

Two Entrapment Avoidance Projects: Studying Crew Cohesion as a Social Human Factor

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ABSTRACT

The paper presents a progress report on two entrapment avoidance projects at the Missoula Technology and Development Center. Experiments with different qualitative study techniques permitted the discovery and documentation of commonsense, successful work practices crewleaders used to resolve crew cohesion problems on wildland fires. Leaders of different kinds of Forest Service fire crews were comfortable telling detailed stories of work practices they used at specific moments on fires to resolve problems with crew cohesion. Their stories preserved the social context of what was going on at the time. The paper presents some examples of different cohesion problems crewleaders faced, as well as examples of some commonsense work practices they used to keep their crews cohesive. Interviews so far show that experienced leaders of fire crews don't see poor crew cohesion as a direct cause of entrapment. Rather, crewleaders saw good crew cohesion as a latent preventative factor that reduced the chances of an entrapment. The paper ends with a short note on work planned for the next 2 years, concluding with a brief discussion of how the stories from crewleaders can be used for training.

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INTRODUCTION

This paper discusses development work for two entrapment avoidance projects at the U.S. Department of Agriculture (USDA) Forest Service, Missoula Technology and Development Center (MTDC). The Forest Service's two technology and development centers (one in Missoula, MT, the other in San Dimas, CA) create tools to help employees solve work problems in the field. The overall goal of the entrapment avoidance projects is to create "human factor" tools that can help crews reduce their chances of entrapment in wildland fire. Developing human factor tools requires working closely with the people who need the tools: wildland firefighters.

Development work for entrapment avoidance projects began at the Center in 1999 and is planned to continue through 2006. The story of our development work has three parts. The first part is a brief history of the first project, which was completed between 1999 and 2003. The second part describes development work completed so far on the current project: crew cohesion and entrapment avoidance. The third part briefly describes work planned for the last 2 years of the project, including the development of human factor tools.

FIRST ENTRAPMENT PROJECT

The entrapment avoidance project (figure 1) at MTDC began in 1999. The center was asked to produce a 30-minute entrapment avoidance training video to accompany a fire shelter training video. The original idea was that both videos would be used as supplementary materials in basic and refresher fire training.



Figure 1—Helping wildland firefighters reduce the risk that they might be entrapped by the fire they are fighting is the goal of the entrapment avoidance projects at the USDA Forest Service’s Missoula Technology and Development Center. (Photo used with permission of wildlandfirefighter.com, photograph by Morton Salt)

Between 1999 and 2003, 24 experienced wildland firefighters and experts in the fire community were interviewed using grounded theory methodology (Glaser and Strauss 1967). A single question was the focus of all interviews: “How can firefighters avoid entrapment?” To our amazement, we found that this general question opened up the entire world of firefighting. Practically all the thoughts and actions of firefighters, especially those with the most experience, were predicated on avoiding entrapment. The interviews covered an amazing variety of topics, problems, and solutions. Our data showed there were no simple solutions to entrapment avoidance. At this point, Leslie expressed our collective exasperation when she said, “This thing is like trying to get our arms around a big pile of spaghetti.” We came to the conclusion that the original project idea—to produce one short video on entrapment avoidance—was simply too ambitious. Based on our data, we knew that separate in-depth studies were needed on the most critical issues brought forth in the 24 interviews.

Completing the First Project: A Project Record

To complete our initial development work, we wrote a summary report (Driessen and others 2002). The report identified the seven key problems associated with entrapments, based on our interviews. These problems were:

- Poor crewleaders
- Keeping communications open (intracrew cohesion)
- Communication between crews and incident commanders (intercrew cohesion)
- Maintaining situational awareness
- Turning down assignments, disengaging from fires, and the problem of managing the pressure to catch the fire
- Importance of and problems with LCES (lookouts, communications, escape routes, and safety zones)
- Problems of training crewleaders to avoid entrapment

After reading the project record, the Forest Service Washington Office's branch chief for equipment and chemicals requested a proposal identifying specific projects on entrapment avoidance. In January 2003, the center submitted a proposal recommending five specific projects:

- Keeping communication open: establishing and maintaining intracrew cohesion (within crews)
- Managing communication between crewleaders and incident commanders: establishing and maintaining intercrew cohesion (among crews)
- Managing complacency and handling information overload
- Managing pressure to catch the fire
- Improving skills of firefighters who serve as lookouts

THE SECOND PROJECT: INTRACREW COHESION AND ENTRAPMENT AVOIDANCE

In 2003, a new project, **intracrew cohesion and entrapment avoidance** was approved by the Technology and Development Program's Fire and Aviation Steering Committee.

