

コックピットの文化

—航空会社運航乗務員のためのCRM訓練における文化的要因の及ぼす影響—

Culture in the Cockpit:

The Impact of Cultural Factors on CRM Training for Airline Flight Crews

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ABSTRACT

クルー・リソース・マネジメント (CRM) は、航空会社における訓練ツールとして重要なものであり、1990年代に米国で開発されて以来、運航乗務員の訓練のために世界中で使用されている。CRMは、無意識のうちに欧米文化に偏っているとして、これまで批判を受けて来ている。本論は、CRM開発からの歩み、および基盤となっている文化的前提を記述するものである。本論では、ホール、ホフステード、トロンペナールス、ジンにより提唱された四つの文化的モデルを用いて、それぞれのモデルがCRM訓練に与える含意を調査する。本論は、全ての国際線運航に関わるが、乗員編成が複数の国籍にまたがる運航には特に深く関係するものである。

Crew resource management (CRM) is an important airline training tool that was developed in the United States and has been used to train flight crews worldwide since the 1990s. CRM has been criticised for being implicitly biased towards Western culture. This paper describes the development of CRM and the cultural assumptions on which it is based. The paper considers four cultural models developed by Hall, Hofstede, Trompenaars and Jing, and examines the implications they present for CRM training. This study is relevant

to all international flight operations, especially those involving mixed-nationality flight crews.

1. Introduction

Awareness has grown in recent decades that many airline accidents have been at least partly caused by cultural factors (Helmreich & Merritt, 1998; Jing & Batteau, 2015). For historical reasons, cultural factors form part of crew resource management (CRM), a training tool developed in the United States but now used by airlines around the world. This paper describes the development of CRM and the cultural assumptions informing it. Culture is inherently difficult to define, but in this analysis it denotes “the norms, attitudes, values, and practices that members of a nation, organization, profession, or other group of people share” (Federal Aviation Administration, 1996, p. 117). The paper considers four cultural models that have been applied to aviation, and examines the implications they present for CRM training. The goal is greater understanding of how cultural factors affect interpersonal interactions in the cockpit. This is an area of increasing relevance, given the sustained growth of airlines in the Middle East and Asia, especially China.

2. A Brief History of CRM

2.1 The Birth of CRM

CRM is a method of training airline crews that developed in the United States at the end of the 1970s following several accidents involving American airlines. These accidents included: the 1972 crash of Eastern Air Lines Flight 401 in the Florida Everglades; the 1977 runway collision between KLM Flight 4805 and Pan Am Flight 1736 at Tenerife; and the 1978 crash of United Airlines Flight 173 near Portland. The last of these, in which the crew were so absorbed with a landing gear problem that they did not realise the fuel was

running out, is often cited as the most important trigger for the creation of CRM (Ginnett, 1993). Each of these accidents was complex and unique, but they all featured poorly functioning teams that combined overbearing captains with junior officers unable to articulate their concerns.

In 1979, NASA organized a workshop for researchers and industry representatives to discuss the concept of flight deck resource management. In the opening presentation, chairman John Lauber reviewed relevant research: interviews conducted by NASA with airline pilots; a simulator study involving flight crews from an American airline; a study of 62 airline accidents; and a study of 250 jet transport incidents (Cooper, White & Lauber, 1980). This seminal workshop addressed a very real problem, but it is important to note that most of the research focused on American flight crews. In other words, there was limited cultural diversity in the data underpinning the establishment of CRM.

2.2 The Evolution of CRM

Following the 1979 conference, CRM training was adopted by American airlines and subsequently spread worldwide. Maurino and Murray (2010) describe six generations in its evolution. One of the early developments was a name change in the 1980s from Cockpit Resource Training to Crew Resource Training in order to emphasize team dynamics and interactions with personnel outside the cockpit, such as dispatchers and air traffic controllers (ATC). In the 1990s increased emphasis was placed on cross-cultural issues in the model developed at the University of Texas, based on organisational research conducted by Geert Hofstede. More recently, the latest manifestations of CRM have an explicit focus on managing threats and errors.

There have been many changes to CRM over the

last four decades, but the fundamental goal remains the same: to train crews in techniques that enable them to work as effective teams and avoid problematic behaviour patterns identified by accident research. Modern CRM programs typically cover the following skill areas: (a) communication/interpersonal skills; (b) situation awareness; (c) problem-solving/decision-making/judgement; (d) leadership/followership; (e) stress management; and (f) critique (Civil Aviation Authority, 2002). In addition to its use in aviation, CRM training has now spread to a number of other high reliability industries such as healthcare, firefighting services, nuclear power generation, maritime and rail transport, and the offshore oil and gas industries (Flin, O'Connor & Crichton, 2008; Harris, 2014).

