Flight Operations Briefing Notes

Human Performance

Effective Pilot / Controller Communications

I Introduction

Until controller / pilot data link communication (CPDLC) comes into widespread use, air traffic control (ATC) will depend upon voice communications that are affected by various factors.

Operators and Air Traffic Management providers, like pilots and controllers, are close partners in terms of "productivity" (i.e., for enhancing the airport / airspace flow capacity); operators and ATM should be also close partners in terms of "safety" (i.e., for risk management).

Communications between controllers and pilots can be improved by the mutual understanding of each other's operating environment.

This Flight Operations Briefing Note provides an overview of various factors that may affect pilot / controller communications.

This Briefing Note may be used to develop a company awareness program for enhancing flight pilot / controller communications.

II Statistical Data

Incorrect or incomplete pilot / controller communications is a causal or circumstantial factor in 80 % of incidents or accidents, as illustrated in **Table 1**.

A survey of the NASA Aviation Safety Reporting System (ASRS) data base identifies the following factors, affecting pilots / controllers communications :

Factor	% of Reports
Incorrect Communication	80 %
Absence of Communication	33 %
Correct but late Communication	12 %

(Source – NASA – ASRS)

Table 1

Communication Factors in NASA ASRS Reports

The survey also reveals how various modes of communication are affected :

Mode of Communication	% of Reports
Listening	45 %
Speaking	30 %
Reading and Writing	25 %

(Source – NASA – ASRS)

Table 2

Communication Factors in NASA ASRS Reports

Incorrect or inadequate …

- ATC instructions (e.g., radar vectors, …);
- Weather or traffic information; and/or,
- Advice / service in case of emergency,

… are causal factors in more than 30 % of approach-and-landing accidents.

III Remark

Although pilot / controller communications are not limited to the issuance and acknowledgement of clearances, this Flight Operations Briefing Note primarily refers to clearances because this provides a convenient example to illustrate this overview.

IV Pilot / Controller Responsibilities

The responsibilities of the pilot and controller intentionally overlap in many areas to provide redundancy.

This shared responsibility is intended to compensate for communication failures that might affect safety.

V The Pilot / Controller Communication Loop

The pilot / controller communication loop supports the safety and redundancy of pilot / controller communications, as illustrated by **Figure 1**.

