Airline international potential route study for a subsidiary airline

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for the Degree of Master of Engineering Program in Engineering Management
Regional Centre for Manufacturing Systems Engineering
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การศึกษาเส้นทางการบินที่มีศักยภาพสาหรับสายการบิน

นายพิทวัส ทวีวัฒนไพศาล

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต
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พิทวัส ทวีวัฒนไพศาล : การศึกษาเส้นทางการบินที่มีศักยภาพสาหรับสายการบิน (Airline international potential route study for a subsidiary airline) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ศ. ดร. ปารเมศ ชุติมา, 216 หน้า.

งานวิจัยชิ้นนี้ จัดทำขึ้นเพื่อศึกษา และคัดเลือก เส้นทางบินระหว่างประเทศที่มีศักยภาพสำหรับสายการบินย่อย เพื่อขยายโครงข่ายการให้บริการ ซึ่งนับเป็นปัจจัยสำคัญอย่างหนึ่งในการวางแผนการบิน ขอบเขตของการวิจัยนี้ จะศึกษาเพียงเส้นทางบินที่ใช้ระยะเวลาเดินทางไม่เกิน 4 ชั่วโมง จากสนามบินสุวรรณภูมิในกรณีบินตรง โดยมีจุดประสงค์หลักเพื่อเพิ่มศักยภาพในการแข่งขันทางธุรกิจจากความหลากหลายของบริการ ซึ่งส่งผลให้อุปสงค์เพิ่มขึ้น

บริษัทกรณีศึกษาที่ใช้ในงานวิจัยนี้ เป็นสายการบิน full-service ในประเทศ แม้ว่าสายการบินกรณีศึกษานี้ จะแยกตัวออกมาอย่างชัดเจนจากสายการบินหลัก แต่ก็เป็นเพียงในส่วนของการบริหารและจัดวางกลยุทธ์เท่านั้น ด้านการตลาด สายการบินกรณีศึกษายังคงไม่สามรถให้บริการในเส้นทางบินที่ซ้ำกับสายการบินหลักได้ เพื่อไม่ให้เกิดการแย่งชิงส่วนแบ่งทางการตลาดซึ่งกันและกัน ดังนั้น สายการบินย่อย จึงจำเป็นต้องเสียโอกาสในบางเส้นทางไปให้แก่สายการบินหลัก ด้วยเหตุนี้ สายการบินกรณีศึกาจึงต้องร่วมมือกับสายการบินหลักเพื่อขยายเครือข่ายในการให้บริการ อันจะเป็นผลประโยชน์แก่ทั้งสองฝ่าย อย่างไรก็ตาม ในการเปิดเส้นทางการให้บริการใหม่นั้น จำเป็นต้องมีการลงทุนที่สูง การศึกษาตลาดและความเป็นไปได้จึงจำเป็น เพื่อป้องกันความล้มเหลวที่อาจเกิดขึ้น

ในงานวิจัยนี้ กระบวนการวิเคราะห์ตามลำดับชั้น ได้ถูกนำมาใช้ในการศึกษาและคัดเลือกเส้นทางบินต่างประเทศที่มีศักยภาพสำหรับสายการบินย่อย จากผลการศึกษา พบว่า จำนวนของสนามบินปลายทางที่อยู่ในขอบเขตการให้บริการนั้น มีจำนวนทั้งหมด 160 สนามบิน โดย ฮ่องกง เซบู สุบารายัน และ สิงคโปร์ เป็น 4 สนามบิน ที่มีศักยภาพสูงสุด จากการศึกษา 4 สนามบินนี้ในรายละเอียด พบว่า เซบู มีความน่าสนใจในการลงทุนมากที่สุด เนื่องจากแนวโน้มของกำไรจากการให้บริการมีสูงสุดเมื่อเทียบกับอีก 3 สนามบินปลายทางที่เหลือ ดังนั้น เซบู จึงถูกเลือกให้เป็นสนามบินปลายทางที่มีศักยภาพ และเหมาะสมแก่การลงทุนมากที่สุดสำหรับการวิจัยนี้

ภาควิชา	ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต	ลายมือชื่อนิสิต	....
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PHITTHAWAT TAWEEWATTANAPAISAN: Airline international potential route study for a subsidiary airline. ADVISOR: PROF. PARAMES CHUTIMA, Ph.D., 216 pp.

The statement of dissertation is the international potential route study for a subsidiary airline is the one of key fleet planning process which can be interchangeably referred to the route selection for the network expansion. The scope of the project is to study airline routes within 4 hours of flight duration from Suvarnabhumi International Airport. The diversity of route alternative will increase the accessing capability of the airline which attracts more air passengers demand. In this study, the Thai subsidiary airline has been the research case studied company. The company has recently been independence from the parent company; where the airline business model is established as the full-service carrier. Due to the stage of independence, the Thai subsidiary airline has lost the market opportunity in the origin-destination market of the parent company. However, the increasing of route network expansion implies the higher investment; where, the airline has to investigate the route potential to prevent the loss in contribution and the route suspension.

The research study is primary approached using the analytic hierarchy process to conclude the decision-making process of route potential. 160 airports have been found in the totals; where, the only top 4 airport which are Hong Kong, Mactan-Cebu, Surabaya and Singapore are the most operation potential route. Among alternatives, the Mactan-Cebu has shown in the outstanding profit performance which has been concluded to be the most appropriate international potential route.

Department:	Regional Centre for Manufacturing Systems Engineering	Student's Signature	....
		Advisor's Signature	....
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Abbreviations

General abbreviations

CAPA	Center for Aviation
FSC	Full-service carrier
LCC	Low-cost carrier
LSC	Low-cost subsidiary carrier
TCATC	Thai Civil Aviation Center

Operating potential airport code

CEB	Mactan-Cebu International Airport
CGO	Zhengzhou Xinzheng International Airport
CKG	Chongqing Jiangbei International Airport
CRK	Clark International Airport
CTU	Chengdu Shuangliu International Airport
HAK	Haikou Meilan International Airport
HGH	Hangzhou Xiaoshan International Airport
HKG	Hong Kong International Airport
KHH	Kaohsiung International International Airport
KHN	Nanchang Changbei International Airport
NGB	Ningbo Lishe International Airport
NKG	Nanjing Lukou International Airport
PEN	Penang International Airport
PVG	Shanghai Pudong International Airport
SIN	Singapore Changi Airport
SUB	Surabaya International Airport
SWA	Jieyang Chaoshan International Airport
TYN	Taiyuan Wusu International Airport
WUH	Wuhan Tianhe International Airport
WUX	Wuxi (Sunan Shuofang) International Airport

XIY	Xi'an Xianyang International Airport
XMN	Xiamen Gaoqi International Airport

Chapter 1: Introduction

The dissertation statement is to investigate and analyze the airline international potential route for a subsidiary airline. The process of dissertation is taken from December 2015 to December 2016. The author has spent several hours and efforts on gathering information, researching on the literature, analyzing the data and developing the proposed result and recommendation to the Thai subsidiary airline case study.

1.1 Background information

The case studied Thai subsidiary airline has established since 2012 as the regional airline under the Thai airline. The vision and value is to focus on the innovation, safety, comfortability, fast service and friendly communication for the reasonably price. The service is offered in both international and domestic destination. (Anon, 2016b). Being a part of the parent airline, the subsidiary airline is sharing the same codename to avoid the confusion as the separated airline; however, the business model is different. Where, the Thai subsidiary airline uses a Hybrid model cooperating between the low cost and the full-service concept, and the primary operation is the point to point service (CAPA, 2014). Since 2014, the Thai subsidiary airline has received the Aviation Operation Certificate, AOC, and become the full subsidiary of the parent airline (CAPA, 2014). The primary base is currently located at Suvarnabhumi Airport, Bangkok, and the secondary base is located at Don Mueang International Airport, DMK, Bangkok. The organization structure chart of Thai subsidiary airline is shown in Figure 1 (Anon, 2016b).

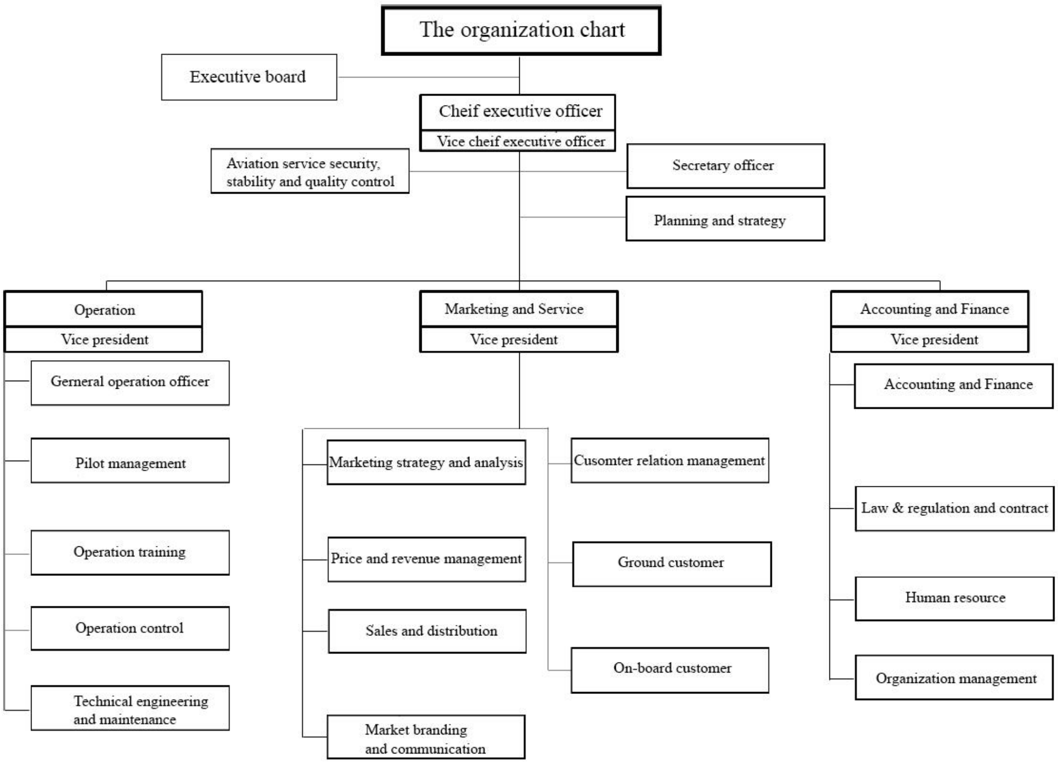

Figure 1: The Thai subsidiary's organization chart (Anon, 2016b).

1.1.1 The aircrafts planning development

Thai subsidiary airline has continuously been developing and planning the fleet resource to improve the route network and operation. The fleet capacity has been increasing from 4 to 20 aircrafts of A320 in the end of 2015 (CAPA, 2014). In 2016, 5 unassigned aircrafts would be available and unoccupied by any route operation. (Anon, 2016b).

1.2 Statement of purpose

The purpose of this dissertation is to study and identify the international potential route for the route expansion of Thai subsidiary airline. The fleet planning is the long-term process. 5 new aircrafts have been ordered and expectedly arrived in the end of 2015. Unfortunately, with the new development of the organization structure, the Thai subsidiary airline has become an independent airline from the parent airline in the end of 2014 and begun to use the different codename. Thai subsidiary's route network, such as Bangkok to Hat Yai, Surat Thani, Ubon Ratchathani and Udon Thani are removed from the international network coordination with the parent airline. Thai subsidiary airline has lost the opportunity of both domestic and international flight (CAPA, 2014). Due to fleet planning of airline, 5 unassigned aircraft will be contributed as the non-opportunity cost. The leasing cost of each unassigned aircraft is £276,000 per month. This cost would be dispersed and equally divided to the entire cost structure of the airline. The financial structure is confidential; so, the value will be represented in percentage. From the given route result of the Thai subsidiary airline, the current contribution of the direct fixed flight equipment cost is equal approximately 22.03% of the total cost without the addition aircraft as shown in Figure 3. 95% of flight equipment cost is from the leasing cost. With addition aircrafts, the airline would be annually paying £16,600,000. So, the total flight equipment cost would be increasing from 22.03% to 37.98% as shown in Figure 2. The value of cost in Figure 2 is converted from Thai to British pound sterling currency and also rounded to the absolute number in 5 digits because the information is confidential.

The proportion of expected flight equipment cost

	Value (£)
Total cost	£104,800,000.00
The current total flight equipment cost	£23,200,000.00
The leasing cost of 5 additional aircrafts	£16,600,000.00
The expected flight equipment cost	£39,800,000.00
The contribution of expected flight equipement cost	37.98%

Figure 2: The proportion of expected flight equipment cost (confidential).

Therefore, the Thai subsidiary airline desires to operate 5 new aircrafts to avoid the loss of opportunity cost. The route expansion would compensate the decreasing route options from the state of independent. According to the fleet planning manager and director of Thai subsidiary airline, the intention of international route expansion has higher advantage than the domestic expansion in term of maintenance cost. The international route would be performing less flight frequency with the same distance as the domestic route; where, the low frequency would lead the low rate of aircraft and equipment's depreciation.

	DMKCNXDMK	CNXHKTCNX	CNXHKT	DMKKKCDMK	DMKHKTDMK	BKKCEIBKK	BKKCNXBKK	BKKKKCBKK
Load Dependable Variable Costs	**4.62%**	**5.81%**	**4.79%**	**5.26%**	**5.57%**	**4.63%**	**5.06%**	**5.79%**
Not Load-Dependable Variable Costs	**61.77%**	**57.74%**	**56.82%**	**64.54%**	**59.78%**	**60.82%**	**61.06%**	**63.48%**
Direct Variable Costs	**66.40%**	**63.55%**	**61.61%**	**69.80%**	**65.35%**	**65.45%**	**66.12%**	**69.27%**
Direct Fixed Costs	**4.97%**	**6.06%**	**6.10%**	**4.40%**	**5.33%**	**5.40%**	**5.27%**	**5.01%**
Total Direct Costs I	**71.36%**	**69.61%**	**67.72%**	**74.20%**	**70.68%**	**70.85%**	**71.39%**	**74.29%**
Contribution I	**-12.53%**	**46.41%**	**15.59%**	**-0.34%**	**8.39%**	**-4.38%**	**-3.19%**	**19.03%**
Flight Equipment Lease Fees A/C	21.67%	21.73%	22.94%	20.50%	22.07%	22.07%	21.61%	20.37%
Flight Equipment Depr./Int.	0.29%	0.36%	0.39%	0.21%	0.30%	0.29%	0.29%	0.22%
Flight Equipment Insurance	0.35%	0.35%	0.37%	0.33%	0.35%	0.35%	0.34%	0.32%
Direct Fixed cost: Flight Equipment	**22.30%**	**22.44%**	**23.69%**	**21.04%**	**22.72%**	**22.71%**	**22.24%**	**20.91%**
Total Direct Costs II	**93.66%**	**92.05%**	**91.41%**	**95.24%**	**93.39%**	**93.56%**	**93.63%**	**95.20%**
Contribution II	**-34.83%**	**23.98%**	**-8.10%**	**-21.38%**	**-14.32%**	**-27.09%**	**-25.43%**	**-1.87%**
Indirect costs	**6.34%**	**7.95%**	**8.59%**	**4.76%**	**6.61%**	**6.44%**	**6.37%**	**4.80%**
Total Cost	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

	BKKUTHBKK	BKKUBPBKK	KKHKTBK	BKKHDYBKK	BKKKBVBKK	BKKURTBKK	BKKNAWBKK	BKKMFMBKK	BKKRGNBKK
Load Dependable Variable Costs	**5.17%**	**5.06%**	**5.22%**	**5.84%**	**6.06%**	**4.98%**	**6.76%**	**4.59%**	**11.50%**
Not Load-Dependable Variable Costs	**63.30%**	**61.62%**	**61.34%**	**58.34%**	**61.54%**	**62.31%**	**55.95%**	**61.18%**	**60.92%**
Direct Variable Costs	**68.47%**	**66.68%**	**47.38%**	**64.19%**	**67.60%**	**67.29%**	**62.70%**	**65.77%**	**72.42%**
Contribution	**0.09%**	**0.84%**	**-4.66%**	**23.75%**	**15.69%**	**0.47%**	**-4.81%**	**-9.83%**	**40.40%**
Direct Fixed Costs	**4.58%**	**4.73%**	**4.96%**	**6.34%**	**5.74%**	**5.20%**	**6.37%**	**5.43%**	**4.56%**
Total Direct Costs I	**73.05%**	**71.41%**	**71.51%**	**70.52%**	**73.34%**	**72.49%**	**69.07%**	**71.21%**	**76.98%**
Contribution I	**-4.49%**	**-3.89%**	**-9.61%**	**17.41%**	**9.95%**	**-4.73%**	**-11.19%**	**-15.26%**	**35.84%**
Flight Equipment Lease Fees A/C	21.16%	22.22%	22.58%	21.13%	20.09%	21.12%	22.59%	20.81%	19.19%
Flight Equipment Depr./Int.	0.24%	0.26%	0.24%	0.35%	0.27%	0.26%	0.34%	0.33%	0.22%
Flight Equipment Insurance	0.34%	0.35%	0.36%	0.34%	0.32%	0.34%	0.36%	0.33%	0.31%
Direct Fixed cost: Flight Equipment	**21.73%**	**22.84%**	**23.18%**	**21.81%**	**20.68%**	**21.72%**	**23.30%**	**21.47%**	**19.78%**
Total Direct Costs II	**94.78%**	**94.25%**	**94.69%**	**92.34%**	**94.03%**	**94.20%**	**92.37%**	**92.68%**	**96.77%**
Contribution II	**-26.22%**	**-26.73%**	**-32.79%**	**-4.40%**	**-10.74%**	**-26.45%**	**-34.48%**	**-36.73%**	**16.05%**
Indirect costs	**5.22%**	**5.75%**	**5.31%**	**7.66%**	**5.97%**	**5.80%**	**7.63%**	**7.32%**	**3.24%**
Total Cost	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Figure 3: The total cost of annual route result (confidential).

The second consideration of the airline is the profitability. The current situation of financial is generated the loss of contribution in many routes as shown in Figure 5. Both domestic and international routes are suffering with the low passenger demand. The average loading factor is only 44% of the total seat capacity in the aircraft as shown in Figure 6. The low passenger demand has led to the decreasing revenue that the affect of low loading factor and also leads to the route suspension. From the historical action, the Thai subsidiary airline had been trying to launch eight different international routes in 2013. Macau was only successful routes; whereas, others seven routes Ahmedabad, Changsha, Delhi, Kuala, Mandalay, Mumbai, Luang Prabang were barely operated because the actual demand was too low to demand. Where, the average loading factor was decreasing from 2012-2014 as shown in Figure 4. The loading factor was reduced nearly to 50% in the average, and the Thai subsidiary was barely making profit from the operation (CAPA, 2014).

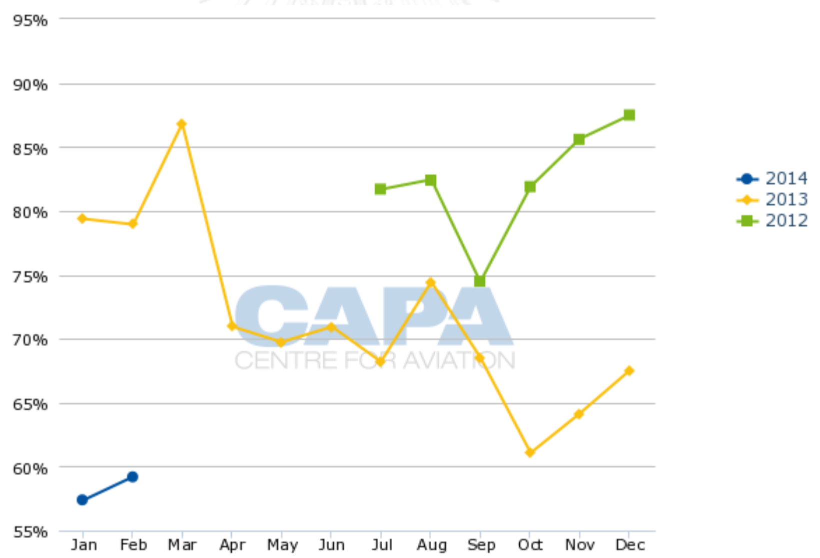

Figure 4: The historical loading factor of Thai subsidiary airline (CAPA, 2014)

Therefore, the fleet planning manager and director decide to develop the route expension rather than increase the frequency of current route for 5 addition aircraft; where, the profitability consideration is also emphasized as well.

	DMKCNXDMK	CNXHKTCNX	CNXHKT	DMKKKCDMK	DMKHKTDMK	BKKCEIBKK	BKKCNXBKK	BKKKKCBKK
Total Revenue	£6,[redacted],711.11	£1,[redacted],844.44	£1,[redacted],622.22	£4,[redacted],977.78	£7,[redacted],133.33	£7[redacted],577.78	£2,[redacted]666.67	£3,[redacted]600.00
Total Cost	£10,[redacted],066.67	£1,[redacted],933.33	£1,[redacted],977.78	£6,[redacted],177.78	£9,[redacted],711.11	£11[redacted],533.33	£3,[redacted]288.89	£3,[redacted]644.44
Results before Tax	**-£4,[redacted],355.56**	**£2[redacted],911.11**	**-£2[redacted],355.56**	**-£1,[redacted],200.00**	**-£2,[redacted],577.78**	**-£3,[redacted],955.56**	**-£1,[redacted]622.22**	**-£2[redacted],044.44**

	BKKUTHBKK	BKKUBPBKK	BKKHKTBKK	BKKHDYBKK	BKKKBVBKK	BKKURTBKK	BKKNAWBKK	BKKMFMBKK	BKKRGNBKK
Total Revenue	£6,[redacted],266.67	£4,[redacted],800.00	£6,[redacted],733.33	£9,[redacted],800.00	£1,[redacted],244.44	£3[redacted],311.11	£1,[redacted]533.33	£4,[redacted]933.33	£9[redacted],355.56
Total Cost	£10,[redacted],688.89	£7,[redacted],755.56	£10,[redacted],177.78	£10,[redacted],955.56	£2,[redacted],311.11	£5[redacted],377.78	£1,[redacted]977.78	£7,[redacted]533.33	£8[redacted],444.44
Results before Tax	**-£3,[redacted],422.22**	**-£2,[redacted],955.56**	**-£3,[redacted],444.44**	**-£1,[redacted],155.56**	**-£3[redacted],066.67**	**-£1,[redacted],066.67**	**-£8[redacted],444.44**	**-£3,[redacted],600.00**	**£1[redacted],911.11**

Figure 5:The summary of profit and loss of Thai subsidiary airline (confidential).

	DMKCNXDMK	CNXHKTCNX	CNXHKT	DMKKKCDMK	DMKHKTDMK	BKKCEIBKK	BKKCNXBKK	BKKKKCBKK
No. of Roundtrip	1,556.0	88.5	135.5	1,089.0	1,214.0	1,373.0	598.5	716.0
No. of Paassenger	184,903	18,272	14,654	157,128	200,232	198,835	65,121	98,682
No. of Passenger per roundtrip	119	206	108	144	165	145	109	138
No. of passenger per flight	59	103	54	72	82	72	54	69
No of seat capacity per flight	168	168	168	168	168	168	168	168
The loading factor per flight	35%	61%	32%	43%	49%	43%	32%	41%

	BKKUTHBKK	BKKUBPBKK	BKKHKTBKK	BKKHDYBKK	BKKKBVBKK	BKKURTBKK	BKKNAWBKK	BKKMFMBKK	BKKRGNBKK	Total (TTHB)
No. of Roundtrip	1,451.0	1,088.0	976.0	1,541.5	180.0	726.0	264.0	452.0	122.0	13,571.0
No. of Paassenger	226,379	149,922	165,233	248,273	46,433	104,006	28,474	61,926	13,662	1,982,135
No. of Passenger per roundtrip	156	138	169	161	258	143	108	137	112	146
No. of passenger per flight	78	69	85	81	129	72	54	69	56	73
No of seat capacity per flight	168	168	168	168	168	168	168	168	168	168
The loading factor per flight	46%	41%	50%	48%	77%	43%	32%	41%	33%	43%

Figure 6: The summary of number of passenger (confidential).

1.3 Research objective

The objective of the research is to identify the most appropriate potential route in term of operation and profitability.

1.4 Scope of the project

The investigation of potential route would be limited up to 4 hours of the flight duration from the Suvarnabhumi International airport, Bangkok, Thailand. The Airbus A320 is the focused aircraft that will be used as the studied fleet resource in this study; where, the potential flight is expected to be operated 7 flight per week as the main route. So, the seasonal route will be avoided. Countries and airports that are located beyond the limitation would be disqualified. The geographic scope of study is shown in Figure 7 (Swartz, 2016). The investigation would be done on each airport as the separate route, origin and destination, and the network structure is point-to-point design.

Figure 7: The circular scope of research (Swartz, 2016).

The airline intentionally enters into the market to seek for the demand and opportunities to make the profit. However, the air transportation market is not the single location, but the area of market is covered from the point of origin to the destination as the whole passenger trip. Where, the origin is started at the point that the passenger begins travel, and the destination is the place where the passenger has stopped. The typical air passenger trip is shown in Figure 8 (Peter et al., 2016). Where, the market is existed in both forward and reverse trip, and the demand in both origin and destination are different according to the country, currency and economic wealth (Peter et al., 2016).

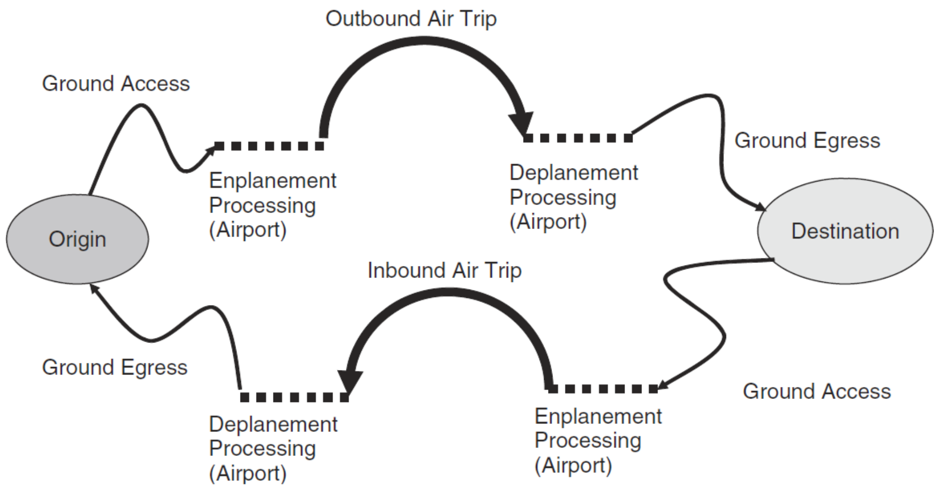

Figure 8: The typical air passenger map (Peter et al., 2016).

The area of market is called as the catchment market as shown in Figure 9 (Peter et al., 2016). These markets are independent from each other. The demand would behave and change within the area but rather stable. The changing factor that occurs at the airport such as the fare price, accessibility, flight time would affect the demand (Cederholm, 2014). The macroeconomic is primary factor that incurs the change of passenger demand. However, there are several origin-destination markets existing within the nearby area which would be wholly called as the parallel market as shown in Figure 10 (Peter et al., 2016). The feature and characteristic of airport would impact the volume of demand. The passenger would have more power of bargain as the increasing airport alternative. Some customers would prefer the advantage of the lower fare or the closer distance between the origin and the airport. Many airlines take the consideration of route as the competitive advantage to catch customers’ interest (Peter et al., 2016).

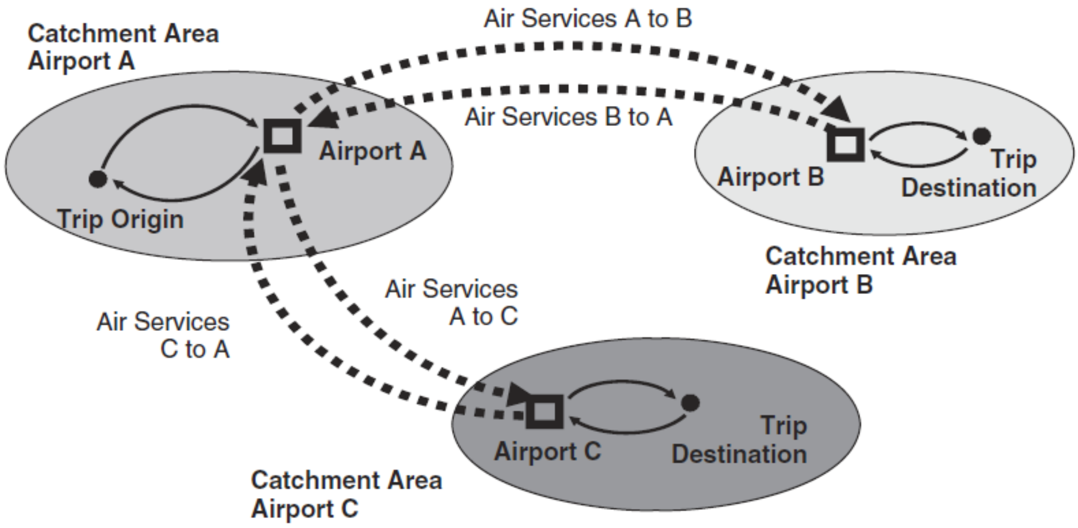

Figure 9: The catch area of destination (Peter et al., 2016).

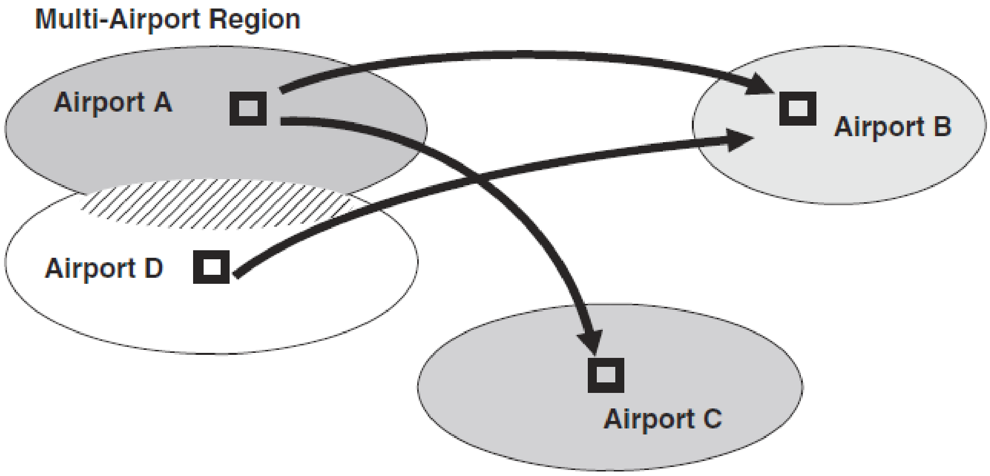

Figure 10: The parallel market (Peter et al., 2016).

The route selection is evaluated upon three considerations which are the practical, economic and strategic consideration. The practical operation of each route is evaluated compare throughout the performance. The basic performance measures of airline can be defined based on the airline traffic & revenue, output & expense and loading factor. The airline traffic is the main factor that are directly driving and carried within the operation such as passenger, cargo and baggage which is measured based on the distance as the revenue passenger kilometer or mile, RPK or RPM (Cederholm, 2014). The RPK or RPM can be used to calculate the value of yield from Equation 1, and the yield is expressed as the average fare per RPK unit (Peter et al., 2016).

$$\text{Yield} = \frac{\text{The total passenger revenues}}{\text{Revenue per kilometer}}$$

Equation 1: The airline yield (Peter et al., 2016).

Whereas, the measurement of output & expense is expressed in term of the efficiency of the spending and comparing to the capacity of aircraft. The unit cost can be calculated as Equation 2 (Peter et al., 2016).

$$\text{The unit cost} = \frac{\text{The total expenses}}{\text{Available seat kilometer}}$$

Equation 2: The unit cost (Peter et al., 2016).

From the above basic measures of airline, the load factor can be calculated as the ratio of RPK and ASK in Equation 3 which represents as the utilization of the aircraft for the individual flight. These basic measurements would indicate the performance of flight and be used to define the profitability of route [9].

$$\text{The loading factor} = \frac{\text{RPK}}{\text{ASK}} = \frac{Passenger}{Capacity}$$

Equation 3: The loading factor (Peter et al., 2016).

The profitability of operation is described as Equation 4. Where, the higher yield would imply for the higher profit that the airline would make, and the unit cost should be kept at the minimum in order to maximize the profitability (Peter et al., 2016).

$$\begin{aligned} \text{Profitability} &= (\text{RPK x Yield}) - (\text{ASK x Cost}) \\ &= \text{The total passenger revenues} - \text{The total expenses} \end{aligned}$$

Equation 4: The profitability of airline (Peter et al., 2016).

1.5 Expected benefits

- To gain the competitive advantage
- To increase the airline route profitability
- To reduce the risk of route suspension

1.6 Dissertation overview

This paper work is has consisted of 6 chapters. The introduction is explained in Chapter 1. Chapter 2 contains the explanation and review of theories, literatures and related case studies such as the airline business model, network structure, value chain, analytical techniques for selection and various case studied focusing on the advantage and disadvantage providing the basic knowledge to capture the content in Chapter 3 and 4. Chapter 3 presents the approaching method in the investigation and analysis process including the information gathering, the potential route selection, the AHP analysis, the net present value analysis in order to obtain the final result. Chapter 4 is consisted of the result and analysis which flows according to Chapter 3's methodology flowchart. The score of each route would be presented and ranked, and the net present value of interested routes would be shown in this chapter. Chapter 5 shows the author reflection and discussion toward the result and objective of the project including the findings of research, the consideration of findings and the limitation of findings. Lastly, Chapter 6 would include the summary and conclusion of findings, result and feedback of the project.

