Flight deck procedures for a new generation of pilots

Huijbrechts, Erik-Jan; van Paassen, M.M.

Publication date
2023

Document Version
Final published version

Published in
22nd International Symposium on Aviation Psychology

5-31-2023

Flight Deck Procedures for a New Generation of Pilots

Erik-Jan A.M. Huijbrechts

M. M. van Paassen

FLIGHT DECK PROCEDURES FOR A NEW GENERATION OF PILOTS

Erik-Jan A.M. Huijbrechts
Airline Pilot and Independent Aviation Safety Researcher
Sassenheim, the Netherlands
M.M. (René) van Paassen
Associate Professor Delft University of Technology
Delft, the Netherlands

This paper considers the combined effect of two trends in commercial aviation. On the one hand, there is a continuing demand for pilots, implying that a new generation of pilots, will soon be flying our aircraft. On the other hand, legal aspects have had an adverse effect on innovation in the safety level of established procedures, leading to a trend for aircraft operating companies to adopt manufacturer's recommended flight deck procedures rather than reviewing these and adapting these where appropriate to local needs. However, with the influx of new pilots to the workforce, the lack of innovation and adaptation of flight deck procedures poses a safety treat. The safety level of the aviation industry relies on the experience of the individual operator (pilot), the demands of the tasks and the available support tools.
If the experience is not in the operator (pilot) we have to put the experience in the procedures to maintain the existing safety level in aviation.
This conference paper is a plea to develop type, and operation, specific flightdeck procedures, adapted to present day operation and usable by the future pilot population.

Suitable flight deck procedures are an essential component in the safety of airline operations. They serve to achieve Work-as-Imagined by legislators, manufacturers and aircraft operating companies and are an integral part of the 4p's (Philosophy, Policy, Procedures and Practices) (Degani A. & Wiener E. 1994) that can be used to model aircraft operation. Clear guidance from procedures is particularly required for less experienced operators (pilots), who cannot yet rely on experience to guide their actions. Manufacturers of aircraft and aircraft equipment provide procedures for operation, supplied as a package with the purchase or lease of the aircraft. These procedures can however often still be improved on the basis of feedback from operational experience, tailoring these to the operational needs that may have changed from the time when the aircraft and instrumentations were designed, or that are specific to localized use that was not imagined by manufacturers.

Sources of Flight Deck Procedures

Flight deck procedures are presented by aircraft operating companies to their operators. They are composed of rules and procedures originating from legislation, manufacturers and commercial incentives. Procedures in general are presented to operators in a Basic Operations Manual (BOM) and operational procedures in an, aircraft type specific, company Flight Crew Operations Manual (FCOM).

The organisational model presented in (Huijbrechts & van Paassen 2021), can be used to illustrate the different influences on procedures. The model in Fig.1 shows the blunt and sharp end in aircraft operation and the way in which flight deck procedures arrive in operation.

Although flight deck procedures preferably must be tailored to the circumstances within which the airline company works (Barshi I. et al., 2016), many aircraft operating companies nowadays choose to present manufacturers' procedures without much adaptation to their operators (pilots). In smaller companies, the knowledge or assets to adapt procedures may not be available. In bigger companies, a fear for liability issues often hinders initiatives to improve safety by tailoring procedures to (changed) circumstances or company's specific needs.

