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Introduction: Error management on Everest

"[…] I know the mountain [Everest] is an environment so extreme

there is no room for mistakes."

(Cahil, 1997, p. 245-246).

This dissertation reports on research on organizational error culture. That is, the way organizations deal with errors, the approaches the organizational members have towards errors, and which of those behaviors are encouraged or discouraged by the organization. In short, organizational error culture entails the way organizations "think" errors are best dealt with, and how organizations actually do deal with errors.

In this introductory chapter I will give definitions of errors and related concepts (violations and error consequences), and discuss two approaches for dealing with errors (error prevention and error management). I will discuss what organizational error (management) culture entails. A rationale is given for the importance of research on organizational error culture, and the benefits of organizational *error management* culture in particular. All will be done by linking the relevant theory to one factual event; the 1996 climb of Mount Everest by the 'Adventure Consultants' and 'Mountain Madness' expeditions. Further, an overview of the remaining chapters is given.

Over the years, more than 150 climbers (one for every 30 attempting to climb it, or one for every five who have reached the summit) have died on Mount Everest (Coburn, 1997). The leaders of the two expeditions that are discussed here - Adventure Consultant's founder Rob Hall and Mountain Madness' founder Scott Fischer- were both highly respected climbers. Yet, the summit bid of the two expeditions, both departing from camp IV around midnight on May 9/10, 1996, have had extremely tragic outcomes: after sunset (the time any climber definitely wants to be back at Camp IV) seventeen climbers were still somewhere high up the mountain. Both expedition leaders, a guide, and two clients died. Three narrowly escaped death.

One client was left for dead twice, but ultimately survived losing an arm and several fingers. What happened? What went wrong? What role did errors and team error culture play? "A few suggested that the tragedy was simply a combination of bad luck, bad weather and bad decision making." (Cahil, 1997, p. 16). Certainly, more can be said about the antecedents of the disaster.

Mountaineering in general, and the tragedy that struck the two 1996 expeditions in particular, has before inspired academics to analyze the events from a psychological perspective. Loewenstein (1999) has applied and extended utility theory based on mountaineering. For the most part, however, emphasis has been on personality of mountaineers (Jackson, 1967; Magni, Rupolo, Simini, De Leo & Rampazzo, 1985); Elmes & Barry (1999) have applied theory on narcissism to explain the tragedy. Breivik (1997) studied risk taking and sensation seeking among the 1985 Norwegian Mount Everest expedition. Sensation seeking was also studied by Rossi and Cereatti (1993), and Cronin (1991). Stress seeking was investigated by Robinson (1985).

The current chapter takes a different perspective. An attempt is made to apply the theory on error handling approaches and organizational — or in this specific case — team error culture aspects to the events and outcomes of the 1996 summit assault.

The first and foremost goal of the current chapter is to introduce to the reader relevant concepts and theory with respect to errors and error culture, and to provide some rationale for the empirical research described in later chapters. The chapter thus attempts to "smoothen the path". Further, I will tip on some specific questions: Has the way the teams handled errors contributed to the tragedy? How can the error

cultures of the expeditions be characterized? What role may these team cultures have played in the outcomes following the summit bid?

It is important to note that I do not claim to be giving an exhaustive analysis of the 1996 Everest disaster. For such an attempt, I would have had to gain far more expertise on mountaineering. Further, the number of sources used here is restricted. At times, it may seem to the reader that the Mountain Madness expedition had more problems, and made more errors. Please note that more problems and errors of the Mountain Madness expedition are *discussed* here, simply because the 'inside' source of this expedition is one of the guides (Boukreev & De Walt, 1997), who had insight in the expedition leader's and guides' strategies, decisions, and errors. With respect to the Adventure Consultants expedition, in contrast, most of the information is derived from one of the clients (Krakauer, 1997), who may have lacked background information on rationales for decisions made by the leader and guides.

In order to understand and appreciate the role of errors and error culture in high altitude mountaineering, some background has to be provided. In alternating segments I will discuss high altitude mountaineering, and theory on errors and error culture: Background and specifics of the two expeditions are followed by theory on errors, preparations for the summit bid, theory on error culture, before I reach the 'climax' of the chapter; the summit bid, its tragic outcomes and the role of error culture.

Of the general factors contributing to a successful (commercial) Mount Everest climb, I will successively discuss expedition staff, equipment, physical and mental health, number of expeditions attempting for the summit in the same season,

and weather.   Strengths and weaknesses of both expeditions' preparations are considered.

Spring 1996. Both expeditions had one head guide (Rob Hall/Scott Fischer, see also Table 1), two guides (Mike Groom & Andy Harris/Anatoli Boukreev & Neal Beidleman), a climbing sirdar (leader of the climbing Sherpas; Ang/Lopsang), six or seven climbing Sherpas, a Base Camp doctor, a Base Camp sirdar, a Base Camp Manager and a Base Camp cook. Both expedition leaders had put effort in hiring the best available people, although Fischer's choice of Lopsang as a climbing sirdar was criticized by outsiders: "Lopsang's climbing no one would question. But, his leading, I don't know. [Lopsang being young and lacking leadership experience] is going to make all sorts of mistakes and could well blow it big time" (Henry Todd, expedition leader of "Hymalayan Guides" cited in Boukreev & De Walt, 1997). The climbing Sherpas take all the gear and provision up the mountain, build consecutive higher camps, prepare meals up the mountain, and fix ropes. As Rob Hall said to his clients; "The Sherpas we've hired are the best in the business. They work incredibly hard for not very much money by Western standards. I want you all to remember we would have absolutely *no* chance of getting to the summit of Everest without their help. I'm going to repeat that: Without the support of our Sherpas none of us has any chance of climbing the mountain." (Krakauer, 1997, p.53).

