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CRITICAL INCIDENTS

Where safety culture meets national culture: the how and why of the China Airlines CI-611 accident

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There has been a great deal of research regarding the relationship between national culture and aviation safety (e.g. Braithwaite, 2001; Helmreich and Merritt, 1998; Jing, Lu and Peng, 2001; Lund and Aaro, 2004; Merritt and Maurino, 2004; Patankar, 2003; Rose, 2004). Soeters and Boer (2000) suggested that safety was enhanced when national culture was more individualistic in nature. They also noted that the greater the degree of collectivism in the culture of a country, the greater the pre-disposition towards regulation and the greater the degree of 'power distance' (Hofstede, 2001) which led to an increased likelihood of accidents. Helmreich and Merritt (1998) proposed that culture fashions a complex framework of national, organisational and professional attitudes and values within which groups and individuals function. The power of culture often goes unrecognised since it represents 'the way we do things here'. In a similar vein to national culture, Reason (1997) defined corporate culture as '*...the set of unwritten rules that govern acceptable behaviour within and outside the organisation. It emanates from the strategic apex of the company and colours all of its activities*'. Pidgeon and O'Leary (1994) suggested that a good safety culture's concern for safety is distributed and endorsed throughout the organisation. Maurino (1992) wrote '*... the design and corporate culture of an organization exert powerful influence on how safely it functions. Pilots, controllers, and other operational personnel do not act in a vacuum – instead they*

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mirror the policies and practices of the organizations to which they belong.' (Cited in Braithwaite, 2001).

Morley and Harris (2006) developed an open system model of safety culture – the Ripple Model (see figure 1). This model identified three threads running throughout the personnel within (and without) an organisation, irrespective of their level and role. These were labelled '*Concerns*', '*Influences*' and '*Actions*' and were evident in line personnel; middle management; senior management; the industry regulator; government and society as a whole. *Concerns* were associated with threats to the needs of the individual and worries about meeting the requirements placed on them by others. *Influences* were concerned with the factors that dictated the methods by which safety needs could be accomplished. *Actions* described the behaviours that directly impacted upon safety, in either a positive or negative manner. In this model the authors argued that elements outside an organization have a profound effect on safety culture. The boundaries for the conceptualisation of safety culture must be extended beyond the organisation if a comprehensive model of the evolution of safety culture is to be developed.

