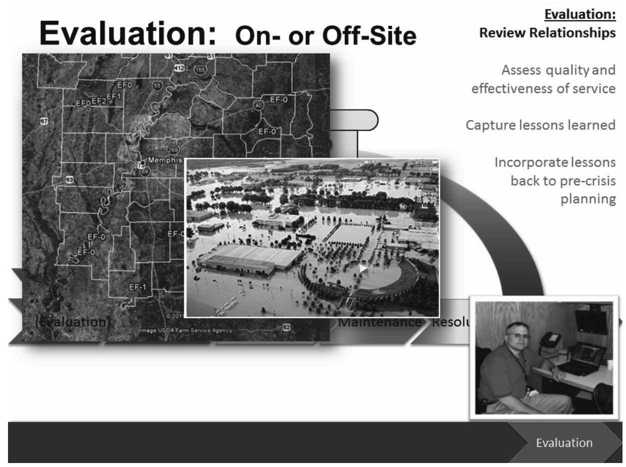
Student Notes:



22. Evaluation: On- or Off-Site

Instructor Notes: After a crisis resolves and you've stood down, the time will come to evaluate the quality and effectiveness of your service and review the relationship with your users.Before 2010 the NWS in Memphis was of the mindset that a physical presence was needed at the Beale St. Music Festival to maintain the quality of their relationships with the Shelby County EOC. But they discovered that when their CWA was subjected to a lot of severe weather, they needed everyone at the office. The following year only reinforced their belief.Jump to Okulski 2:32"Each year is different and we found out you really can't go in with a set idea of what is going to happen in a given year because the following year we didn't show up at all because we had the April 27 the super outbreak and then we follow with the fact that we had a historic river flood that was impending."

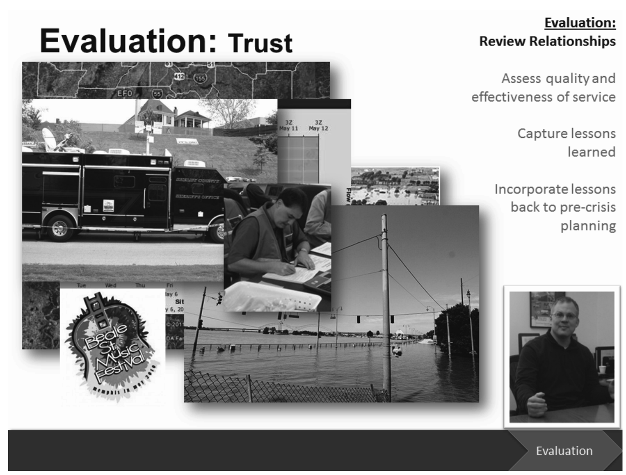
Student Notes:



23. Evaluation: Trust

Instructor Notes: But since they had already well established trust with the festival organizers, they were able to effectively establish remote support. The local EM consulted with the WFO on the forecasted Mississippi river stage — which was near record values — with enough lead time that they could make plans to move the Beale St. Music Festival and a BBQ festival that took place not long after.Jump to Okulski 7:17"That was a remarkable amount of trust and no one died during that flood event and you had the seminal event for Memphis, the BSMF and the BBQ festival occurring right during, before and after peak flood and crest. It was a remarkable partnership between the NWS in Memphis, the EM and response community and the event organizers. It had all been building up step-by-step in 2008 to the point that we got to 2011 that we had built that trust with one another that were able to work in concert for a very complex scenario." However in a new relationship, you may be encouraged to emphasize on-site support.

Student Notes:



24. Evaluation: Meeting Needs

Instructor Notes: Figuring out how well you meet the needs of your users is absolutely critical so that you have a baseline from which you can determine how to improve. At the same time, answering this question can be difficult. Most of the cues NWS offices have received in the past have been through informal reactions by the users such as in Busch stadium showing the fans a radar image of the Derecho. If an office is perceived to have met a user's needs, then that user will contact the office more often in the future. This was true with the officials responsible for Beale St where a successful evacuation implied that the officials were happy with the office's warning. Go to Okulski 37:13"To see that our impact building up to that event in 2010 where they safely evacuated all those folks, gave us at the office great satisfaction that we had played a role in our city and our region and the fact that we had a much better relationship with the EM community in that area, in that year they had become Storm Ready, and had started inviting us to things that we had not been invited in the past."