Chapter 2: Literature review

2.1 Introduction

In this chapter, the academic paper and published literature are reviewed and explained to provide the clear picture and understanding throughout the project. The purpose is to provide the basic knowledge and concept of the approach theory and logic which are used to accomplish the objective in the methodology chapter. This chapter is categorized into 3 main scopes which are the background concept, approaching methodology and analytic tool. The background concept is composed of the theory of airline network and business model in section 2.2 and the airline profitability, demand and supply in section 2.3. The second scope is the approaching methodology which are the porter's value chain in section 2.3, market opportunity in section 2.4 and analytic hierarchy process in section 2.5, and the purpose is to analysis the current airline value, identify the market focus and select appropriate route option. Lastly, the analytic tool is used to help the deep analysis and understanding in order to achieve the result which is composed of the Holt-Winter model in section 2.6, PESTEL analysis in section 2.7, ABC classification analysis in section 2.8 and interview & questionnaire in section 2.9. Throughout the Literature review, the advantage and disadvantage are also discussed to define the appropriate use of each method and tool, and several cases studied are also provided as well.

2.2 Airline network and business model

Within the competitive field of commercial air transport, the strategic structure is developed to gain the competitive advantage in the terminology of economic and operation. The design of airline network implies the operating foundation which will be delivered to passengers as the service (Song and Ma, 2006). There are two types of network structure which are the point to point and hub & spoke design as shown in Figure 11. The selection of airline network is vary depending on the facing market environment, and each network has its own advantage and unique competency (Cook and Goodwin, 2008).

In comparison, the point to point, P2P, design is the fundamental network that initiates the concept of transport; whereas, the hub & spoke, H&S, design is the integrated structure that combine each individual P2P together sharing either the same origin or destination as a hub. The concept of point to point is limited to two independent locations; where, passengers will be physically transferred in distances from the origin to destination without any intermediate stop which can be called as the O-D market (Lordan, 2014). However, the aircraft utilization is the main advantage of the P2P design because only one destination is limited for a single aircraft, and the waiting time is none. Whereas, the hub & spoke design has increase the accessibility. The fewer route will be required to access the same number of destination as the point to point design. However, passengers will require to take at least one intermediate stop at the hub location to connect to the destination, and the single aircraft will be able to serve both A-Hub and A-B passengers (Cook and Goodwin, 2008).

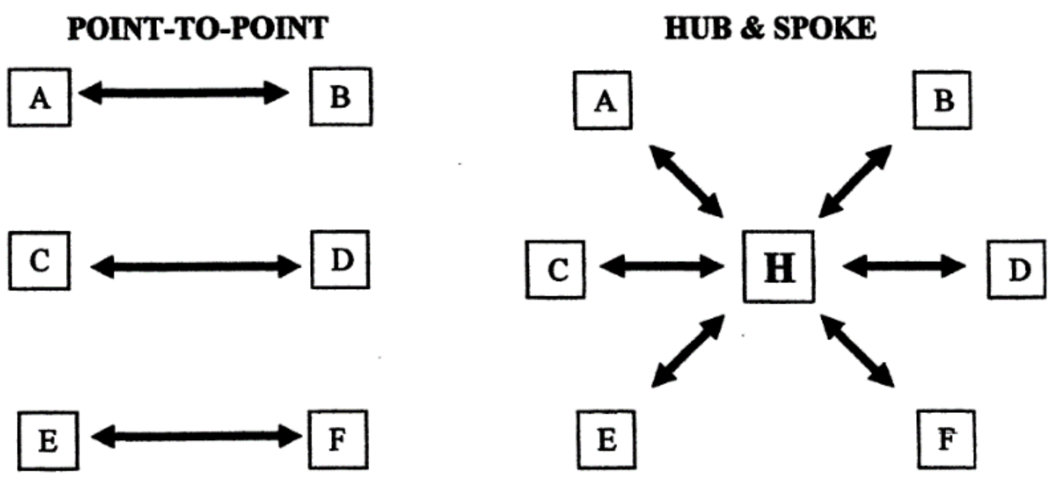

Figure 11: The airline business network design (Cook and Goodwin, 2008).

The main disadvantage of H&S would be inflexibility when several routes are combined. The level of complexity is increased, and the connecting time and schedule become tight. Regardless of the connecting activity, the P2P is more flexible than H&S design (Lordan, 2014). The H&S design is usually operated by the legacy or full service carrier, FSC, which primary focuses on providing the full-service coverage for both ground and on-board service (Bitzan and Peoples, 2016). However, the high demand is necessary to compensate the operating expense. The performance of H&S design significantly provides the opportunity to operate multiple O-D markets. With the capability of H&S, the FSC has the competitive advantage in term of the single airline operation because passengers can be served throughout the entire journey preventing the loss of demand to other airlines (Cook and Goodwin, 2008). Due to the emergence of low cost carrier, FSC has lost the demand of O-D market. The LCC's airfare is 30-40% cheaper than the FSC's, and leisure passengers are attracted to the cheap airfare. The LCC is using the cost leadership strategy focusing on the cost reduction (Ko, 2015). Whereas, the H&S requires additional activities at the hub location such as parking, ramp, gate reservation, baggage transfer and station organization which cannot be avoided (Lordan, 2014).

To achieve the low airfare, the LCC applied the no frill strategy to minimize the operating cost, and the indirect activity is eliminated; so the P2P design is commonly used in the LCC industry (Bitzan and Peoples, 2016). However, the demand for O-D market is usually low. To maximize the seat density and minimize the unit cost, the LCC is limited to use the small to medium size aircraft, Boeing 737 or Airbus 320 which can only be operated as the short haul (Reichmuth, 2008). The operating cost of LCC is approximately 40-50% lower than the FSC. The competitive force from LCC has been increasing that heavily impacts the FSC (Ko, 2015). The market of LCC is continuously growing while the many FSC have faced the significant loss in financial. The FSC required to respond to the emergence of LCC (Cook and Goodwin, 2008). According to the Centre for Aviation, CAPA, two possible responses is found which is to reduce the airfare and to launch the low-cost subsidiary airline. The reducing airfare strategy is found to be inappropriate approach for the FSC due to the high operating cost, and the FSC will be losing the profit and the market position as well. The startup low cost subsidiary airline is the second response that has the competitive potential due to the similar market position initiating the Airline in Airline, the two-brand strategy. However, the success chance is limited because of the parent company's culture and market environment. Several subsidiary airlines have failed to compete with the LCC as shown in Figure 12 (CAPA, 2009). Song airline was the LCS of Delta airline and attempting to compete with the LCC; however, the operation was suspended due to the poor financial result (CAPA, 2009). The cause of failure was discovered by Morrell that was occurred from the coexist of different business models. The majority practice of low cost model was shared and influenced from the parent company leading to the negatively incomparable cost with the pure LCC (Homsombat et al., 2014). However, the Qantas airline group has successfully implemented the LCS using the AinA strategy which will be discussed in the below case study (Whyte and Lohmann, 2015).

Failed low cost airline subsidiaries of full service airlines

Name	Owner	Launch date	Termination	Comments
North America				
Air Canada Tango	Air Canada	2001	2004	Folded back into Air Canada
Continental Lite	Continental Airways	1993	1995	Dropped as "too expensive"
Delta Express	Delta Air Lines	1996	2003	Replaced by Song
MetroJet	US Airways	1998	2001	Abandoned after September 11
Song	Delta Air Lines	2003	2006	Folded back into mainline operations
Ted	United Airlines	2004	2009	High fuel prices led United in Jun-2004 to discontinue separate Ted operation. Folded back into mainline operations
Zip	Air Canada	2002	2004	Folded back into Air Canada as a fare option
Europe				
Basiq Air	Air France/KLM via Transavia	2000	2005	Merged with Transavia, still operates some services under Basiq Air branding
Buzz	KLM	2000	2003	Taken over by Ryanair
Go	British Airways	1998	2002	Sold to private equity then on-sold to easyJet
Snowflake	SAS	2002	2004	Ceased separate operations in 2004 when SAS decided to offer a "no-frills" Snowflake service in a section of the economy class cabin on its existing short-haul routes from Copenhagen.
Virgin Express	Virgin Group	1996	2007	Merged with SN Brussels Airlines to form Brussels Airlines
Asia Pacific				
Impulse	Qantas	Acquired 2001	2004	Absorbed to form Jetstar
Freedom Air	Air New Zealand	1995	2008	Absorbed into the parent, due to minimal brand and cost advantages

Figure 12: The list of failure subsidiary airline (CAPA, 2009).

2.2.1 Case Study 1: Jetstar's AinA approach

This case study is mainly focusing on the Jetstar airline marketing strategy to compete with the standard low cost carrier in Asia. The AinA approach is found to be used as the methodology. Jetstar is the Australian subsidiary airline of the Qantas group. The main hub airport is located at Singapore Changi Airport, Singapore, and the route map is shown as in Figure 13 (Whyte and Lohmann, 2015). Jetstar has successfully implemented the low-cost subsidiary carrier while other airlines have failed. Throughout the strategic framework, 4 primary reasons for the establishment of Jetstar are to compete with the Virgin Blue carrier, the high cost structure of Qantas airline (parent airline), in contract with term and agreement of FSC carrier in the market and lastly the international market expansion (Whyte and Lohmann, 2015). To begin with the market expansion strategy, Jetstar increased the seat configuration from the single to twin aisles seat and announced itself as the primary carrier for the Qantas group. Jetstar took over and began to operate the domestic route in Australia. The vision was set as the leisure route for visiting purpose. Whereas, Qantas airline still provided the service for business purpose between Sydney and the Gold Coast (Whyte and Lohmann, 2015).

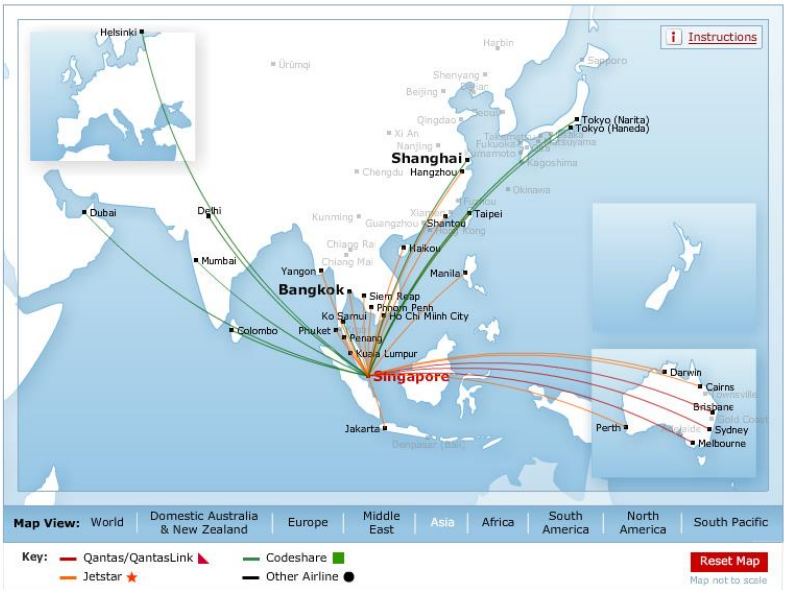

Figure 13: The route map of Jetstar airline (Anon, 2015).

Jetstar internationally attempted to entry the large aviation market such as China and Indonesia; however, the operation could not be initiated due to the policy and government issue; so Jetstar entered the Phuket market, Thailand, in 2005 instead. Unfortunately, the route was finally suspended due to the inconsistent demand and financial loss (Whyte and Lohmann, 2015). Qantas group decided to merge Jetstar and Valuair together to increase the operation in Malaysia focusing on the short haul operation and decreasing the medium haul to maximize the seat density per flight operation. Jetstar began to partner with the pacific airline, Japan airline, China Eastern Airline to create the opportunity in China, Japan, Korea and Vietnam (Whyte and Lohmann, 2015). With the growth of potential market, Jetstar had accomplished 8% of the market share which was similar to Air Asia, the true low cost carrier. As the result of 2012, the profit was made approximately at AUD $203 million (Whyte and Lohmann, 2015).

In summary, the airline network and model is very important to be understood in order to capture the market position of the subsidiary airline; where the author has found that the full-service carrier and low-cost service carrier have the disadvantage and advantage in term of cost. From the literature review and case study, the purpose of a subsidiary airline is to create the competitive response to the low-cost service carrier; however, many airline examples have failed due to the clear differentiation of the business strategy between the low-cost and full-service airline. As Thai subsidiary airline recently become independent from the parent airline, the clear differentiation would help to develop the proper market focus.

2.3 Airline profitability, demand and supply.

The profit is the one of the business key performance indicator that expresses the condition of financial activity. In any market competition, airline industries are attempting to match a supply capacity and demand (Dozic and Kalic, 2015). The differentiation is leading to the low profit. The airline industry highly prefers to operate in with the route that provides the highest contribution among alternatives.

Therefore, the profit can be interchangeably used as the opportunity cost to select the market entry. In the mathematical expression, the economic profit equation can be calculated by the total revenue less by the total expense as shown in Equation 5 (Vasigh et al., 2015).

$$The\ economic\ profit = Total\ revenue - Total\ explicit\ cost$$

Equation 5: The economic profit (Vasigh et al., 2015).

2.3.1 Demand side

The profitability of airline is found to be influenced by three variables which are costs, revenue and loading factor. In the airline industry, the number of passenger, PAX, is the revenue driver which is referred to the purchasing air ticket (Demydyuk, 2012). However, the value of demand on each route is different. Each route has the unique characteristic and been described by the flight duration and distance travel. The flight duration is used to inform the passenger that would impact the traveling decision. Whereas, the distance travel metric is commonly used in the airline to indicate the passenger volume carried on board which is usually referred as the revenue passenger kilometers or RPKs (Vasigh et al., 2013). The RPK, as shown in Equation 6, is the quantitative performance indicator that allow the airline to monitor, manage the output operation and compare with other competitors (Gross and Klemmer, 2014).

$$RPK = the\ number\ of\ carried\ passenger\ x\ the\ distance\ in\ kilometres$$

Equation 6: The revenue kilometers (Gross and Klemmer, 2014)

According to the law of demand, the number of passenger has been oppositely behaving with the airline ticket price. Where, the lesser passenger will purchase the service as the price is higher (Vasigh et al., 2013). The purpose of traveling has been valued in the different range of price, and the passenger will make the decision upon the comparison between these factors such as the price, income, distance, available transportation mode, flight time, frequency, day, season, safety and quality of service. In other word, the passenger looks for the equivalent compensation value to the amount of spending money. The majority of passenger is price sensitive with the evidence of airline deregulation; where, the small decreasing price can persuade the air ticket procurement. In the air market, consumers can be differentiated into two types which are the leisure and business passenger. The leisure passenger will be highly preferring the low cost with inflexibility of service; whereas, the business passenger would be favoring the high price for the good quality of service, availability and no restriction (Tretheway and Oum, 1992). The given example of the demand from John F. Kennedy International Airport to Los Angeles International Airport from American Airlines, US Airways, Delta Airlines and Virgin America is illustrated as shown in Figure 14. Only a few hundreds of passenger would be willing to pay the high price at $2,000 to $4,000. As the price of ticket is decreased, the number of passenger is sharply increased; however, the increasing passenger would begin to slow down at the certain price because the demand is found to be limited (Vasigh et al., 2013).

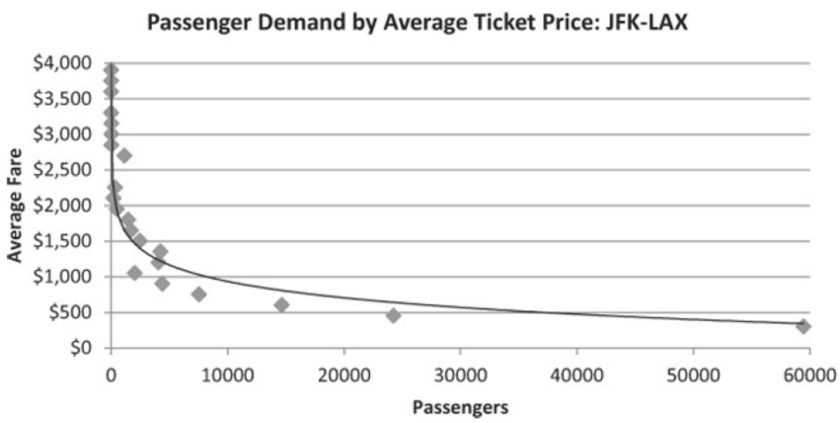

Figure 14: The passenger demand by average ticket price from JFK-LAX (Vasigh et al., 2013)

Due to the decision-making process, the behavior of demand will be continuously changed with the variation based on the individual factor. The impact of individual's desire can lead to the seasonality and trend pattern with the limited level of demand. Therefore, the characteristic of air transportation demand will be mixed with 3 variations (Vasigh et al., 2013).

2.3.2 Supply side

The air transportation capacity is the key profit generator from the supply side. The performance of capacity management is reflecting to the performance of financial as well. The supplying capacity is referred to the providing number of product at the specific price, time and quality of service to match the desired demand. The available seat kilometers tells the number of seat capacity being carried throughout the flight (Vasigh et al., 2015). Similarly, to the demand indicator, the available seat is referred as the air service capacity which is derived into supply performance indicator as the available seat kilometers, ASK. The ASK can be described as Equation 7 (Gross and Klemmer, 2014).

$$ASK = the\ total\ available\ seat\ x\ distance\ kilometers$$

Equation 7: The availability kilometers (Gross and Klemmer, 2014)

The purpose of RPK and ASK is to indicate the aircraft utilization performance as the loading factor as shown in Equation 8. The loading factor reflects to the matching between the capacity and demand indicating the potential profit of the operation (Gross and Klemmer, 2014).

$$The\ loading\ factor = \frac{RPK}{ASK}$$

Equation 8: The loading factor (Gross and Klemmer, 2014)

The capacity cost factor is referred to the necessary activity and resource that requires to initiate the operation such as fuel price, labour cost, landing fees, airport fees and maintenance cost. The total cost can be classified into the total fixed and variable cost as shown in Equation 9. The fixed cost is the constant cost which would remain unchanged upon the increasing output; whereas, the variable cost is changing upon the increasing and decreasing output. The sum of fix and variable cost incurs the cost pattern to shift upward with the trend as shown in Figure 15 (Vasigh et al., 2015).

$$Total\ expense = Total\ variable\ cost + Total\ fixed\ cost$$

Equation 9: The total cost (Vasigh et al., 2015).

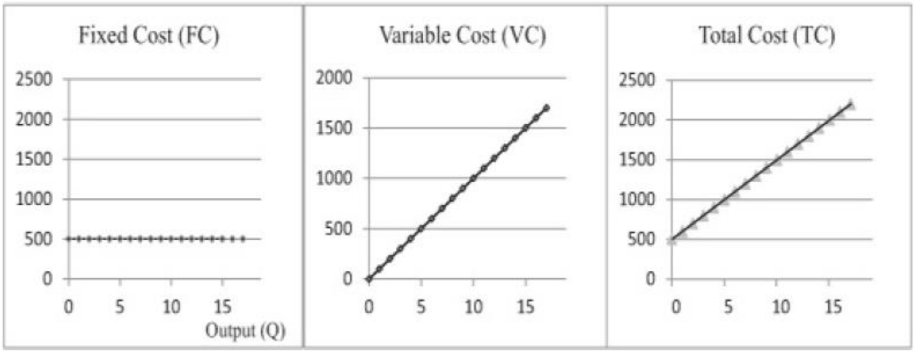

Figure 15: The total cost structure (Vasigh et al., 2015).

Throughout the cost efficiency management, the airline industry can achieve the high cost performance. To compare the cost with other competitors and investigate the supply performance, the airline industry will be capable to increase the flexibility and responsiveness in the change of market by monitoring the RPKs, ASKs, CASKs and loading factor performance indicator (Vasigh et al., 2015).

2.3.3 The net present value analysis

The net present value, NPV, is the decision-making tools that expresses in term of dynamic investment focusing on the time value of money. This purpose is to measure the amount of the generating profit by comparing the amount of cash inflow and cash outflow throughout the period. The NPV concept is assumed that the value of current money would be higher than the future money which is called the discount rate, r. The discount factor is expressed in Equation 10 (Dominy, 2013).

$$The\ discount\ factor = (1 + r)^{-n}$$

Equation 10: The discount factor (Dominy, 2013)

Where,

r= the interest rate or discount rate

n= the number of year

The NPV framework provides the prediction of cash flow allowing the organization to assess opportunity and uncertainty of success rate in the project planning. The cost performance of each project can be directly compared in different periods. Mathematically, the NPV can be calculated as shown in Equation 11 (Dominy, 2013).

$$NPV = -C_0 + \frac{C_1}{1+r_1} + \frac{C_2}{1+r_2} + \ldots \frac{C_n}{1+r_n}$$

Equation 11: The net present value (Dominy, 2013)

Where,

C_0= The initial investment of the project

C_n= The net cashflow of year n

An example of a regional airline that would like to expend the airline route network; where, the airline name is not provided in the case study. To implement the route expansion, the airline decided to lease the aircraft Boeing 737 for 3-year period which cost about $4 million per year. However, this project would cost the initial investment about $10 million to the airline as shown in Figure 16. With the additional annual expense such as fuel, salaries, maintenance, the airline would expect to have the net cash flow at the end of Year 3 at $4.67 million. Regarding to the discount rate at 9%, the airline found that this leasing project would generate the total net value present of $12.32 million (Vasigh et al., 2015).

Cash flows for three-year 737 lease

	Year 0	Year 1	Year 2	Year 3
Capital Spending	($10,000,000)			
Revenues		$40,000,000	$48,000,000	$45,000,000
Expenses				
Fuel		($15,000,000)	($20,000,000)	($19,000,000)
Salaries		($15,000,000)	($15,000,000)	($15,000,000)
Maintenance		($2,000,000)	($3,000,000)	($2,333,333)
Leasing Cost		($4,000,000)	($4,000,000)	($4,000,000)
Net cash flow	($10,000,000)	**$4,000,000**	**$6,000,000**	**$4,666,667**
Discounted cash flow	($10,000,000)	**$3,669,725**	**$5,050,080**	**$3,603,523**

Figure 16: The net present value of Boeing 434 leasing project (Vasigh et al., 2015)

2.3.3.1 The advantage of the net present value

From the above analysis, description and example, the capability of the NPV analysis is to examine the profitability of the interested project; where the analysis structure provides a clear vision of the broken-down cash flow and the return of investment. The concept and methodology are simple and easy to be understood which can also be applied in wide range of application. In the project selection decision making process, the NPV analysis can be used to compare and rank between project alternatives based on the profitability showing the greatest solution.

2.3.3.2 The disadvantage of the net present value

The drawback of the NPV analysis is the lack of accuracy; where the organization will be heavily relying on the assumption which includes the revenue, cost and the discount rate. To compensate this drawback, the proper forecast is necessary. Moreover, the behind calculation of cash transaction is quite complex to obtain discount rate of the individual cost segment for the higher accuracy.

In summary, the primary goal of airline business is to create the profit throughout the flight operation. To identify route potential, the state of business financial is also important to indicate the capability to match the seat capacity with the demand.

The profit is key survivability of the route selection. With the help of performance indicator and the net present value analysis, the airline could assess and determine the route selection in term of both operation and profitability.

2.4 The porter's value chain

The value chain is the set of value creation activities that delivers product or service to the customer. The visual framework analysis is developed by Micheal Porter to investigate how the value is created, captured and delivered throughout the entire process (Porter, 1985). The advantage of value chain is the approach of competitive advantage. The value chain is commonly found and used in the product manufacturing and service provider to assess the value creation at each stage of operation. The firm could assess and compare the product or service with the competition and customer requirement to deliver the right value (Acharyulu et al., 2015). However, the origin concept is lack of the management concept which has been developed into the concept of supply chain by Keith Oliver. The value chain framework is consisted of 2 categories which are the primary and secondary activity as shown in Figure 17 (Kannegiesser, 2008). The primary activity is the set of activities, inbound logistic, operation, outbound logistic, marketing & sale and service, that directly creates or adds the value to the product or service. Whereas, the secondary activity is the set of supporting activities, firm infrastructure, human resource management, technological development and procurement, that increases the efficiency and performance of the primary activity. The description of each element is shown below (Kannegiesser, 2008).

The primary activity as shown in Figure 12 (Kannegiesser, 2008)

Inbound logistic

- The internal activity that related in exchanging of input and output

Operation

- The transforming, combining or adding activity that directly increase value of products or services.

Outbound logistic

- The external activity that related to the distribution or transportation which is required to delivery product or service to the customer.

Marketing & Sale

- The interacting activity with customer that lead to the increasing or sale and revenue.

Service

- The activity that maintain the value of purchased products or services.

The secondary activity as shown in Figure 12 (Kannegiesser, 2008)

Firm infrastructure

- The business structure, routing of operation, culture, support system, accounting, finance and legal function that influences the daily operation.

Human Resource Management

- The activity that recruit the right operator to suit the task and develop the specific skill to achieve the better performance.

Technological development

- The technology that minimize the unnecessary activity and increase the process efficiency creating the competitive advantage.

Procurement

- The purchasing activity that obtain resources into the business

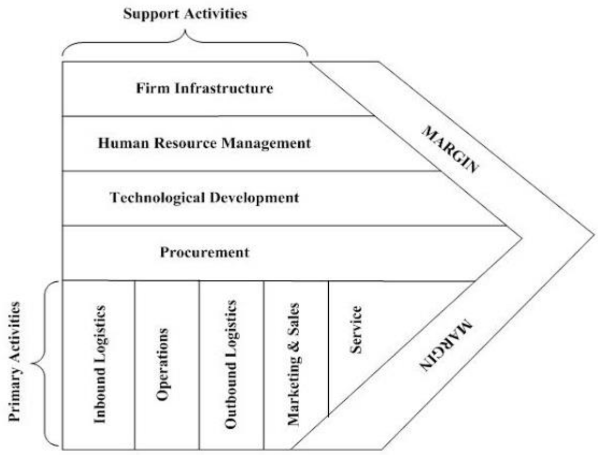

Figure 17: The Porter's value structure (Kannegiesser, 2008)

2.4.1 The advantage of Porter's value chain

The Porter's value chain is the flexible framework that is simple and cheap to identify the value creation from the actvity in which the business can develop and compare the competitive advantage over competitors. The visual framework provides the clear differentiation of each activity allows the firm to acknowledge the non-value added activity which exists in the operation. This tool is very useful and suitable in wide range of application regardless of the size and infrastructure.

2.4.2 The disadvantage of Porter's value chain

The downside of the value chain is the high flexibility of framework that would requires a great amount of input to develop the proper analysis for the specific application. The corrective information gathering is time consuming and requiring much effort. With the modern technology, the market is changing rapidly as well as the information; so, the porter value chain is not appropriate for the responsive market.

In summary, the value creation can be used as the value assessing tool according to the above context. With this advantage, the value of airline service can be identified and compared with the customer requirement. Also, the author would understand the Thai subsidiary airline's marketing strategy and the customer focus of the airline industry as well.

2.5 The market opportunity analysis

Many businesses have failed to play in the dynamic market due to the wrong market entering and the incorrect opportunity assessment. The market opportunity analysis, MOA, is the approaching technique that helps to understand the key factor of market and determines the opportunity and competitive advantage (Woodruff, 1976). The purpose is to develop the decision of delivery of right products or services at the right place, price and time which allows the firm to determine the feasibility of product or service introduction into the market (Administration, 2016). The systematic approach of MOA is the initial framework that focuses on the assessment of knowledge and information sources. The guiding concept is covering 5 key factors which are a segmentation, demand, channel, industry and competitor area regarding to the market size, market requirement and competency as shown in Figure 18 (Woodruff, 1976).

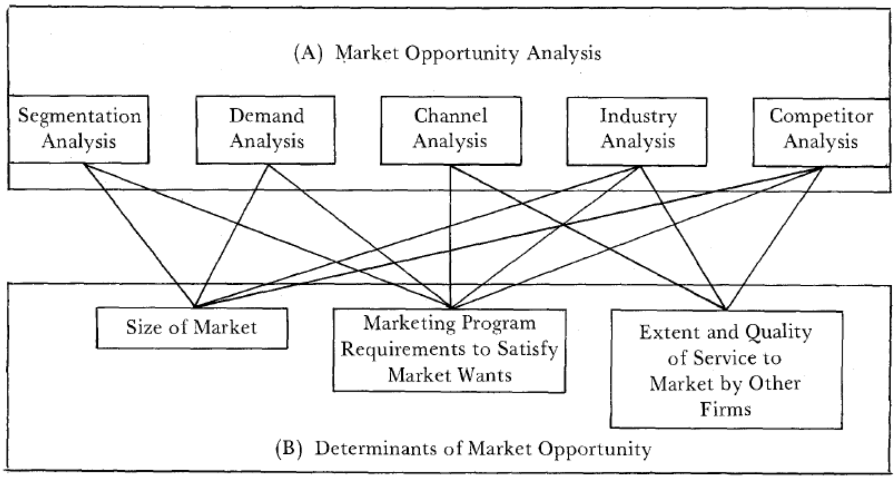

Figure 18: The market opportunity structure (Woodruff, 1976)

However, the MOA framework has been adapted to enhance the perspective of environmental factor and demand forecast as shown in Figure 19 (Administration, 2016). The market environment is rapidly changed and grown overtime; where, the firm would have a small amount of time to develop the decision and respond to the market. The firm that fails to respond would lose the opportunity as well as the competitive advantage. Moreover, the opportunity could be referred only when the strategy and capability of firm are found to be corresponded (Zhao, 2011).

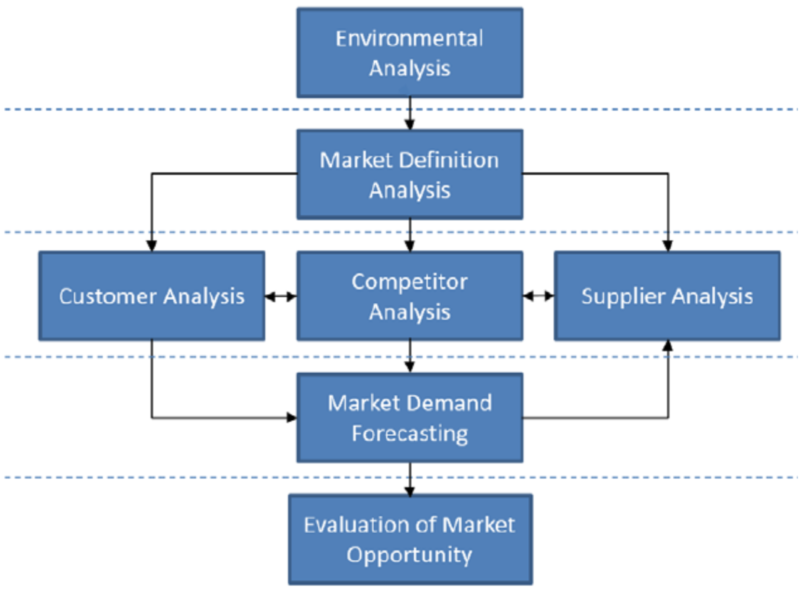

Figure 19: The adapted MOA framework (Administration, 2016)

2.5.6 The advantage of market opportunity analysis

- Provide basic guideline for the novice
- Provide the clear illustrated relationship and process flow
- Support wide-range of market areas

2.5.7 The disadvantage of market opportunity analysis

- MOA is not complete framework; the addition analytic tool is required.
- Require large amount of information to analyses all factors
- Time consuming method

In summary, the market opportunity analysis is a great tool that helps the firm as a guideline to determine the opportunity from the board to narrow perspective. The origin framework has well covered on 5 key market analysis; however, the current market is rapidly changed due to the information, communication technology. This framework is out of dated. While the adapted MOA framework is currently effective; where, the firm can further assess the environmental and the future trend which are uncontrollable forces. In this project, the primary task is to assess the opportunity in several air transportation markets outside Thailand. This adapted MOA would be the appropriate guideline for the author to determine the differentiation of opportunity in each market.

2.6 The analytic hierarchy process analysis

The analytic hierarchy process, AHP, is the decision-making tools which is applied in the multiple choice of selection to identify the best judgement based on the information, knowledge and experience. However, Thomas said that too much information is as bad as same as the little information, and the appropriate decision is difficult to be concluded in either way (Saaty, 2008). This method helps to simplify the complexity of each route's characteristic into the sufficient number relevant elements which will be used to evaluate the score; otherwise, the decision maker will be facing with difficulty of multiple choices. Therefore, the understand of information is important, but the decision maker is required to know the priority and impact of information as well. To do so, the problem and purpose must be well identified to gather the correct information (Vaidya and Kumar, 2004). Criteria and sub criteria are created to simplify the complexity of information and providing the scope of problem preventing the decision maker from losing his or her sight. The decision can be made upon the evaluation of criteria and sub-criteria. The AHP tools can be used in wide-range of application and suitable with both qualitative and quantitative information (Mocenni, n.d.). With the simple structure, the complex system analysis is not required to understand the process. However, the disadvantage of the AHP tools is the dependence of evaluator's knowledge and experience. The result may be varied and inconsistent from person to person (Saaty, 2008).

To applied the AHP tools, there are 4 primary steps as shown in following (Saaty, 2008)

1. To define the problem, purpose and require information.
2. To create the hierarchy structure of decision forming the criteria and sub-criteria from the wide to narrow perspective.
3. To create a set of pairwise comparison matrix between criteria within the same level to compare each element.
4. To compute the weight of each element based on the priority score and add the weight value to obtain the final weight.

