CASE STUDY

Security management and digital platforms: appification of Brazilian Air Force prevention reports

Gestión de seguridad y plataformas digitales: appification de los informes de prevención de la Fuerza Aérea Brasileña

Gestão de segurança e plataformas digitais: appificação dos relatórios de prevenção da Força Aérea Brasileira

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ABSTRACT

In the Brazilian Air Force, as well as in aviation in general, risk management is present in several layers of the organization. There are numerous activities for the prevention of aeronautical accidents, among them are the prevention reports (RELPREV). These reports are prepared by operators who observe any conditions that may generate a risk to the activity and affect flight safety. Currently, they can only be made physically or through computers made available at Air Bases. Considering the current dependence that people currently have on mobile devices, especially smartphones, combined with the practicality that this tool provides for the user, this work carried out a study in the data collection process and developed a web application, aiming at the application of prevention reports.

Keywords: Flight safety; Brazilian Air Force; Prevention reports; Appification.

RESUMEN

En la Fuerza Aérea Brasileña, así como en la aviación en general, la gestión de riesgos está presente en varios niveles de la organización. Existen numerosas actividades para la prevención de accidentes aeronáuticos, entre ellas se encuentran los informes de prevención (RELPREV). Estos informes son preparados por operadores que observan cualquier condición que pueda crear un riesgo para la actividad y afectar la seguridad del vuelo. Actualmente, solo se pueden realizar físicamente o mediante computadoras disponibles en Air Bases. Teniendo en cuenta la dependencia actual que las personas tienen actualmente de los dispositivos móviles, especialmente los teléfonos inteligentes, combinada con la practicidad que esta herramienta brinda para el usuario, este trabajo realizó un estudio en el proceso de recolección de datos y desarrolló una aplicación web, con el objetivo de la appification de los informes de prevención.

Palabras clave: Seguridad de vuelo; Fuerza Aérea Brasileña; Informe de prevención; Appification.

RESUMO

Na Força Aérea Brasileira, assim como na aviação em geral, o gerenciamento do risco está presente em diversas camadas da organização. Existem inúmeras atividades para a prevenção de acidentes aeronáuticos, entre elas estão os relatórios de prevenção(RELPREV). Esses relatórios são confeccionados pelos operadores que observem quaisquer condições que possam gerar risco para a atividade e afetar a segurança de voo. Atualmente, eles podem ser confeccionados

somente por meio físico ou por computadores disponibilizados nas Bases Aéreas. Considerada a atual dependência que as pessoas atualmente possuem dos dispositivos móveis, em especial dos *smartphones*, aliada à praticidade que essa ferramenta proporciona para o usuário, este trabalho apresenta um estudo do processo de coleta dos dados e desenvolvimento de um *web* aplicativo, com vistas à *appificação* dos relatórios de prevenção.

Palavras-chave: Segurança de voo; Força Aérea Brasileira; Relatório de Prevenção; *Appificação*.

1 INTRODUCTION

Air activity is complex because it involves, directly and indirectly, lives of thousands people, making it extremely important to develop efficient mechanisms to maintain safety at an adequate level and to mitigate possible latent conditions that may generate risks for the operation.

Human error is present in most aeronautical occurrences. When analyzing and carrying out an in-depth study, it is possible to observe that it does not come from randomness, being, in most cases, predictable and repeated (SOBREDA, 2011). A characteristic of human beings to be considered is that similar situations generate similar errors, even if they reproduced by different individuals (REASON, 2009). Therefore, it is important to study the occurrences involved in the Air activities and identify conditions and procedures that can be modified or improved, with the aim to improve the process and to the consequent mitigation of the danger for the non-repetition of the error.

1.1 Contextualization

The units of the Brazilian Air Force that own aircraft or that are responsible for performing maintenance services have a sector responsible for managing flight safety. Named Aeronautical Accidents Investigation and Prevention Center (SIPAA), it works in the investigation of aeronautical occurrences and in the prevention of new accidents. In the preventive part, monitoring of the prevention reports (RELPREV) of pilots is carried out, in addition to the promotion of educational and recreational activities, disseminating the organizational culture with a focus on the flight safety mentality.

RELPREV is a report made by the pilots, mechanics or anyone connected to the air activity to record possible unsafe conditions or reports of experiences.