Table 1

Composition of Adventure Consultants and Mountain Madness expeditions

Adventure Consultants		Mountain Madness
Rob Hall	Founder & leading guide	Scott Fischer
Mike Groom	Head Guide	Anatoli Boukreev
Andy Harris	Guide	Neal Beidleman
Ang	Climbing sirdar	Lopsang
John Krakauer	Journalist/client	Sandy Hill Pittman
Doug Hansen	Client	Charlotte Fox
Beck Weathers	Client	Tim Madsen
Yasuko Namba	Client	Pete Schoening
Stuart Hutchison	Client	Klev Schoening
Frank Fischbeck	Client	Lene Gammelgaard
Lou Kasische	Client	Martin Adams
John Taske	Client	Dale Kruse

Equipment and supplies such as tents, ropes, ladders, and oxygen have to be made available. Scott Fischer's expedition had problems in this area. At high altitude, weight matters. As Scott Fischer wanted to maximize the clients' chances of reaching the summit, he opted for the purchase of proportionally light Poisk's three-liter oxygen canisters (Boukreev & De Walt, 1997). Scott and Boukreev had engaged in intense negotiations with the Poisk manufacturers. Finally, at a very late time, a compromise was reached. The shipment, however, was mistakenly delayed by Russian customs, and the oxygen arrived only shortly before the climb. There were similar problems with a custom-made tent. Of concern to both expeditions was the

snow still lingering on sections of the trekking trail to Everest Base Camp, halting the expedition porters and yaks transporting equipment and supplies to Base Camp. These logistical problems caused stress for both expedition leaders.

Besides the obvious importance of physical health, mental health, or 'positive spirit', is also crucial for all attempting to climb (Boukreev & De Walt, 1997; Graydon & Hanson, 1997). The expedition leaders were burdened by a competition of establishing and/or maintaining a market share in the commercial expeditions business. Hall had already established a good reputation, and had no trouble finding clients coming up with the 65,000 US dollars he charged. Fischer was, in 1996, new in the commercial Everest market. He desperately wanted to establish his business. Thus Hall and Fischer, although they respected each other and could get along well, were direct competitors. Hall had the advantage of reputation in the business. Fischer had the advantage that his business was based in the US, where about 80% of potential clients are found. Outnumbering the other at clients brought to the summit (and back safely) was what was going to make the difference. Commercial expeditions, however, imply working with clients whose climbing expertise, physical health and ability to cope in extreme situations are unknown. Guiding clients up the mountain, some of whom substantively lack experience, therefore makes any prediction of the success rate nearly impossible.

In the years preceding the 1996 spring expeditions, Everest had become increasingly popular. In 1996 some three hundred people (climbers as well as supporting staff) resided at Base Camp. In total no less than fifteen expeditions, twelve non-commercial and three commercial expeditions, attempted to reach the summit. Although cooperation among expeditions can be mutually beneficial, there is

an optimum in the number of expeditions attempting a summit assault in the same period. This optimum was exceeded, increasing the risk of bottlenecks and delays on the mountain (Coburn, 1997). For this reason an agreement was reached among the 1996 expeditions. Each expedition was assigned a 'summit day'. For both Adventure Consultants and Mountain Madness it was agreed that they would assault the summit on May 10. As I will discuss later, some expeditions chose to violate the agreement. On May 10 a Taiwanese expedition decided to go for the summit earlier than they were supposed to.

Finally, I want to mention one extremely important factor: weather. The weather does, probably more than anything else, determine the chances of making it to summit and back. It is, at the same time, a factor beyond control. "What the conditions would be on the mountain when [the two expeditions] were finally acclimatized was anybody's guess. Weather on the mountain, like the people with the hubris to climb it, cannot be predicted with any reasonable degree of accuracy. It was possible that when the climbers were ready, the mountain wouldn't be [....]." (Boukreev & De Walt, 1997, p.74).

Acclimatization. "When confronted with an increase in altitude the human body adjusts in manifold ways, from increasing respiration, to changing the pH of the blood, to radically boosting the number of oxygen-carrying red blood cells — a conversion that takes weeks to complete." (Krakauer, 1997, p.69). Due to a decrease in oxygen, while increasing altitude, it is not uncommon to experience acute mountain sickness (AMS, Graydon & Hanson, 1997), which in turn, when neglected, can lead to life-threatening conditions of high-altitude pulmonary edema (HAPE; a condition

associated with the lungs) or of high-altitude cerebral edema (HACE; a condition associated with the brain). At Base Camp (5300m/17,500 feet) the air holds half of the oxygen that is available at sea level ("like working on one lung and walking around in a two-martini fog" Boukreev & De Walt, 1997, p.75), the air at the Mount Everest summit (8848m/29,000 feet) only holds one third (Boukreev & De Walt, 1997; Krakauer, 1997). Needless to say that acclimatization is absolutely necessary. Further, the period of acclimatization provides the guides with the additional advantage that they can asses the physical and mental condition of the clients. But even when appropriately acclimatized, one is likely to experience hypoxia, when residing at high altitude. This means that one's reasoning abilities (for the duration of the stay at high altitude) decrease dramatically, often without even being aware of this effect. The danger as well as the likelihood of hypoxia make high-altitude mountaineers especially error prone.

Near the end of March both expeditions independently trekked up the trail from Lukla (2850m/9,500 feet; Adventure Consultants) and Syanboche (3900m/13,000 feet; Mountain Madness) to Base Camp (5300m/17,500 feet). By flying the clients to Syanboche, Fischer violated the "start below 3040 meters [10,000 feet] and walk up slowly" rule.