2.6.1 The AHP evaluation

The example of matrix A is used to illustrate and explain the process of AHP evaluation. Each element would be computed in the form of matrix A as shown in Equation 12 (Mocenni, n.d.). The column would be represented as k^{th}, and the row would be represented as j^{th}. If the value of a_{jk} is greater than 1, the j^{th} criterion is more important than k^{th} criterion which produces the opposite meaning when a_{jk} is less than 1. To obtain the value of j^{th} and k^{th}, the scoring methodology is done throughout the pairwise comparison according to the third step of AHP tools (Mocenni, n.d.).

$$A = \begin{bmatrix} a_{j_1k_1} & a_{j_1k_2} & a_{j_1k_3} \\ a_{j_2k_1} & a_{j_2k_2} & a_{j_2k_3} \\ a_{j_3k_1} & a_{j_3k_2} & a_{j_3k_3} \end{bmatrix}$$

Equation 12: The matrix structure of example A (Mocenni, n.d.).

$$A = \begin{bmatrix} 1 & 3 & 5 \\ 1/3 & 1 & 3 \\ 1/5 & 1/3 & 1 \end{bmatrix}$$

In the pairwise comparison, the evaluator will be scoring the important of each element over other element according to the standard 1-9 scale as shown in Figure 20 (Saaty, 2008). The intensity of importance is responding to the value of score, and the opposite pairwise would be scored as the reciprocal value as shown in the above example A.

Intensity of Importance	*Definition*	*Explanation*
1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favour one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation A reasonable assumption

Figure 20: The standard 1-9 scale (Saaty, 2008)

To calculate the criteria weight vector, each pairwise comparison score must firstly be normalized according to Equation 13. The normalization would make the sum of a_{jk} equal to 1, and the criteria weight vector, w_j, is calculated from the average of normalized element a_{jk} as show in Equation 14. Where, the m value is the number of criteria (Mocenni, n.d.).

$$\bar{a}_{jk} = \frac{a_{jk}}{\sum_{l=1}^{m} a_{jk}}$$

Equation 13: The normalized vector (Mocenni, n.d.)

$$w_j = \frac{\sum_{l=1}^{m} a_{jk}}{m}$$

Equation 14: The average of normalized vector (Mocenni, n.d.)

According to the example of matrix A in Equation 15 and 16, the normalized pairwise comparison is calculated. The total of all normalize is equal to 1, and the criteria weight vector of A_{j1}, A_{j2} and A_{j3} are 0.633, 0.260 and 0.106 (Mocenni, n.d.).

$$A = \frac{\begin{bmatrix} a_{j_1k_1} & a_{j_1k_2} & a_{j_1k_3} \\ a_{j_2k_1} & a_{j_2k_2} & a_{j_2k_3} \\ a_{j_3k_1} & a_{j_3k_2} & a_{j_3k_3} \end{bmatrix}}{\sum_{l=1}^{m} a_{jk_1} \quad \sum_{l=1}^{m} a_{jk_2} \quad \sum_{l=1}^{m} a_{jk_3}}$$

Equation 15: The matrix structure 2 of example A (Mocenni, n.d.)

$$A = \begin{bmatrix} 1 & 3 & 5 \\ 1/3 & 1 & 3 \\ 1/5 & 1/3 & 1 \end{bmatrix} = \begin{bmatrix} 0.652 & 0.692 & 0.556 \\ 0.217 & 0.231 & 0.333 \\ 0.130 & 0.077 & 0.111 \end{bmatrix}$$
$$\begin{matrix} 1.53 & 4.33 & 9 \end{matrix} \qquad \begin{matrix} 1 & 1 & 1 \end{matrix}$$

$$A = \begin{bmatrix} \bar{a}_{j_1k_1} & \bar{a}_{j_1k_2} & \bar{a}_{j_1k_3} \\ \bar{a}_{j_2k_1} & \bar{a}_{j_2k_2} & \bar{a}_{j_2k_3} \\ \bar{a}_{j_3k_1} & \bar{a}_{j_3k_2} & \bar{a}_{j_3k_3} \end{bmatrix} = \begin{bmatrix} w_{j_1} \\ w_{j_2} \\ w_{j_3} \end{bmatrix}$$

Equation 16: The matrix structure 3 of example A (Mocenni, n.d.)

$$A = \begin{bmatrix} 0.652 & 0.692 & 0.556 \\ 0.217 & 0.231 & 0.333 \\ 0.130 & 0.077 & 0.111 \end{bmatrix} = \begin{bmatrix} 0.633 \\ 0.260 \\ 0.106 \end{bmatrix}$$
$$\begin{matrix} 1 & \quad 1 & \quad 1 \end{matrix}$$

According to the disadvantage of AHP tool, the consistency of decision may be decreased as the complexity is increased. The AHP tool can be cooperated with the consistency index, CI, to check the inconsistency of the evaluation. The consistency index can be calculated as following Equation 18. If CI is equal to zero meaning that there is no inconsistency in the evaluation. The maximum eigen value can be calculated by the Equation 17 (Mocenni, n.d.).

$$X_{max} = \sum_{i=1}^{m} \left(\frac{1}{\bar{a}_{j_i k_i}}\right)(w_{j_i})$$

Equation 17: The maximum eigen vector (Mocenni, n.d.)

$$CI = \frac{X_{max} - m}{m - 1}$$

Equation 18: The consistency index (Mocenni, n.d.)

Where,

CI = the consistency index

X_{max} = the maximum eigen value

m = the number of criterion

To compare the consistency index, the random index, RI, is used to calculate the ratio of inconsistency as shown in Equation 19. The value of RI can be obtained from the standard random index table as shown in Figure 21. The acceptance level of inconsistency is 1, else the pairwise comparison score would be rejected, and the evaluator must rescore the pairwise comparison (Mocenni, n.d.).

$$The\ inconsistency\ ratio = \frac{CI}{RI} < 1$$

Equation 19: The inconsistency ratio (Mocenni, n.d.)

m	2	3	4	5	6	7	8	9	10
RI	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.51

Figure 21: The random index value (Mocenni, n.d.)

2.6.2 Case study 2: The aircraft selection using the AHP tool

The airline industry, where the name of airline was not provided, had used the AHP tool in the decision-making process of aircraft selection. The objective was identifying the most suitable aircraft to operate the network of 27 routes in Southeast Europe. The main characteristics of selected routes were 800-kilometer flight and multiple connections the average of 40-100 passengers per flight (Dozic and Kalic, 2014). The aircraft would be operated at the Belgrade airport. The airline had developed the hierarchy structure consisting of 6 criteria and 7 alternatives aircraft as show in Figure 22. First, the airline scored the pairwise comparison of each criteria and calculated the priority vector according to the AHP evaluation as shown in Figure 23, and the seat capacity was found to be the most important criteria. However, the firm decided to straightly construct the pairwise comparison between the aircraft and criteria rather than create the sub-criteria to evaluate the alternative of aircraft because the information of aircraft was well known by the expert's experience as shown in Figure 24 (Dozic and Kalic, 2014).

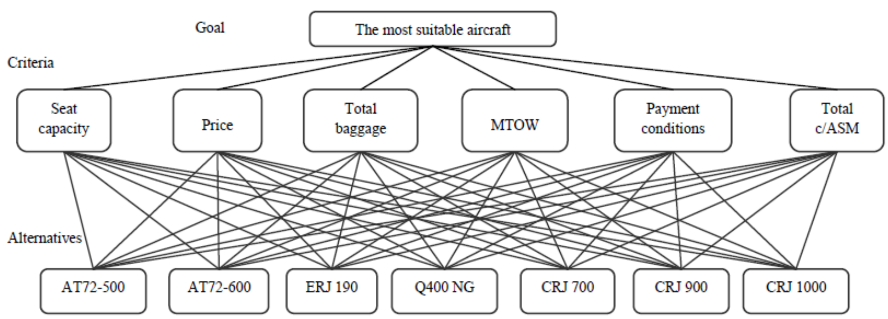

Figure 22: The hierarchy structure of aircraft selection (Dozic and Kalic, 2014)

	Seat capacity	Price	Total baggage	MTOW	Payment conditions	CASM	Priority vector
Seat capacity	1	0.25	3	0.5	0.25	0.25	0.071
Price	4	1	5	5	1	1	0.271
Total baggage	0.333	0.2	1	0.5	0.2	0.2	0.043
MTOW	2	0.2	2	1	0.2	0.2	0.075
Payment conditions	4	1	5	5	1	1	0.271
CASM	4	1	5	5	1	1	0.271

$\lambda_{max} = 6.2154$ $CI = 0.0431$ $CR = 0.0347$

Figure 23: The pairwise comparison of criteria 1 (Dozic and Kalic, 2014).

	Seat capacity (0.071)	Price (0.271)	Total baggage (0.043)	MTOW (0.075)	Payment conditions (0.271)	Total c/asm (0.271)	Final priority vector
AT72-500	0.227	0.250	0.037	0.278	0.263	0.065	0.1947
AT72-600	0.227	0.250	0.056	0.278	0.263	0.065	0.1954
ERJ190	0.051	0.082	0.347	0.033	0.052	0.172	0.1037
Q400 NG	0.134	0.144	0.090	0.176	0.093	0.107	0.1197
CRJ700	0.227	0.144	0.090	0.114	0.110	0.042	0.1082
CRJ900	0.083	0.082	0.148	0.073	0.110	0.274	0.1437
CRJ1000	0.051	0.050	0.232	0.048	0.110	0.274	0.1346

Figure 24: The pairwise comparison of alternative (Dozic and Kalic, 2014).

As the result, the airline received the top 3 alternative solutions with the highest score on the seat capacity which was suitable with the large demand of 27 routes. The first solution was AT72-600 with the score of 0.1954, and the closest alternative was AT72-500 with the score of 0.1947. The AT72-600 and 500 also had the top 2 aircraft in term of price performance as well as the maximum takeoff weight, MTOW. The AHP has brought 6 criteria together to successfully select the right aircraft to be operated at the Belgrade airport (Dozic and Kalic, 2014).

2.6.3 The advantage of AHP analysis

- Multiple criteria and sub-criteria
- Clear distinction between alternatives in numerical term
- Systematical framework, easy to be understood
- Sequentially evaluate throughout multiple criteria and sub-criteria

- Preventing result to be biased by the operator's perspective
- Cheap to be constructed

2.6.4 The disadvantage of AHP analysis

- Heavily relied on the judgement and evaluation of expert
- The increasing of number of criteria and sub criteria's elements would raise the level of inconsistency in the evaluation
- Require much effort and time
- Require the updated information to be accurate
- Only one best solution is accepted

In summary, the AHP is the very useful tool that aids the decision-making process and expresses in the numerical term which is easily to conclude decision without being dominated by the information. From the case study in section 2.6.2, the outcome of aircraft selection shows the best appropriate aircraft for the assigned route. Instead, the route would be selected in this project; where, the aircraft is fixed. With the large amount of airport information, the route selection would be difficult to make the appropriate solution. The advantage of AHP would help to reduce the complexity and achieve the best potential route for the Thai subsidiary airline. However, the author must also aware of the disadvantage. The inconsistency of evaluation would be increased as the number of element is increased. If pairwise comparison score is rejected, there would be also the duplicated work.

2.7 Case study 3: The MOA and AHP tools in the route expansion

This case study was obtained from the Taiwanese airline, and the name of airline was not mentioned. The objective of the study was to expand the air transportation service across the Taiwan Strait to respond to the increasing number of passenger between the mainland China and Taiwan. The airline had used the combination between the MOA and AHP tools to evaluate the opportunity for the market expansion. The MOA was adapted into 4 primary key factors which were the end-user value, channel customer, competition and supplier analysis as shown in Figure 25 to develop the 4 criteria and 15 sub-criteria as shown in Figure 26 (Lu and Liu, 2014).

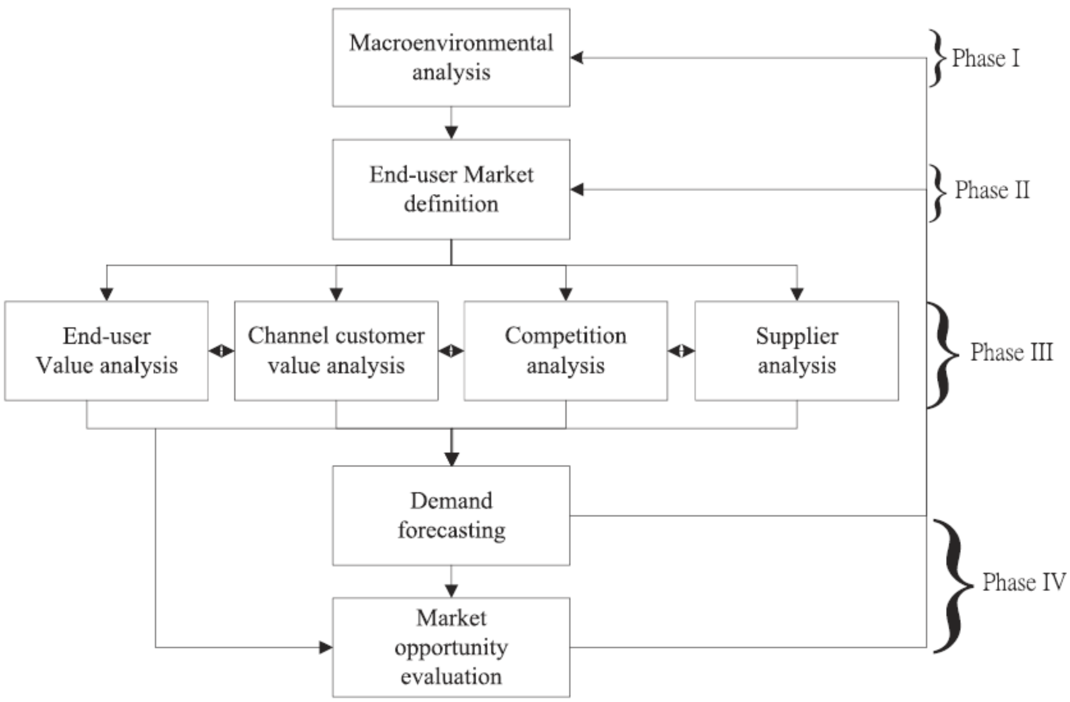

Figure 25: The MOA of Taiwanese airline (Lu and Liu, 2014)

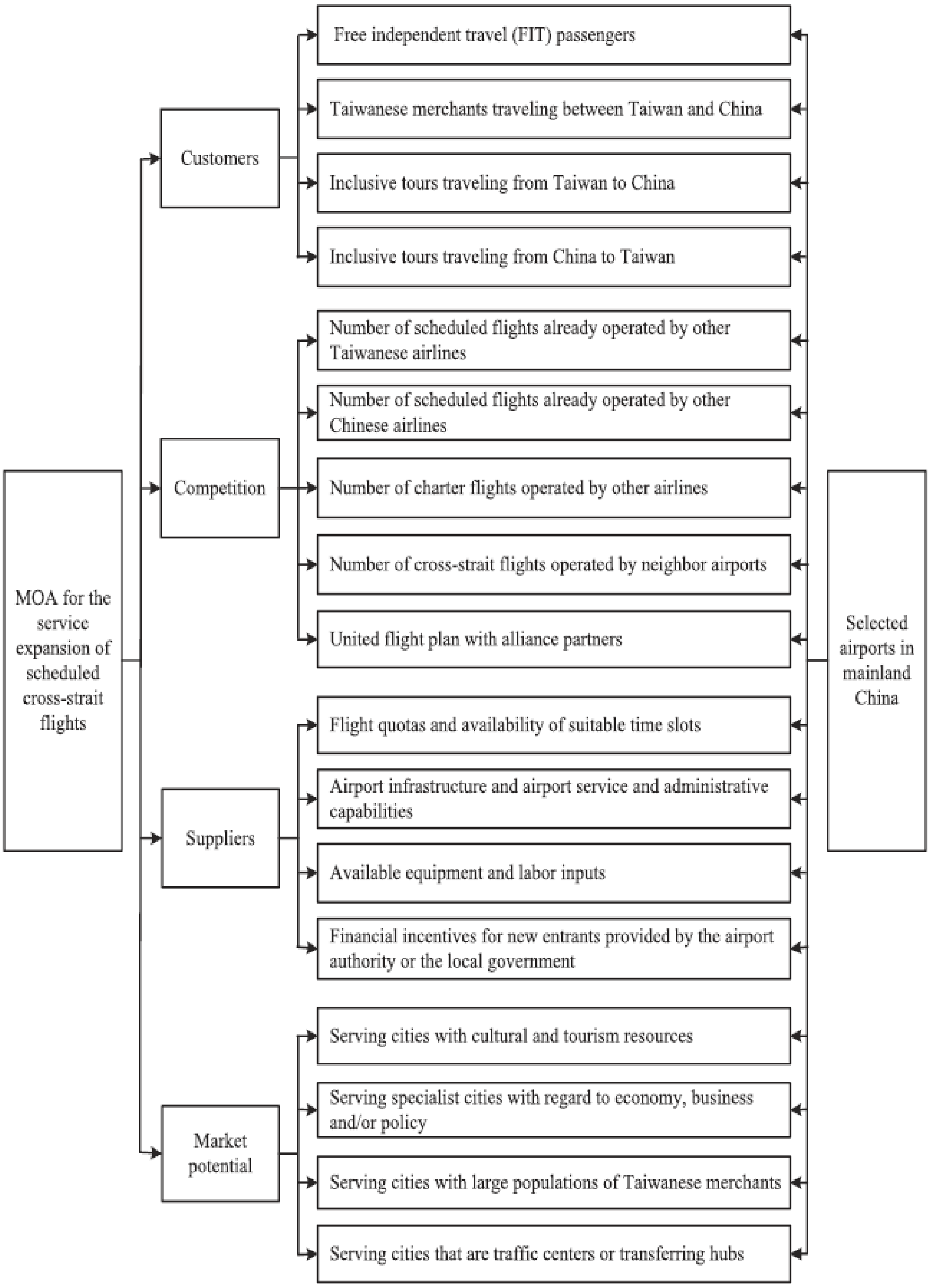

Figure 26: The criteria and subcriteria of Taiwanese airline's route expansion (Lu and Liu, 2014).

The use of MOA and AHP had well played on its role to support each other. The MOA was the strategic framework that provided the understanding of route expansion problem and objective which helped in the development of effective AHP criteria and sub-criteria; whereas, the AHP had done the evaluation role to identify the value of the opportunity which would help in the decision making. The 15 sub-criteria were evaluated from six different airlines China airline, EVA AIR, TransAsia, UNI AIR, Mandarin and Far eastern as shown in Figure 27. Each individual surveyed airline had different perspectives and opinions on criteria and sub-criteria. The final vector of each candidate airport is shown in Figure 28. To combine the score, the geometric mean was used rather than the algorithm mean preventing the changing consistency of each airline assessment (Lu and Liu, 2014).

Criterion & sub-criteria	Weight (rank)					
	China airlines	EVA AIR	TransAsia	UNI AIR	Mandarin	Far eastern
Customers	**0.2675**	**0.2335**	**0.2274**	**0.2480**	**0.2140**	**0.2032**
s1	0.0654 (4)	0.0569 (9)	0.0519 (11)	0.0588 (11)	0.0525 (11)	0.0474 (12)
s2	0.0729 (1)	0.0623 (6)	0.0806 (2)	0.0682 (2)	0.0614 (6)	0.0481 (11)
s3	0.0646 (5)	0.0572 (7)	0.0478 (12)	0.0592 (9)	0.0496 (13)	0.0539 (6)
s4	0.0646 (5)	0.0572 (8)	0.0472 (13)	0.0618 (7)	0.0505 (12)	0.0539 (6)
Competition	**0.2385**	**0.2326**	**0.2342**	**0.2445**	**0.2173**	**0.2219**
s5	0.0476 (14)	0.0557 (11)	0.0527 (10)	0.0494 (13)	0.0405 (17)	0.0449 (13)
s6	0.0475 (16)	0.0454 (14)	0.0461 (14)	0.0489 (14)	0.0407 (15)	0.0443 (14)
s7	0.0475 (16)	0.0440 (15)	0.0453 (15)	0.0488 (15)	0.0533 (10)	0.0442 (15)
s8	0.0482 (13)	0.0438 (16)	0.0451 (16)	0.0488 (16)	0.0423 (14)	0.0442 (16)
s9	0.0476 (14)	0.0437 (17)	0.0451 (17)	0.0488 (17)	0.0405 (16)	0.0442 (15)
Suppliers	**0.2401**	**0.2424**	**0.2314**	**0.2607**	**0.2322**	**0.3718**
s10	0.0670 (3)	0.0863 (2)	0.0658 (6)	0.0660 (3)	0.0572 (7)	0.0872 (3)
s11	0.0575 (11)	0.0498 (13)	0.0548 (8)	0.0643 (5)	0.0646 (5)	0.0857 (4)
s12	0.0582 (10)	0.0558 (10)	0.0561 (7)	0.0660 (3)	0.0550 (9)	0.0890 (2)
s13	0.0575 (11)	0.0505 (12)	0.0548 (9)	0.0643 (6)	0.0554 (8)	0.1099 (1)
Market potential	**0.2539**	**0.2915**	**0.3070**	**0.2468**	**0.3365**	**0.2031**
s14	0.0612 (9)	0.0678 (4)	0.0696 (5)	0.0587 (12)	0.0698 (4)	0.0540 (5)
s15	0.0625 (7)	0.0667 (5)	0.0701 (4)	0.0591 (10)	0.1210 (1)	0.0499 (8)
s16	0.0685 (2)	0.0878 (1)	0.0944 (1)	0.0686 (1)	0.0753 (2)	0.0499 (8)
s17	0.0617 (8)	0.0691 (3)	0.0729 (3)	0.0605 (8)	0.0703 (3)	0.0494 (10)

Figure 27: The weight ranking of 6 airlines (Lu and Liu, 2014).

Airport	Degree of grey incidence (rank)			
	China airlines	EVA AIR	TransAsia	UNI AIR
Tianjin	**0.8730 (3)**	**0.8846 (2)**	0.8370 (6)	**0.8432 (4)**
Chongqing	**0.8740 (2)**	**0.9284 (1)**	**0.8692 (4)**	0.8291 (6)
Hangzhou	**0.8726 (4)**	0.8506 (7)	0.8177 (11)	**0.8416 (5)**
Chengdu	**0.8847 (1)**	0.8507 (6)	**0.8805 (3)**	0.8195 (7)
Shenyang	0.8126 (10)	0.8209 (11)	**0.8871 (1)**	**0.8455 (3)**
Dalian	0.8184 (9)	**0.8630 (4)**	**0.8644 (5)**	**0.8655 (2)**
Xiamen	**0.8616 (5)**	**0.8757 (3)**	**0.8832 (2)**	**0.8945 (1)**
Harbin	0.7781 (11)	0.8119 (12)	0.8303 (10)	0.8000 (12)
Changsha	0.8357 (8)	0.8260 (8)	0.8365 (7)	0.8045 (10)
Shijiazhuang	0.7405 (12)	0.8240 (9)	0.8124 (12)	0.8036 (11)
Kunming	0.8467 (7)	**0.8532 (5)**	0.8364 (8)	0.8048 (9)
Wenzhou	0.8521 (6)	0.8226 (10)	0.8321 (9)	0.8195 (7)

Figure 28: The AHP evaluation result of 6 airlines (Lu and Liu, 2014).

Figure 29: The graphical location of potential airports in China (Lu and Liu, 2014)

The geographic location is illustrated the resulted geometric mean of each airport which indicates the final priority as shown in Figure 29. Chongqing, Xiamen and Chengdu were the top 3 airports that had the highest opportunity to expand the market across the Taiwan Strait. Chongqing had the final score of 0.8901 revealing the high market potential. Whereas, the alternative Xiamen and Chengdu were 0.8742 and 0.8718 respectively. Taiwanese airline had found the good combination between the MOA and AHP tool to develop the opportunity analysis as well as the decision making. With the cooperating method, the result was very effective, and Chongqing was decided to be the expanding location (Lu and Liu, 2014).

In summary, the MOA and AHP have been effectively collaborated to approach the conclusion of the decision making in the airport selection for the route expansion. The market opportunity has guided the criteria of airport location selection; whereas, the AHP analysis has well given the solution according to the provided information; however, this approach is still lack of the profit consideration. Chongqing might have been the best airport among alternatives in term of opportunity, but the feasibility and the successful rate of airline operation have not been investigated. Where, alternative airports might generate the higher profit.

2.8 The Holt-Winter model

The information is the valuable knowledge that can be used to describe the situation of the certain period such as the past, current and future. The information value will be altered and changed from time to time. The graphical time series has the capability to illustrate the characteristic of information change into the clear picture based on the period, L. The further lookback of information will visualize the pattern. With the significant of historical and current information, the future pattern can be predicted (Kalekar, 2004). The Holt-winter model is one of the exponential smoothing method that is used to forecast the systematic component of demand such as the level, trend and seasonality in order to estimate the variability of demand upon the forecast error. The appropriate forecasting method should be selected according to the demand behavior (Chatfield and Yar, 1988).

The time series forecasting method is consisted of the moving average, the simple exponential smoothing, Holt’s model and Winter model; where, each of forecasting method has unique fitness to the application as shown in Figure 30. The moving average and simple exponential smoothing are appropriate when the trend and seasonality component is not found in the demand; However, the simple exponential smoothing has the advantage over the moving average method due the capability of updated level component using the smoothing constant; whereas, the level component of moving average will be estimated from the initial historical (Chopra and Meindl, 2007).

Forward to more complex forecasting techniques, Holt’s model and Winter model have a basis of the exponential smoothing technique that can update the demand’s components. The concept of Holt’s model is focusing on the level and trend component of demand. Due to the collaborating linear regression, the seasonality is omitted. The level component will be estimated from the linear constant, and the slope will be used as the initial trend. Therefore, the holt’s model is inappropriate for the seasonal demand. On the other hand, the Winter’s model is built to correct the disadvantage of holt's model; where, the seasonality component is included. Instead of straightly using the linear regression, the Winter' model is initializing the systematic component of demand from the historical demand using the static forecasting, then each of component would be continually updated (Chopra and Meindl, 2007).

Forecasting Method	*Applicability*
Moving average	No trend or seasonality
Simple exponential smoothing	No trend or seasonality
Holt's model	Trend but no seasonality
Winter's model	Trend and seasonality

Figure 30: The applicability of forecasting method (Chopra and Meindl, 2007)

To estimate the initial value of level and trend based on the static forecasting method, the demand must be deseasonalied in order to remove the seasonal variation. The deseasonalied demand can be calculated as shown in Equation 20. The seasonality of demand would be equalized throughout the period. Then, the trend and level component can be identified by using the linear regression similarly to the holt's model (Chopra and Meindl, 2007).

$$\overline{D}_t = \begin{cases} \left[D_{t-(p/2)} + D_{t+(p/2)} + \sum_{i=t+1-(p/2)}^{t-1+(p/2)} 2D_i \right] \Big/ 2p \text{ for } p \text{ even} \\ \sum_{i=t-(p/2)}^{t+(p/2)} D_i/p \text{ for } p \text{ odd} \end{cases}$$

Equation 20: The deseasonalized equation (Chopra and Meindl, 2007)

To estimate the value of seasonality of each period, the basic ratio of seasonal and deseasonalized demand will show the differential value as shown in Equation 21 (Chopra and Meindl, 2007).

$$\overline{S}_t = \frac{D_i}{\overline{D}_t}$$

Equation 21: The estimate seasonal factor equation (Chopra and Meindl, 2007)

Furthermore, the Holt-winters model is represented into 2 forms which are the multiplicative and additive method. The method selection is depending on the pattern of the demand. The multiplicative seasonal model is capable of forecasting with the time series data that has the increasing amplitude throughout the period as shown in Figure 31; whereas, the additive seasonal model is used when the demand pattern has an equal amplitude at all time (Deshpande, 2014).

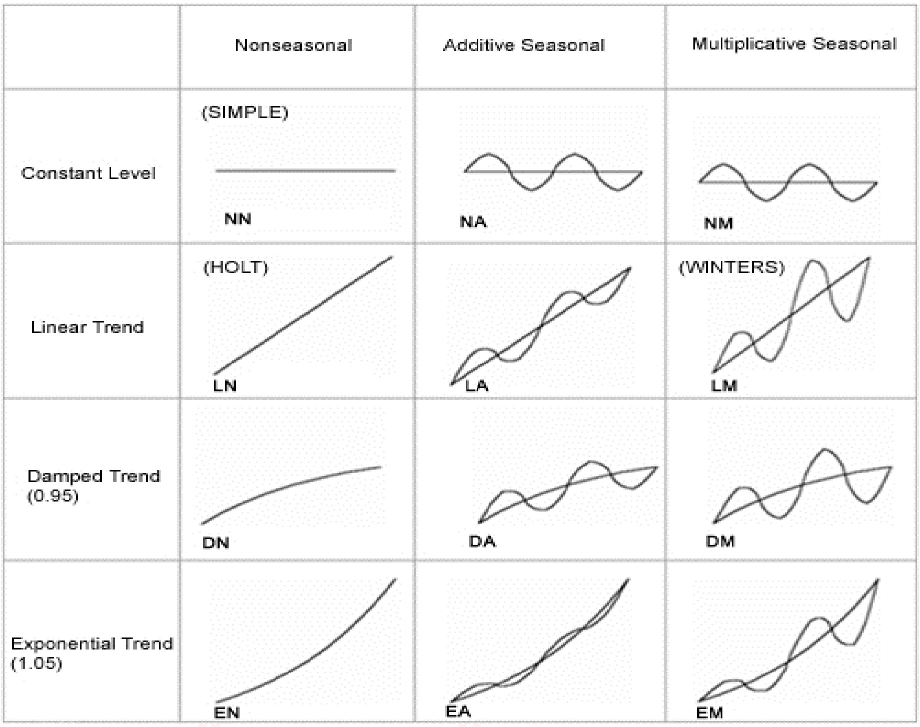

Figure 31: The differentiate of data behaviour (Deshpande, 2014)

To obtain the forecast value, the multiplicative and additive seasonal model will be calculated through different equations as well as the parameters in section 2.8.1. Both methods require the seasonal adjustment to show the trend component. The different between two methods is the seasonal parameter in Equation 25; where, the multiplicative method uses the division because the amplitude is inconstant; whereas, the additive method uses the subtraction because the amplitude is constant. The sum of seasonal factor for the additive method would be equal to zero; whereas, the sum of seasonal factor for the multiplicative method would be equal to 1 (Chatfield and Yar, 1988).

2.8.1 The multiplicative and additive equation

-The Forecast value

$$y_t = (\bar{R}_{t-1} + \bar{G}_{t-1})\bar{S}_{t-L} \text{ for the multiplicative model}$$

$$y_t = (\bar{R}_{t-1} + \bar{G}_{t-1} + \bar{S}_{t-L}) \text{ for the additive model}$$

Equation 22: The forecast value (Kalekar, 2004)

Where,

L is the length of the seasonal period

-The overall smoothing parameter

$$\bar{R}_t = \alpha\left(\frac{y_t}{\bar{S}_{t-L}}\right) + (1-\alpha) * (\bar{R}_{t-1} + \bar{G}_{t-1}) \text{ for the multiplicative model}$$

$$\bar{R}_t = \alpha(y_t - \bar{S}_{t-L}) + (1-\alpha) * (\bar{R}_{t-1} + \bar{G}_{t-1}) \text{ for the additive model}$$

Equation 23: The overall smoothing parameter (Kalekar, 2004)

Where,

α is the overall smoothing constant $0< \alpha <1$

-The trend parameter

$$\bar{G}_t = \beta(\bar{S}_t + \bar{S}_{t-1}) + (1-\beta) * \bar{G}_{t-1} \text{ for the multiplicative model}$$

$$\bar{G}_t = \beta(\bar{S}_t + \bar{S}_{t-1}) + (1-\beta) * \bar{G}_{t-1} \text{ for the additive model}$$

Equation 24: The trend parameter (Kalekar, 2004)

Where,

β is the trend smoothing constant $0< \beta <1$

-The seasonal parameter

$$\bar{S}_t = \gamma\left(\frac{y_t}{\bar{R}_t}\right) + (1-\gamma)\bar{S}_{t-L} \text{ for the multiplicative model}$$

$$\bar{S}_t = \gamma(y_t - \bar{R}_{t-L}) + (1-\gamma)\bar{S}_{t-L} \text{ for the additive model}$$

Equation 25: The seasonal parameter (Kalekar, 2004)

Where,

γ is the seasonal smoothing constant 0< γ <1

The accuracy of the forecast is heavily determined by the smoothing constant which has the value between 0 to 1. The appropriate smoothing constant would give the smallest error value. The mean absolute percent error, MAPE, is often used to identify the error between the actual and forecast which can be calculated according to below Equation 26. The forecaster will be adjusting the smoothing constant to achieve the most accurate result (Chopra and Meindl, 2007).

$$MAPE = \frac{1}{n}\left(\sum \frac{|Actual\ value - Forecast\ value|}{|Actual\ value|}\right)100$$

Equation 26: The mean absolute percentage error (Chopra and Meindl, 2007).

2.8.2 The advantage of Holt-winter model

The advantage of Holt-winters model is the capability of forecasting 3 variations in which does not require several testing methods. The characteristic of exponential smoothing leads the Holt-winter model to become the adaptive method that allow the value to be updated throughout the process. With the standard parameter equation, the formulation and calculation can be simple and easy.

2.8.3 The disadvantage of Holt-winter model

However, the drawback of Holt-Winter model is the long calculation process comparing to other forecasting method regarding to compute all 3 variations. Also, the difficulty that adaptive method might be facing is the inappropriate length of seasonal period, L. The adaptive would well performance at the long period of historical data; whereas, the short lookback would lead to the poor forecasting performance. Another important difficulty of Holt-winter model is to determine the smoothing constant. The only available approach is to calculate the lowest error value in which the time and effort are much required during the adjustment.

