The better the team, the safer the world
Conference on Group Interaction in
High Risk Environments

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Chair:
Professor Rainer Dietrich, Humboldt-Universität zu Berlin

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Rudolf Kellenberger
Deputy Chief Executive Officer, Swiss Re, Zurich, Switzerland

We must observe the development of risks

Rudolf Kellenberger was appointed to Swiss Re's Executive Board in January 1993, responsible for the Northern Europe reinsurance sector and Special Lines. In 1998, he was appointed head of the Europe Division. He became Deputy Chief Executive Officer on 1 April 2000. Mr Kellenberger, a Swiss citizen born in 1945, studied civil engineering at the Federal Institute of Technology (ETH) in Zurich, graduating in 1970. Mr Kellenberger started his career as a project engineer in bridge construction before moving to England, where he worked for a major Swiss construction company. He joined Swiss Re in 1978, holding various assignments in facultative and treaty business within the engineering department. In the early 1980s, he was responsible for Southeast Asia, operating from Hong Kong. In 1990, he was appointed head of the engineering department.

At Swiss Re it gives us both a sense of pleasure and commitment to participate in the presentation of the key research findings of "Group Interaction in High Risk Environments".

Pleasure, because of the involvement of the Swiss Re Centre for Global Dialogue in hosting the final conference of this important 5 year research project. And commitment, because as a global leader in capital and risk management we must observe the development of risks in our communities, economy and environment and foster a broader awareness of potential hazards.

For us it is therefore important that these concrete research findings on group interaction are relevant far beyond the situations in which they were observed. And that this White Book, now allows us to communicate these hardwon insights to our clients and the broader insurance community.

In high risk situations the quality of human interaction is critical to the minimizing of human error. To err is indeed human. But as our societies continue to create more complex technological environments, we must enhance our interaction and dialogue skills to ensure that small mistakes do not spiral into major systems failures.

Only with this consistent application and training of safety related approaches will we avoid or reduce the damage and injury caused through poor or negligible behavior.

And progress in the on-going task Swiss Re has set itself, of supporting the active prevention of hazards and their ensuing harm, thereby contributing to the creation of a safer world.

Prof. Dr. rer. nat. Dr. h.c. mult. Gisbert Frhr. zu Putlitz
Chair of the Board of the Gottlieb Daimler and Karl Benz Foundation
Ladenburg, Germany

Results that make the world a safer place

Gisbert Freiherr zu Putlitz is Professor of Physics at the University of Heidelberg. His scientific work covers elementary particle physics, nuclear physics and quantum liquids. He was formerly Scientific Director of the National Laboratory for Heavy Ion Research (GSI), Chairman of the AGF (now: Helmholtz Association of National Research Centers), Rector of the University of Heidelberg and President of the Heidelberg Academy of Sciences. He has been Managing Chairman of the Board of the Gottlieb Daimler and Karl Benz Foundation since its establishment in 1986.

The recommendations on improving team interaction in high-risk work environments presented at the Conference in Rüschlikon are the results of five years of research work. Sponsored by the Gottlieb Daimler and Karl Benz Foundation, the Ladenburg Collegium united safety experts from the fields of aviation, medicine and nuclear energy, plus linguists and psychologists. Professor Rainer Dietrich of the Humboldt University in Berlin – himself linguist – initiated and led the collegium. Participants originally came from Germany, Switzerland and the USA, later also from Australia, New Zealand and Japan.

The collegium was prompted by the fact that around seventy percent of all air accidents are due to the failure of communication between crew members. The crash of Birgen Air ALW301 over the Dominican Republic on February 6, 1996, is a good example of this: reacting to an incorrect velocity reading apparently showing the aircraft was flying too fast, the crew throttled back the engine below the minimum speed for lift. Intervention was still possible when the captain noticed the fatal error, but rising panic left the crew unable to take the appropriate action.
All 176 passengers and 13 crew members died in the crash.

Since the 1970s, the aviation industry has made great efforts to improve crew communication. The collegium began by considering the direction in which safety training should evolve. The project also looked at whether findings from the field of aviation could be transferred to, for example, surgery and intensive care situations. Team interaction in nuclear power station control rooms was also investigated with the same aim.

This topic was of particular interest to the Gottlieb Daimler and Karl Benz Foundation, which primarily supports interdisciplinary research into the interrelationships between humans, the environment and technology. Earlier foundation projects focused chiefly on investigating ways of improving the interface between man and machine – e.g. in the control rooms of large-scale plants. The approach adopted by this collegium, which considered how people should work together to deal with high-risk situations aided by complex technology, opened up a whole new perspective on the relationship between man and technology.

