

## SKYFLIGHT MOBILE: A SERVICE TO ENHANCE THE LEONARDO FLYING EXPERIENCE

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### Abstract

In recent years, the usage of Electronical Flight Bags (EFBs) has significantly increased to assist pilots in their operations. While initially used as a means of storing, updating and consulting the Aircraft Manuals and information necessary for the flight, latest technological developments and the availability of affordable high specifications electronic personal pads, have given to EFBs the ability to perform also a variety of computational calculations, access databases and display real-time data. EFB can have multiple functions. It can store and display important mission data, give the ability to carry out mission analysis and perform calculations for flight performance and weight and balance validation. The management of the flight operations will likely be more and more automated and integrated in all its aspects, from maintenance to flight. In this scenario, in order to maximise the delivered value and to better meet the operational needs, Leonardo, leveraging on its knowledge as the aircraft manufacturer, has developed and is offering services and technologies.

With a primary focus on the calculations of aircraft performances and weight and balance, SkyFlight Mobile is the Leonardo Helicopters EFB, delivered as a service to enhance the flying experience. SkyFlight provides the means to evaluate on ground all aspects of the mission, to guarantee a thorough safety assessment and to increase the mission effectiveness. Pilots have SkyFlight application installed on their devices to access the web service. Anywhere, the relevant information and calculations for a mission can be used, fully compliant with the Rotorcraft Flight Manual and the authority's requirements. SkyFlight automatizes the daily operations to reduce the flight crew workload and head-down time, to increase the pilot situational awareness and to optimize costs.

SkyFlight has been designed and developed entirely by Leonardo Helicopters, leveraging on its knowledge. In order to keep the pace of modern software applications, a properly tailored Agile methodology has been used, with the aim of delivering quick and continuous updates related to new functionalities and issues identified during the software testing activities. Since the service is meant to be used by the community, the selection of the stakeholders had to take into account some representatives of pilots from the different operations that are meant to be supported. This led to involving both Leonardo Helicopters Division Pilots as well as a set of specific Customers that demonstrated interest in the evolution of the system (in the Executive and Private transport, Medical and Rescue services, Offshore operations, Security services and Utility). The compliance of SkyFlight with the National Aviation Authorities EFB validation standards, is demonstrated with the evidence of the software testing activities achieved, including User Interface testing, reliability testing, and accuracy testing.

The SkyFlight service is designed and developed to enhance the flight experience. Pilots receive value by accessing to the functionalities tailored for their helicopters operations, together with the Leonardo experience, professional skills, systems, facilities, and networks.

### 1. INTRODUCTION

Formerly the aircraft performance calculations for flight planning have been accomplished using paper-based reference material. Since most of this information has turned out to be available in electronic format, pilots have progressively recognized the benefits of having these calculations automatically available and stored in their Electronic Flight Bags (EFB).

This scenario, following the increasing requests from pilots to have an EFB to support their operations, has pushed the development of hardware and software solutions for the aviation market. From the basic scope to store the Aircraft Manuals and Technical Publications the set of

functionalities has expanded with all the capabilities to provide the necessary information and calculations for a complete safety assessment. So that the flight experience starts on ground with the planning and ends after the flight with debriefing purposes.

As a consequence of this increasing trend in the use of portable EFB systems, National Aviation Authorities (NAAs) have standardised evaluation procedures to support the successful realisation and maintenance of high-levels of safety [1][2][3][4][5][6].

It is easy to foresee that the management of the flight operations will be more and more automated and integrated in all its aspects, from maintenance

to flight [7].

Since several years, Leonardo started pioneering in providing advanced services designed and developed to enhance the Customer experience. Now a step further is being made, offering a service to enhance the flying experience.

Through the integration of SkyFlight with the aircraft, it can be seen as an integral part of the Helicopter system, offering the features to increase flight safety, compliant with the aviation rules, through a portable device and a simple and intuitive interface. The simplicity and intuitiveness of the System is also found in the sales approach, through a service, and in the architecture and in the development of the software that follows the agile methodology,

The article is aimed to present all of these key aspects of SkyFlight: its interface and functionalities, the SW architecture, the Software development and test phases.



Figure 1 – SkyFlight

## 2. HUMAN FACTOR AND SITUATIONAL AWARENESS

The term Human Factor refers to a wide set of factors closely related to the pilot that determine the success of the flight mission. These elements are also the most unpredictable and vulnerable factors that can affect the flight. All these aspects must be taken into consideration well before the flight begins.