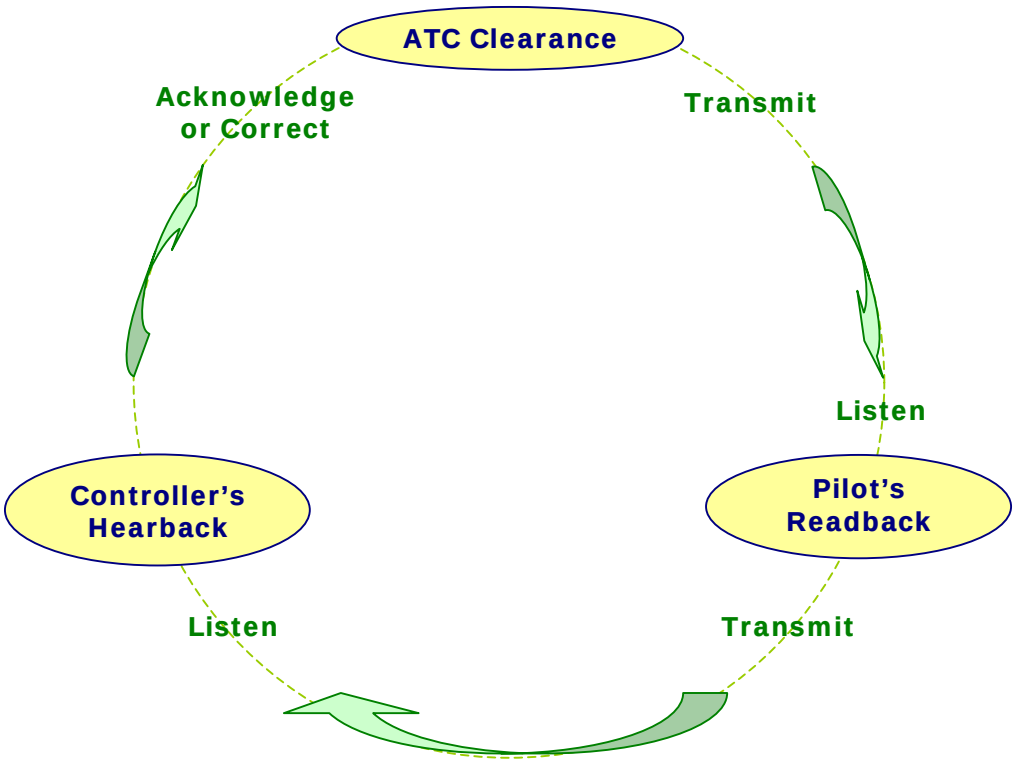

Figure 1

The Pilot / Controller Communication Loop

The pilot / controller communication loop constitutes a confirmation / correction process that ensures the integrity of communications.

Whenever adverse factors are likely to affect communications, strict adherence to this closed loop constitutes a line-of-defense against communication errors.

Readback / hearback errors may result in one or more of the following types-of-event, ranked by number of events observed over the period 1992-1993 (Source – NASA – ASRS – 1994) :

- Operational deviation (non-adherence to legal requirements);
- Altitude deviation;
- Airborne conflict;
- Less than desired separation;
- Lateral deviation;
- Runway incursion;
- Ground conflict;
- Airspace penetration;
- CFIT; and,
- Near midair-collision.

VI Achieving Effective Communications - Obstacles and Lessons Learned

Pilots and controllers are involved equally in the air traffic management system.

Achieving effective radio communications involves many factors that should not be considered in isolation.

Many factors are closely interrelated, and more than one cause usually is involved in a breakdown of the communication loop.

The following provides an overview and discussion of factors involved in effective pilot / controller communications.

VI.1 Human Factors Aspects In Effective Communication

Effective communication is achieved when our mental process is able to accommodate and to interpret the information contained in a message.

This mental process can be summarized as follows:

- How do we perceive the message ?
- How do we reconstruct the information contained in the message ?
- How do we link this information to an objective or to an expectation ?
- What bias or error is introduced in this process ?

Crew resource management (CRM) research highlights the relevance of the context and expectations in this process. Nevertheless, expectations may introduce either a positive or negative bias in the effectiveness of the communication.

Workload, fatigue, non-adherence to the sterile cockpit rule, distractions, interruptions, conflicts and pressure are among the factors that may affect adversely pilot / controller communications and result in :

- Incomplete communications;
- Omission of call-sign or use of an incorrect call-sign;
- Use of nonstandard phraseology;
- Failure to listen or respond; and,
- Failure to effectively implement the confirmation / correction loop.

VI.2 Language and Communication

No individual is expected to speak any language, even his/her own native language, correctly and in a standard way. Acknowledging this fact is a first step towards developing or enhancing communication skills.

The language of pilot / controller communications is intended to overcome this basic shortcoming.

CRM studies show that language differences are a more fundamental obstacle to safety in the cockpit than cultural differences.

In response to a series of accidents involving language skills as a causal factor, an effort has been initiated to improve the English-language skills of pilots and controllers worldwide.

Nevertheless, even pilots and controllers for whom English is the native language may not understand all communications spoken in English, because of regional accents or dialects.

Language differences generate significant communication difficulties worldwide.

Controllers using both English (for communication with international flights) and the country's native language (for communication with domestic flights) prevent pilots from achieving the desired level of situational awareness (because of loss of party-line communications).

VI.3 Communication Techniques

The first priority of any communication is to establish an operational context, by using markers and modifiers to define the following elements of the context :

- **Purpose** - clearance, instruction, conditional statement or proposal, question or request, confirmation;
- **When** - immediately, anticipate / expect;
- **What** and **how** - altitude (i.e., climb, descend, maintain), heading (i.e., left, right), airspeed; and,
- **Where** - (i.e., before or at [...] waypoint).

