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The Program Research on Security Programs Before Flight Based on Single Code Network Plan

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Abstract: The civil aviation industry has made rapid development with the continuous growth of China's economy. At the same time, the airline companies buy more and more civil aircrafts. This phenomenon will lead to a big flying density, which will make airport management become more complex. This paper first introduces the characteristic of security programs before flight and the single code network plan, and then put the security programs before flight into the single code network plan to find out the key route and calculate the guarantee period. Finally, we analyse the programs according to the guarantee period and critical route. It not only provides a support for administrator, but also we present a reasonable methods to reduce the guarantee period.

Key words: civil aircraft; security programs; network plan; period

1 Introduction

The security programs before flight is a initial work, which will directly affect the next flight mission. So it is an critical mission to improve the flight punctuality rate. The security programs before flight involve multiple work. The reasonable arrangments for the work will make staff appear in order and increase the flight punctuality rate.

The single code network plan is a network graph, which use node and number as mission and use arrow as logical relationship. It forms a single code network plan by means of filling working code, name and duration in code [1].

2 The symbols and drawing rule of single code network plan

2.1 Node

Every node in the single code represents a mission. The node should be expressed in a circle or rectangle. The name of work, duration and working code should be marked on the node.

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The nodes in single code network diagram must be numbered. The number are marked on the node, which can be interrupted and can not be repeated. The node number of arrow tail should be less than the number of arrow. Every work must have an unique node and number [2].

2.2 Arrow

The arrow in single code network diagram represents the logical relationship between two adjacent jobs, which do not occupy the work time and do not consume resources. The arrow should be straight, lever or slash. The direction of the arrow horizontal projection should be from left to right, which express the work direction. The logical relationship of working include process and organizational relationships, which displays chronological order with work.

2.3 Line

In the single code network diagram, the formation of each line relies on node, which is numbered in turn from small to large. The single code network must be able to correctly express the logical relationship, which can not appear in the loop. When drawing net-

work diagram, the line should not be crossed. If the cross can not be avoided, the bridge method and pointing method should be adopted. In addition, the single code network diagram should have only one start node and one end node.

3 The calculation of time parameters and the determination of key lines in the network plan

The main tme parameter [3-6] in the single code network diagram are the earliest start time ES_{i-j}, the earliest completion time EF_{i-j}, the latest start time LS_{i-j}, the latest completion time LF_{i-j}, total float TF_{i-j} and free float FF_{i-j}. The annotation form of single code network is shown in Figure 1.

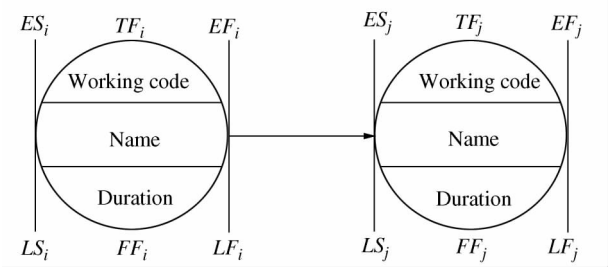

Figure 1 The annotation form of single code network plan

3.1 The calculation of the earliest start time and the earliest completion time

The calculation with the earliest start time and the earliest completion time should be started in turn from start node to end node.

The start node in network plan is zero. When start node is number 1, it is expressed as

$$ES_i = 0 \quad (i = 1) \tag{1}$$

The earliest completion time is the sum of the earliest start time and duration. It is expressed as

$$EF_i = ES_i + D_i \tag{2}$$

The earliest start time is the maximum of last works. When the last work j is work i, it is defined as

$$ES_j = \max\{EF_i\} \text{ or } ES_j = \max\{ES_i + D_i\} \tag{3}$$

ES_i–The earliest start time of the last work j.

3.2 The calculated period T_c

T_c is equal to the earliest completion time of end node n. It is defined as

$$T_c = EF_n \tag{4}$$

3.3 The time interval ($LAG_{i,j}$) between two adjacent work

The time interval($LAG_{i,j}$) between adjacent i and j is the difference between the earliest start time and the earliest completion time. It is defined as

$$LAG_{i,j} = ES_j - EF_i \tag{5}$$

3.4 The total float TF_i

The total float should be calculated in turn from end node. When the plan period is equal to the calculated period, the total float is zero. It is defined as

$$TF_n = 0 \tag{6}$$

The other total float is the minimum, which is the sum of total float of next work and the time interval. It is defined as

$$TF_i = \min\{TF_j + LAG_{i,j}\} \tag{7}$$

3.5 The free float

If the job(i) is the last job, the free float is the difference between plan period and the earliest completion time. It is defined as

$$FF_n = T_p - EF_n \tag{8}$$

If the job(i) is not the last job, the free float is the minimum of the time interval. It is defined as

$$FF_i = \min\{LAG_{i,j}\} \tag{9}$$

3.6 The calculation of the latest start time and the latest completion time

The latest start time is the sum of the earliest start time and total float. It is defined as

$$LS_i = ES_i - TF_i \tag{10}$$

The latest completion time is the sum of the earliest completion time and total float. It is defined as

$$LF_i = EF_i - TF_i \tag{11}$$

3.7 The key work and key lines

The work of the least total float is the key work. The key lines are comprised of key work and the time interval of all works is zero.

