

TO INTERVENE OR NOT TO INTERVENE? THE CO-PILOT'S CATCH 22.

P.A.C.E. PROBING, ALERTING, CHALLENGING, and EMERGENCY WARNING;

THE INTEGRATION OF CREW RESOURCE MANAGEMENT  
with  
OPERATIONAL PROCEDURES.

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#### Abstract

The 'P.A.C.E.' operational methodology presented here is designed to assist subordinate crew members in resolving the basic question of the junior airman: "To Intervene or Not to Intervene?." The "P.A.C.E." system has unravelled "The Co-pilot's Catch 22; You are damned if you ignore the Captain's mistakes and you are damned if you do something about them. "

The four operational procedure steps of "P.A.C.E." establish a progression of inquiries to reduce risks at each level of the intervention sequence. The "P.A.C.E." skills enable subordinate flight crew members to use proven operationally based procedures to effectively intervene when a Captain is not performing up to reasonable professional standards. "P.A.C.E." is the 1995 equivalent of the GUMP check of the 1930's. Just as the GUMP checklist prevented hundreds of "gear-up" accidents, the 'P.A.C.E.' checklist can prevent CRM breakdowns.

'P.A.C.E.' procedures have been developed from case studies of voice recorder transcripts of National Transportation Safety Board aircraft accident reports. The "P.A.C.E." methodology provides the skill and knowledge to implement new, operationally relevant components into Crew Resource Management training for each individual organisation.

#### Introduction and Background

A widely accepted cause of accidents attributed to pilot error in the last twenty years has been poor Cockpit Resource Management (CRM). It has become a well established fact that deficient or flawed attitude and knowledge components of pilot performance have been a major factor in CRM performance breakdowns (Arbon, Mouden, and Feeler, 1990; Besco, 1990, 1991, 1992, and 1994; Caesar, 1989; Cooper, White, and Lauber, 1980; Helmreich, 1990; Hurd, 1987; Lautmann, and Gallimore, 1987; Lederer, 1990; Nagel, 1988; National Transportation Safety Board, 1994; Office of Technology Assessment, 1988; Sears, 1989; and Wiener, 1989). Many Cockpit Resource Management training programs have focused on the personality conflicts and dysfunctional small group dynamics of air crews (Helmreich and Foushee, 1993). Recently CRM programs are starting to provide a reemphasis on more operationally relevant contents of CRM training (Besco, 1994; Besco and Lederer, 1992; Helmreich, 1993; and Schwartz, 1987).

This paper examines the question of what subordinate crew members can do when they must challenge the unacceptable performance of a Captain. Such a critical situation can be very difficult for junior crew members, particularly if they are still in their new-hire, probationary period. If the organisation is one that sanctions fear, intimidation, and reprisal, crew members might be very reluctant to suggest to an established Captain that mistakes are being made (Besco, 1989; Bruggink, 1989; Degani and Wiener, 1991; and NTSB, 1994b).

To handle interventions under these circumstances, a new component is proposed to be added to CRM training. "P.A.C.E." is the acronym used to define this new set of survival skills:

**P**robing for a better understanding;  
**A**lerting Captain of the anomalies;  
**C**hallenging suitability of present strategy;  
**E**mergency Warning of critical and immediate dangers.

These four steps define an ordered progression of inquiries designed to reduce risks at each level of the intervention sequence. The "P.A.C.E." skills will enable subordinate flight crew members to effectively intervene when a Captain is not performing up to reasonable professional standards. The "P.A.C.E." inquiry procedural steps will insure that intervention by Co-pilots will always increase the margins of safety; "P.A.C.E." progression tools are carefully designed to never make a bad situation worse.

#### The Need for Enhanced Survival Skills

There have been many incidents and accidents in which the subordinate flight crew members had detected serious problems in the performance of the Captain. Subordinate crew members were aware of the gravity of the situation but were unable to select or implement suitable responses to the perceived problem (NTSB, 1994b3. The Co-pilots and other subordinate crew members were not able to prevent crashes in the following fatal aircraft accidents:

1. Jetstream into Hibbing, MN, (NTSB, 1994a);
2. DC-8 into Jeddah, Saudi Arabia (NTSB, 1993a);
3. C99 into Anniston, AL, (NTSB, 1993b);
4. Beechjet into Rome, GA, (NTSB, 1992a);
5. DC-8 loss of control at Toledo, OH, (NTSB, 1992b);
6. 707 fuel exhaustion into JFK, Washington DC, (NTSB, 1991);
7. L-1011 windshear accident, D/FW Airport, TX, (NTSB, 1986);
8. MS-748 electrical failure in Pinckneyville, IL (NTSB, 1985);
9. 737 out of Washington National, Washington DC, (NTSB, 1982);
10. DC-8 fuel exhaustion in Portland, OR, (NTSB, 1979);
11. 727 into Dulles New York City, NY, (NTSB, 1975);
12. DC-8 freighter into Cold Bay, AK, (NTSB, 1974);
13. Convair into New Haven, CT, (NTSB, 1972);
14. L-188 into a thunderstorm at Dawson, TX, (NTSB, 1969);
15. Lear Jet out of Palm Springs, CA, (NTSB, 1967);
16. F-27 into Las Vegas, NV, (CAB, 1965).