Crew Cohesion: An Important Human Factor in Firefighter Safety

Before talking specifically about the second entrapment avoidance project, a brief overview of the concept of cohesion may be helpful. For many years, sociologists and psychologists have written about the problems of cohesion in modern industrial societies (Durkheim 1897). Studies of cohesion in industrial workgroups were carried out during the 1930s and 1940s (Roethlisberger and Dickson 1939). Since WWII, cohesion problems have been studied in military units (Henderson 1985; Janowitz 1965; Merton and Lazarsfeld 1950). Only recently, however, has cohesion begun to receive serious attention in the Forest Service. The first mentions of cohesion as a critical human factor in crew resource management and safety were made in an MTDC training guide and a video series (Driessen 1990; Driessen 1996). In 1995, the first wildland firefighters human factors workshop, also in Missoula, MT, recommended paying more attention to cohesion problems in fire crews (Putnam 1995). Three years later, the TriData Report (1998) pointed to the importance of increasing the cohesion of fire crews. Problems with crew cohesion were identified in the Thirtymile Fire (USDA Forest Service 2001) incident reports. In 2002, MTDC published a paper, "Crew Cohesion, Wildland Fire Transition, and Fatalities," that was intended to spark serious discussions among firefighters about the importance of crew cohesion and firefighter safety (Driessen 2002).

Studying Crew Cohesion

During the spring and summer of 2003, we began preliminary work on the second project. We needed to solve four central methodological issues. First, whom would we interview? Second, how would we define crew cohesion? Third, what kinds of data should we collect about crew cohesion and how could we identify data showing the relationship between crew cohesion and entrapment avoidance? Fourth, what specific study techniques would give us the kind of data we wanted?

Interviewing Experienced Crewleaders

In the first entrapment project, experienced firefighters pointed out that good crewleaders played the most important role in preventing entrapment of their crews. Because of this finding, we decided to interview experienced crewleaders during the second project. In addition, we wanted leaders who worked with crews on initial or extended attack fires. These early stages of the response to a wildland fire were selected because studies show that most entrapments have happened during these two periods (Mangan 1999; Munson 2000).

Defining Crew Cohesion

Cohesion is perhaps the most **social** of all human factors. In this respect, it is qualitatively different from psychological human factors such as perception, memory, decisionmaking, attitudes, and similar factors. In past empirical research, most sociologists and psychologists have operationally defined group cohesion as “the measures of the extent to which members of a group find other members of the group attractive” (Gross and Martin 1952). Newcomb (1950), a psychologist, recommended studies on “cohesiveness of groups” rather than cohesion.

Based on our first study, we felt this narrow operational definition missed simple commonsense ideas about the nature of crew cohesion. We deliberately wanted to preserve the “worldly” notions about crew cohesion; that is, we wanted crewleaders’ ideas about the nature of social cohesion (Rose 1992). Rather than restrict ourselves, *a priori*, to some narrow operational definition of crew cohesion, we decided to rely on what sociologists call “self-definitions.” Because we defined cohesion this way, we could base our definition on what crewleaders said they thought constituted crew cohesion based on their experiences with fire crews.

Throughout history, sociologists have tried to measure cohesion as if it were a variable in human groups. In our project, we were not trying to measure cohesion as a variable, but to view it as a social process, something created in crews that needed to be described.

Connecting Crew Cohesion to Entrapment Avoidance

We also wanted to find out how crew cohesion is related to entrapment avoidance. To do so, we decided to ask experienced leaders to tell us how crew cohesion is related to entrapment avoidance.

Looking for Work Practices, Not Rules

Successful work practices can be defined as those things people do to get jobs done without much notice or problem. Most things done well go largely unnoticed (Garfinkel 1967). Many people are so skilled that their work practices appear to be nothing more than commonsense, mundane actions that are taken for granted, unless something goes wrong. With regard to firefighting, experienced crewleaders have different types of common work practices that contribute to cohesion, things they say and do to manage crew cohesion problems successfully on real fires. For this project, we wanted to find, document, and “preserve their work practices that were situated in contexts of fires themselves” (Weick 1995). Once these practices were identified, they could be the basis for training crewleaders in work practices that foster cohesion.