In order to allow acclimatization to the altitude, the teams only covered relatively small distances each day, and rested a lot. On April 8 and 9 the expeditions reached Base Camp, and spent some five days recuperating, upon which further acclimatization started. This entails several one day return trips, followed by longer trips to increasingly higher altitudes, higher camps. Although the basics of any two acclimatization schemes will have similar strategies, details may differ between

teams, and even between team members. An example of an acclimatization plan would be: Day 1; helicopter flight from Kathmandu (1400m/4,500 feet) to Lukla (2850m/9,500 feet). Day 1 to 7; trekking to Base Camp (5300m/17,500 feet), scheduling several rest days in between. Day 8 to 13; acclimatization at Base Camp. Day 14; climb to Camp I (6100m/20,000 feet) and return to Base Camp. Day 15 and 16; resting at Base Camp. Day 17; trekking to Camp I were the night is spent. Day 18; returning to Base Camp. Day 19 and 20; resting at Base Camp. Day 21; climbing to Camp I, were the night is spent. Day 22; proceeding to Camp II (6500m/21,500 feet, "advanced Base Camp", which holds a fully equipped mess tent), spend the night. Day 23; climb up to 6800 meters (22,500 feet), return to Camp II, and descend on to Base Camp. Day 24-26; rest days at Base Camp. Day 27: climb to Camp II, spend the night. Day 28; climb to Camp III (7300m/24,000 feet) and a bit higher, spend the night at Camp III. Day 29; return to Camp II. Day 30; return to Base Camp. Day 31-36; resting before starting the final, full climb.

As soon as acclimatization above Base Camp starts, the clients are presented with a test of physical, mental, and technical preparedness: The Icefall. "No part of the South Col route was feared more by climbers. At around 20,000 feet [6100m, situated between Base Camp and Camp I], where the glacier emerged from the lower end of the Cwm, it pitched abruptly over a precipitous drop. This was the infamous Khumbu Icefall, the most technical demanding section of the entire route. […] Because the climbing route wove under, around an between hundreds of […] unstable towers ["seracs"], each trip through the Icefall was a little like playing Russian roulette: sooner or later any given serac was going to fall over without warning, and you could only hope you weren't beneath it when it toppled." (Krakauer, 1997, p.75-

76). Interconnecting the seracs is a network of fissures ("crevasses"), which can be more than three hundred feet (100m) deep. As they would have to do with respect to other matters as well, the spring 1996 expeditions cooperated. One expedition was elected to take responsibility for preparing the Icefall (and to receive payment from the other expeditions). This entails putting in place more than seventy aluminum ladders to span the crevasses or to ascend vertically. Sometimes four ladders have to be overlapped at their ends and lashed together with climbing rope in order to cover a span.

As some of his clients were not taking the challenges of acclimatization too well, Scott Fischer was forced to make a number of hurried, unplanned excursions between Base Camp and the upper camps escorting clients down. This left Fischer exhausted, and some of his clients poorly acclimatized.

Errors, violations and consequences. In order to address the issues outlined at the beginning of this chapter, I will first define errors, and actions or outcomes that are easily (and often) confused with errors. The concept of errors has, as have most psychological concepts, been defined in different ways. In this dissertation, I focus on action-based definitions of errors. An action is defined as "goal oriented behavior that is organized in specific ways by goals, information integration, plans and feedback and can be regulated consciously or via routines" (Frese & Zapf, 1994, p. 271). Errors, then, are defined as "all those occasions in which a planned sequence of mental or physical activities fails to achieve its intended outcome, and where these failures cannot be attributed to the intervention of some chance agency" (Reason, 1990, p. 9). Or as Frese and Zapf (1994, p. 288) put it: "Errors only appear in goal-

oriented action, they imply the non-attainment of goals, and […] should have been potentially avoidable." At this point, it is important to differentiate (a) between errors and violations, and (b) between errors and error consequences.

In most — if not all — cases, errors do not capture the full range of human contributions to disasters (Reason, 1990). Usually violations are important contributors as well. Errors and violations are similar in the sense that they both involve planned behavior and goals (actions). A violation, however, presumes rules that are disobeyed. Thus, while an error implies a wrong plan or wrong implementation of a plan (hence non-attainment of the goal, hence an error), a violation implies a *conscious* decision to act in a way that strays from predisposed rules of accepted or safe behavior. Further, an error — as discussed above — by definition implies the non-attainment of a goal. This is not the case for violations. An action that is prohibited by rules of some sort, may still result in goal attainment: Crossing a red traffic light may still be associated with the driver's goals of quickly going from A to B. To further illustrate the difference between errors and violations, consider the following event: "Kami [a Sherpa], being young and cocky and inexperienced, didn't think it was really necessary to clip into the rope. One afternoon as he was carrying a load up the Lhotse Face he lost his purchase on the rock-hard ice and fell more than 2,000 feet [600m] to the bottom of the wall." (Krakauer, 1997, p.53-54). The Sherpa in this example consciously violated the accepted rule of securing oneself onto anchored ropes. The following event, which may seem (as it did to fellow climbers) to be a violation, was actually not; "As I advanced, I realized I had made a mistake that morning by not changing out of my "Snickers" [referring to track shoes with spiked cleats usually worn lower on the

mountain, see p.106], and I was upset at having made such a blunder." (Boukreev & De Walt, 1997, p. 109). Boukreev — a Mountain Madness guide whose mistake is described here — did not consciously violate the boots-and-crampons rule here (although he did at lower altitude), rather, he had mistakenly put on the wrong shoes (plan is wrongly executed).

A second important distinction is that between errors and their consequences. The erroneous choice of shoes described above did not have negative consequences, but could have. Whether or not errors have (severe) negative consequences tells us nothing about the severity of the error itself. As a matter of fact, there is no such thing as a severe error. The *same error* may have a variety of — minor or serious — *consequences*, depending on the situation, or system one is working in. Turning a valve in the wrong direction would, when adjusting one's heating system at home, not even be considered worth mentioning. Consider, however, the same mistake when a client of the Adventure Consultants expedition has to await ascending climbers before he himself can descend: "Harris [one of Adventure Consultants guides], who'd left the summit shortly after I did, soon pulled up behind me. Wanting to conserve whatever oxygen remained in my tank, I asked him to reach inside my backpack and turn off the valve of my regulator, which he did. For the next few minutes I felt surprisingly good. My head cleared. I actually seemed less tired than I had with the gas turned on. Then, abruptly, I sensed that I was suffocating. My vision dimmed and my head began to spin. I was on the brink of losing consciousness. Instead of turning my oxygen off, Harris, in his hypoxically impaired state, had mistakenly cranked the valve open to full flow, draining the tank." (Krakauer, 1997, p.8).