Each of these accidents is an example of subordinates knowing that the Captain was denying serious risks and displaying counterproductive and unreasonably perilous behaviour. These subordinate flight deck crews all knew that their respective Captains were either denying, discounting or oblivious to lethal dangers. Unfortunately, not one of them was able to do anything to change their Captain's performance, actions or strategies; most of them could not even get the Captain to acknowledge the problem.

In several other recent accidents, the Co-pilots did not record any comments before the crash (NTSB, 1994b). The possession of "P.A.C.E." tools, skills, and procedures could have prompted these non-contributing Co-pilots to intervene with the non-performing Captain. It is possible that these Co-pilots had detected the anomalies and were reluctant to speak up in any manner, i.e. caught up in the "Co-pilot's Catch 22". Catch 22 is the name that Heller (1955) used in his book about dilemmas in World War II US Army Air Corps aviation. In the context of this paper, the "Co-pilot's Catch 22" is:

- 22a. You are damned if you ignore a Captain's mistakes!
- 22b. You are damned if you do or say something about them!

Another possibility for these non-contributing Co-pilots, cited above by the NTSB, could have been that they were oblivious to the dangers their Captains were ignoring. It is possible that the Co-pilots lacked the airmanship skills and experience to even detect the problems. They could have been so inexperienced that "they didn't know what they didn't know."

The critical need to take over the controls of an airplane from an incapacitated or unconscious Captain has been recognised for years (Orlady, Kidera and Harper, 1973). The techniques for taking over the controls from a dangerously dysfunctional but conscious Captain have never been well defined or universally accepted. The procedures for adopting a new strategy or flight plan that has not been developed by the Captain are also missing from current Standard Operating Procedures (SOP). "P.A.C.E." provides a hierarchy of intervention strategies for both situations. "P.A.C.E." is effective when the Co-pilot is the pilot not flying (PNF) the airplane and is just as useful when the Co-pilot is the pilot flying (PF). "P.A.C.E." starts with very general inquiries and progresses to a final statement that the First Officer is now assuming command and control of the aircraft.

#### The Need for a Precise Language of intervention

Subordinate flight crew members will use the "P.A.C.E." hierarchy of inquiry and intervention strategies to successfully cope with the extremely rare but potentially lethal performance break down of the Captain. First Officers trained and rehearsed in the intervention progression will initiate "P.A.C.E." whenever there is an indication of upper level performance breakdown in airline cockpits. Creative ad-libbing, on the flight deck, will not be productive in life threatening situations. The commercial airline co-pilot needs a message equivalent to that used by the military fighter pilot; there is no misunderstanding, hesitation or mistake in the action to be taken when the wing man calls, "Blue Leader, Break hard left, now!"

The airline Co-pilot and the fighter pilot wing man share many duties and responsibilities. One is to protect the Captain or the flight leader when mission demands result in a focusing of attention and narrowing of perception. It then becomes a question of survival whenever threats and dangers emerge that fall outside of the attention of either the airline Captain or the fighter pilot leader. The Co-pilot and the Wingman both have a responsibility to protect their respective leaders from this potentially lethal form of "tunnel vision" or perceptual narrowing.

Each step in the intervention sequence must provide ways to reduce the hazardous risks and to increase the probability of a successful and uneventful resolution. Additionally, practised inquiry and intervention skills can defuse the potential for open cockpit hostilities. Hostilities can erupt when the Captain does not acknowledge perceptual narrowing, mistakes in logic, or motor performance decrements. Policies of every aviation organisation must support a well-defined hierarchy of intervention in order for Co-pilots to be effective and accepted as protectors of the Captain's "six o'clock position."

The designs of the two-person cockpit in a complex, long-range aircraft have caused an even greater need for well-defined hierarchies. In the three-person cockpit, a confirmation system can be used in the intervention process similar to the voting systems used in auto-land flight controls. In the two-place cockpit, only precise definitions of firmly established, universally accepted, and organisationally supported operational procedures will resolve the intervention conflicts and land the airplane safely on the ground.