1.2 Appification of contents

Currently, there is a constant technological evolution, especially when we use as a reference devices connected to the internet and/or capable of using apps. Thus, the use of mobile devices, smartphones, is widely accepted by the vast majority of people. The practicality of being able to perform numerous tasks with a few clicks has caused considerable population dependence. We rarely come across a person who does not have a mobile device or even who does not take their smartphone with them everywhere (RODRIGUES, et al, 2017).

The Made in web group (2018) says that, as in people's lives, technology influences a company's administrative and operational performance. The ease and dynamism offered by mobile devices bring greater practicality and agility in communication and business management, contributing to better results.

According to WK Serviços (2019), one of the biggest advantages that apps provide is mobility. As a result, a good use of content appification in the management of the organization can bring better results to the company.

It is possible to consider, therefore, that appification, that is, the migration of digital platforms to the app format, can be beneficial for the management of the institution, considering the specific characteristics of each business sector.

1.3 Problematic and objectives

All information contained in prevention reports sent to SIPAA is analyzed and processed for risk management. The sooner the information reaches the Flight Safety Officer (FSO) of the Air Unit, the faster the Accredited Prevention Elements (EC-PREV) can act in order to prevent any unsafe conditions. When the launch is delayed, there is the possibility of partial forgetfulness, with a consequent loss in the richness of details, which can also generate total forgetfulness and the loss of important information that can be beneficial for the improvement of processes.

In order to verify the accessibility of the platform for launching prevention reports and implementing improvements in the data collection process, the following question is presented: is the appification feasible in prevention reports as a form of assistance to the management of flight safety at FAB?

Considering what has been said, the present work aims to promote the study and development of an app prototype for making the RELPREV and, as specific objectives, to quantify the number of reports through the created prototype; analyze the time between the observation of the facts and the preparation of reports; and compare the reports made on the available platforms.

1.4 Justification

Currently, to make a RELPREV, it is necessary to access the Brazilian Air Force intranet network, called intraer, which is only available on certain computers at the Air Bases. Some variables, such as landings outside the places of origin, subsequent involvement in the aerial activity and even fatigue, can make the observer report the information later, which contributes to possible forgetting. Considering this, the barriers to accessing RELPREV and the possibility of forgetting when having to postpone the report can negatively contribute to the management of flight safety by not bringing to the attention of managers the failures and latent conditions that could be worked on to mitigate the risk.

The high dependence that the human being has on mobile devices and the technological evolution allowed the development of platforms that facilitate the management of processes. In this way, the use of apps becomes one of the best options, such as software for the relationship between the operator and the information manager due to its available tools, interface, ease of access, speed in processing information, among others.

2 THEORETICAL REFERENCE

The motivation and culture disseminated in a given location can be impacted and influence the final result, if activities are carried out in an unsafe way. Thus, it is necessary to maintain a high level of safety and reliability in the work environment. The occurrence of an accident at work can affect the motivation, confidence and unity of the group and, consequently, negatively impact productivity. In order for this not to occur, the probability of occurrences must be mitigated as much as possible and a strong and lasting safety culture must be created, in which workers naturally feel safe and confident to carry out their activities (BENITE, 2004).

2.1 Operational Safety Management at FAB

According to ICAO (2018), flight safety management seeks to reduce, as much as possible, the risks inherent in air activity before they result in aeronautical accidents.

As in civil aviation, in military aviation, more specifically in FAB, there are specific legislations, the most relevant being MCA 3-3 (SIPAER prevention manual) and NSCA 3-3 (Flight safety management in Brazilian aviation). In order to guide and standardize prevention activities, these manuals have a range of activities, instructions and standards to be applied by Elo-SIPAER. Among them, the best known and applied by the Flight Safety Officers of FAB Air Units are the reports or prevention reports (RELPREV), the flight safety surveys (VSV), the SIPAER method of risk management (MSGR), the aeronautical accident prevention program (PPAA), in addition to instructions for educational and promotional activities.

2.2 Human, Operational and Material factors

With decades of experience in the field of flight safety, today the Center for Investigation and Prevention of Aeronautical Accidents (CENIPA) is based on the SIPAER philosophy on the triad: "Man, Environment and Machine". As a result, investigations and accident prevention activities use these pillars to guide their activities.

For the Federal Aviation Administration (FAA), the study of human beings is a multidisciplinary effort to generate and gather information about human capabilities and limitations. Using this information to produce safety and comfort improves effective human performance. (ICAO, 2014). It also cites the ICAO (2003, apud MARTINS et al., 2006) according to which, turning our attention to factors related to the human being can improve efficiency, effectiveness, safety and productivity in the aeronautical sector and, consequently, control costs, with a view to reducing incidents.

