Construction of Optimal Management Strategies on Energy Saving and Carbon Reduction for Kaohsiung International Airport

Ta-chen LIN¹,a,* and Yu-heng CHANG²,b

¹School of Environmental Science and Engineering & Key Laboratory of Estuarine Ecological Security and Environmental Health, Xiamen University Tan Kah Kee College, Zhangzhou, Fujian, China
²Department of Transportation Management, National Cheng Kung University, Tainan, Taiwan

a2082135496@qq.com, byhchang@mail.ncku.edu.tw

*Corresponding author

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Abstract. Energy saving and carbon reduction (ES & CR) has become global issues. All governments and private industries work hard together to make great efforts on ES & CR. The aviation industry that bleeds CO₂ to the atmosphere directly is an important one of the industries. The airport is one of the key parts of airway transportation, because they caused most of energy consumption, that they become the one of key factors on ES & CR. In this study, the SWOT analysis, TOWS matrix cross-analysis and expert interview were used to analyze the key factors of management strategies of ES & CR in the case study of Kaohsiung International Airport (KIA). The results showed that four strategies of SO, ST, WO and WT were proposed firstly. Then, four strategic aspects with sixteen strategic executions were established through expert interview. It can not only provide the management strategies for the international airport in response to international competitive environment, but also can achieve the sustainable development.

1. Introduction

With the energy shortage and global warming, the development of the aviation industry is hindered and limits due to the impact on the global climate change and the regional air quality [1-4]. Therefore, the reduction on energy waste and emissions of greenhouse gas become the objectives of sustainable development for the aviation industry [5-7]. Airports are the most important part of airway transportation, since they may result in a huge consumption of energy. Therefore, ES & CR become one of the key factors of competition for sustainable development of the world’s international airport. However, the effect of ES & CR for international airport will be approached from various aspects and factors, including terminal staff education, institutional measures, administrative regulations, electrical and mechanical equipment, building facilities, green materials and products, environmental quality, environmental design, emission control, monitoring system and transportation and so on [8-11]. Concerning the maintenance of comfortable environment quality in the airport terminal, and the benefit balance of energy and function [12,13], the management strategies of ES & CR are more worthy of attention and study in practice.

The purpose of this study is to analyze the key factors and propose the optimal management strategy of ES & CR in KIA for competition in aviation industry, and provide the international airport in the world for sustainable development.

2. Research Method

The relevant factors of management strategy of ES & CR related to the sustainable development have been gathered from the literature in the past five years [5,11,14-16]. Then, the key factors of management strategy of ES & CR were acquiring from expert interviews. The strengths, weaknesses, opportunities and threats of KIA as a case study were analyzed using SWOT analysis.
Then, the four strategies of SO, ST, WO, and WT were put forward in advance using TOWS matrix cross analysis for KIA. Based on these strategies, the optimal management strategy of ES & CR in KIA for competition in aviation industry was constructed. They could contribute to executive reference of management strategy of ES & CR in world’s international airport for sustainable development.

3. Results and Discussion

The results mainly include the competitive strategy obtained from SWOT analysis and TOWS matrix cross analysis of management strategy of ES & CR in Kaohsiung international airport, as well as the optimal management strategy which will make the KIA become more competitive aviation industry. What’s more, it could also provide the world’s international airport with executive guidelines for sustainable development.

3.1 SWOT analysis of management strategy of ES & CR in KIA

SWOT analysis of management strategy of ES & CR is shown in Table 1, which is a based reference for the implementation of ES & CR strategy. Thus, KIA has begun since 2008 years to actively execute ES & CR measures in order to meet the policy of greenhouse gas reduction, benefiting to promote competitive ability and approach to the goal of sustainable development. The result revealed it had reduced 3% of greenhouse gas emissions in 2011, and gradually decreased every year by 1% of greenhouse gas emissions.

