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**Improve CRM and Advocate “One Ballot Veto”**

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Accident investigations showed that most accidents are caused by the flight crew. But in many cases, if the captain can listen to first officer or the observer suggestion, such as "go-around", for safety reasons at the key phase of final approach, many flying accidents/incidents can be avoided. Unfortunately, the captain sometimes would still choose to continue the final approach due to over-confidence, then leading to disastrous consequences in the end. CRM (Crew Resource Management) endeavored to reduced the crew human errors and improve the safety level all the while, but there is no effective way to eliminate this kinds of problems at yet. In this paper, this kind of problems is deeply analyzed from some areas, such as the crew attitude, cultural characteristics, operation standards and regulations, etc. And recommended CAA to improve CRM by advocating the ‘One Ballot Veto’ system—at the key phase of take off and approach, once someone argue against the current operation for the safety reason, the captain must hear the suggestions and take the operation which are more benefit to the safety at once), so that reduce these problems.

The worst disaster in airline history occurred in Tenerife on March 27th, 1977 when a captain of a KLM 747 insisted on commencing a takeoff without clearance in a heavy fog even with the knowledge that a Pan Am 747 taxiing down the runway and had not yet reported clear of the runway. The first officer on KLM 747 had some doubts on whether the take-off clearance had been received and tried to convey his concerns to the captain, but the captain ignored his advice and pushed the power up without any hesitation which caused two Boeing 747 jumbo jets collided on the runway and 583 people were killed[1]. Another instance was a Air China 767 crashed in Pusan, South Korean on 15 April, 2002. During the final approach, the F/O’s advisory on immediate go around was not disregarded by the captain and hence the best opportunity to avoid flying into the terrain was missed[2]. Similar situation are very common among different incidents and accidents occurred in the world.

What caused the captain rejecting safety recommendation from the other crew member and missed the last opportunity to break accident chain and eventually avoid the disaster? Why shouldn’t we take some measures to stop such tragedy? On the basis of analysis on some problems existed in CRM, a new concept—“one ballot veto” is proposed as well as some solutions are discussed in this paper.

**CRM Status**

The target of CRM is to achieve the highest level of efficiency and safety by making use of all available resources effectively. Since the conception of CRM was put forward in 1979, it has been developed and perfected all the way along to its fifth stage—“Threat and Error Management (TEM)”. Statistics shows it plays an important role in enhance flight safety and efficiency[3,4].

However, the following table (see Table 1) indicates that there are total amount of 323 fatal accidents happened world widely in last ten years together with a death toll of 8646, besides no remarkable decrease in the number of the accidents. Moreover, many investigation reports demonstrate more than 70% of the accidents are caused by human factors i.e. fatigue, decision mistake or ignoring automatic system warning, etc[5]. Therefore, to improve CRM, some problems need to be studied further.
Table 1 Statistical Summary on Worldwide Fatal Accidents 1998-2007

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</thead>
<tbody>
<tr>
<td>Number of accidents</td>
<td>26</td>
<td>27</td>
<td>35</td>
<td>28</td>
<td>25</td>
<td>37</td>
<td>28</td>
<td>36</td>
<td>42</td>
<td>39</td>
<td>323</td>
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<tr>
<td>Death toll</td>
<td>750</td>
<td>888</td>
<td>1059</td>
<td>429</td>
<td>679</td>
<td>1101</td>
<td>768</td>
<td>1082</td>
<td>671</td>
<td>1219</td>
<td>8646</td>
</tr>
</tbody>
</table>

**Note:** 1) Data in the above table is from ASN; 2) Aircraft refer to multi-engine commercial airplanes with 14-seating or above.

Among them, the problems related to CRM in the two accidents mentioned before is a kind of severe and unsolved one. One common feature involved in this type of accidents (or incidents) is that, during the critical point in approach and landing (or take-off), to deal with the abnormal situation appeared, one of the crew members (or ATC controller, GPWS system) propose some safety advice or alert (e.g. request for attention to altitude, go-around or take-off abortion etc), which are unfortunately discarded by the captain, who due to CRM defect keep on the wrong side of aircraft control or safety operation, missed the last chance to survive the mistake chain and consequently lead the disaster.

