Leadership in Cinema

Wildland Fire Leadership Development Program

MARS DEAD OR ALIVE

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Director: Mark Davis
Studio: NOVA ....Released: 2004
Genre: Documentary ....Audience Rating: Not rated
Runtime: 55 minutes

Materials

MARS Dead or Alive video, Leading in the Wildland Fire Service, notepads, and writing utensils

Objective

The objective of this lesson is for students to watch MARS Dead or Alive and participate in group discussion concerning cross cultural/program exchanges and teamwork within high reliability organizations (HROs).

Basic Plot

MARS Dead or Alive is a behind-the-scenes look at the Mars Exploration Rovers (MER) project.

Main Characters

Steve Squyres .... Lead Science Investigator, Mars Exploration Rovers

Dan McCleese .... Chief Scientist, Mars Program, Jet Propulsion Laboratory

Gentry Lee..Chief Engineer, Mars Program, Jet Propulsion Laboratory

Randy Lindeman....................................... Rover Systems Engineer, Jet Propulsion Laboratory

Tom Rivellini .... Landing Systems Engineer, Jet Propulsion Laboratory

Adam Steltzner .... Landing Systems Engineer, Jet Propulsion Laboratory

Pete Theisinger.. MER Project Manager

Rob Manning ....Systems Engineer Manager, MER

Ed Weiler .... Associate Administrator, NASA

Facilitator Notes

The [MARS Dead or Alive video](#) is available for viewing online through YouTube.. To order MARS Dead or Alive, or any other NOVA program, for $19.95 plus shipping and handling, call WGBH Boston Video at 1-800-255-9424.

Facilitation Tips

1. Organize a group of students to participate in the MARS Dead or Alive discussion.

2. Have students, individually or as a group, watch MARS Dead or Alive.

3. Conduct a guided discussion using some or all of the associated resources (handout and possible comments provided). Have students discuss their findings and how they will apply leadership lessons learned to their role in wildland fire suppression. Facilitate discussion in groups that have difficulty.

References

Facilitators are encouraged to review the links below in order to obtain information that may be helpful during group/classroom discussions and for continued leadership development.

- [MARS Dead or Alive video transcript](#)

- [NOVA Companion website](#)

- "[Capturing the Spirit of Opportunity: Leadership Lessons from the Mars Missions](#)"

- [Wildland Fire Lessons Learned Center](#)

- [Wildland Fire Leadership Development Program](#) (WFLDP)

- [High Reliability Organizing – What It Is, Why It Works, How to Lead It](#) (information from the BLM Fire and Aviation Directorate, Division of Fire Operations, March 2010 HRO training session)

Leadership Challenge

As part of this lesson, facilitators are encouraged to challenge students to read the following selections from the Professional Reading Program:

- Vaughan, Diane. [Targets for Firefighting Safety: Lessons from the Challenger Case](#). Presented at Interagency Hotshot Crew Workshop. 1996. Based on her extensive research regarding NASA's culture and the decisions leading up to the launch of the Space Shuttle Challenger, Vaughan discusses the role that organizational culture can play in affecting firefighter performance and safety.

- Weick, Karl E. and Kathleen M. Sutcliffe. Managing the Unexpected. Jossey-Bass. 2001. Subtitled "Assuring High Performance in an Age of Complexity," this book looks at how HROs like aircraft carriers, nuclear power plants, and firefighting crews manage high-risk operations.

MARS DEAD OR ALIVE

Guided Discussion with Possible Answers

1. What is meant by the term "high reliability organization" (HRO)?

   - "An organization that operates continuously under trying conditions and has fewer than its fair share of major incidents." (Karl E. Weick and Kathleen M. Sutcliffe)

   - "An organization that has succeeded in avoiding catastrophes in an environment where normal accidents can be expected due to risk factors and complexity." (Wikipedia)

2. What are the five basic principles/characteristics of HROs? Give examples within the video that either support or contradict the HRO characteristics.

