

Review

Strategy risk research on Chinese aviation market: Based on Analytic Network Process (ANP) and the Fuzzy assessment method

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At present, Chinese aviation market is a bloody competition market, to compete from the strategy management point is a new thinking. Based on a review of related concepts, this article identifies the strategy risks in Chinese aviation market through WBS-RBS and interview methods. The Analytic Network Process (ANP) method is used to assess strategy risk and to rank strategy risk factor within Chinese aviation markets. Using triangular fuzzy numbers this study determines the differences between the strategy risks of various Chinese airlines. Among 16 strategy risk factors, strategy change and environment are the biggest risks. Of the 12 Chinese airlines studied, Air China has lowest strategy risk, and Okay Airways has the highest strategy risk.

Key words: Strategy risk, ANP, triangular fuzzy numbers, airlines market, risk assessment.

INTRODUCTION

The aviation market has an essential function in a country's economy and defense security. After 30 years of existence, the Chinese aviation market has recently experienced fast development, yet there is still a big gap when compared with developed countries. The Civil Aviation Administration of China recently proposed that China would strive to construct a powerful country on civil aviation market.

The Chinese aviation market currently faces low margins, big risks, and a complex and fluctuating environment, because it is easily influenced by external factors such as international politics, the economy and the environment (Li, 2008). At present, most research focuses on direct internal and external risks, such as cost control, human resources, disaster risks, risk of government intervention, and fuel risks, yet no research has been done on the risk of airline strategy management based on the market competition strategy. Meanwhile, Chinese airlines are paying increasing attention to strategy management to compete, a field that has experienced three separate phases. The first phase was defined by a period of company creation from 1980 to 1990, when aviation changed from a military to a commercial endeavor. Airlines operated based on a top-down model and there was no market and strategy

management. The second phase lasted from 1990 to 1998 at which time the only strategy for airlines was to expand services and create more routes, the market came to being. The third phase consists of forming strategy management and extends from 1998 to present. In this phase, strategy management has been gradually accepted by the airlines and competition became fierce in the market. For example, Hainan Airlines created its development strategy in 2001, meanwhile China Southern airlines appointed Roland Berger to set its strategy. Price battle spread into every corner of the aviation market, and today, almost every airline has an official strategy management. The increasing importance of strategy management for Chinese airlines is balanced by a need to control the strategy risk, an essential element for success.

LITERATURE REVIEW

From the marketing point, there are thousands of researches on how to compete and how to get bigger market share, in reality, every airline company within China have involved into this blood market competition. Based on the marketing competition, strategy

management is a new thinking and better solution for the development of aviation market.

The basic job of strategy risk research is to unify the definition of strategy risk. According to a summary of the pertinent theories, there are three definitions of strategy risk. The first one is the risk of strategy. Because of changes and mistakes, such as environment change, planning error and poor implementation, strategy management fails or the strategy goal cannot be realized. The second understanding is strategic risk. According to Quinn (1980), strategic risks are the factors which can influence company direction, culture, survival ability and company achievement. Similarly, Simons (1999) points out that strategic risk can weaken a manager's "ability to implement original strategy, and strategic risks are the unpredicted factors or conditions. For this definition, strategic risks are those risks that can influence overall development, the core business or vital matters. The third definition is risk management via the strategy management method. The company can set a risk strategy plan and implement its risk strategy, in short, it has a coherent strategy management.

Strategy includes a series of actions and activities, including the process of strategic thinking, strategy making, strategy choice, strategy implementation and strategy control. Every step can, however, deviate from the original goal and cause losses. At present, only a few studies (Adrian, 2004; Aswath, 2008; Baird, 1985; Zhang and Huo, 2007; Sayan et al., 1999) have focused on the risk of strategy (Gong et al., 2008), as showed on Table 1. Wintrey and Budd (1997) pointed out that strategy risk stems from the relationship between enterprise and the whole environment, and the relationship between resource and market. Yang (2002) focuses on environment risk, resource risk, strategy ability risk and company direction risk. Liu (2004) argues that strategy risks are the risks related to enterprise strategy intention, strategy resources, company competition ability, company leadership and the strategic environment. In the action of strategy, how to control, identify and assess the risk of strategy is very important (Michael et al., 2008). Zhou et al. (2003) indicate that the essence of strategy is in the interaction between company and a changing environment. In a different environment and with a different background, the definition, idea, paradigm and its application will be different.