In summary, each of the time-series forecasting method is created and used for the specific purpose and situation according to the demand variation. The complexity of method would be increasing as the increasing number of systematic components are found in the demand. The first learning point of forecasting is the type of information. The more often of information is updated, the more accurate of forecast would be. The second learning point is the different between Holt and Winter's model. Both methods are initially found to contain the similar concept of demand's component estimation. However, the additional deseasonalized process is required to transform the seasonal demand in order to be applied in the Holt's model. Then, the deseasonalized demand will be used to estimate seasonal factor according to the concept of Winter's model. Therefore, the Winter' model could be referred as the Holt-Winter model. The third learning point is the demand behavior. In general, every demand would be performed regarding to 3 characteristics which are level, trend and seasonality; however, the differentiation could be found from the amount of each characteristic which is contained in the demand. At the end, the Holt-Winter model is found to be an all-in-one method that consider all 3 components. If the seasonality is zero, the season factor would be 1. If the trend is zero, the level component would be left in the equation, and he method would be transformed into the simple exponential smoothing. From the above review, description and analysis, the Holt-Winter model has found to be most appropriate forecasting method for the air transportation demand because the variation of this demand has been involved with the environmental, demand and supply factor; where, individual passenger would have the unique desire.

2.9 The PESTLE analysis

The PESTLE Analysis is the strategic planning tools that is used to assess the business's macro-environment. The potential and risk factor will be recorded and analysis to develop the appropriate strategy responding to the change of environment. The PESTLE can be together described in 5 factors which are political, economic, social, technological, legal and environmental as shown in Figure 32 (Team, 2013). With the macro-environment assessment, the firm can capture the entire view of the surrounding factor on the business detecting the potential and opportunity. The PESTLE will be constructed upon different scenarios in order to assess the possibility and amount of impacts on the business. The cost of construction is relatively cheap which requires only time and effort; however, the assessment is done manually from the perspective of manager (Marmol et al., 2015). In the application, PESTLE analysis can be applied in many fields of business that are involved with the external environment and the strategy decision such as the launching a new product or services, new international market entry and new route decision which are well suitable with the PESTLE analysis as shown in Figure 33. The external environment is unable to be changed or controlled. With the analysis, the firm will only be benefited to respond and adapt to the change of environment (Team, 2013).

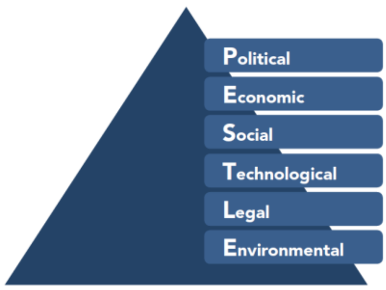

Figure 32: The composition of PESTLE analysis (Team, 2013)

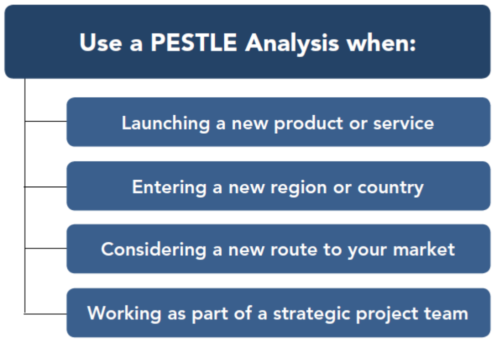

Figure 33: PESTLE's applications (Team, 2013)

2.9.1 The advantages of PESTLE analysis

- Cheap and simple framework
- Providing the clear picture of business environment
- Powerfully tools for various strategic planning related applications
- Understand the opportunity and risk in the market

2.9.2 The disadvantages of PESTLE analysis

- Be bias by the individual understanding
- Time consuming method
- Require the correct and updated information

In summary, the PESTLE analysis is the environment assessing tool which is commonly used in the strategic purpose. The adapted marketing opportunity analysis has included the environment factor; however, the analytic technique is not provided. Therefore, the PESTLE could be the tool that would greatly support the MOA method.

2.10 The ABC classification analysis

The ABC classification is the ranking technique that is commonly used in the inventory management and interchangeably referred as ABC inventory analysis. The purpose of this technique is to identify the critical element by categorizing elements into 3 groups based on their value and importance to the business. This method increases the managerial capability of inventory; where the manager could keep the high and low value item at the right inventory level (Chitale and Gupta, 2014). Like the Pareto analysis, the total contribution in business is equal to 100%; where, 3 groups are categorized into A, B and C class which are shared in proportion as 70%, 20% and 10% respectively (Goldsby and Martichenko, 2005). In order to apply the ABC classification technique, the firm must follow the below steps (Chitale and Gupta, 2014).

1. Define the characteristic of importance
2. Arrange the importance value in descending from the highest to the lowest value.
3. Normalized the importance value as in % of the total value.
4. Calculate the accumulative of % in each element
5. Categorize each element based on the 70/20/10 rule

2.10.1 The advantage of ABC classification analysis

- Show important and value of element
- Gain the capability to control and manage the system
- Reduce the risk of shortage and oversupply

2.10.2 The disadvantage of ABC classification analysis

- Only quantitative information support
- The quantity of each element is not considered, only value based analysis
- B and C class often receive less attention.

In summary, the ABC classification analysis has a major role of management in the inventory related application. Where, the key capability is the value based classification which would be beneficial to the route selection process. Many airports from different countries would be assessed and classified upon the potential factor.

2.11 Interview and questionnaires

To gather the knowledge, recorded information, and experience, Interview is the common method which is appropriate to interact with both group and individual. The method can be done through both face to face interaction and long distance communication. The face to face interaction is the physical methodology that requires movement and time when the individual's attitude and expression is important. However, the cost is high and variable depending on the distance and number of interviewee. Whereas, the long-distance interview is much cheaper and faster than the physical interview which can be done through the telephone line or internet; however, the level of effectiveness would be reduced as the number of interviewee is increasing. The complexity can lead to the recording error. Therefore, the interviewing topic is critically determining the methodology. The physical interview is suited with the specific area that requires knowledge and deep understanding; whereas, the long-distance interview is suit with the general question. (Opdenakker, 2006).

Questionnaire is an indirect information gathering technique which can be categorized into a closed and open-ended. This technique is used to gather a general information such as feelings, perceptions or attitudes toward the objective. Closed-ended is a short response multiple choice question; where the candidate is limited to express according to the alternative options (Farrell, 2016). On the other hand, the open-ended is used for the wide area of topic with the long response question allowing the candidate to freely express their opinions; where, the answer would be more diverse (Robert et al., 2014).

In summary, the use of interview and questionnaire are depending on the type of expected answer whether the desired answer are qualitative or quantitative information. In this route study project, the author would involve with the technical information in the route operation and also the experience of expert to aid the route selection process. The interview and open-ended question would be allowing the expert to fully express his or her perspective, and the result would be more sufficient.

2.12 Literature review summary

Throughout the review of several published literatures, case studies and theories, this chapter includes the airline business strategy, demand and supply, decision-making tools, forecasting method and macro-environmental analysis. The concept of this dissertation is about the route investigation and selection. The knowledge of airline business and decision making process are focused such as the market opportunity analysis and analytic hierarchy process. The first learning is that each airline operates with different strategies and approach. The co-existent of different strategy is no appropriate; where, the strong market focus would rather be more effective. The second learning from the review is the capability of each tool and method. Each individual approach has its own capability which could be adapted upon the application. The use of tools is heavily depending on the perspective of the operator and the defined purpose & problem. The ABC classification and Interview concept are also included to collect and classify the appropriate information for the route potential study.

Chapter 3: Methodology

3.1 Introduction

In this chapter, the methodology is focused to describe and clarify the approaching methods which are used to achieve the aim and objective of the project. The illustrated methodology flowchart is constructed by the author to provide the visibility of the entire process as shown in Figure 34. The methodology process is consisted of Stage 1, Stage 2 and Stage 3. The purpose of Stage 1 is to identify operating potential routes from the list of airports within the scope of the project which requires the understanding of potential requirement to develop the route criteria selection. Stage 1 firstly shows the methodology of the information gathering, analysis of airline value chain in section 3.2.1 and airport details gathering in section 3.2.3 which would be used to define key value creation to capture the passenger demand. Moreover, Stage 1 also includes the method of route criteria to investigate the operating capability and identify operating potential routes. The interview 1 with the fleet planning manager is included in section 3.2.4 to collect the feedback and suggestion toward the potential route selection in section 3.2.5. Whereas, Stage 2 is the continual process of Stage 1. The purpose of Stage 2 is to evaluate and rank the operating potential route to reveal the potential value and priority. Stage 2 shows the methodology of the AHP analysis and pairwise comparison in section 3.3.1 and 3.3.2. The weight evaluation can be fairly produced from the interview 2. The potential value would be calculated by the AHP evaluation which is represented in the numerical term in section 3.3.3 and 3.3.4.

Lastly, Stage 3 would show the methodology of the profit estimation from the net present value analysis in section 3.4.1 and 3.4.2. The purpose is to measure the profitability of selected operating potential routes. The comparison between the score of route potential and profit potential is also shown to identify the success rate of each route in section 3.4.3. Where, the potential route that has the highest success rate would be selected as the most appropriate potential route. The final route selection would be tested in the sensitivity analysis in section 3.4.4 to investigate the effect of changing cost to the profit. Eventually, the structure of recommendation for implementation that will be proposed to Thai subsidiary airline is described in section 3.4.5.

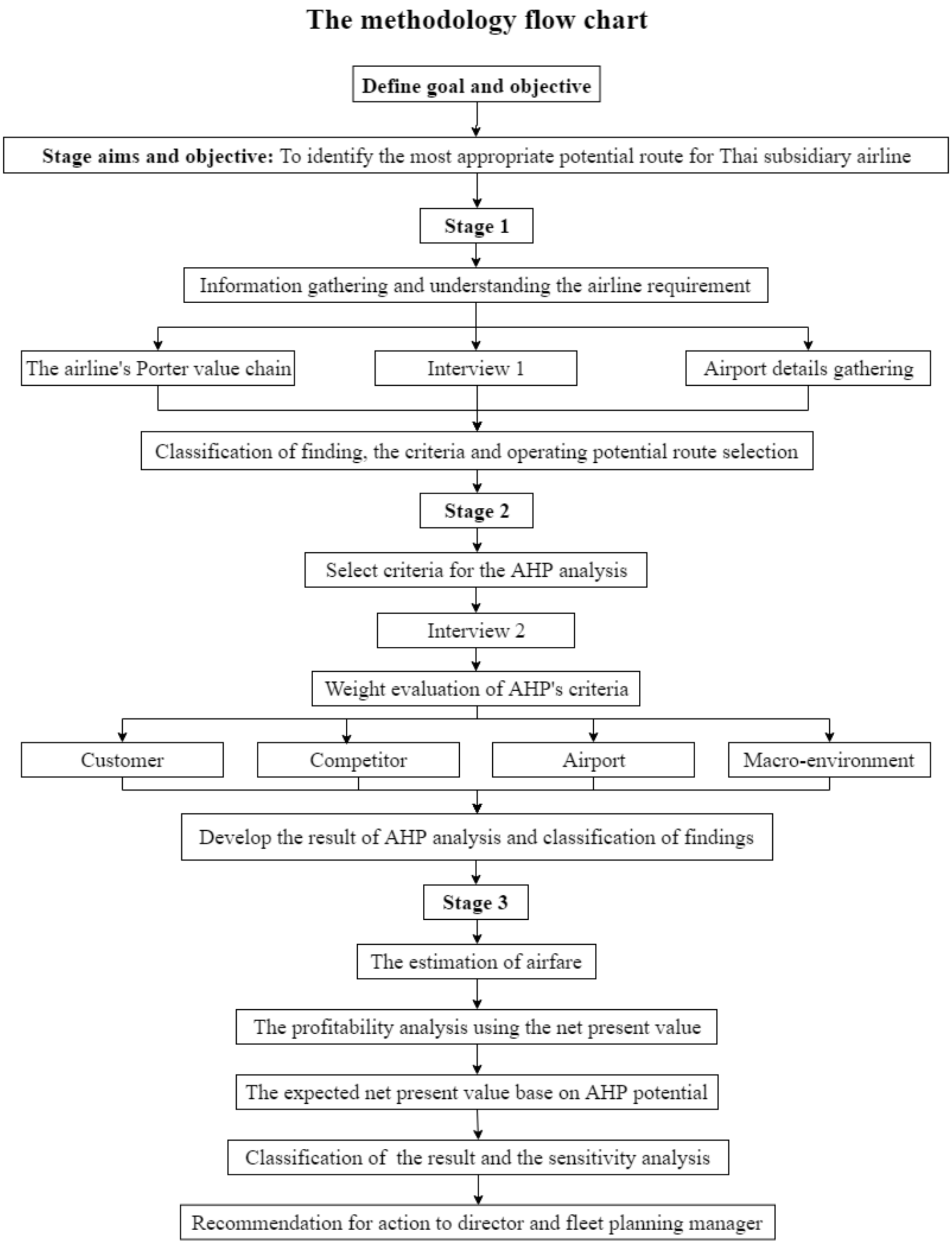

Figure 34: The methodlogy flowchart

3.2 Stage 1

3.2.1 Information gathering and understanding of airline requirement

Throughout the project, the information gathering was helping to capture and understand the concept of the airline operation which were also used in the analysis and evaluation. The information would be classified into 3 types which were the direct information, historical data and research. Most direct information was obtained from the interview and discussion between the author and the fleet planning manager such as the operating aircraft, the aircraft distribution and the financial structure. Whereas, the historical data was obtained from Centre for aviation and Star alliance which were the private database for airline industry, and the accessed account was given by Thai subsidiary airline. Lastly, the research information was obtained throughout online source and published literatures which would be analyzed by the author.

3.2.1.1 The Porter's value chain

To understand the value creation of airline service, the author decided to construct the basic value chain diagram to clearly show the value creation at each stage of the function. The business value creation would be broken down into 5 categories which were classified into the inbound logistic, operation, outbound logistic, marketing & sales and services. The purpose is to identify and investigate the value of service which would be captured by passengers. To do so, the service delivery process would be broken down into a set activity accordingly. The main information was obtained from the information gathering in section 3.2.1. Understanding the characteristic of service, the airline could appropriately establish the strategy approaching customers; where both airline, and passenger would receive the complacent value developing the co-value creation in the service.

3.2.3 Airport details gathering

At this point, the overall basic airline operation was understood, and the value creation was identified. However, the information of destination airport was still unknown. The purpose is to collect the airport information. Throughout the online research, the author first used the great circle mapper, the free online map website, to create the circular area of the scope in order to identify the list of countries. The author also constructed the graphical route map in each country to provide the clear picture of the travelled distance between each route. Once the list of countries was identified; the next step was to find and collect the information of the available international airport in each country. To do so, the author accessed into the Center of Aviation online database with the given member account, and the interested information were type of airport, runways specification, connecting destination and distance travel from Suvarnabhumi international airport. Whereas, the historical passenger demand could be found from the Star alliance private database. Due to the confidential data, several parts of data would be hidden within the grey shade. The author decided to collect the 4-year data from 2012 to 2015. The historical demand was used to identify the popularity of airport based on the traffic; however, the number of airport was found to be numerous in some countries; where, the popular airport would be found in several. Therefore, the author applied the ABC classification analysis to the particular country that contained more than 15 airports and categorized airports into 3 priorities with the rule of 70%, 20% and 10% according to the literature review in section 2.10. Each airport would be ascendingly arranged regarding to the passenger traffic. The airport that contributed at 70% of the accumulative passenger traffic would be placed in Class A. The 20% and 10% of accumulative passenger traffic would be referred as Class B and Class C respectively.

3.2.4 Interview 1

The result of information gathering would be reviewed by the fleet planning manager from the Thai subsidiary airline. Where, the open-ended interview was used according to the literature review in section 2.11 to allow the fleet planning manager to freely express his perspective and constructed at the headquarter of Thai subsidiary airline in Bangkok, Thailand. The action was individually taken in the syndicate room. The purpose of interview 1 is to inform and discuss about the information finding and possible criteria which would be deliberately used to construct the operating potential route criteria. The result of interview was manually recorded throughout the form 1 as shown in Appendix 2, and the fleet planning manager would be required to answer following questions.

1. Is the collected information appropriate to be used in the evaluation?
2. Is there any other possible criterion?
3. What is the most and least important information for the evaluation?

At the end of the interview 1, the author would receive the opinion and review from the fleet planning manage about the criteria selection.

3.2.5 Classification of finding, the criteria and route selection

At this point, the author had received the airport information as well as the suggestion from the above section 3.2.1. The purpose of this section is to identify operating potential airports that would suit for the Thai subsidiary airline's operation. To do so, the author decided to minimize the number of airport by eliminating the unqualified airport throughout the criteria. The criteria would be developed from the result of interview and the fleet capability. Once the appropriate criteria were constructed, the author arranged each criterion into layers of selection to filter out the airport. The selection would focus on 3 aspects which are the capability, performance and operation. The airport information, as shown in Appendix 3, would be tested throughout the constructed criteria. The airport that failed to meet any criterion would be disqualified, and the airport that passed all criteria would be considered as the operating potential airport.

3.3 Stage 2

Throughout Stage 1, 22 operating airports were identified. These qualified airports would be numerically evaluated to identify the value of operating potential airport. The purpose of this Stage is to decide and selected the top 5 operating potential routes. 4 basic steps were needed as following.

4 primary steps of the analytics hatchery process, AHP.

1. To define the problem, purpose and require information.
2. To create the hierarchy structure of decision forming the criteria and sub-criteria from the wide to narrow perspective.
3. To create a set of pairwise comparison matrix between criteria within the same level to compare each element.
4. To compute the weight of each element based on the priority score and add the weight value to obtain the final weight.

The step 1 would be understood and accomplished through the information gathering section in section 3.2.1. During the step 2, the author derived the concept of market opportunity analysis, MOA, into the criteria and sub-criteria which would be constructed into the AHP flowchart to provide the visibility of the entire analysis. The step 3 was done with the cooperation between the author and 3 individual aviation experts to help in the weight evaluation of each criteria and sub-criteria during the interview 2 and to calculate the pairwise comparison matrix. Lastly, the author would calculate the proportional weight of each criterion and sub-criterion which would be summed into the final AHP score.

3.3.1 The analytics hatchery process criteria selection

The purpose of this section is to identify the criteria and sub-criteria for AHP. To do so, the market opportunity analysis was firstly used to simplify the route information into criteria regarding to the environmental, customer, competitor and supplier analysis according to the literature review in section 2.5. Secondly, the author would be developing the sub-criteria based for each assigned criterion based on the notion of airline market potential.

3.3.2 The weight evaluation of AHP criteria

3.3.2.1 Interview 2

The interview of 3 chosen aviation experts was mainly focusing on the importance of criteria and sub-criteria reflecting from the expert's experience. The purpose of interview 2 is to produce the fair and credible score of criteria and sub-criteria. The author interviewed with experts from 3 aviation organizations which were the full-service carrier, the low-cost airline and Thai Civil Aviation Training Center, CATC, to capture resulting score from different perspectives. 3 experts would be individually met with the author at their headquarters, and A 1-9 scale was used as the rating methodology during the evaluation as shown in Figure 35. The result of interview would be manually recorded in the interview form 2 as shown in Appendix 2. The interview 2 would include the short-ended weighting pairwise comparison and the open-ended for each expert to express his or his opinion toward the pairwise comparison.

Scale	Degree of preference
1	Equal importance
3	Moderate importance of one factor over another
5	Strong or essential importance
7	Very strong importance
9	Extreme importance
2,4,6,8	Values for inverse comparison

Figure 35: The standard 1-9 rating scale (Saaty and Vargas, 1991).

3.3.2.2 The evaluation of AHP's criterion and sub-criterion

With the use of resulted score from 3 experts, the author constructed the matrix of pairwise comparison. The purpose is to calculate and finalize the weight of each AHP criteria and sub-criteria. To calculate the pairwise comparison, the author followed the AHP evaluation procedure as shown in the literature review section 2.6.1. Each pairwise comparison would be derived into the normalized scored using Equation 13. The normalized score of each pairwise would be averaged into the mean of weighted score using Equation 14. The resulted would be expressed in term of proportion with the range of 0-100%. However, the error of scoring evaluation could be occurred due to the inconsistency of experts' decision; so that, the author decided to check the inconsistency of the resulted weight by using the ratio of consistency index and random index. The inconsistency ratio could be calculated by Equation 19. The acceptable value of inconsistency ratio was 10%. If the ratio between both index was higher than 1.0, the result would be unacceptable, and the weight evaluation should be repeated.

3.3.3 The impact of AHP criteria and sub-criteria

With the great experience of experts, the resulted of consistency test went well for both criteria and sub-criteria, and the result of weight evaluation was obtained. However, the AHP analysis would be requiring the scoring input of criteria to evaluate the final score for each airport. The purpose of this section is to identify the value of each criteria and sub-criteria. As the result, the AHP criteria was classified into 4 different areas of operating potential which are customer, competitor, airport and macro environment according to the market opportunity analysis.

3.3.3.1 Customer

From the analysis of airline's value chain, the passenger demand was found to be creating the value co-creation with the airline. Also, 3 aviation experts provided the highest weight on customer. The author used the historical passenger demand of 2015 which was obtained from the Star alliance database to forecast the passenger demand in Year 2016. The historical demand covered all airlines that operated under the star alliance. Again, the passenger recorded was confidential. So, the author would be hiding several parts of both raw data and result. The Holt-Winter model was used as the forecasting method due to variations of air traffic passenger demand, level, trend and seasonality according to the literature review in section 2.3.1. The calculating equation for Holt-Winter model was used as the literature review in section 2.8.1. With changing seasonality, the author decided to use the multiplicative concept to forecast the passenger demand. The example forecast calculation would be provided in Appendix 4. To be more specific, the passenger demand was found to be composed of inbound and outbound passenger; moreover, the market capacity ratio was directly used from Stage 1. With the use of numerical data, the customer score would be evaluated by normalizing the total forecast demand, and the result would be shown in the proportion of 100%. The higher number of percentage indicated the higher customer potential and the captured value in the airport.

3.3.3.2 Competitor

In term of competitiveness, the differentiation of airline service is relative low. The comparison of airline in all qualified airport would be very difficult. Therefore, the author only focused on the overview of the market competition based on the new entrance perspective. The purpose of this section is to evaluate the competitor potential. Only 2 aspects were interested which were the number of competitors and frequency; however, the number of competitor would be classified into Thai and foreign competitor because Thai competitor would be more captive due to the tradition and culture advantage. The number of competitor and frequency would be gathering throughout the route development function in Centre for Aviation database, using the origin and destination airport code to identify the current operating airline and direct flight per week in each operating potential route. The number of findings would be normalized into proportion. However, the information is confidential and exclusive to Center for Aviation member; so, the author would be rounding the number as appropriate.

3.3.3.3 Airport

Airport is the distribution center that receive and sent out passengers. To determine the airport potential, the author focused on 3 aspects which were the airport ranking and connectivity. The connectivity was classified into international and domestic channel. The data would be mainly collected from the Center for Aviation that represent in the numerical term. However, the airport ranking was difficult to normalize due to the lower ranking number as the priority is increased; so, the author decided to prioritize the airport based on the market share in Asia pacific which corresponds to the airport rank as well. Lastly, the result of each sub criteria would be normalized.

3.3.3.4 Macro-environment

In this section, the author only focused on the surrounding of the destination due the point-point network design. Only destination would be different; so, the comparison between destinations' environment would be sufficient. The purpose is to evaluate the macro-environment potential for the new entry airline. The changing of environment is one of the influential factor that impacts the decision-making process. In term of the environment analysis, the author used the concept of PESTLE analysis which covered the political, economic, social, technology, legal and environment factor. The information and data was gathered from the online based research. The author attempted to collected the information in term of numerical data which would reduce the complexity in the evaluation.

3.3.3.4.1 Political

The primary focus is the living condition of population under the government control. Most of political information was found to be represented as the qualitative data that required the great experience to evaluate into the score. However, the author found and used the freedom house analytic report that provided the freedom score of each country in the world. The result of freedom house was found to be express in 2 terms which were the political right and civil right rating. The used rating scale was 1 to 7 as the best to worst. The freedom house data could be found in Appendix 5. These ratings would reflect the current government system and morality which could impact the everyday lifestyle. The author also evaluated the purchasing power from the personnel income tax, and the personnel tax information would be gathering from the trading economic database, the free access database. If the personnel income tax is increasing, the purchasing power would be decreased. The result would produce the negative impact to the potential score

3.3.3.4.2 Economic

The economic analysis was done using the GDP value as the economic quantitative metric, and the detail of analysis was based on country-level. The purpose is to see the effect of the changing economy in the air transportation market. The information was gathering throughout online economic research such as the world bank and international monetary fund, IMF. So, the author constructed the linear chart between the growth of GDP and the growth of number passenger to confirm the relationship. However, the value of GDP only indicated the economic performance for individual country, but the comparison of different countries was insufficient. Once the relationship between GDP and the air transportation market was found to be corresponding, the author used to the GDP per capita of 2015 to investigate and compare the economic potential of each country. The higher value of GDP per capita would indicate the standard living of population as well as the air transportation market potential.

3.3.3.4.3 Social

To investigate the social factor, the author interested in the travelling trend of passengers. Where, the growth of passenger demand in each O-D route is the important indicate which would be used to analyze the social potential. The information was derived from Stage 1 and gathered from the CAPA database. The detail of information was based on the airport-level. The average of 3-year growth was calculated to show the direction of travelling demand. The higher number of average growth; the higher potential would be.

3.3.3.4.4 Technology

The capability of communication between the airline and customers is key factor that allow the information to be transmitted. Where, the amount of technological resource has been differently producing and providing to consumers in each country. The purpose is to identify and evaluate the level of technology in the living environment. The detail of analysis was based on the country-level. The author found and used the infrastructure and digital content score from the latest global information technology report 2015 as shown in Appendix 8 which was produced by the World Economic Forum. The score rating was provided in 1 to 7 points as the worst to best. Where, the value of score would produce the positive impact in the potential score

3.3.3.4.5 Legal

The air traffic right between countries is settled down according to the agreement. The purpose is to evaluate the legal potential at the certain country. The location, number of flight and weekly frequency are known to be limited and different. The author contacted the Thai Civil Aviation Training Center and sent the requested letter for the traffic right information as shown in Appendix 7. Due to the traffic right information, the score evaluation was classified into conditional and unconditional which were set as 0 and 1 because each country was found to have the specific and unique term & agreement which could not be evaluated under the same standard parameter. Therefore, the country that has the restriction in either the location, flight frequency or capacity would be referred as the conditional country, and the non-restricted country is referred as the unconditional country. These limitations would reveal the legal potential itself in the numerical term, and the data would be normalized into the score. The result would produce the positive impact to the potential score.

3.3.3.4.6 Environment

The risk and safety are the critical concern for passenger and airline that perhaps lead to the injury or unconditional equipment. The environment activity is an uncontrollable factor but predictable. Passengers would avoid putting themselves in the dangerous state, and the information could be acknowledged throughout various sources of media. The purpose of this section is to analyze the environmental threat in each country. The information was available publicly from the InfoRM-index for risk management online database which was the collaborative project between Inter-Agency Standing Committee, IASC, and European Commission. The used rating scale was 0 to 10 points as low to very high risk. The score risk was classified into 3 main dimensions which were the hazard & exposure risk, vulnerability and lack of coping capacity. The data could be found in Appendix 6. The result would show the score of 3 dimension as well as the overall risk index of each country and would reflect the negative effect.

3.3.4 Develop result of AHP analysis and classification of findings

The summary of the scoring criteria and sub-criteria would be taken into the account in this section. The purpose is to make the decision of which airports are appropriate for the new airline route from the total score. To do so, the author calculated the value of criteria and sub-criteria together according to the resulted weight and summed all the value of criteria together into the overall AHP score. The overall AHP score would be ranked in order from the highest to lowest showing the most and least potential. The author also investigated the characteristic of each airport using the conditional formatting in excel function to show the strong and weak criterion of each route representing in the shade of color from green to red. The green color would indicate the strength; whereas, the red would indicate the weakness. Only 5 highest potential airports would be selected as the alternative potential route options. The result of AHP analysis would be summarized and concluded; in despite, the author also concerned about the profitability; so that, the new operating route must be able to produce the profit as well which would be studied in Stage 3.

3.4 Stage 3

3.4.1 The estimation of airfare

The purpose of this section is to estimate the price of air ticket. The Thai subsidiary airline suggested to use the average breakeven airfare at the loading factor from 50% to 90% as the estimate ticket price because the total cost was found to be varied depending on the number of passenger. To begin with, the basic financial structure template was given and consisted of the revenue, direct cost and indirect cost. The total cost estimation could be found in Appendix 9. The total cost was computed by inputting variables of route specification such as distance per roundtrip, airborne hour per roundtrip, block hour per roundtrip. Where, the number of weekly frequency was assumed to be fixed at 7 roundtrips, and the total seats was fixed at 24 business seats and 312 economy seat per roundtrip according to the A320 specification. The author adjusted the loading factor to obtain the total cost at each stage. The breakeven and average airfare could be calculated by below Equations 27 and 28 as shown in following

$$B.A._{L.F.\%} = \frac{TC_{L.F.\%}}{(Seat\ capacity)(L.F.\%)}$$

Equation 27: The breakeven airfare (Anon, 2016b)

$$A.F. = \sum_{i=1}^{n} \frac{B.A._1 + B.A._i}{n}$$

Equation 28: The average airfare (Anon, 2016b)

TC = The total cost of each route at % of loading factor.

L.F. = The loading factor

B.A.= The breakeven airfare at the assign loading factor.

A.F. = The average breakeven airfare.

3.4.2 The profitability analysis using the net present value

As the selling ticket price of each potential route was identified, the revenue could be estimated according to the loading factor of 60%. Launching the new airline route is the long-term project. The purpose of this section is to evaluate and compare the profitability of each route throughout the project planning. The author used the NPV analysis to determine the net cash flow for each potential route according to the literature review in section 2.3.3. To construct the NPV analysis, the fleet planning manager requested for the 6-year term analysis, and the minimum cabin factor is given at 60%, 65%, 69%, 72%, 74% and 75% respectively as shown in Appendix 9. The discount factor was set at 10% as the inflation of changing value of currency. The profitability was calculated by subtracting the estimated revenue with the total cost which could be obtained from the cost structure template. The result of 6-year profitability would be plotted into chart to give the clear picture of different profit between potential routes. The result of NPV was only the estimation which was created by the author; so, the value could be publicized.

3.4.3 The expected NPV based on AHP potential analysis

At this point, the result of 2 potential score, profitability and operation, were obtained. To identify the appropriate airport. The author constructed the linear analysis to identify the combination potential representing the feasibility of each route. Two potential data would be plotted into the graphical chart. The purpose is to evaluate the expected net present value regarding to AHP potential. The result would be achieved by visually investigating the trend and data location of each airport. The author also constructed the simple geometric calculation to calculate the expected net present value by identifying the area under the linear graph to support the assumption which could be calculated as Equation 29. Where, the net present value would increase as the AHP value was increased.

$$The\ triangular\ area\ of\ value = \frac{the\ operating\ potential\ x\ the\ returning\ of\ investment}{2}$$

Equation 29: The triangular area of potential value.

3.4.4 Classification of the result and the sensitivity analysis

The final result would be addressed and concluded in this section. The highest success rate route would be more like to be selected as the new launching route. The understanding of cost variable is important to be aware. The author decided to construct the sensitivity analysis of the final route selection to identify the change of profit based on the changing variable cost. To do so, the author selected the high impact cost using the ABC classification according to the methodology section 2.10. The purpose of this section is to show the sensitivity of each variable upon the net present value. The sensitivity analysis is the mathematical model that show the relationship between the changing of interested variables and result while other variables are fixed. In this analysis, variables that exist in Class A would be investigated and alternatively increased and decreased at every 10% to identify the changing NPV. The author would also plot the result into chart to show the clear picture of the most sensitive variable.

3.4.5 Recommendation for action to the director and fleet planning manager

Lastly, the recommendation was developed to propose the result and finding to the director and fleet planning manager. The purpose of recommendation is to address the result of project and the critical factor that may affect the profitability of proposed route. So that, the Thai subsidiary would be aware of the potential threats as well. The recommendation would include as following which would be either approved or rejected based on their judgement.

1. Who is the author?
2. What is the project objective?
3. The propose solution
4. The finding problem and critical factor
5. The recommendation

Chapter 4: Result and analysis

4.1 Introduction

This chapter is directly related to the chapter 3 that contains the result and analysis of research and methodology. The result shows the list of potential routes that are located within 4 hours of flight duration or 3,000 kilometers away from Suvarnabhumi international airport in Bangkok, Thailand. The structure of this chapter is consisting of Stage 1, Stage 2 and Stage 3. Stage 1 shows the result of airline information gathering in section 4.2.1 and airport details gathering & analysis in section 4.2.3 which will be firstly assessed throughout the interview 1 in section 4.2.4 and the criteria selection in section 4.2. 5 to identify the list of operating potential airports. Where, Stage 2 shows the process of AHP criteria and sub-criteria selection in section 4.3.1 and the evaluation of each operating potential route in section 4.3.2 and 4.3.3 to make the route potential decision in term of score. The evaluation of pairwise comparison will be shown throughout the interview 2 of 3 different aviation experts. The analysis focuses on market potential which includes the customer, competitor, airport and macro-environment. Stage 3 firstly shows the result of estimation of airfare in section 4.4. which will be used to develop the result of profitability analysis in section 4.4.2; where, the method will include NPV analysis in section 4.4.4 and sensitivity analysis in section 4.4.5 in Stage 3. At the end of this study, the route characteristic that impacts the operating and profit potential will be understood. The appropriate potential route for a subsidiary airline will be proposed to the director and fleet planning manager with the attached recommendation in section 4.4.5.