That there is no such thing as a severe error does not imply that any one error is similar to the next. Actually, various error taxonomies (e.g. Rasmussen, 1982; Zapf, Brodbeck, Frese, Peters & Prümper, 1992) exist that have helped researchers as well as practitioners at understanding error-prone situations, and develop systems that prevent and/or correct errors.

Error prevention versus error management. With the distinction between errors and their consequences, the ground has been laid for discussing two general approaches to errors: error prevention and error management. In principle, both approaches have the same ultimate goal: Avoiding negative error consequences. Error prevention does so by avoiding the error altogether. Error management (Frese, 1991), on the other hand, is based on the understanding that, no matter how hard one tries, one cannot prevent all errors. Further, it is not really the error you want to avoid, but rather its negative consequences. Error management is thus 'lenient' in the sense that it accepts error occurrence, yet the approach stresses the importance of taking errors seriously and dealing with them. Error management is aimed at avoiding or reducing negative error consequences, and at learning from errors. The latter is what conceptually links the two approaches: Learning from errors that have occurred (error management) helps preventing errors in the future.

Bringing up an example already described above; Boukreev's erroneous choice of shoes did not have negative consequences. On the one hand, Boukreev, as he indicates, "had to be deliberate when I placed my feet" (Boukreev & De Walt, 1997, p. 109). Boukreev thus employed error prevention, avoiding making the mistake of slipping on the icy surface. On the other hand, he was "not in a dangerous

situation because I was on fixed ropes" (Boukreev & De Walt, 1997, p. 109), making sure that an error such as a slip on the ice could not yield the negative consequence of falling into a crevasse. Thus, he also employed error management.

Both error prevention and error management are commonly used in daily life, working life as well as in mountaineering. In daily life, for example, traffic signs indicating a sharp curve, are aimed at preventing drivers from making the mistake of driving to fast in an area where doing so is unsafe. In the event that one does make the mistake (or violation!) of speeding, an automatic anti-blocking system of the car will manage this error, and thereby avoid negative consequences. In working life, for example, our computer asks us whether we really want to delete all of our files, preventing us from doing so erroneously. Also, most software allows direct rectification of errors by means of an undo function. In mountaineering, slipping on ice is largely prevented by attaching crampons to one's boots. Additionally, the consequences of slipping are avoided by securing oneself to anchored ropes.

Errors on Everest. Is Everest a place for error management? "[...] I know the mountain [Everest] is an environment so extreme there is no room for mistakes." (Cahil, 1997, p. 245-246). This quote indicates that error prevention is advisable. Others have gone so far as to say that error prevention is the *only* advisable approach and that error management would not work on Everest: "Unlike your routine life, where mistakes can usually be recouped and some kind of compromise patched up, [on Everest] your actions, for however brief a period, are deadly serious." (Alvarez cited in Krakauer, 1997, p.73). I believe, however, that it is unrealistic, in any environment, in any situation, to think mere reliance on error prevention will be

sufficient. The unexpected error that occurs has to be prepared for and handled, *especially* in an environment where its consequences can be severe. Much of the preparation for future errors can be done through what has been learned from errors in the past. Proper equipment, physical and technical preparedness help to prevent as well as to manage errors. But it cannot be predicted what exactly will happen high up on the mountain.

Error culture. Rybowiak, Garst, Frese, & Batinic (1999) have done research on how individuals tend to deal with occurring errors ("error orientation"). Building on the same line of research, Göbel (1998; Göbel & Frese, 1999) showed that those actions and attitudes that support error management are related to success of small-scale entrepreneurs. In organizations, people not only have their personal goals to focus on. Similarly, on Everest, "The consequences of a poorly tied knot, a stumble, a dislodged rock, or some other careless deed are as likely to be felt by the perpetrator's colleagues as the perpetrator." (Krakauer, 1997, p.38). In organizations, as well as in mountaineering, error culture rather than mere individual error orientation, is important.

Given that it is impossible to eradicate errors, it is important for an expedition (or organization) to acquire error-handling strategies. The examples on error prevention and error management in daily life, work, and mountaineering discussed above illustrate that error prevention and error management strategies can be embedded in the system: Although the users decide they 'do not want to erase all files' (error prevention), and want to 'undo' a dramatic alternation in lay-out (error management), it is actually the computer (the *system*) that was constructed in such a

way that both error prevention and error management are made easy for the users. The organization and its culture can be viewed as a similar system. The error culture, which entails shared beliefs, attitudes and behavioral styles, can be viewed as a system that can support or impede error management. In this introductory chapter, as well as throughout the remaining chapters of this dissertation, I argue that shared beliefs and habits related to error handling affect, through the avoidance of negative error consequences and through the rendering of positive error consequences, organizational (or team) performance.

Preparing for the summit bid. After the acclimatization period had been concluded, the two expeditions stayed at Base Camp for several days to recuperate. On May 6 (Adventure Consultants) and May 7 (Mountain Madness) they headed for their final ascent. In between taking off at Base Camp and the actual summit push, several problems emerged. As Scott Fischer assisted people back to Base Camp several times during acclimatization, he was exhausted by the time he reached Camp IV. Furthermore, several clients of both expeditions were exhausted and/or experiencing (minor) physical problems. Lopsang, Mountain Madness climbing sirdar, had been carrying a satellite phone up the mountain for reporter Sandy Hill Pittman in addition to the other gear he was supposed to carry. As it turned out, the phone did not work at Camp IV, yet carrying it drained Lopsang's energy, which he needed for safety related tasks. There were delays in roping sections and establishing Camp IV. Two of Fischer's clients abandoned the summit attempt and returned to Base Camp.