We wanted to avoid formulating another list of “rules” for crewleaders to follow. Incident investigation reports of entrapment fatalities indicate that most, if not all, of the fire orders were disregarded by the crewleaders during these incidents. Why? Perhaps the answer lies in the fact that rules themselves do not contain the specific instructions or

work practices one needs to follow in a specific context (Garfinkel 2002). Rules are qualitatively different than the commonsense work practices used by crewleaders to get the job done. In our study, we wanted to find common work practices crewleaders used successfully while fighting wildland fires.

Experiments in Collecting Data

In the early stages of the new project, we decided to collect data through interviews. To help crewleaders immerse themselves in their accounts and recall the details of their work practices that fostered cohesion, we used memory-recall devices such as:

- Real-time recordings on fires
- Maps
- Sand tables

Testing Techniques to Record Real-Time Work Practices

We tried to collect the data on work practices using video cameras, pocket tape recorders, still cameras, and internal radio networks. We worked with a type II crew, its crewleader, and two smokejumpers. We gave each of the crewleaders a small tape recorder and a still camera. We asked them to record those times when their work practices were focused on the cohesion of their crew. In addition, when the crewleader and crews were dispatched to fires, we sat by the crew buses and listened to the crewleader's chatter on the internal radio networks.

Unfortunately, this data gathering was fraught with problems. Our first problem was simply trying to keep track of the crews' whereabouts. The crews were dispatched suddenly and the crewleaders did not have time to keep us involved and up to date. The second major problem involved the radio chatter. It often broke up or we could hear only one of the speakers. In some cases, firefighters talked over each other on the radio, making the recordings unintelligible.

The final problem was more serious. One crewleader became concerned about confidentiality. He wasn't worried that we were recording him or his crew. He was worried that we would be recording other people, outside of his group, who did not know about the study. We were, in fact, recording people who had not given us permission to record them. The legal and professional problems surrounding the question of confidentiality put a stop to recording. By the end of the summer, we knew we needed to try some other study techniques.

Problems Using Sand Tables and Maps

We had no choice but to rely on in-depth interviews with crewleaders to obtain our data. We thought we could use sand tables and maps to help crewleaders remember and talk about specific moments on a fire when they had to use a work practice that contributed to crew cohesion. During several interviews, we asked crewleaders to draw a specific fire

on a map or to model it on a sand table, drawing it in the sand. We then asked the leaders to go step by step through the progression of their work with their crew on a fire. We thought these exercises would help them remember the details of the work practices they used on a fire to solve problems with cohesion.

Both of these exercises proved to be of little value. During the interviews, the crewleaders used the technical language of firefighters to describe how they fought the fire. Most of them did not use their “ordinary language.” Instead, they talked about tactics, strategies, situational awareness, LCES, the standard fire orders, watchouts, weather, fire behavior, logistical support, and the like. This professional fire talk did not describe and account for the interactions of people on the crew. These interviews largely ignored human factors going on during real fires. When we tried to get crewleaders to think about human factors, especially crew cohesion, they had difficulty describing in rich detail their experiences with the crew interactions that make for crew cohesion. We needed to discover how we could get into the world of crewleaders’ work practices that contribute to cohesion; that is, to record the things they say and do on real fires.

Professor Watson: Making “Cultural” Things Visible

Faced with this problem, we wrote a letter to Professor Rodney Watson, a colleague who is a sociologist at the University of Manchester in England. After reading about our troubles, he replied with a lengthy letter suggesting we abandon the idea of recording real-time work practices of crewleaders on fires. He gently reminded us that “cultural data,” such as social human factors, cannot be captured using “clock time.” The work practices of crewleaders that contribute to crew cohesion, as well as crew cohesion itself, are cultural objects. Because they are cultural, they can be only gathered through the talk and gestured actions of people. Watson suggested the only way we would ever capture work practices as cultural objects was to let crewleaders talk freely about ways they solved cohesion problems with their crews when they were fighting fires.

