THE QUALITY AND ACCURACY OF THE FDR
IN THE SYSTEM OF OBJECTIVE FLIGHT CONTROL
IN RELATION TO FLIGHT SAFETY

Abstract

The main aim of the article is to approach the issues related to the role of an objective system of air traffic control in maintaining aviation security. Moreover, the article presents the core of the system of objective flight control and the scope and type of tasks implemented as a subsystem of the safety system. Great attention is paid to the fundamental objective of the system, as for instance to maintain the objectivity of the measurement of flight parameter. Taking the selected flight parameter as an example, an analysis of the potential risks of losing objectivity was performed. The path of transformation of parameters in the system and the potential danger of losing objectivity that may occur at each stage, were indicated. Those areas of the system were selected which are essential as sources of potential errors of parameter measurement.

Keywords: objective flight control system, objective parameter, feeder.

Introduction

The development of modern aviation as well as continuously increasing its popularity as a means of transport, force aviation organizations to apply high standards to ensure safety. Security is not a one-time or short-term, ad hoc activity but a number of specific, characterized by continuity of identified actions forming processes of the security system. Therefore, security is a condition in which the possibility of harm to people or property are minimized and maintained at the acceptable level or below this level, due to a deliberately carried continuous process of hazard identification and safety risk management.

Maintenance and improvement of the system of flight safety in modern aviation organizations is realized on many levels and with almost a direct implementation by organizations of proven risk management models in aviation (Reason’s model, Singleton’s theory, 5M, CRM - Crew Resource Management, MRM - Maintenance Risk Management) and using adequate methods of the analysis of the safety system.

However, taking into account real aspects of the functioning of the system, such activities can be divided into two groups: ante - and post factum. On the basis of the experience of functioning of the systems, taking into account not only the related
aspects of the level of achievement of the objectives, costs and time, but also primarily efficiency, it can be certainly stated that prevention is always better than cure. Thus, the emphasis mainly on the action “before” in the form of hazard identification and risk assessment of their effects are the main issues of the Safety Management System (SMS). Organizational criteria for the SMS system include such items as: management of the organization, procedures, training and security policy of the organization.

A very important element in this system is the role of information which includes: obtaining, analyzing, qualifying and a proper use.

One of the main sources of generating information in the field of aviation systems are onboard aircraft recorders. The significance of this information is particularly important because of their properties and a direct impact on the functioning of the security system. The management of any information from on-board recorders is a separate system which is a subsystem of the safety system, namely the system of Objective Flight Control (OFC). Even the requirement of having this type of system in any organization confirms its significance in maintaining security both in the areas of civil and military aviation. However, it should be noted that the mentioned importance of the system of objective flight control does not arise from the nature of information management but above all the main and most important for this system features, like for instance, credibility. This system has the ability to capture relevant data in order to answer the obvious questions such as: At what altitude did the aircraft make a flight? What was the speed of flying? Were there any transgressions during the flight? Therefore, the credibility of the answers to such questions are the quality and accuracy of acquired data to answer objectively. The greater credibility is, the greater the degree of approximation to the real value of the event or parameter. The only way to fulfill this criterion is "interception" of information as accurately as possible, taking into account the physical characteristics and its management of the maintenance of a specified level of accuracy. Obtaining answers to these kind of issues associated with the phenomena occurring nowadays or in the past, enables to develop and apply the measures of correction (repair) effectively. It should also be noted that an appropriate use of information in the system of objective control, even during the current operation of the aircraft, is an important element in the framework of the activities ante factum, for instance, the broader prevention and safety diagnostics of the technical condition of the aircraft. Thus, to what extent are the speedometer or altimeter indications reliable? In order to answer that question, the path of obtaining objective information and its management on the example of one of any of the recorded by on-board flight data recorders, parameter, should be examined.