Camp IV marks the beginning of the "Death Zone", where "[…] any mistake is amplified in the rarefied air […]" (Boukreev & De Walt, 1997, p. 93). In the death

zone people are particularly susceptible to mistakes and death because of severe oxygen deprivation: "Above 26,000 feet [8000m] […] the line between appropriate zeal and reckless summit fever becomes grievously thin. The slopes of Everest are thus littered with corpses." (Krakauer, 1997, p.177).

While the two expeditions arrived at Camp IV on May 9 a storm took on, which seriously endangered the summit attempt planned at midnight. At 7:30 p.m., however, the storm eased. There was almost no wind; excellent conditions for a summit bid. The change of weather brought a Taiwanese expedition to decide, against agreements made earlier, to attempt for the summit as well. This meant that no less than a total of thirty-three people would be climbing at the same time, all having to use the exact same route and anchored ropes.

Error culture on Everest. The Adventure Consultants and Mountain Madness expeditions had quite different leadership styles and cultures: "If the name of Hall's business, Adventure Consultants, mirrored his methodical, fastidious approach to climbing, Mountain Madness was an even more accurate reflection of Scott [Fischer's] personal style. By his early twenties, he had developed a reputation for a harrowing, damn-the-torpedoes approach to ascent. Throughout his climbing career, but especially during those early years, he survived a number of frightening mishaps that by all rights should have killed him." (Krakauer, 1997, p.62). Fischer himself said: "[…] I'm gonna make all the right choices. When accidents happen, I think it's always human error. So that's what I want to eliminate." (Fischer cited in Krakauer, 1997, p.65).

Differences in convictions of safe conduct in the inherently dangerous activity of high altitude climbing were at the core of different cultures of the two expeditions: "The differences between Hall's and Fischer's philosophies of guiding were emblematic of an ongoing debate between practitioners in the adventure travel industry. The camps of belief can be roughly divided between the "situationalists" and the "legalists". The situationalists argue that in leading a risky adventure, no system of rules can adequately cover every situation that might arise, and they argue that rules on some occasions should be subordinated to unique demands that present themselves. The legalist, believing that rules can substantially reduce the possibility of bad decision making, ask that personal freedom take a backseat." (Boukreev & De Walt, 1997, p. 155). The legalist approach to mountaineering most resembles an error prevention approach, where mistakes should be avoided by a thigh system of rules. The situationalist approach, on the other hand, most resembles an error management approach, where one prepares in such a way that the unexpected error is optimally dealt with.

I do not believe that Hall and Fischer were either legalists or situationalists in the strict sense. Yet, Hall leaned more towards the legalist approach, while Fischer was closer to that of the situationalists. This situationalist approach of the Mountain Madness expedition was strengthened by the beliefs of one of its guides: "As a Russian, Boukreev came from a tough, proud, hardscrabble climbing culture that did not believe in coddling the weak. He was quite outspoken in his belief that it was a mistake for guides to pamper their clients. "If client cannot climb Everest without big help from guide," Boukreev told me, "this client should not be on Everest. Otherwise there can be big problems up high."." (Krakauer, 1997, p. 149-150). Boukreev was

disturbed with the way clients were being prepared for the summit bid: "It had been my impression that Scott [Fischer]'s primary interests were in my experience and what I could bring to ensure client safety and success on summit day, and I had been working with that in mind, focusing primarily on details that I thought would bring success and attempting to anticipate the problems that would prevent us from making a bid on the summit. It was not clear to me that equally if not more important was chatting and keeping the clients pleased by focusing on their personal happiness." (Boukreev & De Walt, 1997, p. 97). Beidleman — Mountain Madness' other guide — responded to this: "[…] many of our members don't understand many of the simple things. They want us to hold their hand through everything." (Boukreev & De Walt, 1997, p. 98). These quotes illustrate the tension between guiding approaches based on the legalist/situationalist distinction and the related issues of error prevention and error management.

How can a system, an expedition culture, employ error prevention? By learning from past experience, by developing methods and rules that will prevent known problematic situations and errors. In an error prevention culture, the importance of following the rules and compliance to the leader's decisions will be emphasized. This might have some drawbacks: "Personally I looked with concern upon the closely regimented expeditions where the clients performed as tin soldiers. [..] I felt it was important to encourage independent action". (Boukreev & De Walt, 1997, p. 106). Indeed, such an error prevention culture does not allow sufficient preparation for unexpected problems and errors.

How can a system, an expedition culture, prepare for the unexpected error? By preparing in the best possible way for *dealing* with those errors and problems: By,

for one thing, encouraging self-reliance. Krakauer, a client of the Adventure Consultants, said: "To my mind, the rewards of climbing come from its emphasis on self-reliance, on making critical decisions, and dealing with the consequences. When you become a client, I discovered that you give all that up. For safety's sake, the guide always calls the shots. (Krakauer, 1996, p. 58).

As I will convey in the following, several problems arose and mistakes were made during the summit bid. I have tried to especially discuss the ways these problems and errors were dealt with, and how the expedition's cultures contributed to the impact of those errors.

The summit bid. Around midnight, the expeditions departed from Camp IV. All members carried two oxygen canisters; a third canister for each of them was stashed at the South Summit to be picked up underway. With normal use, each canister provides oxygen for about six hours. This meant that no one was to return to Camp IV later than 6 p.m.. It is therefore common to set a strict turn-around time. Hall had lectured his clients repeatedly on the importance of a predetermined turn-around time: "With enough determination, any bloody idiot can get *up* this hill. The trick is to get back down alive." (Hall cited in Krakauer, 1997, p. 147). The turn-around time of the Adventure Consultants was going to be either 1 p.m. or 2 p.m.. Hall, according to Krakauer, never actually decided on the turn-around time: "We were simply left with a vaguely articulated understanding that Hall would withhold making a final decision until summit day, after assessing the weather and other factors, and would then personally take responsibility for turning everyone around at the proper hour." (Krakauer, 1997, p. 177). Gammelgaard, a Mountain Madness client, said: "I never

heard anything whatsoever about a turn-around time on summit day." (Boukreev &

De Walt, 1997, p. 168). Indeed, Fischer never set a definite turn-around time either.