In Rüschlikon today, the collegium will present findings that can be applied to improving teamwork in other fields as well – disaster prevention or firefighting, for example. We would like to thank Professor Rainer Dietrich, the heads of the research projects and their staff for their impressive work, which, may we add, would not have been possible without generous and frequent support from numerous businesses and institutions. Their names are listed in the White Book to be presented at this conference today. They also deserve our sincere thanks.

Professor Rainer Dietrich
Humboldt-University of Berlin, Institute for German Language and Linguistics

Maintain contact with team members

Rainer Dietrich, born 1944, is currently Professor of Psycholinguistics at the Humboldt-University of Berlin. His main research interests are in the field of language production and second language acquisition. He heads the psycholinguistic experimental lab of the faculty of Arts II and has conducted a number of experiments on language processing. The specific objective of the latter is the structure of the production system and the time course of utterance production under conditions of workload. Rainer Dietrich initiated and led the Ladenburg Collegium on "Group Interaction in High Risk Environments", in which he conducted research on the subject of "Language Processing under Conditions of High Workload".

The sciences form a big family, and we frequently differentiate between two branches: Natural Sciences and Humanities. My discipline, psycholinguistics, occupies a fascinating dual position that straddles this distinction. In terms of its subject matter and the questions it raises, it is undoubtedly one of the humanities. As far as methods are concerned, however, it could be labeled a natural science.

The ability to master a language is one of the few skills exclusive to man amongst living creatures. We all acquire language as a matter of course – 'on the job', so to speak, simply by using it. One of the most fascinating questions in psycholinguistics deals with how man accomplishes the quasi-miraculous task of learning a language – especially in an age in which so many people are unable to connect with far less demanding systems such as chess, for example.

But there are many other less complex and equally fascinating questions, too:

- How are we able to name an object on a picture in less than half a second – provided, of course, we know the word?
- And why does it take that long?
- What do we actually do in that half-second?
- What happens when we get our words mixed up, as in *die Sorte von Tacher* or *mama wakes the world go round*?
- Why does a fire engine head for the *Königstraße*, when the emergency call came from the *Kaiserstraße*?
- Why is it so difficult to drive a car and use a telephone at the same time?

Questions like the last two take us directly to the investigations I and my team have been busy with over the past few years:

- How is it that around a third of all aircraft accidents in the nineties were linked with language in some way (NASA Aviation Safety Reporting System, 1998)?
- And how should the principal actors (pilot, co-pilot, air traffic controller) behave, particularly in high-risk situations, to reduce accidents and make flying even safer?

Watching, and, in particular, listening to successful teams as they deal with high-risk situations is an excellent way to gather ideas, although that alone is not enough. You also have to run systematic tests and experiments to ensure your observations are valid in general, not just in certain circumstances. This leads to recommendations such as:

- Adjust the way you talk. Make it easier for your interlocutor to understand what you want to say. Keep your sentences simple. Short, for example. Uses sentences with only one verb, rather than subordinate clauses. Use Yes / No questions wherever possible: *Have got enough fuel?* not *How much fuel do we have?*
- Above all: Maintain contact with team members at all times: respond to questions or at least signal that you cannot answer for the moment. When team communication fails, teamwork is jeopardized. And a threat to teamwork is a threat to the success of the mission.

Professor Peter J. Pronovost
Anesthesiology/Critical Care Medicine, Surgery, Nursing and Health Policy & Management, The Johns Hopkins University School of Medicine, Baltimore, USA

Practical tools to build teams that improve patient safety

Peter J. Pronovost, MD, Ph.D. is an Associate Professor in the Departments of Anesthesiology/ Critical Care Medicine and Surgery in the School of Medicine, the Department of Nursing in the School of Nursing, and Health Policy and Management in the Johns Hopkins Bloomberg School of Public Health at the Johns Hopkins University. He is a practicing, board-certified anesthesiologist and critical care specialist who works in the surgical intensive care unit. Dr. Pronovost has published on patient safety, ICU care, quality health care and evidence-based medicine. His special interest is applying clinical research methods that improve quality of health care and safety, especially in intensive care units (ICUs). Dr. Pronovost is currently leading a large nationwide safety project which will implement an error reporting system in Intensive Care Units. He is also involved in a wide variety of outcomes research projects and is vigorously pursued for lecture tours worldwide.

The Institute of Medicine identified patient safety as a ubiquitous problem needing attention. Yet, little evidence suggests that improvement efforts have been made. We sought to implement and validate a comprehensive unit-based safety program (CUSP) and evaluate dissemination to a second unit.

At Johns Hopkins Hospital, an 8-step safety program was implemented in one Intensive Care Unit (WICU) with a second control (SICU) receiving intervention later. Improvement teams (physician, nurse, and administrator) were identified in each unit to champion efforts between ICU staff and the Patient Safety Committee. CUSP steps included (1) culture of safety assessment; (2) staff education on sciences of safety; (3) staff identification of safety concerns; (4) senior hospital leaders adopt a work unit; (5) safety concerns addressed / improvements implemented; (6) efforts documented and analyzed; (7) efforts shared; and (8) culture of safety reassessment.