   - Preoccupation with failure

     o "If we are going to break it, we ought to break it as soon as possible." (11:50 – 11:56) This quote refers to not testing and having total failure in space.

     o A mix-up in 1999 between English and metric units caused the loss of the orbiter. Many previous attempts to land on Mars failed. (12:51 – 14:06)

     o "With that very first test, when we first see it happening, that technical part of your brain says, 'This has to work.' That emotional part of your brain is saying, 'Yeah, but what did you forget? You're not as smart as you think you are.' And let's just say we never get past that fear until we're successful." – Randy Lindemann, Rover Systems Engineer, JPL (15:24 – 15:50)

     o There have been many unsuccessful space missions conducted by the U.S. and the Russians.

   - Reluctance to over simplify

     o "Of all the things that could go wrong, the airbags seem the least likely to cause trouble. It's a relatively simple idea: inflate a cushion around the lander, and let it bounce." The airbag landing system fails. (18:36 – 20:23)

     o The problem with the parachute is simple in theory, but "the physics of inflation are complex and hard to predict." (37:17 – 38:13)

     o The fired pyros are misplaced. No one expected that they would be needed again. (43:48 – 44:36)

   - Sensitivity to operations

     o "I think it's easy to forget about the big picture when you start getting a little tired, a little burned out." (5:13 – 5:17)

- o Due to cost factors, the engineers must perform a stress test on an irreplaceable flight unit (Mini-TES) which endangers the mission. (7:20 – 7:46)

- o "Go with what you know. We had success. Take the drawings off the rack for Pathfinder, build a new set. Except Pathfinder got dinged for not having enough science return, so we're going to up the science return by stuffing a big rover inside of this lander." (21:05 – 21:24) This small variation caused a series of unintended consequences: airbag failure and subsequent parachute failure (squidding) not seen before.

- o There is a potential problem with the pyros that jeopardizes the mission. (41:30 – 44:36)

- Deference to expertise

  - o Due to the length of communication time between Mars and Earth, "the rovers will have to be smart enough to make many of their own decisions." (7:20 – 7:46)

  - o Steve Squyers (lead scientist) defers to Steve Silverman (Technical Director, Planetary Systems, Raytheon) and a dynamicist regarding whether to perform the test on the Mini-TES. (9:48-11:56)

  - o The bosses from JPL who have been through similar challenges arrive to assess the problem situation. (34:48 – 37:17)

  - o Scientists defer to the engineers to resolve the parachute problem.

- Commitment to resilience

  - o "With that very first test, when we first see it happening, that technical part of your brain says, 'This has to work.' That emotional part of your brain is saying, 'Yeah, but what did you forget? You're not as smart as you think you are.' And let's just say we never get past that fear until we're successful." – Randy Lindemann, Rover Systems Engineer, JPL (15:24 – 15:50)

  - o "They were caught by surprise because they'd done this all before, on a highly successful mission from 1997 called Mars Pathfinder." – MARS Dead or Alive Narrator (20:23 – 21:05)

  - o The engineers redesign landing systems to make landing at the scientists' choice of Gusev crater possible.

3. What lessons can wildland fire leaders learn from the Mars Exploration Rover (MER) project?

   - Answers will vary but may include any response from the bullets listed below the "HRO ~ The Five Basic Principles" in High Reliability Organizing – What It Is, Why It Works, How to Lead It (included as a student handout).

4. After the engineers successfully conduct a test on a $5,000,000 piece of equipment to ensure it can withstand impact, Steve Silverman leaves the engineers to conduct a postmortem exercise. What is a postmortem exercise? What is a premortem exercise? Discuss in your group your experiences conducting premortem and postmortem exercises.

- Answers will vary. See definitions provided in High Reliability Organizing – What It Is, Why It Works, How to Lead It (included as a student handout).

5. Scientists and engineers worked together to ensure the success of the MER project. In your groups, discuss the following quote and possible similarities found within the wildland fire service: "There's a natural built-in creative tension between the science and the engineering. And ultimately, even though it gets people kind of riled up sometimes, it works to the benefit of the system."