The core of objective flight control

Undoubtedly, with regard to the system approach in the management of aviation safety as well as taking into account the fact that the area of air traffic control objective is a permanent element of the security system to be defined, the concept of objective flight control will be subject to the same criteria. Thus, by using a systemic approach: The OFC - is a system that uses procedures, processes and resources required to monitor: quality of aviation tasks, the efficiency of aircraft, the level of flight safety, prevention (prediction and forecasting).
Considering a variety of the areas of modern aviation, the question arises: Whether the above definition is “versatile” for all areas of aviation, including civil and state aviation? To answer this question, an overall analysis of the OFC system, limited to the determination of elements (functional areas) of the system, data transformation In and Out and system environment, should be made.

**System components:** principal elements of the OFC system (Fig. 1) are three subsystems: the subsystem of data collection, the subsystem of data processing and the Subsystem of data usage.

![Fig. 1. The system model for Objective Flight Control](source: author’s own material).

The tasks of the individual elements in the system are:

- Subsystem of data collection - collecting data from all sources operating in the system and in a closer environment. The main sources of information are on-board recorders, ground recorders, and data from proximal and distal environment of OFC system as audio recorders, video used extemporaneously by the person authorized or obtained by chance (third parties). At this point, attention should be paid to the concept of OFC materials - objective and reliable information is stored in on-board or ground-based recording devices used for an analysis within the OFC system. Thus, the term "reliable" is worth emphasizing as it fulfills the criteria of origin (environment) and the recording quality.

- Subsystem of data processing - Flight Control Laboratory (FCL) - machining of available OFC materials to the form enabling an objective presentation to the
interested function persons included in the subsystem of the use of data and with an appropriate expertise in the field of reading and analysis of data.

- Subsystem of use of data - the use of data by launching the procedures, processes and resources required to monitor: air quality execution of tasks, the state of flight safety, efficiency of aircraft accident investigation.

- In and Out Data: the input to the process is the data carrying any valuable information that can be used in the OFC system, to analyze in the most objective degree. This information, both expected from the system (subsystem of data collection) and random (obtained from sources that are not elements of the system) is subject to a process of transformation. The process of transformation and processing of input data to the process involves an analysis taking into account its level of detail. The analysis is performed while providing resources in the form of: decryption equipment, software, methods, qualified personnel, approved procedures and regulations. The implementation of the transformation process of objective information in the OFC is presented in Fig. 2.

![Fig. 2. The process of transformation of objective information in the OFC system](source: author’s own material)

- OFC system environment which is determined mainly by a primary goal in aviation worldwide, namely maintenance of aviation safety at the highest level. OFC system environment can be divided into two main areas: further and closer. An essential element of the further environment affecting the functioning of the OFC system is indicated (Fig. 2), a law segment including the European aviation and national laws.

For establishing and maintaining a high uniform, a level of civil aviation safety in Europe under the provisions of the European law corresponds to the European Aviation Safety Agency (EASA). It is the basis element, a competent authority which regulates the functioning of civil aviation safety. Therefore, normative documents of the EASA are mandatory for aviation organizations. As regards the provisions governing the functioning of the OFC system, the regulations applicable result from the Commission Regulation (EU) No. 965/2012 of 5th October 2012 establishing technical
requirements and administrative procedures related to air operations pursuant to the Regulation of the European Parliament and of the Council (EC) No. 216/2008. The requirements for operating flight data recorders are contained in the entering into force of Annex VI to the above regulation - non-commercial operations performed using a complex aircraft engine-driven Part-NCC [5]. In contrast, the requirements for data management of OFC system are contained in Annex III above. regulation - PART-ORO (ORO.AOC.130.) [2].

Closer environment are elements directly affecting the system resources and method for monitoring the system, to provide adequate resources, principally affected by the choice of appropriate provider organizations in the field of registration systems and data processing and ensuring an effective training package for staff. As a result, much faster management system in order to achieve and maintain a certain level of competitiveness, not only commercial but above all quality is obtained.

The above formal - legal factors directly concern functioning of the OFC system in the field of civil aviation. Does this mean that the OFC system in other areas of aviation, for example in the Air Force, is different from the general principles, national and those recognized by the EASA? As it is known, air force differs primarily from the civil aviation by its destiny and a nature of activity. However, taking into account normal conditions of functioning of both types of aircraft, even though the legal regulations concerning the operation are quite (of course) different, it can be indicated a strong similarity between OFC systems civil and military aviation.