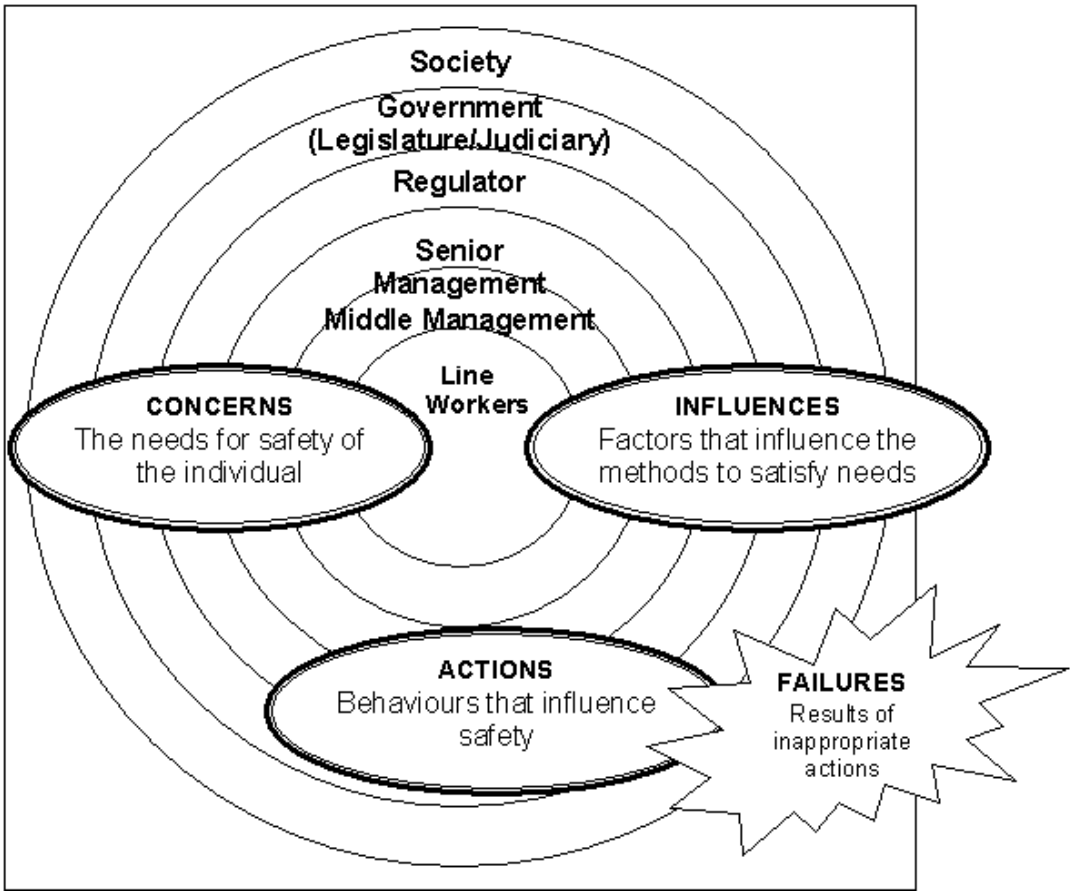


Figure 1 Layers of influence and categories comprising the Ripple Model of safety culture (Morley and Harris, 2006).

There is an argument against the concept that safety culture is distinct to organisational culture. The safety culture of an organisation is one of many cultures to which a worker will simultaneously belong. Authors such as Merritt and Helmreich (1995) and Glendon and Stanton (2000) propose that safety culture is a sub-culture of organisational culture, which is itself a sub-culture of the industry culture, which in turn is a sub-culture of national culture (cf. Hofstede's conceptualisation of culture). If attempts to separate safety culture from organisational culture are difficult enough trying to fully separate these entities from national culture is almost impossible.

The manner in which the various layers and dimensions of safety culture operates can be illustrated with reference to accident case studies. In this case, the accident in question is that involving China Airlines (CAL) flight CI-611.

Summary of China Airlines CI-611 accident

On May 25 2002, 15:29 Taipei local time China Airlines (CAL) Flight CI611, a Boeing 747-200 crashed into the Taiwan Strait approximately 23 nautical miles northeast of Makung, Penghu Islands of Taiwan, Republic of China (ROC). Radar data indicated that the aircraft experienced an in-flight breakup at an altitude of 34,900 feet, before reached its cruising altitude of 35,000 feet. The aircraft was on a scheduled passenger flight from Chiang Kai-Shek (CKS) International Airport, Taipei, Taiwan, ROC to Chek Lap Kok International Airport, Hong Kong, China. One hundred and seventy-five of the 225 occupants on board the CI611 flight, which included 206 passengers and 19 crewmembers, sustained fatal injuries; the remainders are missing and presumed killed

In February 7 1980, the accident aircraft suffered a tail strike occurrence in Hong Kong. The aircraft was ferried back to Taiwan on the same day un-pressurized and a temporary repair was conducted the day after. A permanent repair was conducted on May 23 through 26, 1980. The permanent repair of the tail strike was not accomplished in accordance with the Boeing SRM [Structural Repair Manual]*, in that the area of damaged skin in Section 46 was not removed (trimmed) and the repair doubler did not extend sufficiently beyond the entire damaged area to restore the structural strength. According to maintenance records, starting from November 1997, B-18255 had a total of 29 CPCP* [Corrosion Prevention and Control Program] *inspection items that were not accomplished in accordance with the CAL AMP* [Aircraft Maintenance Program] *and the Boeing 747 Aging Airplane Corrosion Prevention & Control Program. The aircraft had been operated with unresolved safety deficiencies from November 1997 onward. The CPCP scheduling deficiencies in the CAL maintenance inspection practices were not identified by the CAA audits.* (Aviation Safety Council Report AOR-05-02-001)

Table 1 contains an analysis of the China Airlines CI-611 in-flight breakup accident within the framework provided by the Ripple Model. It provides a summary of the actions, influences and concerns described at the various levels in the model. The arrows between the elements are intended only to demonstrate the complexity of the interactions taking place between elements of the system in the lead up to the accident. They do not necessarily imply causality and do not represent an exhaustive list of the factors which were instrumental in bringing about the accident. The numbers in parentheses in the following sub-sections indicate the section numbers of the accident report (Aviation Safety Council Report AOR-05-02-001) which supports the observation.

Line personnel at China Airlines

Concerns The actions taken to keep the aircraft flying despite numerous maintenance deferrals can be related to line personnel's concerns to accomplish the job in time. It is suggested that this was a direct product of the CAL organizational culture.