There are many different concepts and studies on risk in different fields, such as finance, accounting, organization behavior and strategy management. According to the ISO31000 (2009) published by the International Standardization Organization, risk is the effect of uncertainty on an objective. Based on this concept, the strategy risk in this paper is the effect of uncertainty on a strategy objective.

Strategy management has been studied from many different angles and under varying circumstances. According to Johnson and Scholes (2004), strategy

management process includes three inter-influenced parts: strategy position, strategy choice and strategy implementation, as seen in Figure 1. This is the essential definition of strategy management in this paper. The whole strategy management process will be sub-divided into many strategy risk factors, and the main purpose of this paper is to identify and assess the strategy risk for Chinese airlines.

STRATEGY RISK IDENTIFICATION FOR CHINESE AVIATION MARKET

Strategy risk identification attempts to point out potential risk sources and to differentiate strategy risk factors from real strategy risks based on investigation and analysis. It has two steps, finding out the strategy risk source (strategy risk factor) and identifying the changing condition. A strategy risk factor can transform into a strategy risk only under certain conditions, therefore, through the analysis of the transforming condition, the company can cut the transforming channel, decrease the risk probability and mitigate the loss. In theory, the uncertainty which influences a strategy goal is an infinite muster, in order to make it easy to operate, in this article, the uncertainty of strategy risk is regarded as a limited cluster.

The basic strategy risk identification framework is presented in Figure 2. Through interviews with aviation experts, as noted in the framework of Figure 2, the final strategy risks are summarized in Table 2.

Table 2 shows the two-level strategy risk factors of Chinese aviation market, according to the strategy risk identification framework, the following step is to analyze the conditions for transforming potential strategy risk factors into real strategy risks. Taking the environment factor (R11) as an example, environment is the key factor for company survival, and a favorable environment can facilitate the company's strategy goal, while a fluctuating and bad environment will restrain company development. In summary, when the environment is unpredictable and fluctuating, environment will be the strategy risk.

STRATEGY RISK ASSESSMENT OF CHINESE AVIATION MARKET

Strategy risk assessment is based on strategy risk identification, and for Chinese airline companies, the assessment will be implemented according to occurrence probability, influence scope and uncontrollability. Considering the dependence and feedback within and between clusters and elements, Analytic Network Process (ANP) proposed by Saaty (1996) based on the Analytic Hierarchy Process (AHP), is used in the assessment of Chinese airlines. The AHP with its dependence assumptions on clusters and elements is a special case of ANP.

Table 1. Studies on the risk of strategy.

Year	Author(s)	Variables	Conclusion
1985	Baird Inga Skromme Howard Thomas	Macroeconomic risks Industry risk Organization risk Strategy problem risk Decision makers risk	Risks are from external and internal of an organization
1997	Frank L Winfrey James L Budd.	Company open risk Operation risk Competition risk	Risks are from the relationship between company and environment
1999	Simons, R.	Operation risk Capital loss risk Competition risk Goodwill risk	Risks are from the competition, customer needs changing, supplier changing.
1999	Sayan Chatterjee. Michael H Lubatkin William S Schulze.	Strategy risk is more important than traditional risk.	CAMP is not enough for strategic risk.
2002	Yang Jianghua	Environment risk Resource risk Strategy ability Developing direction	Economy, political, industry and market structure and competition Resources lack Weak company ability
2003	Zhou Sanduo Zou Tongqian	Value Culture history	Chinese culture has a key influence on strategy management, environment cause the risk of strategy
2004	Adrian Slywoztky	Technology innovation Consumer risk New business risk Brand risk Competition risk Industry and market risk	Low technology, changing customer need, bad quality, weak brand management, industry recession and market stagnate
2004	Liu Shengfu	Political, technology, manager, organization, market, resource and operation	Company strategy content, strategic ability, strategic resource, competition ability, leader, strategic environment.
2004	Gerry Johnson Kevan Scholes	Strategy position strategy choice strategy implementation	Risks are from every steps of the process of strategy management.
2007	Zhang Ronglin Huo Guoqing	Strategy hypothesis Strategy governance Strategy dislocation Strategy rigid	Power balance among stakeholders Stratategy analysis, vision and technology within company Value and governance structure
2008	Michael A.Hitt R Edwarf Freeman Jeffrey S Harrison	Strategy theory is complex and full of schools	Different company should have different strategy management, and different strategy risk.

Table 1. Contd.