The structure and construction of the initial and subsequent message(s) should support this context by :

- Following the chronological order of the sequence of actions;
- Grouping instructions and numbers related to each action; and,
- Limiting the number of instructions in the transmission.

The intonation, the speed of transmission (i.e., speech rate) and the placement and duration of pauses may positively or adversely affect the correct understanding of a communication.

ICAO Annex 10 – Volume II and PANS ATM (Doc.4444) provide rules and procedures for pilot / controller communications.

ICAO guidelines and techniques for radio transmission highlight the following objectives:

- Transmissions shall be conducted concisely in a normal conversational tone;
- Full use shall be made of standard phraseologies, whenever prescribed in ICAO documents and procedures; and,
- Speech-transmitting techniques shall be such that the highest possible intelligibility is incorporated in each transmission.

To reach the above objectives, pilots and controllers should :

- Enunciate each word clearly and distinctly;
- Maintain an even rate of speech (not exceeding – typically – 100 words per minute);
- Make a slight pause preceding and following numerals, this makes them easier to understand;
- Maintain the speaking volume at a constant level;
- Be familiar with the microphone operating techniques (particularly in maintaining a constant distance from the microphone, if the aircraft does not feature a constant-level modulator); and,
- Suspend speech temporarily if it becomes necessary to turn the head away from the microphone.

VI.4 Use of Non-standard Phraseology

Use of nonstandard phraseology is a major obstacle to voice communications.

Standard phraseology is intended to be easily and quickly recognized.

Pilots and controllers expect each other to use standard phraseology.

Standard phraseology helps lessen the ambiguities of spoken language and thus guarantees a common understanding among speakers :

- Of different native languages, or,
- Of the same native language but who use or understand words differently (e.g., regional accents or dialects).

Non-standard phraseology or the omission of key words may change completely the meaning of the intended message, resulting in potential conflicts.

For example, any message containing a “number” should indicate whether the number refers to an altitude, a heading or an airspeed. Including such key words prevents an erroneous interpretation and allows an effective readback / hearback.

Pilots and controllers might use non-standard phraseology with good intentions; however standard ICAO phraseology always minimizes the potential for misunderstanding.

Use of non-standard ICAO phraseology may result from national practice.

The most significant example is the North American phraseology "taxi into position and hold", that has the same meaning as the ICAO phraseology "line up [and wait]", whereas the ICAO phraseology "taxi to holding position" is a clearance to taxi to, and hold at, a point clear of the runway (e.g., the CAT I or CAT II / III holding point / line).

VI.5 Building Situational Awareness

Radio communications (including party-line communications) contribute to build the pilot's and the controller's situational awareness.

Flight crew and controller may prevent misunderstandings by providing each other with timely information, for better anticipation.

At all times, pilots should build and update a mental picture of the other traffic in the vicinity of their intended flight or ground path.

VI.6 Frequency Congestion

Frequency congestion significantly affects the correct flow of communications during critical phases such as takeoff-and-departure as well as approach-and-landing, particularly at high-density airports, this requires enhanced vigilance by pilots and by controllers.

VI.7 Omission of Call-sign

Omitting the call-sign or using an incorrect call-sign jeopardizes an effective readback / hearback process.

VI.8 Lack of Readback or Incomplete Readback (Readback Errors)

ICAO Annex 11 requires that the safety-related part(s) of any clearance or instruction be readback to the air traffic controller.

The following parts of a clearance shall always be readback :

- ATC routes clearances;
- Clearances and instructions to enter, land on, takeoff on, hold short of, cross or backtrack on a runway;
- Runway in use;
- Altimeter setting;
- ATC transponder (SSR) code;

- Altitude of FL instructions ;
- Heading and speed instructions ; and,
- Transition levels (whether issued by the controller or broadcasted by the ATIS).

The pilot's readback must be complete and clear to ensure a complete and correct understanding by the controller.

The readback message shall always include the flight callsign.

Readback of an hold short, crossing, takeoff or landing instruction shall always include the runway designator.