Certainly, as a common feature of the OFC system, it can be indicated the possibility of a comprehensive analysis and evaluation techniques of piloting and monitoring the efficiency of aircraft maintenance, and thus an impact of the quality, safety tasks and operation of the flight. The limitation for civil aviation is the use of the OFC system to control the course of training in the air and evaluation of flight safety.

System environment, both close and distant, needs to be consistent with the basic parameters of its operation to obtain a desired effect of the efficiency of an entire system. The main difference between the impacts of close and distant environments is the speed of a system response to the received signal from a particular environment. In practice, it is shown that the response to signals from a further environment significantly increases system response time to adjust to new conditions. However, in the case of changes in law or normative documents (legal segment), these changes are more noticeable for the system. There is an inverse relationship between the change in the elements of a close environment - a faster response of the system, but relatively smaller influence on changes in the system.

However, before defining the concept of "objective flight control", it is necessary to clarify the meaning of the word "objective". The process of evaluating the gathered OFC information requires defining a set of parameters that allow comparison of their values for different spatial configurations in the preparation and execution of the flight. The information gathered in the subsystem to collect flight data can be divided into the parameters of an objective and subjective character.

Objective parameters are the defined patterns and take exact numerical values or can be determined by measurement.

Subjective parameters are related to a subjective assessment of the people involved in the process and are expressed by providing appropriate terms to a particular parameter, which characterize a given property of the described parameter.

Having known the role of outlined in the model components of the objective flight control system and meaning of the word "objective", the area of the OFC operation can be specified as follows: Objective Flight Control system is featured by
a range of extraction, transformation and use of flight information with the form of "raw" recording equipment provided by the system and outside it, to a format that allows analysis performance and conclusions.

In other words, the degree of objectivity of the information depends on the properties of the system it generates. This system automatically determines a practical dimension of its objectivity as a specific numerical value given to a particular (the maximum for the system) degree of accuracy. If for the system limit threshold option is to present information with accuracy, for instance, $A [\pm 0.001]$, it means to that value it is dealt with objective information. At the same time, the above value is the limit value for the objectivity of the information. Any analysis and worrying excess of the tolerance level are the subjective information, going beyond the system of objective flight control.

As the idea of an objective system of air traffic control has been discussed, it cannot be forgotten an ultimate purpose of that system, for example to ensure objectivity in the transformation of information, data and parameters (objective assessment of the phenomenon and its analysis). This objective is dependent on many factors, both occurring in the system itself and its surroundings. The most important include measurement errors that may occur in the processing of data. It seems that an easiest way to analyze such area risks is to indicate a type of error which has to be mainly dealt with in the OFC system.

**Errors in the OFC system**

Before the areas of potential sources of an error are predicted, firstly the nature of an error with which the OFC system has to be to dealt with, must be specified. Measurement, as one of the main sub-processes of data collection and processing of data determines the behaviour of objectivity of the collected parameters at different levels of its processing. The measurement is a primary source of information in physics. The measurement is called the experimental operations in order to determine values of the tested physical size. The core of each measurement is to compare the measured value to the standard measure of the size adopted for the unit (for instance, length measurement in m, km, etc.). The measurement’s result must therefore be composed of two parts: a numerical value, determining the fold measurements to determine the deviations from the pattern. Measurements of physical quantities are divided into direct and indirect. Direct measurements rely directly on a comparison of the size of an appropriate measure of the calibration. Measurement’s result is obtained directly without performing any calculations. Indirect measurements define a size of the test value on the basis of direct measurements of other physical quantities which are associated with a well-known physical law that requires the calculation of measured values based on direct measurements of other quantities $X_1, X_2, X_3, \ldots, X_n$ related to them known functional relationship $y = f (X_1, X_2, X_3, \ldots, X_n)$.