We found that safety culture improved in post vs. pre-intervention period (6 months), in both ICUs. Positive safety climate increased from 35% to 52% in the WICU and 35% to 67% in the SICU. Senior leader intervention led to new patient transport teams, pharmacy presence in ICUs, discharge medication reconciliation, a new short-term goals sheet and relabeling epidural catheters. One year after CUSP implementation, LOS dropped from an average of 2 days to 1 in the WICU and 3 days to 2 in the SICU ($p < 0.05$ for WICU and SICU). Medication errors in transfer orders were nearly eliminated and nursing turnover decreased from 9% to 2% in the WICU and 8% to 2% in the SICU; these were not statistically significant.

CUSP was successfully implemented in an ICU and expanded to a second ICU. If replicable for broad implementation, this program could improve patient safety, reduce medication errors, length of stay and potentially nursing turnover.

Many healthcare organizations recognize that they need to improve patient safety, yet lack a strategic plan on how to do so. The CUSP provides a framework for organizations to improve safety throughout their organization. It is structured enough to provide a framework to organizations yet malleable enough to allow each organization to identify its unique issues. We are applying CUSP in 107 ICUs in Michigan and in over 50 in New Jersey.

Professor Robert L. Helmreich
Department of Psychology,
The University of Texas at Austin, USA

Dealing with danger: managing threat and error in aviation and medicine

Robert Helmreich is professor of psychology at The University of Texas at Austin. He received BS, MS, and Ph.D. degrees from Yale University. He is director of University of Texas Human Factors Research Project which investigates human performance and threat and error management in aviation and medicine. Helmreich received the Flight Safety Foundation Distinguished Service Award in 1994 and Human Factors award in 2004. He was Chair of the Foundation's Icarus Committee. He received Laurels from Aviation Week and Space Technology in 1994 and 2002 for his research into human factors in aviation. He is the 2004 recipient of the Flight Safety Foundation Human Factors Award and the Roger Green Medal of the Royal Aeronautics Society. He is a fellow of the Royal Aeronautical Society, the American Psychological Association, and the American Psychological Society. His research has been supported by the National Science Foundation, NASA, the Agency for Healthcare Research and Quality, and the Daimler-Benz Foundation. He has more than two hundred publications and is author, with Ashleigh Merritt, of Culture at Work in Aviation and Medicine: National, Organizational, and Professional Influences.

There are great differences in risk (to passengers and patients) associated with aviation and medicine. In commercial aviation in the U.S., there were no deaths of passengers on major airlines in the last year . In contrast, the US Institute of Medicine estimates that as many as 90,000 unnecessary deaths may result from preventable medical error; in fact medical error is seen as the 3rd leading cause of patient death.

Despite these stark differences in risk, there are many parallels between aviation and medicine. Safety is a primary goal for both and both deal with new technology; there are multiple sources of risk, there is much second guessing when things to wrong; and teamwork is essential. As a result efforts are underway to translate aviation's safety practices to medicine.

Culture is one area under investigation. It is defined as the shared values and beliefs of members of groups. There are three cultures which influence safety – national, organizational, and professional. Understanding their effects is a critical component of enhancing safety.

There are a host of threats to safety in both aviation and medicine. These reside in the environment, in the individual, in characteristics of the profession, and in the system – medical or aviation – in which flight or medical practice occurs.

Another source of risk is human error, which is inevitable because of the limitations of human beings – their imperfect memory, their limited mental processing ability, and their susceptibility to fatigue and negative effects of stress.

To understand the influence of threat and error on outcomes, whether in the air or the operating room, the University of Texas Threat and Error Management Model was developed. The model provides a framework for analysis of both superior and flawed performance. It is currently being used worldwide as the model for analysis of air crashes and by a number of airlines for examination of close calls. Its use in medicine is starting to grow.

There are a number of things that organizations can do to minimize the negative consequences of threat and error. These include having a clear policy about human error (accepting its inevitability but not willful violation of rules), defining formal procedures for complex activities, recognizing the risks associated with fatigue, and providing formal training for front-line personnel in threat and error management.

Professor Gudela Grote
ETH Zürich,Institut für Arbeitspsychologie

Team ccordination: why rules are better some of the time

Gudela Grote, born 1960 in Wiesbaden, Germany, professor of work and organizational psychology at the Swiss Federal Institute of Technology (ETH) in Zürich, studied psychology in Marburg and Berlin, Germany, and received her Ph.D. at the Georgia Institute of Technology in Atlanta, USA, in 1987. Main research interests are the effects of automation, safety management and safety culture, computer-supported co-operation, planning in organizations, multimedia learning, and the relationship between work and personal identity.