Overall, statistical data show that, in the vast majority of air accidents involving large aircraft, human error is present as a contributing factor

(MARQUES, 2004, apud MARTINS et al., 2006). Furthermore, according to CENIPA, between 2004 and 2013 the human or operational factor was present in about 95% of the occurrences. Paoli et al. (2007, apud BESSI, 2018) mention that, in more than 70% of cases, the origins of aeronautical occurrences are linked to this same factor. These data show the importance that should be given to this area of aviation safety management to reduce the rate of occurrences.

The possibility of human error can arise from a multitude of variables, from a misinterpretation of a given procedure, fatigue, to psychological factors linked to external problems. According to Helmreich (1998), cited by Martins et al. (2006), whenever human beings operate systems of a certain complexity, errors and deviations from procedures will occur and, given the aforementioned variables, in addition to overloads, stresses, among others, the probability of error increases proportionally to the complexity of the activity.

When referencing human error, there is a wide range, which would make the possibility of delimiting and reaching the same result for all situations unlikely. In this area, the ICAO (2003), cited by Martins et al. (2006), emphasizes that both behavioral and performance and evaluative aspects are addressed, from the evaluation of human judgment for decision making, interpretation of situations, to the interaction of man with other individuals, also considering the relationship of the human being with the machine.

There are also several theories that are used as beacons for the prevention and management of flight safety. The theories of Heinrich and Frank Bird emphasize that the occurrence of serious accidents is usually preceded by several other small-scale occurrences or near misses (HEINRICH, 1931), (FERRARI, 2006). On the other hand, the Swiss cheese model, developed by James Reason (2000), defends the idea that an accident walks through several gaps in the various layers of a system, similar to a Swiss cheese. Another well-known model in aviation is the SHELL model, created by Edwards in 1972 and later modified by Hawkins in 1975. In this model, the human being is represented as a central component that relates to the other components. - software, hardware, environment and liveware - (ICAO, 2018). In addition, for an occurrence to occur, there is a failure in human interaction with some of the components of the system (CENIPA, 2020).

As already pointed out, most serious incidents are preceded by near misses or other minor occurrences. This underscores the importance of knowing the latter in order to avoid major risks.

2.3 Appification of contents

Nowadays, there is a great dependence of the human being on a smartphone, which is an essential device to their routine and that is usually carried with them wherever they go. Dependence on this device is largely due to the ease and mobility that the device generates, in addition to the easy access to any information or communication with other people instantly.

Almeida (2016) emphasizes that technology has directly affected the routine, the strength of man's relationship with the world and with companies, and that, currently, companies increasingly seek to bring technology in their favor, improve the development of the activities and the management of the structure. Carr (2011, apud CORREA, 2012) argues that more and more companies need to seek the appification of their content, that is, modify their digital businesses so that they can be migrated to the form of apps. In addition, Kosner (2012) states that in the future, technology will tend to migrate to the appification of certain websites, especially those related to services, due to the greater benefits and interactivity they have.

3 METHODOLOGY

The main focus of the work is on the creation of a web app to verify the feasibility of appification of the RELPREV data collection process. In order to measure the impact of the process, a quantitative research method was chosen to verify two main aspects: raising the number of reports made by the pilots after the creation of the software and a comparison with previous years, as well as the time difference between the observation of the fact to be reported and the preparation of the report. A comparison of the result obtained by the production made by the developed software and by the FAB intranet network.

As a sample space for the research, a FAB Air Unit was used, which had the participation of about 55 pilots. For this, a test was developed with the web app available to all members of the Squadron's Crew

Board, so that it would be accessible to any of them who showed interest. In addition to the software created for the appification of prevention reports, the other forms of preparation continued to be available normally, so that was an additional form in the data collection process.

4 BACKGROUND OF PREVENTION REPORTS

RELPREV is an instrument used for voluntary reporting, which aims to provide relevant information to those responsible for security management, so that they can reach the several sections of the system.

Currently, the limitation of production by digital means is due to the fact that it is made available on a site on the FAB intranet network. With this, access becomes possible, for the most part, only on specific devices that are connected to this network.