4.2 Stage 1

4.2.1 Airline information gathering

The majority of information was gathered throughout the research and analysis. The author used the result of analysis as the knowledge and information for the further analysis. The Thai subsidiary airline case study had stated their requirement and given the financial template structure to examine the cost of international potential route. The author also received several opinions and technical information from the fleet planning manager throughout the general discussion. The requirement is mentioned as following

- A320-200 is used in the operation
- International potential route selection must be located within 4 hours of the flight duration or 3,000 kilometers

The main airport was found to be the Suvarnabhumi international airport, and the service was found to support both leisure and business purpose. The service level was equivalent to the parent airline. The Thai subsidiary airline was currently operating 9 international destinations such as Siem reap, Changsha, Chongqing, Gaya, Varanasi, Jalpur, Lucknow, Penang and Yagoon. However, Macau was recently suspended due to the negative contribution from the inadequate demand.

4.2.1.1 The Porter's value chain of Thai subsidiary airline

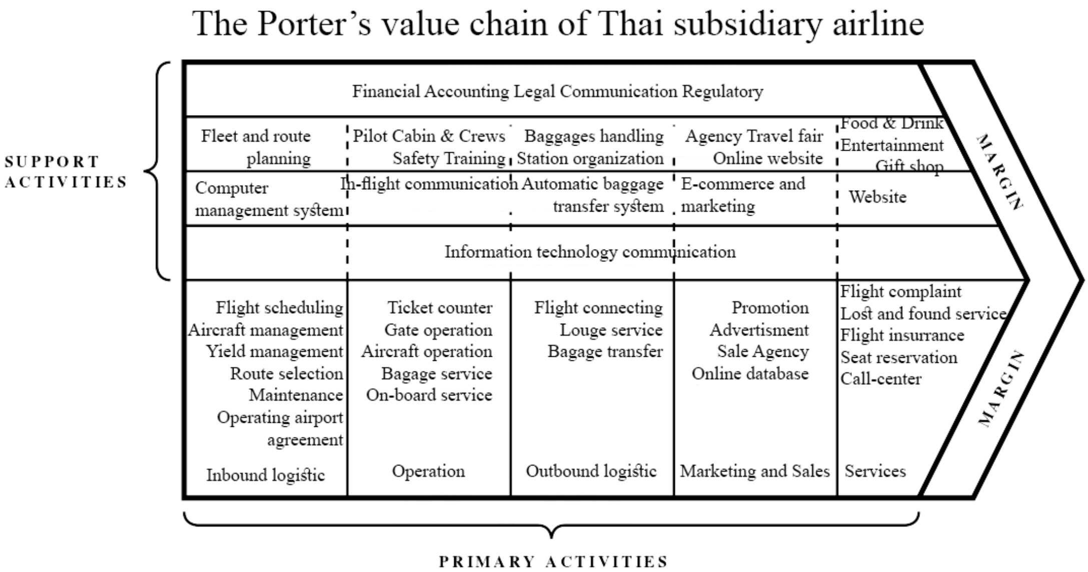

Figure 36: The Porter's value chain of Thai subsidiary airline

Throughout the Porter's value chain, the value creation of subsidiary airline is illustrated in term of the inbound logistic, operation, outbound logistic, marketing & sales and services as shown in Figure 36. The value of airline service was initially created before the actual take off to help passengers arrive at the connecting or destination airport without any difficulty.

4.2.1.1.1 Inbound logistic and operation

To prepare the service operation, the value was initially created since the planning section to determine the input requirement for the operation. The aircraft A320 was found to be the fleet resource that was used in the Thai subsidiary airline. The aircraft specification is shown in Appendix 1. The A320 was consisting of 12 business seats and 156 economy seats which equaled to 168 seats of the total configuration. The aircraft was the first value had effected the value of operation; where, most of passenger would prefer to travel with the large aircraft due to the interior of aircraft and safety according to the literature review in section 2.2. The variety of route was also limited by the fleet capability. The medium-size aircraft had less accessible capability than the large aircraft. Secondly, each destination route was distinguished by the distance and flight duration. The value was increasing as the further destination was located. However, the aircraft A320 was capable to operate the non-stop flight at 6,000-kilometer maximum. To access to the further destination, the larger aircraft would be required, and the value of the operation would also be increased. Thirdly, the Thai subsidiary airline had outsourced the maintenance activity from its parent company which satisfied several airline regulations such as the Federal Aviation Regulations of Federal Aviation Administration USA and Joint Aviation Regulations of Joint Aviation Authorities (Anon, 2016b). These certifications had added the value of safety and quality of service to the operation. Fourthly, the flight time and frequency also added the value of the service operation; where passengers would choose the specific flight at the desire time.

Therefore, the value of air transportation service would be varied depending on the destination route, type of aircraft, flight schedule and service quality. The route selection has the indirect value to passengers throughout the operation. Passenger would begin to receive the value at the operation section forward to the service. The inbound logistic operation would be internal organization process which would not be realized by passengers.

4.2.1.1.2 Outbound logistic

According to the airline service, both economy and business class were provided, but leisure and business passenger would be receiving the different value of service on-board. The seat space of business class would be wider and larger than the economic class. Where, the business class would be eligible to enter and leave the aircraft first in order to forward to the immigration without the long waiting queue. Also, the baggage for the business passenger would be the priority that would be earliest transferred and delivery. These values were created for the time sensitive passenger. Moreover, the subsidiary airline also provided the lounge service for the connecting passenger at Suvarnabhumi International airport.

4.2.1.1.3 Marketing & sales and service

In the digital age, the technology had been mainly involved with most of the application to provide the convenience. The airline also used the information and communication technology to approach customers with the e-commerce, online advertisement & promotion which could be easily seen via the internet. Customers could acknowledge and purchase the service at home. With high accessibility, the service was more likely to be sold. The cost of advertisement and promotion would be also included into the value of the ticket; however, passengers would not realize. Other than the distribution channel, customers could provide the feedback and issue the problem from anywhere at any time throughout the company website. These indirect activities were added into the service value. The example budget of Advertisement and Management &administration is shown in Table 1.

Table 1: The budget of advertisement and management & Administration for Thai subsidiary (confidential)

Advertisting & Publicity	56,395.40	THB
Management & Administration	111,041.95	THB

Moreover, Thai subsidiary airline also provided the in-flight service such as meal & drink and service for the international flight which added the value into the service. The cost of in-flight service for the business class would be generously higher than the economy class as well as the quality of service as shown in Table 2. The other variable cost can be found in Appendix 9.

Table 2: The cost of service -Meal & Drink (confidential)

Direct Pax Service -Meal & Drink		
Business class	190	THB/Pax
Economy class	110	THB/Pax
Direct PAX Service-Material		
Business class	104.97	THB/Pax
Economy class	45.27	THB/Pax

From the above information and discussion, the primary value focus was the co-value creation between the airline and passenger which was showed as the passenger demand. Where, the potential route selection would be effecting the flight operating which was operated with the fixed value of aircraft, and the aircraft, A320, would be considered in this study. Therefore, the airline business interested on the significant demand that would support the operation, and the passenger would also look for the sufficient value of service. To select the potential route, the flight operation would be investigated.

4.2.3 Airport details gathering

Based on the given requirement from the Thai subsidiary airline, 13 countries had found to be covered within the circular range of 3,000 kilometers which were Cambodia, China, Bangladesh, Hong Kong, India, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Taiwan and Vietnam as shown in Figure 37. 160 international airports were found from 13 countries; however, the coverage of circular range did not entirely reach the area of China, India, Indonesia and Philippines; so, the operating potential airport would be located less than 160 locations. The specification of each airports was investigated as shown in Appendix 3.

Figure 37: The circular scope of research (Swartz, 2016)

4.2.3.1 Cambodia

Cambodia had 3 international airports which were Siem Reap (REP), Phnom Penh (PNH), and Sihanouville international airport (KOS) as shown in Figure 38; however, only REP and PNH were operating the direct flight to and from Bangkok, Thailand which would take about 1 hour of travelling time. The Phnom Penh international airport was serving the capital city and the furthest airport with the distance of 504 kilometers; whereas, the nearest airport was Siem Reap airport, 333 kilometers.

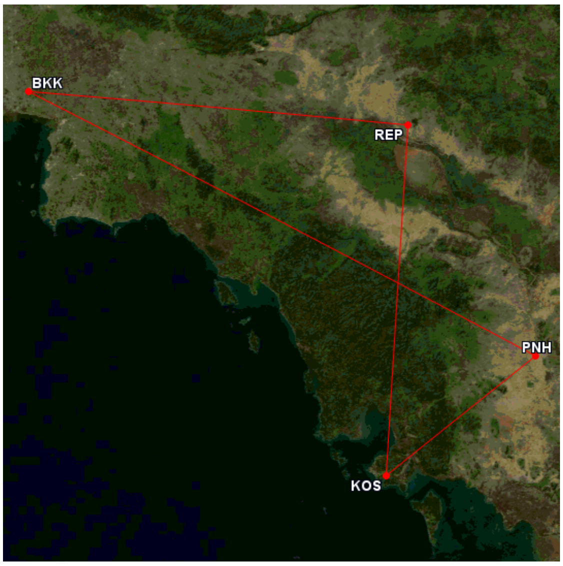

Figure 38: The routemap of Cambodia (Swartz, 2016)

According to the star alliance data, the grand total of passenger demand from 2012 to 2015 was 2,043,341 passengers; where, the Phom Penh international airport was the busiest airports having 1,353,782 passengers which was equal to 66.23%; where, the passenger demand for Sihanoukville airport was the less than 1% of the total market share as shown in Table 3.

Table 3: The historical demand of Cambodia (confidential) (Alliance, 2016)

Airport name	Code	2012	2013	2014	2015	Grand total
Phom Penh International airport	PNH	293241.6	334800	[redacted]	391623	1353782.6
Siem Reap International airport	REP	142828.2	[redacted]	197149	148431	688650.2
Sihanoukville International airport	KOS	12.3	200	203	[redacted]	908.3
Total		43[redacted]94.1	5[redacted]255	53[redacted]84	5[redacted]562	2043341.1

4.2.3.2 China

China was the largest country in Asia that had the highest number of international airport; where, 71 registered international airports had found across China as shown in Figure 39. 16 destination airports that could be accessed via the direct flight between Bangkok and China. The range of direct flight duration was covered from 1 hour and 50 minutes up to 4 hours, and the furthest airport in China was the Linyi Shubuling airport which was located 2,950 kilometers away from BKK; whereas, the nearest airport was Jinghong Gasa airport.

Figure 39: The routemap of China (Swartz, 2016)

49 international airports had found to have passenger demand between Bangkok, Thailand and China. The average number of passenger was approximately 6.103 million passengers over past 4 years. According to the ABC classification in Figure 40, Shanghai, Guangzhou, Kunming, Chengdu and Xiamen that had the market share of

66.8% and been categorized in Class A. The passenger demand of Shenzhen, Wuhan, Chonqing, Hangzhou, Changsha, Shantou, Zhengzhou and Fuzhou were summed up to 22.5%. Whereas, the rest of 36 airports were only 10.8% of the total market shared.

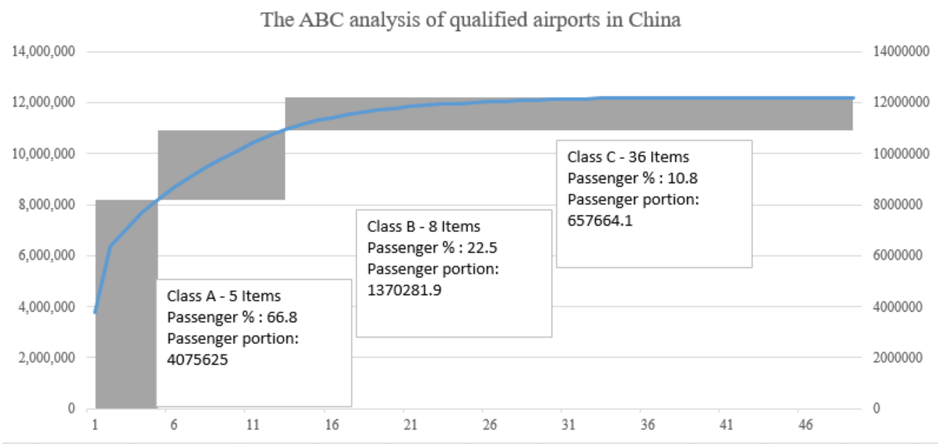

Figure 40: The ABC analysis of qualified airports in China (Alliance, 2016)

4.2.3.3 Bangladesh

Bangladesh had 3 international airports which were Chiitagong, Shah Amanat (CGP), Dhaka Hazrat Shahjalal (DAC) and Sylhet Osmani (ZYL) as shown in Figure 41; where, the DAC was serving for the capital city, Dhaka. The farthest airport was ZYL locating 1,557 kilometers away from Bangkok, Thailand. The Shah Amanat was the nearest airport in Bangladesh with 1,339 kilometers. According to Table 4, the 96% total roundtrip passenger demand arrived at Dhaka International airport; whereas, CGP and ZYL airport were only 4% of the total market share.

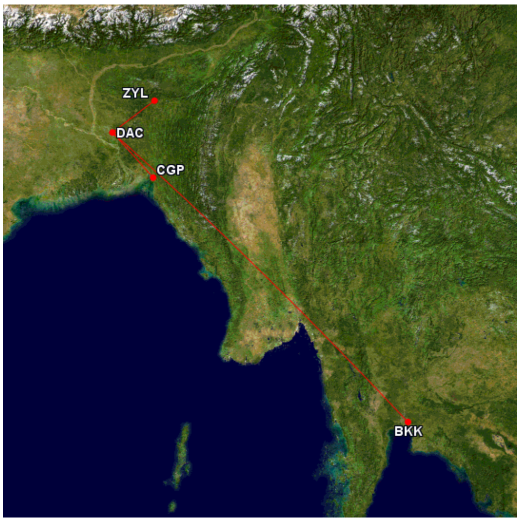

Figure 41: The routemap of Bangladesh (Swartz, 2016)

Table 4: The historical demand of Bangladesh (confidential) (Alliance, 2016)

Airport name	Code	2012	2013	2014	2015	Grand total
Dhaka International Airport, BD	DAC	25[redacted]50.8	[redacted]30743	2[redacted]145	245[redacted]3	967441.8
Chittagong Shah Amanat International Airport, BD	CGP	2995	1918	1[redacted]69	24[redacted]5	39907
Sylhet Osmani International Airport, BD	ZYL	6.2	8	17	205	236.2
Total		[redacted]852	[redacted]32669	2[redacted]31	270[redacted]3	1007585

4.2.3.4 Hong Kong

Hong Kong was one of the special administrative region of China that had only one international airport, HKG. The direct flight was accessible. The HKG was located 1,688 kilometers away from Bangkok, Thailand as shown in Figure 42. The runway specification was 3,800 meters. The passenger demand was 11,326,970 passengers as shown in Table 5.

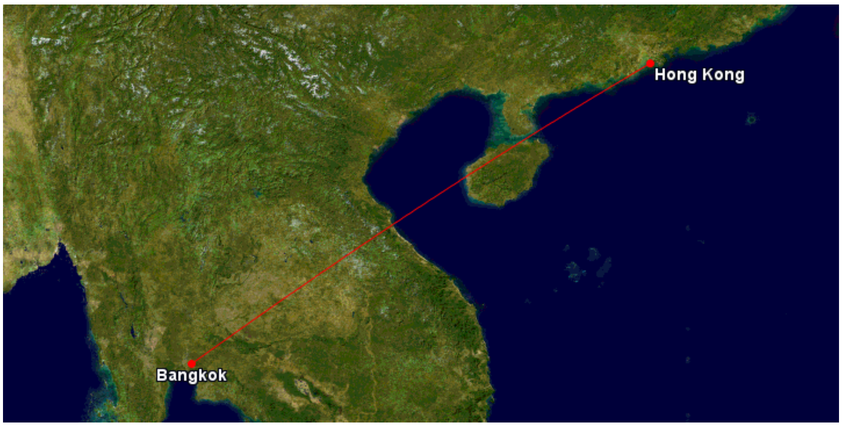

Figure 42: The routemap of Hong Kong (Swartz, 2016)

Table 5: The historical demand of Hong Kong (confidential) (Alliance, 2016)

Airport name	Code	2012	2013	2014	2015	Grand total
Hong Kong, HK	HKG	[redacted]290555	2[redacted]3060	252[redacted]45	[redacted]517710	11326970

4.2.3.5 India

There were 19 international airports found in India. Where, the direct flight could only access to 5 international airports of India which were Indira Gandhi (DEL), Kempegowda (BLR), Rajiv Gandhi (HYD), Chennai (MAA) and Netaji Subhas Chandra Bose (CCU). The transition was required to access other destination airports as shown in Figure 43. Jaipur (JAI) was the farthest airport from Bangkok with 2,975 kilometers locating in the northern India and near the Indira Gandhi airport. The passenger was likely to arrive at the Indira Gandhi airport according to the historical demand; where, the passenger demand of DEL was 42.3% of the total market share. As for the southern India, the sum of passenger demand was still lower than the Indira Gandhi airport. According to ABC classification of India airports as shown in Figure 44, 69.3 % of the total passenger was Class A which was consisted of DEL and CCU.

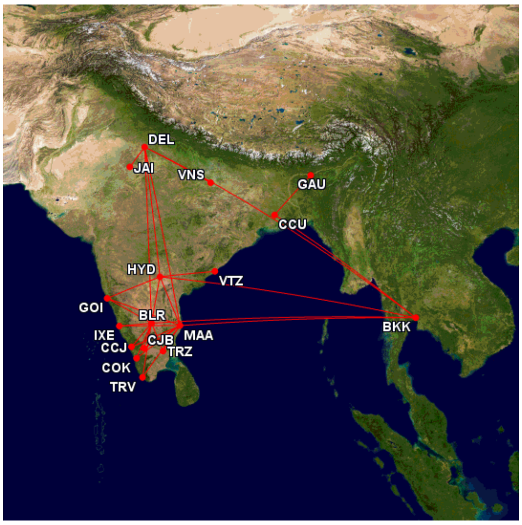

Figure 43: The routemap of India (Swartz, 2016)

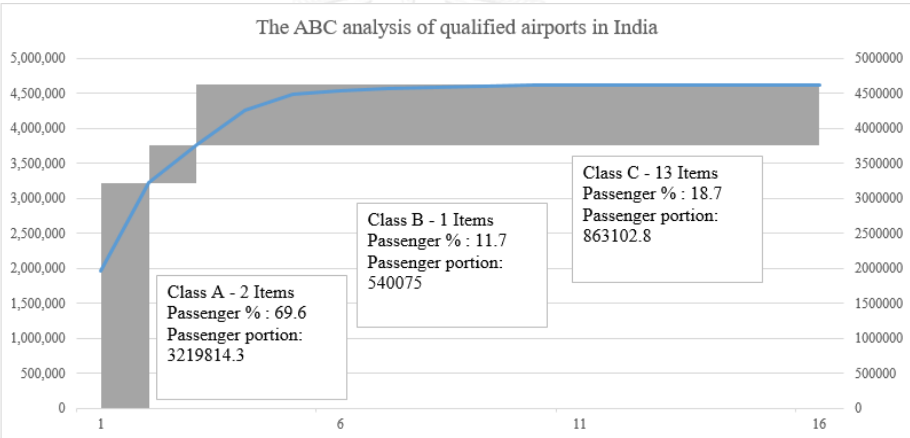

Figure 44: The ABC analysis of qualified airports in India (Alliance, 2016)

4.2.3.6 Indonesia

Indonesia had 18 international airports that were located within the range of 3,000 kilometers, and all runways specification were above 1,680 meters long as shown in Appendix 3; however, there were only 3 airports that operated the direct flight between Bangkok and Indonesia which were Jakarta Soekarno-Hatta (CGK), Bali Denpasar Ngurah Rai (DPS), and Surabaya (SUB) as shown in Figure 45. These airports also had the highest passenger demand, 69.1%, 20.5% and 6.5% respectively in Indonesia. According to the ABC analysis of Indonesia in Figure 46, the rest of 15 airports had shared less than 5% of passenger demand in the aviation market.

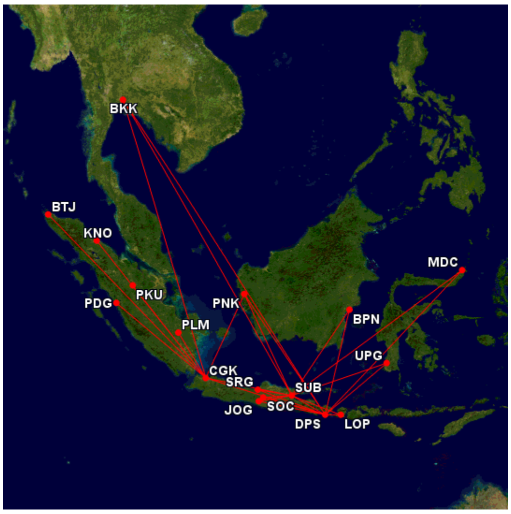

Figure 45: The routemap of Indonesia (Swartz, 2016)

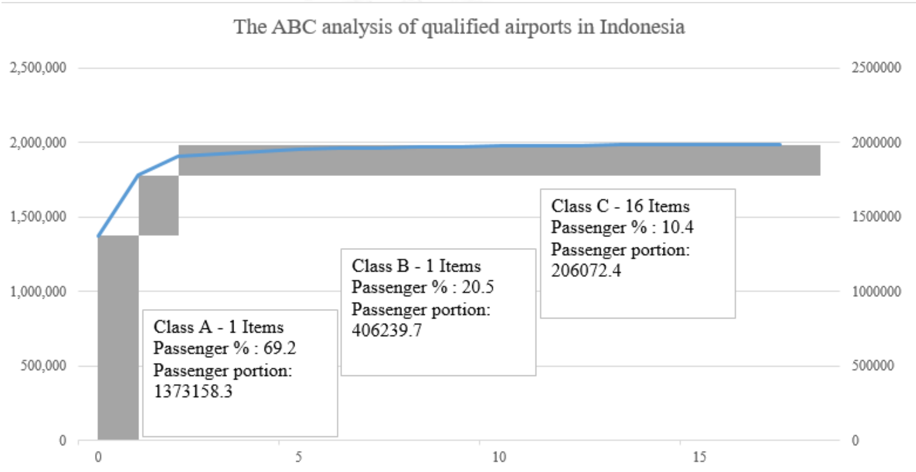

Figure 46: The ABC analysis of qualified airports in Indonesia (Alliance, 2016)

4.2.3.7 Laos

Laos had 5 international airports in total as shown in Figure 47 which were Luang Prabang (LPQ), Vientiane Wattay (VTE), Attapeu (AOU), Pakse Airport (PKZ) and Savannakhet (ZVK) The average flight duration between Bangkok and Laos was approximately 1 hour and 30 minutes for 600 kilometers. The farthest airport was LPQ, and the nearest airport was VTE. The VTE had the highest passenger demand comparing to other airports which contained 74.6% of the total market share as shown in Table 6.

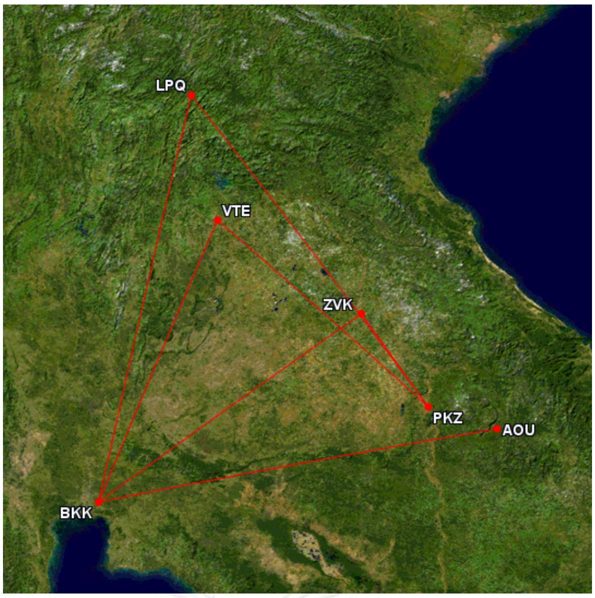

Figure 47: The routemap of Laos (Swartz, 2016)

Table 6: The historical demand of Laos (confidential) (Alliance, 2016)

Airport name	Code	2012	2013	2014	2015	Grand total
Vientiane Wattay	VTE	2[redacted]77	33[redacted]437	2[redacted]447	[redacted]5324	1120785.1
Luang Prabang	LPQ	[redacted]6662.1	[redacted]5277	[redacted]5734	8[redacted]450	305123.1
Savannakhet Airport	ZVK	8783.7	14[redacted]88	8431	8233	39935.7
Pakse Airport	PKZ	56[redacted]6.4	[redacted]083	9393	[redacted]1785	35907.4
Attapeu	AOU	0	0	0	0	0
Total		342[redacted]9	[redacted]0285	3[redacted]005	[redacted]52792	1501751.3

4.2.3.8 Malaysia

Malaysia had 12 international airports, but only 3 airports that operated the direct flight from Bangkok which were Kuala Lumpur (KUL), Malacca Batu Berendam (MKZ) and Penang (PEN) as shown in Figure 48. The nearest airport, 821 kilometers, was Langkawi (LGK); whereas, the Tawau (TWU) airport was the farthest with 2,171 kilometers away. The range of flight duration was taking from 1 hour up to 4 hours according to the distance travelled. From 2012 to 2015, Kuala Lumpur International airport had been the busiest airport in Malaysia which had the market share of 83.58%, and the second busiest airport was Penang International Airport as shown in Table 7.

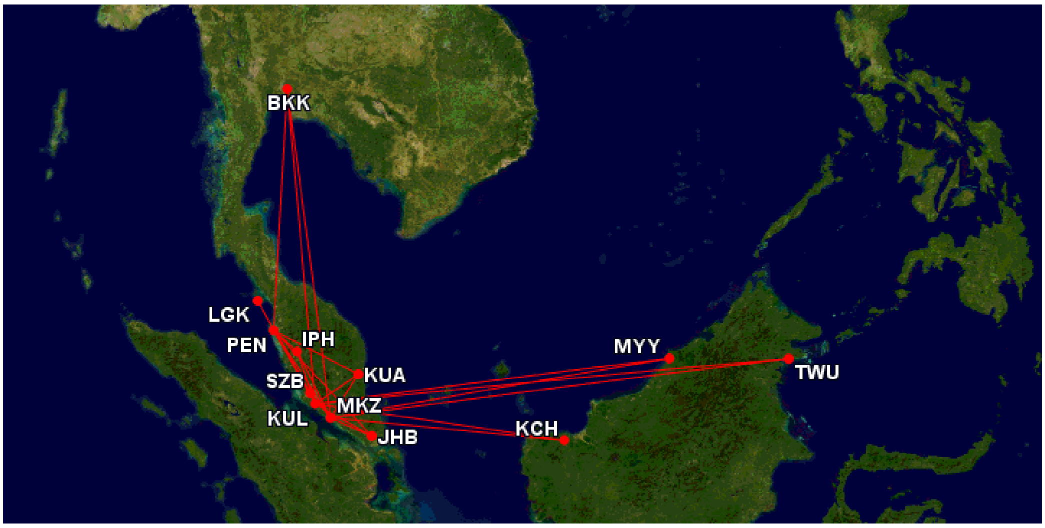

Figure 48: The routemap of Malaysia (Swartz, 2016)

Table 7: The historical demand of Malaysia (confidential) (Alliance, 2016)

Airport name	Code	2012	2013	2014	2015	Grand total
Kuala Lumpur International Airport	KUL	[redacted]8331	6[redacted]741	5[redacted]906	[redacted]6208	2616186.2
Penang International Airport	PEN	[redacted]32503	[redacted]6517	8[redacted]498	[redacted]9350	414868
Kota Kinabalu Airport	BKI	[redacted]347.6	7657	[redacted]371	[redacted]049	25424.6
Kuching Airport	KCH	3[redacted]18.6	4[redacted]04	4428	[redacted]889	18339.6
Johor Bahru Senai International Airport	JHB	[redacted]897.8	4517	4406	[redacted]074	17894.8
Kuantan Airport	KUA	4[redacted]23.5	4[redacted]57	[redacted]862	[redacted]200	15142.5
Langkawi Airport	LGK	1[redacted]31.4	3[redacted]27	3397	[redacted]146	11201.4
Miri Airport	MYY	[redacted]119.6	1781	2[redacted]80	[redacted]184	9164.6
Tawau Airport	TWU	[redacted]2.5	[redacted]	391	524	1551.5
Kuala Lumpur Sultan Abdul Aziz Shah Airport	SZB	139.6	10	0	12	161.6
Ipoh Sultan Azlan Shah Airport	IPH	9.2	23	15	9	56.2
Malacca Batu Berendam Airport	MKZ	0	0	0	1	1
Total		1022224	795768	628354	683646	3129992

4.2.3.9 Myanmar

Myanmar had 3 international airports which were Mandaley (MDL), Nay Pyi Taw (NYT) and Yangon Mingaladon International Airport (RGN), and every airport could be accessed via the direct flight from Bangkok, Thailand as shown in Figure 49. Mandaley International Airport was located about 1,020 kilometers away from Bangkok which was farthest airport in Myanmar; whereas, the nearest airport was Yangon Mingaladon Airport which was the busiest airport serving 90% of the total aviation market in Myanmar as shown in Table 8. The airport details could be found in Appendix 3.

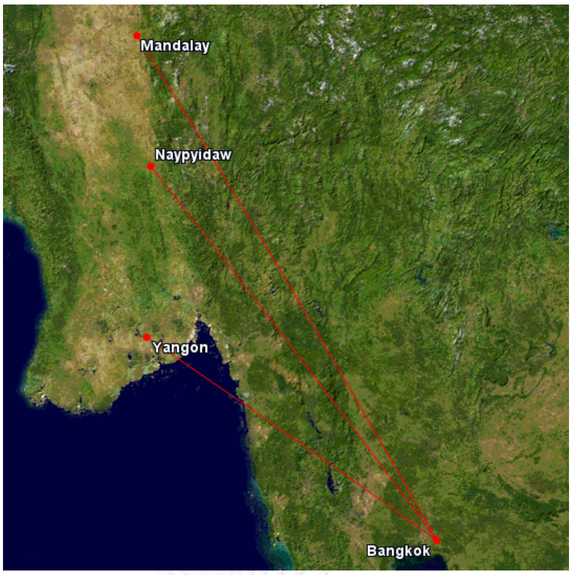

Figure 49: The routemap of Myanmar (Swartz, 2016)

Table 8: The historical demand of Myanmar (confidential) (Alliance, 2016)

Airport name	Code	2012	2013	2014	2015	Grand total
Yangon Mingaladon Airport	RGN	5[redacted]965	5[redacted]664	57[redacted]32	[redacted]4743	2287104.3
Mandalay International Airport	MDL	12.2	[redacted]2871	7[redacted]74	[redacted]236	204693.2
Nay Pyi Taw International Airport	NYT	0	4450	19636	[redacted]480	40566
Total		[redacted]7978	[redacted]2985	[redacted]8942	[redacted]2459	2532363.5

4.2.3.10 Philippine

Philippine had 12 registered international airports and 1 unregistered airport, Northern Cagayan Lallo International Airport. The Subic Bay International Airport was one of the registered airport, but it had no operating route to and from Bangkok because there was no demand; so, 11 international airports were left to be investigated. To arrive at or depart from Philippine, the passenger would have to stop at Manila which was the capital city because Manila was the single international airport that currently operated the direct flight to Bangkok as shown in Figure 50. The passenger demand at Manila airport was approximately 86.8% of the total market share. The second airport was Clark International airport which has 8.6%, and the third airport was Mactan-Cebu International airport at 3.18% as shown in Table 9. The distance from Suvarnabhumi airport to Manila airport was about 2,190 kilometers which equaled to 3 hours and 10 minutes of travelling time; whereas, the average distance travel to any airport in Philippine was about 2,300 kilometers.

Figure 50: The routemap of Philippine (Swartz, 2016)

Table 9: The historical demand of Philippine (confidential) (Alliance, 2016)

Airport name	Code	2012	2013	2014	2015	Grand total
Manila Ninoy Aquino International Airport	MNL	43[redacted]23	[redacted]75772	[redacted]21899	[redacted]2987	1817080.9
Clark International Airport	CRK	[redacted]262.2	7[redacted]65	[redacted]231	68	180326.2
Mactan-Cebu International Airport	CEB	[redacted]3424.5	2[redacted]476	[redacted]3740	[redacted]997	66637.5
Davao Francisco Bangoy International Airport	DVO	2[redacted]79.2	3061	[redacted]682	3132	11154.2
Puerto Princesa Airport	PPS	[redacted]354.7	[redacted]90	761	513	4318.7
Iloilo Mandurriao Airport	ILO	557.3	[redacted]171	967	[redacted]53	3548.3
Bacolod–Silay International Airport	BCD	724.7	[redacted]16	664	989	3293.7
Kalibo Airport	KLO	[redacted]06.5	943	[redacted]52	[redacted]11	2412.5
Zamboanga Airport	ZAM	[redacted]73.8	[redacted]58	1[redacted]17	24	2072.8
General Santos International Airport	GES	3[redacted]5.8	275	451	[redacted]36	1557.8
Laoag Airport	LAO	34.1	96	1[redacted]4	29	303.1
Total		533702	587327	471064	500310	2092402.6

4.2.3.11 Singapore

Singapore has only one international airport, the Singapore Changi Airport as shown in Figure 51. This airport was accessible via the 2 hours direct flight and suitable for all type of aircraft with the maximum runway of 4,000 meters, and the total of 4-years passenger demand was 11.05 million passengers as shown in Table 10.

