Motion analysis in the application of civil aviation security research

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Abstract. In order to reduce the security of time, this paper introduced the action analysis, guided by the economic principle of motion principle, Uses the IEMS video motion analysis software, in the process of security action analysis. By removing invalid move, improve the effective dynamic element, obtain a new motion video. Without any increase in funds, sites and staff under the premise of to provide considerable work action to security personnel, improve the efficiency of security.

Introduction

In order to eliminate risk and ensure the security of passengers, airport security services as an important link of aviation journey service implementation for nearly thirty years in China.Airline passengers for queuing problem complain with the security queuing problems at the top.Soaring onerous security steps and the number of passengers make passengers waiting for security check the inevitable process.It is necessary to find a more efficient screening method can rapidly in passengers through security at the same time not interfere with the effectiveness of the security.

Action analysis is also called the action research method, dynamic analysis, study or work is a important method in industrial engineering research study, the purpose of it is found through the analysis of the various methods or seek the most economic and effective method of work.Action analysis is to study and formulate correct reasonable action, save time, improve work efficiency, reduce fatigue, the easy degree, the reduction of labor intensity, improve the work, improve the utilization of effective method, its purpose is the least energy consumption to achieve maximum results in other words, try to increase the value in the practical work of action, shorten or cancel the futile action to improve labor productivity.

Based on the element analysis by using motion analysis method with advanced video motion analysis software in the pure visual motion analysis, improve the efficiency of security, from the perspective of the screening process starting from the security personnel work action, the premise is that not to increase equipment, employees, and even security personnel strength, it can be more exquisite and the analysis of the security personnel action, reduce the passenger waiting time and improve the passenger satisfaction.

The civil aviation security process analysis

Based on the operational principle, principle of effectiveness, and economic principle of motion for the action plan design principles [6], using three methods of motion analysis (visual analysis, dynamic analysis and video analysis three methods) from the working process of security, under the condition of the process is reasonable to analyze deletion operation action and improve effective action without direct contribution, forming a set of new job action video.Passengers to improve each work cycle in order to shorten the time to deal with security, improve the working efficiency of the security personnel and improve the passenger satisfaction for security services.

Security process analysis

In this paper, the security video for the real film has strong operability.Because of security actions are trained to complete so security personnel actions are roughly the same and each security the complete process of representative.

To each subsequent decomposition action on the effectiveness of the first in the video a complete screening process comprehensive and detailed analysis of the whole process and will push

element analysis method get seven divided into action.Analysis of each movement, disassembly eventually broken down into 9 class 28 dynamic element and its movements and dynamic process as shown in table 1.And then by the movements of the IEMS analysis software is used to get the duration of each movement.According to the data found that some of the action takes large proportion.

Table 1 Action frames of security process and therblig form

No.	Action Name	Duration of Action （SEC/frames）	Instructions	Therblig
1	Start Security Checking	0.92/6	Check the right side of the passenger	U
			Check the right side pants pocket	U
2	passenger open the pocket	1.16/55	Search the right pocket	SH
			Hand into the pocket	RE
			Take out things	U
3	Keep on Security Checking	1.84/67	Staff check the right side of the passenger	U
			Staff move the left hand to left side of passenger	M
			Check the upper part of the passenger	U
			Check the left pocket of the trousers	U
4	Passenger open the pocket again	6.84/144	Passenger lifts the left hand to look for the pocket	RL
			Passenger position the pocket	P
			Passenger hands into the pocket	RE
			Passenger look for things in the pocket	UD
			Passenger takes out things,and staff prepare to take them with left hand	PP
			Passenger places things wiht staff positioning together	M
			Staff and passenger turn around and put down things together	M
5	Security checking again	3.72/55	Staff recover the body in advance	M
			Staff move to security position again, and guide passengers back to security position	P
			Prepare to security check	PP
			Check the belt	U
			Check the pockets in both side	U
6	Turn around, and check the back side	1.76/56	Guide passenger to turn around and wait	UD
			Check the bace side	U
7	Check the legs	2.16/63	Check the left leg	U
			Check the right leg	U
8	Finish	2.16/51	Check the waist	U
			Finished.stand aside and tell the passenger	RL
9	Passenger communicate with the staff	1.88/28	Passenger asks whether has finished	RT

Dynamic analysis

Galbraith seek the lowest economic principle of motion is defined as fatigue to obtain the highest efficiency and the economic activity rule to follow is a research and analysis of the scene of action is an effective method of homework.It is divided into four basic principles: a reduction in the number of movements, both hands to work at the same time, shorten the distance of action and the action of relaxed and comfortable.Based on this principle we push element classification into three broad categories.Because it accounts for 25% of the total dynamic element number is four auxiliary dynamic element and three invalid and dynamic element in addition to the working process of the less than 30 seconds to complete the 21 items of effective dynamic element needs to be highly focused and proficiency so in this article summarize the problem for two: (a) auxiliary element and invalid move element causing unnecessary waste of time (2) the effective dynamic element quantity is various.

