5. CROSS-CULTURAL FACTORS IN AVIATION SAFETY☆

Ashleigh Merritt and Daniel Maurino

ABSTRACT

This paper presents the safety case for the consideration of cross-cultural factors in aviation by focusing on cultural interfaces, those situations where members of one culture encounter people or artifacts from other cultures. Global aviation is strongly influenced by the USA and Western Europe as the largest manufacturers and largest customers; hence almost all cultural interfaces are weighted in favor of the dominant users. The challenge for safety is not to ignore or eliminate these interfaces but to manage the potential threats they pose. To move forward, there is a role for those inside and outside the dominant model.

INTRODUCTION

Unlike no other technology before or since, aviation is responsible for creating the "global village." It is now possible to reach any part of the world by air, and to do so in previously unimaginable time. Whereas international travel had previously been a privilege of the wealthy elite or the adventurer, today's world is accessible to more and more people. Business, leisure, even religious pilgrimages are now achieved with the help of air travel. Aviation has changed the way we think about the world and what is possible in the world.

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Civil aviation is the global success that it is today because of its dedication to improving safety. This pursuit of improved standards has advanced the industry in several directions. First and foremost, brilliant minds have created ever more sophisticated machinery – today's aircraft are extraordinary marvels achieving speeds and load factors never before imagined. A second avenue of improvement has focused on the human in the aviation system. Hawkins' SHEL model placed the human at the center of the aviation enterprise, and reminded us that the best machinery must still be handled by humans (Hawkins & Orlady, 1993). Crew Resource Management (CRM) expanded the Human Factors horizon from individuals to teams (Wiener, Kanki & Helmreich, 1993), and Reason's model of Organizational accidents went one step further to show how policies and activities at the management level can impact safety-related activities throughout an airline, including in the cockpit (Reason, 1997). This dedication to improving safety has led to the investigation of cross-cultural factors in aviation safety.

There is a prevailing way of doing business in global aviation that has been shaped in large part by the manufacturers and the largest customers. The industry's standards and practices have been shaped via competitive deregulation, professional interest groups and resource-rich investment in technology. The outcome of this influence and investment is the outstanding safety record that civil aviation now enjoys. Despite this overall success, some regions of the world do not enjoy the same high safety record as others, prompting the inquiry as to why. International standards and practices should be equally relevant, equally applied, equally enforced, and equally affordable around the world. However, the Safety Oversight Audit Program of the International Civil Aviation Organization (ICAO) has clearly demonstrated this is not the case (ICAO, 2000). Regional accident rates vary dramatically around the globe, suggesting that the prevailing model of aviation practice may not be equally applicable around the world. Understanding these variable safety statistics more completely was the impetus for this document.

This paper presents the safety case for the consideration of cross-cultural factors in aviation. It does so by focusing not on cultures per se but on cultural interfaces, those situations where members of one culture encounter people or artifacts from other cultures. Put at its most simple, as long as one stays within the bounds of one's culture, all of the advantages of cultural membership hold; fellow members and the environment are predictable, thereby making daily routines easier and quicker. But as soon as we encounter members or artifacts (aircraft, procedures, regulations) from other cultures, these cultural efficiencies are challenged and the opposite occurs: The environment becomes less predictable, more uncertain, and requires more cognitive effort. In time, and with sufficient exposure, new habits emerge to deal with the cultural interface. In civil aviation today, cross-cultural contact is the norm rather than the exception. In such a global context, cultural interfaces are a daily reality.

To illustrate the safety case surrounding cultural interfaces, the paper builds upon three existing industry conceptual models. First, Hawkins introduces the notion of interfaces and notes their relevance for Aviation Human Factors. Second, Reason's model of organizational accidents broadens the Human Factors horizon to include organizational factors distant from yet influential upon the cockpit. The safety case surrounding cultural interfaces in aviation seeks to broaden the horizon even further, showing how members of one culture can incur confusion, misunderstanding, and misapplication when encountering members or artifacts of another culture. In this sense, cultural interfaces can be seen as latent conditions. Lastly, the Threat and Error Management (TEM) Model (Helmreich, Klinect & Wilhelm, 1999) provides a framework for "seeing" the cultural interface in the operating context. It can determine which types of cultural interfaces are the most problematic for a specific context; it can also study the threat management strategies employed by aviation personnel within specific contexts to manage these interfaces. Successful solutions can be shared with the industry.

CULTURE, CONTEXT, AND CULTURAL INTERFACES IN AVIATION

In a broad sense, culture can be defined as the ongoing interaction of a group of people with their environment. The environment shapes the responses of the people, and the people's responses in turn modify the environment. A culture develops and changes due to three processes – technological and physical changes in the environment; changes in the internal dynamics of the social system, and historical circumstances that are fortuitous or serendipitous (Fig. 1).

A simple but significant example of technological change affecting a culture is the invention of the mechanical clock. The first town clock was installed in a town in France in 1314; many public clocks appeared throughout Europe shortly thereafter. Prior to this invention, the concept of time was simple, general, and loose. With the widespread use of the mechanical clock, time began to be conceptualized as a succession of measurable units. The "working day" was invented and announced by the bells of the town clock. The invention of the airplane has been no less profound; it has changed the way people conceptualize the world and their "neighbors."

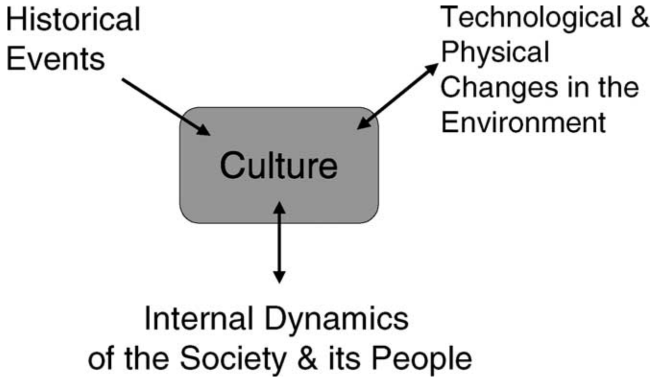

Fig. 1. How a Culture Develops and Changes.

Some Definitions of Culture

A shared system of beliefs (what is true), values (what is important), expectations, and behavior meanings (what is implied by engaging in a given action) developed by a group over time in order to meet the requirements of living and operating in a particular (geographical) niche. (Psychologist)

It's what I expect of myself and what I expect of others in the groups in which I live and work. (Medical practitioner)

It's the human-made part of the environment. (machines, buildings, technology) (Anthropologist)

It's the way we do things around here. (customs, procedures) (Business CEO)

The longer a group stays together, works together, or shares common goals together, the more its members will discover and share acceptable solutions to common problems with each other. The more the members share solutions, the more they will start to think and act alike. This ongoing adaptation is the basis of culture. This logic holds whether it's a national culture, an organizational culture such as an airline, or a professional culture such as pilots.

Because a culture is shaped by its environment and evolves in response to changes in that environment, *culture and context are really inseparable*. This rather broad definition is deliberately adopted here to allow the greatest scope in understanding culture and cross-cultural influences on aviation safety.[1]

Culture and Context

There are many layers of context in which a culture is embedded, including the political, the physical, the social, and the economic. Figure 2 shows the four contexts in which all aviation endeavors occur. Any airline finds itself influenced by these contexts; its daily operations are the solutions to the problems and demands created by these contexts.

Economic and Political Context

This layer includes several macro-level features, including:

- National wealth, per capita income, and tax base
- Population size and density
- Stability of economic and political systems
- Laws
- Education

Together these factors decide the size of the aviation customer base in a country and the general affordability of air travel for people in that country. It also decides the size and stability of government support for the aviation infrastructure. The level of education in a country determines the population's familiarity with technology and their ability to work with it or create their own technology.

Fig. 2. Civil Aviation: A Complex System.

Geographic and Physical Context

Perhaps the easiest to see is the physical context. The features that define this context include:

- Geography and complexity of terrain
- Climate and weather
- Population dispersion and accessibility

Combined with other factors such as customer demand, these factors decide flight routes and schedules.