3.2 TOWS matrix cross analysis of management strategy of ES & CR in KIA

Based on SWOT analysis, the four strategies were put forward in advance through TOWS matrix cross analysis as shown in Table 2. There are (1) combining with the strengths and opportunities strategy (SO strategy), such as excellent geographical location linking to High-Speed Railway and MRT transportation, (2) enhancing the strengths but avoiding the threat strategy (ST strategy), such as excellent geographical location avoiding energy consumption (3) improving the weakness and mastering the opportunity strategy (WO strategy), such as loading of mass transportation reduced by developed traffic network (4) improving the weakness and avoiding the threat strategy (WT strategy), such as promoting the communication efficiency of network traffic and mass transportation. The result revealed it had reduced 5% of greenhouse gas emissions in 2016 years.
<table>
<thead>
<tr>
<th>Internal environment analysis</th>
<th>Strengths (S)</th>
<th>Weakness (W)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>S1. Excellent geographical location shortens transportation distance and makes less carbon emissions.</td>
<td>W1. Mass transportation due to the only airport with domestic and international lines in southern Taiwan make mass usage of energy and fuel, and mass carbon emissions.</td>
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<td></td>
<td>S2. Using green equipment with high efficiency and low energy consumption can reduce the energy loss and carbon emissions.</td>
<td>W2. Improving the operations performance and enhancing transport services level, make energy and fuel consumption increase.</td>
</tr>
<tr>
<td></td>
<td>S3. Implementing ES &amp; CR plan, greenhouse gas inventory and assessment, can reduce energy loss and carbon emissions.</td>
<td>W3. Expanding the airport operating base, and improving service capacity, make fuel and energy consumption increase.</td>
</tr>
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<td></td>
<td>S4. Improving environmental processing can reduce energy consumption and carbon emissions.</td>
<td>W4. Providing baggage transfer service and increasing transportation service make energy and fuel consumption increase.</td>
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<td></td>
<td>S5. Using renewable energy and priority to solar equipment can reduce energy usage and carbon emissions.</td>
<td>W5. Airport pavement damaged by long-term weather makes aircraft fuel consumption increase.</td>
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<td></td>
<td>S6. Establishing system management and electronic operating system can reduce resources consumption and waste.</td>
<td>W6. Finance shortage postpones equipment replacement and makes energy and fuel consumption increase.</td>
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<tr>
<td>External environment analysis</td>
<td>Opportunity (O)</td>
<td>Threats (T)</td>
</tr>
<tr>
<td></td>
<td>O1. High oil price reduces the usage of air transportation that makes energy consumption reduce and carbon emissions reduction.</td>
<td>T1. Combining international airport transfer system with Kaohsiung Railway Station, MRT and High-Speed Railway, mass transportation system makes energy consumption increase and carbon emissions increase.</td>
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<td></td>
<td>O2. Domestic industry transfers to overseas and high transportation of High-Speed Railway makes energy consumption reduce and carbon emissions reduction.</td>
<td>T2. Adjacent to the Kaohsiung Software Park and Kaohsiung harbor cargo transport facility, mass transportation system of cargo circulation makes energy consumption increase and carbon emissions increase.</td>
</tr>
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<td></td>
<td>O3. Domestic and manufacturing industry moved abroad, make energy and fuel consumption reduce and carbon emissions reduction.</td>
<td>T3. Near southern Industrial Park and developed green industrial zone, mass cargo transportation makes energy consumption increase and carbon emissions increase.</td>
</tr>
<tr>
<td></td>
<td>O4. Kaohsiung international airport combined with High-Speed Railway and MRT system, make energy consumption reduce and carbon emissions reduction.</td>
<td>T4. Expansion of Kaohsiung city brings many commercial activities. Mass population transportation makes energy consumption increase and carbon emissions increase.</td>
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<td></td>
<td>O5. Daily life circle of High-Speed Railway transportation services, reduced domestic air lines, that makes energy and fuel consumption reduce and carbon emissions reduction.</td>
<td>T5. Cross-strait tourism promotion plan of government policy, brings mass transportation and makes energy consumption increase and carbon emissions increase.</td>
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<td>O6. Planning long-term aviation with United States, UK, Japan, Australia and other countries for sustainable development, and planning alternative energy make energy reduce and carbon emissions reduction.</td>
<td>T6. Connecting to the east and west road traffic system and near Kenting resort, mass tourists transportation makes energy consumption increase and carbon emissions increase.</td>
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Table 2. TOWS matrix cross analysis on executive strategies of ES & CR for KIA.