During the measurement, it is impossible to accurately determine an actual value of the measured value - an obtained numerical value always differs from the theoretical predictions. With regard to the reasons for this discrepancy, the term ‘measurement error’ is used. In this application, the concept of measurement error occurs in terms of quality, but in quantitative measurement, an error is the difference between the measurement result and the actual value. An absolute error is defined as the difference in the measurement result and the actual value $x_R$:

$$
\Delta x = x - x_R
$$

(1.1)
and the relative error as the ratio of an absolute error for the actual value:

$$\delta x = \frac{\Delta x}{x} = \frac{x}{x_R} - 1 \quad (1.2)$$

It should be emphasized that the concept of the actual value is purely theoretical, as in practice is not known. Therefore, dealing with the value of the error appears to be difficult. Taking into account the causes of errors during measurement, they can be divided into the following three categories: gross errors, systematic errors and random errors.

Gross errors arise from the inability to use an instrument, mistakes when reading and recording of results, sudden changes in measurement conditions, etc. For a gross error, the difference between the measurement result and the actual value is generally very high. For a series of measurements, results flawed gross are easy to detect and remove. The graphs of measured or appointed values the measurement points not flawed gross are arranged in accordance with regularity occurring in the theory of the phenomenon studied and the results are burdened with this error are much different from the others.

Measurements are subject to systematic errors when with the repetition of measurement for measurement series there is a difference between the measured values and the actual value subject to certain regularities, and the scattering of the results of individual measurements is small or even does not exist.

The occurrence of random errors is revealed as the scattered measurement results around the real value. The result of each subsequent measurement is different. The chance of larger or smaller results than x 0 determines the type of statistical distribution (for instance, Gaussian, rectangular, uniform), which is subject to these results. Random errors arise from different random factors and those which could not be taken into account.

On the basis of the above (generally accepted) classification of errors, it should be remembered that not only a gross mistake carries serious consequences. In practice, it is shown that the rank of error does not correspond proportionally to its consequences. Depending on the situational or temporary “configuration” of errors, systematic or one-off - this one (usually insignificant in the system) leads to serious consequences and a disorder of the OFC system. This type of phenomenon should be classified as a fatal (systemic) error.

In general, the causes of errors during the measurement result from:

- inadequacy of the person performing an experiment;
- inadequacy of measuring instruments;
- flaws in the methods of measurement;
- inadequacy of the measured objects and analysis of them leads to the following conclusions:
  1) gross errors should be completely eliminated, carefully performing the measurements and carefully analyzing the results (the result of measurement should not be responsible for their influence);
  2) systematic errors may be corrected at the stage of selecting the method of measurement and analysis of measurement results, their boundaries should be clearly defined;
  3) random errors due to their accidental (random) character cannot be entirely avoided or corrected, but their impact on the final result can be minimized [2].
The history of one parameter

Having known the structure of the OFC system and tasks performed by various subsystems, it can be indicated a correct path of the parameter after the elements of the system. First of all, as a "correct", an objective must be understood in the sense of preserving the value of the real (physical) parameter. One of the recorded parameters has been chosen and the dangers for its objectivity have been examined. Without going into the technical aspects of some of the measuring tracks of board recorders, the parameter that will slightly stimulate the imagination even of a layman and the key issues, namely an altitude of an aircraft, have been analyzed.

The altitude for the OFC can be determined by ground and on-board equipment. On-board flight data recorders measure the altitude and registration based on the measurement of atmospheric pressure (static). This measurement is characterized by high reliability and it is fully autonomous. It should be noted that the same sizes can be obtained with the commonly used GPS satellite receivers (as commercial), the measurement accuracy is mostly satisfactory (less than 5 meters) for measuring the height of using the supporting system in Europe (EGNOS), however the problem arises from the small reliability of GPS receivers which for various reasons may not provide correct results. Thus, the method of measurement based on the measurement of atmospheric pressure is very convenient because of the independence of the measured and recorded altitude of the aircraft position in space. However, in the accepted method, the measurement is not being made in relation to the ground, but against a reference level - the isobaric level with parameters: $P = 760$ mmHg (1013.25 mbar), $t_0 = 15$ o C. measured in this way is called the barometer standard altitude. Since the accepted isobaric level is variable in space and time, hence the barometric altitude can have different values at a constant real height in relation to sea level, the so-called absolute altitude ($H_{abs}$ to the mean sea level). Types of height and their dependencies are shown in Fig. 3.