The use of the term Roger is not an acceptable readback as it does not allow the controller to confirm or correct the clearance or instruction, thus decreasing the pilot's and the controller's situational awareness :

- Pilot may use Roger to acknowledge a message containing numbers (instead of a normal readback), thus preventing effective hearback and correction by the controller; or,
- Controller may use Roger to acknowledge a message requiring a specific answer (e.g., a positive confirmation or correction, such as acknowledging a pilot's statement that an altitude or a speed restriction cannot be met).

VI.9 Failure of Correct an Erroneous Readback (Hearback Errors)

Any readback by the pilot requires an hearback by the controller, in order to close the communication loop.

Most pilots perceive the absence of an acknowledgement or correction following a clearance readback as an implicit confirmation of the readback.

The lack of acknowledgement by the controller usually is the result of frequency congestion, requiring the controller to issue clearances and instructions to several aircraft.

Uncorrected erroneous readback (known as hearback errors) may cause deviations from the assigned altitude or non-compliance with altitude restrictions or with radar vectors.

A deviation from a clearance or instruction may not be detected until the controller observes the deviation on his/her radar display.

Less-than-required vertical or horizontal separations, near midair collisions or runway incursions usually are the result of hearback errors.

VI.10 Perceiving What Was Expected or Wanted (not what was actually said)

The bias of expectation can affect the correct understanding of communications by pilots and controllers.

This involves perceiving what was expected or wanted and not what was actually said.

The bias of expectation can lead to:

- Transposing the numbers contained in a clearance (e.g., an altitude or FL) to what was expected, based on experience or routine; or,
- Shifting a clearance or instruction from one parameter to another (e.g., perceiving a clearance to maintain a 280-degree heading as a clearance to climb / descend and maintain FL 280).

VI.11 Failure to Seek Confirmation (when a message is not understood)

Misunderstandings may include half-heard words or guessed-at numbers.

The potential for misunderstanding numbers increases when a given ATC clearance contains more than two instructions.

VI.12 Failure to Request Clarification (when in doubt)

Reluctance to seek confirmation or clarification may cause pilots to either :

- Accept an inadequate instruction (over-reliance on ATC); or,
- Define by themselves the most probable interpretation.

Failing to request clarification may cause flight crew to believe erroneously that they have received the expected clearance (e.g., clearance to cross an active runway).

VI.13 Failure to Question an Incorrect or Inadequate ATC Instruction

Failing to question an incorrect or inadequate instruction may cause a crew to accept an altitude clearance below the sector MSA or a heading that places the aircraft near obstructions or on a collision course with another aircraft.

VI.14 Taking a Clearance or Instruction Issued to Another Aircraft

This usually occurs when two aircraft with similar-sounding call-signs are on the same frequency and are likely to receive similar instructions or if the call-sign is blocked by another transmission.

When pilots of different aircraft with similar-sounding call-signs omit the call-sign on readback, or when simultaneous readback are made by both pilots, the error may go un-noticed by the pilots and the controller.

Some national authorities have instituted call-sign de-confliction programmes (Source – Eurocontrol – Level Bust Briefing Notes) to minimize or eliminate this threat.

Eurocontrol recommends that all operators study their schedules and arrange call-signs to reduce the chances of company aircraft operating in the same airspace at the same time, having similar call-signs.

VI.15 Effective Listening - Filtering Communications

Effective communication requires active and intensive listening by all parties involved, concentrating on each part and word in order to fully understand the whole message.

Because of other flight deck duties, pilots tend to filter communications, listening primarily to communications that begin by their aircraft call-sign and not hearing other communications.

For workload reasons, controllers also may filter communications (e.g., not hearing or responding to a pilot readback, while being engaged in issuing clearances / instructions to other aircraft or ensuring coordination with an other ATC center).

To maintain situational awareness, this filtering / selection process should be adapted, according to the flight phase, for more effective listening, e.g., :

- Whenever occupying an active runway (e.g., while back-tracking or holding into position / being lined up and ready for takeoff) or when conducting a final approach to an assigned runway, pilot's should listen and give attention to all communications related to this runway; and,

- When operating in a congested airspace, pilots should listen and give attention to all communications related to clearances to climb or descend to, or through, their flight level.

