

# I. The meaning of communication and cooperation skills for flight safety

## Contents

1.	Experiences about the practical importance of communication skills in the cockpit	1
2.	Functions of communication	2
3.	Communication skills	3
4.	Empirical findings based on a study of German Lufthansa AG	4
5.	Empirically based data about the frequency of problem categories	5
	References	8

## 1. Experiences about the practical importance of communication competences in the cockpit

Since the aircraft accident in Teneriffa in March 1977 (vgl. [http://de.wikipedia.org/wiki/Flugzeugkatastrophe\\_von\\_Teneriffa](http://de.wikipedia.org/wiki/Flugzeugkatastrophe_von_Teneriffa)) in a big number of later aircraft accidents could be shown, that a lack of cooperation and communication belonged to the substantial causal or contributing factors (see: Hawkions, H.F., 1987, Chapter 7) of these accidents.

Modern concepts of flight safety (CRM, MCC, TEM) therefore emphasize the meaning of social interaction in a team.

For concretion of the demands on communication and cooperation in the cockpit Deutsche Lufthansa (DLH) among other means uses a list as big as a credit card, which encases the following items:

Tab. 1: List of demands on communication and cooperation

- A cared about a positive first impression (BQ)
- B performed active listening (KH)
- C asked for the opinions of others
- D performed duly positioning of knowledge
- E presented the own opinion adequately
- F supported others adequately
- G accepted criticism
- H carried out feedback
- I addressed even unclear compunction
- J addressed frictions

K	took care for human redundancy
L	used all information
M	watched out for options
N	evaluated advantages and disadvantages
O	explained my intentions
P	delegated expediently
Q	challenged decisions
U	affixed gates
V	performed foresight
W	avoided time pressure
X	fought against distraction
Y	structured decision making.

This list is specifying actions to be recapitulated before a flight or to be used for a self check after a flight. Most of the items refer to concrete forms of team interaction (cooperation and communication). Some of them dwell on a larger context, like mental preparation or strategic aspects of a cooperative action. These behaviors can substantially improve the efficiency of communication and cooperation and finally conduce to flight safety.

Such a list can help to acquire a repertoire for social interaction which, after a time of appliance, becomes a competence which can be used according to the needs of a situation or a task.

For a more systematic consideration one can differentiate between functions and skills of communication.

## **2. Functions of communication**

### **2.1. Functions in the details**

The most general function of communication is the exchange of information. More specific variants, which are important in the cockpit are:

- produce and keep the same information status for each crew member (situation awareness)
- steering the cooperation
- feedback
- self comments about my own activities
- decision making
- motivating
- giving instructions
- read back
- ask back
- helping

- explaining
- express arising doubts
- criticizing, etc.

Also call outs, checklists and the phraseology in interaction with the ATC are applications of communication. But because they do not give much space for variation, the requirements on communication skills are not very high, apart of clear articulation, adequate loudness and talking speed.

## 2.2. The preventive function of communication

Among the most challenging requirements are

- problem prevention and problem solution
- conflict prevention and conflict solution.

Therefore more recent approaches stress the preventive strategy, that means to avoid problems and conflicts instead of waiting until they are obvious, because prevention is much more effective than management of already existing problems and conflicts.

Therefore communication is a *continuous need*, beginning with the briefing at the beginning of a flight and ending with the debriefing at the end of a flight and not only in situations of already existing problems.

## 3. Communication skills

One can apply communication functions in a more or less qualified way. In order to do it in an optimal way one needs communication skills.

Important skills are

- language knowledge
- grammar
- repertoire of terms, especially technical terms
- clear articulation
- listening
- precise use of terms
- logic conclusiveness of statements
- non confrontative criticism
- explain matters clearly
- give clear instructions
- come to the point
- asking focused.

#### 4. Empirical findings based on a study of German Lufthansa AG

In a till nowadays unique empirical study of German Lufthansa (GLH) during 1997 to 1999 a concrete interrelation between team interaction and flight safety could be shown. The contents of this study were developed by a team of pilots from GLH. The author of this paper coached the study conceptually and methodically and evaluated it.

2070 pilots answered a questionnaire about critical events they experienced. 1897 of them really experienced a critical event and described it. They answered questions about the critical factors comprised by the event, their further development and on how the crew managed the problems. Based on a scale of six steps they also rated the maximum risk during the critical event described.

The data presented in the following table (Table I.2.) are based on a part of the questionnaire, which especially was focusing on problems with communication and cooperation between CM in the cockpit. They refer to N = 283 critical events.

For each event the pilots could answer several problem categories. So the count of reported items (N = 1325) outruns the number of critical events substantially. One single event mostly included several aspects of interactional problems.

From the left side to the right the table embraces the serial number, the question number, the frequency of "yes" answers for the category, the text of the respective question and a category in order to classify the problem type (classified by the author).