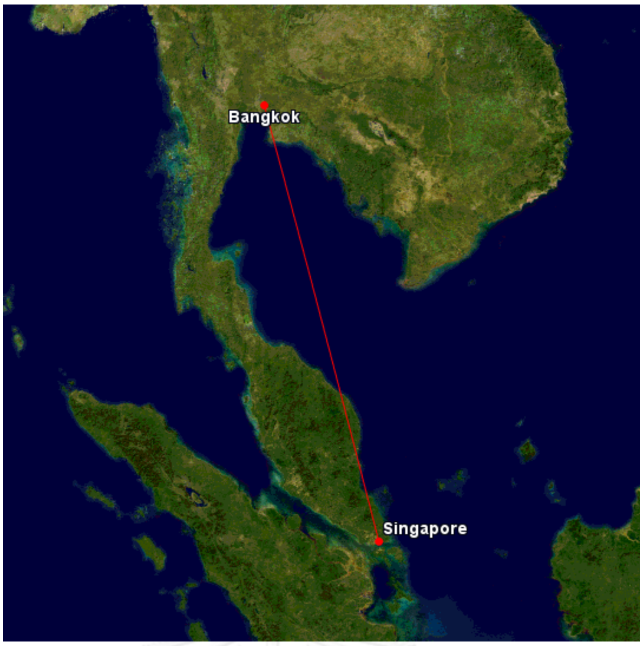

Figure 51: The routemap of Singapore (Swartz, 2016)

Table 10: The historical demand of Singapore (confidential) (Alliance, 2016)

Airport name	Code	2012	2013	2014	2015	Grand total
Singapore Changi Airport	SIN	[redacted]96765	[redacted]57753	2[redacted]2112	[redacted]5230	11051860

4.2.3.12 Taiwan

Taiwan had 5 international airports in total; however, the international direct flight from Bangkok, Thailand, only operated at 2 airports which are Taipei Taoyuan (TPE) and Kaohsiung (KHH) International airport as shown in Figure 52. Whereas, Taichung Ching Chuan Kang (RMQ), Tainan (TNN) and Hualien (HUN) would receive the transiting passenger from TPE and KHH. According to the historical data in Table 11, the majority of passenger were more likely to arrive at the Taipei Tao yuan airport which covers up to 92% of the total market shared; whereas, the 8% of the market were shared by 4 international airports.

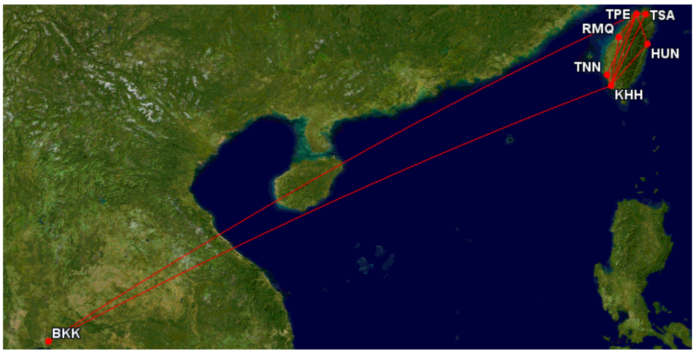

Figure 52: The routemap of Taiwan (Swartz, 2016)

Table 11: The historical demand of Taiwan (confidential) (Alliance, 2016)

Airport name	Code	2012	2013	2014	2015	Grand total
Taipei Taoyuan International Airport	TPE	[redacted]4247	[redacted]0381	[redacted]0542	[redacted]397	3326567.3
Kaohsiung International Airport	KHH	[redacted]634.9	[redacted]68	46868	[redacted]3932	246302.9
Taichung Ching Chuan Kang Airport	RMQ	[redacted]753.8	[redacted]99	670	[redacted]03	6125.8
Taipei Songshan Airport	TSA	[redacted]41.5	[redacted]022	48	[redacted]43	2954.5
Tainan Airport	TNN	0	0	5	0	5
Hualien Airport	HUN					
Total		838978	1008070	838133	896775	3581955.5

4.2.3.13 Vietnam

Vietnam had 7 international airports, but only Hanoi Noi Bai Airport (HAN) and Ho Chi Minh City Tan Son Nhat Airport (SGN) were currently operating the direct flight to Bangkok, Thailand as shown in Figure 53; however, every airport in Vietnam had a sufficient length runway which suited for the A320, and the distance were not very far from Bangkok, Thailand. Where, the farthest distance was only about 1,000 kilometers as shown in Appendix 3. Passengers would take about 2 hours up to 3 hours of flight duration to arrive. The Hanoi Noi Bai was located in the north of Vietnam and serving the capital; where, the Ho Chi Minh City was located in the south of Vietnam. According to the historical demand from Star Alliance in Table 12, SGN had the highest passenger demand with 54.7% of the total market share, and HAN has 44.1%. These airports were the main international airport in Vietnam.

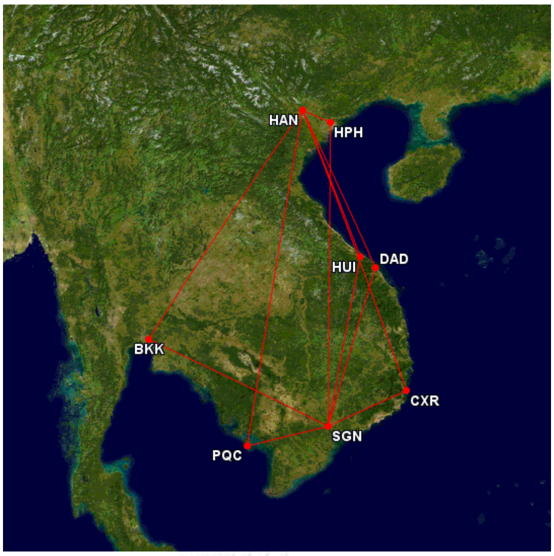

Figure 53: The routemap of Vietnam (Swartz, 2016)

Table 12: The historical demand of Vietnam (confidential) (Alliance, 2016)

Airport name	CODE	2012	2013	2014	2015	Grand total
Ho Chi Minh City Tan Son Nhat	SGN	62[redacted]476	5[redacted]604	4[redacted]135	6[redacted]100	2[redacted]0315
Hanoi Noi Bai	HAN	44[redacted]39	4[redacted]943	4[redacted]503	6[redacted]7964	1[redacted]0249
Da Nang	DAD	36[redacted]9.1	[redacted]011	[redacted]156	[redacted]712	[redacted]538.1
Nha Trang Cam Rang	CXR	[redacted]0	[redacted]630	[redacted]501	[redacted]798	[redacted]6929
Hue Phu Bai	HUI	7[redacted]2.4	[redacted]418	[redacted]001	[redacted]995	[redacted]116.4
Phu Quoc	PQC	1[redacted]6.5	[redacted]044	[redacted]795	[redacted]309	[redacted]294.5
Hai Phong Cat Bi	HPH	12[redacted]8.3	[redacted]242	[redacted]100	[redacted]530	[redacted]080.3

From the airport details gathering section, the summary of international airports with 3,000 kilometers from Suvarnabhumi International airports is shown in Figure 54. Most of airports in each country were found to be distance qualified according to the scope of the project. However, China was the large country that the scope was unable to cover the entire area. Only 49 out of 71 airports were found to be qualified. Each country would have 2 popular airports in average

Country	Initial airports	Qualified airports	Popular airports
Cambodia	3	3	2
China	71	49	5
Bangladesh	3	3	1
Hong Kong	1	1	1
India	19	19	2
Indonesia	18	18	1
Laos	5	5	2
Malaysia	12	12	2
Myanmar	3	3	1
Philippine	12	11	1
Singapore	1	1	1
Taiwan	5	5	2
Vietnam	7	7	2
Totals	160	137	23

Figure 54: The summary of airport detail gathering

4.2.4 Interview 1

Based on the result of interview 1 in Appendix 2, the author had been presenting the gathered information and airport data to the fleet planning manager and told that there were too many qualified airports which required more criteria other than the project requirement to minimize the number of airports. The suggestion was to consider the passenger demand and A320 operating capability as the new criteria. The A320 could only be operated in the maximum runway length of 1,670 kilometers. To identify the demand capability, the average number of passenger must fulfil at least 25% of A320 cabin; so that, the new route that had been recently operated in 2016 would be allowed to pass the criteria. Another suggestion was to consider the market performance and relationship between demand and supply of each route; where the demand should be at least 60% of the market capacity to be the profit potential.

4.2.5 Classification of finding, the criteria and route selection

According to the above information, the airport details and the suggestion from the fleet manager, all 160 airports had been found to share the same characteristics which were the travelling distance, passenger demand, runway size. The criteria selection had been concluded to identify operating potential routes as following:

4.2.5.1 Criteria for route selection

Criterion 1: The distance travel must be below 3,000 kilometers

$$The\ different\ travelling\ distance \ = 3{,}000 - the\ traveling\ distance \geq 0 = passed$$

Criterion 2: The runway specification must be longer than 1670 meters

$$The\ different\ runway\ length = 1{,}670 - the\ runway\ length \geq 0 = passed$$

Criterion 3: The average passenger demand must be equal to or higher than 25% of A320 capacity.

$$The\ loading\ factor\ ratio = \frac{4\ years\ average\ passenger\ demand}{(0.25)(0.6)(Aircraft\ capacity)(52\ weeks)(7\ days)} \geq 1 = passed$$

Criterion 4: The average passenger demand must be equal to or higher than 60% of the supply capacity.

$$The\ market\ ratio = \frac{4\ years\ average\ passenger\ demand}{Annual\ market\ capacity} \geq 0.6 = passed$$

4.2.5.2 Criterion 1: The distance travel requirement

In Criteria 1, the pie chart was constructed to help in representing the number of airport that had passed as shown in Figure 55. The result of screening 160 airports from 13 countries had shown that 25 airports have failed; whereas, 137 airports were found to be located within 3,000 kilometers away from the Suvarnabhumi Airport, Bangkok, Thailand. The majority of failed airports were located in China.

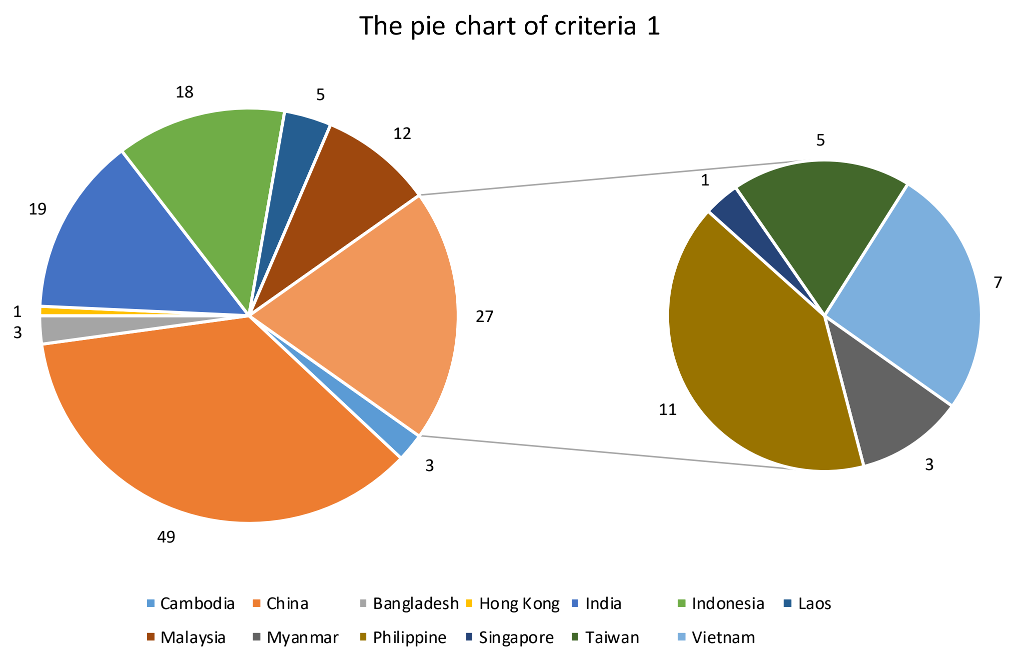

Figure 55: The pie chart of criteria 1

4.2.5.3 Criterion 2: The runway specification

According to Appendix 3, there were only 3 airports that have found to be inappropriate for A320 operation which were AOU, PKZ and ZVK. These airports were located in Laos. The runway of AOU, PKZ and ZVK airport were about 1,320, 1,625 and 1,633 meters in length respectively. The result of criteria 2 was 134 international airports.

4.2.5.4 Criterion 3: The loading factor

At this criterion, 134 international airports would be assessed throughout the 4 years average passenger demand in this section. 47 international airports had shown the ratio equal to or above 1.0 which indicated that the average of 4 years-demand was above 25% of the cabin; whereas, 92 airports that had the ratio less than 1.0 would show insufficient demand potential. The qualified airports were composed of 1 Bangladesh, 2 Cambodia, 21 China, 1 Hong Kong, 5 India, 3 Indonesia, 2 Laos, 2 Malaysia, 2 Myanmar, 3 Philippine, 1 Singapore, 2 Taiwan and 2 Vietnam airports as shown in Table 15.

Table 13: The list of airports in Criteria 3

lo.	Airport name	Code	Country	Cabin rati
1	Dhaka Internationa airport	DAC	Bangladesh	16.55
2	Phom Penh International airport	PNH	Cambodia	23.16
3	Siem Reap International airport	REP	Cambodia	11.78
4	Shanghai Internationa airport	PVG	China	64.64
5	Guangzhou Internationa airport	CAN	China	44.21
6	Kunming Internationa airport	KMG	China	11.58
7	Chengdu Internationa airport	CTU	China	10.90
8	Xiamen Internationa airport	XMN	China	8.96
9	Shenzhen Internationa airport	SZX	China	8.30
10	Wuhan Internationa airport	WUH	China	7.20
11	Chongqing Internationa airport	CKG	China	5.64
12	Hangzhou Internationa airport	HGH	China	6.04
13	Changsha Internationa airport	CSX	China	5.70
14	Shantou Internationa airport	SWA	China	5.09
15	Zhengzhou Internationa airport	CGO	China	4.75
16	Fuzhou Internationa airport	FOC	China	3.75
17	Nanning Internationa airport	NNG	China	3.20
18	Xi'an Internationa airport	XIY	China	3.24
19	Ningbo Internationa airport	NGB	China	2.08
20	Nanchang Internationa airport	KHN	China	1.71
21	Haikou Internationa airport	HAK	China	1.70
22	Wuxi Internationa airport	WUX	China	1.44
23	Nanjing Internationa airport	NKG	China	1.14
24	Taiyuan Internationa airport	TYN	China	1.19
25	Hong Kong Internationa airport	HKG	Hong Kong	193.74
26	Indira Ganhi International Airport	DEL	India	33.46
27	Netaji Subhas Chandra Bose International Airport	CCU	India	21.61
28	Kempegowda International Airport	BLR	India	9.24
29	Chennnai International Airport	MAA	India	8.51
30	Rajiv Grandi International Airport	HYD	India	3.99
31	Jakarta Soekarno-Hatta International Airport	CGK	Indonesia	23.49
32	Bali Denpasar Ngurah Rai Airport	DPS	Indonesia	6.95
33	Surabaya Juanda Airport	SUB	Indonesia	2.21
34	Vientiane Wattay	VTE	Laos	19.17
35	Luang Prabang	LPQ	Laos	5.22
36	Kuala Lumpur International Airport	KUL	Malaysia	44.75
37	Penang International Airport	PEN	Malaysia	7.10
38	Yangon Mingaladon Airport	RGN	Myanmar	39.12
39	Mandalay International Airport	MDL	Myanmar	3.50
40	Manila Ninoy Aquino International Airport	MNL	Philippine	31.08
41	Clark International Airport	CRK	Philippine	3.08
42	Mactan-Cebu International Airport	CEB	Philippine	1.14
43	Singapore Changi Airport	SIN	Sigapore	189.04
44	Taipei Taoyuan International Airport	TPE	Taiwan	56.90
45	Kaohsiung International Airport	KHH	Taiwan	4.21
46	Ho Chi Minh City Tan Son Nhat Airport	SGN	Vietnam	40.71
47	Hanoi Noi Bai Airport	HAN	Vietnam	32.84

4.2.5.5 Criterion 4: The market capacity

After 3 stages of criterion, 47 qualified international airports were left to be investigated in Criteria 4; however, these airports were still invalid to be concluded as operating potential airports because the size of market demand was unknown comparing to the market capacity. Entering into the large market capacity would be a suicide for the airline industry; where, the demand would not be enough to be competed. According to the result of Criteria 4, there were 22 operating potential airports within 7 countries, Cambodia, China, Hong Kong, Indonesia, Malaysia, Philippine, Singapore and Taiwan, that had the operating potential to be the new route between Bangkok, Thailand as shown in Table 14. The highest ratio was Mactan-Cebu International airport, 3.35, and the lowest ratio was Xiamen International airport, 0.60.

Table 14: The list of operating potential route in Criteria 4

No.	Airport name	Code	Country	Market capacity ratio
1	Mactan-Cebu International Airport	CEB	Philippine	2.26
2	Nanjing Internationa airport	NKG	China	1.06
3	Zhengzhou Internationa airport	CGO	China	0.94
4	Surabaya Juanda Airport	SUB	Indonesia	1.36
5	Wuxi Internationa airport	WUX	China	1.37
6	Chongqing Internationa airport	CKG	China	0.89
7	Xi'an Internationa airport	XIY	China	0.73
8	Nanchang Internationa airport	KHN	China	0.70
9	Hangzhou Internationa airport	HGH	China	0.69
10	Taiyuan Internationa airport	TYN	China	0.81
11	Kaohsiung International Airport	KHH	Taiwan	0.66
12	Ningbo Internationa airport	NGB	China	0.83
13	Singapore Changi Airport	SIN	Sigapore	0.70
15	Penang International Airport	PEN	Malaysia	0.68
14	Shantou Internationa airport	SWA	China	0.65
16	Wuhan Internationa airport	WUH	China	0.71
17	Haikou Internationa airport	HAK	China	1.02
18	Chengdu Internationa airport	CTU	China	0.62
19	Xiamen Internationa airport	XMN	China	0.60
21	Clark International Airport	CRK	Philippine	0.63
20	Hong Kong Internationa airport	HKG	Hong Kong	0.64
22	Shanghai Internationa airport	PVG	China	0.61

4.2.5.6 The classification of operating potential route selection

According to the Table 4, the list of operating potential route was found to be composed of both high passenger demand and the low passenger demand airport. The number passenger demand could be found from the airport detail gathering in section 4.2.3. The operating potential route result had shown 7 high demand routes, Shanghai, Chengdu, Xiamen, Hong Kong, Singapore, Kaohsiung and Penang international airport, and the remaining operating potential routes had low passenger demand. From the result, the customer factor was concluded to be the partial impact of the operating potential.

4.3 Stage 2

4.3.1 The analytics hatchery process criteria selection

With the result of Stage 1, the author had filtered 22 operating potential airports for the Thai subsidiary airline to launch the new route in the future. The geographic route is displayed in Figure 56. The author had adapted criteria from the market opportunity analysis according to the methodology in section 3.3.1 into 4 main criteria, customer, competitor, airport and macro-environment, and 15 sub-criteria falls under the main criteria as shown in Figure 57.

1. Customer
    a. Inbound passenger demand
    b. Outbound passenger demand
    c. The market capacity ratio
2. Competitor
    a. The number of operating Thai airline
    b. The number of operating Foreign airline
    c. The number of direct flight frequency
3. Airport
    a. The airport ranking by the market share in Asia Pacific
    b. The number of international connecting destination
    c. The number of domestic connecting destination

4. Macro-environment

   a. Political

   b. Economic

   c. Social

   d. Technological

   e. Legal

   f. Environmental

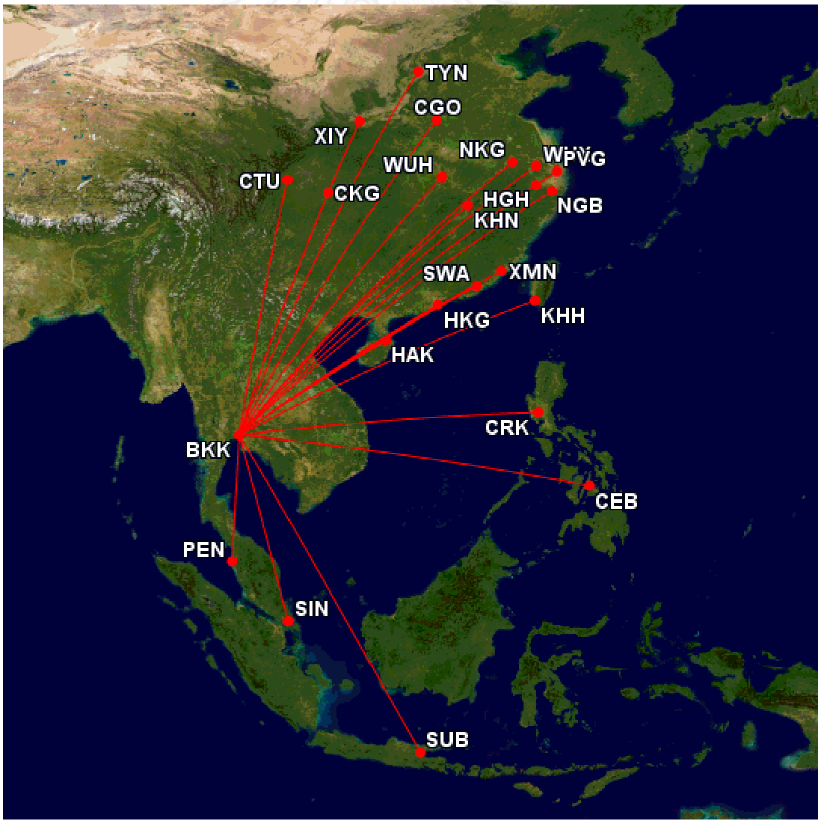

Figure 56: The routemap of international potential routes (Swartz, 2016)

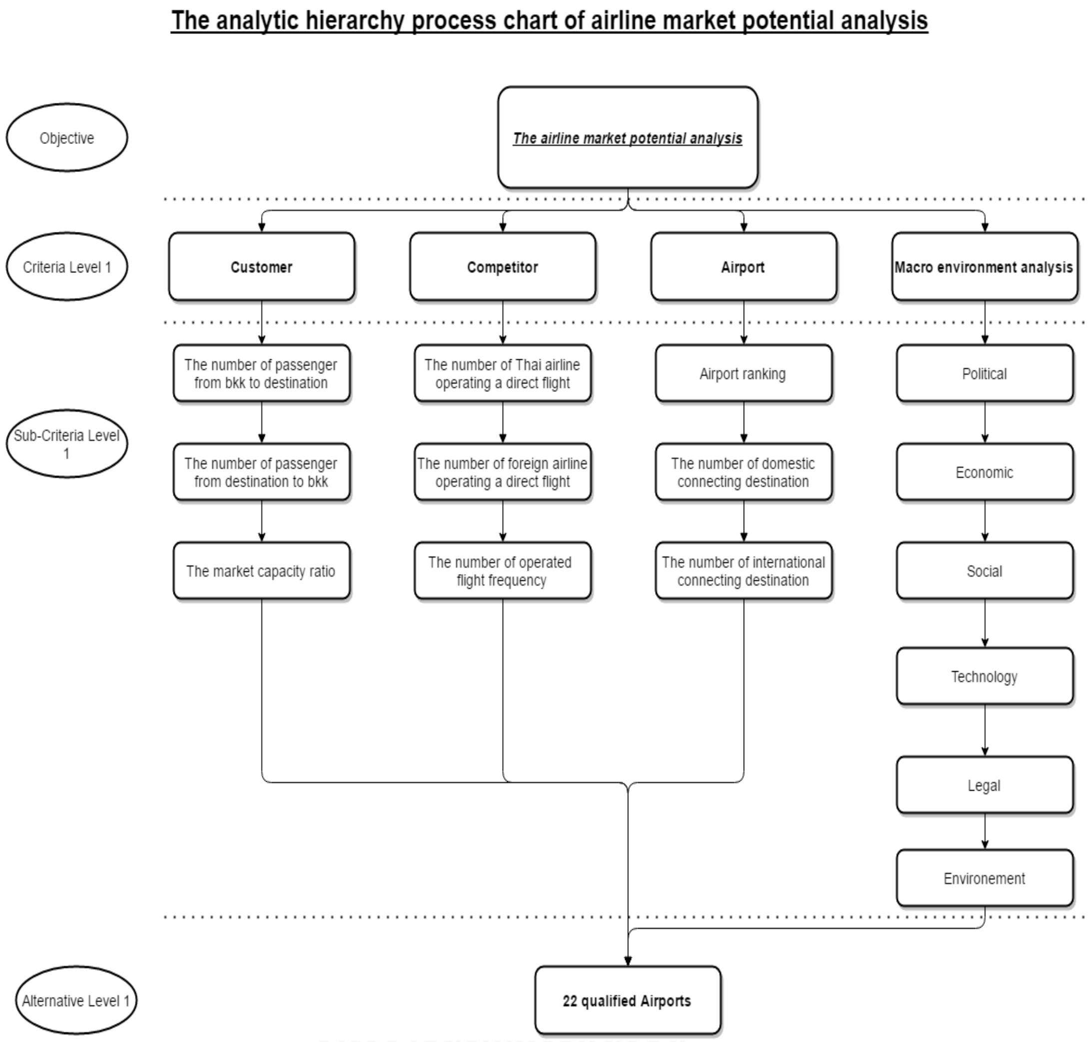

Figure 57: The hierarchy process structure of route potential study

4.3.2 Interview 2

The main criteria and sub-criteria had been identified to evaluate the route potential; however, the weight of each element was still unknown which required the scoring from the aviation expert. 3 different aviation experts from the full-service airline, the low-cost airline and Thai civil aviation training center, TCATC, were interviewed in order to weight the criteria.

From the result of interview 2 in Appendix 2, the weight score evaluation is shown in the interview 2 form. The 4 criteria had firstly been weighted as shown in Table 15. The customer was found to be the heaviest criterion from all 3 experts’ experience indicating the highest importance because the major revenue in the airline industry was generated from customers. The competitor was secondly important and creating the competitiveness in the market because the demand was shared. However, the different view had been recognized. The low-cost airline rather focused on factors that impacted the competitiveness than the service quality; where, the competitor was seen to be 5 times more important than the airport because the low-cost airline performed in the price sensitive market. The slight change of price would heavily impact the revenue. The airfare was found to be the core competency that mostly attracted the customer in the market. Whereas, the full-service carrier and TCATC had seen the airport as the resource that created the value for the time sensitive passenger.

Table 15: The summery of criteria's weight evaluation

The summary of Criteria's weight evalution				
The full service carrier				
	Customer	**Competitor**	**Airport**	**Macro environment**
Customer	1.00	4.00	3.00	7.00
Competitor	0.25	1.00	0.30	3.00
Airport	0.33	3.33	1.00	5.00
Macro environment	0.14	0.33	0.20	1.00
Total	1.73	8.67	4.50	16.00
The low-cost carrier				
Customer	1.00	2.00	7.00	5.00
Competitor	0.50	1.00	5.00	7.00
Airport	0.14	0.20	1.00	2.00
Macro environment	0.20	0.14	0.50	1.00
Total	1.84	3.34	13.50	15.00
Thai Civil Aviation Training Center				
Customer	1.00	3.00	5.00	9.00
Competitor	0.33	1.00	0.50	5.00
Airport	0.20	2.00	1.00	3.00
Macro environment	0.11	0.20	0.33	1.00
Total	1.64	6.20	6.83	18.00

Throughout the AHP weight evaluation method in the literature review in section 2.6.1, the customer criterion had been weighted more than 50% of the total proportion. Whereas, the second priority was interchangeably either competitor and the airport criterion as shown in Table 16. 3 weighted applications were found to have the inconsistency level at 7%, 7% and 9% respectively.

Table 16: The calculation of criteria's weight evaluation

The calculation of criteria's weight evalution					**Vaiables**		
The full service carrier					m=4	RI=0.900	
	Customer	**Competitor**	**Airport**	**Macro environment**	**Xi**	**Average**	**CI**
Customer	0.58	0.46	0.67	0.44	0.92568	0.54	0.07
Competitor	0.14	0.12	0.07	0.19	1.11449	0.13	**CI/RI**
Airport	0.19	0.38	0.22	0.31	1.2515	0.28	0.08
Macro environment	0.08	0.04	0.04	0.06	0.91266	0.06	
Total	1.00	1.00	1.00	1.00	**4.20432**	**1.00**	
The low-cost carrier					**Xi**	**Average**	**CI**
Customer	0.54	0.60	0.52	0.33	0.9181	0.50	0.07
Competitor	0.27	0.30	0.37	0.47	1.17627	0.35	**CI/RI**
Airport	0.08	0.06	0.07	0.13	1.16355	0.09	0.08
Macro environment	0.11	0.04	0.04	0.07	0.95612	0.06	
Total	1.00	1.00	1.00	1.00	**4.21404**	**1.00**	
Thai Civil Aviation Training Center					**Xi**	**Average**	**CI**
Customer	0.61	0.48	0.73	0.50	0.95529	0.58	0.09
Competitor	0.20	0.16	0.07	0.28	1.10816	0.18	**CI/RI**
Airport	0.12	0.32	0.15	0.17	1.29357	0.19	0.10
Macro environment	0.07	0.03	0.05	0.06	0.91873	0.05	
Total	1.00	1.00	1.00	1.00	**4.27575**	**1.00**	

Firstly, investigating the customer sub-criterion, the result showed the important of inbound and outbound passenger which were seen to be equivalent due to the immigration regulatory as shown in Table 17. The total forward and backward demand would be similar; however, the returning period was vary depending on the individual. The returning flight would be carrying the same capacity with less passenger. The expert from the full-service carrier had suggested that the market capacity ratio should be more than 50% in either way because the sharing revenue; otherwise, the total flight would produce the loss in contribution. Therefore, the route must have a sufficient demand to fill the aircraft capacity in both ways. The market capacity ratio was found to be the highest important.

Table 17: The summary of customer's weight evaluation

The summary of customer's weight evaluation			
The full service carrier			
	Outbound PAX	Inbound PAX	The market capacity Ratio
Outbound PAX	**1.00**	1.00	0.33
Inbound PAX	1.00	**1.00**	0.33
The market capacity Ratio	3.00	3.00	**1.00**
Total	5.00	5.00	1.67
The low-cost airline			
Outbound PAX	**1.00**	1.00	0.20
Inbound PAX	1.00	**1.00**	0.20
The market capacity Ratio	5.00	5.00	**1.00**
Total	7.00	7.00	1.40
Thai Civil Aviation Training Center			
Outbound PAX	**1.00**	1.00	0.33
Inbound PAX	1.00	**1.00**	0.33
The market capacity Ratio	3.00	3.00	**1.00**
Total	5.00	5.00	1.67

Due to the equivalent weight of inbound and outbound passengers, the scoring went very well and straight forward. Also, the number of sub-criteria is small. The inconsistency of all 3-weighted application had found to be zero as shown in Table 18. The market capacity ratio was the first priority that had the weight score equal to and above 60% in the customer sub-criterion.

Table 18: The calculation of customer's weight evaluation

The calculation of customer's weight evaluation				Vaiables		
The full service carrier				m=3	RI=0.580	
	Outbound PAX	Inbound PAX	The market capacity Ratio	Xi	Average	CI
Outbound PAX	0.20	0.20	0.20	1	0.20	0.00
Inbound PAX	0.20	0.20	0.20	1	0.20	CI/RI
The market capacity Ratio	0.60	0.60	0.60	1	0.60	0.00
Total	1.00	1.00	1.00	3	1.00	
The low-cost airline				Xi	Average	CI
Outbound PAX	0.14	0.14	0.14	1	0.14	0.00
Inbound PAX	0.14	0.14	0.14	1	0.14	CI/RI
The market capacity Ratio	0.71	0.71	0.71	1	0.71	0.00
Total	1.00	1.00	1.00	3	1.00	
Thai Civil Aviation Training Center				Xi	Average	CI
Outbound PAX	0.20	0.20	0.20	1	0.20	0.00
Inbound PAX	0.20	0.20	0.20	1	0.20	CI/RI
The market capacity Ratio	0.60	0.60	0.60	1	0.60	0.00
Total	1.00	1.00	1.00	3	1.00	

Secondly, the competitor was basically described into Thai and Foreign airline. 3 experts said that Thai airline was more important to focus than the foreign airline because Thai airline would be familiar with Thai customers in market due to the communication and culture as shown in Table 19 since the customer was more likely to choose their national airline. However, the price sensitive market was regardless of the competitor type; where, the Thai airline and foreign airline were similarly equivalent. The low-cost airline and Thai Civil Aviation Center expressed in the same perspective. Moreover, each route was operated with many frequencies per day according to the flight schedule. The number of frequency indicated the capacity and availability to capture passengers. Entering the market with the high capacity would be small chance to capture passengers; in despite, the number of competitor was low. Therefore, the flight frequency in the market was the most important.

Table 19: The summary of competitor's weight evaluation

The summary of competitor's weight evaluation			
The full-service carrier			
	No. of Thai airline	**No. of Foreign airline**	**No. of frequency**
No. of Thai airline	**1.00**	7.00	2.00
No. of Foreign airline	0.14	**1.00**	0.33
No. of frequency	0.50	3.03	**1.00**
Total	1.64	11.03	3.33
The low-cost service carrier			
No. of Thai airline	**1.00**	2.00	2.00
No. of Foreign airline	0.50	**1.00**	0.50
No. of frequency	0.50	2.00	**1.00**
Total	2.00	5.00	3.50
Thai Civil Aviation Training Center			
No. of Thai airline	**1.00**	2.00	0.33
No. of Foreign airline	0.50	**1.00**	0.33
No. of frequency	3.03	3.03	**1.00**
Total	4.53	6.03	1.66

As the result of the competitor sub-criterion evaluation, the inconsistency level of 3 weighted applications were vary from 0% to 6%. The full-service carrier focused on the trust, loyalty and service quality rather than the price unlike the low-cost carrier. The weighted number of foreign airline was different as shown in Table 20. Whereas, the Thai Civil Aviation Center saw the frequency to be the most important which would determine the competitive advantage in the market as the frequency was limited in the certain area depending on the term and agreement between two countries.