"Instead, he had worked out […] a simple strategy, an adaptation of the tactic he'd

been using throughout the expedition. His climbing sirdar, Lopsang […], and his

guides, Boukreev and Beidleman, would alternately lead; he would bring up the rear,

and as he overtook stragglers, he would turn them around. If problems arose, he

would establish radio contact with Lopsang […], who, it was assumed, would always

be at or near the front of the pack. Neither Beidleman nor Boukreev was issued a

radio." (Boukreev & De Walt, 1997, p. 168).

As it turned out, however, Lopsang was never at the front. For reasons that

have not become fully clear even afterwards, he short-roped client Hill Pittman. This

tactic, which is something like pulling someone up the mountain, drained his energy.

It also meant that he was at the rear and not the front, unable to keep the agreement

with Adventure Consultant's sirdar Ang on cooperatively roping the steeper sections

above Camp IV. Ang, who was upset that he, again, would have to make up for

Lopsang's absence (see Krakauer, 1997, p. 175) refused to work on the ropes above

the Balcony. Krakauer recalls: "When Ang […] and I first arrived at the Balcony at

5.30 a.m., we were more than an hour in front of the rest of Hall's group. At that

point we could have easily gone ahead to install the ropes. But Rob [Hall] had

explicitly forbidden me to go ahead, and Lopsang was still far below, short-roping

Pittman, so there was nobody to accompany Ang […]." (Krakauer, 1997, p. 174).

"Whatever motivated him, Lopsang's decision to tow a client up the mountain didn't

seem like a particularly serious mistake at the time. But it would end up being one of

the many little things — a slow accrual, compounding steadily and imperceptibly toward critical mass." (Krakauer, 1997, p. 170).

A bottleneck arose. Four of Hall's clients decided to turn around, figuring that with the fatigue they already experienced and late hour, they would be unable to reach the summit and descend in time. Doug Hansen, also a client of Adventure Consultants, decided to turn around as well. "Then Rob [Hall], who was bringing up the rear, caught up to Doug, and a brief conversation ensued. Nobody overheard the dialogue, so there is no way of knowing what was said, but the upshot was that Doug got back in line and continued his ascent." (Krakauer, 1997, p. 165).

Lopsang is seen vomiting, which indicates that he was in trouble. The Taiwanese expedition — whose leader had decided, against earlier agreements, to summit on the same day the Adventure Consultants and Mountain Madness expeditions did — had a slow climbing style, climbing really close together, hindering members from the Adventure Consultants and Mountain Madness expeditions to pass them. Just before the Hillary step — one of the most famous pitches in mountaineering, forty feet of near-vertical ice and rock — further delays in rope fixing arose. "Clients huddled restlessly at the base of the rock for nearly an hour while Beidleman — taking over the duties of an absent Lopsang — laboriously ran the rope out. Here, the impatience and inexperience of Hall's client Yasuko Namba nearly caused a disaster. […] as Beidleman clung precariously to the rock 100 feet above the clients, the overly eager [Adventure Consultant's client] Yakuso [Namba] clamped her jumar to the dangling rope, before the guide had anchored his end of it. As she was about to put her full body weight on the rope — which would have pulled

Beidleman off — [guide] Mike Groom intervened in the nick of time and gently scolded her for being so impatient." (Krakauer, 1997, p. 176).

When fixing the ropes … "Beidleman [one of the guides for the Mountain Madness expedition] couldn't find another anchor to tie [the rope] into. Not wanting to leave the unanchored length of rope on the surface of the snow because a climber might clip on thinking it was anchored above him [or her], Beidleman tossed the rope toward Tibet." (Boukreev & De Walt, 1997, p. 170), thus employing error prevention. Less than half of the intended route to be fixed had been covered… "[...] leaving [...] the most exposed part of the climb where the climbers had to perform a pretty precarious solo traverse were a slip could be fatal" (Martin Adams cited in Boukreev & De Walt, 1997, p. 170), thus leaving the route without proper error management conditions.

Finally, between ten to forty-five minutes after 1 p.m. the first climbers (Boukreev, Krakauer, Harris, Beidleman, and Schoening) reached the summit. Other climbers were still going up well after 2 p.m., some arriving at 2.15 p.m. but only descending after 3.10 p.m., some arriving even later than 3.30 p.m. or 4 p.m., thereby seriously violating turn-around times (had they been set). Most climbers had picked up, and started using, their third canister of oxygen on the way up, arriving at the summit with only a few hours of oxygen left. As guide Boukreev, then still on the way up, recalls: "[…] there on the South Summit, I began to wonder again where Scott [Fischer] was. Here, I thought, maybe it would be necessary to turn some clients around, but there was no Scott to do it. I felt I did not have the right to make this decision. The clients had paid big money and had given Scott that authority, not

me." (Boukreev & De Walt, 1997, p. 167). As Boukreev was not issued a radio, he could not consult with Fischer.

Krakauer notices 'wispy clouds' filling the valleys to the south, obscuring all but the highest peaks. As Krakauer leaves the summit to descend, he runs into Beidleman and Adams. "Adams, [an experienced airplane pilot], later told me that he recognized these innocent-looking puffs of water vapor to be the crowns of robust thunderheads […]" (Krakauer, 1997, p. 185). However, at the time, no one but Adams was worried about the weather, and Adams only expressed his concerns after the expeditions had ended.

