

Research on Transportation Safety Management of Air China Based on Game Theory

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Abstract

"Safety first" is the enduring theme of civil aviation, and safety is the lifeline of civil aviation. In the current period of time, the aviation safety situation at home and abroad is complicated. The overall situation of my country's civil aviation transportation is stable, but there are worries in the stability. Incidents, serious incidents, and human-caused incident rates have all increased since December 2015, exceeding the annual average. Therefore, the research on transportation safety management of airlines is particularly important. This paper uses Air China as an example, and analyzes the airline's transportation safety management by using game theory. By establishing the game model of safety management, this paper deeply explores the game relationship between the government and airlines, uses Nash equilibrium to solve the problem, analyzes the safety management countermeasures and suggestions for China International Airlines, and provides information for my country's civil air transport safety management system provide a theoretical basis.

Keywords

Transportation , Safety management, Game theory.

1. Research background and significance

1.1. Research background

With the rapid development of my country's aviation industry, the traffic volume of the civil aviation industry has increased significantly, and the opening of a large number of new routes has made the route network more complex and greatly increased the pressure on daily operation guarantees. Although my country's civil aviation safety operation record is at the forefront in the world, with the rapid and rapid growth of traffic volume, the public and the country's expectations for aviation safety are also increasing day by day. Therefore, ensuring aviation safety is of great significance and has broad societal implications. Although the game theory research in my country started late, with the advent of the Internet age and the continuous improvement of computing means, the game theory research in my country is also progressing steadily. This paper constructs a game model by applying game theory to the field of civil aviation to provide enlightenment and advice for the safety management of civil aviation industry. This article uses Air China as an example. Air China, as the only flag carrier in China and a member of Star Alliance, is more representative.

1.2. Research significance

The research and practice of civil aviation safety management in foreign aviation industry developed countries is earlier and more mature. At present, the civil aviation industry in developed countries has completed the construction of the airport safety management system within 20 years, and it has reflected the systematicness and superiority of its management. In order to improve the overall safety level and eliminate risk factors, China's civil aviation must establish a safety management system with Chinese characteristics through reference and learning, combined with the actual situation. Under this urgent and realistic demand, this

paper closely combines the current research status of existing safety management systems at home and abroad, takes Air China as the research object, and builds a game model, which has industry guidance and demonstration significance.

2. Air China safety management game model

2.1. Construction of the game model

In a game of incomplete information, at least one player does not fully understand the information of the model, and may not know the payoff function of the others. In this model, the government aims at maximizing social welfare, and at the same time, the civil airline has its own revenue function, and the revenue function of Air China is unknown, so this paper adopts the incomplete information game model. In the model, the government supervises airlines and pursues the maximization of social welfare, while civil air transport companies may have safety accidents for some reasons.

The model construction of this paper comes from the ‘Game analysis of civil air transportation safety management’ by Zhou Yue[1]. In the model established in this paper, the set of actions that civil airlines can choose is assumed to be A_1 , then $A_1 = \{\text{unsafe operation, safe operation}\}$; at the same time, the set of actions that the government can choose is assumed to be A_2 , then $A_2 = \{\text{unregulated, Supervision}\}$. It is assumed that the government and the civil airline know each other about the actions that the other can choose.

The input assumptions of government management in the model are as follows: The input cost of the government's investment in the safety management and inspection of civil airlines is C , and the government can receive benefits from aviation safety operations as P , then the government's management agency will perform inspections. $P-C$, when the government does not invest additional costs for effective management, the benefits are the benefits of safe production.

On the other hand, the investment assumptions of civil airlines are as follows: the investment of civil airlines to ensure safe operation is a . Here, the author assumes that the larger the civil airline is, the more it invests to ensure safety; The company's safety production income is W ; otherwise, its income is G . Obviously, $G > W$, if there are hidden dangers detected by the government management department, the airline needs to pay a fine of F , and the loss suffered by the government in the event of a civil aviation accident is L .

Table 1 Air Transport Safety Regulatory Payment Matrix

civil airline administration	government	Safe operation	Unsafe operation
Supervision		$P-C; W-a$	$P-C+F; G-F$
No supervision		$P; W-a$	$-L; G$

2.2. Analytical game model

From the perspective of the government, the government believes that in order to ensure higher profits, civil airlines will try their best to reduce costs, including the cost of safe operation. Therefore, the government and the airline do not form a cooperative relationship, and it has always been a non-cooperative relationship. Mixed strategy Nash equilibrium.

3. Game Model Analysis and Discussion

Through the equilibrium analysis of this game model, the following propositions can be obtained:

(1) It can be seen from the payment matrix that when the government chooses to supervise whether the airline operates safely, when the airline reduces the cost of ensuring safe production and the government increases the punishment, the airline will be more inclined to choose safe operation.

(2) When the government chooses not to supervise the safe operation of airlines, the airlines will take a chance and choose to operate unsafely, which requires more investment in safe operation with lower cost, so that airlines can guarantee safe operation. Reduced costs, thereby opting for safe operations.

(3) Narrow the gap between the airline's safe operation income and unsafe operation income, and at the same time, the government will increase the punishment, so that the airline will not risk choosing unsafe operation for profit reasons.

As Air China is the only flag carrier in China and a member of Star Alliance, its social status and social influence are relatively large, so the government should manage and supervise it more to ensure the positive development of my country's civil aviation industry.

4. Summary

With the rapid development of my country's civil aviation industry, some management loopholes gradually surfaced, which requires more coordinated cooperation between the government and airlines. And Air China, as a leading enterprise in my country's civil aviation industry, should shoulder its social responsibility, ensure safe operations, and allow every passenger to land safely. At the same time, government supervision departments should also keep pace with the times, continuously improve the supervision system, strengthen the training of relevant personnel, and make the staff more professional. The two complement each other, make progress together, and contribute to the development of my country's civil aviation industry.

References

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