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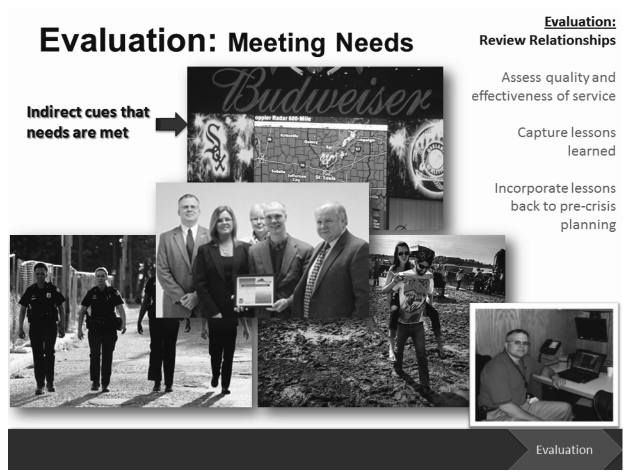

25. Evaluation: Do users know what they need?

Instructor Notes: Sometimes a stakeholder/partner may be satisfied with their relationship with an NWS office but they might not be getting what they need. This comes about because a stakeholder may not know what to ask for if he/she is not an expert at understanding the hazards, and evaluating the sensitivities of the people exposed to them. At times getting to the right question occurs serendipitously. That's most likely to occur with frequent, close contact. This was the case with the ER met at the Deepwater Horizon command center. At the start of the event, sometimes, responders did not seem to understand what was needed. They discovered needs when booms were put out or high altitude aerial reconnaissance was used and through other response activities. Jump to Graham 48:12 "One of the examples goes back to wave steepness, when you're forecasting the seas and you're forecasting the winds on the Gulf and then you overhear somebody that comes back from a mission and somebody says wow the seas weren't too bad but we just got beat to death. A water cooler type of talk, if a meteorologist hears that he thinks what do you mean you got beat to death, the waves were only 2 feet. Well those waves were really steep. Those casual conversations that led us to realize wow 2 foot seas is one thing but it's the steepness that really beats them up, we better figure out a way to do that."

Student Notes:

26. Evaluation: Learning about user needs

Instructor Notes: Certainly being embedded offers many chances of learning more about your stakeholder through what could be called 'water cooler moments', and more importantly, through multiple daily planning cycles. If you don't have this, then having a long relationships improve understanding stakeholder needs. The longer a relationship lasts, the more likely an NWS office will have a more complete understanding of what the user needs. Likewise, confidence should grow that the user also knows what he or she needs. The Beale St. Music Festival organizers have been working with the Memphis NWS office on- and off-site for four years.Jump to Okulski 2:29"By the time we reached 2010-2011, they were very well aware of what was needed for them in terms of what do you mean by flood, what do you mean by major flood, what will cause Tom Lee Park to go under water, what is a tornado warning, what does it mean, where is it going, how much time do I have before this severe thunderstorm with the potential of producing a tornado is going to move over the festival site. " As you can see the many years of working together has improved the NWS's understanding of their stakeholder's needs and the stakeholder understands what the NWS can provide. If you don't have years or the opportunity to undergo multiple daily planning cycles, there is another way to build up a mutual understanding. We'll describe this way in the next lesson.

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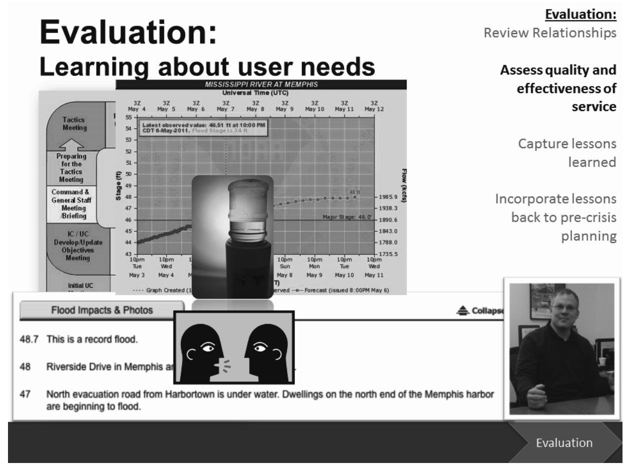

27. Evaluation: Getting that Feedback

Instructor Notes: When it comes to assessing the quality and effectiveness of service, feedback is crucial. It came come during and after an event. After the Deepwater crisis ended, one statement made to the office summed up very nicely whether the NWS Slidell was meeting the responder's needs.Go to Graham 44:53"I guess I'll never forget the comments from Admiral Landry when she said that nobody died as a result of this response. When it came to all the lightning, the waterspouts, the heat, we had a lot of severe weather that occurred in the spring and early summer during Deepwater Horizon. For the most part, if you look at the result, it met their needs and if it didn't, we heard about it. There was a very comfortable relationship, because of the nature of the crisis to come back and say we need this or say I don't know what I need but let me describe it. We could kind of fill in those blanks and I'm confident, looking back that if we weren't meeting a need, we would have heard about it." Indeed they would've because the crisis was so long and it had an incident command structure in which the emergency response meteorologist was deployed.