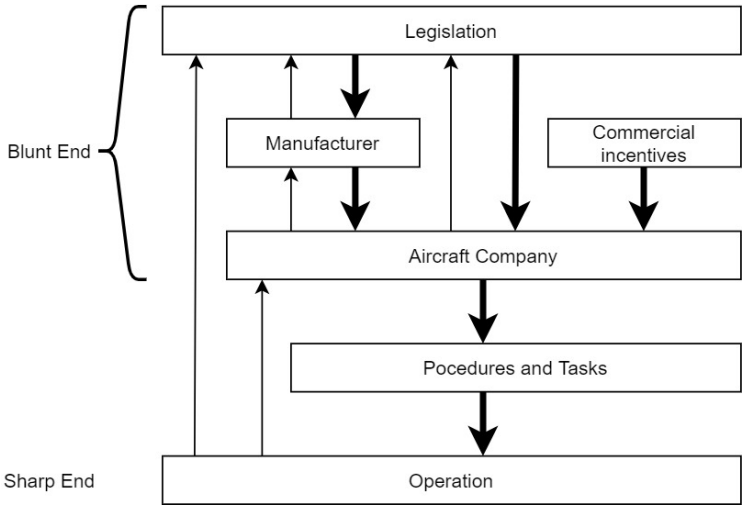

Fig.1 Blunt End and Sharp End in aircraft operation (Huijbrechts & van Paassen 2021)

On the work floor (at the sharp end), safety related issues with systems and procedures and flaws in legislation may emerge that are not obvious to the blunt end. The thin, upward flowing, lines in fig. 1 indicate that the feedback to the blunt end is not as strong as the instructions from the blunt end downwards. From the work floor perspective, there are several observations that may help to explain why present flight deck procedures must be improved to serve less experienced pilots.

The focus of management has shifted from operation and product oriented to process and legal oriented.

Until about the turn of the century, in many companies, management supported efforts to tailor flight deck procedures for ease of use and safety. Companies developed their own procedures and management took responsibility for the operation on the work floor. This led to remarkable differences in operating procedures between different companies (Degani A. & Wiener E., 1994).

But management policy has changed. Instead of assuming responsibility for tailored company procedures, management nowadays prefers to use manufacturers' procedures. Where these procedures are not suitable in a specific operational context, adapting and deviating from these is left to the responsibility of individual operators. This same observation implies that safety related efforts of management often are focused on (and limited to) compliance with legislation.

Manufacturers' procedures are not always tailored for operational use.

A manufacturer is not an operator. (Barshi I. et al., 2016 p. 6) This observation requires adaptation of procedures on the work floor. Manufacturers procedures are sometimes made up by non-operational experts or in a simulator. As an example the Boeing remote de-icing procedure will be considered in this paper.

Manufacturers' procedures do not cover all operational situations.

This observation shows the need to add specific procedures. Companies sometimes add structured guidance on how to handle non-normal situations. Operators may identify the need for a type specific checklist to guard for omissions in case of a late runway change or return to gate.

The effect of legal aspects on Flight Deck Procedures

Certification is a legal process that was intended to provide a good safety level in aircraft operation. Examples can however be found where the certified status of procedures and equipment has hindered further safety innovations (Huijbrechts & van Paassen 2021).

A specific example is found in a major European company, that decided to revert to using manufacturers' procedures discarding the operational experience that was enclosed in their own, adapted, procedures. This decision was influenced by an accident in a daughter company that showed the vulnerability of companies to liability claims after an accident. This change did not provide an improvement in operational safety but shifted the responsibility for safe operation to individual operators, mitigating the risk for the company for being held liable for company procedures.

Authorities require companies to install incident reporting systems that include questions on how procedures can be improved. The aim of such systems is to transform companies into learning organizations. Results of the incident reporting are, in general, shared by company management with operators, adding to their experience. But even here, with an explicit structure in place to improve safety, manufacturers' procedures are seldomly adapted by companies in response to incident reports, because the fear for liability issues outweighs the drive for safety. Thus liability can be seen as a barrier for a learning organization.

Certification and liability can be considered as legal aspects that have an adverse effect on safety innovation in flight deck procedures.

Types of Operators

The SRK framework (Rasmussen 1983) can be used to distinguish between operators that can rely on experience and less experienced operators. Operators on a flight deck (pilots) in general are smart people that are selected and employed because they can show, or develop, a high level of knowledge-based behaviour. Combining this with the 4P's Knowledge based behaviour can be seen as the Practice to use, select and adapt Procedures to the situation according to a Policy within the Philosophy of the aircraft operating company.
Based on experience and 'modus operandi' we propose here a distinction between operators in craftsman and rulesman.