2.3 Limitations of CRM

In terms of its longevity and worldwide usage, CRM has undoubtedly been a success. However, two extensive reviews of studies that evaluated CRM training were unable to determine whether there was any impact on organizational safety (Salas, Burke, Bowers & Wilson, 2001; Salas, Wilson, Burke & Wightman, 2006). Proponents of CRM point to cases when lives were saved, most notably the 1989 crash landing of United Airlines Flight 232 at Sioux City. This aircraft's crew made a remarkable landing despite losing all flight control surfaces, with the captain later observing they would not have survived without the use of CRM techniques (Haynes, 1991).

Notwithstanding the successes, a number of limitations of CRM have been identified over the years. Criticism has included the following: early programs relied on organisational training activities with little relevance to airline operations (Helmreich & Merritt, 1998); as team dynamics became more prominent, CRM was labelled "a form of 'New Age' brainwashing aimed at achieving group harmony" (Helmreich & Merritt,

1998, p. 146); the integration of CRM techniques with technical flying skill training led to increased proceduralization, reducing the focus on leadership and team building skills (Helmreich, Wilhelm, Klinect & Merritt, 2001); and the expanded range of program content obfuscated the overall goals (Helmreich & Merritt, 1998).

A further persistent criticism is that CRM is implicitly biased towards Western culture (Hisam & Hampton, 1996; Engle, 2000). In the 1980s, there was a common belief that CRM could, with minor changes, be adapted for use by any airline in the world, but this view of "culture-free CRM" has now been discredited (Maurino & Murray, 2010). Problems associated with implementing CRM in other countries, such as the translation of specialized vocabulary and the use of feedback questionnaires on personality or working styles, were highlighted by Johnston (1993). He cautioned that the underlying causes of aviation accidents may vary by region, and that detailed research was required before CRM was applied worldwide.

Criticism continues to this day. Analysing survey data from Taiwan and accidents involving Asian airlines, Jing and Batteau (2015) concluded that CRM is underpinned by cultural values alien to Chinese society, and moreover these differences are compounded by the increasing technological complexity of modern airliners. With such comments in mind, this paper examines four cultural models and the implications they pose for CRM training.

3. Four Cultural Models

3.1 Hall's Hidden Culture

In a career spanning most of the twentieth century, the anthropologist Edward T. Hall identified numerous ways in which culture informs human behaviour. He noted that people remain largely unaware of this "hidden culture" because it

operates below the level of consciousness. Discussing the relevance of Hall's research to CRM training, Hisam and Hampton (1996) provided examples of how pilots from various countries act differently. American pilots, for example, soon start addressing each other using first names whereas Europeans tend to remain more formal. The following paragraphs describe specific implications for CRM arising from three of Hall's concepts.

3.1.1 High-Context and Low-Context Communications

Hall (1976) contrasted high-context cultures, for example Japan, where relationships are deep and information is shared using messages that are simple but rich in meaning, with low-context cultures, such as America, where people are not bonded so tightly and there is less distinction between insiders and outsiders. He cautioned that meetings between the two cultures could present problems. Hall applied these concepts to communication, stating that high-context communications are fast and efficient because pre-programmed information is in the receiver and setting, with minimal information in the transmitted message. By contrast, low-context communications encode most of the information in the message, with a minimal amount in the internal or external context.

The concept of a high- or low-context *culture* is problematic because Hall stated that, at least within France and Japan, a given *person* may have both high- and low-context aspects depending on the situation. Scollon, Scollon and Jones (2012) resolved this dilemma by proposing that the concept be applied not to entire national groups, but instead to particular speech events or situations. Consider, for instance, radio communications between pilots and ATC. These communications employ standard phraseology, a set of pre-fabricated phrases for typical flight situations. Considerable time must be spent training personnel

to use this system, but the payoff is high-context communications, enabling the quick and efficient exchange of information.

It may be hypothesized that people who favour low-context communications require more extensive programming to use standard phraseology effectively. There is some evidence, albeit limited, to support this idea. In an analysis of a radio exchange reported by Kim and Elder (2009, p. 23.11), experienced Korean pilots and controllers described an American pilot's "verbosity and inappropriate word choice... when phraseology would have sufficed" as "typical of native English-speaking aviation personnel".