Social Context

The third layer is most closely related to the people and their customs. They include:

- Socially agreed upon ways of making sense of the surrounding environment
- A group's preferred ways of thinking, acting, and interacting
- Values – what is considered important
- Behaviors – what is considered normal

These features develop over time, handed down from one generation to the next, evolving into a social system of shared meanings and coordination among a culture's members. These shared understandings make living and working more ordered and predictable.

The social context is what allows people to manage their daily lives so efficiently by providing many short cuts based on familiarity. One need only be a tourist in a new land, driving on the opposite side of the road or buying groceries, to recognize how mentally demanding the unfamiliar can be. Similarly, flying into a new airport or dealing with Air Traffic Control (ATC) in foreign countries can be very demanding compared with flying in local familiar airspace. Humans function more efficiently in their own social context because generally they know what to expect from others and they know what is expected of them. And usually, as long we stay within our cultural bounds, we are correct in our expectations.

Values – what is important, what is correct – are also shaped within the social context. Values are held so deeply that most people are surprised, shocked, and even offended when they encounter people with values different from their own. Because they are held so deeply and emotionally, values tend to be unquestioned and resistant to change. Some values that drive daily aviation operations throughout the world, and which likely differ throughout the world, include:

- How fast should be the pace of life and work? How fast is too fast; how slow is too slow?

- How important is technology vs. humans? Who or what has the greater authority, flexibility, “wisdom?” Do I trust the machine or do I trust the person?
- Similarly, how important are rules and regulations vs. human discretion? Who or what has the greatest authority, the greatest “wisdom?”
- What is the acceptable level of safety and related risks? Is one accident per million departures reasonable given the level of safety in other transports and industries? Should it be higher? Should it be lower?
- What is the appropriate way to use and interact with authority? Does everyone have a legitimate voice, or only those with experience and seniority?

The social context is what people most associate with culture because of the customs, norms, values, and beliefs. Historically derived and shaped over time in response to environmental demands and changes, the social context is every bit as important as the economic, political, and physical contexts in determining how people will act and react.

Airline Operating Context

The features of the airline operating context are familiar to all aviation personnel. This layer includes:

- The international and local regulations governing aviation traffic
- The airline’s policies and procedures
- Aircraft
- Manuals and other documentation
- Maintenance, and ground equipment
- Air Traffic Control
- Airports
- Passengers and their expectations

Figure 2 shows that this context is impacted by all three outer layers discussed above, yet many of the features in this layer are similar the world over. Airlines tend to fly the same planes and adhere to the same procedures and regulations despite the fact that they operate in different economic, political, social, and physical environments. This is an important point that speaks to the heart of this paper. Why do airlines the world over look at least superficially similar? What are the safety consequences of this apparent similarity? This issue will be discussed at length later in this paper.

To summarize this section, a culture can be considered the ongoing interaction of a group of people with their environment. It can be understood more completely by paying attention to economic, political, physical, and social factors.

Cultural Interfaces

There are many advantages to being a member of a culture. Fellow members and the environment are more predictable, thereby making daily routines easier and quicker. There is security in this knowledge, and this confidence furthers one's efficiency in the culture. But as soon as we encounter members or artifacts from another culture, these cultural efficiencies are challenged and the opposite occurs. The world becomes less predictable, more uncertain, and requires more mental effort. We need to "think on our feet" to make sense of the surrounding context, rather than taking it effortlessly for granted. In time, and with sufficient exposure, new habits emerge to deal with the interface. Understanding new habit formation and its implications in human interactions is at the heart of cross-cultural endeavors.

Cultural interface

Members of one culture come into contact with members or artifacts of another culture.

Artifact

Any human-made object, e.g. airplanes, navigation aids, SOP's, training manuals, regulations

By its very nature, aviation is a cross-cultural endeavor. Pilots fly in foreign airspace, transporting passengers and cargo around the world. Even when flying within their country of origin, many pilots fly aircraft designed and built in another part of the world. The cultural interfaces in aviation are many and diverse. Table 1 provides a non-exhaustive list of these cultural interfaces, highlighting the fact that it is not only when people interact with people, but also when people interact with products of other cultures that uncertainty can be introduced.

Moderating Factors

Given the daily occurrence of cross-cultural interactions in aviation, there are several factors that moderate the experience, including cultural distance, resource match, and experience at the interface.

Cultural distance explains how some countries can be culturally similar, despite the geographic distance, because of a common language, shared history, similar religion, or political systems, while other geographically close countries remain culturally distant. For example, Australia and the USA are culturally closer than the USA and Mexico. *The larger the cultural distance between two countries, the greater the uncertainty there will be at the cultural interface*. Hence a Chinese regulator trying to understand a (translated) Australian accident report is likely to

Table 1. Cross-Cultural Interactions: A Daily Occurrence for Aviation Personnel.

Members of Culture 1	Members & Artifacts of Culture 2	Interactions at the Interface
Pilots	People	
Flight Attendants	Pilots	Multicultural cockpits, airline mergers, alliance/contract pilots
Engineers	ATC	Language exchanges in foreign airspace
Airline & Airport Personnel	Flight Attendants	Different training, goals, and expectations
Accident Investigators	Ground Personnel	Different priorities; confusion around standards
Local Regulatory Body	Passengers	Different expectations for service
	Trainers	Training in another country on new aircraft or as a cadet
	Investigators	International investigation teams
	Artifacts	
	Manuals	Manuals written by personnel in one part of the world are translated or interpreted in other parts of the world.
	Aircraft	Equipment specifications that make sense in one part of the world may not be so "logical" in other parts of the world Maintenance & engineering proficiency as defined and schooled in one part of the world may not be possible in other parts of the world
	Regulations	Regulations created for a specific economic, political, and social context are interpreted and applied in other parts of the world
	Legal Systems	Different paradigms of accident investigation and accountability

Note: Language difficulties apply across all domains.

experience more uncertainty about its meaning than a Canadian reading the same document.

A second difference relates to resource similarities in the operating context. To the extent that the social and economic context differs between two cultures, the greater will be the mismatch at the interface. For example, the latest safety advance from the aircraft manufacturer may bemuse a pilot from a developing country, given that the local infrastructure is in no position to support it.

The great talent of humans is their ability to adapt. The more experience at the interface, the less the interface will appear challenging. A pilot flying for the first time into a new airport in a distant country experiences the interface more

Table 2. Four Options at a Cultural Interface.

ASSIMILATION A > B Members of Culture A learn and adopt Culture B's ways, in whole or in part	INTEGRATION A + B Members of Cultures A and B learn each other's ways & compromise
ASSIMILATION B > A Members of Culture B learn and adopt Culture A's ways in whole or in part	SEPARATION A | B Members of Cultures A and B ignore each other's ways & do not change

acutely than a pilot who regularly travels in and out of that airport. *Experience at the interface builds familiarity and reduces uncertainty*. Hence pilots flying internationally for multicultural airlines are able to develop the necessary familiarity while maintaining a heightened awareness of cultural differences.

With experience and exposure comes adaptation. However, adaptation is mostly based on cosmetic behaviors. It is a commented fact that cosmetic behaviors crumble under stress and a reversion to native behaviors takes place. The safety concern about dealing with cross-cultural interfaces through adaptation is obvious; in stress situations adaptation may become ineffective.

Behavior at the Cultural Interface

Broadly speaking, there are 4 possible responses when members of one culture encounter members or artifacts of another culture (Berry, 1990). These are summarized in Table 2.

The first two options are mirror images – either members of Culture A learn and adopt the ways of Culture B, or members of Culture B learn and adopt the ways of Culture A. Both options reflect a willingness or necessity to accept the ways of the other culture. *Even within a single national culture*, for example, in airline mergers, we see that the smaller airline usually ends up adopting the practices and policies of the larger airline, *even where the smaller airline has a better way of doing things than the larger airline*.