2008	Aswath Damodaran	Firm value Risk assessment Real options Risk taking	Great companies become great because they seek out and exploit intelligent risks, not because they avoid all risk.
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Source: summarized through the literatures

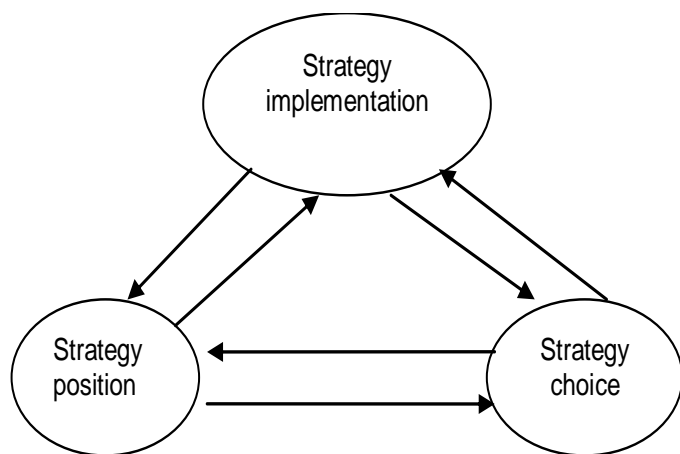


Figure 1. The strategy management model from Johnson and Scholes (2004)

The ANP structure and principle

The ANP is a coupling of two parts. The first one consists of a control hierarchy or network of criteria and sub-criteria that control the interactions, including goal and decision rule. The second one is a network of influences among the elements and clusters. The network varies from criterion to criterion and a different supermatrix of limiting influence is computed for each control criterion. At the end, each of these supermatrices is weighted by the priority of its control criterion and the results are synthesized through addition for all the control criteria. The principle and typical structure is shown in Figure 3.

According to dominance theory, two elements under the same criterion can be ranked directly, and they can also be indirectly compared, to analyze the degree of influence between the two elements and sub criterion under certain criterion. Generally the operation involves five successive steps.

- (1) Determine the ANP structure
- (2) Determine supermatrice elements
- (3) Determine the cluster weight matrix
- (4) Determine supermatrices by weighting
- (5) Find final index weights and element weights

Once the weights are determined, consistency of the

comparison matrices is measured by calculating the consistency ratio (CR). CR can be calculated as:

$$CR = \frac{CI}{RI} \tag{1}$$

where CI represents the consistency index and RI represents random consistency index. CI can be formulated as follows:

$$CI = \frac{\lambda_{max} - n}{n - 1} \tag{2}$$

where λ_{max} represents the maximum eigenvalue for the matrix. RI is determined empirically as the average CI of a large sample of randomly generated comparison matrices. If $CR \leq 0.1$, then the level of inconsistency is acceptable based on Saaty's rule of thumb. Otherwise, the inconsistency is high and the decision maker may need to re-estimate the relative importance of each criterion to realize better consistency.

Because of the exhaustive computing work, researchers always use software to run this ANP operation.

The strategy risk assessment result of Chinese aviation market

Using the ANP principle, one Chinese airline's ANP structure is represented in Figure 4. In this figure the control hierarchy includes probability, loss and uncontrollability; in the network hierarchy it includes three inter-influenced factors, strategy position, strategy choice and strategy implementation.

A 1-9 ratio scale is used in the comparison among criterion, elements and clusters. Based on interviews with 5 aviation experts, the data was input into the *Super Decisions* software. As an example, comparing between probability, loss and uncontrollability using the Super Decision software, the matrix and weight vectors are shown in Table 3.