The main objective is the understanding of all the expectable human abilities and limitations. This knowledge can then be applied in the definition of a standardize approach in the design of procedures and requirements.

In the complex operation, everything the pilot needs to know while flying can be included

under the terms of situational awareness (SA), from the operational point of view, due to the inner complexity of the aviation operations; a potential small error can cause serious huge problems. SA means having a deep understanding of all the aspects determining the current situation and the involved dynamics to anticipate future developments and changes, clearly understanding the consequences for that particular action.

A general definition of SA is that it is the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future [11].

In this scenario, it is easy to understand that the prime way for pilots to manage their workload and to increase the SA is the pre-flight planning.

“Plan well in advance”. The pre-flight planning activities include not only the plan of the route itself with the associated information such as airports, weather conditions, etc. but also knowing exactly the aircraft’s capabilities.

The pilot shall brief himself and all the crew on the plan, reviewing together each phase of the upcoming flight including the necessities such as the route, the fuel required, the respect of the limits, and anything else that might be useful for that flight.

SA is essential and the Human Factor impact is pervasive for flight safety.

Planning and communication are necessary components to coordinate each flight phase.

To have a really effective planning system, in addition to the mere definition of the functionalities, it must be considered also the way in which the contents are presented and how they are used. It is worthy to note that the interface is as consistent as possible with the crew station and the avionic instruments, in terms of look and feel, operational workflow, interaction manner and logical flow for the decision making.

The SkyFlight Mobile Service has been designed to consider these key concept for the main functionalities that the Pilot must consider prior to fly, reducing the in-flight crew workload by providing all the info in just one tool and delivering it in an intuitive way.

Delivering this as a service, to which pilots can access from wherever, guarantees also the data update, fully compliant with the Manuals. Moreover the service allows focusing on the operational requirements and the growing features to support it.

To better reflect these dynamic aspects of

software evolution, it was decided to follow the Agile methodology which, by its very definition, allows developing the software in a fast, flexible and responsive way.

### 3. THE SKYFLIGHT MOBILE SERVICE

Leonardo is designing and developing a growing portfolio of advanced services to answers to its Customer needs for the enhancement of the safety of the flight and to better support them in their operations.

Products and services are two strictly related concepts, and, indeed, most products have an element of service in them. In addition to the tangible components of the Aircraft, the Customer buys a widespread bundle of service for its benefits. Nevertheless there is a distinct difference between a service and a product. A product is something that is produced and delivered and then the main related activities are in charge of the owner, while a service is the result of the application of skills and expertise towards an identified need. Moreover for the nature itself of the service, the Customer and its need to be fulfilled, are put at the centre, holding at supplier level the management of the components involved to provide it and all the associates risks.

Therefore, a service can be defined as the production of an essentially intangible benefit, either in its own right or as a significant element of a tangible product, which through some form of exchange, satisfies an identified need [8].

With SkyFlight service, Customers receive value by accessing to the functionalities tailored for the helicopters operations, together with the Leonardo experience, professional skills, systems, facilities, and networks; without taking ownership of any of the elements involved [9].

Due to the inner nature of the service, Customers can benefits of the typical community scenario, where all the stakeholders are involved to identify the improvements and evolutions. Moreover the development costs can be shared among the community.

#### 3.1. Available Functionalities

While most of the other commercial solutions deal with the aspects of navigation, SkyFlight mainly focus on the aircraft and the planning. Leonardo as original equipment manufacturer has the advantage to know the aircraft and its customers operations. This allows to offer an integrated solution and to keep data up to date by providing direct access to it to all the Service Customers.

The flight experience starts on ground with SkyFlight, to continue on board the aircraft, and eventually to end with the available debriefing features.

According to the various scenarios of the helicopter missions, there are features designed specifically for Offshore, Executive and Private Transport, Medical and Rescue services, Security services and Utility.

Time is money but most importantly time could also have a much higher value, like in the HEMS missions where one minute can make the difference and the planning can save both patient and flight crew life. So the challenge is to give in pilots hands an instrument which rapidly provides the key information and calculations for the safety of the flight.