3.1.2 Monochronic and Polychronic Views of Time

A second cultural scale described by Hall (1983) differentiated between monochronic people, who like to do one thing at a time, and polychronic people, who prefer doing several different activities at once. Hall again noted that interactions between the two categories may be problematic, with monochronic people liable to be disorientated when confronted by polychronic behaviour. This has implications for flight crew composition: for example, a monochronic American captain and a polychronic Latin American first officer may approach the same set of tasks differently. In the context of international business, Hall (1969) suggested that office design could ameliorate such problems, but at present this is not an option for pilots operating in confined airliner cockpits.

Hisam and Hampton (1996) noted that monochronic people are vulnerable to interruptions. In airline operations it is commonplace for disturbances – such as unexpected calls from cabin crew or ATC – to put task completion at risk. Citing dozens of incidents in which American crews experienced disturbances, Loukopoulos, Dismukes and Barshi (2009) stressed the importance of CRM techniques for managing workload effectively.

Techniques for dealing with interruptions would appear to be especially important for monochronic personnel, but there is no research evidence to support this. Instruments for measuring polychronicity have, however, been developed and applied to other organizational contexts (Bluedorn, 2002).

3.1.3 Action Chains

The action chain is a sequence of actions that two or more individuals carry out in order to complete a task. Action chains play a vital role in the cockpit both in the formulaic exchanges between pilots and ATC, and also in the form of standard operating procedures (SOPs), or written descriptions of tasks for each flight phase. Hall (1976) noted that monochronic people tend to focus on completing tasks, while polychronic people place more emphasis on maintaining good human relations. Misunderstandings may occur when monochronic and polychronic people work together on the same action chain.

The 1990 crash of Avianca Flight 052 near New York provides an illustration of such a misunderstanding. Shortly before the crash, one of the Columbian flight crew commented that an American air traffic controller was *angry*. In an analysis of the accident, Helmreich (1994) interpreted this comment to indicate a failure to focus on the task of safely landing the plane. However, a polychronic interpretation suggests that the crew member was expressing concern with the human relations involved in the situation, rather than a lack of concern with the task of landing. CRM training in interpersonal skills should at the very least raise awareness of these different cultural perspectives.

3.2 Hofstede's Cultural Dimensions

The social psychologist Geert Hofstede (1980; 1983) investigated differences in national culture in a research programme that started in the 1960s.

Applying factor analysis to data aggregated from surveys of 88,000 workers in 66 countries, four cultural dimensions were identified and numerical values calculated for each country on each dimension. With easy-to-comprehend national scores, seemingly validated by the huge amount of input data, Hofstede's work has been influential in many fields including aviation. Indeed, it has been described as the third leg of the "three-legged stool upon which broad, systematic-oriented aviation safety and efficiency endeavors rest" (Helmreich & Merritt, 1998, p. xvii).

3.2.1 Application of Hofstede's Model to Aviation

Using test items and methodology adapted from Hofstede, University of Texas researchers conducted surveys of airline crew attitudes in over 20 countries. They found a strong correlation with Hofstede's results for the dimensions of power distance and individualism-collectivism, with a weaker correlation for uncertainty avoidance (Helmreich et al., 2001). This research fed directly into fourth-generation CRM programs in the 1990s. Helmreich (1994) used Hofstede's cultural dimensions to analyse the actions of the Columbian flight crew in the aforementioned crash of Avianca 052. Since Columbia scores highly in power distance – the extent to which less powerful members of organisations accept unequal power distribution – he posited that the first officer and flight engineer were reluctant to suggest alternative courses of action to the captain. Columbia is also strongly collectivist, with people defining themselves through social groups rather than as individuals, which may have made the flight crew reluctant to declare an emergency and push themselves ahead of other crews they perceived to be in a similar situation. In addition, Columbia scores highly in uncertainty avoidance, and therefore the crew, instead of facing the ambiguity of discussing possible alternate airports, may have

preferred to simply follow the initial flight plan.

Hofstede's model appears to be of particular value in making sense of accidents featuring junior officers unable to voice concerns to experienced captains, such as the Avianca 052 crash or the accidents that led to the inception of CRM. It should be noted, though, that cockpit operations typically involve dyadic or triadic interactions, whereas Hofstede's research was based on large-scale surveys. As Hofstede (1994, p. 16) himself observed, claims made about national cultural characteristics are "common trends, but individuals may differ from them".

