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Analysis of human factors in aeronautical information based on SHEL model

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Abstract

With the continuous promotion of smart civil aviation construction and the gradual implementation of digital operation. Aeronautical information service plays a more and more important role in airlines operation control. However, in daily work, there will still be some errors due to the limitations of individual and system of Aeronautical Information Service. Therefore, analyzing the human factors in aeronautical information work and putting forward targeted countermeasures can reduce the errors in aeronautical information work of airlines. Improve the safe operation level of airlines.

Keywords

Aeronautical information; SHEL model; human factors.

1. Introduction

Statistics show that more than 70% of aviation accidents are related to human factors [1]. The human factor analysis method based on SHEL model has been widely studied and applied in many departments and fields of civil aviation industry. For example, Shen Jie and others used SHEL model to study human factors in airline operation control [2]; Sun Yuhu et al. Studied human error in flight based on SHEL model [4]; Wang Xinming and others studied human factors in air traffic control based on SHEL model [5]. In the field of aeronautical information, Xu Guoji [6], Zhang Xuewu [7], Liu Yong, Zhao Qiaoni [8], Li Jiayue [9] and others have made corresponding research work respectively, but their research focus is on the aeronautical information work of air traffic management system. On the basis of summarizing many years of airline information work experience and teaching experience in college, the author analyzes the human factors in airline aeronautical information work and puts forward corresponding countermeasures, so as to effectively control human errors in airline aeronautical information work, Improve the level of aeronautical information service.

2. Brief introduction to aeronautical information work of airlines

The task of civil aviation aeronautical information service is to collect, sort out and edit civil aviation data, design, produce and publish relevant aeronautical information service products in the territory of the people's Republic of China and in the areas specified in international treaties concluded or acceded to by China, and provide timely, accurate and complete aeronautical information required for civil aviation activities [10]. Unlike air traffic control aeronautical information work, airline aeronautical information work is mainly to receive the update of aeronautical chart manual, telegram, NOTAMs and control order No.1 issued by Air Traffic Management Bureau and aeronautical information service Department of Civil Aviation Administration of China(CAAC), analyze them, and summarize the information that has an impact on the operation of the company, so as to provide necessary information for flight plan adjustment and safe and smooth operation.

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The aeronautical information business of airlines is mainly divided into two parts: aeronautical data management and navigation data management.

Aeronautical data management includes ordering the navigation data required by the company's operation and the Aeronautical Information Publication (AIP) according to the list of airports in the company's current and future expected flight plans and operation specifications. For domestic aeronautical charts, the navigation data shall be updated every 28 days; Jeppesen charts are updated every 7 or 14 days. After receiving the update page, update and replace the airborne data package to ensure that the airborne aeronautical charts and other data are valid and meet the needs of flight operation.

Navigation data management includes:

(1) Maintenance of Computer Flight Plan (CFP) on jetplan.com website, filed flight plan message (FPL) data in aeronautical information subsystem of airline FOC system, alternate aerodrome, etc;

(2) Processing of NOTAM and setting of preflight information bulletin (PIB) in NOTAM processing system;

(3) Order, maintain, check, bill processing and payment of navigation database;

(4) Fill in the new route demonstration form and evaluate the main airports and alternate airports;

(5) EFB (electronic flight package) aeronautical chart data update management, equipment maintenance and distribution.

In addition, it also provides flyover application information, including entry point, exit point, flight altitude, etc. Airline application for foreign crew, temporary airline application; Operation tips issued; Provide flight route data (flight route and altitude), such as scheduled flight, extra flight and charter flight; Carry out training for flight dispatchers and pilots, such as information knowledge, publicity and implementation of new routes, etc.

The quality of aeronautical information work will directly affect the safety operation of airlines, so we should pay attention to the analysis of human factors in aeronautical information work and reduce the "mistakes and omissions" in aeronautical information work.