Watson also discussed the difficulties of recording cultural phenomena, such as crew cohesion and the work practices that contribute to cohesion. The main problem always is figuring out how to make cultural phenomena (things made by people) visible. People largely take their own cultural phenomena for granted. Cultural objects, such as cohesion and the work practices crewleaders use to manage cohesion, exist but they are unnoticed. Watson suggested we should focus on crewleaders’ troubles with crew cohesion. Trouble has a way of making cultural objects available, bringing them from the background into the foreground, where we can study them. Only when crewleaders have had trouble with crew cohesion does it come to the foreground of their attention. When trouble arises, cohesion becomes an accessible topic, something crewleaders and interviewers can talk about. After pondering Watson’s helpful observations, we asked ourselves how his ideas could be applied to our study of crew cohesion and entrapment avoidance.

Focusing On Stories: Crewleaders’ Troubles with Crew Cohesion

We thought it would be reasonable to ask crewleaders to think about **specific moments or those occasions** (Gumperz and Hymes 1972; Goffman 1963) on fires when they actually experienced real or possible problems with cohesion on their crews. We hoped crewleaders could provide detailed accounts of these moments and also describe work practices they used to resolve various kinds of problems with crew cohesion.

We knew from our earlier interviews that crewleaders had trouble restricting their accounts to cohesion problems that occurred during initial and extended attack. As a result, we encouraged crewleaders to pick any cohesion problem that happened at any time during a fire. With these new interview guidelines, we again set out to interview experienced crewleaders during the summer and fall of 2004. The rest of the paper will discuss important discoveries we made after we began following Watson’s advice to “Let people talk about trouble.”

In our next round of interviews, which took longer than 6 months to complete, we asked experienced crewleaders to recall specific moments on real fires when they had to solve a problem with crew cohesion. We weren’t looking for “war stories.” We wanted their detailed “accounts” about what happened and what they did (the work practices they

used) to solve the different kinds of problems they faced with crew cohesion. (Driessen 1997).

Helping Crewleaders Describe their Work Practices on Fires

Before we interviewed crewleaders, we sent each one a short paper describing the project and asking them to think of a time when they had a problem with crew cohesion. We began our interviews by talking informally and off camera. We introduced ourselves and answered any questions crewleaders may have had about the project. Usually, each crewleader had recalled a couple of occasions when they had a **problem with crew cohesion on a fire**. After we talked informally about these instances, the crewleaders settled on one or two stories they felt comfortable telling us about.

During the formal videotaped interviews, we helped crewleaders recall details in their account. We asked them to describe the scene, the people, and the places on the fire. We asked them to describe in detail **what was going on** between people that caused the cohesion problem, as well as the specific work practices they used to solve the problem. These accounts preserved the worldly context (Rose 1992) and made sense of the work practices used by the crewleaders. Their stories were not about rules they were following, but about work practices they used based on what was happening in the crew at that time on the fire. The crewleaders themselves preserved the social context or occasions in their story, providing outsiders an understanding of why they used specific kinds of work practices.

During the last round of interviews, we became convinced that this approach, suggested by Watson, was paying off. Through stories of troubles, we had found a way to study crew cohesion and the work practices that fostered cohesion. These accounts bridged the gap between the crewleaders and us.

Refining the Definition of Crewleaders and Crews

Identifying Crewleaders of Small Crews

When we looked around for experienced crewleaders to interview, we could not rely on formal job titles to find the real leaders of small workgroups. Firefighters may have many red card qualifications and can be assigned to fires in different work roles throughout a season. To select crewleaders, we asked them about their experiences. We wanted to know if they had face-to-face experiences leading small groups of firefighters (figure 2) on wildland fires.