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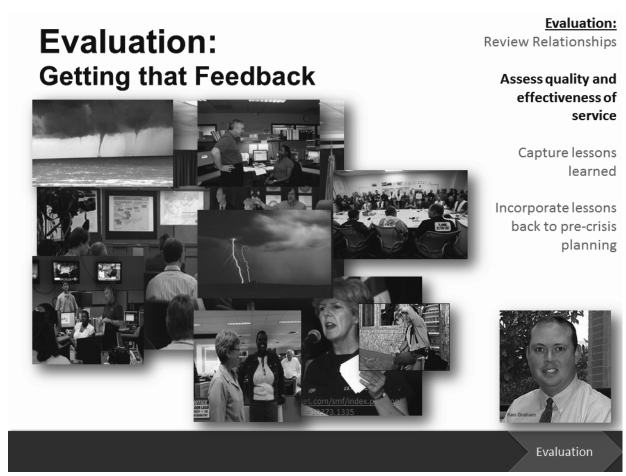

28. Evaluation: Service Assessment

Instructor Notes: There is an even more formal type of feedback. Following the Enbridge Oil Spill in Michigan, due to the magnitude and longevity of the decision support resources provided in the response there, a regional Service Assessment Team was formed to examine the products and services provided to the State of Michigan's Emergency Operations Center and the U.S. Environmental Protection Agency Incident Command Post. One of the findings of the Assessment was to develop a template for providing ICP support instructions. The template can help provide instructions to accommodate the use of adequate resources and tools that are sufficient at the ICP to empower the NWS Emergency Response Specialists with knowledge to complete the IDSS mission. Before any IDSS deployment, a comprehensive review of past events should help determine deployment procedures, rotational staff assignments to maintain continuity of operations, event cost accounting and reimbursement procedures and even contingency plans for rotating ERS staff in a way to minimize the total number of unique NWS personnel deployed to an event.

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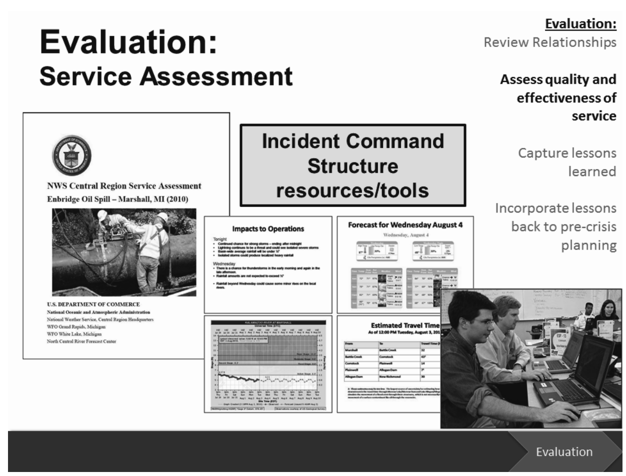

29. Evaluation:Was equipment used in best ways?

Instructor Notes: Capturing lessons learned is another important phase in the evaluation stage. These lessons are important nuggets that go into the planning for the next crisis. For instance, the NWS Memphis office learned from 2010 to 2011 that understanding how to use equipment for on-site support was something they considered very important. Rich explains more:Go to Okulski 12:38"If you're gonna go off-site, to prepare your equipment beforehand because there are a lot of things with a laptop that has security on it and you're using, you're adapting that security that equipment, you're tying it into an environment outside your office. Make sure you can do it by yourself and it works before you show up, and know your equipment inside and out before you go in so you can make adjustments because your IT support is on the other side of the city. "

Student Notes:

30. Evaluation:What information is cross-usable?

Instructor Notes: Not just equipment but also being able to provide graphics compatible with the systems that stakeholders use was another lesson learned. When attempting to present forecast graphics to the Deepwater Horizon responders, NWS Slidell had a problem. Most of their partners requested graphics in GIS format while the NWS did not have that capability. The NWS office endeavored to make sure they could provide compatible graphics in the future.

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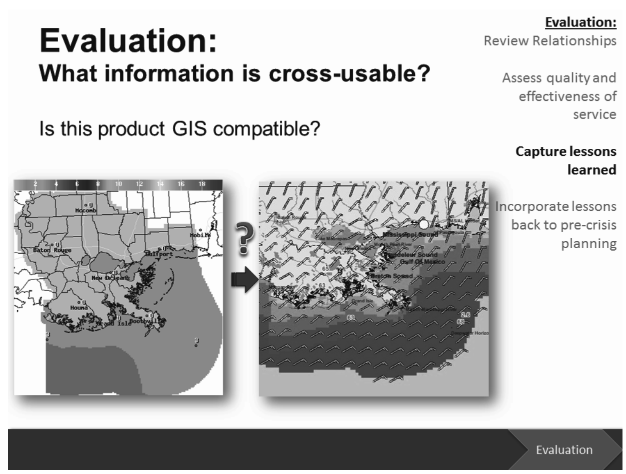