Craftsman:

Craftsman in general do not need formalized rules and procedures to perform their task. They rely on their experience to guide their actions. Their rule-based behaviour (in Rasmussen's definition) is experience-based and effortless, rather than recipe-driven, and their high level of skill-based behaviour provides them with time and resources to display knowledge-based behaviour in reflecting on circumstances and adapting procedures to the actual situation.
Rigid rules and procedures can hinder craftsman in achieving their goals.

Rulesman:

Rulesman strongly rely on formalized rules and procedures to perform their tasks. Inexperienced operators often need a clear set of rules and procedures to guide them. Rule-based behaviour prevails over skill and knowledge-based behaviour. Over time a rulesman can turn into a craftsman by gaining experience.

Example: The Boeing remote De-Icing procedure

Before an aircraft can start its flight it has to be clear of contaminants on critical surfaces. If snow or ice is present this has to be removed through de-icing. Guidance can be found in FCOM. Through the years the practice of de-icing has changed. In the sixties and seventies it was common practice to have the aircraft de-iced at the gate before engine start. In the eighties remote de-icing on an apron platform became in use. This offered a more efficient use of de-icing equipment, better use of Hold Over Times and the spilled de-icing fluids could better be collected to prevent damage to the environment.

The Boeing de-icing procedure was originally designed for gate de-icing but later adapted for remote de-icing. The Boeing remote de-icing procedure shows evidence that it is not made up based on operational experience. For example, it requires operators to move controls and flaps before de-icing (The Boeing Company FCOM B737). The major European company that reverted to using manufacturers procedures was confronted by operators (pilots) that refused to perform the procedure by the book as this could damage control surfaces covered with a layer of snow or ice. In response the company did not change the procedure but added notes in their company FCOM stating that it is Subject to Captains Discretion (SCD) to delay control and flaps movement to after being de-iced (KLM FCOM B737). Examining the procedures of a major American company shows that they simply omitted publishing a detailed procedure for de-icing (Continental FCOM B737).

In such cases the responsibility to perform a safe procedure is shifted to the crew.

For most operators (pilots) de-icing is not a daily procedure and, in particular, inexperienced pilots would likely benefit from having clear guidance on what actions have to be performed.

Note: When I (the first author) was involved in company procedure development a simple solution was found to cover the remote de-icing situation. The before taxi procedure was performed twice; once before taxiing to the de-icing station omitting moving controls and flaps and once after de-icing, including the controls check and flaps setting (The latter may be postponed to just before take-off if prolonged taxi is required through precipitation after de-icing). This principle can be used for all aircraft types including those with electronic checklists.

Collecting information to improve Flight Deck Procedures

Manufacturers cannot foresee changes in common practices and only have a limited knowledge of operational practice. In order to improve procedures operational information has to be collected from aircraft operating companies and operators (pilots).

Collect information from aircraft operating companies.

Aircraft operating companies may have adapted manufacturers procedures based on incident reports or their own operational experience. Companies may have collected information from their operators that procedures can be improved without acting on this. Companies may have added structured guidance to operators e.g. on how to handle non-normal situations.

Collect information from operators.

Operators (pilots) use their own tricks to assure a safe operation. E.g. leave the Aircraft Maintenance Log on the glareshield as long as not all technical issues are resolved or use trigger events to check if all necessary actions are performed. Collecting and sharing these tricks may help new pilots to develop their own way of working. Operators may have good reasons to divert from company or manufacturers procedures based on their own experience. If diverting from Procedures becomes common Practice the former may have to be changed. Operators may recognise flaws in legislation that can be improved. Operators may also recognize situations that are not covered by manufacturers procedures that would benefit from better guidance.

Developing Flight Deck Procedures for a new generation of Pilots

If a significant number of companies and operators are willing to share information, this can be used to develop Procedures that contain both the manufacturers technical knowledge and the operational experience. The aim must be to combine these, to develop procedures that can be used by both craftsman and rulesman. In this practice the operational safety level has to prevail over legal correctness. In our opinion, this works best if procedures are developed, at the sharp end on the work floor and that this working method is supported and approved by the authorities.