Table 2.: Interactional problems within the cockpit.				
No.	Qu..	No.	Problems	General Category
1	4.1	116	Nessecary remarks were not made	Lackof communication
2	4.2	101	outstanding doubts were not made	Lackof communication
<b>3</b>	<b>Sum.</b>	<b>217</b>		
4	4.3		Important remarks ... ..	
5	4.3.1	27	were incomprehensible	effectivity
6	4.3.2	28	were ambiguous	effectivity
7	4.3.3	31	were incomplete	effectivity
8	4.3.4	21	were incorrect	effectivity
9	4.3.5	106	were disregarded/ignored	effectivity
10	4.3.6	45	were not heard	effectivity
11	4.3.7	53	were disorganized, irrational	effectivity
<b>12</b>	<b>Sum.</b>	<b>311</b>		
13	5.9		CMs were not able to coordinate because :	
		63	of a distraction	mental state
14	5.10		CM`s were not able to coordinate because of :	
		35	emotional strain	mental state

## Communication in Cockpit

<b>15</b>	<b>Sum. 98</b>			
16	4.4		The behaviour or comments by the person were communicating with was/were ... :	
17	4.4.1	51	unsettling, intimidating	role relationship
18	4.4.2	82	not decisive enough	role relationship
19	4.4.3	36	provocative, hurtful	role relationship
20	5.5	61	criticisme was made more difficult because of steep authority gradient	role relationship
21	5.6	79	Attempts to coordinate between CMs were made more difficult due to authoritarian behaviour	role relationship
22	5.11	19	Discipline was affected by complacency	role relationship.
<b>23</b>	<b>Sum. 328</b>			
24	4.5	70	The attention of the CMs was distracted from the problem by irrelevant communication	Cooperation
25	5.1	29	No clear goals were defined	Cooperation
26	5.2	19	The division of responsibilities was unclear	Cooperation
27	5.3	112	One CM went out on a limb	Cooperation
28	5.4	26	CMs were acting against one another	Cooperation
29	5.7	35	A conflict between CMs caused a breakdown of cooperation	Cooperation
30	5.8	30	One CM caused the other one to act inadequately	Cooperation
<b>31</b>	<b>Sum. 321</b>			
<b>32</b>	<b>5.12 50</b>		<b>Other types of problems</b>	
<b>33</b>	<b>Total :1325</b>		<b>In total mentioned problems.</b>	

The outcome shows the following sums for the problem categories:

- 217 demand of communication was not realized
- 311 communication was not effective; i.e. did not meet its function
- 98 the condition of a CM was not optimal for communication and cooperation (emotional, distracted)
- 328 there were problems with role concepts respectively gradient of authority
- 321 cooperation was inadequate or disturbed
- 50 there were problems with cooperation and communication which could not be allocated to the classification criteria offered.

These data give an impression about the actual meaning of interactional problems in the cockpit. Nearly 15 % of all events (adverted to 1897 events) include this type of social interactional problems in the cockpit as a problem aspect (N = 1298) or exclusively (N = 11). One also can not tell, that the pilots applied a "delicate" standard while naming

those events as a part of the problem. Every of the N=283 critical events in Tab. 1.2 statistically comprehends 4,7 different aspects of social interactional problems.

With regard to this frequencies and variety of interactional problems it also becomes comprehensible, why “problems with communication and cooperation”, out of four categories have been classified (significantly) as the most dangerous type of events (Scale from 1-6) by the pilots (mean: > 4,00).

Of course those data are subjective evaluations. But prior to devaluating the quality of this type of data one should be aware that it is this subjective type of data, which guides actions and reactions of a person. The reactions of CM are based on their subjective appraisal of the situation and not on an anyway objective situation.

For this reason so called “objective” data can not replace the subjective data type. Partly the objective data can only be decoded by subjective data.

## 5. Empirical data about the frequency of problem categories

In the study of GLH altogether 4 problem categories have been differentiated:

- technical problems
- mistakes of persons
- aggravating operational conditions and
- aggravating social factors.

They all can arise as a critical event separately or in combinations.

The following table 3 shows the way of combinations of problem types and their relative frequency for the N=1897 events.