Table 20: The calculation of competitor's weight evaluation

The calculation of competitor's weight evaluation				Vaiables		
The full-service carrier				m=3	RI=0.580	
	No. of Thai airline	No. of Foreign airline	No. of frequency	Xi	Average	CI
No. of Thai airline	0.61	0.63	0.60	1.00976	0.61	0.00
No. of Foreign airline	0.09	0.09	0.10	1.01742	0.09	CI/RI
No. of frequency	0.30	0.27	0.30	0.9761	0.29	0.00
Total	1.00	1.00	1.00	3.00328	1.00	
The low-cost service carrier				Xi	Average	CI
No. of Thai airline	0.50	0.40	0.57	0.98095	0.49	0.03
No. of Foreign airline	0.25	0.20	0.14	0.9881	0.20	CI/RI
No. of frequency	0.25	0.40	0.29	1.09167	0.31	0.05
Total	1.00	1.00	1.00	3.06071	1.00	
Thai Civil Aviation Training Center				Xi	Average	CI
No. of Thai airline	0.22	0.33	0.20	1.13437	0.25	0.04
No. of Foreign airline	0.11	0.17	0.20	0.95478	0.16	CI/RI
No. of frequency	0.67	0.50	0.60	0.98151	0.59	0.06
Total	1.00	1.00	1.00	3.07067	1.00	

Thirdly, the sub-criteria of airport were classified into the airport traffic ranking, international connecting and domestic connecting destination. All 3 experts reviewed that the airport traffic had the lowest weight among 3 sub-criteria as shown in Table 21. The number of traffic might indicate the potential of destination but not always. The popularity of airport caused the delay issue leading to the schedule problem as well. In this case, 3 experts assumed that the managing performance of all airports were equivalent. However, the connecting destination was the key potential indicator that led to the increasing passenger traffic and the distributing channel. In the H&S system, the passenger would require to stop at the intermediate airport before proceeding to the destination airport.

Table 21: The summery of airport's weight evaluation

The summery of airport's weight evaluation			
The full-service carrier			
	Airport ranking	No. of dom. connecting destination	No. of int. connecting destination
Airport ranking	**1.00**	0.33	0.33
No. of dom. connecting destination	3.00	**1.00**	1.00
No. of int. connecting destination	3.00	1.00	**1.00**
Total	7.00	2.33	2.33
The low-cost carrier			
Airport ranking	**1.00**	0.33	0.20
No. of dom. connecting destination	3.00	**1.00**	0.33
No. of int. connecting destination	5.00	3.00	**1.00**
Total	9.00	4.33	1.53
Thai Civil Aviation Training Center			
Airport ranking	**1.00**	0.20	0.20
No. of dom. connecting destination	5.00	**1.00**	1.00
No. of int. connecting destination	5.00	1.00	**1.00**
Total	11.00	2.20	2.20

According to the AHP evaluation in Table 22, both intentioned domestic connecting destination had the equivalent score above 45% of the total proportion. Where, the lowest priority was the airport ranking. The inconsistency was relatively low due to the equivalent weight similarly to the customer sub criteria,

Table 22: The calculation of airport's weight evaluation

The calculation of airport's weight evaluation				Vaiables		
The full-service carrier				m=3	RI=0.580	
	Airport ranking	No. of dom. connecting destination	No. of int. connecting destination	Xi	Average	CI
Airport ranking	0.14	0.14	0.14	1	0.14	0.00
No. of dom. connecting destination	0.43	0.43	0.43	1	0.43	CI/RI
No. of int. connecting destination	0.43	0.43	0.43	1	0.43	0.00
Total	1.00	1.00	1.00	3	1.00	
The low-cost carrier				Xi	Average	CI
Airport ranking	0.11	0.08	0.13	0.95541	0.11	0.03
No. of dom. connecting destination	0.33	0.23	0.22	1.12882	0.26	CI/RI
No. of int. connecting destination	0.56	0.69	0.65	0.97113	0.63	0.05
Total	1.00	1.00	1.00	3.05536	1.00	
Thai Civil Aviation Training Center				Xi	Average	CI
Airport ranking	0.09	0.09	0.09	1	0.09	0.00
No. of domestic destination	0.45	0.45	0.45	1	0.45	CI/RI
No. connecting destination	0.45	0.45	0.45	1	0.45	0.00
Total	1.00	1.00	1.00	3	1.00	

Lastly, the macro-environment was divided according to the PESTEL analysis. 2 major factors were political and economy as shown in Table 23. The political situation existed in the conflict between parties which would create the incident that led to injuries; where, the economy issue would cause the robbery, poverty and protest. The effect of incident was reflecting to the risk and safety for tourists. The performance of government was causing the direction of economy; so that the political factor was seen to be slightly important than the economy. Whereas, the legal factor was the third important factor due to the limitation of traffic right. The aircraft would be allowed to access the specific location with limited capacity and frequency according to the agreement. With the low accessibility and allowance, the potential was also limited. Both experts from the full-service and low-cost carrier expressed with the same perspective toward the politic, economy and legal factor; whereas, the social, technology and environment were far less important. However, the Thai Civil Aviation Center highly focused on the legal factor than other aspects.

Table 23: The summery of Macro environment's weight evaluation

The summery of Macro-environment's weight evaluation						
The full-service carrier						
	Political	Economic	Social	Technology	Environment	Legal
Political	**1.00**	2.00	7.00	7.00	3.00	3.00
Economic	0.50	**1.00**	5.00	7.00	5.00	2.00
Social	0.14	0.20	**1.00**	3.00	0.33	0.20
Technology	0.14	0.14	0.33	**1.00**	0.33	0.20
Environment	0.33	0.20	3.00	3.00	**1.00**	0.33
Legal	0.33	0.50	5.00	5.00	3.00	**1.00**
Total	2.45	4.04	21.33	26.00	12.67	6.73
The low-cost carrier						
Political	**1.00**	2.00	9.00	9.00	5.00	3.00
Economic	0.50	**1.00**	5.00	5.00	3.00	0.50
Social	0.11	0.20	**1.00**	0.33	0.20	0.14
Technology	0.11	0.20	3.00	**1.00**	0.33	0.11
Environment	0.20	0.33	5.00	3.00	**1.00**	0.33
Legal	0.33	2.00	7.00	9.00	3.00	**1.00**
Total	2.26	5.73	30.00	27.33	12.53	5.09
Thai Civil Aviation Training Center						
Political	**1.00**	2.00	5.00	5.00	3.00	0.33
Economic	0.50	**1.00**	7.00	5.00	3.00	0.50
Social	0.20	0.14	**1.00**	1.00	0.20	0.14
Technology	0.20	0.20	1.00	**1.00**	0.20	0.14
Environment	0.33	0.33	5.00	5.00	**1.00**	0.33
Legal	3.00	2.00	7.00	7.00	3.00	**1.00**
Total	5.23	5.68	26.00	24.00	10.40	2.45

In fact, the political was turned out to be first priority of the macro-environment sub-criteria with the score of 23% to 40% because the political had involved and effected every aspect. The second priority was interchangeably between the economic and legal element. The inconsistency level of 3 weight applications were found to be around 7% closing to the reject point because the number of elements was high as show in Table 24.

Table 24: The Macro-environment's weight evaluation calculation

The calculation of Macro-environment's weight evaluation							Vaiables		
The full-service carrier							m=6	RI=1.240	
	Political	Economic	Social	Technology	Environment	Legal	Xi	Average	CI
Political	0.41	0.49	0.33	0.27	0.24	0.45	0.89193	0.36	0.08977
Economic	0.20	0.25	0.23	0.27	0.39	0.30	1.1095	0.27	CI/RI
Social	0.06	0.05	0.05	0.12	0.03	0.03	1.15911	0.05	0.0724
Technology	0.06	0.04	0.02	0.04	0.03	0.03	0.88267	0.03	
Environment	0.14	0.05	0.14	0.12	0.08	0.05	1.20303	0.09	
Legal	0.14	0.12	0.23	0.19	0.24	0.15	1.20261	0.18	
Total	1.00	1.00	1.00	1.00	1.00	1.00	6.45		
The low-cost carrier							Xi	Average	CI
Political	0.44	0.35	0.30	0.33	0.40	0.59	0.90602	0.40	0.09826
Economic	0.22	0.17	0.17	0.18	0.24	0.10	1.03518	0.18	CI/RI
Social	0.05	0.03	0.03	0.01	0.02	0.03	0.86856	0.03	0.07924
Technology	0.05	0.03	0.10	0.04	0.03	0.02	1.2262	0.04	
Environment	0.09	0.06	0.17	0.11	0.08	0.07	1.18762	0.09	
Legal	0.15	0.35	0.23	0.33	0.24	0.20	1.26771	0.25	
Total	1.00	1.00	1.00	1.00	1.00	1.00	6.49		
Thai Civil Aviation Training Center							Xi	Average	CI
Political	0.19	0.35	0.19	0.21	0.29	0.14	1.1936	0.23	0.09023
Economic	0.10	0.18	0.27	0.21	0.29	0.20	1.17462	0.21	CI/RI
Social	0.04	0.03	0.04	0.04	0.02	0.06	0.95765	0.04	0.07277
Technology	0.04	0.04	0.04	0.04	0.02	0.06	0.92425	0.04	
Environment	0.06	0.06	0.19	0.21	0.10	0.14	1.3089	0.13	
Legal	0.57	0.35	0.27	0.29	0.29	0.41	0.89214	0.36	
Total	1.00	1.00	1.00	1.00	1.00	1.00	6.45		

Table 25: The result of weight evaluation from 3 aviation experts

The result of weight evalutaion from 3 aviaton experts

Criteria & Sub-criteria	Weight				
	Thai Full-service	*Thai Low-cost service*	*Thai Civil Aviation Center*	*Average*	*Geometric Mean*
Customer	**0.5363**	**0.4982**	**0.5809**	**0.5385**	**0.5374**
c1: Inbound passenger	0.1073	0.0712	0.1162	0.0982	0.0961
c2: Outbound passenger	0.1073	0.0712	0.1162	0.0982	0.0961
c3: Load factor	0.3218	0.3559	0.3486	0.3421	0.3417
Competitor	**0.1286**	**0.3519**	**0.1787**	**0.2197**	**0.2007**
c4: Thai direct flight	0.0790	0.1726	0.0448	0.0988	0.0848
c5: Foreign direct flight	0.0119	0.0695	0.0283	0.0366	0.0286
c6: Flight frequency	0.0377	0.1098	0.1057	0.0844	0.0759
Airport	**0.2781**	**0.0862**	**0.1893**	**0.1845**	**0.1656**
c7: Airport ranking	0.0397	0.0091	0.0172	0.0220	0.0184
c8: International connecting destination	0.1192	0.0225	0.0860	0.0759	0.0613
c9: Domestic connecting destination	0.1192	0.0546	0.0860	0.0866	0.0824
Macro-environment	**0.0570**	**0.0637**	**0.0510**	**0.0573**	**0.0570**
c10: Poltical	0.0207	0.0256	0.0116	0.0193	0.0184
c11: Economy	0.0157	0.0115	0.0106	0.0126	0.0124
c12: Social	0.0031	0.0018	0.0019	0.0023	0.0022
c13: Technology	0.0019	0.0029	0.0020	0.0023	0.0022
c14: Environment	0.0054	0.0060	0.0064	0.0060	0.0059
c15: Legal	0.0102	0.0159	0.0186	0.0149	0.0144

The weighted result of each criteria and sub-criteria were combined, and the weighted score had been proportion as shown in Table 25. Using the geometric mean, the customer criterion was found to be the most important criterion with the average weight of 53.74%, and the second priority was the competitor, 20.07%. The third priority is airport, 16.56%. Lastly, the macro-environment had been weighted at 5.70%. The result of weight AHP was constructed into the diagram as shown in Figure 58.

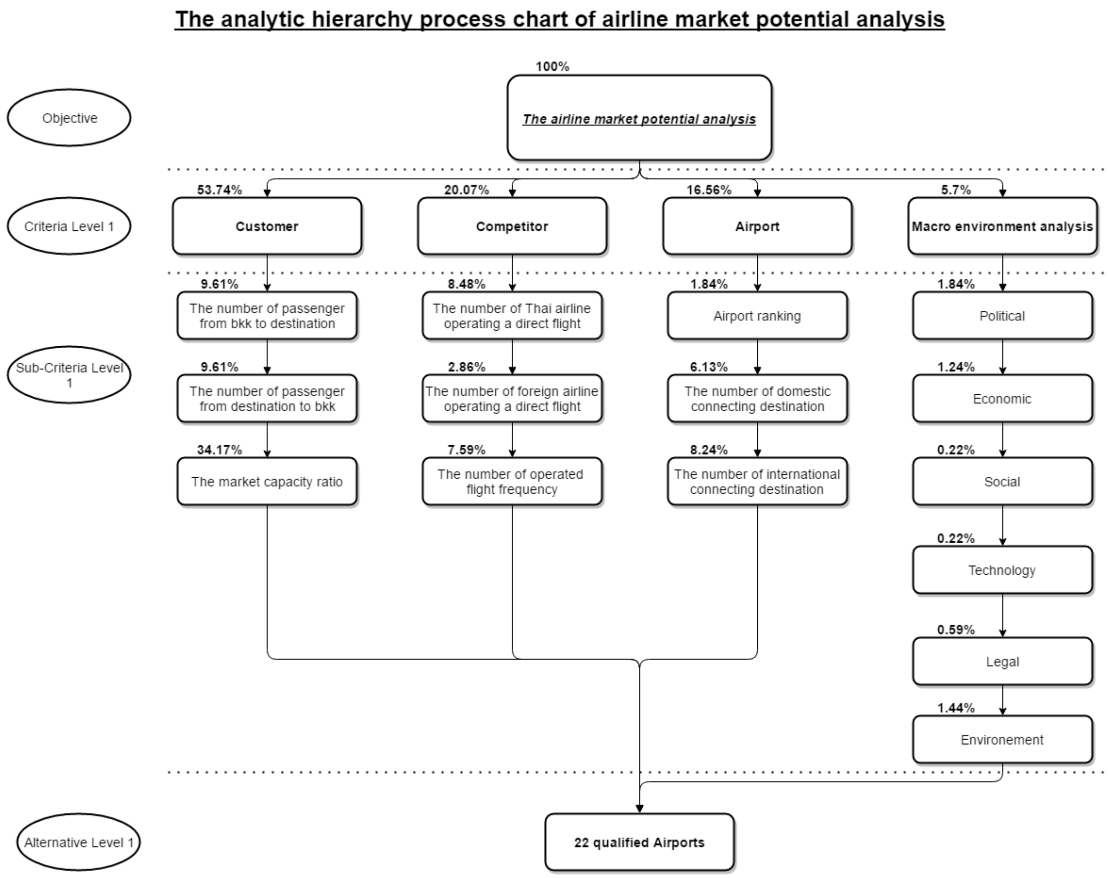

Figure 58: The result of weighted AHP diagram

4.3.3 The weight evaluation of AHP's criteria and sub criteria

4.3.3.1 Customer

According to the methodology in section 3.3.3.1 and the calculating equation in the literature review section 2.8.1, the result of passenger demand forecast for each operating potential route had been calculated with the alpha, beta and grammar. The alpha and beta exponential smoothing value of every route were individually calculated to identify the optimum forecasting solution.

The example of CEB, HKG, SUB and SIN are shown in Appendix 4. The average forecast error was acceptable most routes; however, two irregular route were found which were NKG and CRK; where, the forecasting result contained a high MAPE error for both inbound and outbound as shown in Table 26 and 27. The cause of these routes were found to be different. The author examined the historical demand in details and found that the NKG was the seasonal route due to the removal of seat capacity from the dominated airline. According to the Figure 59, the passenger cycle would repeat every 6 month because the dominant airline only operated the NKG route during the high season. So that, the low season period, March, April, May, June, September, October, November and December, were assumed to be low demand. Due to the scope of research, the NKG route, the seasonal route, was removed from the study

NKG			
Inbound		**Demand**	**Seats**
1	**Jan**	1215	1099
2	**Feb**	288	2318
3	**Mar**	1385	785
4	**Apr**	321	157
5	**May**	685	0
6	**Jun**	153	0
7	**Jul**	3032	1884
8	**Aug**	2158	3140
9	**Sep**	293	0
10	**Oct**	559	0
11	**Nov**	136	0
12	**Dec**	637	0
Outbound		**Demand**	**Seats**
1	**Jan**	1270	1099
2	**Feb**	450	2161
3	**Mar**	1571	942
4	**Apr**	471	157
5	**May**	555	0
6	**Jun**	431	0
7	**Jul**	2248	1570
8	**Aug**	3444	3140
9	**Sep**	208	157
10	**Oct**	355	0
11	**Nov**	147	0
12	**Dec**	562	0

Figure 59: The historical demand of NKG in 2015 (confidential)

The CRK was the second problem; where the average forecasting demand was found to be less than 10 passengers per month which was unusual. From the historical demand of CRK in Figure 60, the passenger demand was tremendously decreasing since 2014 until the end of 2015. The reason was the political unrest in Thailand. Where, the Cebu pacific and Philippines airline were the only dominant airline in this route, and these airlines decided to withdraw to the operation. However, this incident could not be used to conclude the amount of demand. The author contacted the fleet planning manager about the problem and informed that the CRK route had the high passenger demand during 2012 and 2013. The suggestion was used the most recent demand which was the demand of 2013. After the revision of forecasting demand as shown in Table 28 and 29, the MAPE of CRK route was only 12%, and the average forecasting demand was above 600 passengers per month.

Sum of Passengers	Column Labels															
	2012	2013	2014												2015	Grand Total
Row Labels			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Angeles/Mabalacat, PH	3 [redacted] 134.3	3 [redacted] 721	2 [redacted] 16	2 [redacted] 06	2 [redacted] 80	1 [redacted] 86	1 [redacted] 72	1 [redacted] 12	1 [redacted] 93	8	5	2		7	43	90085.3
Bangkok, TH	3 [redacted] 134.3	3 [redacted] 721	2 [redacted] 16	2 [redacted] 06	2 [redacted] 80	1 [redacted] 86	1 [redacted] 72	1 [redacted] 12	1 [redacted] 93	8	5	2		7	43	90085.3
Bangkok, TH	3 [redacted] 127.9	3 [redacted] 044	2 [redacted] 20	2 [redacted] 00	2 [redacted] 01	1 [redacted] 72	1 [redacted] 56	1 [redacted] 43	1 [redacted] 45	5			2		25	90240.9
Angeles/Mabalacat, PH	3 [redacted] 127.9	3 [redacted] 044	2 [redacted] 20	2 [redacted] 00	2 [redacted] 01	1 [redacted] 72	1 [redacted] 56	1 [redacted] 43	1 [redacted] 45	5			2		25	90240.9
Grand Total	7 [redacted] 262.2	7 [redacted] 765	4 [redacted] 36	4 [redacted] 06	5 [redacted] 81	3 [redacted] 58	3 [redacted] 28	3 [redacted] 55	3 [redacted] 38	13	5	2	2	7	68	180326.2

Figure 60: The historical demand of CRK (confidential).

In summary of the forecasting demand, the route that had the highest passenger demand was HKG which received the normalized score of 0.3191 and 0.4128 for the inbound and outbound. Whereas, the lowest passenger demand route was the CEB with the normalized score of 0.0021 and 0.0013 for inbound and outbound. Moreover, the normalized result of the market capacity ratio from Stage 1 selection had showed that the CEB had the highest market capacity ratio; in despite, the passenger demand was low because there was no capacity to serve the passenger. The normalized market capacity ratio of CEB was 0.1244, and the Hong Kong's score was 0.0352. The HKG was known as the highest demand, but the market was quite competitive because the market capacity ratio of 0.64 showed that there was more capacity than the desire demand as shown in Table 30.

Table 26: The result of forecasting inbound demand

Inbound Forecast											
Airport	**CEB**	**NKG**	**CGO**	**SUB**	**WUX**	**CKG**	**XIY**	**KHN**	**HGH**	**TYN**	**KHH**
Jan-16	622.50	134.43	7273.35	837.11	813.99	2636.61	3616.59	5126.63	6602.99	2427.70	2324.95
Feb-16	640.09	126.31	7484.39	828.56	810.67	2527.42	3191.93	5535.54	6673.81	2550.55	2224.51
Mar-16	657.16	118.62	7603.79	822.88	826.75	2409.85	2772.38	5747.67	6792.42	2673.35	2015.64
Average	639.91	126.46	7453.84	829.52	817.14	2524.62	3193.63	5469.95	6689.74	2550.53	2188.36
MAPE	6%	45%	8%	8%	9%	16%	8%	14%	15%	8%	14%
Optimal Alpha	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.39
Optimal Beta	0.01	0.01	0.01	0.01	0.01	0.01	0.73	0.99	0.01	0.01	0.99
Optimal Grammar	0.79	0.13	0.37	0.68	0.44	0.52	0.99	0.55	0.51	0.99	0.67

Airport	**NGB**	**SIN**	**PEN**	**SWA**	**WUH**	**HAK**	**CTU**	**XMN**	**CRK**	**HKG**	**PVG**
Jan-16	1515.11	103235.05	4145.71	3423.73	5509.16	5319.06	8217.10	5759.09	1.28	106994.77	39527.75
Feb-16	1484.88	102119.20	4106.94	3305.55	6680.81	5755.00	7954.65	5564.71	0.93	98518.66	38136.87
Mar-16	1378.12	102550.09	4069.81	3187.44	6603.81	6102.33	7585.54	5368.19	0.75	87656.20	36747.67
Average	1459.37	102634.78	4107.49	3305.58	6264.59	5725.46	7919.10	5564.00	0.99	97723.21	38137.43
MAPE	14%	5%	5%	11%	18%	19%	10%	17%	28%	14%	3%
Optimal Alpha	0.01	0.01	0.01	0.01	0.01	0.01	0.44	0.01	0.06	0.32	0.01
Optimal Beta	0.01	0.01	0.99	0.01	0.01	0.01	0.99	0.01	0.01	0.99	0.01
Optimal Grammar	0.38	0.57	0.92	0.93	0.14	0.56	0.85	0.78	0.01	0.98	0.88

Table 27: The result of forecasting outbound demand

Inbound Forecast Airport	CEB	NKG	CGO	SUB	WUX	CKG	XIY	KHN	HGH	TYN	KHH
Jan-16	622.50	134.43	7273.35	837.11	813.99	2636.61	3616.59	5126.63	6602.99	2427.70	2324.95
Feb-16	640.09	126.31	7484.39	828.56	810.67	2527.42	3191.93	5535.54	6673.81	2550.55	2224.51
Mar-16	657.16	118.62	7603.79	822.88	826.75	2409.85	2772.38	5747.67	6792.42	2673.35	2015.64
Average	639.91	126.46	7453.84	829.52	817.14	2524.62	3193.63	5469.95	6689.74	2550.53	2188.36
MAPE	6%	45%	8%	8%	9%	16%	8%	14%	15%	8%	14%
Optimal Alpha	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.39
Optimal Beta	0.01	0.01	0.01	0.01	0.01	0.01	0.73	0.99	0.01	0.01	0.99
Optimal Grammar	0.79	0.13	0.37	0.68	0.44	0.52	0.99	0.55	0.51	0.99	0.67

Airport	NGB	SIN	PEN	SWA	WUH	HAK	CTU	XMN	CRK	HKG	PVG
Jan-16	1515.11	103235.05	4145.71	3423.73	5509.16	5319.06	8217.10	5759.09	1.28	106994.77	39527.75
Feb-16	1484.88	102119.20	4106.94	3305.55	6680.81	5755.00	7954.65	5564.71	0.93	98518.66	38136.87
Mar-16	1378.12	102550.09	4069.81	3187.44	6603.81	6102.33	7585.54	5368.19	0.75	87656.20	36747.67
Average	1459.37	102634.78	4107.49	3305.58	6264.59	5725.46	7919.10	5564.00	0.99	97723.21	38137.43
MAPE	14%	5%	5%	11%	18%	19%	10%	17%	28%	14%	3%
Optimal Alpha	0.01	0.01	0.01	0.01	0.01	0.01	0.44	0.01	0.06	0.32	0.01
Optimal Beta	0.01	0.01	0.99	0.01	0.01	0.01	0.99	0.01	0.01	0.99	0.01
Optimal Grammar	0.38	0.57	0.92	0.93	0.14	0.56	0.85	0.78	0.01	0.98	0.88

Table 28: The revised forecasting inbound demand

Inbound Forecast Airport	CEB	CGO	SUB	WUX	CKG	XIY	KHN	HGH	TYN	KHH	
Jan-16	622.50	7273.35	837.11	813.99	2636.61	3616.59	5126.63	6602.99	2427.70	2324.95	
Feb-16	640.09	7484.39	828.56	810.67	2527.42	3191.93	5535.54	6673.81	2550.55	2224.51	
Mar-16	657.16	7603.79	822.88	826.75	2409.85	2772.38	5747.67	6792.42	2673.35	2015.64	
Average	639.91	7453.84	829.52	817.14	2524.62	3193.63	5469.95	6689.74	2550.53	2188.36	
MAPE	6%	8%	8%	9%	16%	8%	14%	15%	0.08	14%	
Optimal Alpha	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.39	
Optimal Beta	0.01	0.01	0.01	0.01	0.01	0.73	0.99	0.01	0.01	0.99	
Optimal Grammar	0.79	0.37	0.68	0.44	0.52	0.99	0.55	0.51	0.99	0.67	
Normalized Average forecast	0.0021	0.0243	0.0027	0.0027	0.0082	0.0104	0.0179	0.0218	0.0083	0.0071	
Airport	**NGB**	**SIN**	**PEN**	**SWA**	**WUH**	**HAK**	**CTU**	**XMN**	**CRK**	**HKG**	**PVG**
Jan-16	1515.11	103235.05	4145.71	3423.73	5509.16	5319.06	8217.10	5759.09	1391.95	106994.77	39527.75
Feb-16	1484.88	102119.20	4106.94	3305.55	6680.81	5755.00	7954.65	5564.71	1091.46	98518.66	38136.87
Mar-16	1378.12	102550.09	4069.81	3187.44	6603.81	6102.33	7585.54	5368.19	800.24	87656.20	36747.67
Average	1459.37	102634.78	4107.49	3305.58	6264.59	5725.46	7919.10	5564.00	1094.55	97723.21	38137.43
MAPE	14%	5%	5%	11%	18%	19%	10%	17%	11%	14%	3%
Optimal Alpha	0.01	0.01	0.01	0.01	0.01	0.01	0.44	0.01	0.01	0.32	0.01
Optimal Beta	0.01	0.01	0.99	0.01	0.01	0.01	0.99	0.01	0.01	0.99	0.01
Optimal Grammar	0.38	0.57	0.92	0.93	0.14	0.56	0.85	0.78	0.53	0.98	0.88
Normalized Average forecast	0.0048	0.3351	0.0134	0.0108	0.0205	0.0187	0.0259	0.0182	0.0036	0.3191	0.1245

Table 29: The revised forecasting outbound demand

Outbound Forecast

Airport	CEB	CGO	SUB	WUX	CKG	XIY	KHN	HGH	TYN	KHH
Jan-16	468.39	7578.39	666.70	898.65	2358.70	3291.10	4366.59	4335.29	2803.79	2641.25
Feb-16	464.37	7476.25	627.56	521.44	2003.93	2917.31	4530.36	3511.37	2990.90	2925.64
Mar-16	460.14	7379.89	590.96	156.35	1634.54	2545.65	4592.80	2719.38	3178.03	3033.86
Average	464.30	7478.18	628.41	525.48	1999.06	2918.02	4496.58	3522.01	2990.91	2866.92
MAPE	20%	8%	14%	24%	20%	11%	12%	7%	24%	16%
Optimal Alpha	0.11	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04
Optimal Beta	0.33	0.87	0.01	0.01	0.01	0.26	0.18	0.01	0.01	0.99
Optimal Grammar	0.76	0.41	0.65	0.42	0.53	0.99	0.54	0.63	0.99	0.26
Normalized Average forecast	0.0013	0.0209	0.0018	0.0015	0.0056	0.0082	0.0126	0.0098	0.0084	0.0080

Airport	NGB	SIN	PEN	SWA	WUH	HAK	CTU	XMN	CRK	HKG	PVG
Jan-16	1623.95	103785.27	3911.44	3330.80	5830.75	4007.47	10466.86	6331.93	1007.81	144689.84	43338.92
Feb-16	1372.82	103522.33	3936.91	3290.61	5704.06	4153.61	10364.28	5767.88	650.90	147820.86	43246.31
Mar-16	1080.56	104878.50	3962.93	3250.41	5080.81	4266.95	10200.52	5203.00	299.71	150849.28	43152.39
Average	1359.11	104062.03	3937.10	3290.61	5538.54	4142.68	10343.89	5767.60	652.81	147786.66	43245.87
MAPE	8%	6%	5%	12%	15%	10%	10%	16%	12%	16%	5%
Optimal Alpha	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Optimal Beta	0.25	0.01	0.01	0.01	0.72	0.01	0.01	0.01	0.01	0.01	0.01
Optimal Grammar	0.47	0.55	0.88	0.99	0.20	0.68	0.58	0.82	0.50	0.70	0.85
Normalized Average forecast	0.0038	0.2907	0.0110	0.0092	0.0155	0.0116	0.0289	0.0161	0.0018	0.4128	0.1208

Table 30: The market capacity ratio for potential routes (CAPA, 2016, Alliance, 2016)

Code	The market capacity ratio	Normalized
CEB	2.26	0.1244
CGO	0.94	0.0518
SUB	1.36	0.0749
WUX	1.37	0.0754
CKG	0.89	0.0490
XIY	0.79	0.0435
KHN	0.7	0.0385
HGH	0.69	0.0380
TYN	0.81	0.0446
KHH	0.66	0.0363
NGB	0.83	0.0457
SIN	0.7	0.0385
PEN	0.68	0.0374
SWA	0.65	0.0358
WUH	0.71	0.0391
HAK	1.02	0.0562
CTU	0.62	0.0341
XMN	0.6	0.0330
CRK	0.63	0.0347
HKG	0.64	0.0352
PVG	0.61	0.0336

4.3.3.2 Competitor

Throughout the online research, the number of competitor was composed of Thai and foreign airline; where, both airlines were operating and competing within the same market. According to the Table 31, the number of airline that operates the direct flight to 22 operating potential airports had been investigated. There were 8 airports that have no direct flight to the destination; whereas, 14 airports had been occupied by the dominant airline. The airport that had many players would be assumed to have a high traffic such as SIN, HKG and PVG according to the direct flight frequency. The high number of flight frequency came with the high capacity as well. From the investigation, SIN was found to be the most competitive among airports due to the high number of competitors and flight frequency. Whereas, CEB, SUB, WUX and CRK were found to be zero competitiveness for the direct flight service.

From the result of the above investigation, the competitor criterion reduced the potential to the operating potential route; where, all sub-criteria would be used as the negative score in the AHP evaluation. HKG had found to have the highest threat with the score of 0.6968 because of the high frequency. Moreover, SIN and PVG also had a high competitor threat with the score of 0.5418 and 0.3768 respectively. From the result, the high demand market was concluded to be higher competitive as well. On the other hand, CEB, SUB, CRK and SUB were found to be the non-competitor threat because there was no operating direct flight within these routes.

Table 31: The competitor criteria evaluation (CAPA, 2016)

Code	Thai airline	Normalized	Foreign airline	Normalized	Weekly frequency	Normalized	Total
CEB	0	0.0000	0	0.0000	0	0.0000	0.0000
SUB	0	0.0000	0	0.0000	0	0.0000	0.0000
CRK	0	0.0000	0	0.0000	0	0.0000	0.0000
WUX	0	0.0000	2	0.0227	4	0.0035	0.0262
NGB	0	0.0000	2	0.0227	6	0.0052	0.0280
TYN	0	0.0000	2	0.0227	8	0.0070	0.0297
KHH	0	0.0000	2	0.0227	14	0.0122	0.0349
CGO	0	0.0000	2	0.0227	28	0.0244	0.0472
KHN	0	0.0000	4	0.0455	16	0.0140	0.0594
SWA	0	0.0000	4	0.0455	18	0.0157	0.0612
HAK	0	0.0000	4	0.0455	20	0.0175	0.0629
WUH	0	0.0000	4	0.0455	28	0.0244	0.0699
XIY	0	0.0000	6	0.0682	26	0.0227	0.0909
HGH	0	0.0000	6	0.0682	30	0.0262	0.0944
XMN	2	0.1000	2	0.0227	34	0.0297	0.1524
CTU	2	0.1000	6	0.0682	40	0.0349	0.2031
CKG	4	0.2000	0	0.0000	14	0.0122	0.2122
PEN	4	0.2000	0	0.0000	14	0.0122	0.2122
PVG	2	0.1000	10	0.1136	187	0.1632	0.3768
SIN	2	0.1000	15	0.1705	311	0.2714	0.5418
HKG	4	0.2000	17	0.1932	348	0.3037	0.6968

4.3.3.3 Airport

According to Center for Aviation database, the airport ranking was found to be evaluated based on the traffic share within Asia pacific region which represented in the numerical data; where, the details of each airport such as the international and domestic connecting destination were also found. As the number of connecting destination was increasing, the airport was tended to have a high traffic as well. There were 5 operating potential airports, PVG, HKG, SIN, CTU and SUB that had been ranked in the top 50 of Asia pacific. HKG was the highest total number of connecting destination with 147 destinations; whereas, CRK had only 8 connecting destination in total. According to the scoring result in Table 32, HKG had won with the overall score of 0.1288, 0.2322 and 0 in the airport ranking, international and domestic connecting destination respectively; where, the lowest score was CRK.