Ecological Interface Design

Ecological interface design (Burns, C.M. & Hajdukiewicz, J., 2004) can be used to improve safety on the work floor. Improvement is already being made in flight deck instrumentation and e.g. performance software with graphical displays that may help in recognizing invalid input values and offer a check against gross input errors compared to the predicted load and fuel figures. Preferably procedures will be designed to offer enough flexibility that they will not hinder craftsman in their skill & knowledge-based behaviour but can still be used by rulesman as a do-list (Rantanen & Huijbrechts, 2021).

Improving Manufacturers Procedures

The biggest challenge is to break through the legal barriers that nowadays prevent improvement on manufacturers' procedures. This means that the responsibility for published procedures cannot be shifted to manufacturers, companies or legislators. An independent party, e.g. the Flight Safety Foundation (FSF) or NASA, can take the initiative to provide a recommended format to include manufacturers, company and operators input in a, type specific, Flight Crew Operations Manual (FCOM) that can be used as a standard for many companies with approval/validation of legislators and other stake holders. This will however require a big effort comparable to the Global Action Plan to Prevent Runway Excursions (GAPPRE) (FSF & Eurocontrol 2021).

Evaluation

A system has evolved in aviation where manufacturers try to shift responsibilities to legislators by means of certification (Huijbrechts & van Paassen 2021). Legislators are not always effective in promoting companies as learning organizations because of the barriers posed by liability issues. The ultimate responsibility for a safe operation thus greatly rests on the work floor that sometimes has to cope with unpractical procedures. Collecting operational feedback by an independent party may reveal flaws in legislation and (certified) procedures and equipment that can be improved. If operational experience can be included in flight deck procedures the loss

of safety level through the change of focus in management and resulting effect on organizational safety (Rantanen & Huijbrechts, 2021[2]) can be partly recovered.

Conclusions

There are several barriers to further improving safety in the aviation system, one of these is the certified status of procedures and equipment as a barrier for safety innovations. Another is the liability issues faced by aircraft operating companies, which act as a barrier for a learning organization, by limiting innovation in procedures.

For operators (pilots) new to the aviation system, who did not yet have the opportunity to collect a wide experience, we have to put previously collected experience in the procedures to maintain the existing safety level in aviation.

To improve flight deck procedures the knowledge of manufacturers has to be combined with the operational experience of aircraft operating companies and operators (pilots).

Acknowledgements

I want to thank Maartje Huijbrechts for critical reading, hints and tips. This report is not initiated by, nor does it reflect, the views of my employer.

References

Barshi, I., Mauro, R., Degani, A., and Loukopoulou, L., *Designing Flightdeck Procedures*, NASA/TM-2016-219421, October 2016

Burns, C.M. & Hajdukiewicz, J. *Ecological Interface Design.* CRC Press. 2004

Continental Airlines *Flight Crew Operations Manual B737*

Degani A. & Wiener E. *On the Design of Flight-Deck Procedures*
NASA Contracter Report 177642, June 1994

Flight Safety Foundation & Eurocontrol, *Global Action Plan to Prevent Runway Excursions (GAPPRE)* 2021.

Huijbrechts & van Paassen *Is our Current Certification Process a Threat to Safety Innovation?*
Conference Paper, ISAP 21, may 2021

KLM Royal Dutch Airlines *Flight Crew Operations Manual B737*

Rantanen, E. & Huijbrechts E-J.A.M., *Procedures as an Ecological Interface*
Conference Paper, ISAP 21, may 2021

Rantanen, E. & Huijbrechts E-J.A.M. [2], *Organizational Safety in Airline Operations*
Conference Paper, ISAP 21, may 2021

Rasmussen, J. *Skills, Rules, and Knowledge; signals, signs and symbols and other distinctions in human performance models.* IEEE transactions on Systems, Man and Cybernetics, SMC-13(3) 257-266

The Boeing Company *Flight Crew Operations Manual B737*