![Fig. 3. Types of flight altitude](image)

Source: author's own material.
Feeders of on-board recorders are scaled from isobaric level of \( P = 760 \text{ mmHg} \) (1013.25 mbar), \( a = 15^\circ \text{C} \), for instance, for those conditions was adopted \( H_{bar} = 0 \). In contrast to the onboard altimeter, where the pilot can measure the height of any isobaric level, on-board recorder always measures the height of the level of \( P_o = 760 \text{ mmHg} \) (1013.25 mbar). As a consequence due to the pressure, it causes changes that the altitudes read, for example, during the next few take-offs, it can have different values for the same aircraft. The calculation of the actual flight altitude takes place according to the following equation:

\[
H_r = H_{bar} + \Delta H_{bar} = H_{absolute} - H_{ter}
\]

*where:*

\( \Delta H_{bar} \) - barometric correction of an altitude resulting from changes in atmospheric pressure. This is the value that determines how many meters the isobaric level \( P (H_{bar} = 0) \) raised or lowered at the point of measurement;

\( H_{ter} \) - the height of terrain above sea level;

\( H_{absolute} \) - flight altitude above sea level.

To calculate the barometric correction, it is necessary to:

1. Measure the atmospheric pressure, for example at the airfield level \( P_l = 750 \text{ mm Hg} \) (1000 hPa).
2. Determine a barometric altitude corresponding to \( P_l = 750 \text{ mm Hg} \) (1000 hPa) according to the standard atmosphere table (AW), which corresponds to \( H_{AW} = 110 \text{ m} \).
3. Using the known height of the airport above sea level, for example, \( H_{ter} = H_l = 550 \text{ m} \) / this height corresponds to the pressure according to EN AW = 711.7 mm Hg (949 mbar) and this will be its value, if the sea level is \( P = 760 \text{ mm Hg} \) (1013 hPa) / calculate the height difference resulting from the pressure difference

\[
\Delta H_{bar} = H_l - H_{AW} = 550 - 110 = 440 \text{ m}.
\]

This means that the barium level corresponding to \( H_{bar} = 0 \), \( P_o = 760 \text{ mmHg} \) (1013 hPa) increased by 440 m.

The conclusions of the above are as follows:

1. The altitude read from the board recording system, for example, when taking off at \( P_l = 750 \text{ mm Hg} \) (1000 hPa), should be \( H_{AW} = 110 \text{ m} \), the actual height above sea level, \( H_l = 550 \text{ m} \).
2. When reading from the recorder any height over the airport, for example, \( H_{bar} = 750 \text{ m} \), other types can be calculated:

\[
H_{absolute} = H_{bar} + \Delta H_{bar} = 750 + 440 = 1190 \text{ m};
\]

\[
H_{relative} = H_{bar} + \Delta H_{bar} - H_l = 640 \text{ m}.
\]

The above example assumes obtained on the basis of the recording system the numerical value of the barometric altitude. However, due to the errors resulting from the measurement technique, atmospheric pressure measuring system does not measure (record) barometric altitude but burdened with specific errors, altitude of instruments
To get from the known values of $H_p$, barometric altitude $H_{bar}$, the corrections in accordance with the following formula should be considered:

$$H_{bar} = H_p + \Delta H_a + \Delta H_f + \Delta H_{to} + \Delta H_{op},$$

where:

- $H_p$ - read from a record height value;
- $\Delta H_a$ - aerodynamic correction with characteristics RAP (Receivers of Air Pressure), it is referred to the calibration charts RAP attached to the aircraft operating manual;
- $\Delta H_f$ - wave correction determined by the influence of the accumulation waves on the performance characteristics RAP. It is determined with the instructions of the aircraft;
- $\Delta H_{to}$ - correction due to temperature deviation of the actual temperature from the specified AW, it is determined using the tables AW;
- $\Delta H_{op}$ - correction for delay indications (records), it is defined on the basis of nomograms attached to the aircraft operating manual (for the height change $\Delta H < 50$m/s, $\Delta H_{op} = 0$).