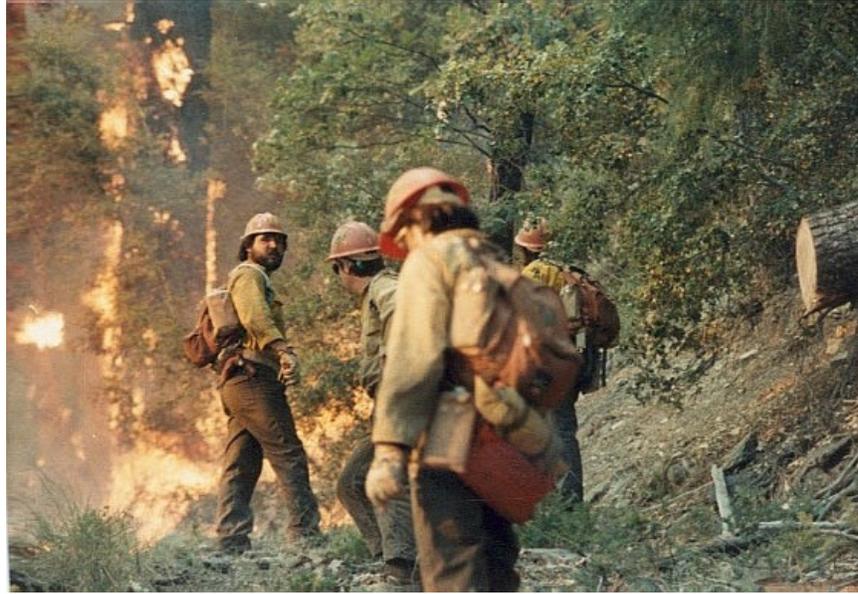


Figure 2— Interviews were conducted with firefighters who had face-to-face experience leading small groups of firefighters on wildland fires. (Photo used with permission of wildlandfirefighter.com, photograph by Jim G.)

Second, we wanted to know whether they had experienced and solved a crew cohesion problem on a fire. In this respect, the kind of crewleaders we wanted to interview for the project were leaders who shared a set of known practices about managing problems with crew cohesion to help avoid entrapment (Garfinkel 2002).

Gathering Stories of Intracrew and Intercrew Cohesion

During the last round of interviews, we encountered problems with the word “crew.” The project was supposed to focus primarily on intracrew (within) crew cohesion. Forest Service firefighters, however, use the word “crew” to refer to two different sorts of workgroups.

When we started our interviews, we used the word “crew” to mean a small, relatively stable group of people who worked together face to face and who had established a social relationship. Social scientists refer to these kinds of groups as “primary groups” (Cooley 1902). Studies of primary workgroups in the military focus on small units, such as squads and platoons. In industrial and business settings, studies of primary workgroups focus on shop floor mechanics, assembly line workers, and office crews. Our focus was on small units of firefighters, such as engine crews, hotshot crews, type II crews, smokejumpers, and district fire crews. During our interviews, crewleaders talked about cohesion problems stemming within (intracrew) their own crewmembers.

In other interviews, however, crewleaders used the term “crew” to refer to a completely different kind of work group. This type of “crew” referred to larger, complex workgroups, temporarily assigned to work together (figure 3). People in these groups usually had never worked together before and had no prior social relationship. This kind

of group is qualitatively different from a “primary group.” Sociologists refer to these kinds of groups as “secondary groups.”



Figure 3—Crews are sometimes mixed into larger, more complex workgroups when they are fighting large wildland fires. (Photo used with permission of wildlandfirefighter.com, photograph by Josh O’Connor)

The distinction between primary work “crews” and secondary work “crews” doesn’t appear to hold in the world of firefighting. Often, small workgroups on a fire can present both intracrew and intercrew cohesion problems for crewleaders. We will not restrict ourselves to the analytical definitions of primary and secondary crews. When selecting crewleaders to interview, we will continue to look for those people who have led small groups of firefighters on fires with intracrew or intercrew cohesion problems. Most stories told to us so far are accounts of problems with intercrew cohesion.

In the next sections, we will present some of the stories we have collected so far. These stories illustrate some of the different kinds of crew cohesion problems. The stories also contain examples of work practices crewleaders have used to solve different kinds of cohesion problems.

Types of Cohesion Problems and the Work Practices that Resolved Them

Classifying Cohesion Problems and Work Practices from Stories

We have interviewed 17 crewleaders, collecting one to three stories from each of them. Each story has described a different kind of crew cohesion problem. Also, each story contained crewleaders’ accounts of the work practices (figure 4) they used to resolve specific cohesion problems. We are using key words in the stories themselves to classify the different types of crew cohesion problems and different work practices (Driessen 1997; Glaser and Strauss 1967).



Figure 4—Briefings are one of the work practices that can contribute to crew cohesion. (Photo used with permission of wildlandfirefighter.com, photograph by J. Foster)

Examples of Cohesion Problems and Crewleaders' Work Practices on Fires

Crewleaders talked about a variety of cohesion problems they encountered in a variety of different situations. They also described work practices they use to deal with the different problems. These stories illustrate how cohesion problems ebb and flow during different moments on fires.