According to Boeing company\(^5\) (see Figure 1), most of the accidents are occurred at take-off and approaching to land. The number of the accidents happened during these two phases amounts 51% of the total, in contrast to the duration of the phases is only 6% of the total flight time. It is easily found that any CRM problem occurred during takeoff and landing are likely threaten flight safety seriously and resulted in fatal disaster. On the basis of accident chain theory, any interruption in the chain connection could prevent the accident from happening. As far as the accident or incident discussed in this paper, the final decision made by the captain is the last minute to interrupt the chain, but if the captain still persist in his fault even after the other member suggesting to go-around or abort take-off or warning triggered by onboard instruments, it is impossible to avoid the accident. As a result, how to solve such kind of problem by means of develop CRM is of great importance to strengthen global air transportation safety. In fact, it has been noticed in aviation industry already and it is the major factor to push forward the adoption of CRM. In order to communication in cockpit, a lot of books have been published as well as some principles including “double check” and “being most conservative”. Through analysis, “one ballot veto” principle was promoted by us and illustrated as the follows:

![Fig.1 fatal accidents and onboard fatalities by phase of flight (1997-2006)](image)

**Analysis on Causes to These Problems**

Due to some deficiency of CRM, the flight crew is unable to prevent the accident at critical moment by interrupting the accident chain, which is usually divided into two types:
1) Captain doesn’t accept safety recommendations from F/O or warning system, for examples of the two accidents mentioned in the first part.

2) For some reason, crew member doesn’t express any fear or objection to captain’s wrong decision or action.

Most of the cases belong to type 1, since type 2 is an extreme situation rarely occurred nevertheless more serious and hard to deal with. The following factors are found to be the causes of the problem.

**Personal Attitude of Crew Members**

The study showed that one of the main causes to CRM problem is the inappropriate personal attitude of the crew.

1) Inappropriate personal attitude of captain:

   - Autarchy;
   - Actuation;
   - Overconfidence;
   - Show-off.

   Being an absolute leader in the cockpit, the captain is likely to regard any safety advice by any other crew member as a challenge to his authority or interruption to his order so that respond in a negative and autarchical behavior. Some captains are so overconfident that they don’t think any mistake he or she could make as well as any disaster could happen to them. Besides, someone may take a risk to show his power and boldness [6]. It is often to find these improper attitudes in the cockpit with two captains. More and more rule violation cases are found in the cockpit due to improper competition or struggle led by overconfidence. Moreover, as an operator, some captains intend to control everything and take immediate response to any situation which often resulted in a rush action. Usually, the best way to handle emergency situation is to go around instead of trying to land, unfortunately, go around is regarded as “being incapable to perform” among lots of the pilots.

2) Inappropriate attitude of F/O:

   - In awe of authority;
   - In fear of make mistake;
   - Irresponsible;
   - Usual assumption.

   On the contrary to the captain’s attitude, other crew members are possibly passive and take no action to the captain’s dangerous operation at critical moment. Being a F/O, he or she is probably hesitant to give any negative comments when flying with an experienced and capable captain. Even if they point out the captain’s errors, they would like to use some mild words. For example, being a trainee, the F/O would not tell a captain the final approach speed is 15knots slower than required, on the other hand, he or she may say that “the speed seems a little bit slow” or in even more polite way by reminding the captain of “wind shear may be encountered”, which are dangerous rather than ineffective since it may screen the severity. To take over control of the aircraft from the captain is supposed even more difficult, simply because the F/O have to worry about losing his job.

**Training on CRM**

How to improve communication in the cockpit is covered by CRM training syllabus, but up to now, no effective training course is set up targeted to help the captain abandon his or her stubbornness
at the urgent moment. Why haven’t these problems been worked out effectively? It is found that the main reason is that the captain in the cockpit is over-authorized and at an ultimate leadership. Of course, the existing power unbalanced reality is the exact reason for putting forward the concept of CRM, but it is a pity that no effective solution is achieved. How does the crew make a safety beneficial decision at crucial point? When is the proper time for the F/O to extend his worries on safety issue or how to put forward his argument against the captain? When shall the F/O take the control actively so as to ensure safety? All of these questions are required to be considered in CRM training courses.

**Regulations and Standards**

Actually, there is specific instruction on when to go around or abort taking off in flight rules or standards currently in force. In accordance with REASON theory, the operator of the aircraft is the last safety defense line. However, it is impossible for a human being to make no mistake. For a variety of reason, the operator may ignore some regulations helpful for safety and take a risky action. Additionally, the current regulations and standards on going around and take-off abortion are focused on technical point of view as well as there is no particular explanation on how to ensure its implementation and what kind of rights could support the F/O.

**Cultural Features**

It the social culture to lead the F/O are easily obey the authority and seldom resist, moreover, the control column is in the hand of the captain\[^7\]. This phenomenon is very common, especially in Asian area, just because the social or national culture is in favor to the person with superiority and power. Meanwhile, the Asian people are more easily to accept the social estate and power inequality in their daily life which eventually facilitate autarchical habit built by the powerful one, which make it hardly possible to overcome the authority limitation for the junior and object the instruction from the senior even if in case of emergency. It is not so bad in western countries.