Aerodynamic correction ($\Delta H_a$) and wave correction ($\Delta H_f$) may be contained in one aerodynamic and wave correction ($\Delta H_{af}$). The aerodynamic problem is caused that the receiver RAP static pressure system of the aircraft, even though arranged at a distance from the hull of the aircraft, is located in the area of flow disturbances. The movement of aircraft at subsonic speed causes disturbances in the incoming stream to the RAP. As a result, the static pressure of the disturbed value is increased in relation to the pressure of undisturbed area, the higher the air speed, the greater its effect on the altitude indicator.

Wave error ($\Delta H_f$) is caused by the influence of the shock waves formed during flight at about the sound speed of aircraft on the system RAP in terms of the range of Mach number $0.95 \div 1.05$. After exceeding the speed of sound when the shock wave passes through the holes of accumulation receiver pressure system RAP (at $Ma > 1.05$), aerodynamic and wave errors disappear. Altimeter indicates the height similar to the barometric.

Temperature error ($\Delta H_t$) is due to the deviation of the actual air temperature on the ground of ambient temperature $t_e = +15^\circ$C. This error may be roughly set so that approx. $3^\circ$C difference between the actual temperature near the ground and the temperature of $+15^\circ$C temperature correction is $1\%$ of the height (if the actual temperature is less than $15^\circ$C, $\Delta H_{to}$ has a negative sign, and if it is higher - positive sign).

Error $H_{op}$ is caused by the inertia of the static pressure variations in the installation from RAP to the sensor. The value of this error depends on the vertical speed. This correction is not taken into account at the vertical speed $0 \div 50$ m/s ($H_{op} = 0$).

Having known the range of an error with which a measurement of an altitude of the aircraft is burdened, another element of transformation of height parameter, namely the device presenting measured values, can be analyzed. This device is placed in the instrument panel barometric altimeter, which is nothing but a pressure gauge in the most commonly used among aviation gauges (belonging to the group of pressure gauges of the spring). A sensor is diaphragm (membrane) made of a resilient material, sealed onto the circumference of the flanges between the top and bottom of the instrument (Fig. 4).
The measured pressure is fed into one of the chambers formed by the diaphragm and the sensor housing. The deflection of the center of the diaphragm, deforming under the pressure is transmitted via the lever and gear for a hint, the deflection is a measure of the pressure. In order to obtain a linear relationship between strain and the operating pressure, the diaphragm with embossed waves is applied. Diaphragm pressure gauges used to measure pressure, does not exceed 3 MPa. Most often, however, these gauges are used for measuring negative pressures and pressure differences [3].

The knob which is located in the lower part of the indicator is used to set pressure in mm Hg. In the above image, the kind of altimeter can be seen, where the value of the set pressure, on the basis of which height will be measured, is located in a small window between 4 and 6.
The altimeter has the ability to set the reference pressure for the correct calibration of the instrument. It can be set to three different values of the ambient pressure:

- pressure of take-off airfield, marked QFE. Altimeter then indicates the relative height;
- sea level pressure (QNH), giving absolute altitude;
- standard pressure on the averaged sea level (QNE), or 1013.2 hPa (760 mm or 29.92 inches of mercury).

Undoubtedly, the most important feature of the height indicator as each instrument, are accurate indications. Checking the accuracy of the indications height indicator is a repetitive process, specified by the indicator manufacturer. Manufacturer's data (model) is contained in the indicator metric and is the reference point in the case of necessity of checking during the operation of the aircraft. Entries in the metric determine the acceptable error rate values for individual instrument readings. Verification is made on the position of control - measuring, equipped with a control (reference), the ratio of the required accuracy class, with a valid proof of legalization. The indication accuracy of altimeters depends on the scope of the indicator.

It should be mentioned that an extremely important issue (often underestimated) which significantly affects a total error of the measured parameter, is the accuracy of reading the values indicated by the indicator. The failure to technological requirements or utility causes the reader to generate through the so-called parallax error, an additional error into the system input data for an analysis. This can occur both during laboratory checks and during operation.

![Image 2. Parallax error of the indicator](Source: authors own elaboration.)

Another element of the transformation of the height parameter is a signal height feeder. The principle of operation is the same as height indicator, since it is identical to the indicator (as a rule of action) instrument - gauge. Since the idea of its work has been discussed above, a slightly different aspect of the role which a feeder plays in maintaining objectivity of parameter, will be dealt with.