After the test,

$$CR = 0.0176 \leq 0.1$$

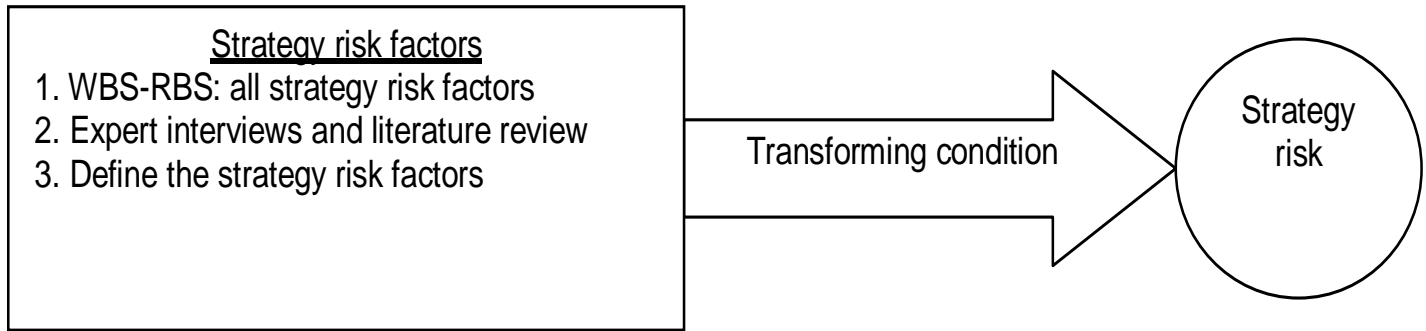


Figure 2. Strategy risk identification framework

Table 2. Strategy risk factors of Chinese Airlines.

R1 Strategy position	Environment	R11
	Strategy ability	R12
	Expectation and goal	R13
	Strategy hypothesis	R14
R2 Strategy choice	Direction and choice	R21
	Internalization	R22
	Diversification	R23
	Stakeholder strategy	R24
	Strategy alliance	R25
	M& A	R26
	Low price strategy	R27
	Competition strategy	R28
R3 Strategy implementation	Resource fit	R31
	Organization structure	R32
	Strategy change	R33
	Enterprise culture	R34

Source: from Johnson and Scholes (2004) and expert interview.

So the matrix has a satisfactory consistency.

The computed results of the super decision software are shown in Table 4 and Table 5.

As shown in Table 5, the top five strategy risks are strategy change, environment, strategy direction and choice, resource fit, expectation and goal, and the lowest risk is M & A. For the present Chinese aviation industry, strategy change is the top risk, and airlines should have stable strategy to manage this risk. Because of the vulnerability, every environment change will have a serious influence on aviation industry, such as earthquake, storm and so on. For the concept of environment, there are also political environment and social environment. As the Table 5 showed, we can explain in detail the ranked strategic risks in the further research.

STRATEGY RISK DIFFERENCE ANALYSIS BASED ON TRIANGULAR FUZZY NUMBERS

Strategy risk assessment alone is not, however, enough for the aviation market, because strategy management is the main management activity for airlines. As a result, it is necessary to assess different airlines using the same criterion. Different companies have different strategy risk levels. To compare our test group of 12 Chinese airlines, showed as Table 6 and 5, Chinese aviation experts were interviewed. The expert's descriptions are uncertain and fuzzy and triangular fuzzy numbers can be used to average the fuzziness.

The scale includes 7 levels expressing relative importance using, for example: very low, lower, low, middle, high, higher, very high. One triangular fuzzy weight

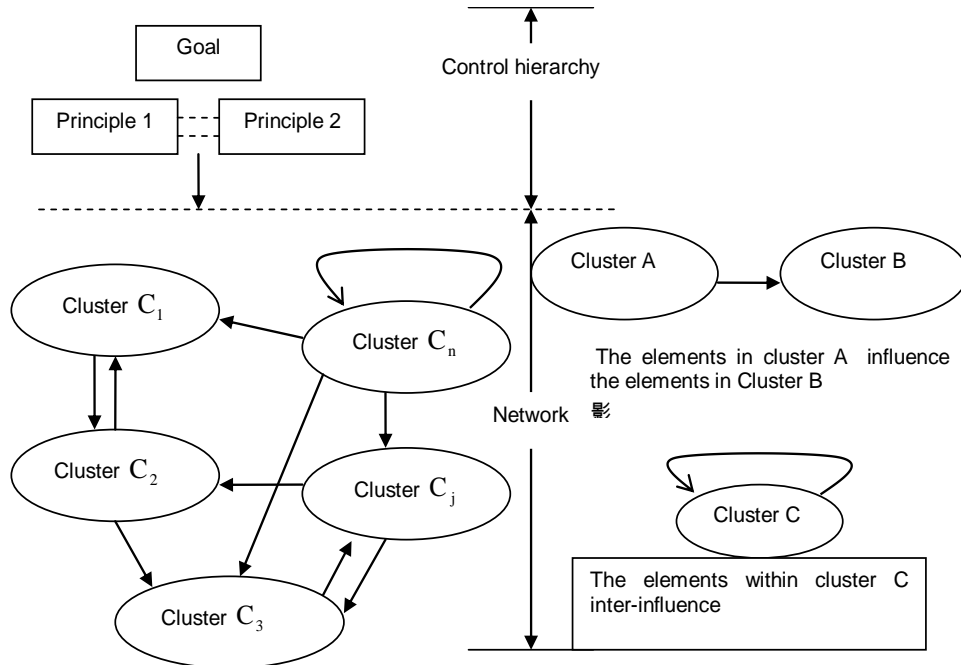


Figure 3. Typical ANP structure from Saaty Thomas L, Luis G Vargas (2006).