A third option for interaction, Integration, allows members of Cultures A and B to learn something of each other's ways, and find compromises that will be the most effective for that interface. In this approach, the two merging airlines might form pilot committees to review documentation and procedures and create a new (and improved) set of standard operating procedures suitable for pilots from both airlines.

The final option, Separation, acknowledges that in many cases, members of Cultures A and B choose to ignore the ways of the other culture, and maintain their own cultural preferences. This model has been observed in some airline mergers, in so much as many years after a merger, some pilots will still identify with their former airline, drawing a distinction between themselves and the pilots of the other "dominant" airline, refusing to fully accept their connection with the other airline.

Bearing in mind the moderating factors of cultural distance and resource match, and the motivation arising from the perceived benefits of adopting other cultural practices, the learning that takes places at the interface can be of varying quality. The understanding and adoption of practices from another culture can be:

- *Conscious or unconscious* – Members may not even recognize they are adopting a different way, yet they do it nonetheless. Unconscious adaptation can be problematic when the social norms in the two cultures vary because the behavior may look the same, yet be driven by different underlying logic. As the surprised tourist can attest, a gesture in one country may have a totally different meaning in another!
- *Complete or in part* – Some practices may be easier (and more natural) to adopt than others. For example, the need for communication in the cockpit as advocated by CRM is appreciated globally, while the "best" form of command authority differs as a function of leadership preferences in different countries.
- *In good faith or otherwise* – There may be a genuine effort to adapt, or in the face of confusion, there may be a superficial effort at adopting the other's ways. The logic of some international regulations may be obscure to some developing countries, yet they feel compelled to adopt them as is.
- *Successful to varying degrees* – Success is when members of one culture know how to act as if natives of the other culture. They understand the organizing principles of the culture sufficiently to predict the behavior of others in the new culture. In truth, it is very difficult for most people to achieve this level of cultural knowledge and awareness.

This section introduced the concepts of culture and cultural interfaces. Table 1 listed some examples of the confusion that can arise at the intersection of two cultures and showed that cross-cultural interactions are a daily occurrence in aviation. The success of these interactions varies depending on familiarity and motivation. *Because of the potential for confusion, misunderstanding, and misapplication, these cultural interfaces deserve closer scrutiny*. The safety case for managing cultural interfaces is presented in the next section.

THE SAFETY CASE FOR CULTURAL INTERFACES IN AVIATION

This section draws on three models of human performance to argue the safety case for cultural interfaces in aviation. Hawkins' SHEL model, adopted by ICAO as the conceptual model to explain Aviation Human Factors, is used to justify the basic safety case underlying cultural interfaces in aviation. Reason's model of organizational safety is used to describe cultural interfaces as latent conditions in the system which if not managed can lead to active failures. Finally, the University of Texas Threat and Error Management (TEM) Model is proposed as an operational tool to deal with cultural interfaces as potential threats that must be managed in the same way as other environmental threats.

SHEL Model

The SHEL model[2] (the name being derived from the initial letters of its four components) was the first model in aviation safety to directly address the risks latent at operational interfaces (Hawkins & Orlady, 1993). The interfaces were the interaction of Liveware (humans) with Hardware (machines), Software (procedures, symbology, etc.), other Liveware, and the Environment. The model placed the human at the centre of the four interfaces; a quick review of each of these interfaces will show the presence of culture.

Liveware. Some of the factors affecting the performance of individuals include physical (the individual's physical capabilities to perform the required tasks), physiological (those factors that affect the human's internal physical processes), psychological (those factors affecting the psychological preparedness of the individual to meet all the circumstances that might occur during a flight), and psycho-social factors (external factors in the individual's social system that influence them in their work environment). Though not directly mentioned in the original model, it is reasonable to include cultural factors with other physiological, psychological, and psycho-social factors influencing basic human performance issues such as workload, attention, memory, communication, and so forth.

Liveware-Hardware (L-H). This interface looks at how the human interfaces with the physical work environment, e.g. displays to match the sensory and information processing characteristics of the user, of controls with proper movement, coding and location. This interface has received the most attention, as researchers and designers struggle to understand how humans will adapt to new technology, e.g. automated aircraft. Given that manufacturers are unlikely to build aircraft for different regions and populations, it is incumbent on them to build the most universally acceptable aircraft – by no means an easy task. The extent to which pilots have been exposed to similar technology previously will affect their ability to adapt. Nonetheless, technology designed with thoughtful consideration of cross-cultural issues involved in the transfer of technology can go a long way to neutralize cultural differences.

Liveware-Software (L-S). The L-S interface is the relationship between the individual and all the supporting systems found in the workplace; e.g. the regulations, manuals, checklists, publications, standard operating procedures, computer software design, and so forth. It includes such "user friendly" cultural issues as format and presentation, vocabulary, clarity, symbology, etc. Unlike equipment, which cannot be so easily customized, software is an area with potential for manufacturers to work with their customers, to produce culturally calibrated documentation to ease the cultural interface.

Liveware-Liveware (L-L). The L-L interface is the relationship between the individual and other persons in the workplace. In aviation, the advent of Crew Resource Management (CRM) (Wiener, Kanki & Helmreich, 1993), resulted in considerable focus on this interface, focusing on group performance activities such as leadership, crew co-operation, and teamwork. Adding culture to the mix expands the possibilities for confusion and misunderstanding as preferred modes of social behaviour interact across cultures in multicultural cockpits and international flights. As with early aviation Human Factors, this is the interface that so far has been the focus of cross-cultural endeavours.

Liveware-Environment (L-E). This interface involves the relationship between the individual and both the internal and external environments. The internal workplace environment includes such physical considerations as temperature, ambient light, noise, vibration, air quality, etc. The external environment (for pilots) includes such things as visibility, turbulence, terrain, weather, etc. Further, the aviation system operates within a context of broad political and economic constraints, which in turn affect the overall corporate environment. Included here are such factors as the adequacy of physical facilities and supporting infrastructure, the local financial situation, regulatory effectiveness, etc. The contexts discussed in the previous section are clearly implied here.

In sum, while culture was not on the Human Factors radar back in the 1970s when the SHEL model was first proposed, the idea of interfaces has been with us for 30 years. Extending the model to acknowledge cross-cultural realities is a logical step.

Reason's Model of Latent Conditions

The SHEL model placed the human at the center of the aviation system to emphasize its most critical role. In so doing, it might inadvertently have generated a situation that held the individual accountable for any failures in that system. Professor James Reason provided a broader perspective on aviation safety (Reason, 1997).

Reason explained that seldom does an error by one individual operating in isolation precipitate an accident; typically, several causal and contributing factors converge in time and space to create a situation that is particularly vulnerable to one or more unexpected unsafe acts. Examples of such catastrophes include the accidents at the Three Mile Island (Pennsylvania, USA, 28 March 1979) and Chernobyl (Ukraine, USSR, 26 April 1986) nuclear power plants, the Challenger space shuttle (Florida, USA, 28 January 1986), and the double B–747 disaster at Tenerife (Canary Islands, Spain, 27 March 1977).

Analysis of major accidents in technological systems indicated that the preconditions to disasters can be traced back to identifiable systemic deficiencies. It is typical to find that a number of undesirable events, all of which may have contributed to an accident, evolved through an "*incubation period*" of perhaps years, until a triggering event, such as an abnormal operating condition, precipitates a disaster. Reason refers to these preconditions as latent unsafe conditions. Latent unsafe conditions have certain characteristics:

- Latent conditions are to technological organizations what resident pathogens are to the human body. Like dormant bodily pathogens, which may lead to human disease, latent organizational conditions may be present for many years before they combine with local circumstances and active failures to penetrate the system's many layers of defense.
- Latent conditions are present in all systems. They are an inevitable part of organizational life where compromises between conflicting goals, e.g. production and safety, lead to shortfalls somewhere in the system.
- Unlike active failures, which usually have relatively immediate and short-lived effects, latent conditions can lie dormant for a long time until they interact with local circumstances to defeat the system's defenses.
- Latent conditions may only become evident once the system's defences have been breached. They may be present in the system well before an accident and are generally created by decision-makers, regulators and other people far removed in time and space from the accident.
- Latent conditions include poor design, gaps in supervision, unworkable or ambiguous procedures, clumsy automation, shortfalls in training, and less than adequate tools and equipment.
- Those at the human-machine interface, the operational personnel inherit any defects in the system, such as those created by poor equipment or task design; conflicting goals (e.g. on-time service vs. safety); defective organization (e.g. leading to poor internal communications); or bad management decisions (e.g. deferral of a maintenance item).