Influences The China Airlines case illustrates some of the influences such as the desire to keep the aircraft flying coupled with a lack of experience with permanent repair. Line personnel were highly motivated to keep the aircraft flying and took the steps necessary to do this. However, some of the risks this regard were attributable to a lack of skill and knowledge on the part of line personnel and a lack of equipment and resources (2.3.3).

Actions The inquiry identified numerous active failures at the line level which contributed to the accident including failure to follow the SRM (Structural Repair Manual) for repairing of the tail strike 22 years prior to the accident (2.3.1.1); a failure to detect structural defects (1.6.4.4), and poor cleanliness of the bilge area (1.6.8) which hindered inspection.

Middle management at China Airlines

Concerns China Airlines prior to the accident had undergone a considerable organizational restructure. The concern in this case was to support and achieve flight operational objectives (1.17.1.1).

Influences Middle management at CAL were inexperienced with the self-auditing system and its required documentation (2.4.4.3) and there was a lack of communication between MOC (Maintenance Operation Center) and MPS (Maintenance Planning Section) (2.4.4.1) in the airline.

Table 1 The Ripple Model applied to CAL CI-611 accident

	Concerns	Influences	Actions
Society	The safety of air transport Cheap flights	High power-distance culture; high uncertainty avoidance	Avoid conflict and confrontation (where possible)
Government	Concerned to make everybody happy (both airlines and society) Concerned about promoting economics growth and improving aviation safety	Need to balance conflict between the airlines and CAA (safety; profit and regulation versus economic and tourism growth) Not a member of ICAO	Oversight of the fact that the regulator had been ineffective in dealing with CAL for a long period
Regulator	Successful implementation of government 'open sky' policy	Problems accessing update information for safety operation Increased regulatory load resulting from the government's 'open sky' policy	Failure to identify CPCP scheduling deficiencies of CAL Inadequate supervision of CAL since 1997 No specific audit system and failing to provide both flight safety inspection training and handbook for inspectors
Senior Mgt.	Concerned with benefits and profits of the organization and its shareholders	Overly focussed on the economic environment	Aircraft operated with unresolved safety deficiencies since 1997 Communication problems between CAL and Boeing FSR Inadequate supervision of CPCP
Middle Mgt.	Achieving operational objectives Well-being	Lack of communication between MOC and MPS A tendency to focus on the job at hand while neglecting to document maintenance activities	Failure to inspect 29 CPCP items from Nov. 1997 No (or incomplete) maintenance records before the accident Failure to provide adequate lighting and equipment for structural inspections
Line	To accomplish the job on time and a desire to keep the aircraft flying	A lack of experience with permanent repair Poor lighting and equipment for structural inspections	Failure to detect structural defects Failure to follow SRM for repairing of the tail strike 22 years prior to the accident (1980) Bilge area was not clean

Actions Some of the actions which contribute to the development of a positive safety culture at the middle management level were lacking at CAL. For example, little effort was expended by CAL middle management to ensure safety inspections took place. There was a failure to inspect 29 CPCP items since 1997 (2.4.4.2). There was little coaching of safe behaviour to line personnel and failures to provide adequate lighting (2.4.1.1.2) and magnifying glasses (2.4.1.1.3) for inspections.

Senior management at China Airlines

Concerns CAL had a 'flight safety enhancement' project between 1995 and 1999 (1.17.1.1). However, as a result of the influence of increased competition, the commercial imperative was probably becoming the prime concern of senior management at CAL. As one of the roles of senior management is to ensure that the organization continues to exist, the primary concern facing senior management during this period would appear to have been the viability and survival of the airline.

Influences The economic environment in aviation was becoming very competitive as a result of the government's 'open sky' policy (1.17.3.1). There were lots of new airlines joining the aviation market

Actions The development of a safety culture is largely a top down process. The communication of an organizational mission which includes safety, organizing work operations to achieve that mission and striving for continuous improvement in terms of safety are key actions of senior management to create a safety culture. A lack of such actions on the part of senior management at CAL has already been identified. Aircraft had operated with safety deficiencies since 1997 (2.4.4.2). There were also communication problems between CAL and Boeing Field Service Representatives – FSR (2.3.2) and inadequate supervision of middle management (2.4.4.3).

The Regulator

Concerns The 'open sky policy' had considerably increased the workload of the ROC CAA. To cope with the flourishing aviation industry, another amendment for the organizational rules of CAA was drafted in 1998 (1.17.3.1).