The feeder is a primary sensing element which receives and processes the measured parameter into an electrical signal, which is an input signal to block the acquisition of on-board recorder. Location and built of the feeder on the aircraft...
is conditioned by reliability (objectivity) to measure the parameter by feeder and technological possibilities of the feeder. Thus, for example, height feeder may be built into the aircraft cabin or in the height indicator. At this point, when talking about a height feeder, a variety of feeders and its classification by type of signals should be made. Feeders are divided into the following groups: continuous signals feeders (analog) and disposable commands feeders.

Height feeder is analog when a main measuring sensor is a spring aneroid measuring changing static pressure with an increase or a decrease in height. The change in pressure causes deformation of the cans, which through a combination of mechanical connection changes proportionally slider of a wire potentiometer. As a result of dimensional changes of the can, a proportional voltage change deposited in the resistor is obtained according to the changing height. Nevertheless, it might me asked: Why to measure the height for the second time now, if it is measured and indicated by the altimeter? Firstly, it is not possible because of structural reasons, for the altimeter to generate another "electrical" signal, but also it would not be advisable to conduct these two functions in a single device, even if the reasons mentioned in the analysis of the OFC system (security, training, verification, prevention). The use of such a solution with a separate measurement of the height signal (and other analog signals), carries the risk of a differential error between the index and the feeder. To avoid the "divergence" of the measured values to the same parameter for two different devices, for example, an altimeter and a height feeder and thus to avoid ambiguity in measuring height feeder are the subject to the same operating requirements as the indicator of height. Indicator check conditions are specified by the manufacturer and the manufacturer of the recorder, and are included in the technology of scaling indicators used on the aircraft.

The results of scaling are the operational documentation of aircraft. It should be emphasized that the proper performance of the scaling is of fundamental importance in the processing and data reading from the onboard recorder. It is required at the stage of scaling to take a great care of the order and the quality of operations in accordance with scaling technology.

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![Image 3. Height feeder MDD-Tje- 1-780](source: author’s own material.)
Conclusion

Based on this brief analysis of the OFC system and measurement channel of height parameter in the system, potential areas affecting the quality of the signal processing can be identified. Bearing in mind the characteristics of these areas, two categories of errors can be distinguished: organizational errors and technical errors.

In terms of organizational mistakes, as a region having a significant impact on the behaviour of objectivity, data collection subsystem should be noted. Operation of registrants and scaling parameter feeders, are the main elements of this subsystem. They have a direct impact on generating a gross error, with a high risk of crossing a critical error.

![Diagram showing organizational and technical support systems](source)

**Fig. 5. Places of emergence of potential gross error**

*Source: author’s own material.*

In any case, the objectivity of the measurement parameter will not be saved if the scaling process is not performed in accordance with the current technology and by trained personnel. This type of action arises, for example, from a failure to check the methodology or lack of knowledge, the effect of generating an incorrect graphic of scaling the parameter. The graphic then becomes a kind of a carrier of "bad" information, introducing gross errors into the data processing subsystem. In the case of not capturing the above irregularities in defective scaling schedule, there is a systematic error, unfortunately, often identified incidentally in the course of a detailed analysis. Scaling is the process repeatedly executed during the operation of the aircraft. This is when feeder is replaced, during a periodic service, but also in situations not specified in the technology of technical services, like the conclusions from the analysis of flight data or a suspected malfunction of the board device.
Fig. 6. The road of height parameter signal in the OFC system

Source: author’s own material.

In the end, the boundaries of "chasing" the accuracy of the parameter measurement in the OFC system should be defined. Certainly, an impassable limit to maintain correct functioning of the OFC system is simply ensuring the objective of measurement of all parameters in the system undergoing transformation. The reality but also the purely technical aspects related to the capabilities of devices for measurement as accurate as possible, force the OFC system to determine the tolerance of accuracy range of measuring the phenomenon. They consist of formal and technical requirements regarding all components of the system relating to the management system (obligations of the function personnel), as well as technical equipment documentation (manufacturer’s data, maintenance data) and readability of the data logger.

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