Reason argues that *Safety efforts should be directed at identifying and mitigating these latent unsafe conditions on a system-wide basis*, rather than localized efforts to minimize unsafe acts by individuals, as unsafe acts are only the proverbial tip of the iceberg.

Using Reason's logic, cultural interfaces can be considered a latent condition, unless explicit attention is directed to them. They exist in the system, lying dormant, and operational personnel are expected to manage them. No one claims responsibility for them, yet they may one day foster unsafe acts leading to an active failure. They will foster these unsafe acts by virtue of the uncertainty and potential for misunderstanding they inject into the system. Otherwise competent professionals will "trip" at a cultural interface at a time when other defences are weak, perhaps when they're under stress, and the results will be disastrous. As with other latent conditions, *safety efforts should be directed at identifying and mitigating the potential adverse safety consequences of these cultural interfaces if left unchecked*. The more these interfaces are actively understood and managed, rather than being allowed to continue unchecked as a pathogen in the system, the fewer unpleasant safety surprises they will generate.

Cultural Interfaces and the Threat and Error Model

The University of Texas Threat and Error Management (TEM) Model (Helmreich, Klinect & Wilhelm, 1999) provides a way of translating cultural interfaces from latent conditions into more visible and immediate concerns seen in an airline's operating context. The TEM model, which evolved out of work with Line Operational Safety Audits (LOSA),[3] posits that a typical line flight involves inevitable and mostly inconsequential threats and errors. Some errors are due to flaws in human performance (e.g. selecting wrong frequencies, acknowledging incorrect read-backs, mishandling switches) and others are fostered by external threats such as a late gate change, difficult terrain, a dispatch error, or equipment malfunction.

> ***Threat***
> ***An event or error that occurs outside the influence of the flight crew but requires their attention and management to maintain adequate safety margins.***

Threats are different from latent conditions in that they are not necessarily weaknesses in the aviation system; rather they are conditions or events that increase the complexity of flight operations and therefore hold the potential to foster error. Flightcrew threats include environmental threats such as weather, ATC, terrain, and airport conditions, and airline operating threats such as dispatch, cabin, ramp, and maintenance problems. Successful flight depends on successful threat management.

Cultural interfaces fit the definition of threat in several ways:

- Threats can be detected and successfully managed; they can also be ignored, leading to consequential or inconsequential outcomes. This is also the case with cultural interfaces.
- Cultural interfaces are part of the operating environment, as are weather, terrain, airport conditions, and so forth.
- Cultural interfaces, like other threats, require attention and management to maintain adequate safety margins.
- Not every cultural interface produces a threat, but it does contain the *potential* of a threat.

Viewed from this perspective, *cultural interfaces are an inevitable component of the aviation environment*, along with environmental threats and airline operating threats. Acknowledging the existence of cultural interfaces raises awareness of their threat potential – an important first step.

To summarize the safety case for cultural interfaces: Hawkins introduced the notion of interfaces in the 1970s and noted their relevance for Aviation Human Factors. Reason brought the model of organizational accidents to aviation in the 1990s and broadened the Human Factors horizon to include organizational factors distant from yet influential upon the tip of the arrow, i.e. the flight deck, the ATC room, the maintenance hangar. Cultural Interfaces broaden the horizon even further, showing how members of one culture can incur confusion, misunderstanding, and misapplication when encountering members or artifacts of another culture. The Threat and Error Management Model provides a framework for “seeing” the cultural interface in the operating context. Bringing these interfaces to the forefront allows for systematic investigation. This investigation can determine which types of cultural interfaces are the most problematic; it can also study the threat management strategies employed by aviation personnel to manage these interfaces. Successful solutions can be shared with the industry.

The aim is not to eliminate culture or make us all the same. The goal is to recognize and manage the potential threats posed by different cultural interfaces.

A DOMINANT MODEL IN AVIATION: SOME CONSEQUENCES

Up to this point cross-cultural interactions have been conceptualized as the interaction of two relatively equal parties. The members of one group decide the extent to which they want to adopt or negotiate the practices of another culture. The reality of global aviation suggests that many interactions are not so balanced, that they are usually weighted in favor of a more dominant group or culture. This section explores the evolution of these weighted interfaces and some of the global consequences. Manufacturing, standards, research and technology, and global accident rates will be discussed.

Manufacturing

The first plane designed to carry fare-paying passengers was built in 1927 – the Ford Trimotor had 12 passenger seats. Boeing built the more comfortably advanced 247 in 1933, and Douglas Aircraft Company improved upon the concept with the 21-seat DC–3 in 1936, the first aircraft that enabled airlines to make money by carrying passengers rather than cargo.

The major aviation innovations of World War II – radar and jet engines – occurred in Europe; production was the chief goal of the United States. There were fewer than 300 air transport aircraft in the United States in 1939; by the end of the World War II, U.S. manufacturers were producing 50,000 planes a year. The three major manufacturers were Douglas, Lockheed, and Boeing, and with 80% of the commercial airplane market, these companies established the United States as the leader of postwar civilian aircraft production.

A new generation of jet airliners arrived in 1963 using the fuel-saving technology of the turbofan engine. Several models produced in Europe and the United States found popular support in the market: the Boeing 727 and 737, the French Caravelle, the BAC 111, the DC–9, the Fokker F–27 Friendship, and the de Havilland Twin Otter. Boeing continued its hold on the market with the 747. Airbus was established in 1970 as a European consortium of French, German and later, Spanish and U.K. companies. Airbus' first aircraft, the A300B, was launched at the 1969 Paris air show. Ten years later, the consortium had expanded its family of aircraft to 16, and now Airbus shares the market for new aircraft equally with Boeing. (As Boeing has been established for longer, its aircraft outnumber those of Airbus by a factor of six to one.)

The conclusion is obvious: Despite the former USSR's formidable aviation industry, and enterprises in countries including Australia, Canada, Brazil, and Indonesia, North America and Western Europe are the major suppliers of aircraft equipment for civil aviation.

Markets and Standards

The U.S. government played a pioneering role in the liberalization and deregulation of the global airline industry during the post World War II era. At the Chicago

Convention of 1944, the United States pushed for “unrestricted international operating rights” in foreign airspace but was met with intense resistance from European nations fearing that an open skies regime would lead to domination by U.S. airlines. However, since America was developing as the world’s largest and most lucrative air transportation market, European governments were essentially forced into deregulating their airline industry to gain access to American skies.

Rapid liberalization of the airline industry in the early 1980s resulted in a significant increase in the demand for air transportation between countries, causing intense competition among national carriers for profitable long haul flights. With airlines from one country now having access to another country’s airspace, national airlines formed multinational airline alliances to strengthen their international position and prevent further encroachment by foreign competitors.

With almost 70% of the world’s aviation departures occurring in either the United States or Western Europe, these regions are in a strong position to influence standards for airline operations. These standards were first formalized by ICAO through the Chicago Convention of 1944 and its eighteen supporting annexes. In spite of the multi-national nature of ICAO and its harmonized rule-making process, the United States and Western Europe have wielded considerable influence in the development of the rules and regulations of international aviation standards throughout the latter half of the 20th century. This occurred not only through ICAO but also through other international organizations such as the International Air Transport Association (IATA). However, the most important influence has been wielded through the goods and services (training, SOP, safety practices, operational standards and so forth) prescribed by American and European aircraft manufacturers such as Boeing, McDonnell, Douglas, Lockheed, Airbus, and British Aerospace.