There is a general understanding that rules and standards support safe operation in complex systems. At the same time, it is also known that high levels of standardization may impede flexible adaptation to changing demands. Comparing team coordination in the highly standardized setting of cockpits of commercial aircraft with coordination in anesthesia teams who operate with far fewer standards helps to understand the impact of rules on team performance.

Interestingly and contrary to our original assumptions, we found that anesthesia teams coordinate more implicitly than cockpit crews despite having fewer written rules guiding their behavior. Several reasons may account for this finding: cockpit crews have been trained much more to coordinate explicitly even in seemingly obvious situations in order to prevent overreliance on common standards as basis for a common understanding of the situation and its demands; anesthesia teams share a common field of action and use cues provided by each other`s actions much more for seamless coordination than pilots who operate in different visual fields; there are manifold unwritten rules in medicine which support a common understanding of the situation and the actions required. For the aviation data, a clear link between higher levels of explicit coordination and higher levels of performance could be established, which hints at the importance of backing up standards with a constant effort to reassure a common understanding of the situation and the relevance of the standards for the situation.

A second set of analyses concerned patterns of coordination within each professional setting, comparing work phases with different degrees of standardization and task load. One important finding here was that personal leadership is only required in situations with few standards. In highly standardized situations, the standards act as a form of impersonal leadership which does not require additional efforts of personal leadership. To the contrary, high levels of personal leadership in highly standardized situations appears to be related to worse team performance.

In a third set of analyses, the rules themselves were investigated, determiming e.g. the level of action regulation: rule only specifies goal to be achieved, rule specifies process to be followed to determine the correct course of action; rule specifies the course of action to be followed. In aviation, the vast majority of rules prescribed the course of action to be taken, while in medicine, more often the process to determine the correct course of action is specified. Considering the higher degrees of operational uncertainty contained in handling a patient as compared to flying an aircraft, the less specific rules in medicine seem appropriate. Such analyses may help to support a more systematic rules management taking into account an appropriate balance between guidance and scope of action.

Dr. Oliver Sträter
Safety and Security Management,
Eurocontrol, Brussels, Belgium

Safety Management from Research to Regulation

Dr. Oliver Sträter studied engineering psychology and worked for GRS (Gesellschaft für Anlagen – und Reaktorsicherheit), the German Nuclear Regulatory Body, from 1992 till 2002. He counseled for the International Atomic Energy Agency (IAEA), the Nuclear Regulatory Commission (NRC) of the United States, the Swiss Regulatory Body (HSK), and the OECD Halden Reactor Project. Main topics of research and development are errors of commission, cognitive errors, organizational safety and incident evaluations. After his Ph.D. at the Institute of Ergonomics of the University of Technology Munich he has also been working at the Institute in the fields of human factors for automobile, occupational safety and aviation. In 2002 he moved to EUROCONTROL, the European organization for the safety of air navigation. Since 2003 he has been a member of the German Reactor Safety Commission.

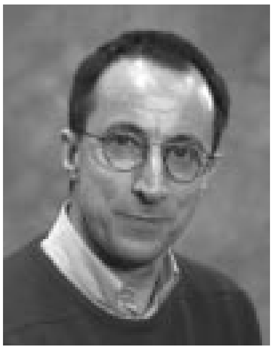
The innovation cycle of technological products is increasingly accelerating. About 100 years ago research result needed about 50 years to become implemented widely into industrial applications (e.g., steam engine). Enough time was available to adjust societal, organizational and human issues to the new product. Nowadays, research leads to technological applications in less than 5 years and there is currently no sign that this acceleration is decreasing again. Computer industry is one of the key players in this development. As nearly every other industry is relying on this technology, this acceleration results into an accelerated product innovation in nearly every other industry. Examples are power plants, operational centers for air traffic management, cockpits, or automobiles. All industries are approaching less than 5 years for product innovation. Considerable problems could have been observed in the industries that are more a result of the societal and organizational changes involved in the acceleration of the innovation cycle than from the technology itself.

The acceleration has an effect on how systems are developed, build, maintained and assessed. As a consequence, the technological systems are becoming more and more of evolving nature than being in a stable state. We observe an increased number of human errors and organizationally induced accidents as a consequence. As an example, knowledge management became a critical factor for productivity and safety due to increased outsourcing of know how and increased turnover of manpower. A couple of accidents and incidents throughout all industries are demonstrating the safety critical aspects of this acceleration and the importance of adapting safety methods to the new evolving situation. Safety management is seen as one mean to cope with this situation. However, safety management is a managerial framework and needs valid methods and tools, which have to be developed and provided by research.