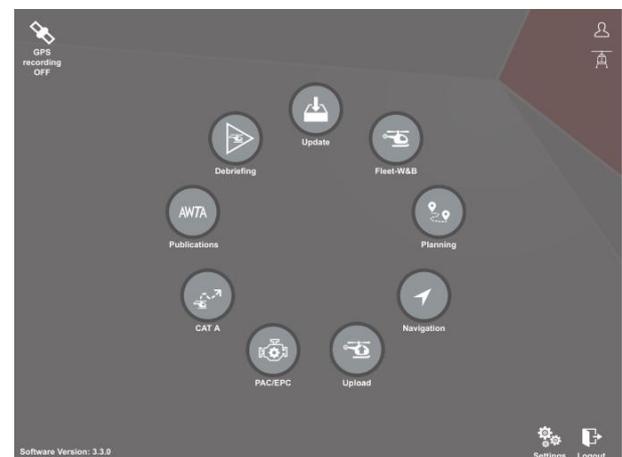


Figure 2 – SkyFlight main functionalities

Using SkyFlight Mobile Service, in just one single application, the pilot has at his disposal all the necessary information for an in-depth evaluation of the aspects related to the flight.

In particular, SkyFlight supports the flight crew with accurate weight and balance calculations, customized to reflect the real fleet configuration. Moreover, the functionalities allow transposing the aircraft updates and changes in terms of cabin configurations, kits list, weight and centre of gravity.

So the Aircraft and its data contained in the OEM approved documentation is the key of all the functionalities provided. A pre-flight evaluation of route design, amendment and assessment makes aircrew readily aware of what may affect the safety of the flight with a real time stream of weather and aeronautical data.

SkyFlight performs what-if analysis with complete performance calculations for each leg of the flight, fully compliant with the performance charts of the Rotorcraft Flight Manual, taking into account the

defined aircraft configuration and the relevant weather data.

Rapidly, in just a few clicks, the flight crew prepares reports in compliance with the National Aviation Authorities (NAAs) procedures.

Each pilot can save and share with the others and re-use his planned data, permitting a multi-model fleet control in terms of weight configuration and scheduled flights.

The planned flight can be promptly uploaded on board of the Wi-Fi enabled aircrafts (when aircraft is on ground).

An automated Engine Power Assurance Check is available for AW139, fully compliant with the Flight Manual limits.

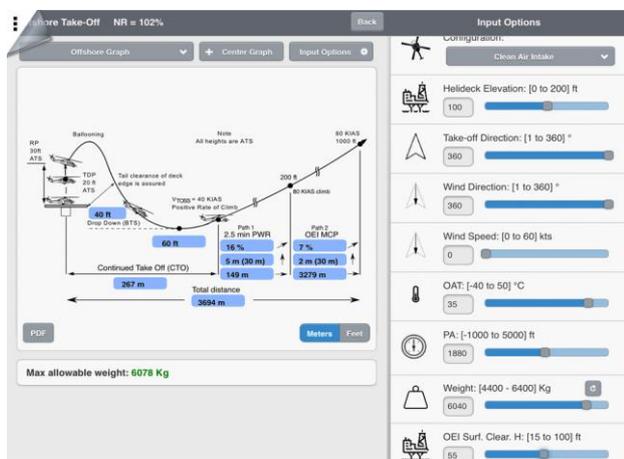


Figure 3 – CAT Take-Off Calculations

The CAT A performance calculation assists pilots to run their operations effectively, giving them the ability to manage data, from the certified Flight Manual, with ease, from anywhere. SkyFlight delivers CAT A key data in a single comprehensive view, increasing efficiency and reducing the risk of inaccuracies.

Post flight, the flight path data can be overlaid onto the maps, allowing a thorough debriefing.

Moreover, SkyFlight allows the integration with the Leonardo Helicopters Manuals.

### 3.2. Focus on Safety

SkyFlight is the optimal off-aircraft mean to carry out the evaluation of the flight, ensuring a thorough safety assessment [10].

The planning itself is a way to mitigate the risk when flying.

Within all functionalities of SkyFlight, a strategic use of colour coding and an intuitive way to

represent results, with icons and graphics, help in memorizing the information and increases the scenario understanding level.

Starting from these simple and common concepts, the safety is also addressed at a finer level in many features and with deep performance calculations.

SkyFlight highlights which data is not up-to-date and allows the user to download the latest available version.