The improvement of the civil aviation security process

The improvement of the "rest" dynamic element

Use the IEMS statistical analysis of a complete process in the video will take a total of 532 frames.The entire process takes 21.28 seconds altogether if according to the speed of 30 frames per second to calculate the end of the passenger security to leave footprint of 1.88 seconds.Imagine there are passengers came up behind the preparation of the security check it for the time will be a waste.In this paper, the following two solutions in order to short it a solution: from the perspective of the security staff.

Security personnel in advance to inform passengers security end in security action will be completed at the same time he suggested that the next passenger can come forward to prepare security checks.Two passengers react when this process would be exactly is security checks at the end of the formal.Compared to plan a second can under the condition of the security security screening efficiency and there is no cost.

Invalid element of improvement

Specialized in front of the problem, in addition to the analysis of the "rest" dynamic element also made clear that the dynamic element "delay" of the invalid to the influence of the process and auxiliary element "alignment" and its "on".So on the whole is invalid in that dynamic analysis.

Through the specific analysis process can be found "delay" and "alignment" invalid move is caused by passenger tao pocket action.Passengers were cut two pockets in total consumption for 8 SEC.Passengers should have empty pocket in advance before the security to security in the process of can leave out the unnecessary action but in the process of the daily security pocket with a passenger is still a lot of things through security.

First of all, this article suggest install in security eye-catching sign for this problem.It at the time of transfer passengers attention can remind passengers waiting in line in the process of take out his pockets.Secondly baggage security staff should inform passengers take out before passengers to accept personal security items except money in his pocket.Such combination must be won't appear in the process of security because of the passengers had a pocket items hold up the efficiency of the security situation.

Moreover there is a "delay" is to back the security staff in the process of passengers turned and waste of time.At security is indispensable in the process of waiting passengers turned a process but if workers in a security action is coming to an end when she was told passengers and passengers receive this information and then respond to its processing will lead to stay to really turn is just at the end of the positive inspection.It's at least shorten half reaction then turned to the waiting time of waiting for passengers.

Such as improve the efficiency of the security check at the same time making passengers perceived security time is shorter, so the original scheme of dynamic element no longer exists "delay" has improved the passenger satisfaction.

Improve the effective dynamic element number

Usually reduce dynamic element method is to replace each element order to make the same move at the same time.Because of the particularity of problem of this article, the seriousness of security and must be so only change too much repetitive movements.According to the conclusion that remove invalid move element will effectively dynamic element to improve configuration as shown in table 2 after the screening process.

Table 2 Improved Security Process

Therblig Name	Therblig	Second/frame
Check the right side of the passenger	U	0.20
Check the right pocket of the trousers	U	0.12
staff check the right side of the passenger	U	0.16
Staff move the left hand to left side of passenger	M	0.48
Check the upper part of the passenger	U	0.6
Check the left pocket of the trousers	U	0.6

Check the belt	U	0.12
Guide passenger to turn around and wait	UD	0.26
Check the bace side	U	0.92
Check the left leg	U	1.24
Check the right leg	U	1.88
Inform passenger to convey to the next passenger to start security checking and finish checking	RL	0.28

Conclusion

Compare the improved security process with the original one, and examine the superiority of the new plan. Overall, the entire process of the original security scheme takes 21.28 seconds, and the improved one takes only 11.72 seconds. It saves 9.56 seconds, which is 44.92% of the time, and the efficiency increased by nearly 200%. The faster security process reduces passengers waiting time. From the perspective of therblig, the invalid therblig of the entire process reduce from 4 to 1. The simplify of move decreases the physical loss of security person, and the quality of the service will be improved relatively. Without the waiting time, the security time of passengers will be shorter. No matter considering from the perspective of passenger satisfaction or the profit of airlines, using the low-costing action analysis to improve the working process of the security is more practical and more advantage. And at the same time, the method of therblig analysis can also be adopted to improve the efficiency of other work in the field of civil aviation.

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