Integration of research into industrial developments and into the safety regulation is hence an important mean to overcome safety critical events in the evolving future. Research is needed to anticipate future safety issues that needs to be regulated, to provide data on safety prediction, and to provide means to overcome safety critical situations. For dealing with human issues, inter-disciplinary research is one prerequisite but also inter-industrial research is needed in order to learn from other industries and to share data. The GIHRE project has shown, how such a process can be established and how research can be integrated into industrial applications and regulations. The results of this project have proven that it is possible to validate safety concerns by exchange of data between various industries. As a perspective, GIHRE found a way of complementing information available for regulation by basic research and a cross-industry approach for dealing with the human role in safe systems.

Capt. Werner Naef
Operational Safety Human Factors Investigator,
Air New Zealand, Auckland, New Zealand
and
Capt. Martin Wyler,
Commander Airbus A320/A330, Swiss International Airlines, Zurich, Switzerland

Training for leadership and outcome – Are we doing the right thing the right way?



Werner Naef: Career as airline pilot, instructor, fleet – and training manager and subject matter expert in human factors. Postgraduate in psychology. Studies and activities centered on training and leadership. Involvement in international scientific associations/ boards, called upon as expert by national (Swiss CAA) and international (European JAA) regulatory bodies as well as by airline industry (Assoc. of Europ. Airlines). Research project owner Daimler-Benz foundation. Partner and consultant of gemako Ltd, Ennetbuergen/ Switzerland and gemako Intl Ltd, Auckland. Consulting-, coaching- and training. Lecturer in Switzerland at ETHZ (Swiss Federal Institut of Technology), at MBA/university Zuerich and at Engineering college at Rapperswil.
Since Aug 2003 with Air New Zealand as Human Factors Investigator.

Martin Wyler's roots are in the millitary and civil air service. Today he is commander of Airbus A320/ A330 with Swiss International Airlines. He has worked as an instructor and flight teacher for training programs at Swissair and SAirGroup. After obtaining his executive MBA at the University of St. Gallen, he focused his work on topics such as the reorganization of the division of flight operation, the management of fleet renewal and on diverse consulting contracts. Additionally, he has been involved in development of training concepts for SAirGroup's middle and upper level cadre. He continues to pursue a similar focus in his ongoing work as coach, trainer, and consultant.

The presentation's focus is on criteria and process involved when management decision making is taking place under stress. The goal is arousal of awareness and understanding of specific links between factual decision making and individual behavioural patterns in stressful situations.

The lead-in takes Swissair's collapse as an example looking at behavioural patterns of top managers at the time. It enlightens the differences between – and the qualities of – an open process that typically takes place in a relaxed, team-oriented situation versus a self-contained, leader-focussed solitary decision making event.

Decision making related behavioural markers certainly depend on one side on the specific situation, on decision making skills, on leadership style and on the level of experience available. On the other side analysis of crucial decision making process shows that personality traits – especially when under stress – become quite influential. To improve quality of decision making, a comprehensive understanding of all cognitive issues involved is a prerequisite. At the same time it is of paramount importance – as key decisions are at stake – that awareness and control of one's own emotional and social behaviour is continuously open to evaluation and modification.

Often a leadership style is rather a representation of one's own need and predilection than one of well explored leadership effectiveness. Research in aviation shows that co-operative leadership style leads to overall better results than a strong leader-centered process. But such co-operative leadership style and decision making cannot be applied out of the blue if not well established before. Such process is rather part of an organisational culture that complements strategy and structure reflecting awareness of the need of "optimal use of all available resources".

Co-operative leadership culture includes fitting and maintenance of "fire alarms" that will speak-up once stress symptoms are taking over. Recent examples of management run-offs and failures show the striking absence of such sensors.

Observation of leadership style in decision making environments – not being limited to aviation – shows that leader-centered decision making often ends in self-setup traps characterized by typical stress mechanisms. Each person shows a specific pattern of psychological needs linked to personality traits. These needs – if not being satisfied for a certain time – create specific stress patterns that change in character and force with increasing frustration. Once caught by one's own stress pattern the behaviour does typically not allow for alternatives anymore but rather follows a distinct path comparable to an instinct based process once kicked-off.

Management style can be taught, discussed, applied and modified. To lastingly change and adopt a management style, it is known that an enormous effort is needed. This becomes especially true if such behavioural changes are required in situations characterised by stress, emotional involvement and / or by risk- and time-critical factors.

Aviation simulators provide for high fidelity representation of all pertinent factors relevant to performance training in complex and risk specific systems. Management training can be enhanced by simulations as well – especially if stressful situations are being involved. Our inhouse developed GemaSim™ methodology allows for leadership training under stress. It allows for analysis of related bahavioural markers, for modification of these markers and for re-training and consolidation of modified behaviour under stress. It allows for analysis of team dynamics and for modification, re-training and consolidation as well.