#### The Need for Structured Intervention

Every airline organisation needs to develop and implement its own organisationally specific "P.A.C.E." progression steps with standardised terminology, semantics, and syntax. These structured phrases and the universally accepted definitions are to be used by subordinate crew members when they perceive anomalies in the Captain's performance. These terminology and procedures should pay special attention to the opening statements at each step of the intervention hierarchy. The accepted key wording for each progressive step needs to be learned verbatim by all seniority levels of flight crew members. These initial

opening intervention statements should cover at least four progressive steps of increasing concern for the immediacy of the dangers.

Intervention models and strategies must be structured so that the immediate flight safety threats are lessened by each step in the sequence. Steps in the progression should be structured so that there will be no fear that the statements will make the current situation worse. These communication patterns and skills must also enable junior crew members to unequivocally alert senior crew members of their safety and survival concerns. Also, the warnings must be made without fear of reprisal to either the subordinates long term career security or to their promotion potential.

Not long ago, before the arrival of CRM, an unwritten but universal motto of Co-pilots was "Shut Up and Move Up." There was a twofold implication in that statement. First, it could be implied that when a Captain is doing something wrong, the Co-pilot should ignore it and let the Captain suffer the consequences of the mistake. Second, it could be implied by junior crew members that if they were critical of a Captain, they could only lose by letting negative judgements become public. A corollary to this motto was the principle "The key to success in this organisation is to keep your critical opinions and lousy attitudes a secret." The Green Eagles Code of Ethics was an example of these attitudes on the part of co-pilots.

The following set of ironic ethical principles and codes of conduct for Co-pilots were developed over 25 years ago. Known as The Green Eagle Code of Ethics, they were developed as a tongue-in-cheek political counter force to the organisation of senior pilots known as the Gray Eagles. It was thought that the Green Eagles Code might help relieve, in a humorous way, the sometimes awkward relationship between Captains and junior crew members. This code also illustrates that CRM problems have their roots deep in conflicting organisational policies and practices.

The Green Eagle Code of Ethics:-

Don't sleep while your Captain is.  
Encourage your Captain to smoke.  
It's hell to fly with a nervous Captain, especially if you're the one making him nervous!  
Don't interfere if your Captain absolutely insists on making a fool of himself.

Survival Rules:-

Don't fly with a Captain nicknamed "Lucky";  
Don't fly at night;  
Don't fly in bad weather;  
Don't mess with the red switches;  
Never, ever eat a crew meal in the dark.  
Keep your lousy attitude a secret.  
Speak very, very softly when you speak to your Captain.  
Don't make better landings than your Captain, until the last trip of the month.

The two basic rules of a Captain's authority:-

Rule One. The Captain is always right.  
Rule Two. IF, the Captain is ever observed making a mistake, see Rule One.

When you upgrade to Captain, you must:-

1. Accept responsibility for being right all of the time.
2. Compensate for all of those inept and disrespectful Co-pilots.

Keep your Captain out of the morgue, jail, paper, FAA hearings, and Chief Pilot's office.

It's better to be down here, arguing about how you are going to do it up there; than to be up there arguing.  
Buy your Captain scuba gear, power tools, hang gliding and/or hot dog ski lessons.  
Always let your Captain be the first out the door of the airplane. After all, there may not be any stairs.

As a Co-pilot, your primary job is to detect and correct mistakes:-

1. First, your own mistakes.
2. Second, your Captain's mistakes.
3. Finally, everybody else's mistakes.

Never, ever awaken your Captain when he is smiling in his sleep.  
Talk up the advantages of early retirement.

Don't expect your Captain to:-

1. Pick up the meal check on a layover;
2. Be impressed with your flying background;
3. Think flying is more fun today than it was in the good old days;
4. Hear and understand the ATC request the first time;
5. Believe the FAA is doing a satisfactory job;
6. Buy anything without asking for an airline discount;
7. Wear a small or inexpensive wristwatch;
8. Wear expensive uniform shoes;
9. Respect the competency of senior airline management;
10. Purchase his own newspaper to read on a trip.

Formal Written Policy Needs to Precede "P.A.C.E."

In all day to day activities on the flight deck, not just for crisis prevention, upper management must vigorously promote and actively support the participation of subordinate crew members in minimisation of anomalous performance without threat of reprisal. American Airlines, for more than thirty years, has had a formal definition of Co-pilot responsibilities that undoubtedly has had a significant effect on supporting Co-pilots to advise Captains of anomalies and errors.