Cohesion Problems

- Change in command
- Cliques forming
- Fights among crewmembers
- Unqualified contract crews
- Crewmembers staggering in at different times
- Distrust of the incident commander
- Fright and flight reaction
- Incompetent workers
- Brandnew crew
- Personal problems with individual crewmembers
- Self-dispatched crew
- Radio overload
- Scattered crew

- Sick of each other
- Silence
- Crew of strangers

Work Practices

- Apologizing
- Assessing and testing the skills and knowledge of crewmembers
- Breaking up cliques and rotating people around
- Giving a briefing
- Changing or taking command
- Releasing a crew from the fire
- Disengaging the crew temporarily
- Giving an incompetent crew a safe job
- Reassuring the crew and telling them the truth in a dangerous situation
- Listening to complaints and concerns
- Pulling back, gathering the crew, and talking
- Scaling work back
- Showing skills and demonstrating knowledge
- Staying calm and “in charge”
- Using humor to release tension
- Welcoming the crew and getting acquainted

Stories from Crewleaders Telling How They Solved a Cohesion Problem

- Story 1: A crew of strangers
A story about how a crewleader solved a cohesion problem with a crew of strangers. The crewleader took time to welcome the crew and have them get acquainted. He gave a thorough briefing and scaled the crews’ work back for one shift until he learned their abilities.
- Story 2: A crew that was sick of each other
A story about how a crewleader solved the problem of crewmembers becoming sick of each other and their assignment. The crewleader solved the problem by having the members and the leaders switch places. This added humor and fun to the task of bringing the crew back together.
- Story 3: A crew that left its division
A story about a crew that left one division and dispatched themselves to another. The crewleader solved this problem by retying the crew into the formal fire organization. He sternly spoke to them face to face, warning them not to leave again. He then tied them into his operation by informing them about the fire situation on that division and gave them a safe job to do.

- **Story 4: An incompetent contract crew**
A story about how a crewleader solved the problem of having what appeared to be an incompetent contract crew show up on the fireline. The crewleader solved the problem by testing the contract crew's skills with a routine assignment. When the crew couldn't do the job, he protected the cohesion of his crew by keeping the contract crew out of the way. He eventually sent the contract crew home.
- **Story 5: A fleeing crew**
A story about how a leader had to keep his crew from fleeing in the face of a blowup. The crewleader solved the problem by threatening the crew, telling them to stay put in their safe spot.

Crew Cohesion and Entrapment Avoidance

During our interviews, we asked crewleaders to connect good crew cohesion to entrapment avoidance. Crewleaders connected crew cohesion to entrapment primarily in two ways. First, crewleaders said when there is good cohesion, crewmembers trust their leaders. As a result of that trust, crewmembers share information with crewleaders when they see dangerous situations. Crewmembers also are more likely to follow a trusted crewleader's instructions in dangerous situations.

Second, crewleaders said crews with good cohesion had heightened situational awareness. Crew cohesion helps the crew and their crewleader stay focused on the fire situation. When all the members of the crew are watching out for dangerous situations, there is a greater chance someone will give a warning to help avoid a possible entrapment.

These findings are preliminary. As we conduct more interviews and analyze the data in greater depth, we hope to discover more connections and understand better how crew cohesion reduces the chances of entrapment.

Crew Cohesion as an Important Latent Human Factor in Entrapment Avoidance

Our data from interviews show that crewleaders do not make direct causal connections between crew cohesion and entrapment avoidance. Most expressed the belief that crew cohesion was an extremely important human factor in preventing entrapment, but not a silver bullet (by itself, it would not prevent all firefighter entrapments). Crewleaders described crew cohesion (figure 5) similar to the way safety professionals describe a "latent preventative factor." In this respect, crewleaders saw breakdowns in crew cohesion as extremely important and in need of attention and repair. Experts in safety and organizations describe the role of preventative factors this way:



Figure 5—Cohesion can help reduce the chances that a crew might become entrapped by the wildland fire they are fighting. (Photo used with permission of wildlandfirefighter.com, photograph by Brian W.)

Where do we stand on the practical question of accident prevention? The answer lies in two questions. First, whether or not latent organizational and managerial factors can be identified and corrected before an accident occurs, and second, the degree to which these interventions can improve the systems' natural resistance to local accident producing factors (Maurino and others 1995, p. 5).