4 The security program analysis before flight

4.1 The work disintegration of security program before flight and the calculation of duration

According to the standards of security program before flight and the manual of department of ground service of AnHui aivil aviation airport group [7], the security program can be decomposed into the following contents: A, the preparation before the flight; B, finishing handover work; C, to remove landing gear safety pin and letting the flight crew check it; D, the measurement and record of tire pressure; E, inflating tire and check; F, passengers boaring and checking maintenance personnel; G, retracting the alert cone; H, checking around the plane; I, installing the mop; J, pushing the plane; K, starting the engine number 2 and number 1; L, disconnecting mop and trailer; M, disconnecting the plane and trailer; N, connecting the mop and drag bar ; O, waiting the plane leave.

Because different people need different completion time to finish the same work, this paper adopts "estimation method of three type time" to calculate the duration. It is defined as

$$D_{i-j} = (a + 4c + b)/6 \quad (12)$$

Where a is the fastest completion time; b is the slowest completion time; c is the usual completion time.

According to formula and logical relationship, the duration, last work and next work can be get. It is shown in Table 1.

Table 1 The logical relationship and work duration in the security programs before flight

Work	Last work	Next work	The fastest completion time	The slowest completion time	The usual completion time	Duration
A	—	B、C	15	15	15	15
B	A	D	2	6	4	4
C	A	D	1	5	3	3
D	B、C	E	4	8	4.5	5
E	D	F	5	19	9	10
F	E	G、H、I	40	40	40	40
G	F	J	0.6	1	0.65	0.7
H	F	J	1	1.6	1.45	1.4
I	F	J	0.4	0.6	0.5	0.5
J	G、H、I	K、L	0.7	1.1	0.75	0.8
K	J	O	1.1	1.3	1.2	1.2
L	J	M	0.1	0.1	0.1	0.1
M	L	N	0.1	0.1	0.1	0.1
N	M	O	0.1	0.1	0.1	0.1
O	K、N	—	0.4	0.6	0.5	0.5

4.2 The network flow chart of security program before flight

According to the relationship in Table 1, the network flow chart with security program before flight is shown in Figure 2.

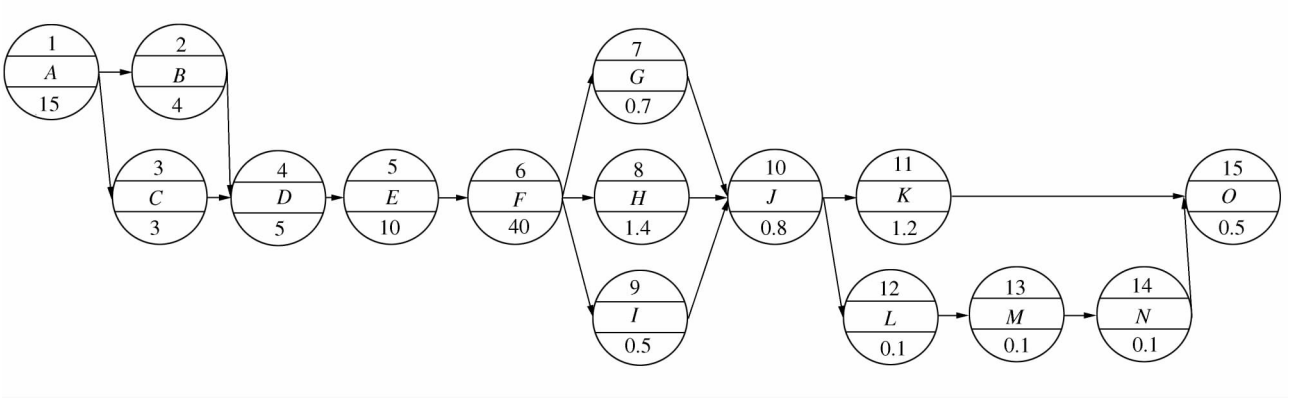

Figure 2 The security flow chart before flight

4.3 The calculation of time parameter

According to the duration in Table 1 and the relevant formula in the second quarter, the relative time parameters can be calculated, which is shown in Table 2.