31. Evaluation:Learning response needs

Instructor Notes: Another lesson learned was that of learning about the response times that a stakeholder needs. The injuries incurred at Busch Stadium during the derecho led the stadium officials and the NWS St. Louis to evaluate their relationship. Did the NWS give them the right information? Did the stadium do all they could to protect their patrons? While most of them had sufficient time, there were quite a few that didn't. Some of them were injured by a large plastic sheet that blew off an open air press box. As a lesson learned, the stadium officials realized that perhaps their evacuation needed more time, more than a typical severe thunderstorm or tornado warning may offer. After all, a typical warning serves a broad variety of people with different requirements needed to take action. Some of those in more vulnerable positions, such as near things that could blow down more easily, need to be moved earlier. The NWS St. Louis learned to be more proactive in scaling up severe weather operations to give their partners more lead time to account for unexpected turns. Jump to Kramper 38:37“Even if SPC doesn't expect it to hit us, even if we're kind of confident it's going to slide east, if it's going to be on our edge we will still have at least one or two people handy that if things change, they can quickly step in and take over. “ This lesson was made quite clear several years later at Indianapolis state fair when the stage for the Sugarland concert blew down killing 7. In this event, the state fair officials incorrectly interpreted the lead time to the dangerous winds thinking it was 20 minutes instead of nine since the gust front was ahead of the line of convective cores.

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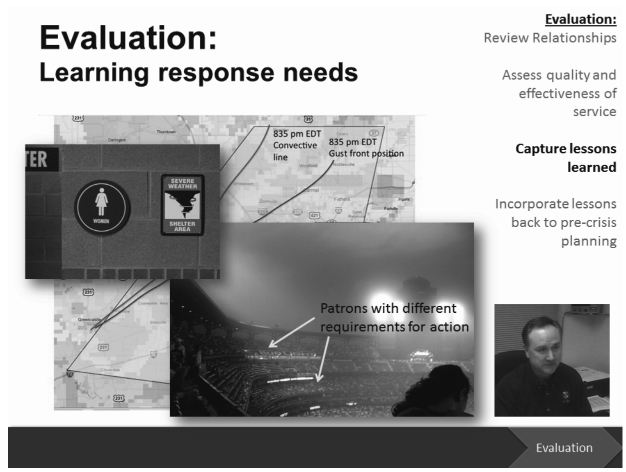

32. Evaluation:Dedicated support

Instructor Notes: Many of the lessons learned in a crisis goes directly into planning for the next crisis. And one of these lessons learned folded into how an NWS office provides dedicated support. The New Orleans office for instance had a dedicated Emergency Response Desk (ERD) fully staffed and in contact with the incident meteorologist in Houma. It evolved during the crisis to meet the needs of the NWS Slidell to solely provide decision support. It was so beneficial to them that the ERD didn't go away.Jump to Graham 1:03:54 “We have that ERD if there's an explosion or a tropical storm or a hurricane, that person has specific duties that we learned during Deepwater Horizon that were important. That person is not doing the radar, that person is making sure that our partners are taken care of, that the briefings are done and we're getting that information out. A whole separate desk handles the radar so Deepwater taught us that one person can't do everything, you have to be able to have the staff with very specific tasks to be successful.”That person is doing communication, exporting the forecasting products out to their users. And the products themselves are evolving. The ERD now exports powerpoints detailing all the information EMs and other users need for their preparation. Jump to Graham 1:04:51" It's that person that's on the ERD that's creating the powerpoint that's emailed to the emergency managers. It's on our hidden website. It's something they can scroll in their EOC, it's something that they can see on their cell phones basically. So during a crisis the EM's aren't going to the Hurricane local statement, they're not going to any of these traditional things. They want to know what we're briefing and what's in that powerpoint. After 18 years of this, I'm definitely noticing a trend that the bigger the crisis, the less people use our routine products."

Student Notes:

33. Evaluation: Planning for next time

Instructor Notes: The Deepwater Horizon crisis was a gamechanger for NWS Slidell. Not only is the ERD a part of all future crisis planning but the staff fundamentally adapted to how they relate to their stakeholders. Their meetings before Deepwater Horizon were primarily about storm surge forecasts during landfalling tropical cyclones.Jump to Graham 1:11:00"The meetings are still about those type of topics after Deepwater Horizon but there are meetings that we never had before that talk about the parameters and the forecasts that we gave during Deepwater Horizon. It's this other capability that we have to do detailed forecasts, spot forecasts. So as a result of Deepwater it was the ultimate way to teach these responders what the weather service is really capable of giving them and without it, I don't know how we would have been able to market that."   At New Orleans, they've taken their lessons learned and have been participating in more planning exercises with the Coast Guard and other federal partners of which they've not planned with before Deepwater. The NWS office has become a pilot project center for the WeatherReady Nation initiative to take the new abilities they've created and promote them further amongst other government agencies.