Quotes and themes that may promote discussion

- "I think it's easy to forget about the big picture when you start getting a little tired, a little burned out." – Art Thompson, Rover Engineer, JPL (5:13 – 5:17)

- "Even for a robot, it's a hostile environment, but these rovers will be prepared for the worst." – MARS Dead or Alive Narrator (6:10 – 6:20)

- "But even at the speed of light, it will take 10 minutes or more for radio signals to reach Mars; so the rovers will have to be smart enough to make many of their own decisions…" – MARS Dead or Alive Narrator (7:20 – 7:46)

- "With that very first test, when we first see it happening, that technical part of your brain says, 'This has to work.' That emotional part of your brain is saying, 'Yeah, but what did you forget? You're not as smart as you think you are.' And let's just say we never get past that fear until we're successful." – Randy Lindemann, Rover Systems Engineer, JPL (15:24 – 15:50)

- Unexpected problem (18:05 – 21:05)
    - "Of all the things that could go wrong, the airbags seem the least likely to cause trouble." – MARS Dead or Alive Narrator
    - "What's happened here? This is unexpected." Adam Steltzner, Landing Systems Engineer, JPL
    - "They were caught by surprise because they'd done this all before, on a highly successful mission from 1997 called Mars Pathfinder." – MARS Dead or Alive Narrator

- "There's this natural tension between the scientists and the engineers, because the engineers are the ones who have to tell the scientists, 'the possibility of failure, if we do what you want, is too high.'" – Pete Theisinger, Mars Exploration Rovers Project Manager, JPL (29:15 – 29:28)

- "This test is the big deal. If we have a failure here, that's going to start a measure of desperation we never want to find ourselves in, so…" – Adam Steltzner (33:56 – 34:07)

- Chute fails to inflate (34:48 – 38:13)
    - "Instead of solving a problem, they've uncovered a new one, and they don't know what's causing it." – MARS Dead or Alive Narrator
    - "Just when we thought we were there, just about to cross the finish line, out of nowhere this thing comes. It certainly was the worst feelings I'd had thus far in the project." – Adam Stelzner
    - "Every one of our missions seems to have some sort of grand challenge in the final year before launch. It just seems to be part of the deal. I guess it's because we don't do this often enough. It adds to the stress levels, especially since Mars is marching closer and closer. That launch date is coming closer and closer, and we have very little elbow room." – Rob Manning, Systems Engineering Manager, MER
    - In theory, it's simple. But in practice, parachutes are a nightmare for engineers. The physics of inflation are complex and hard to predict." – MARS Dead or Alive Narrator

- "The team has worked very, very hard, and there have been some fairly significant sacrifices. – Adam Stelzner (51:03 -51:15)

High Reliability Organizing (HRO)

HROs practice a form of organizing that reduces the pain created by unexpected events, helps us contain them, and speeds up recovery.

We all plan for what we expect and even develop contingencies for ways we think things could go wrong. Managing the unexpected is difficult to "plan" for by definition. We never imagined those surprises!

Relying only on what we can imagine can eventually mean big surprises, unless we create a mindful infrastructure that is continually

- Tracking small failures
- Resisting oversimplification
- Sensitive to operations
- Maintaining capabilities for resilience
- Taking advantage of shifting locations of expertise

There are ways to build upon our skills to both anticipate and recover from the unexpected test.

The ability to see things coming long before they arrive, even when events are quickly unfolding outside of expectations, or our systems are quietly breaking down just below the surface, can be learned and taught.

The ability to recombine the resources at hand into novel approaches to problem resolution, emotional maturity evidenced in respectful communication under duress, and deep knowledge of how the system's technologies function are a few signs of a commitment to building resilient people, teams and organizations.

The best HROs expect people will make mistakes and that their systems can fail in unimagined ways. This vision is evident in the underlying principles of mindfulness that heighten awareness, increase vigilance, create clarity in the midst of noise, and deal with disasters before they can fully develop.

Continuous updating in a mindful way minimizes the likelihood of large failure, speeds recovery, and facilitates real organizational learning.