So, to reduce crew errors, pilots receive instant and frequent feedbacks on their inputs, and where possible outputs are automatically calculated and clearly represented to the user. Terrain collision, restricted airspaces infringement, warning and restrictive NOTAMs detections, are highlighted and the flight feasibility is evaluated after a deep what-if analysis.

Finally, a notification summary is displayed for each flight, with all evidence listed and promptly represented also on map and on vertical view.

All of this contributes to positively increase the Pilot Situational Awareness and reduce mission risks.

## 4. SYSTEM ARCHITECTURE

The System infrastructure is a client-server as depicted in Figure 4.

The application AW SkyFlight is downloaded from the on-line store and installed on the tablet.

The application is the gateway to the service and it gives the access to calculations and data stored in the Leonardo Data Centre.

At the first log-in, a set of data is transferred into the tablet database to allow the basic functionalities such as maps, weight and balance calculator, and basic performance, to work also offline.

When connected to the internet all the services and data residing on Leonardo Data Centre are available. Therefore the user will receive updated weather and aeronautical data relevant to the planning area, the results of the deep aircraft performance calculations and the what-if analysis.

Also the files are prepared in the aircraft on board system format to be then transferred to the avionic system on board through the aircraft Wi-Fi connection.

This software architecture enables the cloud sharing capabilities and guarantees a better user experience with a high software performance, using the Leonardo Data Centre computational

resources for heavy calculations.

Moreover the infrastructure permits precautions and measures for the treatment of data. Indeed the data are stored in the Leonardo Server in compliance with the Security regulations. No data are contained in the application available on internet store.

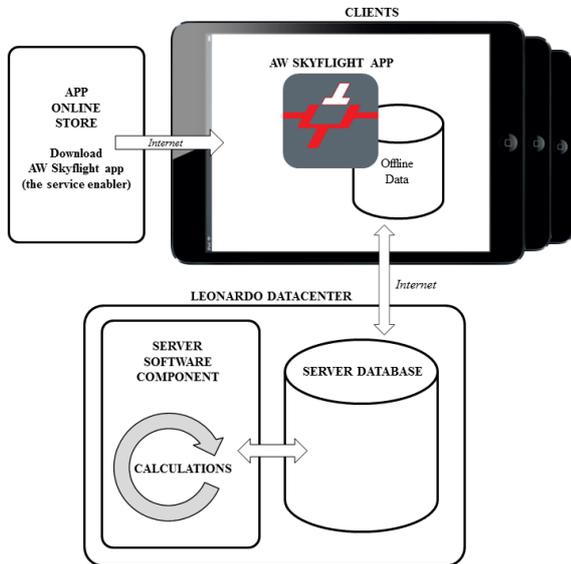


Figure 4 – System Architecture

Data are downloaded from the Leonardo Server into SkyFlight app, after the log-on procedure has been completed successfully. Other than username and password also the device unique code is checked and compared to the registered device. This additional check is to avoid unwanted transfer of username and password to others.

## 5. DEVELOPMENT PROCESS

In order to keep the pace of modern software applications, a properly tailored Agile methodology has been used, with the aim of delivering quick and continuous updates related to new functionalities and issues identified during the software testing activities.

To have a business approach oriented to deliver a service that meets the Customer needs together with the company goals; it is required to develop a fast-growing software with an iterative process development, where the software rapidly evolves in line with the requirements thanks to the close collaboration of cross-functional teams.

This is the typical scenario of the Agile methods, where the followed process consists in a set of best practices for the project management and project engineering, aimed to deliver an high-quality software with recurrent adaptations and

inspections.

All the request/requirements/suggestions are organized in user stories and regrouped in a product backlog.

The priority associated to a new feature described by a user story into the backlog is defined considering the number of stakeholders requiring it, the development effort and the benefits for the end user in terms of safety, usability, etc.

The requirements with an higher priority constitute the product roadmap.

The software development lab environment allows frequent face-to-face briefings between all the stakeholders. This provides the capability to reduce to a minimum Scope Creep issues, and to optimise the development and testing efforts. As an aid to the Agile process, software tools such as Software Configuration Versioning and Issue Tracking are used, also in combination with Continuous Integration servers to reduce the workload related to repeatable tasks.



Figure 5 – Performance what-if analysis

## 6. VERIFICATION AND VALIDATION PROCESS

To guarantee the development and maintenance of the highest levels of safety it has been noted that the National Aviation Authorities have established EFB validation standards [1] [2].

The compliance of SkyFlight with these standards is demonstrated with evidence of the software testing activities achieved with the software beta release candidate for operational use [7].

The testing activities includes User Interface testing, reliability testing, and accuracy testing.

Following the applicable guidelines, the User Interface testing aims to demonstrate that the application is not error-prone and that calculation

errors can be detected by the crew.

Reliability testing validates that the application is stable and deterministic in its operating environment, i.e. identical answers are generated each time the process is entered with identical parameters.

Accuracy testing proves that the aircraft flight and CAT A performances, together with the weight and balance computations provided by SkyFlight, are correct in comparison with data derived from the Flight Manual, under a representative cross section of conditions. This demonstration includes a sufficient number of comparison results from representative calculations throughout the operating envelope of the helicopters.

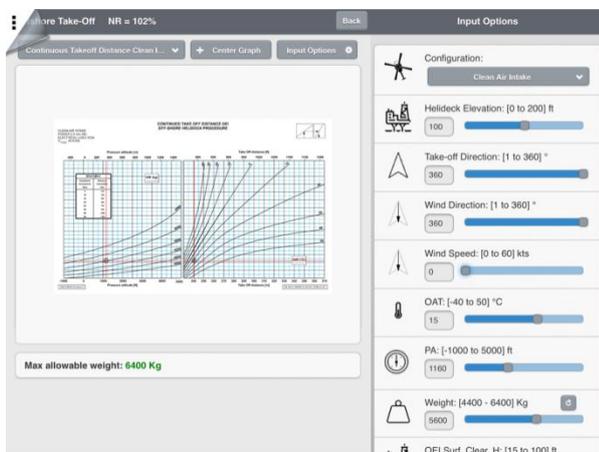


Figure 6 – Flight Manual Charts

## 7. FUTURE DEVELOPMENTS

The future developments are listed in the product roadmap defined with the support of all the stakeholders.

In particular the SkyFlight Roadmap is aimed to develop all the functionalities for all the Leonardo fleet and to further increase the Safety.

SkyFlight Mobile Service tries to meet the operational requirements for all the Helicopter missions.

The Service has been thought for both small and bigger operators. The former, since they may not have the necessary funds to commission the development of a software customized to their specific activities with the helicopters, are able to share the costs in the service community scenario and have a big advantage. The latter who may have their own software and an articulated IT environment, definitely see the value for functionalities that are strictly related to the

helicopters OEM data for deep performance calculations (like flight and CAT A performances).

In addition to this, the worldwide operators are asking to have the capability to interface SkyFlight on the server side with their enterprise software and their IT environment in one harmonious landscape. Therefore the integration capability is the key.

Furthermore, the direct connectivity between the EFBs and the ground systems will allow a more effective and synchronized mission.

The technical development will proceed to the final step of the integration with the cockpit. The EFB application will display the information to be used directly by the flight crew to assess the real-time status of aircraft critical and essential systems, with a bi-directional data communication between the EFB and the avionics.

## 8. CONCLUSIONS

SkyFlight Mobile Service has been developed in order to provide an enhanced experience to Leonardo Helicopters customers, allowing performing critical flight mission operations with the ease of modern mobile devices and the guarantee of the original equipment manufacturer knowledge.

Pilots can perform most of the evaluation that were previously performed with pencil and paper, with a few taps, on a state of the art tablet device, by means of an application built around the Customer needs and the aircraft capabilities.

The main focus has been kept, since the beginning of the service development, on increasing flight safety and reducing times and costs for the most demanding operations where time is critical but flight safety cannot be overlooked.

By reducing the paperwork, granting a tool that performs weight and balance and performance computations according to the Rotorcraft Flight Manual, providing the means to plan with aeronautical and environmental data continuously updated, SkyFlight Mobile Service reduces times and risks of mistakes in computation, leading to an improved safety of the flight and an enhanced situational awareness.

In order to provide to Customers a continuously improved experience, thanks to the support of the involved stakeholders, a set of future enhancements have been identified and are included in the Service development roadmap.

The development approach that has been adopted, allows to quickly adapt the Roadmap dynamically, in order to follow aircrafts evolution and Customers' needs.

All of these aspects presented in this paper make SkyFlight a mainstay in the planning activities, to increase safety with an easy, intuitive, reliable and constantly evolving assistant.

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