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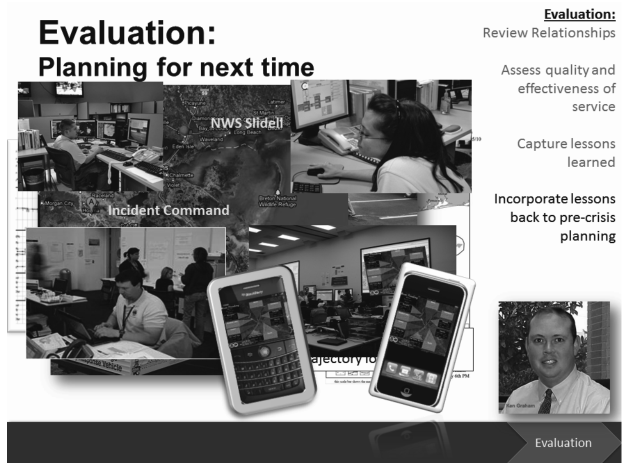

34. Evaluation:Make Storm Ready

Instructor Notes: Another way to fold the lessons learned into planning for the next crisis is to make a venue Storm Ready. After the injuries incurred at Busch Stadium, NWS St. Louis proposed this idea to the stadium officials. Jump to Kramper 40:07“It would be a good way for them to look at their procedures and see if there are some things that maybe they wanted to step up and maybe change. So we went over the StormReady idea with them, they were very interested in it and as it turned out, they had pretty much had most of the things in place already. There wasn't a whole lot they had to add, they had to add a few things here and there, change a few procedures but for the most part they were in pretty good shape. So they decided to pursue that and they have become, technically a StormReady supporter and, as far as I understand, they were the first actual stadium or organization in MLB to become StormReady so we're pretty happy about that.“ StormReady was initially designed for towns. However, with the concept that Venues and institutions can also be StormReady, the concept has been applied to many more places like Busch Stadium

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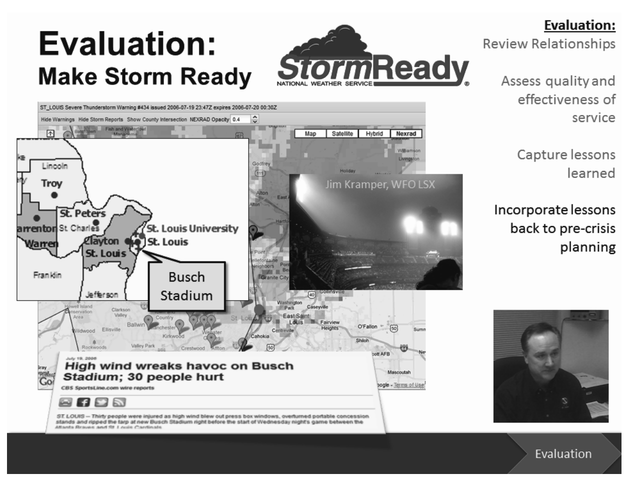

35. Evaluation: Make Storm Ready (continued)

Instructor Notes: In addition to the stadium officials benefiting, the St. Louis office also benefited by better understanding the stadium's procedures. Five years later, they saw the benefits of their evaluation from the previous crisis.In 2011, a tornadic supercell passed across the northwest parts of the St. Louis metro area. The Lambert Field airport was struck by the tornado. As the storm approached Busch stadium, a game was about to begin. Jump to Kramper 46:00"We kind of had Busch Stadium in the back of our mind but we knew from the track that it probably wasn't going to hit them but still they could be affected by wind gusts and hail and other things but they did a great job. Once we found out that they were on top of it, we said 'great you have what you need?' They said 'yeah, we're fine' so it worked out really good and I think a lot of that was the previous event and us working together. "NWS St. Louis is now working to make the airport StormReady.

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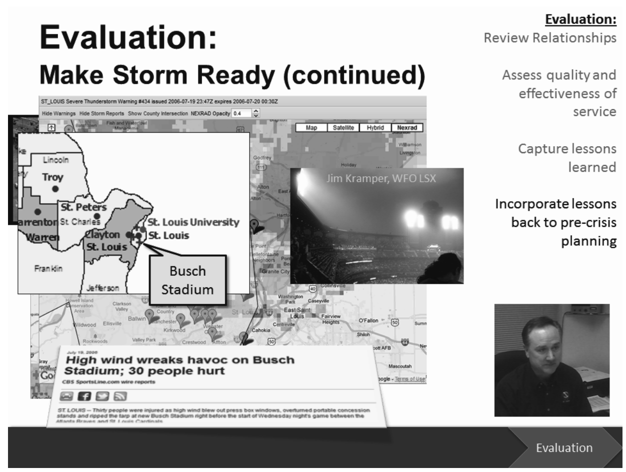

36. Evaluation:Storm Ready Nation-wide

Instructor Notes: StormReady was initially designed for towns with emergency managers being your primary stakeholders. However, with the concept that Venues and institutions can also be StormReady, the process has been applied to many more commercial places like Busch Stadium including universities, military sites and Indian Nations and the list of stakeholders have increased.