Upon the mistake with the valve of the oxygen regulator, described earlier in this chapter, Krakauer had to wait for an hour at the top of the Hillary step before he could descend. When finally reaching the South Summit, he was eager to screw on a new canister of oxygen. Guide Harris, however, stated that all canisters were empty. In reality they were not, it was (as Krakauer learns only after the expedition has ended) merely Harris' regulator that was frosted, due to which it registered all canisters to be empty. Harris, however, could not be convinced. "In hindsight, Andy [Harris] was acting irrationally and had plainly slipped well beyond routine hypoxia, but I was so mentally impeded at the time myself that it simply didn't register. […] Given what unfolded over the hours that followed, the ease with which I abdicated responsibility — my utter failure to consider that Andy might be in trouble — was a lapse that's likely to haunt me for the rest of my life." (Krakauer, 1997, p. 188). Krakauer gives some indication of Groupthink (Janis, 1972) as an aspect of the expedition's culture as he says: "My inability to discern the obvious was exaggerated to some degree by the guide-client protocol. Andy and I were very similar in terms of

physical ability and technical expertise; had we been climbing together in a non-guided situation as equal partners, it's inconceivable to me that I would have neglected to recognize his plight. But on this expedition he had been cast in the role of invincible guide, there to look after me and the other clients; we had been specifically indoctrinated not to question our guide's judgement." (Krakauer, 1997, p. 188).

Somewhat lower on the mountain, Krakauer ran into Adventure Consultants client Weathers, who had, due to eye-surgery some years earlier, almost completely lost his vision in the low barometric pressure. Weathers had, several hours earlier, agreed that he would wait on Hall to return from the summit and descend with him. Krakauer offered to lead Weathers to Camp IV, but Weathers declined. A bad decision in retrospect. "Beck [Weathers] was nearly persuaded when I made the mistake of mentioning that Mike Groom [a guide] was on his way down with Yasuko [Namba], a few minutes behind me. In a day of many mistakes, this would turn out one of the larger ones." (Krakauer, 1997, p. 191).

Only Boukreev, Krakauer, Adams, and of course those who had turned around on the morning of May 10, made it back to Camp IV before 7 p.m.. Daylight had gone and a fierce storm broke loose. At 4.30 p.m. Doug Hansen, the client who had been convinced by Hall to proceed ascending, had collapsed and was in need of oxygen above the South Summit. Hall stayed there to help Hansen. The night was setting in. Hall and Hansen were too high up on the mountain to be rescued, especially during the heavy storm. The people at Base Camp strongly urged Hall over the radio to descend, or to at least descend to the South Summit to pick up extra canisters of oxygen. Guide Andy Harris, however, repeatedly intervened with his

own radio, stating his earlier conviction that all oxygen canisters were empty. This may well have contributed to Hall's decision not to move. At 4.45 a.m. May 11, Hall radioed that Hansen 'was gone'. By this time, Hall himself was unable to move. He died on the evening of May 11.

Guide Harris was also somewhere high up on the mountain, as was Fischer. At 8 p.m. the batteries of the Mountain Madness radios ran out. It is unclear what exactly happened to Harris, he never returned. On May 11 Lopsang attempted a courageous rescue for Fischer, but Fischer was too far-gone, not at all responding to oxygen and tea offered. Gau, the Taiwanese expedition leader, was brought down alive.

Meanwhile, during the evening of May 10, several members got lost not far from Camp IV. The storm had severely reduced visibility, and the tracks from the ascent had been erased by the wind. Groom, Namba, Adams, Beidleman, Schoening, Madsen, Fox, Hillman Pitt, Weathers and two Sherpa's mistakenly wandered east instead of west. The group lost all orientation and got onto the Tibetan (instead of Nepalese) side of the South Col risking falling off the Lhotse Face.

Boukreev, earlier that day, had been one of the first to leave the summit. When he met Fischer, who then was still ascending, he proposed that he would descend quickly, in order to regain strength possibly needed later. Fischer agreed. Several people have criticized Boukreev's decision to 'abandon' his clients. Boukreev's rationale, however, is persuasive. "I said to Scott [Fischer] that the ascent seemed to be going slowly and that I was concerned that descending climbers could possibly run out of oxygen before their return to Camp IV. I explained I wanted to descend as quickly as possible to Camp IV in order to warm myself and gather a

supply of hot drink and oxygen in the event I might need to go back up the mountain to assist descending climbers. Scott [Fischer], as had Rob Hall immediately before him, said "OK" to this plan. I felt comfortable with the decision, knowing that four Sherpa's, Neal Beidleman (a guide like me), Rob Hall, and Scott Fischer would be bringing up the rear to sweep the clients to Camp IV." (Boukreev & De Walt, 1997, p. 249).

As it turned out, Boukreev was the only one who was able to rescue climbers. The clients that had returned were totally exhausted. Some Sherpa's, who had not summited in order to assist if an emergency would arise, had been incapacitated with carbon monoxide poisoning from cooking in a poorly ventilated tent.

Boukreev's first rescue attempt was fruitless. He could not locate the wandering climbers. Then, at 0.45 a.m. Beidleman, Groom, Gammelgaard, Schoening and two Sherpa's arrived at Camp IV. Being lost on the South Col, Schoening [a mountain Madness client] had pulled himself together: "[...] his attitude was, "Okay, no panic, no fear, no disaster. What can we do about the situation?"" (Gammelgaard cited in Boukreev & De Walt, 1997, p. 206). Schoening was able to lead the stronger members of the lost group to Camp IV. Boukreev was given directions on where to find the others. At 4.30 a.m. Boukreev brought back Fox, Madsen and Hill Pittman to Camp IV. Namba and Weathers were (presumed) dead.

On the morning of May 11, after spending a night unconscious lying face-down in the snow, Weathers miraculously walked into Camp IV. "[…] I could see that his pile jacket was open down to his stomach, his eyes were swollen shut, and his arm was locked upright, parallel to his shoulder like a low-budget horror flick. His face was so badly frostbitten that he was unrecognizable. Then I realized it had to be

Beck [Weathers]." (Henry Todd cited in Coburn, 1997, p. 176). The next day, at Camp IV, he is left for death the second time, but again, revived. Upon treatment in a hospital Weathers lost an arm and several fingers, but survived. Looking back, he commented: "I don't think the doctor that looked at me should be faulted for declaring me dead, or close to dead. It may not have been the best diagnosis, but we all make mistakes at times, even at sea level." (Beck Weathers cited in Coburn, 1997, p. 200).