Considering the dynamism of the flight journey, due to being inside the aircraft and not having access to computers, in addition to other involvements with this activity, such as filling in reports and ground procedures during intermediate landings, it is necessary to postpone the preparation of the report in some cases. With this, it is customary for pilots to leave their reports to be made after the end of their involvement with the air activity. Sometimes, fatigue, other flight involvement or subsequent administrative activities, for example, can further delay reporting. In this way, the facts listed here can increase the time between flights and the transmission of some information that may be important for security management.

5 APPIFICATION OF PREVENTION REPORTS

Taking advantage of people's dependence on mobile devices, ease of use, speed in data processing and the flow of information, this work sought the appification of prevention reports. For this to be possible, a web app was developed to prepare the reports, so that they could be organized by the personal mobile devices of the airmen.

In order to create an interactive platform that would facilitate the preparation of prevention reports, some hypotheses were analyzed. The first would be to create software in the form of an app. For this, it would be necessary to hire a specialized service, in addition to dependence on support and disengagement of financial resources.

Another simpler and, therefore, applicable hypothesis, which would bring greater benefits to this initial study, would be the creation of a web app. A web app is software developed by a responsive website, that is, it adapts the page size according to the device's screen size, all with the layout of an app, with the ease of being accessed by any device that has a browser and internet connection. It is worth mentioning that, despite being hosted on a website, the web app can be inserted as a shortcut on the home screens of mobile devices as if they were really a mobile app. Furthermore, as it is a simple platform to be created, modified and which, commonly, does not present technical problems, it could be developed and managed by Elo-SIPAER.

5.1 Web app creation

To create the web app, the Firebase was used, a platform managed by Google Clouds that works as a database. In it, you can store files, process data or host servers and websites without concern for the structure.

For development, it is necessary to have a Gmail account, in which to login and create a project on the Firebase website, and specific programming settings in the computer's command prompt to create the layout. These activities are not complex and instructions can be easily found on the internet, through articles and explanatory videos.

To access the web app, just click on the generated link, which consists of the "project name" + ".web. app". In this case, the project was named by coding that only pilots know, so that external people do not have access to the generated link. Once the RELPREV option is selected, there is a redirection to a page to fill in a password, which is also known only to the Unit's pilots. After that, you can create the form.

In addition to the possibility of filling in the RELPREV, there are other tabs available for meteorological consultations, planning of flight missions, in addition to redirecting to a FAB spreadsheet with all fuel contracts in the various locations in the country. For the creation of other utilities for the web app, it was intended that there would be a routine interaction in the use of the platform, in order to make the usability of the software cultural for some specific tasks of the pilots.

6 DATA ANALYSIS

6.1 Total amount of RELPREV

As a way to quantify the adherence of pilots to the use of the web app, we compared the total number of reports made in the last ten years.

Considering that the current year is not yet closed, in order to make a more reliable comparison, the months from January to August from 2012 to 2021 were used as a reference.

As can be seen in Table 1 and Graph 1, considering the years in which the web app was not available – 2012 to 2019 – the average number of reports created from January to August was 297. In the years 2020 and 2021, there was a considerable increase, with a clear increase since May 2020, given the creation and dissemination of the software in that month.

Table 1 – Principais eventos da primeira fase.

MONTH	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
January	2	4	1	1	3	6	14	4	3	7
February	14	14	18	18	24	11	22	18	9	55
March	39	21	13	57	28	29	40	30	15	134
April	20	42	43	39	27	48	72	41	54	214
May	95	34	27	38	38	52	82	27	114	186
June	92	37	24	45	36	31	51	6	171	157
July	71	71	35	43	41	32	68	89	228	134
August	74	63	64	39	47	51	68	42	96	77
TOTAL	407	286	225	280	244	260	417	257	690	964

Source: SGSV.