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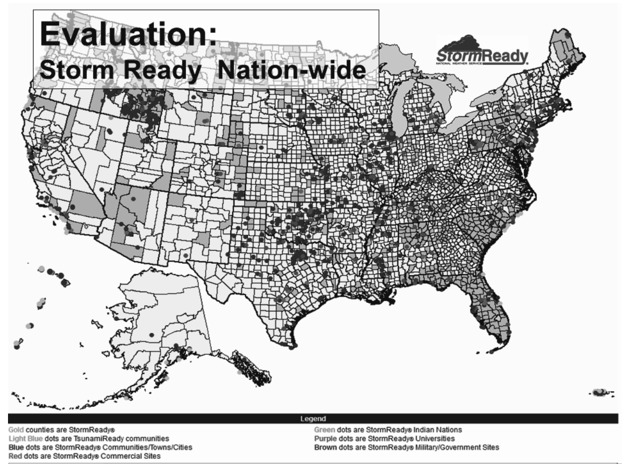

37. Evaluation:Pre-crisis Planning

Instructor Notes: Being StormReady adds the advantage to the stakeholders to be prepared to receive and disseminate operational NWS watches and warnings. This happens because the NWS requires redundant NWS information reception. Then there must be multiple methods of monitoring the weather. And there has to be multiple methods of disseminating the weather to their patrons. Other than that a Storm Ready entity trains its spotters with NWS help, and visits the NWS office on a regular basis. During a crisis event like a storm, following the StormReady paradigm explicitly means there is typically a thick trunk of communication from the NWS to the user and a thin trunk from the user back to the NWS, typically in the form of storm reports. However, supporting a storm ready program does NOT mean there is enhanced risk management communication through decision support.

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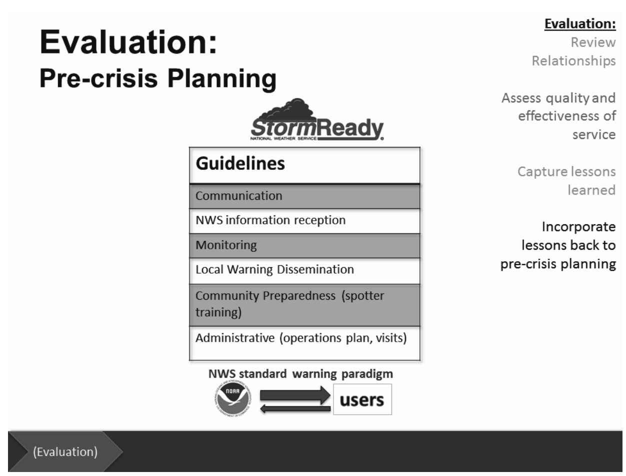

38. Evaluation: Pre-crisis planning - risk management

Instructor Notes: Instead the NWS offices in the stories were actually practicing risk management communication by going beyond just a Storm-Ready paradigm where fixed hazard intensity threshold warning products predominate. In other words, they practiced a warning paradigm where they took into account both the intensity of the threat and the exposure sensitivity of the responders and created more of a person-centric warning threshold. This is where a person or identified group of people's exposure sensitivity is taken into account and a warning is adjusted to compensate. In the Deepwater Horizon story, the NWS Slidell practiced risk management when they dialed down the threshold heat advisory in response to multiple reports of heat exhaustion. They accounted for the exposure sensitivity of the responders in hazmat suits. This kind of communication also applied in the case of Beale St. where the NWS Memphis issued a tornado warning of 60 minutes, instead of the usual 30, to allow plenty of time for the officials to evacuate a large outdoor crowd. These elements of risk management that you saw were all successful applications of the crisis communication cycle because there was a more active two-way communication between the stakeholder and the NWS. How do you identify exposure sensitivities? You do it by learning more about your stakeholder's needs and lesson 2 will give you tools to help.