Managing the Unexpected; Assuring High Performance in an Age of Complexity

Dr. Karl Weick and Dr. Kathleen Sutcliffe

Source: Wildland Fire Lessons Learned Center

HIGH RELIABILITY ORGANIZING

What It Is, Why It Works, How To Lead It

(Derived from the BLM Fire and Aviation Directorate's Division of Fire Operations March 2010 HRO training session)

HRO – Why It Works

Karl Weick and Kathleen Sutcliffe cite wildland firefighting crews as one example of a high reliability organization in their book, Managing The Unexpected – Resilient Performance in an Age of Uncertainty. They ask their readers to use our organization as a benchmark, "not because they 'have it right' but because they struggle to get it right on a continuous basis."

HRO: A Discipline or a Recipe?

Donna Hunter explained to attendees that HROs are developed more through discipline than following a recipe for success.

The goal of HRO is to have employees operate in a hyper-vigilant state of mind. Hyper-vigilant employees "recognize even subtle signals, and know that the signal was significant in context."

Quoting Karlene Roberts in New Challenges to Understanding Organizations, Hunter noted that employees in HROs:

1. Seek perfection but never expect to achieve it.
2. Demand complete safety but never expect it.
3. Dread surprise but always anticipate it.
4. Deliver reliability but never take it for granted.
5. Live by the book but are unwilling to die by it.

The four key pillars for sustainable risk management taken from James Reason's Managing the Risks of Organizational Accidents are:

- **Reporting Culture** ~ Safety cultures are dependent on knowledge gained from near misses, mistakes, and other "free lessons." People must feel willing to discuss their own errors in an open, non-punitive environment.
- **Just Culture** ~ An atmosphere of trust where people are encouraged to provide essential safety-related information yet a clear line is drawn between acceptable and unacceptable behavior.
- **Flexible Culture** ~ One that adapts to changing demands by flattening hierarchies and deferring to expertise regardless of rank.
- **Learning Culture** ~ The combination of candid reporting, justice, and flexibility enables people to witness best practices and learn from ongoing hazard identification and new ways to cope with them.

To be a premier organization we must:

- Feed the learning back into the organizations
- Encourage team members to ask critical questions.

HRO ~ The Five Basics Principles

Dave Thomas and Donna Hunter

1. *Preoccupation with Failure*

   - Vigilant attention to early detection of small errors.

   - Encourage reporting of errors and near misses.

   - We should be worried we haven't caught everything…we worry when things are going too smoothly…we realize that any lapse is a symptom that something could be wrong with the system.

   - We tend to look at large errors with catastrophic consequences but we should look for small failures to avoid large errors. We should be preoccupied with failure before an event occurs.

   - We should look at fatality incidents starting months before the accident and ask ourselves, "Why did everything they did make sense to them at the time?"

2. *Reluctance to Over Simplify*

   "Checklists have their place so we shouldn't throw them out because they are over simplified. Rather, we need to continually ask ourselves what we are missing in our over-simplification." ~ Michelle Ryerson, BLM Safety Manager

   - This is not the KISS (Keep It Simple and Short) theory. While checklist and standard operating procedures (SOPs) help us stay focused on key issues and indicators, we know that to manage for the unexpected, we should be reluctant to accept over-simplification.

   - We must overcome the tendency to simplify by inviting skepticism to conventional wisdom, questioning standard procedures, and reconciling diverse opinions.

3. *Sensitivity to Operations*

   Quote: "When they (HROs) 'recognize' an event as something they have experienced before and understood, that recognition is a source of concern rather than comfort. The concern is that superficial similarities between the present and the past mask deeper differences that could prove fatal." ~ Karl E. Weick

   - Even small variations in operations deserve individual attention.

   - A vigilant eye on operations helps us make continuous adjustments that prevent small errors now before they become large errors in the future.

   - We must notice anomalies while they are still tractable and can be isolated. They need to be caught before they escalate into a catastrophic accident.