"First Officer Responsibility: The pilot occupying the First Officer position is charged with the responsibility of informing the Captain immediately and at any time, should he believe the aircraft is being handled improperly or placed in jeopardy. The Captain may choose to disregard this counsel, such is his command privilege, but no matter to what degree or how often such advice may be disregarded or ignored, the pilot occupying the First Officer's position will nevertheless be held responsible for always offering such advice." (American, 1983).

This policy, when practised, protects the assertive First Officer from official corporate reprisal initiated by the Captain. Also, the Captain is denied the authority to order the First Officer to stop offering advice. Without this type of organisational support, the strategies of intervention will seldom operate (Mager and Pipe, 1984). It is necessary to "re-engineer" the organisation, before you can be successful with training programs to "re-engineer" the pilots. CRM training will never substitute for positive corporate policies and practices.

This type of policy makes it clear to both the Captain and the Co-pilot that one of the prime duties of the subordinate is to protect the "six o'clock position" or the blind side of the leader or Captain.

"P.A.C.E." Avoids Over Emphasis on Personality Conflicts

Many CRM training programs have focused on the personality dynamics of the flight crew (Helmreich and Foushee, 1993; Helmreich, Predmore, Irwin, Butler, Taggart, Wilhelm and Clothier, 1991:). The

negative outcome of this mental health emphasis has been that many, if not most, crew members will not identify themselves as possessing personality problems. Even further, many flight crews will not acknowledge unsanitary small group dynamics as the source of past CRM breakdowns in other crew members (Besco and Lederer, 1992; Helmreich and Wilhelm, 1989).

There is considerable scientific evidence that personality differences are not now and have never been related to pilot performance differences (Besco, 1994; Dolgin and Gibb, 1989; and Hunter and Burke, 1992). Since the majority of flight crews do not exhibit these poor characteristics of mental health, individual crew members will not acknowledge that the operational risks of poor CRM exists on their particular flight decks. Most flight crew members will reject the theory that unsanitary mental health traits are the primary sources of CRM errors. The majority of crew members will judge that they are competent and reasonable flight crew members. Consequently, they do not perceive that they are at risk to commit the same mistakes that crews will commit when the crew contains domineering Captains, submissive Co-pilots or other potentially dangerous psychological characteristics.

The need to structure training methods, procedures, and contents to the more operationally and organisationally based components of CRM breakdowns has been defined in recent years (Besco, 1994; Besco and Lederer, 1992; and Wiener, 1993). The aviation community will benefit when CRM training programs place their main emphasis on removing the organisational and operational barriers to effective CRM.

The resolution of personality differences on the flight deck will be, at most, a tertiary issue when the operational and organisational communications barriers are effectively reduced or eliminated. "P.A.C.E." is the type of operationally-based training program that can enhance crew performance in all aviation organisations. The "P.A.C.E." progression is gradual and operationally relevant. Each step is a building block for the next step. Each step of the inquiry progression serves as a non threatening signal to the Captain that consideration, explanation, and response is required.

#### "P.A.C.E." A Four Step Progression to Survival

"P.A.C.E." -- Probing, Alerting, Challenging, Emergency Warning -- is a four step progression going from inquiry to disaster warning. The progression is incremental and operationally relevant. Each step is a building block for the next step. Each step serves as a non threatening signal to the Captain that a response to each step is required.

The example below illustrates "P.A.C.E." steps that could and should have been used by the Co-pilot of the MS-748 in the Air Illinois, night Instrument Flight Rules (IFR), complete electrical failure accident (NTSB, 1985). The aircraft departed Springfield in night, VFR conditions on an IFR flight plan through a line of predicted thunderstorms. The final destination was Carbondale, the corporate maintenance headquarters. Both generators became inoperative shortly after takeoff, while still in VFR conditions. The Captain elected to continue on into the frontal system on battery power. The aircraft suffered complete electrical power failure when the battery when dead. All aboard were lost.

#### Step I: PROBING statement:

"Captain, I need to understand why we are flying like this."

Example for the HS-748 Co-pilot: "Captain, I don't understand why we are proceeding into night IFR with a line of heavy rain showers ahead of us. Why don't we maintain VFR (Visual Flight Rules), go back to Springfield and land before the battery goes dead."

Vernacular translation: *"Captain, Aren't you painting yourself into a corner and aiming to shoot yourself in the foot."*

#### Step 2: ALERTING statement:

"Captain, It appears to me that we are on a course of action that is drastically reducing our safety margins and is contrary to both your briefing and to company's SOPs."

Example for the HS-748 Co-pilot: "Captain, if we proceed ahead, from VFR conditions into the line of heavy rain showers, on battery power only, we will crash because-we have no way to fly instruments when our battery goes dead. We should not even be flying day IFR with one generator inoperative, let alone flying night IFR into lightning and heavy rain showers with both generators inoperative."