The conclusion is obvious: North America and Western Europe are the largest markets for aviation. Professional and special interest groups within these countries have influenced global aviation standards.

Case Study

USA: The Largest Aviation Customer and Supplier

Based on passenger figures from the year 2000, 42% of all air travel originates in the USA, 26% originates in Europe, and 23% originates in the Asia-Pacific region; the remaining 11% occurring in diverse locations. The aviation industry in the United States contributes 9% of the Gross Domestic Product, making it the largest industry in the most industrialized nation in the world.

To put this number in perspective, the money generated by civil aviation in the United States is larger than the entire Gross Domestic Product of Canada, a country with the 8th largest GDP in the world.[4] How did this situation come to exist? How did the United States become the largest customer and the largest supplier in global civil aviation? There are several factors that together explain this outcome. Their origins can be traced to three of the contexts discussed in Section I.

Socio-economic and political context

Population: The population of the United States exceeds 250 million; a large population makes an expensive mass-transit system viable.

Historic: The U.S. emerged from World War II as the primary supplier of airplanes. Within the US, manufacturers competed by building ever more successful planes in terms of size, fuel economy, and passenger comfort.

Political: The U.S. has enjoyed a stable government system throughout the twentieth century. This has allowed government structure to grow, stabilize, and become predictable in terms of controls and support.

Tax Base: A corollary of this political stability has been a relatively high and stable tax system that provides consistent government support for the aviation infrastructure. The tax base also funds aviation research.

Economic System: Capitalism and the belief in a free-market economy led to deregulation of the aviation industry in 1978. Competition has created survival of the strongest, with little sympathy or assistance for those airlines or manufacturers who cannot compete.

Education: 90% of the population have gone to high school; more than 75% enroll in some form of tertiary education. An educated population provides the demand *and* the human resources for research and development of new technology and products.

Economic Resources: The Gross Domestic Product of the USA is the largest in the world, twice that of the next largest country Japan. High per capita income makes air travel affordable.

Geographic and physical context

Geography (the USA): The U.S. is a vast country with the majority of the population living on the East and West coast, making air travel more of a necessity than a luxury. Air travel is the primary means of public transportation between cities in the U.S. today.

Geography (the world): The U.S. is separated from most of the world by large oceans. Air travel is the only fast way of reaching these countries.

Social context
Ideas & Authority: The U.S. is characterized as having low power distance relationships relative to many other countries (Hofstede, 1980, 2001). This attribute, combined with a highly educated population and a market-driven economy results in ideas, especially practical (money-making) ideas, taking precedence over status. Anyone can have a good idea, and ideas propel change.
Pace of Life: People in the United States have a more urgent sense of time than people in many other countries. This urgency is well serviced by faster air travel and convenient schedules.
Risk: In a market-driven democracy, the flying public decides the level of acceptable safety. The absence of civil strife, plus ever-improving health statistics such as longevity rates drives the perception of acceptable risk ever downward.

While a similar case might be made for Western Europe as a whole, no other single country has quite the same confluence of history, geography, economy, population, politics, and national values; it is not surprising then that the United States has emerged as the largest customer *and* the largest supplier of commercial aviation in the world.

Research and Technology

The aviation industry owes its existence to modern technology. Most of this technology has been developed by researchers working in government and industry-funded institutions in politically stable, resource-rich countries such as North America and Western Europe. Like anyone else, these researchers think and work in an environment that is influenced by larger economic, political, cultural, and physical concerns. For example, the popularity of air travel in North America and Western Europe has shifted the notion of acceptable risk. As more and more people use airlines as a common and cheap mode of transport, so too the public now expects air travel to be as safe as riding a bus. This demand for safer and safer air transport drives the research for safety-enhancements. At the same time, the economic context determines what is possible financially, and in what form.

Research is typically undertaken to solve local issues with tools supported by local conditions. In North American and Western Europe, technological solutions are usually expensive, but they are validated and compensated by strong customer demand. These solutions are a good fit for the problems generated in high traffic-density situations supported by a strong and stable infrastructure with modern fleets and enforced maintenance and training standards. These characteristics are a reliable part of the operating context in these countries and are part of the researchers' starting assumptions when they start to shape solutions. But these solutions are then transferred to other parts of the world where the infrastructure is not equally strong, fleets are older, and training and maintenance are as good as they could be given the local constraints. Different contexts create different priorities and problems. They require different solutions.

Assumptions about what problems are important and what solutions are viable drive all research efforts. Technology is a cultural artifact because it is driven by:

- What is perceived as a problem in the current environment
- The suitability of tools that are brought to bear on a problem, and
- The goodness-of-fit between solutions and the most likely users.

Technology is the product of people solving problems that they see; hence, it is less of a problem when used within the culture of its origin. In such circumstances, the technology may be the perfect alignment of problem, tools, and user-customers. But when members of one culture encounter technology created in another culture, the cultural interface may introduce potential mis-matches. The mis-match may occur in the definition of the problem, the suitability of the tool, or the cultural norms and preferences of the user-customers.

Conclusion: Researchers based in North America and Western Europe have developed technology that has led to significant global improvements in aviation safety and efficiency. However, it's a matter of record that these improvements have not been equal around the world.

Global Consequences of Weighted Interfaces

The preceding sections suggest that North America and Western Europe have exerted strong influences on aviation through manufacturing, the size of their markets, and the technological advancements they have funded and developed. As a result, when we talk of cultural interfaces in aviation, most of the time we are talking about aviation personnel encountering aircraft, equipment, training, manuals, and standards that originated in the economic, political and cultural context of North America and Western Europe. Some examples of these weighted interfaces are listed in Table 3.

Further evidence of these weighted interfaces may be found in regional accident rates. In the USA, Australia and Western Europe, the civil aviation accident rate is less than one accident per million departures. In other parts of the world, the rate

Table 3. Some Unintended Consequences of the Dominant Model in Aviation.

Issue	Example
Identification of problems	Researchers in North America and Western Europe are developing solutions to reduce the accident rate from one per million to one per 10 million departures. In some parts of the world, the rate is closer to one accident per 100,000 departures. These regions have different, possibly more essential problems that need to be identified.
Solutions	The high-technology response to traffic problems is to install radar, GPWS and other expensive solutions. In certain parts of the developing world, this is not viable due to a smaller customer base and reduced national wealth. When flight support services are unreliable in this context, the low-technology solution is for pilots to rely on other pilots in the airspace for updated information. Another example: An international safety group developed an ALAR Tool Kit based on extensive research. They translated the product into several languages and copied it on to one efficient compact disc for global distribution. When distribution of the product started, it was realized that pilots in many developing countries do not have compact disc readers.
Language	The *Lingua Franca* of aviation is English. This standard favors pilots in some areas of the world more than others. Nonetheless, all are expected to speak English as the normal way of doing business in international aviation. A software company experimenting with English vs. native language computer interfaces discovered that pilots committed more ATC readback errors when the interface was English and not their native language. Despite the higher error rate, the pilots still said they preferred the English computer interface, as it was important to them to "be like other pilots."
Training	Airlines in some countries buy training "off the shelf" from North American and Western European suppliers, often with little or no customization for local conditions. This has been particularly problematic with CRM training, which is a very culturally influenced tool because of its focus on communication and command authority.
Technology transfer	In an industrially developing society, new technology must be dealt with in the absence of prior experience of its earlier stages because there is no tradition in the use of earlier, related technologies. There can be a significant gap from existing knowledge and skills to those required for successful operation and maintenance of the to-be-implemented new technology. As a general example, it is easier for a person who has worked with Microsoft Office 95, 98 and 2000 to work with the latest upgrade than it is for a person who has never before worked with Microsoft software.