   - Most accidents are not the result of a single error, but rather an accumulation of numerous small errors that result in a disproportionately large accident.

"We look at our organization like an air traffic controller looking at a radar screen…looking for weak signals that just bleep on occasion. This is how we maintain an organizational preoccupation with failure and sensitivity to operations." ~ Sheldon Wimmer, SFMO Utah

4. *Deference to Expertise*

- HROs push decision making down to the front line (point of the spear), and authority migrates to the person with the most expertise, regardless of rank.

- Expertise is not confused with experience. Experience by itself does not guarantee expertise. We must scan up and down the chain of command to find the right expertise needed to handle the current or potential problem.

- Decision making should migrate to the person with the unique knowledge needed to confront the given situational complexities.

5. *Commitment to Resilience*

- HROs have the ability to be stretched and still bounce back. They continuously evaluate the worst case scenario and practice internal fire drills.

- They know they haven't seen all the ways that a system can fail.

- HROs cultivate employees to confront organizational obstacles and actively find solutions or workarounds.

- HROs are vigilant at keeping errors small and improvising workarounds that allow the system to keep functioning.

"HROs put a premium on training, personnel with deep and varied experience, and skills of recombination and making do with whatever is at hand." ~ Karl E. Weick and Kathleen M. Sutcliffe

Organizational Inputs to a Resilient System

The ability to deal with an emergency situation is dependent on the systems, structures, and cultures put in place before a crisis occurs. Resiliency includes both individual and organizational inputs. These inputs include:

- Knowledge gained through openness and sharing of information.

- Accumulated experience.

- Facilitated learning.

- Maximize a reporting culture.

- Restructuring to meet demand of the organization not previously anticipated.

- Coping with unforeseen challenges.

- Flexibility and adaptability in available people and resources to mitigate challenges.

- o We need to have the right people with the right authority to make decisions in a timely matter.

- o We feel empowered to take drastic measures when necessary; e.g., closing down a major freeway during a wildfire or exercising the right to turn down an assignment.

How Do We Maintain Resiliency?

- Sponsor leadership courses which stress communications and the ability to speak up at all levels of the organization.

- Lead by example (show quick decision making or play "what if" games).

- Run premortem and postmortem exercises.

Premortem Exercises

Premortem exercises are very powerful tools that begin by looking at an incident that will take place in the near future. All participants are instructed to assume that something went spectacularly wrong and are then asked to determine the cause of this tragic ending, and identify ways of preventing this failure from happening. Premortem exercises:

- Can be done on a scheduled prescribed fire or in an incident action plan (IAP).

- Let all participants introduce their idea of what went wrong. Supervisors invite subordinates to tell them how this incident or plan can fail.

- Look for blind spots.

- Determine ways to prevent this failure.

Postmortem exercises

Postmortem exercises look at a past incident. Participants identify what happened and then analyze why it happened. Postmortem exercises:

- Are more in depth than an after action review (AAR) but not as detailed as an investigation.

- Look at organizational systems months before the incident.

- Are designed to avoid hindsight bias.

Source: *High Reliability Organizing – What It Is, Why It Works, How to Lead It.* BLM Fire and Aviation Directorate, Division of Fire Operations. March 2010.

MARS DEAD OR ALIVE

Guided Discussion

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2. What are the five basic principles/characteristics of HROs? Give examples within the video that either support or contradict the HRO characteristics.

3. What lessons can wildland fire leaders learn from the Mars Exploration Rover (MER) project?

4. After the engineers successfully conduct a test on a $5,000,000 piece of equipment to ensure it can withstand impact, Steve Silverman leaves the engineers to conduct a postmortem exercise. What is a postmortem exercise? What is a premortem exercise? Discuss in your group your experiences conducting premortem and postmortem exercises.

5. Scientists and engineers worked together to ensure the success of the MER project. In your groups, discuss the following quote and similarities experienced within the wildland fire service: "There's a natural built-in creative tension between the science and the engineering. And ultimately, even though it gets people kind of riled up sometimes, it works to the benefit of the system."