3. Impact Analysis of human factors in aeronautical information work

3.1 Brief introduction to SHEL model

SHEL theoretical model is a conceptual model proposed by Professor Elwyn Edwards in 1972 to describe human factors. It was developed and graphically by Frank Hawkins in 1975. SHEL model is composed of four modules: software, hardware, environment and liveware. SHEL model establishes the relationship between various elements, And graphically show the relationship between various elements and the graphics of mutual cooperation interface [3]. As shown in Figure 1.

Figure 1 Schematic diagram of SHEL model

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3.2 Analysis of SHEL model in aeronautical information work

For the aeronautical information work of airlines, the significance of each module of SHEL model is as follows:

L (liveware): it mainly refers to the aeronautical information engineers and relevant personnel of aeronautical information work, including pilots, flight dispatchers, performance engineers, etc. The aeronautical information engineer is at the core of the whole system.

S (software): civil aviation regulations, workflow and software programs related to aeronautical information work.

H (hardware): hardware equipment related to aeronautical information work. Including computer, telephone, fax, printer, electronic flight bag (EFB), aeronautical chart manual, etc.

E (environment): the working environment of the aeronautical information engineers, including the reference room and the duty Hall of the operation control center (AOC).

The meanings of each interface of SHEL model are as follows:

Liveware-liveware (L-L) interface: (1) Coordination and communication between aeronautical information engineers: For small and medium-sized aviation companies, different aeronautical information engineers may come from different companies with different work experience and working methods. In daily work, they should do a good job in division of labor, help each other and complement each other. Strengthen information communication, for example, important information should be notified to everyone, not only cc seat email, to prevent some staff due to scheduling, vacation and other reasons did not receive important information. (2) Coordination and communication between aeronautical information engineers and flight dispatchers: The on-duty aeronautical information engineer shall timely inform the dispatcher of any information affecting the flight operation. (3) Coordination and communication between aeronautical information engineers and flight crews: The on-duty aeronautical information engineer shall do a good job in the publicity and pre-flight explanation of important changes in airspace and routes for the flight crew. (4) Communication and coordination between aeronautical information engineers and outstation: When periodic data takes effect, colleagues of outstation may be required to help replace airborne data.

Liveware-hardware (L-H) interface: Refers to the relationship between aeronautical information engineers and hardware devices. For example, backward computer hardware configuration will affect work efficiency. Since aeronautical information engineers need to compare and process telegrams, charts, manuals, etc., at the same time, two or more screens can reduce page switching and improve work efficiency.

Liveware-software (L-S) interface: Refers to the relationship between aeronautical information engineers and software and workflow, including CAAC rules and company manuals, standard and regulated operating procedures. Aeronautical information engineers need to be familiar with the work flow, the operation flow of common software and internal logic. If the process is not standardized, there may be differences in the way aeronautical information engineers work, which will cause problems for the dispatcher and other related personnel. Sailing to agents commonly used software CNMS (China notam management system), for example, each month 1 need to deal with the check list, if check single message is too long, is divided into two or three parts to send, when processing NOTAM need to merge processing, otherwise it will cause some effective message is set to failure, affect the complete, accurate, effective notice to NOTAMs.

Liveware-environment (L-E) interface: including lighting and temperature regulation in the duty hall of operation control center, noise interference between seats, VHF voice interference, etc. It also includes the layout of AOC navigation information seats, and the position relationship between the dispatch and release seats, flight planning seats, and assistant dispatch seats. If the seat is too far away, you need to remind the dispatcher of important matters by telephone. Especially during the night shift, the influence of the environment is more important.

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4. Analysis on Countermeasures of human factors of aeronautical information engineers

4.1 From the schematic diagram of SHEL model, it can be seen that people are at the core of the whole system. In terms of human factors, there are two ways: external introduction of talents and internal promotion. In case of loss of aeronautical information engineers and weak on duty force, foreign aid can be introduced and dispatched in the short term, but in the long term, it is still necessary to strengthen recruitment and recruit suitable candidates. In order to ensure the long-term stability of the on duty force, because the imported foreign aid is not familiar with the aeronautical information business, there is a hidden danger of error.

(1) Improving the quality of aeronautical information engineers.