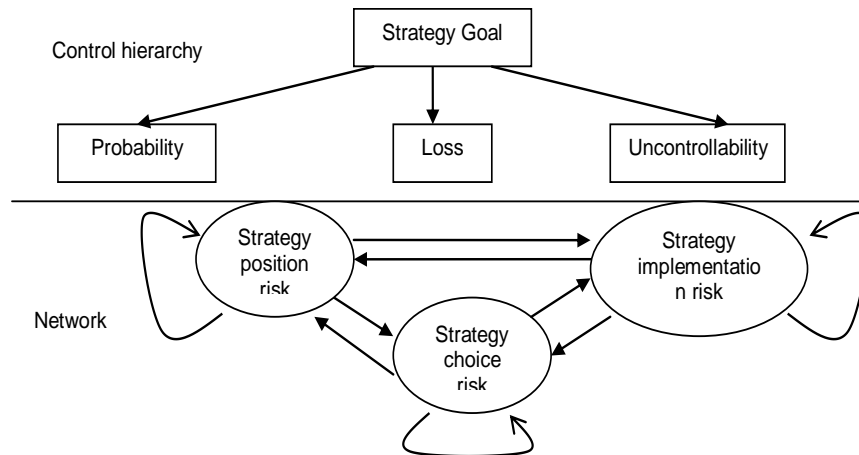


Figure 4. ANP structure of Chinese airlines.

cluster is set as

$$W1^*, W2^*, W3^*, W4^*, W5^*, W6^*, W7^*$$

And

$$W1^* = (0, 0, 0.2)$$

$$W2^* = (0, 0.2, 0.4)$$

$$W3^* = (0.2, 0.35, 0.5)$$

$$W4^* = (0.3, 0.5, 0.7)$$

$$W5^* = (0.5, 0.65, 0.8)$$

$$W6^* = (0.6, 0.8, 1)$$

$$W7^* = (0.8, 1, 1)$$

The membership function of the 7 triangular fuzzy numbers are shown in Figure 5. Using the evaluating data from the 5 experts concerning 12 Chinese airline companies, after defuzzification, and combined with the strategy risk weight of the whole aviation market, the outcome of the strategy risk difference between the 12 airlines is shown in Table 7. Higher risk value means higher strategic risk for the concerned airline company, all 12 airlines were ranked according to the risk value, Air

Table 3. Weight of control hierarchy from super decisions

Comparisons wrt'Goal' node in 'Control Criteria' luster																					
Graphic Verbal Matrix Questionnaire																					
1.L	9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5	No comp.	P
1.L	9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5	No comp.	U
1.P	9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	9.5	No comp.	U
Priorities													The inconsistency index $i=0.0176$. It is desirable to have a value of less than 0.1								
													L	0.319618							
													P	0.121957							
													U	0.558425							

Table 4. Strategy risk priorities for Chinese airlines

Super decision main window risk1.mod: Priorities			
Here are the priorities			
Icon	Name	Normalized by cluster	Limiting
No Icon	L	0.00000	0.000000
No Icon	P	0.00000	0.000000
No Icon	U	0.00000	0.000000
No Icon	Goal	0.00000	0.000000
No Icon	R11	0.34198	0.083045
No Icon	R12	0.18636	0.045255
No Icon	R13	0.25148	0.061067
No Icon	R14	0.22018	0.053468
No Icon	R21	0.26750	0.077289
No Icon	R22	0.19605	0.056644
No Icon	R23	0.01692	0.004889
No Icon	R24	0.18462	0.053341
No Icon	R25	0.06874	0.019862
No Icon	R26	0.01210	0.003497
No Icon	R27	0.22045	0.063695
No Icon	R28	0.03360	0.009709
No Icon	R31	0.25649	0.120098
No Icon	R32	0.17229	0.080675
No Icon	R33	0.36929	0.172916
No Icon	R34	0.20193	0.094549

Table 5. Rank and priorities of Chinese airline strategy risk.