Tab. 3.: Event configurations and their frequencies

<b>Configurations</b>	No.	%	Examples
<b>Single factors</b>			
Aggravating social factors (SF)	11	0,58	Conflict between CM in the cockpit
Operational problems	15	0,95	Bad weather + problems with documentation
Mistakes of persons	128	6,75	Wrong input into a device; + planning mistake
Technical problems	119	6,27	Problems with engines + problems with pressure cabin
<b>Combinations of 2 problems</b>			
Technical problems + aggravating social factors (SF)	40	2,11	Problems with FMS + problems with CRM

## Communication in Cockpit

Operational problems + aggravating social factors (SF)	19	1,00	Bad weather + negative social climate
Mistakes of persons + technical problems	33	1,74	Navigation mistake + problems with the auto pilot
Technical problems + operational problems	64	3,78	Wrong warning + time pressure
Mistakes or persons + operational problems	172	9,07	Non compliance of rules + problems with flight documentation
Mistakes of persons + aggravating social factors (SF)	274	14,44	Forgetting of checklists + conflicts between CM
Combinations of 3 factors			
Mistakes of persons + technical problems + aggravating social factors	47	2,48	Problems with dealing of equipment + problems with electrical system + lack of CRM
Mistakes of persons + technical problems + operational problems	54	2,85	Incorrect planning of take off performance + problems with primary flight control + problems with loading
Technical problems + operational problems + aggravating social factors	62	3,27	Problems with landing gear + problems with documentation + conflicts between CM
Mistakes of persons + operational problems + aggravating social factors	672	35,42	Actions based on insufficient knowledge + time pressure during flight + communication problems with ATC
Combinations of 4 factors			
Mistakes of persons + technical problems + operational problems + aggravating social factors	184	9,70	Necessary action was not carried out + problems with APU + time pressure at the ground + communication problems within the aircraft
Total Number	1987	100	

These data give an empirically based impression of the relative frequencies of problem factors and their combinations as problem configurations.

- 1) In the first place of the frequency chart there are the configurations in which mistakes of persons are involved in (N=1564).
- 2) In the second place are the configurations in which aggravating social factors are involved in (N=1309).
- 3) Configurations which include one of the other problem factors show the following frequencies: together with operational problems N =1245, together with technical problems N=603.

- 4) The combination of mistakes of persons and aggravating social factors even as an isolated event type has a relatively high range (N=274) und altogether with other factors involved, N=1777.
- 5) The frequency of a combination of operational problems with aggravating social factors is N=19 and altogether with other factors involved, N=937.
- 6) The frequency of a combination of technical problems with aggravating social factors is N=40 and altogether, with other factors involved is N=333. The last one allows the assumption of a protective effect of the technical problems on interactional processes, possibly based on the availability of detailed briefing and the amount of training with regard to this type of problems.

The reported frequencies refer to events the pilots experienced most recently. It is unknown how often different pilots report about the same event, if they sat in the same aircraft at the time of the event.

Extrapolations of the results into different directions have to be considered difficult. Based on the frequencies of the last experienced events one can not draw conclusions on a total number, e.g. per annum. To do that, one needed accurate numbers about the total account of critical events per pilot and time unit. It is also not possible to draw conclusions on any numerical value of risk. To do that one needs a base rate of situations/circumstances in which critical events could have happened.

Representative are the *relative frequencies* of problem factors being comprised by the critical events. The reference base in this case is the last experienced event of almost 50% of all pilots working for GLH in 1997.

## References

- Argyle, M. (1969). Soziale Interaktion. Kiepenheuer & Witsch.
- Bergmann, J., Nazarkiewicz, D., Dolsciuis, D. und Finke, H. (2005). Entscheidungskommunikation im CFockpit. Kurzbericht. Forschungsprojekt, 2004-2005. Bielefeld.
- Braun, P., Kemmler, R. & Neb, H. (2001). Berichte zum Forschungsprojekt „Flugsicherheit“ der Deutschen Lufthansa AG, Würzburg, GAPF
- Braun, P. (1990). Zur Funktion und Auswirkung von Konfrontation als Interaktionsform im Gespräch. In: Baumgartner, E, u.a. (Hrg): : Das Ich und die Gruppe. Hogrefe, S.75 - 104.
- Brehmer, B. (1990). Dynamic decision making: Human control of complex systems. In: Acta Psychologica 81, 211-241.
- Dörner, D. (1976). Problemlösen als Informationsverarbeitung. Kohlhammer, Stuttgart.
- Goldberger, L. & Breznitz, S.(Hrg):(1982). Handbook of Stress. The Free Press, New York

- Hawkins, F.H. (1993<sup>2</sup>). Human Factors in Flight. Avebury Technical,  
Maurino, D.E., Reason, J., Johnston, N. und Lee, R.B. (1995). Beyond Aviation Human  
Factors. Avebury Aviation  
Meier, H.D.,(1996). Crew Coordination. Rotorblatt, 1/96 & 1/96.  
Schulz von Thun, F., Ruppel,J., Stratman, R. (2006). Miteinander reden:  
Kommunikationspsychologie für Führungskräfte. Rowohlt Taschenbuch  
Verlag.  
Watzlawik, P. und Weakland, J.H. (Hrg)(1980). Interaktion. Hans Huber, Bern .