Table 3. (*Continued*)

Issue	Example
	There is also the problem that the technology implicit in the design of the new technology can clash with the culture of the user.
Regulator	A region imported another country's civil aviation regulations as the best (and cheapest) way to comply with the international standards. They even used automatic translation. It was not successful because there was no adaptation to the local context. For example, the inspectors are traditionally paid considerably less than airline personnel in this region and it is possible to circumvent the inspector because of his low status. The respect accorded to inspectors to do their job in this region is considerably lower than in the culture in which the civil aviation regulations originated.

varies from 2 to 10 accidents per million departures. There is a negative correlation between accident rates and the extent to which regions posses the same economic, political, and social contexts as North America and Western Europe. The richer the country, the more politically stable, and the more economically viable that air travel is in that region, then the lower is its accident rate. In other words, the closer the fit to the dominant model as influenced by North America and Western Europe, the less consequential the outcomes at the interface appear to be.

Interactions at Weighted Cultural Interfaces

Section I described four possible ways to behave at a cultural interface. They were: Assimilation whereby members of Culture A learn and adopt Culture B's ways, or conversely, members of Culture B learn and adopt Culture A's ways; Integration whereby members of Cultures A and B learn each other's ways & compromise; or Separation whereby members of Cultures A and B ignore each other's ways & do not change. In light of the discussion re the dominant influences on many of the interfaces in aviation, the model can be updated as shown in Table 4.

Option 1, *Assimilation*, remains the same as in the previous model. The more a country shares similar political, economic and social factors with the dominant model as shaped by North America and Western Europe, the more chance it has of fully assimilating into the dominant model and succeeding. This option has much popular support in the guise of "One Size Fits All" approved practices and regulations. This is an attractive option because the majority of research and technological advancements have been pored into the dominant model. Hence, for those who can assimilate, the safety and productivity benefits are substantial.

Table 4. Four Options at a Weighted Cultural Interface.

Option 1 ASSIMILATION Culture A learns and adopts dominant model *One size fits All*	Option 3 INTEGRATION Culture A interacts with proponents of Dominant Model to understand and modify approaches *Local solutions*
Option 2 COSMETIC COMPLIANCE Culture A gives the appearance of adopting dominant model *Face Value*	Option 4 MARGINALIZATION Culture A unable to adopt dominant model; no option *Isolation*

Option 2, *Cosmetic Compliance*, acknowledges the unlikelihood that members of the dominant model will assimilate into other cultures. Instead, this option addresses the difficulty of full assimilation. Cosmetic compliance applies to those cases where members of Culture A want to emulate the dominant model and its practices, but full assimilation is not possible, usually because they do not share the same contextual traits as mentioned previously (infrastructure may be weaker, fleets older, customer base smaller, technicians and civil servants may come from different educational backgrounds). The result is likely to be superficial adherence based on insufficient resources, incomplete understanding, and/or mis-matched tools. This option invariably fails under high-stress situations as the more fundamental logic of one's primary culture takes hold and directs behavior.

The first two options show the strength and influence of the dominant aviation model as shaped by North America and Western Europe. The majority of airlines around the world have adopted the dominant model, or tried to, hence the real and apparent similarity observed across airlines. These options support the absolute notion that "An Airline is an Airline; A pilot is a pilot" regardless of background and that therefore there is no need to address cross-cultural factors in aviation. As stated previously, the advantages of adopting the dominant model are numerous; nonetheless, there are serious safety concerns inherent in cosmetic compliance.

Skipping ahead to Option 4, *Marginalization* is the result of members of Culture A being unable to assimilate into the dominant model, yet having no substantive alternative. The differences in context and resources as so profound as to make Assimilation virtually impossible. At the same time a viable alternative is not known. Advocates of the dominant model may offer help, *but the help is nearly always based on the contextual assumptions of the dominant model*, hence the members of Culture A are back where they started, unable to use the "help." The result is regionally isolated groups with poor performance and high accident rates as currently seen in some parts of the world.

The last option to be discussed, *Integration*, offers the greatest hope for successful management of cultural interfaces and the potential threats they pose. The concern for global safety and the recognition of threats in common airspace is sufficient reason to consider the Integrationist perspective. It requires members of Culture A to be able to identify and articulate the problems they see in trying to adopt the dominant model to their local conditions, and it requires members of the dominant model to consider culturally calibrated modifications to their model. Integration is the only way to develop accurate and efficient solutions to local problems in areas that do not share the same economic and cultural features inherent in the dominant model. ICAO and other international organizations have played significant mediating roles in this respect.

Summary

The United States emerged from World War II with the economic resources and mass-production capabilities to dominate aircraft manufacturing. Western Europe followed shortly thereafter, and technological innovations in the following decades further strengthened their position as leaders in civil aviation. With large customer bases and secure infrastructures, these countries were able to research and develop safety enhancements that were quickly absorbed into an evolving dominant model. Decades of significant financial investment have sustained and developed the dominant aviation model to such a level that a serious competitive alternative seems unlikely.

Global aviation is a constant cross-cultural endeavor. However, the emergence of a strongly dominant model has meant that most cultural interfaces, certainly those involving technology, are now weighted in favor of the dominant model and its practices.

In light of this dominance, the options that promote the greatest global safety are full Assimilation into the dominant model and Integration of the dominant model with local conditions to produce efficient local solutions. Full Assimilation is possible only when the contextual factors in the receiving model are similar to those found in the dominant model. In reality, some form of cosmetic compliance is often the case. Integration offers the most hope for crafting local solutions for local problems; however, it also requires the most effort, as explained in the next section.

THE WAY FORWARD

This paper has presented the safety case for cross-cultural factors in aviation by focusing not on cultures so much as on cultural interfaces, those situations where members of one culture encounter people or artifacts from other cultures. In a global industry such as aviation, interactions at these interfaces are an every-day occurrence.

Cross-cultural issues in aviation can only be resolved with joint effort. This is not something that "they" (the other cultures) have to fix – there is a role for people on both sides of the interface, for members of the dominant model as well as people outside the dominant model.

At this time, there is almost no systematic information available about cultural interfaces. We don't know which interfaces are problematic; nor do we know the extent of successful assimilation or integration in different regions of the world. In order to move forward, two broad and interdependent strategies are proposed. The first strategy is to raise awareness of cultural interfaces and their threat-potential amongst various aviation personnel via training and analysis. This paper hopes to facilitate this awareness. The second strategy is to collect systematic data in the operating context of different regions around the world to quantify the threats posed by different cultural interfaces and to understand local adaptations to the dominant model. The specific details of each strategy are described below.

Raising Awareness: It Takes Two to Tango

Training to "See" Culture

One of the interesting things about culture is that everyone is a member of at least one culture, yet people can rarely explain their culture very clearly to others. That is because like fish unaware of the water in which they swim, people in their own culture tend to be unaware of the principles and values that guide their behavior. Historically derived, the culture is handed down from generation to generation as folk wisdom. The trainers teach the cadets, the Captains shape the First Officers, the "old guys" in the hangar teach the new guys "how things are really done around here" and so the cultural beliefs are passed on to the new members.

It is natural for people to believe that the culture in which they were socialized is the "way of the world" and that practices and beliefs are similar the world over, i.e. "the same as mine" (Ward, Bochner & Furnham, 2001). However, in today's world of global media and global travel, this ethnocentrism cannot be logically sustained. To believe that one culture is inherently superior to another is arrogance or ignorance or both (Stewart & Bennett, 1991).

Helping people move beyond their own cultural boundaries to accept other cultures without becoming defensive is something that can be addressed through training (Bennett, 1998). Being able to accept other cultures requires a person to look objectively and with some distance at their own culture. Once a person can see the strengths and shortfalls in their own culture, they can start to see the pluses and minuses in other cultures. Next, the person can then start to see how something that works in their culture may not work in another culture, *for good reason*. The final step is to be able to see how an idea or tool from one culture can be modified to make sense in another culture. This is the end goal – to see how culturally produced artifacts and procedures can be modified and adapted for other cultures.