Only the fostering of all leadership elements – like management of strategical, cultural and organisational issues as well as management of communicative and stress-related process – allow for ultimate excellence and success in leadership and decision making process.

Professor Manfred Krifka
Institute for German Language and Linguistics,
Humboldt University of Berlin, Germany

The language trap: communication under high task load

Professor Dr. Manfred Krifka is Chair of General Linguistics at Humboldt University, Berlin, and Director of the Center for General Linguistics, an extramural research institution in Berlin. He received his university education at the University of Munich, where he worked on the syntax of Bantu languages and on the semantics of aspect. After three years in a department of computational linguistics at the University in Tuebingen, he became, in 1990, Assistant Professor at the linguistic department of the University of Texas at Austin, where he was granted full professorship in 1999. In 2000 he relocated to Berlin. He has been a fellow of the Center for Advanced Study in the Behavioral Sciences, Stanford, and of the Institute of Advanced Studies at Hebrew University, Jerusalem. He was or is editor of two major linguistic journals, "Linguistics and Philosophy" and "Theoretical Linguistics". His main area is in the semantics of natural language, especially in its relations to syntax, and in pragmatics, the study language use.

Communication failure has been implied as a contributing cause in many accidents, from aviation to medical surgery. If we want to prevent such accidents, we also have to reduce the likelihood of communication failure.

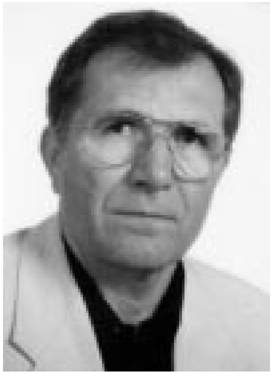
To a considerable degree, communication failure is caused by the asymmetry in the social relations in many groups. Group members differ in the type or the depth of their professional expertise, or in their power of command. While this is necessary for the proper functioning of groups, it also may lead to the supression and distortion of crucial information in moments of acute danger. Crew Resource Management Training, successfully instituted in aviation, addresses such problems, and should be introduced in other domains. A simple measure like institutionalizing a short debriefing session in which misunderstandings can be openly discussed after the action is over is a first big step in the right direction.

In addition to a general awareness of social influences on the way how we communicate, group members should be sensitive for problems lurking in communication itself. The goal of communication is to maintain and increase the common knowledge of a group, which is a prerequisite for coherent, goal-directed action. For this, group members have to work with their assumptions about the information states and current tasks of the other crew members. They have to know what is relevant to whom at which time, they have to remember that someone occupied by a tricky task may not have the capacity of understanding things quickly and completely, they have to identify possible gaps in their own information state and ask the right questions, to the right person, to fill them out. We think that this ability can be trained, and we have identified a number of rules-of-thumb that should be heeded: questions should be answered, intentions should be made clear, and acknowledgements that something has been understood should be given, in important cases by “reading back” what has been said. For members in power of command it is especially important to encourage crew involvement explicitly.

In addition to that, care should be taken to develop an efficient language of communication that reduces the potential of misunderstandings by ambiguity. Also, it is of utmost importance to understand the problems that arise if the medium of communication is a foreign language: There is evidence that even for very fluent speakers, a language acquired after childhood binds more cognitive energy than one's native languages.

Professor Werner Sommer
Institute of Psychology,
Humboldt University of Berlin, Germany

The mind under pressure microscopic views from the lab



Prof. Dr. Werner Sommer (born 1952) received his diploma in Psychology from the University of Würzburg in 1976. He obtained both his doctoral degree (1982) and his Dr. habil. (1991) at the University of Konstanz. In 1995 he was appointed professor of Biological Psychology and Psychophysiology at the department of Psychology at the Humboldt-University Berlin. His general research interest is the investigation of human information processing by recording electrical brain potentials. Currently, he is engaged in studies on movement preparation, dual task processing, language perception, processing facial information, and the significance of specific brain potentials.