Graph 1 - RELPREV in the last ten years.
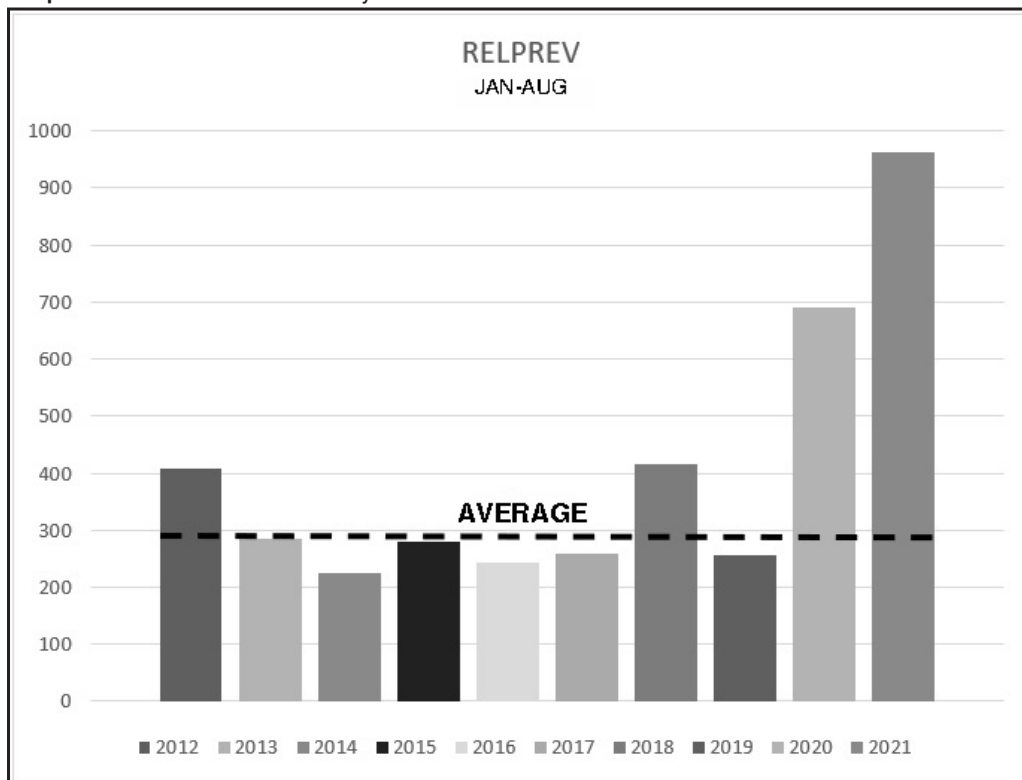
Source: SGSV.

The percentages show that the year 2020 had an increase of 168%, highlighting the creation of the website in mid-May. When observing the data presented in the year 2021, the increase is even more significant, 225%.

It is also worth mentioning that adherence to the new method of preparing the reports has become adequate, considering that in 2021 alone, 328 reports were prepared through the web app, a number that represents almost 40% of all reports prepared. This number shows that, despite having traditional methods that have been consolidated for many years in the culture of the Brazilian Air Force, the web app had good adhesion, taking into account the short time in activity.

6.2 Time to make RELPREV

Considering that it is one of the improvements that can contribute most to the improvement of the process of preventing new aeronautical occurrences, the time it takes for the information to reach the Flight Safety Officer is of fundamental importance for the initiation of mitigating actions and the prevention cycle. According to Diana et al. (2020), in addition to quality, time optimization is essential for good process management.

Thus, we made a comparison of the reports prepared by the web app and the intranet, considering the dates of preparation of the reports and the date of the event.

Considering that the data entered in the SGSV are only available from the year 2016 onwards, Table 2 illustrates the average time between the preparation of the reports obtained from that year onwards. Table 3 presents the same data illustrated in Table 2, but with the addition of information for the year 2021 and the change in the total average, as a way of visualizing the difference that this last year presented. Table 4 shows the reports prepared in 2021 in more detail, specifying, separately, the data obtained by the web app, by the intranet network, the average difference between the platforms and the total average. For statistical purposes, the RELPREV written by physical means represented less than 2% of the total amount and were considered together with the data obtained from the intranet network, as this is the method already used by the Unit.

As can be seen, the average time spent to make the prevention reports until the year 2020 was almost five days, that is, the information that could improve safety management, in these cases, took almost a week to get to the knowledge of managers in some cases, considered non-working days.

In the year 2021, the average dropped considerably, reaching 2.72 days. Analyzed separately for the year, the reports created remotely through the developed web app took about 1.23 days to be written, while the others took, on average, 3.49 days. Thus, it can be observed that the data collection process, considering the time it takes for the information to be in the system available for viewing by the flight safety manager, reduced by almost three times in the case of information processed by mobile devices.

Table 2 - Average time to prepare the reports (2016 - 2020).

2016	2017	2018	2019	2020	average
4,73	3,51	2,58	6,63	4,91	4,47

Fonte: SGSV.