"What we can do now is contribute to a clearer understanding of what happened that day on Everest in the hope that the lessons to be learned will reduce the risk of the others who, like us, take on the challenge of the mountains."
(letter written by Boukreev printed in Boukreev & De Walt, 1997, p. 251).

The role of error culture in the tragic outcomes. Several people have offered explanations for the tragedy. I will cite two sources: "Along with friends from other expeditions, the climbers assessed the tragedy, not intending to assign blame to individuals -if this was even possible- but to make sense of the catastrophe and to learn from the mistakes that were made. The tragedy, they agreed, resulted from the confluence of bad luck and poor judgement. The guides and clients together had cut their safety margins too thin." (Coburn, 1997, p.192). And: "The events of May 10 were not an accident, nor an act of God. [...] They were the end result of people who were making decisions about how and whether to proceed. Unfortunately, not all the guides were really given the leadership or operating protocol for dealing with the

various situations that arose on the mountain. The organization was very loose." (Jim Williams cited in Coburn, 1997, p.193).

With an inclination towards error prevention (legalist approach), Hall aimed at setting tied rules. He did not allow clients to go far ahead of the rest of the group. He was a leader that usually worked with a tight turn-around time. Referring to another expedition that had, earlier that spring, turned around just an hour before the summit, Hall had said: "To turn around that close to the summit … That showed incredibly good judgement […]. I'm impressed — considerably more impressed, actually, than if he'd continued climbing and made the top." (Hall cited in Krakauer, 1997, p. 147). Yet, for the 1996 summit bid, he did not set a turn-around time, he expressed disappointment when some of his clients turned around before reaching the summit, and he even persuaded one client not turn around but to continue for the summit. The reason for his uncharacteristic actions remains unclear. Possibly he wanted to bring more clients to the top than Fischer would. Possibly his thinking was impaired by hypoxia. Possibly both. In any event, his clients had, throughout the previous weeks, been conditioned to rely on rules and the guides rather than on their own judgement. On summit day rules had not been set, or were unclear, guides were absent or impaired with hypoxia, thus clients were on their own.

A client of Mountain Madness ultimately led the stronger of the wandering clients from both expeditions (and an Adventure Consultant guide) back to Camp IV. A Mountain Madness guide — Boukreev — saved those who were left behind. The Mountain Madness sirdar — Lopsang — saved the leader of the Taiwanese expedition. Yet, the Mountain Madness culture, with its inclination towards the situationalist approach, was not perfect either. The expedition was not fully prepared

for dealing with errors and unexpected problems. Both Fischer and Lopsang were already exhausted when the summit bid began. Only two radio's were issued (to Fischer and Lopsang) leaving the two guides without one. It was therefore impossible to make a proper assertion of the situation and the needs high on the mountain. There was no possibility to communicate strategies between the guides, leading guide and sirdar. It was therefore unnecessarily difficult to adequately deal with problems.

The most explicit choice for an error management approach was Boukreev's harshly criticized decision (Boukreev & De Walt, 1997; Krakauer, 1997) to descend in front of the others. As described above, this enabled him to assist expedition members who were in trouble. Further, when leading a commercial Everest expedition one year later, he enforced a culture of self-reliance rather than obedience, and of coaching rather than leading. His successful 1997 expedition to Everest was organized in such a way that previous errors could be avoided and unexpected problems could be handled (see Boukreev & De Walt, 1997, epilogue). He used a more intense acclimatization strategy that involved strong commitment from the clients: By climbing consecutive higher mountains (rather than going up and down the same mountain for acclimatization) he was able to (a) ensure proper acclimatization, and (b) to properly assess the clients strengths and weaknesses. He made it very clear that he was willing to serve as a guide, give advice, be a member of a rescue team if so needed, but he stressed that the clients would have to take some responsibility for the hubris of their ambition. Boukreev would act as a coach, not as an authoritan leader. Further, radios were issued to all climbers and guides.

A summation of violations and mistakes contributed to the problems the expeditions encountered on summit day. Neither of the two expeditions had a very

strong or very explicit error culture. Neither of the expeditions turned out to be optimally prepared to prevent problems or to avert its consequences. Adventure Consultants inclination towards an error prevention culture left the team with an inability to deal with the unexpected. Mountain Madness error management oriented culture may have lacked consistent implementation to be effective. Boukreev's successful approach in 1997 and the expedition's culture he explicitly enforced may have been the right answer. He may have been able to implement a true error management culture. The issue of error culture raised in this chapter may therefore be an important one.

Overview of the dissertation

This dissertation reports five studies, using various methodologies, aimed at investigating the role (importance, content and dynamics) of organizational error culture.

Chapter 2 describes the precursor of a survey reported in Chapter 3: Teams of managers from a real organization engage in a dynamic simulation in which organizational decisions have to be made (Study 1). The design of this management game is such that errors are likely. It is established that 'ways of dealing with errors' can be distinguished at the team level. Three dimensions surface: Mastery orientation, Awareness, and Error Aversion. Team error management culture is measured and linked to team performance. A negative correlation is found between Error Aversion and team performance.

Chapter 3 describes a survey (Study 2) and a qualitative study (Study 3) both investigating the link between organizational error management culture and organizational performance. In 65 Dutch organizations, active in various lines of industries, the three dimensions of error management culture are related to organizational performance. Mastery orientation is found to be correlated with both a 'subjective' management assessment of organizational performance as well as 'objective' economic measures. In-depth interviews, using the critical incident approach (Flanagan, 1954), confirm the survey findings and further point at the role of leadership styles such as punishment and showing empathy.

Chapter 4 reports on the improvement of the error culture questionnaire. In Study 4 interviews with managers are analyzed in order to determine lacunas in the original questionnaire and to develop new items and scales. In Study 5 the development of new scales is finalized by means of exploratory (half of full sample) and confirmatory (remaining half of sample) factor analysis using structural equation modeling (LISREL). Further, a nomological net is built around error culture.

In Chapter 5, the findings of Chapters 2 to 4 are integrated, conclusions are drawn and directions for future research are discussed.

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