In my research I deal with fundamental questions about how human beings think. We investigate these questions in well-controlled laboratory settings by observing the performance of our subjects and by recording their neuroelectric brain responses. Therefore the GIHRE project posed the special challenge for us to connect basic and applied research. In our project we investigated how task load, e.g. time pressure or having to deal with several sub-tasks simultaneously, impacts on aspects of the thought process which are important for communication between team members. Communication comprises, amongst other things, understanding and responding to verbal messages. We therefore looked at how an important part of communication – understanding of verbal messages – is affected by various task load factors. In order to study this comprehension process as directly as possible, we measured a specific component in the neuroelectric potential, the so-called N400. The N400 is an electrical negativity of several microvolts which usually reaches its maximum around 400 milliseconds (a little less than half a second) after reading or hearing a word. It is large when a word is difficult to fit into the current semantic context e.g. in sentence reading or conversation – and it is small when the word is predictable from the context. The N400 therefore reveals the extent and timing of the brain activity employed for word comprehension within a meaningful context. By purposively eliciting N400 we experimentally investigated the influence of different task load factors on the word comprehension process. We found that the comprehension process for single words can be delayed by simultaneous additional tasks by as much as half a second. Hence it is easy to see that multiple delays in longer messages can build up and make them difficult or even impossible to understand. This may even happen with individual words occurring in conjunction with a difficult additional task if the listener,s attention is not directly focused on the meaning of the word. Comprehension problems such as these are exacerbated if communication takes place in a second language rather than in the mother tongue, as is the case at many workplaces, e.g. in the aviation industry or in hospitals.

These results point to a number of recommendations for workplace design and procedures. For example, wherever possible teams should be assemble in such a way that members can communicate in their native language, and display instruments should require as little linguistic translation work as possible, as this could interfere with the process of comprehending simultaneously arriving verbal messages.

Dr. Hansjörg Fricker
Executive Team Member of Financial Services Business Group
and co-Head of Corporate Risk Underwriting
Swiss Re, Zurich, Switzerland

Is there survival in high risk environments? – Insurance aspects

Hansjörg Fricker is a Managing Director and Co-Head of Corporate Risk Underwriting. Currently staffed with 180 employees, this business unit is responsible for the Property, Casualty and Aviation facultative book of business. Hansjörg Fricker joined Swiss Re in 1984 to work on a variety of functions in Risk Management and as Manager of Swiss Re's Environmental Impairment Liability Portfolio. As of 1994, he was instrumental in the development of the International Business (IB) unit of Swiss Re addressing the Corporate client segment. IB later became one of the cornerstones of the Financial Services Business Group (FSBG), section Risk Solutions, formed in 2002 out of the Swiss Re New Markets unit. Mr. Fricker holds a PhD degree in natural sciences from the Swiss Federal Institute of Technology of Zurich.

Insurers sell promises to cover future losses, enabling the insured to transfer risk to the insurer. In this risk transfer the insured can reduce future uncertainty.

The basic principle of insurance is the notion of solidarity and interrelation. Insurance aims to distribute the loss suffered by an individual member among all the members of that community. The risk behaviour of each individual has an effect – for better or worse – on all the others.

To set prices (premium), insurers must be able to predict future losses. As per the 'law of large numbers', it is relatively easy to determine an adequate premium for a community of insureds with a **homogeneous risk profile**, because the expected loss is similar for all members. The premium is determined via distributing projected losses among all the insureds.

In reality, however, no risk profile is absolutely homogeneous. This is particularly true in the corporate risk segment with its focus on solutions tailored for large companies. Substantial differences in products, manufacturing processes, socioeconomic environment, natural hazard exposures and many other risk factors do exist.

The need for individual risk assessment arises from both the interests of insured and insurer. Those in the insured community who try to reduce their own risks, often at a considerable expense, expect to pay less premium as a 'compensation' for their risk improvement. The insurer not only needs to assess and select the risk based on **loss statistics** [historical view], but also on the [future] **loss potential**.

Until recently, safety and risk management was primarily understood as a technical task, and risk assessment was limited to facts of 'hardware'. The importance of 'soft factors' (processes, procedures, management, people) was not adequately recognised and was not part of objective judgement. Following very large losses caused or aggravated by failures of 'soft factors', risk management, the assessment and tools became more sophisticated. It is now generally accepted that risk and safety management is not only a question of reliable technology, but also depends on good interaction between machines and humans. Today, risk assessment includes analysis of historical statistics as well as potential losses caused or aggravated by individual and collective behaviour, organisational structures, attitudes and other soft factors.

Although loss predictability is highly developed, forecast and reality can differ [similar to meteorology]. In insurance this is known as 'underwriting risk'. Finally, it may be relatively easy to determine the qualitative risk of an insured, however, quantification of potential losses continues to be a great challenge for the insurer. **Therefore, with high severity but low frequency risks, only risk selection does the trick and proves to be the most effective form of underwriting.**

Ernst G. Zirngast
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Insurance in high-risk environments

Ernst Zirngast is a qualified mechanical engineer. He worked as a Technical Manager and Field Services Manager in Mexico and England between 1988 and 1995. He then completed a post-graduate course in Business Administration at the Fachhochschule in Burgdorf, Switzerland, where he also taught mechanical engineering at the same time. He joined Swiss Re in Zurich as a risk analyst in 1996, and now investigates safety culture and process safety at world-scale oil and petrochemical plants. He has co-designed, launched and used an assessment tool permitting organizational changes aimed at taking advantage of opportunities in the insurance industry. His invaluable experience as a troubleshooter for complex problems (offshore, refineries and nuclear power plants) is a great asset. He also trains Swiss Re customers and staff.