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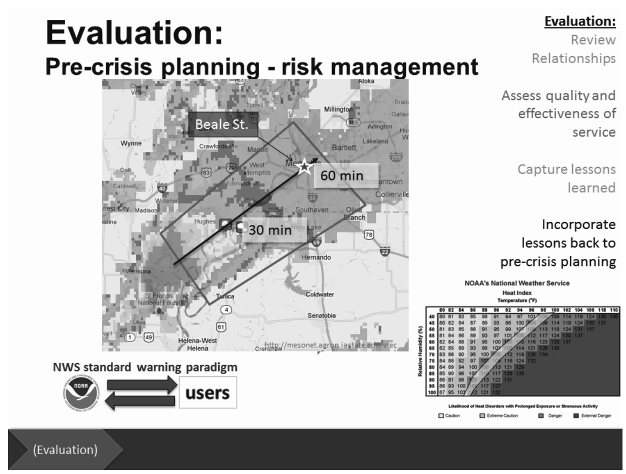

39. Public-Private roles and large venue decision support

Instructor Notes: You may have noticed that two of our stories detail the NWS providing support to private sector venues. And you may wonder if we are overreaching into the private sector realm. After all, both private and public sectors provide weather support to private sector venues. The result could be problems if the NWS and private sector meteorologists attempted to provide weather support to a venue without clearly defined roles. Our role, as part of the NWS, is to consult with venues officials about weather events that will threaten the safety of the patrons and to ensure that venue officials understand the standard suite of forecast and warnings provided by the NWS. In the Beale St. and Busch Stadium stories, the local NWS offices only communicated with venue officials about immediate threats to public safety. Both venues had long-standing working relationships between their respective county emergency management and the NWS and understood that the NWS was there to provide severe weather warning support. In Busch stadium, the NWS only contacted stadium officials about life threatening weather to their patrons. When you have the opportunity to work with a private sector venue official about providing decision support make sure that the venue officials are aware that the NWS works with local and state government officials to provide public safety support for large venues. However, to really provide the most detailed risk management support, you should let the venues know that there are many options available through the private sector. Provide the venue operators with this guide available on the stormready webpage. It provides information on how the NWS can provide support and also a guide on options available from the private sector. Also, to avoid any confusion about your role representing the NWS, please view the directives located in the NWS strategic planning and policy site. Finally, WDTB has a course about the private/public sector relationships that may help you better understand our respective roles.

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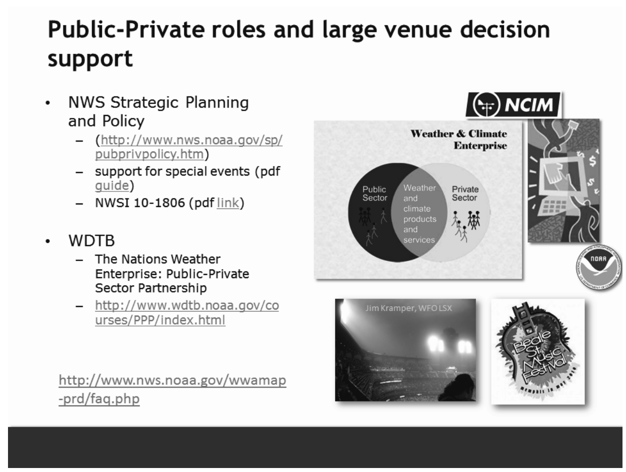

40. Revisiting Key Points

Instructor Notes: The previous three stories were meant to highlight different aspects of the crisis communication model as they apply to the NWS' relationship with its stakeholders and partners. There are variations to this model depending on the nature of the crisis and the affected parties. Some crisis are short-lived and may not exhibit obvious transitions between adjacent phases. Others phases may not exist if there are no relationships, especially that of the pre-crisis mode. But there are common key points: The better the alliances are in the pre-crisis mode, the more likely you and your stakeholders will successfully weather a crisis. Responding quickly and providing relevant risk explanations (e.g., forecasts and warnings), the more quickly you'll establish credibility in the initial phase. The maintenance phase builds on the initial phase and so capturing feedback is important so that you can adapt and provide better risk explanations. As you enter the resolution phase, it may pass quickly for some severe weather events, not so quickly for an incident response. Either way, your stakeholders will be most receptive to new ideas and changes in your relationship as long as they are improvements on what you did. Take advantage of it. Into evaluation mode and you're in a period to reflect upon your relationships and capture the lessons learned. These go into your pre-crisis planning for the next time. Meet with your stakeholders and see what you can do to improve your next crisis response.

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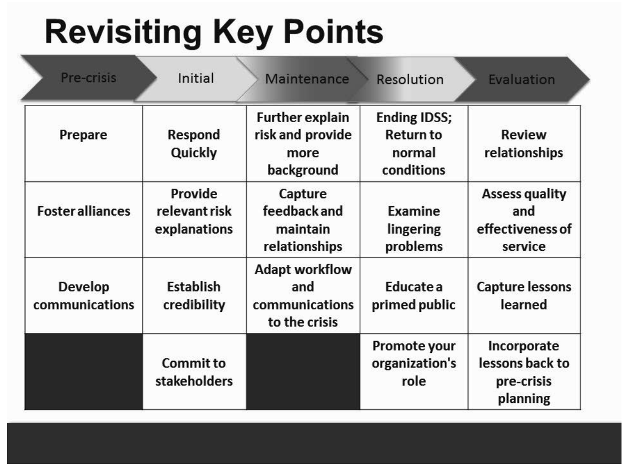