Table 2 The calculation of time parameters with recurity before flight

Work	The earliest start time	The earliest completion time	The latest start time	The latest completion time	Total float	Free float
A	0	15	0	15	0	0
B	15	19	15	19	0	0
C	15	18	16	19	1	1
D	19	24	19	24	0	0
E	24	34	24	34	0	0
F	34	74	34	74	0	0
G	74	74.7	74.7	75.4	0.7	0.7
H	74	75.4	74	75.4	0	0
I	74	74.5	74.9	75.4	0.9	0.9
J	75.4	76.2	75.4	76.2	0	0
K	76.2	77.4	76.2	77.4	0	0
L	76.2	76.3	77.1	77.2	0.9	0.1
M	76.3	76.4	77.2	77.3	0.9	0
N	76.4	76.5	77.3	77.4	0.9	0.9
O	77.4	77.9	77.4	77.9	0	0

4.4 The security diagram before flight based on single code network plan

According to Table 2 and Figure 1, the single code network plan with security program before flight can be draw, which is shown in Figure 3.

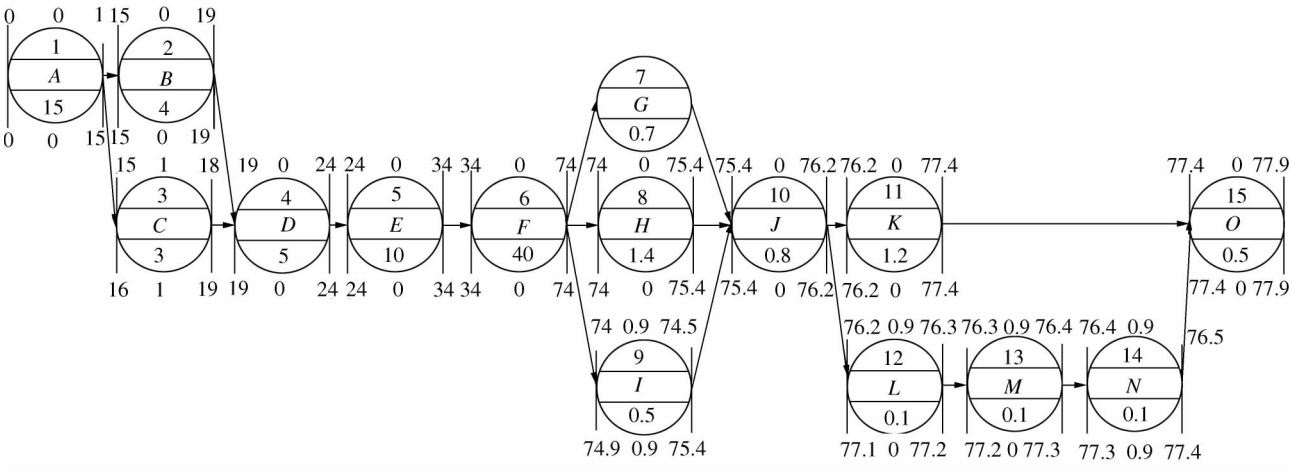

Figure 3 The single code network diagram with security programe before flight

4.5 The significance of the work, key lines and guarantee period

According to the calculation results, the total float of A、B、D、E、F、H、J、K、O is zero. So this works are key work by definition. The key lines are composed of key work from start node to end node, whose time interval are zero. The key lines can be get from Figure 3, which are shown in Figure 4.

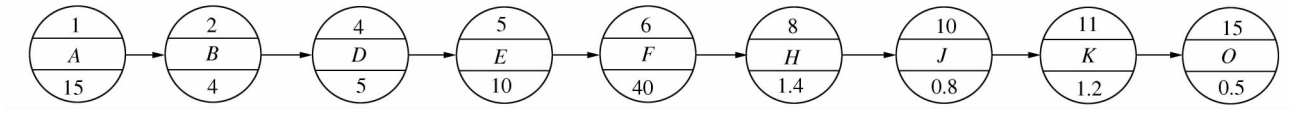

Figure 4 The key lines of security programs before flight

The guarantee period can be calculated from Figure 3, which is 77.9 minutes. When the plan period is equal to calculated period, the security is 77.9 minutes. Through the calculation of key lines, the most important work can be known. When the key work is only adjusted, the security work before flight can be planed reasonably. The flight delay can be reduced by maintenance personnel through reasonable arrangement for works. According to security period, the security period can become more and more reasonable. And then the work before flight can be finished availably.

5 Conclusions

This paper take the security program before flight as an example, which can be disassembled by using a single code network plan technology. And then the key work, key lines and security period can be found. Thus the maintenance personnel have a reliable basis to arrange the work and security period. At the same time, the delay can be reduced to some extent.

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Brief Biographies

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