From the perspective of crewleaders interviewed thus far, crew cohesion is just one of many critically important factors that reduce the “chances” their crew will be entrapped. Cohesive crews can be entrapped as well as crews that are in disarray. If one considers entrappings to be accidents, there is one big difference between cohesive crews and crews in disarray: **poor cohesion increases a crew’s chances of an entrapment; good cohesion reduces a crew’s chances of an entrapment** (Driessen 1990; Durkheim 1897).

PART III: DEVELOPMENT WORK FOR 2005–2006

Gathering More Stories: Seeking Saturation

Next year, we plan to conduct more interviews with leaders of fire crews. We need to collect many more stories about problems with crew cohesion that crewleaders experienced on fires. We want to hear from different crewleaders in different parts of the country about different kinds of cohesion problems and learn the different ways crewleaders solved those problems. Sometime within the next year we expect to reach a point of “story saturation,” a time when we no longer hear any new kinds of stories or any new types of work practices (Glaser and Strauss 1967). At that time, interviewing will stop.

Classifying Cohesion Problems and Work Practices

During the next year, we will begin constructing an overall classification scheme of the types of crew cohesion problems on fires and the types of work practices crewleaders use to resolve these problems. After the classification scheme is completed, we will shift the focus of our work to developing a product or products that can be used to supplement the training of crewleaders.

Product Development

Carrying out the development mission of MTDC, the last year of the project will focus on preparing tools for field use. In this case, the tools will be materials that can be used to supplement human factors training for wildland firefighters.

Possible Video Series to Supplement Training of Crewleaders

The original project proposal called for a single video that would help train crews to avoid becoming entrapped in wildfire. We found in the first project that the subject matter was far too complex to present in a single short video. Despite the narrower focus of the second project, we may have to produce, not one, but a series of videos (figure 6) to cover the complex subject matter. The primary audience for these new videos would be leaders of fire crews.



Figure 6—An example of a video series produced by the Missoula Technology and Development Center.

Publishing Stories: Guides not Rules

Another product may be a guidebook (figure 7) containing crewleaders' stories. The guidebook would contain complete stories from crewleaders describing how they managed different kinds of crew cohesion problems on fires. The stories would preserve the real-world context within which crewleaders have to work. The guidebook would not be a collection of "rules" for crewleaders to follow.



Figure 7—An example of a guidebook that incorporated work practices.

Crewleaders could use these stories to better understand the different kinds of problems they are likely to face with crew cohesion. The stories would be intended to increase crewleaders' "stock of knowledge" (Schutz 1962). Knowledge gained from stories about types of crew cohesion problems and the types of work practices used by crewleaders to resolve them, connects directly to Klein's "recognition-primed decision model" (Klein 2001). The new stock of knowledge will expand crewleaders' awareness of common patterns of cohesion problems. Stories also will provide crewleaders a bank of common work practices they can use to manage different problems at different times on fires. The guidebook would not be prescriptive and would not be a substitute for thinking. Crewleaders still would have the responsibility to determine the kind of problems they face with crew cohesion and the appropriate work practices they should use to resolve those problems.

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Driessen, Jon; Outka-Perkins, Lisa; Anderson, Leslie. 2005. Two entrapment avoidance projects: studying crew cohesion, a human factor. Tech. Rep. 0551–2821–MTDC. Missoula, MT: U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center. 22 p.

The paper presents a progress report on two entrapment avoidance projects at the Missoula Technology and Development Center. Experiments with different qualitative study techniques permitted the discovery and documentation of commonsense, successful work practices crewleaders use to resolve crew cohesion problems on wildland fires. Leaders of different kinds of Forest Service fire crews were comfortable telling detailed stories of work practices they used at specific moments on fires to solve problems with crew cohesion. Their stories preserved the social context of what was going on at the time. The paper presents some examples of different cohesion problems crewleaders faced, as well as examples of some commonsense work practices they used to keep their crews cohesive. Interviews thus far show that experienced leaders of fire crews don't see poor crew cohesion as a direct cause of entrapment. Rather, crewleaders see good crew cohesion as a latent preventative factor that reduces the chances of an entrapment. The paper ends with a short note on work planned for the next two years, concluding with a brief discussion of how the stories from crewleaders can be used as training material for crewleaders.

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