Vernacular translation: *"Captain, it is my function and responsibility to protect your blind spots. I see you are about to walk off a cliff."*

Step 3: CHALLENGING statement.

"Captain, you are placing the passengers and aircraft in irreversible and immediate danger. You must immediately choose a course of action that will reduce our unacceptably high risk levels."

Example for HS-748: "Captain, you are placing the passengers in a position of a certain crash when the battery goes dead. You must immediately reverse course and get back to night VFR conditions."

Vernacular translation: *"Captain, you are about to self destruct. You have the equivalent of a very angry and armed bogey in your six o'clock position. We are all about to get the civil aviation equivalent of a 20 millimetre enema."*

Step 4: EMERGENCY WARNING.

"Captain, if you don't immediately increase our safety margins, it is my duty and responsibility to immediately take over control of the airplane."

Example for the HS-748: "Captain, if you don't immediately reverse course and get back to night VFR conditions, I must take over control of the airplane. I cannot allow you to subject the passengers to such an unnecessary and high risk of certain death. Under these conditions, it is my duty and responsibility to relieve you of your command."

Vernacular translation: *"Captain, you, your airplane and every one on board are about to be dead meat. I choose not to join you. If you don't immediately cease and desist, I will take the airplane away from you. I owe it to myself, my family, our passengers, and our company to restore an adequate margin of safety."*

"P.A.C.E." Survival Step - INTERVENTION AND TAKE-OVER:

"Captain (Jones), I have the airplane !!

(Jerry), Take your hands off the controls, NOW!!" (Spoken loudly, slowly, and with firm authority!!)

### Taking Over Control from the Captain

A Co-pilot take-over of the active control of an airplane has more immediate and life critical ramifications than in other complex systems operations environment. The cockpit of an aircraft is no place to physically wrestle over the controls. The operational etiquette or intervention hierarchies must be clear-cut as to when the Co-pilot should announce the intention to take command; there should then be no doubt as to the appropriateness of the Co-pilot's actions.

The "P.A.C.E." steps -- Probing, Alerting, Challenging, Emergency Warning require that the Captain make a satisfactory response to the Co-pilot at each level of inquiry and intervention. It should be an organisational SOP that if the Captain ignores the Co-pilot through all four steps of "P.A.C.E.", the Co-pilot must proceed to assume command and control of the airplane.

For the actual announcement of change of command on the flight deck, the Co-pilot could use a phrase such as "Captain (Jones), I must take over control of the airplane. (Jerry), take your hands off the controls. NOW!" This use of a personal first name or a nickname can be very effective to break the perceptual narrowing of the Captain. A third crew member, if present, can use terminology such as, "Captain (Jones), you must give control of the airplane to (Barry) immediately."

When the Co-pilot is already flying the airplane (PF), the "P.A.C.E." intervention steps must be used by the Co-pilot to announce the intention to implement a strategy not initiated by the Captain. Even though the Co-pilot has control of the aircraft, the Captain still has command responsibility for the basic flight plan and mission control. These same four steps of progression to intervention strategy must be followed by the PF Co-pilot to formalise the change in command and return the aircraft to the pre-planned margin of safety.

### Conclusions

When the Captain decides to replace the Co-pilot on the controls of the airplane, the time honoured "I've got it" by the Captain is readily acknowledged by everyone. Unfortunately, there is no equivalent universally accepted procedure for the Co-pilot to use in taking over control of the airplane from a conscious but dysfunctional Captain.

What a Co-pilot needs is the commercial aviation equivalent of a universally understood communication, such as the well-accepted warning in the life or death teamwork of military fighter pilots. When a lead fighter pilot hears the words "Blue Leader, Break Hard Right, NOW," there is no doubt and no question as to its meaning or its urgency. The lead pilot receiving this message will give no thought to group dynamics, assertiveness, personalities or the need for more information to reassess the situation. Furthermore and most importantly, there is no hesitation on the part of the wing man to intervene and alert the Flight Leader of any and all impending dangers.

The entire aviation industry will benefit greatly from the development of a universally accepted set of intervention TERMINOLOGY, OPERATIONAL PROCEDURES AND SYSTEMS for all flight crew members. The "P.A.C.E." progression is suggested as a model on which to build such a system.

"P.A.C.E." is based on the following four steps.

Probing - for a better understanding.

Alerting - the Captain of the anomalies.

Challenging - the suitability of present strategy.

Emergency Warning - of critical and immediate dangers.

These four steps of an intervention strategy -- "P.A.C.E." -- will help "to make the world a better place in which to fly."