Table 3 - Average time to prepare reports (2016 – 2021).

2016	2017	2018	2019	2020	2021	average
4,73	3,51	2,58	6,63	4,91	2,72	4,18

Fonte: SGSV.

Table 4 - Average of time– 2021 (web app x intranet).

intranet	web app	≠	average
3,49	1,23	2,26	2,72

Fonte: SGSV.

6.3 Comments

Based on the data obtained to quantify the applicability of the use of the created platform, it was possible to verify that the influence was positive in the data collection process, considering that there was an increase of approximately 225% in the number of reports received, when comparing the year 2021 to the average of previous years in which the software was not available as an aid.

It is not possible to confirm only by the numbers obtained, but there are strong indications that a considerable part of this increase was due to the practicality of carrying out the relevant comments at the time of the event. As the custom of carrying out the preparation of the report in future times can cause forgetfulness or procrastination, it is safe to infer that the practicality and the possibility of carrying out this task at the exact moment raised more reports from May 2020.

Regarding the prevention cycle, it begins with the observation of the fact and ends with the disclosure of the measures already adopted to mitigate the risk, after the work carried out by the Flight Safety Officer. The reduction in the time of this process is one of the greatest gains that can be considered for prevention activities, given that this reduction means that the unsafe condition was mitigated in a shorter period of time, with less exposure of pilots and aircraft to active failures or latent conditions.

As can be seen in the time analysis, the difference between the methods already available and the web app were considerably large, since, in 2021, the software created generated a reduction in time of almost three times when compared to the conventional system, being this difference of more than two days in the prevention cycle. If the comparison is made with the average time of previous years and with the web app, the difference is even greater, exceeding three days.

7 FINAL CONSIDERATIONS

Through the data obtained in the study, it was possible to observe that the appification of content is beneficial for the RELPREV data collection process. This corroborates with Kosner's (2012) statement that the appification of content would be a great advance for the future of technology and process improvement.

For Oliveira (2018), the use of smartphones in the work environment is of fundamental importance these days, in view of the ease of communication and carrying out activities, in addition to the various features that apps can provide.

Considering this, this work aimed to use people's "dependence" on smartphones to bring one more facility to the user and to the management of the process. The appification of the content provided the flight safety manager with more agility in the processing of information and, consequently, reduced the time of exposure to risk in several reported situations, as exposed in this work.. In addition, engagement with reports increased, considering that in 2021 there was an increase of more than 200% compared to previous years. The increase in the number of reports is of great importance for the Flight Safety Officer, as these data can be used for dissemination, as a way of exchanging experiences, culminating in a greater level of attention to certain aspects, in addition to stimulating the culture organizational unit with the commitment and focus on flight safety.

Although the appification of the RELPREV has proved to be adequate for the improvement of flight safety management, there are conditions that present other opportunities for improvement, which, if possible, can be applied in order to contribute even more to the prevention of aeronautical accidents. The web app created facilitated the preparation of reports by the pilots and, in addition to increasing the number of reports, it reduced the time for their preparation due to practicality. This process, however, brought a slightly higher workload for the flight safety manager, since the RELPREV launched by the web app does not go directly to the SGSV. The reports prepared by the created platform are stored on a platform external to the network, requiring the insertion of this report in the intranet network by the Flight Safety Officer. This process is fast, does not require a lot of work and the gain that comes with the increase in the amount of information reported and in the reduction of the time for preparation by the pilots compensates for this detail. Despite this, the interconnection of an app with the Brazilian Air Force's intranet network would bring an even greater improvement to the process, which stimulates future studies and works.

Currently, FAB has an app with several administrative, informative and promotional tools. If it were possible for the application to intercommunicate with the Flight Safety Management System, it would be possible to create a tab for making reports.

FAB is a reference in world aviation, contributing from its beginnings to the present day. In the area of flight safety, this importance remains, in view of the work carried out by CENIPA in investigations carried out in Brazil and in the world, in addition to its technological capacity compared to major world powers. Although flight safety management is well conducted, improvements can always be made, in order to make the process evolve, as presented in this work. Still, there are aspects that can be improved with a view to maximizing the improvements.

Thus, after presenting the improvements that the appification of prevention reports can present for the management of flight safety, this work ends with the stimulus for the evolution of the appification process, so that the launches of the reports are sent directly to the Flight Safety Management System on the Brazilian Air Force intranet network.

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