VI.16 Timeliness of Communications

Deviating from an ATC clearance may be required for operational reasons (e.g., performing a heading or altitude deviation for traffic or weather avoidance, inability to meet a restriction, …).

Both the pilot and the controller need time to accommodate such deviations; therefore ATC should be notified as early as possible to obtain a timely acknowledgement.

Similarly, when about to enter a known non-radar-controlled flight information region (FIR), contacting the new air route traffic control center (ARTCC), approximately 10 minutes before reaching the FIR boundary, may prevent misunderstandings or less-than-required separations.

VI.17 Blocked Transmissions (simultaneous communications)

Blocked transmissions often are the result of not immediately releasing the push-to-talk switch after a communication.

An excessive pause in a message (i.e., holding the push-to-talk switch while preparing the next item of the transmission) also may result in blocking part of the response or part of another message.

Simultaneous transmission of communications by two stations (i.e., two aircraft or one aircraft and ATC) results in one of the two (or both) transmissions being blocked and unheard by the other stations (or being heard as a buzzing sound or as a squeal).

The absence of readback (by the pilot) or the absence of hearback acknowledgement (by the controller) should be considered as an indication of a possibly blocked transmission and, thus, prompt a request to repeat or confirm the information.

Blocked transmissions are responsible for many altitude deviations, missed turnoffs and takeoffs and landings without clearance.

VII Communicating with ATC on Specific Events

The following events or encounters should be reported as soon as practical to ATC, stating the nature of the event or encounter, the actions taken and the flight crew's further intentions (as applicable) :

- TCAS / ACAS resolution advisory (RA) events;
- Severe turbulence encounter;
- Volcanic ash encounter;
- Windshear or microburst encounter; and,
- (E)GPWS / TAWS terrain avoidance maneuver.

VIII Pilot / Controller Communications in Emergency Situations

In an emergency, the flightcrew and the controller should adopt a clear and concise communications pattern, as suggested hereafter.

VIII.1 Flight crew

In an emergency, flight crew should appreciate that the controller may not be familiar with the aircraft and its performance capability.

The controller may not understand a message that is too technical; a simple message should be used to inform the controller of the prevailing condition.

In an emergency, the initial message should comply with the standard ICAO phraseology :

Pan Pan – Pan Pan – Pan Pan; or,

Mayday – Mayday – Mayday,

... depending on the criticality of the prevailing condition, to alert the controller to the level of urgency and trigger an appropriate response.

Then, to explain the situation, simple and short messages should be used highlighting the operational implications of the prevailing condition.

VIII.2 Controllers

Controllers should recognize that, when faced with an emergency situation, the flight crew's most important needs are:

- Time;
- Airspace;
- Silence on frequency.

The controller's response to the emergency situation could be patterned after the **ASSIST** memory aid, proposed below (Source : Amsterdam Schiphol ATC) :

- **A**cknowledge :
  - Ensure that the reported emergency is well understood and acknowledged.
- **S**eparate :
  - Establish and maintain separation with other traffic and/or terrain.
- **S**ilence :
  - Impose silence on your control frequency, if necessary; and,
  - Do not delay or disturb urgent cockpit actions by unnecessary transmissions.
- **I**nform :
  - Inform your supervisor and other sectors, units and airports, as appropriate.
- **S**upport :
  - Provide maximum support to the flight crew.
- **T**ime :
  - Allows flight crew sufficient time to manage the emergency situation.

IX Awareness and Training Program

A company awareness and training program on pilot / controller communications should involve both ATC personnel and pilots (e.g., during meetings and simulator sessions) to promote a mutual understanding of each other's working environment, including :

- Modern flight decks (e.g., FMS reprogramming);
- Modern ATC equipment (e.g., elimination of primary returns such as weather returns on synthetic radar displays);
- Operational requirements (e.g., aircraft deceleration characteristics, performance, limitations); and,
- Procedures (e.g., SOPs) and practices (e.g., CRM).