The personnel who could benefit from such training include:

- Those who study human performance
- Those who design aviation tools and equipment
- Those who write operating manuals
- Those who train personnel from other regions
- Those who interact directly with personnel from other regions (multi-cultural cockpits, pilots and flight attendants working international flights)

Training should include a mix of culture-general theories and culture-specific practices (Landis & Bhagat, 1996). There is research that shows that people from different cultures differ in their preferred way of communicating, interacting, learning, thinking, reasoning, and problem-solving (Helmreich & Merritt, 1998; Hofstede, 2001; Nisbett, 2003; Samovar & Porter, 1998). These fundamental human processes underlie all design and training issues.

As mentioned earlier, this type of training is not just for those who want to assimilate into the dominant model. By way of example, English is the lingua franca of aviation. Does this mean that only non-native speakers of English must study and perfect their standard English usage? The answer is most definitely "No." The dominant model favors certain nationalities because of the English requirement. The challenge for these English-speakers is to remove all jargon, jokes, excess words, complex sentence constructions, and non-standard phraseology from their professional communication in order to communicate *standard* English to those from other backgrounds. The majority of Anglos are mono-linguists who have never faced the challenge of communicating in a second or third language. Anglo pilots and Anglo ATC need to appreciate the necessity for slow, short, and clearly articulated words, especially if stress or comprehension is an issue.

Analysis to "See" Culture

Whether one advocates Assimilation ("One size fits all") or Integration (Informed Local Solutions) as the best model of global air safety, the first step is the same – to analyze and explain the underlying logic and intent of the dominant model and its tools. Researchers, designers, manufacturers, and regulators need to recognize the assumptions upon which their work is based, and make the logic available for scrutiny by others. The contextual framework introduced in Section I can be used to explore the factors that shaped the thinking of those who shaped the dominant model. Even if advocates of the dominant model ethnocentrically believe that Full Assimilation is the best global solution, they are still obliged to clarify the model, its tools, and its assumptions so as to allow clear and unobstructed adherence. An example of such an analysis can be seen in the Case Study on LOSA below. Notice how the case study focuses on the cultural assumptions and beliefs that underlie LOSA; it does not address "other" cultures, it simply explains the designers' logic.

It is the obligation of aviation personnel outside the dominant model to assess the extent to which conformity with the dominant model is plausible. In order to do that, a contextual analysis similar to the one just mentioned but applied to local conditions would be necessary. These two analyses could form the basis of an Integrationist dialog aimed at identifying mis-matches in the operating environment regarding problem definition, tools, and/or customer and user-preferences.

Case Study

Cultural Assumptions Underlying Line Operations Safety Audits (LOSA)

LOSA is an aviation safety tool originally developed by the University of Texas Human Factors Research Project (see LOSA Manual, ICAO Document 9803). LOSA is endorsed by the International Federation of Airline Pilots' Associations (IFALPA), ICAO, and IATA, and has been used by airlines in the United States, Asia, Australia-Pacific, and Europe. As LOSA becomes better known, more airlines are asking what is it, and should we be using it? The following analysis should help airlines decide if LOSA is right for them. The analysis addresses three areas – how the problem was defined for which LOSA was seen as the answer, the tools that were brought to bear on the problem, and the cultural norms and preferences of the user-customers. The analysis is not presented as "proof" that LOSA should be adopted universally; on the contrary, its logic is laid bare to allow interested parties to determine if a LOSA or some modification would be a useful tool in their local environment. (Note: Many of the factors mentioned earlier regarding U.S. norms and preferences are also relevant here.)

The problem in context

Every airline asks itself, "Are we safe enough?" In many airlines, the answer was originally determined by looking at accident and incident data. Researchers studied the data, introduced new technology and other solutions to address the hypothesized deficit, assessed its effectiveness, and modified where necessary. This led to reduced accidents (and reduced accident data to analyze). Still, the public wanted less risk/more safety – a single accident could mean the demise of an airline – and seeking a competitive edge in a market-driven industry, airlines looked for more sophisticated and more proactive means of improving their safety records. The problem was how to stay ahead of the public's perception of acceptable risk, reduce costs associated with adverse events, and still make a profit.

Tools to address the problem

LOSA is the joint product of a research group located in the Psychology Department of an American University and several major American airlines. Cultural biases are therefore unavoidable. One such culturally fostered belief among the University of Texas researchers (an Anglo-Saxon group), like most American and Western European scientists, is that "Truth" is established via the scientific method – a method that proposes you can take a sub-group of the population, and by systematically observing that sub-group, you can draw inferences about the whole group. Statistical analysis of the observations allows probability-based inferences to be made. There is a belief that the scientific method has a purity and lack of bias that makes it superior to individual opinion, regardless the individual. Rigorous scientific technique ensures unbiased outcomes, i.e. greater truth. The scientific method is one way to acquire knowledge, but it carries many underlying assumptions about empiricism and objectivity; other forms of inquiry acknowledge the inevitability of subjective "truth" and include ethnographic field studies and interviews.

There is also a strong belief, supported by cultural practices that data can be confidential (in other words, not shared with inappropriate others) and anonymous (the respondent's identity is protected), and that these characteristics will further the unbiased nature of the outcome. It is very common to conduct surveys in the USA and Western Europe based on the promise of confidentiality and anonymity, so much so that respondents accept it as standard and proper practice. This faith in protection against exposure is not necessarily the case everywhere.

As psychologists, the researchers focus on human rather than machine performance, and look at antecedents and consequences of that performance. Being from an American university, the research group obviously subscribes to many American values. There is very low power distance within the group, and all ideas are welcomed from the most junior student upwards. There is a sense of time urgency and a need for constant innovation and change that propels the group to constantly evolve its research ideas and products. Pragmatism – always asking if something will work or if it will be useful – is a guiding principle that motivates the researchers to constantly test their ideas in the field with end-users An idea only has value if it can be used. The urge for activity ("doing" more than being or thinking) also motivates constant evolution and testing of tools in the field.

Ongoing funding by the Federal Aviation Administration has enabled this research evolution. The money is generated through taxes and allocated annually. That is, there is an assumption that aviation research is valuable and should be funded by the general population. This is part of a greater belief in science and technology as valid paths to a more valued future.

As part of the greater community of aviation researchers located in resource-rich, technologically enabled countries, the group has had ongoing access to new theories and ideas. The concept of error as an inevitable and healthy aspect of human behavior – first expounded in Western Europe and later exported to America – has greatly influenced the group's work. Several years of discussions, conferences, and published papers (in English) have enabled the researchers to advance their ideas in a community of like-minded scientists. The Threat and Error Management model discussed in Section II evolved out of this intellectual context.

In sum, the tools that were brought to bear on the problem included empiricism and its belief in "Truth through Data," a focus on human performance, years of research backed by stable funding and enhanced through interaction with like-minded researchers, and a time-urgent pragmatism mixed with a belief in constant improvement.

Norms and preferences of the user-customers

LOSA was developed with the help of personnel working in large Anglo-Saxon airlines. As a result, many of the features of the LOSA "solution" reflect their norms and preferences. LOSA is defined by ten operating characteristics:

(1) Jumpseat observations during normal flights
(2) Joint management/pilot association sponsorship
(3) Voluntary crew participation
(4) De-identified, confidential, and non-disciplinary data collection
(5) Targeted observation instrument
(6) Trained and calibrated observers
(7) Trusted data collection site
(8) Data cleaning roundtables
(9) Targets for enhancement
(10) Feedback results to the line pilots

An examination of these characteristics reveals several cultural assumptions and beliefs. First, there is a strong reliance on empiricism and the scientific

method (#4, 5, 6, 7, and 8 above); there is also a strong egalitarianism and sense of low power distance that places pilots, unions and management on equal footing for the purposes of #2, 3, and 10. Point # 9 presupposes that the reason for conducting LOSA is a desire to improve (not simply to get a "check"). Finally Point #1, on which all of LOSA is predicated, presupposes that pilots will allow confidential, anonymous, and objective observation of their performance. To establish this credibility with the pilots, the proposed solution requires that pilots observe pilots. They may be retired pilots, first officers, training captains, or line pilots; nonetheless the airline must be prepared to pay these people to observe others working. As such, LOSA can be an expensive tool.
LOSA was developed in response to a problem defined by airlines operating within the dominant model, and it was shaped to suit the preferences of the users, namely airlines operating within the dominant model. Other airlines will need to decide:

- If the problem as defined is relevant to them and shares the same sense of priority as other safety concerns in their local environment. Resources might be more effectively applied elsewhere in the system to improve safety, there may not be the same level of public outcry for safety, and there may not be a market-driven, competitive need for improvement.
- Whether the empirical data-driven tools brought to bear on the problem would be logical and acceptable to pilots and management in their local context, and
- If they would need to modify the tool in any way to make it more acceptable to their pilots or management.