Given that high-risk sectors (aviation, nuclear plants, hospitals, the processing industry) tend to report relatively few incidents, it is obviously inappropriate to measure the quality of an insured risk by the history of past claims; other evaluation criteria are also required. The human factor, i.e. the role played by typically human attributes, has been excluded from risk assessment for too long. In the past, the insurability of major risks was assessed in terms of, above all, the quality of structural and technical protections.

When I visit plant, I am receptive to impressions that are not easily categorized within the above framework. I find myself walking through a control room with a plant manager, for example, discussing the alarm management system. He bumps into an operator and asks whether his daughter is feeling better. Then another plant manager takes me through the corridor on the management level. A discussion erupts about a planned hot tapping intervention (drilling a high-pressure hydrocarbon line during operations). We move on again after exchanging a few words and he complains: “They don’t believe in me”. During a third risk trip, the CEO from the distant parent company also happens to be visiting. When the usual meetings finish, the CEO does not depart with the Department Managers for dinner, but invites a third of the workforce at a time to join him for an evening meal. We observe a boss cultivating friendly relations with his staff, an attitude that undoubtedly has a positive impact on the working environment.

My gut feeling is that these impressions must be relevant to risk assessment. The style of communication, the trust between employees and managers, the credibility of the safety management system, the work climate, the role models and the culture, etc. should also be taken into account in any appraisal of risk quality. So how can one quantify and categorize this?

In the nineties, working together with the Institute of Work Psychology of the Swiss Federal Institute of Technology (ETH) Zurich and Swissair, we came up with a concept to measure these kinds of impressions. We developed a perception questionnaire which we now distribute to a cross-section of the workforce during plant visits; this questionnaire asks staff to note their impressions, perceptions and opinions about safety relevant topics. The subsequent statistical evaluation generates profile curves which allow conclusions to be drawn about group interaction and the safety culture.

This method showed that there is a correlation between the frequency of incidents, the quality of group interaction and the safety culture. The plant operators are grateful for the insights provided by the questionnaire into how the workforce and the managers of the individual organizational operating units perceive things – and about how they stand in relation to safety measures and costs, training, the handling of near-miss incidents, the quality of communication, the effectiveness of role models and the safety culture in general.

Claude Nicollier
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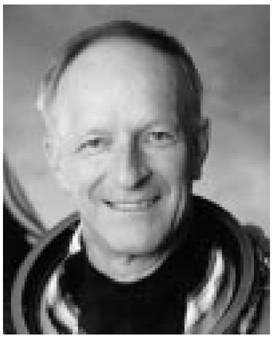
Success and failure stories in space exploration



Claude Nicollier is a European Space Agency (ESA) astronaut of Swiss nationality. He graduated from the University of Lausanne in 1970 (Bachelor of Science in physics) and the University of Geneva in 1975 (Master of Science in astrophysics). He also graduated as a Swiss Air Force pilot in 1966, an airline pilot in 1974, and a test pilot in 1988 (Empire Test Pilot's School, Boscombe Down, United Kingdom). He was a member of the first group of ESA astronauts selected in 1978. He joined Group 9 of NASA astronauts in 1980 for Space Shuttle training at the Johnson Space Center, Houston, Texas, where he has been stationed until today. He has been a crewmember on four Space Shuttle flights, STS-46 in 1992 (EURECA deployment and first test of TSS), STS-61 in 1993 (first servicing mission of the Hubble Space Telescope), STS-75 in 1996 (second flight of TSS, and USMP-3 microgravity investigations), and STS-103 in 1999 (third servicing mission of the Hubble Space Telescope). He has logged more than 1000 hours in space, including a spacewalk of 8 hours 10 minutes duration to install new equipment on the Hubble Space Telescope on STS-103.

If there is a field where teamwork is paramount, it is human spaceflight. The working conditions are very different than on Earth, the environment is tremendously hostile and the machines we operate are most of the time very unforgiving. If you are alone in the midst of some critical activity, the likelihood of getting distracted, or confused, or inefficient, is always there, and the consequences of mistakes might be severe, sometimes fatal. Teamwork in human spaceflight has several dimensions: Teamwork in training, within the crew and with the training team and control room personnel, teamwork during the mission to succeed, and sometimes to survive, and teamwork post-mission to forward to others the knowledge acquired and the lessons learned. For large scale space projects, teamwork takes also another meaning: cooperation between nations and Agencies, beyond traditional teamwork, becomes a must, and this is a component that makes of human space exploration such a deep and enriching experience.