Influences The regulatory authority at the time had no specific audit system (1.17.3.6). The ROC is not an ICAO contracting state, therefore there was no official approach for assessing and updating safety information and the ICAO did not evaluate the safety of flight operations administered by the ROC CAA (1.17.3.7).

Actions The ROC CAA was criticised in the report of the commission for failing to provide flight safety inspection training, a handbook for inspectors (1.17.3.6) and for failing to properly scrutinise the operations of CAL (2.4.5).

The Government

Concerns The primary concern of the government was to making everybody happy by ensuring the stability of the government itself through the promotion of economic growth and fostering a positive image of aviation safety.

Influences The government of the day needed to balance the conflict between the airlines and CAA. The issues facing the ROC government included promoting the 'open sky policy' to encourage economic development; encourage competition among the airlines to reduce the cost of air travel to the passenger while at the same time demanding a greater degree of aviation safety.

Actions The most significant actions of the government in shaping the safety culture operating at CAL were as a result of an earlier major accident in 1998. The introduction of a re-structuring programme at CAL led to the governmental oversight of the fact that regulator was ineffective in dealing with CAL for a long period of time.

Society

It is at the societal level where the influence of national culture on safety culture is perhaps most obvious. Safety culture is merely a sub-set of national culture, and national cultural characteristics are all pervasive throughout all levels in the 'Ripple Model'. However, it is on the dimension of *influences* where national culture meets corporate and safety culture. It is suggested that there is an almost universal desire in society for the safety of air transport and for cheap flights (*concerns*), however, it is on the dimension of *influences* (and hence indirectly safety *actions*) that national culture plays its part. National culture provides a fundamental basis for a group member's behaviour, social roles and cognitive processes and it also provides the underlying rules concerning safety and communication Taiwan can be characterised as a culture which has a high power distance, is collectivist in nature, feminine and exhibits high uncertainty avoidance (Hofstede, 2001). Soeters and Boer (2000) have identified such national cultures as having a poor safety record but mere description and categorisation alone has little (or no) explanatory power in describing *why* these cultures appear to be more accident prone.

According to Hofstede's classification, the Taiwanese culture is predisposed toward organisations with tall, centralised decision structures and which have a large proportion of supervisory personnel. In these cultures subordinates expect to be told what to do. However, members of these high power distance cultures frequently experience role ambiguity and overload. Group decisions are preferred but information is constrained and controlled by the hierarchy and there is resistance to change. Members of society in high power distance countries are also unlikely to speak out when their opinions may contradict those of their

superiors. Confrontation is generally avoided. Low power distance and high individualism promotes greater autonomy of action at the lower levels of an organisation. The Taiwanese culture on the other hand, which is less reactive as a result of its preferred organizational structures that discourage autonomy, is also resistant to change. Uncertainty avoidance reflects how the members of a society perceive the potential threat posed by uncertain situations and the extent to which they subsequently try to avoid these situations by means of regulation and/or bureaucratic sanction. Taiwan is a strong uncertainty avoidance culture. Organisations tend to demonstrate a great deal of hierarchical control with a highly formalized concept of management. The power of superiors depends upon the control of uncertainties.

These cultural aspects are evident in the *influences* and subsequent *actions* outlined in table 1. There are many layers of management but little action in terms of auditing and oversight which may have resulted in conflict. There is a great deal of concern to satisfy the requirements of the government, shareholders or the objectives of senior management even when resources and equipment were inadequate. It is noticeable from this analysis that the *actions* of entities outside China Airlines and the companies Senior Management had a direct impact to the actions of personnel closer to the operation itself (middle management and line personnel).

It is suggested that the study of safety culture within an organisation is meaningless without reference to the wider context. The inter-relationship between *concerns, influences* and subsequent *actions* needs to be understood. A high level of *concern* for safety coupled with the appropriate *influences* promoting safety (particularly at higher levels of management and governmental levels) should lead to appropriate and effective *actions*. However, these latter factors are as much a product of national culture as they are of safety culture. A government responds to society's *influence*, *concerns* and even *actions* not directly, but through the actions of a regulator. The regulator's requirements are translated into actions by several layers of management. At each level of management and society the *actions* and *influences* at work differ. However, these *actions* can only be interpreted in light of the less overt *influences* and *concerns* that drive them, such as that of national culture, hence the requirements for an 'open systems' based approach to the study of safety culture.

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