3.2.2 Limitations of Hofstede's Model

The limitations of Hofstede's research have been widely documented. McSweeney (2002) challenged several underlying assumptions, such as the use of limited sets of survey respondents to represent national populations, and the identification of cultural dimensions through analysis of questionnaire responses. Analysing the political subtext of Hofstede's methodology, Ailon (2008) cautioned against an uncritical application of the dimensions to other cultures. In a study of multicultural work teams, Aritz and Walker (2010) raised several questions: whether Hofstede's data may be reliably applied to countries not included in the initial surveys (such as China); whether the data are applicable to other workforces or national populations, given that the survey participants were sales managers and engineers; and what insights the dimensions offer to everyday intercultural interactions, such as team decision-making.

Within aviation, Hofstede's model was criticised by Hutchins, Holder and Pérez (2002) on numerous counts, including: the absence of data regarding intra-country variability in the dimensions; the methodology used to determine the probes; the problem of translation effects in cross-cultural surveys; and the fundamental issue of how survey

responses relate to cockpit operations. Hofstede responded to some of the criticism with further surveys that included East Asian participants, and with investigations of organisational culture and cultural differences within a single country. Two new cultural dimensions were identified, but the underlying methodology remains unchanged (Hofstede, Hofstede & Minkov, 2010).

3.3 Trompenaars' Waves of Culture

During the 1980s and 1990s the management consultant Fons Trompenaars conducted large-scale surveys of cultural diversity in companies operating in 50 countries. From this data he developed a model with seven cultural dimensions describing relationships with people, time and the environment (Trompenaars & Hampden-Turner, 1997). This model has not been incorporated into CRM programs, although it has been used in a correlational study of airline accident rates and attitudes to authority (Jing, Lu & Peng, 2001).

Trompenaars' use of survey data to identify cultural differences is open to similar criticisms to those levelled at Hofstede's work, but a point of difference is that Trompenaars draws on intercultural business anecdotes to contextualize the dimensions in interpersonal interactions. However, Trompenaars' cultural dimensions are not conceptually distinct, and Hofstede (1996) claimed that only two could be confirmed statistically. There is also some overlap with other cultural models, with, for example, Trompenaars' specific-diffuse dimension corresponding closely to Hall's concept of high-context and low-context. The following paragraphs discuss implications of two of the dimensions for CRM.

3.3.1 Individualism-Communitarianism

Trompenaars' individualism-communitarianism is similar to Hofstede's individualism-collectivism, with both measuring the extent to which people regard themselves as individuals or part of a group.

To illustrate national differences in this dimension, Trompenaars and Hampden-Turner (1997, pp. 64-65) described a “critical incident” in a factory owned by an American multinational where a Japanese worker made a “serious error” causing the loss of a production batch. After the work group accepted responsibility, the factory director – to the amazement of a Western investigator – did not try to identify or punish the errant worker because in Japanese culture the shame of letting the group down was punishment enough.

Reluctance of individuals in communitarian cultures to openly accept responsibility for errors may impact on two aspects of the error management training that forms an important part of modern CRM programmes. Firstly, inside the cockpit individual crew members are trained to assertively communicate problems, including errors (CAA 2002). Secondly, inside an organisation it is essential for employees to report errors as part of an effective “safety culture” (Helmreich & Merritt, 1998). It is clear that attitudes to error vary significantly, which may necessitate different CRM solutions for different cultures.

3.3.2 Achievement-Ascription

In achievement cultures, such as the United States, people are accorded status based on how they perform work and their recent accomplishments. By contrast, in ascription cultures, such as Japan or China, status is accorded based on age, kinship, gender, connections and educational record. Status is thus perceived very differently in different cultures, and this may affect leadership and communication in the cockpit.

Status is integral to a person’s authority. One of the assumptions of CRM leadership training is that captains can learn how to establish an appropriate level of authority. Ginnett (1993) described three techniques used by effective captains: establish competence in the pre-flight briefing; disavow

perfection in order to allow other crew members to take responsibility; and engage the crew during the briefing and group formation process. These techniques, based on NASA research with American flight crews, may prove effective in achievement cultures but less so in ascription cultures where status is not related to work performance.