Strategy Risk	Weight	Rank	Strategy risk	Weight	Rank
R33 Strategy change	0.36929	1	R22 Internalization	0.19605	9
R11 Environment	0.34198	2	R12 Strategy ability	0.18636	10
R21 Direction and choice	0.2675	3	R24 Stakeholder strategy	0.18462	11
R31 Resource fit	0.25649	4	R32 Organization structure	0.17229	12
R13 Expectation and goal	0.25148	5	R25 Strategy alliance	0.06874	13
R27 Low price strategy	0.22045	6	R28 Competition strategy	0.0336	14
R14 Strategy hypothesis	0.22018	7	R23 Diversification	0.01692	15
R34 Enterprise culture	0.20193	8	R26 M & A	0.0121	16

Table 6. Basic information of 12 Chinese Airlines.

Airlines	Founded	Lines	Flights	Property	List on	Business type
SC	1994	110	60	State-owned	Shenzhen	network
MU	1988	650	207	State-owned	HK,NY, SH	network
CA	1988	250	256	State-owned	HK, London, SH	network
CZ	1992	600	350	State-owned	HK,NY, SH	network
HU	1989	500	148	Joint venture	SH	network
ZH	1992	300	150	Private		network
3U	1986	130	51	State-owned		network
MF	1984	140	69	State-owned		network
BK	2005	20	11	private		regional
9C	2004	40	15	private		Low cost
G5	2006	25	30	Joint venture		regional
HO	2005	30	14	private		regional

Source: summarized through the data from Civil Aviation Administration of China <http://www.caac.gov.cn/>

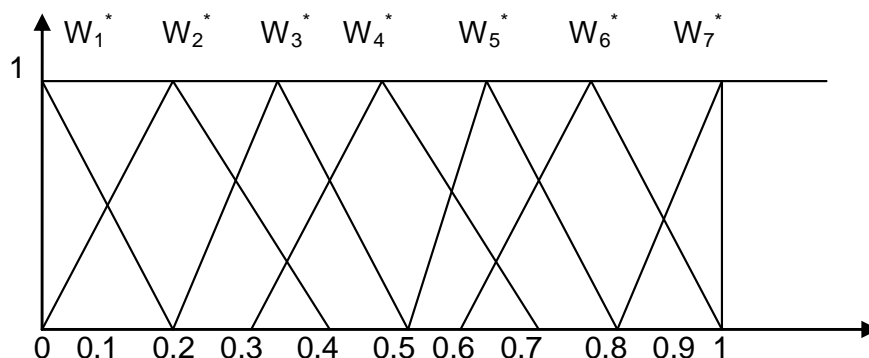


Figure 5. The membership function of 7 triangular fuzzy numbers.

Table 7. Differences between 12 Chinese airlines.

Airline	Risk value	Rank	Airline	Risk value	Rank
SC	0.573915	7	3U	0.554226	8
MU	0.604738	6	MF	0.551635	9
CA	0.430191	12	BK	0.732763	1
CZ	0.530385	10	9C	0.64111	3
HU	0.467754	11	G5	0.644721	2
ZH	0.618306	5	HO	0.636595	4

China (CA) has the lowest strategy risk and OKAIR (BK) has the greatest strategy risk. According to the result of risk value, we can know the difference among airlines, and for the managers, they can do further research to find the reasons.

CONCLUSION

Strategy risk identification highlights the important

strategy risk factors using the ANP method. As a result, the 16 most important overall strategy risks can be ranked. The top five strategy risks are strategy change, environment, strategy direction and choice, resource fit and expectation and goal. Based on this result, airline company can get the competitive advantage from the focus on strategy change, environment, strategy direction and choice, resource fit and so on. Further study using triangular fuzzy numbers shows Air China has lowest strategy risk and OKAIR (BK) has greatest strategy risk.

For Air China, it is the flag airlines of China, and it has enough resource and capital to deal with all kinds of risks. On the contrary, OKAIR is a young private company, and it does not have enough resource to deal with risks, such as capital, lines, management experience, talents and so on. In another words, OKAIR does not have enough strategic resource and strategic ability to conquer strategy risk. For the managers, it is helpful to have a deep understanding of the competitive environment and risks, and find out the position of every company, what is more important is to take related measures to control the high risks. Based on this research, further researches can be done on how to deal with the ranked strategic risks, how to use this method in other fields. Because most of Chinese airlines are state-owned, Chinese government can make policy to ameliorate the whole environment according to the result of this research. Generally, on theory, this research extends the concept of risk into the field of strategy, and uses ANP and triangular fuzzy numbers methods. In practice, through making out measures to control the ranked strategic risks, company can have a sustainable development and China will have a promising civil aviation industry.

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