**Advocate “One Ballot Veto” and Improve CRM**

Creating strong CRM is the basis for safety assurance. Scientific and reasonable CRM is very helpful to maintain the control of the aircraft in bad condition, which is the first priority to ensure safety. On the basis of the above analysis, the principle of “one ballot veto” is advocated so as to improve CRM, prevent those evitable accidents from happening and enhance aviation safety in China.

**Definition of “One Ballot Veto”**

The principle of “one ballot veto” refers that the captain should accept advice and take immediate action once any member of the crew (including flight crew or ATC controllers) shows uncertainty or objection to continue current operation (i.e. take-off, approach and landing) and provides recommendations favorable to flight control and safety (i.e. abort take-off, maintain altitude or go around) according to relative rules and standards. It is initiated basing on the guideline of “safety first” always implemented in China civil aviation. The main purpose for the initiative is to drive high attention paid on any safety advice or disagreement during flight and choose the safest plan at some critical phases. Two circumstances are listed, firstly, during the final approach, in case of any condition be harmful to control or safety, one of the crew member suggests to give up approach (go around) i.e. oppose to take on a risk of approaching to a final landing, the captain must go around. Secondly, before take-off, if some crew member has any doubt on safety, the captain must abort take-off and check it.
Function of “One Ballot Veto”

The principle of “one ballot veto” may contribute to improve CRM in several aspects;

At critical time, it is very helpful for the crew to make a safety beneficial decision, take an action accordingly and interrupt the accident chain so that the accident would not happen, as it is demonstrated by case 3 and case 4 in appendix. Suppose the aircraft is at low level or some emergency situation occurred, it may make the situation worse if the crew’s attentions are distracted by arguing which method is more economical or simple, or the captain sticks on his own opinion deliberately for showing his flying skill. It will be improved if the principle of “one ballot veto” is implemented in a proper way and safety will be enhanced.

The principle will contribute to train the crew members to get into the habit of good communication, which in return protect the captain against being dogmatic and stubborn for a variety of reason as well as relieve the F/O’s tension to “say no”. Besides, it will assist the crew members better understand their own roles and duties and dedicate to flight safety.

It will be of great support to carry out the guideline of “Safety First” and establish more active cockpit atmosphere and reporting culture.

Conclusions and Suggestions

Through the above analysis, it is concluded that the principle of “one ballot veto” does play an active role in solving the problem related to CRM discussed in the paper. It is believed that nobody will query or disagree the captain’s decision and action without any reason. Once some other voice is heard, it must be for the purpose of flight safety assurance instead of challenging the captain’s authority. As far as it is concerned, the captain has dual responsibilities, one for controlling the aircraft, another for collecting team members’ opinions and making a final decision. Therefore, rather than destroy the captain’s authority and deprive his decision making right, advocating “one ballot veto” will certainly improve CRM, build up favorable safety culture and encourage the captain to accept more reliable measures suggested and avoid accident at critical fight phases. Meanwhile, it should be clarified that the principle does not mean anyone could take a measure immediately without the captain’s approval once he or she propose some safety advice, otherwise, it will go to another extreme.

In order to implement the principle of “one ballot veto” correctly, improve CRM and enhance flight safety, it is strongly recommended to do the followings:

1) Further research should be conducted to distinguish those factors harmful to successful CRM and find different solutions. The current flight rules and standards should be revised so as to specify the conditions applicable to the principle as well as corresponding implementation directory and authority necessary should be made.

2) Strengthen CRM training by increasing more cases study to assist the pilots realizing the severity of the problems and educate them to be able to prevent the accident by taking the advantage of the principle, especially in case of emergency. It is very important to help them to recognize “once the approaching is not successful, going around quickly may be the last chance for evading accident. During approach to landing, if you are not sure of current situation and confident with the safety of continuing to land, you’d better not to take any adventure and go around immediately since it is probably the last opportunity to replace the accident report by the reporting of “it is the worst approach I have ever done”. On the other hand, CRM training course should cover the responsibility and action taken by the other crew members once they observe any decision threatening safety by the captain. It is necessary to require pilots understanding the accidents involving human factors discussed herein and set up guides about when and how to take the control from the captain so as to prevent accident.
Relative reporting system should be established to encourage pilots provide written reports if they find any decision obviously endanger safe operation. Penalty regulations should be published for punishing those captains clinging on their action threatening safety.

References