Special emphasis should be placed on pilot / controller communications and task management during emergency situations.

X Summary of Key Points

Achieving effective pilot / controller communications requires a holistic approach, the importance of the following key points should be emphasized :

- Adherence to company SOP's;
- Understanding of pilots and controllers respective working environments and constraints;
- Disciplined use of standard phraseology;
- Strict adherence to the pilot / controller communication loop (i.e., confirmation / correction process);
- Alertness to request clarification or confirmation, when in doubt;
- Readiness to question an incorrect clearance or an inadequate instruction;
- Preventing simultaneous transmissions;
- Adapting listening of party-line communications as a function of the flight phase; and,
- Adopting clear, concise and adapted communications in an emergency situation.

In addition, Operations Manual and/or SOPs should define the following company policies:

- Primary language for use with ATC and in the cockpit; and
- Use of headsets below 10 000 ft.

XI Associated Flight Operations Briefing Notes

The following Flight Operations Briefing Notes may be reviewed to expand the discussion on Effective Pilot / controller Communications :

- **Standard Operating Procedures (SOPs) – Operating Philosophy**
- **HF Aspect in Incidents / Accidents**
- **CRM Aspects in Incidents / Accidents**
- **Managing Interruptions and Distractions**
- **Enhancing Situation(al) Awareness**
- **Preventing Runway Incursions**

XII Regulatory References

Reference regarding pilot / controller communications can be found in many international and national publications, such as :

- ICAO – Annex 6 – Operation of Aircraft, Part I – International Commercial Air Transport – Aeroplanes, Appendix 2, 5.15.
- ICAO – Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM, Doc 4444).
- ICAO – Procedures for Air navigation Services – Aircraft operations (PANS-OPS, Doc 8168), Volume I – Flight Procedures (Post Amendment No 11, applicable Nov.1/2001).
- ICAO - Annex 10 – Volume II / Communication Procedures – Chapter 5 / Aeronautical Mobile Service.
- ICAO - Manual of Radiotelephony (Doc 9432).
- ICAO – Human Factors Training Manual (Doc 9683).

- ICAO – Human Factors Digest No 8 – Human Factors in Air Traffic Control (Circular 241).
- The respective national Aeronautical Information Publications (AIPs).
- National publications, such as :
  - the U.S. Federal Aviation Administration (FAA) Aeronautical Information Manual (AIM) – Official guide to basic flight information and air traffic control procedures;
  - the guide of Phraseology for Radiotelephony Procedures issued by the French Direction de la Navigation Aerienne (DNA); and / or,
  - the Radiotelephony Manual issued by the U.K. Civil Aviation Authority (Civil Aviation Publication - CAP 413).
- FAR 121.406, 121.419, 121.421 or 121.422 - CRM Training for pilots, cabin crew and aircraft dispatchers.
- FAA AC 60-22 – Aeronautical Decision Making.
- JAR-OPS 1.945, 1.955 or 1.965 - CRM Training.
- UK CAA - CAP 710 – On the Level.
- UK CAA – Air Traffic Information Services Notice 8/2002 – Phraseology Associated with Clearances Involving FL 100, 200, 300 and 400.
- UK CAA – Flight Operations department Communication 11/2000 – Understanding and Interpreting Phraseology and Procedures used by Air Traffic Services Providers.

XIII Industry References and Publications

- IATA Report – English Language in Civil Aviation.
- IHS – AV-DATA website :
  - **http://www.ihserc.com/regulations/aviation-av-data/index.html**
- GAIN – Report of Working Group E (Flight Operations / ATC Operational Safety Information Sharing) – Pilot / Controller Collaboration Initiatives : Enhancing Safety and Efficiency, available on GAIN website – **http://www.gainweb.org/**
- NASA – ASRS website - **http://asrs.arc.nasa.gov/main.htm**

- Eurocontrol – Level Bust Tool Kit.
- Eurocontrol website – Level Bust website :
  - **http://www.eurocontrol.int/safety/LevelBust_LevelBust.htm**

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