The University of Texas researchers endorse the Integrationist approach of local solutions for local problems. As such, they invite airlines to enter into a dialog with them about how LOSA might be modified to meet their different needs.

In sum, raising awareness of cultural interfaces via training and analysis is an essential step toward recognizing and managing them. Those who shape the dominant model as well as those who try to adapt it need this awareness.

Data-Driven Research

Another way to focus attention on cultural interfaces is through data-driven research. Focusing on cultural interfaces rather than cultures allows culture to be taken out of the head and put into the operating context where it can be studied more dispassionately and with greater operational focus. Cultural interfaces deserve a place on the aviation safety research agenda.

TEM – A Methodology for Investigating Cultural Interfaces

The University of Texas Threat and Error Management model (TEM) (Helmreich, Klinect & Wilhelm, 1999) divides the operating context into environmental and airline operating threats, error, undesired aircraft states, and their respective management patterns. As discussed previously, cultural interfaces fit the definition of a threat and can be incorporated into the model. Jumpseat observations during normal operations (the LOSA methodology) will proactively identify problematic interfaces and their management. It will also identify those interfaces that are not problematic, and most importantly, it will identify successful local adaptation and integration strategies to manage problematic interfaces. Crew interviews will further the understanding of these interfaces. For example, it may become apparent from flying in certain parts of the world that certain procedures are unworkable, that communication with ATC is problematic due to accents or equipment, that constraints make some maintenance activities unviable at some stations, that navigation aids are unreliable, that weather notifications are based on outdated or incomplete data, that passengers are likely to carry hazardous materials, and so forth.

Culture and cultural interfaces, while interesting in and of themselves from an anthropological perspective, are only interesting here in how they impact safety. Thus, *tying cultural interfaces to their management in the operating context is the bottom line*. Manufacturers, legislative bodies, individual airlines, airline alliances, and cross-cultural teams of Human Factors researchers could conduct the research. “Seeing” some of the interfaces may be initially challenging due to reasons mentioned above; hence, the presence of one or more cultural mediators (see below) on the research team would be a great advantage.

Cultural Mediators: An Indispensable Component

Some people are more suited to understanding cultural interfaces than others. Of particular importance are those people who have lived and worked effectively in two or more cultures and are able to explain the practices and logic of one culture to members of another culture in a way that makes sense to both sides (Bochner, 1981). *These cultural mediators act as bridges between cultures*. Such people exist in aviation coincidentally, but more are needed. To that end, the design of programs to specifically develop more cultural mediators is proposed as a solution. These programs, in the form of internships and exchange programs, could occur within airlines, airline alliances, research institutions, civil aviation authorities, accident investigation services, and manufacturers. There are existing programs similar to those advocated here, but they are initiatives of specific organizations rather than a concentrated, industry-wide endeavor. Making cultural interfaces an explicit (not implicit), often-discussed topic would be part of these programs. Some interfaces need to be challenged, and that will only come with increased confidence and understanding on both sides. Hence, any programs, exchanges, or internships that would accelerate the number of cultural mediators in aviation would be very welcome.

SUMMARY AND CONCLUSION

Cultural interfaces will always be a part of global aviation. The challenge for safety is not to eliminate these interfaces but to manage the potential threats they pose. Systematic research of the interfaces in different regions around the world will uncover strengths and weaknesses in the global system. These successes and failures will focus future efforts to improve the interface. To move forward, there is a role for those inside and outside the dominant model.

The Role of Advocates and Insiders of the Dominant Model

- Continue to advance safety in the industry utilizing all resource-rich advantages
- Recognize that inevitable cultural boundaries surround many solutions and advances
- Recognize full assimilation into the dominant model is not always possible due to contextual differences
- Accept integration and adaptation as valid safety strategies and open the door for integration (ideas from outside the dominant culture) as a way to build a stronger global industry
- Support systematic research of cultural interfaces in different operating contexts
- Establish programs that develop cultural mediators (internships, exchange)
- Enlist cultural mediators in the development of tools, policy, and procedures
- Encourage manufacturers to work at the level of Standard Operating Procedures with their customers.
- Provide awareness training for those who operate at cultural interfaces

The Role of Cultural Groups Outside the Dominant Model

- Recognize contextual differences with the dominant model
- Acknowledge constraints in complying with external standards

- Articulate local problems and mis-matches with the dominant model
- Recognize cultural limits of some solutions advanced by the dominant model
- Encourage systematic research of cultural interfaces in the operating context
- Encourage personnel to become cultural mediators
- Develop the knowledge and confidence to challenge the dominant model
- Develop the knowledge and confidence to advance local solutions
- Provide awareness training for those who operate at cultural interfaces

As the first and greatest of all global industries, it is time for aviation to acknowledge cross-cultural factors in aviation safety. With combined effort, one of the last frontiers in aviation safety can be confronted, investigated, and managed.

NOTES

1. Anthropologists, psychologists, political scientists, and sociologists all differ in their definitions of culture. However, culture is bigger than any one discipline, and much can be learned from accepting all definitions simultaneously.
2. The SHEL concept was first developed by Professor Elwyn Edwards in 1972, with a modified diagram to illustrate the model developed by Frank Hawkins in 1975.
3. For a full discussion of LOSA, see ICAO Doc. 9803.
4. GDP statistics issued by the International Monetary Fund.

REFERENCES

Bennett, M. J. (1998). *Basic concepts of intercultural communication*. Intercultural Press.

Berry, J. W. (1990). Psychology of acculturation. In: J. Berman (Ed.), *Cross-Cultural Perspectives* (Vol. 37, pp. 201–234). Nebraska Symposia on Motivation 1989.

Bochner, S. (1981). *The mediating person: Bridges between cultures*. Boston, MA: G. K. Hall.

Hawkins, F., & Orlady, H. (1993). *Human factors in flight* (2nd ed.). Aldershot: Ashgate.

Helmreich, R. L., Klinect, J. R., & Wilhelm, J. A. (1999). Models of event, error, and response in flight operations. In: R. S. Jensen (Ed.), *Proceedings of the Tenth International Symposium on Aviation Psychology* (pp. 124–129). Columbus: Ohio State University.

Helmreich, R., & Merritt, A. (1998). *Culture at work in aviation and medicine: National, organizational and professional influences*. Brookfield, VT: Ashgate.

Hofstede, G. (2001). *Culture's consequences* (2nd ed.). Beverly Hills: Sage.

International Civil Aviation Organization (2000). *ICAO safety oversight audit manual, Doc 9735*. Montreal, Canada: Author.

Landis, D., & Bhagat, R. (1996). *Handbook of intercultural training*. Thousand Oaks, CA: Sage.

Nisbett, R. (2003). *The geography of thought: How Asians and Westerners think differently . . . and why*. New York: Free Press.

Reason, J. (1997). *Managing the risks of organizational accidents*. Aldershot: Ashgate.

Samovar, L., & Porter, R. (1998). *Intercultural communication* (5th ed.). Belmont, CA: Wadsworth.

Stewart, E., & Bennett, M. (1991). *American cultural patterns: A cross-cultural perspective*. Intercultural Press.

Ward, C., Bochner, S., & Furnham, A. (2001). *The psychology of culture shock*. London: Routledge.

Wiener, E. L., Kanki, B. G., & Helmreich, R. L. (Eds) (1993). *Cockpit resource management*. San Diego, CA: Academic Press.