If a large difference exists between the status of the captain and junior officers, then a steep authority gradient may result. This can create a barrier to communication, and has been identified as a causal factor in several accidents including the previously mentioned 1977 collision at Tenerife. CRM programmes teach polite assertiveness techniques to help junior officers overcome this problem, but these may not be effective in ascription cultures where status derives from intrinsic characteristics such as age and gender.

3.4 Jing’s Dragon

In the 1990s, using a modified version of a questionnaire developed by Helmreich, Professor Hung-Sying Jing surveyed approximately 1,000 pilots and managers at airlines in Taiwan, including a significant number of foreign pilots. The results highlighted differences between Chinese and foreign pilots in attitudes to interpersonal relations and authority (Jing & Batteau, 2015). Believing these differences could not be adequately explained by uni-dimensional concepts such as power distance, Jing developed a model to describe interpersonal relations and authority in Chinese culture.

3.4.1 Differentiated Order Model

Drawing on research by the scholar Fei Xiao-Tung, Jing outlined a differentiated order model to describe how the Chinese categorize people around them. This model has four levels of intimacy: kin, acquaintance, fellow and alien. According to the

model, Chinese pilots consider that: close family are kin; other Chinese pilots are acquaintances; other Chinese workers in the same company are fellows; and foreign workers in the same company are aliens. Jing and Batteau (2015) stressed that the structure is not fixed and individuals can change level, for example by marrying into a family or having a serious falling out. To this model of interpersonal relations, Jing added a description of the Chinese concept of authoritarianism, which is dominated by the father-son relationship and which for several thousand years has been symbolised by the dragon.

3.4.2 Implications of Jing's Model for Aviation

Jing has used the differentiated order model to analyse accidents involving Asian airlines, such as the 1995 crash of a TransAsia Airways ATR72 aircraft in Taiwan. Immediately before the crash, the captain was talking to a cabin attendant in the cockpit, which distracted him from monitoring the aircraft's status and disrupted communications with ATC. Jing and Batteau (2015, p. 30) suggested that the captain regarded the cabin attendant as an acquaintance but considered the air traffic controller to be a stranger, adding that "Every Chinese person would be inclined by instinct to attend to a friend first, not the stranger". Western pilots may consider such behaviour a blatant dereliction of duty, but Jing's work highlights the impact cultural factors can have on cockpit interactions. Interestingly, it also echoes Hall's description of the way that polychronic people favour personal relations.

This accident was curious in several regards: it occurred on New Year's Eve; the plane was carrying no passengers; and the captain was actually *junior* to the first officer in terms of their previous air force service. With regard to training, it emphasizes the importance – even under unusual circumstances – of adhering to rules, such as the sterile cockpit rule, which prohibits non-essential speech when flying

below 10,000 feet. As Hisam and Hampton (1996) noted, different cultures have differing interpretations of a sterile cockpit, so CRM training should be tailored accordingly.

Finally, regarding cockpit procedures, Jing and Batteau (2015) observed that Chinese pilots are conditioned by the non-linear ideographic Chinese language and therefore have difficulty following sequential SOPs. Jing and Batteau see this as one manifestation of a systematic problem whereby Chinese pilots are not culturally programmed to use either commercial aircraft or an air transport system largely designed by Westerners.

4. Conclusion

CRM training has proved enduring and successful, but its validity outside of Western cultures has been questioned. Elements of Hostede's cultural model have been incorporated into CRM, and clearly have value for training Western pilots and analysing certain types of accident. However, both the model and its applicability to aviation have been criticised. The three other cultural models examined in this paper have not been incorporated into CRM. Each offers valuable insights into national characteristics, especially regarding differences between Americans and East Asians. There have been repeated calls for the development of different versions of CRM for different regions of the world, "culturally calibrated" to the needs of target participants (Hisam & Hampton, 1996; Helmreich & Merritt, 1998; Maurino & Murray, 2010). Elements of each of these models could be incorporated into a modular CRM package.

There are two broad areas for future research. Firstly, the studies presented at the 1979 workshop that launched CRM were extensive, but were largely limited to American crews and are now dated. There is a pressing need for a similar research effort covering all major regions of the

world that focuses on accidents involving cultural factors. This should incorporate ethnographic research including interviews and observations of flights and training (Hutchins et al., 2002). Secondly, several similarities between elements of the four models have been noted, which hints at the possibility of ultimately constructing a unified cultural model. This will require considerable further research into differences in national, regional, organizational and professional cultures.

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