<table>
<thead>
<tr>
<th>Competitive strategy</th>
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<th>External environment analysis</th>
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<td>Strengths (S)</td>
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<tr>
<td></td>
<td>SO strategy</td>
<td>ST strategy</td>
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<td></td>
<td>WO strategy</td>
<td>WT strategy</td>
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<td></td>
<td>SO1. Promoting ES &amp; CR awareness and behavior education to develop a long-term action plan (S3 + O6)</td>
<td>ST1. Implementing electronic administration and constructing electronic information to strengthen transportation services (S6 + T1).</td>
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<td></td>
<td>SO2. Using solar energy and green energy equipment (S5 + O2, O3).</td>
<td>ST2. Using low energy consumption for high efficiency of transportation services (S1 + T2, T3).</td>
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<td>SO3. Reducing energy usage in response to the decline in domestic economic production (S2 + O2, O3).</td>
<td>ST3. Complying with the international rules and government regulation to enhance the competition (S3 + T3).</td>
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<td>SO4. Combining design concept of green building with geographical advantages and convenient transportation system (S1 + O4, O5).</td>
<td>ST4. Implementing management system of environmental quality to improve service quality and strengthen the international competition (S4 + T4).</td>
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<td>W01. Promoting green environment by planting for carbon reduction to enhance the international image of KIA (W1 + O2, O3).</td>
<td>WT1. Using environmentally friendly material to reduce environmental impacts and reduce energy losses (W2, W5 + T5, T6)</td>
</tr>
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<td></td>
<td>W02. Using system control to let aviation operations cost down (W2 + O1, O2, O3).</td>
<td>WT2. Using green building materials in science park to improve reduction of pollution emissions (W5 + T3, T5).</td>
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<td></td>
<td>W03. Using green concept products for benefit to life function (W6 + O5).</td>
<td>WT3. Using automatic monitoring system to improve transportation system and airport performance (W1, W2 + T1).</td>
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<td></td>
<td>W04. Planning automatic monitoring and emission system, and long-term plan on ES &amp; CR (W5, W6 + O6).</td>
<td>WT4. Recycling resources and facilities to reduce resources consumption (W4 + T2, T3).</td>
</tr>
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3.3 Optimal management strategy

In order to achieve the goal of reducing 10% of greenhouse gas emissions in 2020 years, the key factors of management of ES & CR in Kaohsiung international airport were acquired from the expert interviews based on SWOT analysis and TOWS matrix cross analysis. There are four strategic aspects including “administration system and regulations (AR)”, “green design and intelligent monitoring (GI)”, “green building and environmental protection (GE)”, and “resources recycling and quality control (RQ)”. The executive strategies were also established under the four strategic aspects as shown in Fig. 1. Hence, the optimal management strategy of ES & CR in KIA was constructed, which could contribute to the world’s international airport for sustainable development.
4. Summary

The conclusions and suggestions through the case study of management strategy of ES & CR in KIA are as follows:

(1) There are four key strategies that were figured out by using SWOT analysis and TOWS matrix cross analysis, including SO strategy, ST strategy, WO strategy and WT strategy for KIA to compete in aviation industry.

(2) There are four strategic aspects with sixteen strategic executions that were establish based on SWOT analysis, TOWS matrix cross analysis and expert interviews as the management strategies of ES & CR in KIA for sustainable development.

(3) The contribution of this study is to construct the optimal management strategy of ES & CR in KIA for competition in aviation industry, which could provide the world’s international airport with execution guidelines for sustainable development.

References