Pre-crisis	Initial	Maintenance	Resolution	Evaluation
Prepare	Respond Quickly	Further explain risk and provide more background	Ending IDSS; Return to normal conditions	Review relationships
Foster alliances	Provide relevant risk explanations	Capture feedback and maintain relationships	Examine lingering problems	Assess quality and effectiveness of service
Develop communications	Establish credibility	Adapt workflow and communications to the crisis	Educate a primed public	Capture lessons learned
	Commit to stakeholders		Promote your organization's role	Incorporate lessons back to pre-crisis planning

41. Toward Module 2

Instructor Notes: Throughout this module we've been stoking you module 2, and for good reason. In order to know well your stakeholder's exposure to risk and their sensitivities to such exposures, you need to do one of a few things: Embed with your stakeholders until you understand each other's needs and capabilities. This takes numerous trips around the planning cycles. The first few will be tough but you'll start to understand each other within a week. Have a multi-year relationship where each year you go through a crisis communication cycle multiple times. The first few may be fairly rocky as you'll learn by mistake and then have to wait some time before the next crisis. Boost the process by taking module 2 and applying the exercises contained within the lesson. Module 2 will give you four tools to help you drill down to better understand past events, anticipate future events, and get to know your stakeholders better.

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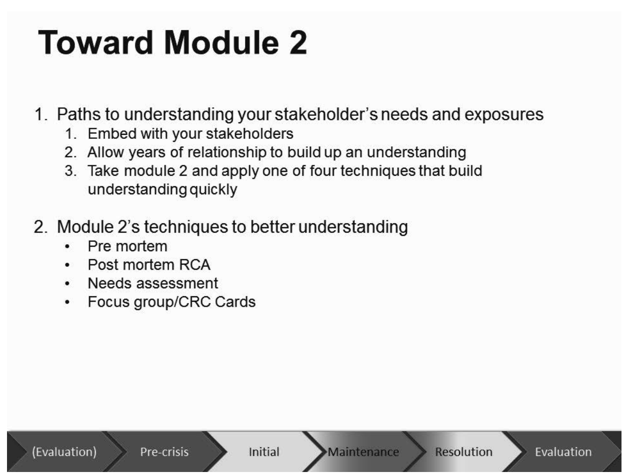

42. Testing Your Understanding

Instructor Notes: Module 1 has a quiz. It'll take the shape as an addendum to this module (a separate articulate) where we will present a fourth story. You will answer questions about this story centering around the objectives that you've learned.

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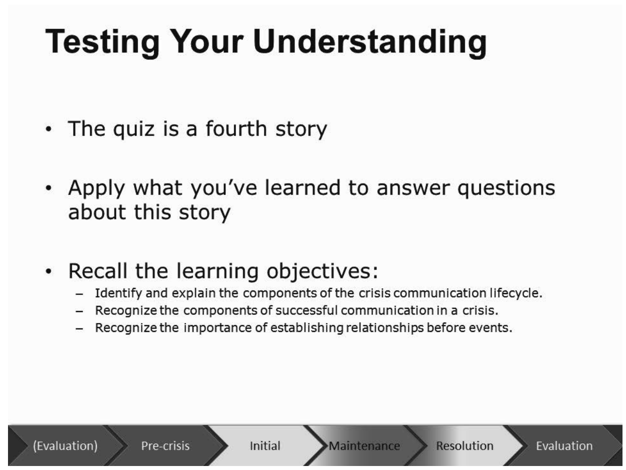

43. Quiz1

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44. References

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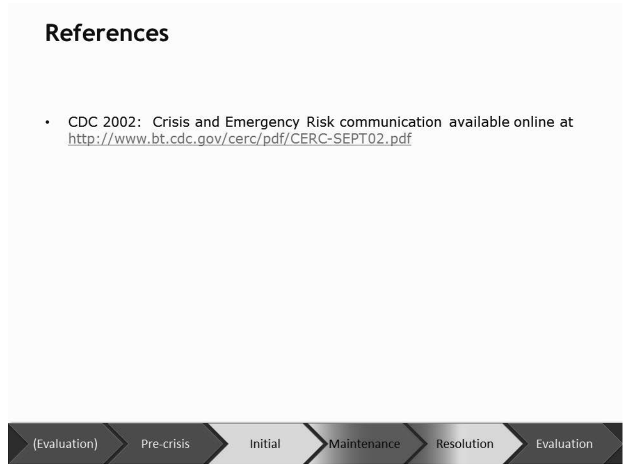

45. Contributors and Contact Info

Instructor Notes:

Student Notes: