

Research on the Technical Innovation and Improvement of the Secondary Release Procedure

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Abstract: This study aims to explore the technical innovation and improvement of secondary release procedures to improve the accuracy, efficiency and safety of aircraft release. As an important link in the air transport system, the secondary release procedure is directly related to the safety and punctual take-off of flights, so the technological innovation and improvement are of great significance to the aviation industry. This study will focus on the application of automation technology, intelligent technology, information technology and data analysis technology in the secondary release program, and analyze the effectiveness and feasibility to provide feasible solutions for the technical innovation and improvement of the secondary release procedure. Through the study and analysis of the existing technologies, this study will evaluate the practical application effect of various technologies in the secondary release process, so as to provide important technical support for the safety and efficiency improvement of the air transport system. Finally, through the research of technological innovation and improvement, we hope to provide useful reference for the automation, intelligence, information and data development of secondary release procedures in the future, and promote the development of air transport system towards a safer and more efficient direction.

Keywords: Secondary Release Procedure; Technological Innovation; Automation; Intelligent Technology; Information Technology; Data Analysis

1. Introduction

As an important link in the air transport system, the secondary release procedure is directly related to the safety and punctuality of flights. Secondary release refers to the last step of the aircraft after the completion of the ground. It needs to ensure that the aircraft meets the conditions of safe take-off after the inspection and preparation, including the structural integrity of the aircraft, the normal operation of the system, the safety of the cargo compartment, etc. However, the traditional secondary release procedure still relies on a large number of manual operations and inspection, which has the problems of inefficiency and low inspection accuracy^[1]. Therefore, the research of technical innovation and improvement of secondary release procedures has become one of the hot spots in the field of air transport.

With the rapid development of automation, intelligence, information technology and data analysis, the aviation industry has put forward higher requirements for the technical level and safety of secondary release procedures. The research of technological innovation and improvement aims to make full use of modern technical means, optimize the secondary release process, improve the release efficiency and accuracy, and reduce the flight safety risks^[2]. The application of automation technology can reduce human error and improve the accuracy and consistency of operation; intelligent technology can automatically optimize the process and parameter setting of secondary release according to real-time flight data and airport status, and give optimal release suggestions; the application of information exchange between aircraft and ground equipment to provide more comprehensive, accurate and timely information support for secondary release; data analysis technology can find potential safety risks and operation problems by deep mining and analysis of historical flight data and airport operation data, and provide strong support for the improvement suggestions of secondary release procedure^[3].

The purpose of this study is to explore the application of the above techniques in the secondary release procedure, and to analyze

the effectiveness and feasibility for the technical innovation and improvement of the secondary release procedure. Through the study and analysis of the existing technologies, we can evaluate the practical application effect of various technologies in the secondary release process, so as to provide important technical support for the safety and efficiency improvement of the air transport system. Through the research of technological innovation and improvement, we hope to provide useful reference for the development of automation, intelligence, information and data of secondary release procedures in the future.

2. Status of the secondary release procedures

The secondary release procedure has an important position and role in the air transport system. First, the secondary release procedure is the last pass to ensure the safety of the aircraft. After the aircraft has completed ground maintenance, support and preparation, the secondary release procedure requires a comprehensive inspection of the aircraft, including its structure, system equipment, fuel status and many other aspects, to ensure that the aircraft is ready to take off safely. Secondly, the secondary release procedure is directly related to the punctuality of the flight. Once there is a problem, additional inspection and repair of the aircraft is required, which may lead to delays in the flight, thus affecting the normal operation of the airline and the passengers' travel plans. Therefore, the accuracy and efficiency of the secondary release procedure are essential for the proper operation of the air transport system.

However, there are still some problems with the current secondary release procedure. First, the secondary release procedure still relies more heavily on manual operation, and there is the possibility of human error. Manual operations may be influenced by operator experience, workload, and environmental factors, prone to negligence or errors, resulting in inadequate or inaccurate inspections. Secondly, the traditional secondary release procedure is heavy workload, time-consuming and inefficient. In the busy airport environment, it is necessary to complete the secondary release of the aircraft in time to ensure the flight departure on time. However, the traditional manual operation mode is often difficult to meet this demand. In addition, due to the complexity and onerous of the secondary release procedure, it may be difficult to detect or eliminate potential safety risks of the aircraft in some special circumstances, leading to flight safety risks.

3. Future innovation direction

3.1 Application of the intelligent machine vision system in the secondary release procedure

Intelligent machine vision system is an automated technology that uses cameras, image processing algorithms, and artificial intelligence technology to achieve automatic detection and identification of aircraft structure and equipment status. In the secondary release procedure, the intelligent machine vision system can be applied to the safety inspection outside the aircraft, such as damage detection on the surface of the aircraft, inspection of landing gear and tires. Here are the specific steps of the technical route: (1) camera installation, with the smart camera as appropriate at the airport to cover the exterior of the aircraft. (2) Image acquisition. The camera captures the image of the surface of the plane and transmits it to the image processing system. (3) Image processing. The image processing system uses advanced image processing algorithms to analyze and process the images and extract the key information of the aircraft surface. (4) State recognition, using artificial intelligence technology, to identify the state of the processed images, such as damage, oil leakage, dirt and other states. (5) State feedback, and feedback the identified status information to the relevant secondary release operating system. (6) Safety assessment. The secondary release system evaluates and decides on the safety status of the aircraft according to the status information provided by the intelligent machine vision system. (7) Results transmission, inform the relevant airline to airport staff of the final release result.

The goal of this technology route is to use an intelligent machine vision system, thereby improving the accuracy and efficiency of the secondary release procedure (see Figure 1).

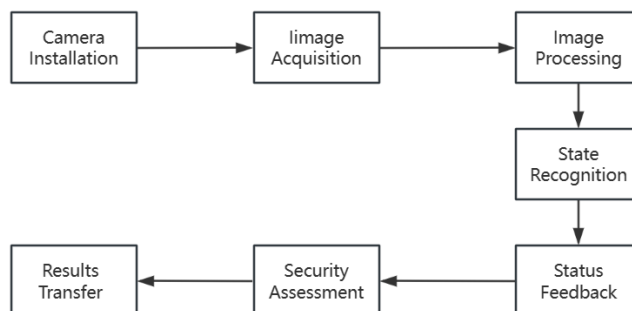


Figure 1: Application of the intelligent machine vision system in the secondary release procedure

3.2 Application of an intelligent decision support system based on AI and big data analysis in the secondary release procedure

The intelligent decision support system uses artificial intelligence and big data analysis technology, combines real-time flight data and airport status, automatically optimizes the process and parameter setting of secondary release, and gives the optimal release suggestions. The following are the specific steps of the technical route: (1) data collection, collecting real-time flight data, airport status, weather conditions, flight plans and other large amount of data. (2) Data cleaning and integration, clean and integrate the collected data, remove the outliers and integrate the data, and establish a data warehouse.(3) Data analysis, using big data analysis technology to analyze the data, including aircraft performance data, weather data, airborne equipment status, etc. (3) Modeling and training. Based on the data analysis results, establish a model of the intelligent decision support system, train the system, and improve the decision-making accuracy of the system. (4) Decision support. Based on the real-time data and the established model, the intelligent decision support system can give the best secondary release suggestions, including the take-off time, route and flight parameters, etc. (5) Decision execution, inform the relevant airline and airport staff of the final decision suggestions, and implement the release suggestions given by the intelligent decision support system. (6) Monitoring and feedback, monitoring and feedback of the implementation results, to provide data support for the further optimization of the system.

This technical route aims to use artificial intelligence and big data analysis technology to achieve intelligent optimization of the secondary release process and improve flight safety and efficiency (See Figure 2).

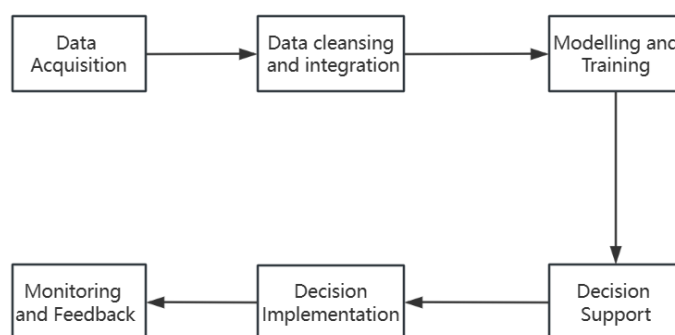


Figure 2: Application of intelligent decision support system based on artificial intelligence and big data analysis in secondary release procedures

3.3 Application of information technology based on the Internet of Things and cloud computing in the secondary release program

Information technology based on the Internet of Things and cloud computing can realize real-time information exchange between aircraft and ground equipment, providing more comprehensive, accurate and timely information support for secondary release procedures. The following are the specific steps of the technology route: (1) sensor deployment, deploying various types of sensors, such as temperature sensors, pressure sensors, humidity sensors, etc., on aircraft and airport ground equipment, and connected to the Internet of Things platform. (2) Data collection and transmission, real-time data of the sensor collection environment and equipment, and transmitted to the cloud server through the Internet of Things platform. (3) Data storage and processing. The cloud server stores and processes the transmitted data, including data cleaning, real-time monitoring and anomaly detection. (4) Data analysis and decision-making. Use the cloud computing platform for big data analysis, analyze the real-time data of aircraft status and ground equipment, and provide support for the secondary release decision. (5) Information sharing and feedback. According to the analysis results, the

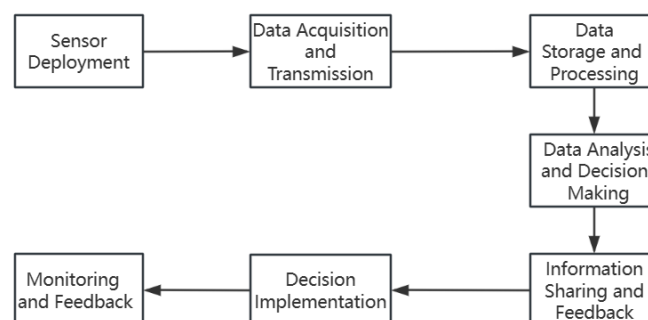


Figure 3: Application of information technology based on the Internet of Things and cloud computing in the secondary release program

appropriate release information will be shared to relevant departments and personnel in real time through the cloud platform, and the feedback will be provided through mobile terminal applications or other ways. (6) Decision implementation. Airlines and airport staff shall execute the corresponding secondary release procedures according to the real-time information provided by the cloud platform, such as troubleshooting and adjusting flight plans, etc. (7) Monitoring and optimization, monitoring of the execution results and continuous optimization of the system, including sensor deployment optimization, data processing algorithm optimization, etc.

This technology route aims to use the Internet of Things and cloud computing technologies to achieve real-time monitoring and information sharing of the status of aircraft and airport equipment, thus improving the accuracy and efficiency of secondary release procedures (see Figure 3).

3.4 Application of real-time flight data monitoring and early warning system based on data analysis technology in the secondary release procedure

The real-time flight data monitoring and early warning system based on data analysis technology uses data mining and real-time analysis technology to monitor and analyze the aircraft operation data in real time, timely find abnormal situations and give early warning, and provide support for the secondary release decision. The following are the specific steps of the technical route: (1) real-time data collection, collect real-time flight data of the aircraft, including flight altitude, speed, heading, engine parameters, meteorological data, etc. (2) Data transmission and storage, transfer real-time flight data to the data storage system for real-time storage and management. (3) Data cleaning and processing, cleaning, denoising and processing of the collected real-time flight data, to ensure the accuracy and integrity of the data. (4) Real-time monitoring and analysis, using data analysis technology to monitor and analyze the real-time data, and find out the abnormal conditions in the operation state of the aircraft. (5) Early warning and prompt. Once the abnormal flight data is detected, the system will issue an early warning signal and prompt the relevant staff to further investigate and deal with the abnormal situation. (6) Decision support, providing the analysis results and early warning information to the secondary release decision system to provide support and reference for the release decision. (7) Real-time feedback and recording, real-time feedback of the monitoring results and early warning information to the relevant airlines and airport staff, and the monitoring data are recorded and traced.

This technical route aims to use data analysis technology to monitor and analyze real-time aircraft data, realize real-time warning of aircraft operating status and discovery of abnormal conditions, and provide support for secondary release decision (See Figure 4).

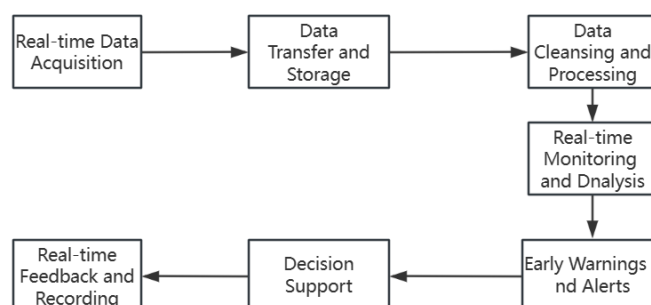


Figure 4: Application of the real-time flight data monitoring and early warning system based on data analysis technology in the secondary release procedure

4. Summary

This study aims to improve the efficiency and safety of secondary release procedures by integrating automation, intelligent, information and data-driven technologies. The study also focuses on the impact of the new fuel policy on flight planning and the application of secondary release methods to route analysis. These efforts are designed to drive the development of air transport systems and improve safety, efficiency and environmental sustainability.

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