Improve their own quality and professional level: the knowledge of Aeronautical information is relatively trivial, and improving their working ability needs a long-term learning mechanism. For aeronautical information engineers, they can improve their professional level by asking for advice from senior aeronautical information engineers, reading manuals and work processes, and participating in relevant aeronautical information training and annual retraining.

For aeronautical information engineer teams, internal learning and improvement plans can be developed. For example, arranging a learning theme every week and organizing online training or online learning in the form of online video conference or microlecture can reduce the fatigue caused by commuting and on-site training. Or use the methods of promoting learning through examination, improving ability through examination, and substituting training through examination to improve the aeronautical information engineers' learning enthusiasm and master solid business knowledge.

(2) Moderate workload and reasonable scheduling system.

Comply with the natural law and reasonably arrange work and rest: because the characteristic of civil aviation is all-weather operation, it is inevitable for civil aviation practitioners to shift to night shift. When arranging the rota, we should consider the influence of biological clock and respect the circadian biological rhythm of human body. Studies have shown that reasonable shift scheduling can improve sleep quality and living conditions, improve work quality and reduce errors at work [11]. On the basis of reasonable shift arrangement, take a full rest during the rest time before on duty. Don't play games or exercise violently for a long time, so as not to affect your energy at work. After the night shift, you should also have a full rest, otherwise long-term sleep loss will lead to sleep disorders.

The accident investigation shows that 4~6 a.m. is the prone period of flight accidents or unsafe events [3]. For aeronautical information work: except for the work that must be completed at night, other work shall be arranged during the day as far as possible to reduce work errors caused by fatigue at night.

(3) Murphy's Law indicates that nothing is as simple as it seems, and anything that can go wrong will always go wrong [12]. So we need to take a series of measures to reduce the occurrence of mistakes from the system. For example, air traffic controllers are required to work in a dual-post system, with one controller responsible for control command and the other responsible for coordination, supervision and inspection [13]. aeronautical information engineers should make clear the cross-inspection system when assigning daily work, and the responsibility should be assigned to people. Responsible personnel and checkers, each in its own right, can move forward to identify potential errors before they affect flight operations. Before the operation of important flights, the personnel on duty at the information desk should strengthen the check of important data such as route direction and filed flight plan message (FPL). Ensure the accuracy of background data.

4.2 As for software, more advanced systems and software can be developed or introduced. For example, the China notam management system (CNMS) basically meets the work requirements of the navigation information Department, but there are shortcomings such as the failure to provide graphical and intuitive display of message content for the crew, the unfiltered Preflight Information Bulletin (PIB) and too many pages [14]. A new system can be developed by upgrading or a mature

NOTAM processing (SNMS) system introduced. The system has a high degree of automation, which can insert pictures and simplify PIB content in the PIB, improve the reading efficiency of the crew and reduce the misunderstanding caused by poor communication.

4.3 In terms of hardware, work efficiency can be improved through updating office computers, combination of multi-display screens and angle adjustment. This is because the information desk takes up hardware resources while simultaneously processing traffic announcements, making flight plans and opening electronic route charts. And data comparison and analysis need to open multiple pages at the same time, so double or multi-screen display will greatly improve efficiency, reduce the error caused by page switching and reading the wrong line.

4.4 Environment Improvement.

In terms of environment, the AOC duty hall can improve the working environment by optimizing the layout of seats, increasing the arrangement of green plants and prohibiting indoor smoking. For the duty lounge, it is necessary to consider the distance between the lounge and the duty place is not too far, and the lounge should be far away from noise sources.

5. Conclution

Aeronautical information work is an important part of the operation control of airlines. The effective control of flight dispatchers needs accurate navigation information support. Under the background of intelligent civil aviation and digital operation, aeronautical information engineers need to constantly improve their own quality and service level, and airlines should gradually improve their software and hardware environment to cope with the operation requirements of increasing operation areas and complex routes. This paper analyzes the human factors of aeronautical information engineers and puts forward the corresponding countermeasures, which can provide reference for the management and reduction of work errors of airline aeronautical information engineer team.

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