Table 32: The airport criteria evaluation (CAPA, 2016)

Code	Airport ranking	Normalized	International connecting destination	Normalized	Domestic connecting destination	Normalized
CEB	21.5	0.0173	12	0.0196	23	0.0243
CGO	56.7	0.0457	15	0.0245	60	0.0635
SUB	48.8	0.0393	7	0.0114	28	0.0296
WUX	15.1	0.0122	10	0.0163	25	0.0265
CKG	78.8	0.0635	29	0.0473	93	0.0984
XIY	93.6	0.0754	22	0.0359	105	0.1111
KHN	20.8	0.0168	7	0.0114	36	0.0381
HGH	78.6	0.0633	29	0.0473	77	0.0815
TYN	28.1	0.0226	10	0.0163	44	0.0466
KHH	16.1	0.0130	40	0.0653	44	0.0466
NGB	19.1	0.0154	13	0.0212	37	0.0392
SIN	147.1	0.1185	133	0.2170	0	0.0000
PEN	17.2	0.0139	17	0.0277	9	0.0095
SWA	9.4	0.0076	6	0.0098	23	0.0243
WUH	55.2	0.0445	31	0.0506	56	0.0593
HAK	35.9	0.0289	9	0.0147	53	0.0561
CTU	100.2	0.0807	42	0.0685	98	0.1037
XMN	60.4	0.0486	22	0.0359	65	0.0688
CRK	2.3	0.0019	7	0.0114	1	0.0011
HKG	167.8	0.1351	147	0.2398	0	0.0000
PVG	168.9	0.1360	5	0.0082	68	0.0720

4.3.3.4 Macro-Environment

According to the methodology in section, the PESTLE analysis was used to inspect the potential of the surround market which would affect the entire supply chain of the airline industry. 6 different areas that would be covered such as political, economy, social, technology, environment and legal.

4.3.3.4.1 Political

The political factor was the huge impact on the airline industry which was related to the legal elements such as the taxation policy, situation stability and law & regulation. However, the airline industry was protected by the airline deregulation, and the details was depending on agreement between two countries. The legal elements were controlled and involved with the politic decision effecting the situation stability. In fact, the instability was resulting in the increasing tension in the living environment.

The majority of qualified airports were located in China. China was seen to be no political right and very restricted public expression with the government that used the extremely violence or rule. According to Freedom house rating, the China's political right had been scored at 7 points; whereas, the civil liberties right was scored at 6 points (Aghekyan et al., 2015). The Chinese government had the supreme power to control people by pressure and force. The civilization had no right to oppose the government which would results in the increasing tension and reducing safety as well. Safety was one of the major travelling concern for air passengers. Ever since 2011, the number of strike and protest had been sharply increasing as shown in Figure 61 (Griffiths, 2016).

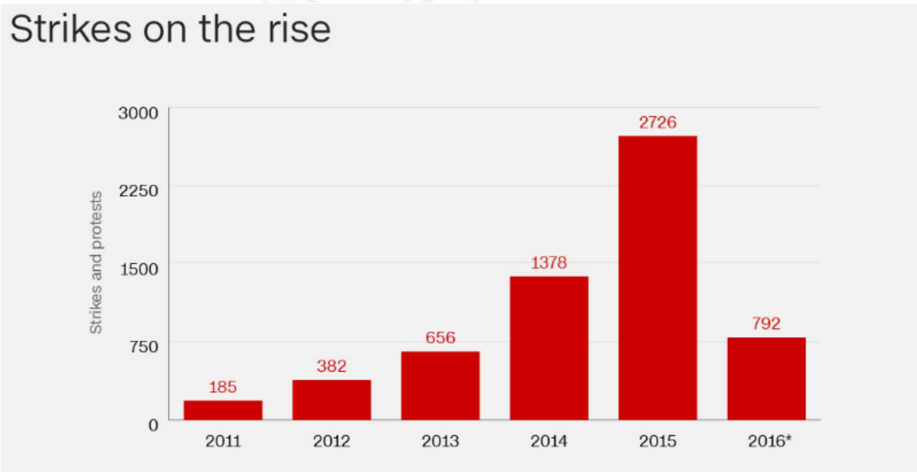

Figure 61: The number of strike and protest in China (Griffiths, 2016)

Recently, China received the strike from Chinese mining labors in 2016. Around 500 protests had been occurred in January due to the slowdown economy. Angry workers protested with violence for their low wage and unpaid salaries. The situation was neutralized by force, and the government action was to pressure on businesses to generate available cash for wage and payment; so, businesses began to hold the wage and even reduced the employment to control their financial. According to the strike record in 2015, the number of strike and worker protests had been occurred around the country as shown in Figure 62 (Griffiths, 2016).

Figure 62: The geographic data of strike and protest (Griffiths, 2016)

Hong Kong was a special administrative region of China that had its own government; however, the law & regulation of China was not in effect. The government was seen to have most of the political right throughout the electoral process; where, the president would be selected from the majority vote and served for the five-year term. The civilian had the freedom to express opinions and accesses several information sources. The newspaper and broadcast media were expressed in English allowing the foreign media to access the information. Hong Kong's political and civil right had been rated at the score of 5 and 2.

Moreover, Philippine, Singapore and Malaysia's political and civil right had been equivalently rated at 3, 4 and 4 which were in the same level as Hong Kong according to the Freedomhouse rating methodology, but the civil right was little more restricted to information. The censorship board could edit or ban any criticize contents or government related before releasing to public.

Lastly, Taiwan and Indonesia had the best score on the political and civil right as shown in Table 33; where, the government was fairly elected throughout the process, and the feeling and opinions were freely expressed and shared in public.

The third factor that impacted the tension of environment and economy as well was the income tax. Every citizen was required to pay taxes to the government based on their wage and salary. The personnel income tax implied two concerns which were the purchasing power and the government balance. As the government required more cash into the account, the income tax rise, and the purchasing power of consumer would be reduced. According to Table 33, Hong Kong and Singapore had the lowest income threat; whereas, China and Taiwan had the highest income threat.

Table 33: The political evaluation (Economics, 2016, Aghekyan et al., 2015)

Country	Personel income tax	Normalized	Political right	Normalized	Civil liberities	Normalized
China	0.5	0.2123	7	0.2692	6	0.2400
Hong Kong	0.2	0.0708	5	0.1923	2	0.0800
Indonesia	0.3	0.1415	2	0.0769	4	0.1600
Malaysia	0.3	0.1179	4	0.1538	4	0.1600
Philippine	0.3	0.1509	3	0.1154	3	0.1200
Singapore	0.2	0.0943	4	0.1538	4	0.1600
Taiwan	0.5	0.2123	1	0.0385	2	0.0800

4.3.3.4.2 Economy

The overall macro-economic was described in term of the gross domestic product indicating the total value of products and services produced within the country's territory. According to the GDP in 2015 from the world bank data, China, including Taiwan as one of the province, had the highest value of GDP at 10.866 trillion US dollars; whereas, other countries had the GDP less than 1 trillion US dollars. The market size of China was seen to be 10 times bigger than Hong Kong, Indonesia, Malaysia, Philippine and Singapore as shown in Table 34.

Table 34: The GDP of 7 countries in 2015 (IMF, 2016)

	The GDP of 2015
China, including Taiwan	$10,866,443,998,394.20
Hong Kong	$309,928,790,732.48
Indonesia	$861,933,968,740.33
Malaysia	$296,217,641,787.22
Singapore	$292,739,307,535.64
Philippines	$291,965,336,390.95

Based on the historical data of 6 countries, the average growth of air passenger and GDP from 2011-2015 had been plotted into chart as shown in Figure 63. The trend line showed the correlation between the number of passenger and the GDP. As the GDP is growing, the number of passenger was also increases. Therefore, the GDP could be used to indicate the passenger potential.

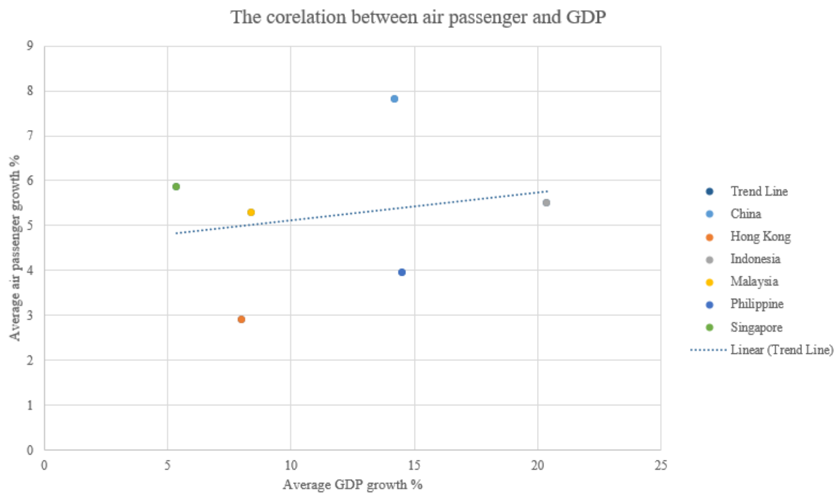

Figure 63: The corelation between the air passenger and GDP (IMF, 2016)

To compare the GDP between different countries, the GDP per capita was used to indicate the standard living. Where, Singapore, Hong Kong and Taiwan had the outstanding economic performance which would have the higher passenger potential as well. From the international monetary fund, IMF, data, Singapore had the highest GDP per capita at $85,400 as shown in Figure 64. The lowest GDP per capita was $7,300 which was Philippines.

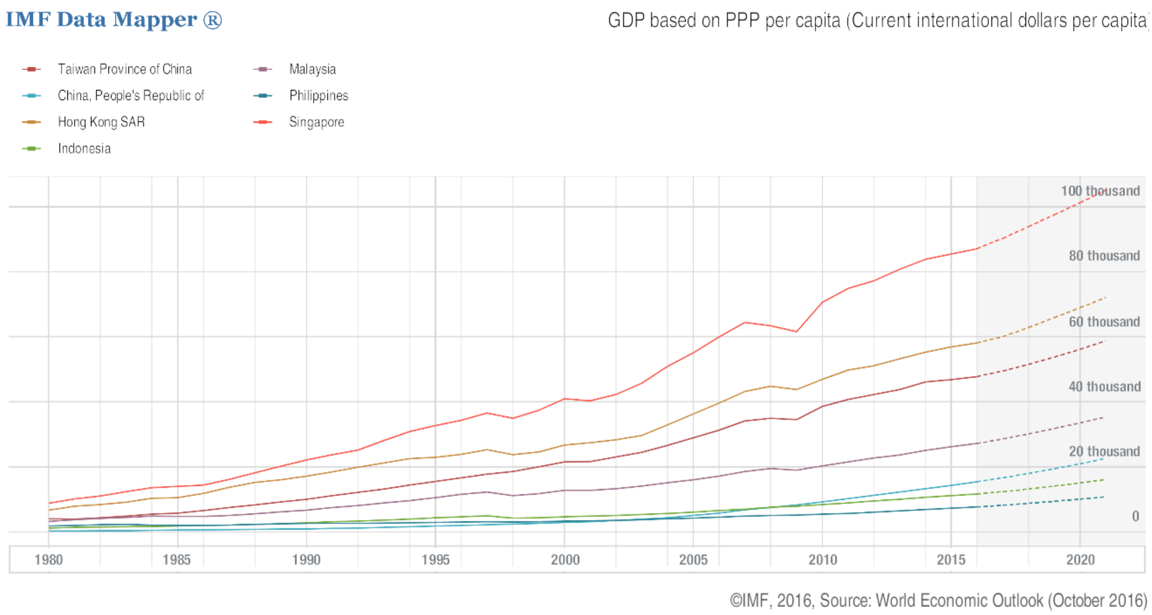

Figure 64: The GDP per capita of 7 countries in 2015 (IMF, 2016)

Table 35: The economic evaluation

	GDP per Capita	Normalized
China	$ 14,300.00	0.05775
Hong Kong	$ 56,900.00	0.22981
Indonesia	$ 11,100.00	0.04483
Malaysia	$ 26,200.00	0.10582
Philippine	$ 7,300.00	0.02948
Singapore	$ 85,000.00	0.34330
Taiwan	$ 46,800.00	0.18901

The positive number of normalized score indicated the potential to the airline industry. Among 7 countries, Singapore had the highest potential with the score of 0.3433; whereas, Philippines had the lowest potential with the score of 0.02948 as shown in Table 35.

4.3.3.4.3 Social

The growth rate of passengers was a significant indicator for the travelling trend and demand behavior which could be used to identify the current health of the route. 13 operating potential routes had been found to regularly fluctuate within 100% growth rate resulting from the change of capacity. However, WUX, XIY, KHN, HGH, TYN, NGB, WUH and HAK route had a tremendous average growth rate over 200%; where the passenger demand was highly fluctuated as shown in Table 36. So, the author consulted with the aviation expert from the Thai subsidiary airline, and the given reason for this high fluctuation was that there may be airlines who decided to end the operation on the certain route; where the entire capacity was removed from the schedule. The new entry airline also caused the increasing capacity as well as the passenger demand. For the study of trend and demand behavior, the aviation expert advised to set the growth rate at 15% for both positive and negative result. After the revision, Nanjing had highest trends with the score of 0.3129; whereas, CRK had the lowest score of -0.1942.

Table 36: The social evaluation (Alliance, 2016)

Code	The aveage of 3 year passenger growth	The revised growth rate	Normalized
CEB	0.2100	0.21	0.0755
NKG	0.8700	0.87	0.3129
CGO	2.8500	0.15	0.0540
SUB	-0.2800	-0.28	-0.1007
WUX	9.6500	0.15	0.0540
CKG	0.2300	0.23	0.0827
XIY	2.3700	0.15	0.0540
KHN	3.4500	0.15	0.0540
HGH	1.1700	0.15	0.0540
TYN	5.4900	0.15	0.0540
KHH	0.0300	0.03	0.0108
NGB	4.1500	0.15	0.0540
SIN	-0.0600	-0.06	-0.0216
PEN	-0.0800	-0.08	-0.0288
SWA	0.1700	0.17	0.0612
WUH	4.6800	0.15	0.0540
HAK	2.3400	0.15	0.0540
CTU	0.2900	0.29	0.1043
XMN	0.2900	0.29	0.1043
CRK	-0.5400	-0.54	-0.1942
HKG	0.1800	0.18	0.0647
PVG	0.1200	0.12	0.0432

4.3.3.4.4 Technology

Nowadays, technology had been spread across the airline industry from the operation to the communication. The communication channel opened the opportunity to rapidly and accurately interacted with customers throughout the online booking, self-check-in and flight monitoring. However, the effectiveness of technology required the cooperation from both suppliers and customers. The mobile or smartphone became one of the personnel belonging device that had been carried with customers throughout the day. In order to connect to the channel, customers required two things which were the electricity and the internet access; whereas, the airline must secure the customer's information throughout the transfer process. The limitation of resources would limit the potential as well. According to record in 2013 from World Economic Forum, the infrastructure and digital content had been investigated as shown in Table 37. China had been found that only 4.5 kilobyte was available per internet user which was low in despite the mobile coverage was covered more than 95% of the area; whereas, Hong Kong provided the high-speed internet for the ease of communication.

Table 37: The composition of infrastructure (Dutta et al., 2015)

Country	Electricity production kWh per capita	Mobile network coverage rate %	International Internet bandwidth Kb per internet user	Secure internet servers per million popluation
China	3508.4	99.5	4.5	3.9
Hong Kong	5519.3	100.0	1939.5	623.6
Indonesia	748.1	100.0	10.1	4.1
Malaysia	4523.5	95.2	29.5	66.8
Philippine	727.8	99.0	57.6	8.1
Singapore	8873.8	99.0	580.8	609.3
Taiwan	10859.0	100.0	65.1	0.1

Based on the overall score of the infrastructure, Taiwan had received the highest number with 7 point showing the important of electricity which was the main resource driver for technology as shown in Table 38. Whereas, the second important resource for communication was found to be the internet bandwidth comparing between China and Philippine. Lastly, Indonesia had the lowest infrastructure and the communication potential among any other countries.

Table 38: The technology evaluation (Dutta et al., 2015)

Country	Infrastructure and digital content	Normalized
China	3.2	0.0955
Hong Kong	5.8	0.1731
Indonesia	3.0	0.0896
Malaysia	4.2	0.1254
Philippine	4.1	0.1224
Singapore	6.2	0.1851
Taiwan	7.0	0.2090

4.3.3.4.5 Legal

According to the traffic right document from the Thai Civil Aviation Training Center, every Thai airline was operated under the freedom of air as shown in Appendix 7. The third and fourth freedom were allowed in all 7 studied countries. China, Hong Kong, Singapore, Malaysia, Taiwan provided the unlimited flight frequency and capacity between Thailand. However, Bangkok, Chang Mai, Chang Rai, Phuket, Hat Yai, Jakarta, Denpasar, Surabaya, Medan and Makassar could be travelled without and capacity restriction between Thailand and Indonesia, but only 21 flights were allowed per week in any other route. Philippine also had the air restriction which was classified into 5 conditions. The condition 2, 3, and 4 were mainly involved with the commercial airline. The route between Bangkok and Manila was limited to 3,050 seats per weeks according to the second condition. Whereas, the third and fourth condition had allowed the unlimited flight frequency and capacity for any route excluding the flight between Bangkok and Manila. Indonesia and Philippine had found to be conditional country; whereas, 5 countries were unconditional. According to the weighting score as shown in Table 39, the author decided that the conditional route had no traffic right potential, 0, and the unconditional route was scored as 1 which equal to 0.5. The unconditional would be referred to the open-sky which had no potential threat.

Table 39: The legal evaluation (CATC, 2016)

	Conditional	Unconditional	Scored	Normalized
China		*	0	0
Hong Kong		*	0	0
Indonesia	*		1	0.5
Malaysia		*	0	0
Philippine	*		1	0.5
Singapore		*	0	0
Taiwan		*	0	0

4.3.3.4.6 Environment

The environment condition was becoming the major concern for the airline industry because the effect of disaster heavily impacted both aircraft operation and passenger safety. In order to arrive or departure under the disaster, the operation would be difficult and cost, and also passengers would try to avoid from the risk. So, the location with the high disaster risk would produce more threats than potentials. According to Inform risk index as shown in Table 40, the environment condition of each countries had been collected and analyzed upon 3 major areas which were the hazard & exposure, vulnerability and lack of coping capacity. The result of analysis showed that Philippine had the highest risk index at 5.2 due the hazard & exposure; where, the major cause was from the natural disaster. Many natural disasters such as typhoons, earthquakes and the eruption of volcano had been occurred in Philippine causing the injury, damaged property and loss of life. Philippine annually suffered with 80 typhoons (Wingard and Brandlin, 2013). Whereas, China and Indonesia had been as the most frequently hit by the natural disaster as well; however, Hong Kong and Taiwan were located very close to China and received the same amount of impact. In summary, Philippine received the highest score of 0.1955 that had the highest disaster risk; whereas, Singapore was the safest destination with the lowest score of 0.0150.

Table 40: The environmental evaluation (INFORM, 2016)

Country	INFORM RISK INDEX	Normailized	Hazard & exposure	Natural	Human	Vulnerability	Socio-Economic	Vulnerable group	Lack of capacity	Insitutional	Infrastructure
China	4.3	0.1617	6.9	8.2	5.1	2.9	2.4	1.7	2.9	2.9	2.9
Hong Kong	4.3	0.1617	6.9	8.2	5.1	2.9	2.4	1.7	2.9	2.9	2.9
Indonesia	4.6	0.1729	6.5	7.4	5.5	2.8	2.4	3.1	5.2	4.7	5.6
Malaysia	3.5	0.1316	3.8	4.3	3.2	3.4	2.4	4.2	3.3	3.2	3.3
Philippine	5.2	0.1955	8.1	8.9	7.0	4.0	2.5	5.2	4.2	4.6	4.1
Singapore	0.4	0.0150	0.1	0.1	0.0	0.5	0.7	0.3	1.2	1.3	1.1
Taiwan	4.3	0.1617	6.9	8.2	5.1	2.9	2.4	1.7	2.9	2.9	2.9

4.3.4 Develop result of AHP analysis and classification of finding

According to the above result and analysis, 17 positive airports and 4 negative airports were found as shown in Table 41. The range of resulted score was vary in between -0.0072 and 0.0521. SIN had won the rank 1 implying as the most potential international airport. The rank 2, 3 and 4 airports were found to be HKG, CEB and KHH and WUX that had the final AHP score of 0.0502, 0.0318, 0.0162 and 0.0156 respectively. Each airport was located in different countries such as Hong Kong, Philippine, Taiwan, Singapore and China.

According the analysis, SIN and HKG had very high passenger demand and airport connectivity with the stable environment; however, the disadvantage of this market was the competition; where many players were competing for the high demand; so, these airports would be inappropriate for the low competency or new entrance airline. Whereas, CEB was the third ranked airport that had the medium demand opportunity and low competition, but the macro-environment was poor due to the hazard and exposure. The connectivity was quite low. Only 12 international and 23 domestic connecting destination were available. This airport was not good for the large hub-system operating airline but rather suitable for the small and medium size airline who was focusing on the direct flight operation. Fourthly, KHH had the similar market characteristic as CEB, but the passenger demand was less by twice. Lastly, WUX was the mid-range potential location; where, the customer and macro-environment potential were above the average. The strength was the low competitor, and the weakness was the airport.

Table 41: The result of AHP evaluation

Ranked	Code	Customer	Competitor	Airport	Macro-environement	AHP scored
1	SIN	0.0733	0.0340	0.0155	-0.0030	0.0518
2	HKG	0.0824	0.0455	0.0172	-0.0038	0.0502
3	CEB	0.0429	0.0000	0.0035	-0.0146	0.0318
4	KHH	0.0139	0.0016	0.0081	-0.0042	0.0162
5	WUX	0.0262	0.0009	0.0034	-0.0131	0.0156
6	SUB	0.0260	0.0000	0.0039	-0.0148	0.0151
7	CGO	0.0220	0.0025	0.0076	-0.0131	0.0140
8	XIY	0.0167	0.0037	0.0127	-0.0131	0.0126
9	HAK	0.0221	0.0026	0.0061	-0.0131	0.0124
10	HGH	0.0160	0.0039	0.0108	-0.0131	0.0098
11	WUH	0.0168	0.0032	0.0088	-0.0131	0.0094
12	TYN	0.0168	0.0012	0.0053	-0.0131	0.0078
13	NGB	0.0164	0.0010	0.0048	-0.0131	0.0071
14	PVG	0.0350	0.0241	0.0089	-0.0131	0.0067
15	CTU	0.0169	0.0131	0.0142	-0.0129	0.0051
16	KHN	0.0161	0.0024	0.0041	-0.0131	0.0048
17	SWA	0.0142	0.0025	0.0027	-0.0131	0.0013
18	CKG	0.0181	0.0179	0.0122	-0.0130	-0.0006
19	XMN	0.0146	0.0114	0.0088	-0.0129	-0.0010
20	CRK	0.0124	0.0000	0.0008	-0.0155	-0.0023
21	PEN	0.0151	0.0179	0.0027	-0.0072	-0.0072

In this case, the top 5 airports would be selected as the potential airport to serve for 5 unassigned routes; however, the result of summary was given to the Thai subsidiary airline. The airline wanted to avoid the high competitive market because they recently became independent, and they experienced in the high competitive market, Macau, and the competition was too intense for the sustainability, and Macau route was suspended. Therefore, SIN and HKG would be removed from the profit investigation due to the high competition.

4.4 Stage 3

4.4.1 The estimation of airfare

The estimation of airfare was calculated from the cost of route operation. The majority of cost was the variable cost which was vary depending on two factors which were the number of passenger and travelling distance. The resulted cost estimation of CEB, KHH and WUX route were shown in Table 42. The highest operating cost was 1.8 million Thai Baht in the CEB route, and the lowest operating cost was 1.7 million Thai Baht in the KHH route. With the same loading factor, the farther route would require the higher operating cost due to the increasing duration and fuel consumption.

Table 42: The total cost of 3 potential routes (confidential) (Anon, 2016b)

Result

Assumption CF 60%	CEB	KHH	WUX
Weekly Frequency	7	7	7
Overnight	0	0	0
Distance per R/T	5,110	4,590	5,646
Airborne Hour per R/T	7.50	7.83	8.28
Block Hour per R/T	8.25	8.58	9.17
Total Seat BC (Config) / RT	24	24	24
Total Seat EY (Config) / RT	312	312	312
Total Cost (THB)	1,8[redacted]	1,7[redacted]	1,8[redacted]

The number of carried passenger indicated the incoming revenue that would be compensating the operating cost. If the revenue was higher than the operating cost, the profit would be generated. The average loading factor was 60% of the aircraft capacity which was approximately equaled to 100.9 economy seats and 12 business seats per flight. The average breakeven airfare is calculated as shown in Table 42. The breakeven price was gradually cheaper as the loading factor was increasing. The average ticket price of CEB was 8,365 Thai Baht which was the most expensive among 3 potential routes. Regarding to the resulted airfare, the average price would be used as the selling price. The airline would be generating more profit as the number of carried passenger was increasing because the breakeven price was decreasing.

Table 43: The average breakeven-airfare (confidential) (Anon, 2016b)

Code	C.F.	50%	60%	70%	80%	90%	
KHH	Rev & Cost	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
	Seat'	336	336	336	336	336	
	Sale	168	202	236	269	303	**Average**
	Fare	10,104	8,570	7,477	6,685	6,045	7,776
CEB	Rev & Cost	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
	Seat'	336	336	336	336	336	
	Sale	168	202	236	269	303	**Average**
	Fare	10,878	9,222	8,043	7,187	6,497	8,365
WUX	Rev & Cost	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
	Seat'	336	336	336	336	336	
	Sale	168	202	236	269	303	**Average**
	Fare	10,859	9,188	7,999	7,136	6,440	8,325

4.4.2 The profitability analysis

With the average ticket price, the result of estimated cost in Appendix 9 is showing the relationship between the cost and revenue. At the load factor of 60%, 3 potential route still generated the negative contribution in Year 1 as shown in Figure 65; in despite that the average price was calculated from the loading factor between 50% to 90%. However, the airline had assumed that the number of carried passenger would be respectively increasing at 60%, 65%, 69%, 72%, 74% and 75%.

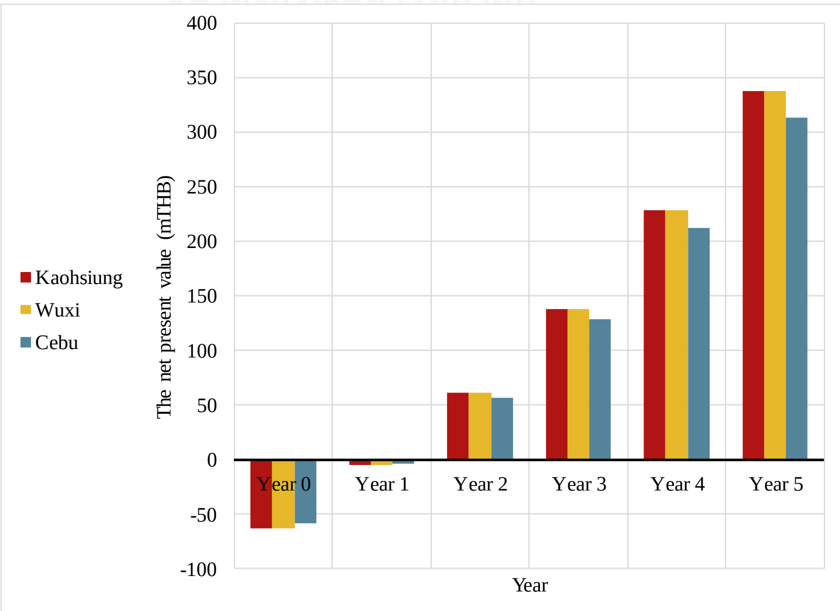

Figure 65: The accumulative present value for 6 years

Table 44: The summery of net present value for 3 potential routes

Rank	Airport Name	NPV3 10%	NPV5 10%	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
1	Cebu	87.88	454.28	-62.65	-4.46	61.42	138.19	229.18	338.00
2	Wuxi	87.13	452.96	-63.17	-4.65	61.39	138.15	228.94	337.35
3	Kaohsiung	81.75	422.06	-58.05	-4.10	57.03	128.30	212.83	313.95

According to the NPV analysis, the net present value of 3 potential routes became positive in Year 3. The CEB route had the highest NPV at 87.88 million Thai baht, and the lowest NPV was KHH route at 81.75 million Thai baht. The result of NPV in Year 6 had proved the relationship between length of flight operation and profitability as the loading factor was increased. Throughout the operation planning in Year 6, the CEB route generated the highest NPV at the 10% of discount factor as shown in Table 44. The WUX route was ranked in the second place, and the KHH route was the third. However, the result showed the profitability at the equivalent route potential. Regarding to the different route potential, the final potential route would be determined in the expected NPV in the below section.

4.4.3 The expected NPV based on AHP potential analysis

According to the graphical analysis of NPV and route potential as shown in Figure 66, the KHH airport had the lowest NPV and second ranked AHP. Whereas, CEB and WUX airports had a similar NPV. By vision, CEB route had the highest potential among 2 alternatives. Due to the triangular area under the graph between the operating and profit potential, the expected NPV of CEB had found to be 1.397; whereas, the value of WUX was only 0.6794. On the other hand, CEB had the higher NPV and AHP than WUX. Therefore, the CEB was obviously found to be the outstanding route.

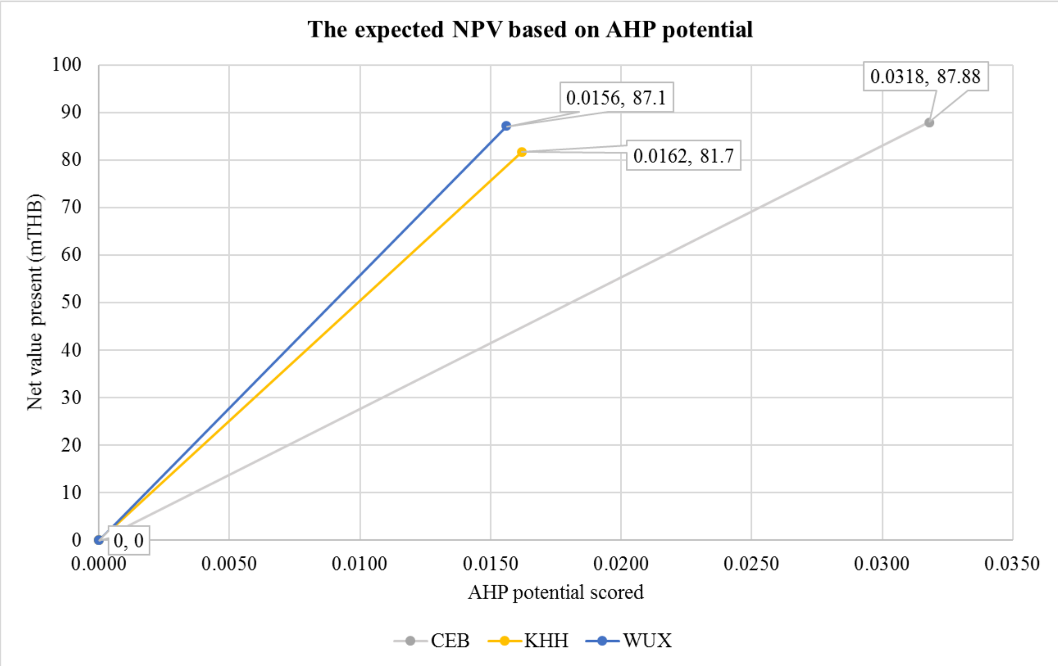

Figure 66: The expected net present value

4.4.4 Classification of result and the sensitivity analysis

The CEB route was found to be the appropriate route because the AHP potential score of CEB was approximately 2.03 time higher than WUX, and also CEB generated 0.9% of profit higher than WUX. Therefore, the CEB route was found to be the most appropriate route among 3 options that had the sufficient profitability and operating potential for the Thai subsidiary airline case study. According to the ABC classification analysis of cost structure, the top 5 highest variable cost were the fuel & oil, flight equipment lease fees, total overhaul & maintenance, management & administration and flight equipment insurance which located in Class A category covering up to 69.3% of the total cost as shown in Figure 67; so, the list of variable cost in Class A would be used in the sensitivity analysis. The change of any cost in Class A would makes the significant change in the NPV based on the sensitivity analysis as shown in Figure 68.

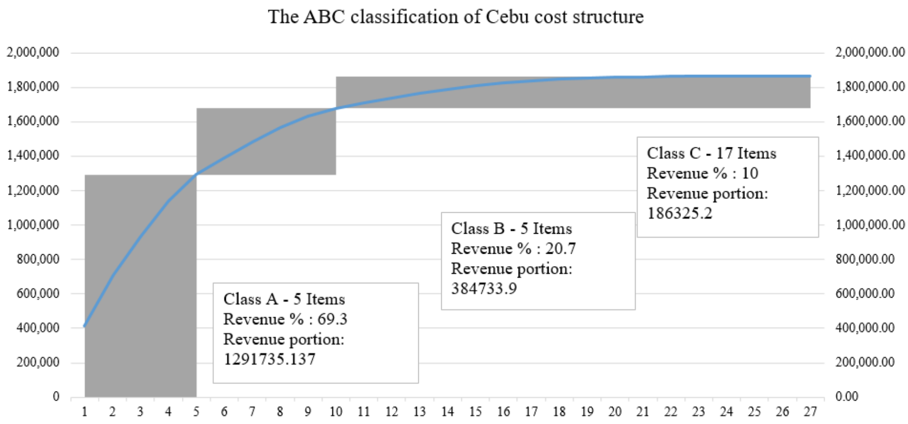

Figure 67: The ABC analysis of the cost structure

The increasing 10% of fuel & oil cost would decrease the NPV by 24.06%. The change of overhaul & maintenance, flight equipment lease fees, management & administration and flight equipment insurance cost would decrease the NPV by 16.85%, 13.49%, 11.89%, 8.77% respectively as shown in Figure 68. Whereas, the increasing 10% of airfare would produce the positive effect and increase the NPV by 98.23%. The fuel & oil cost was found to be the most sensitive variable among others cost.

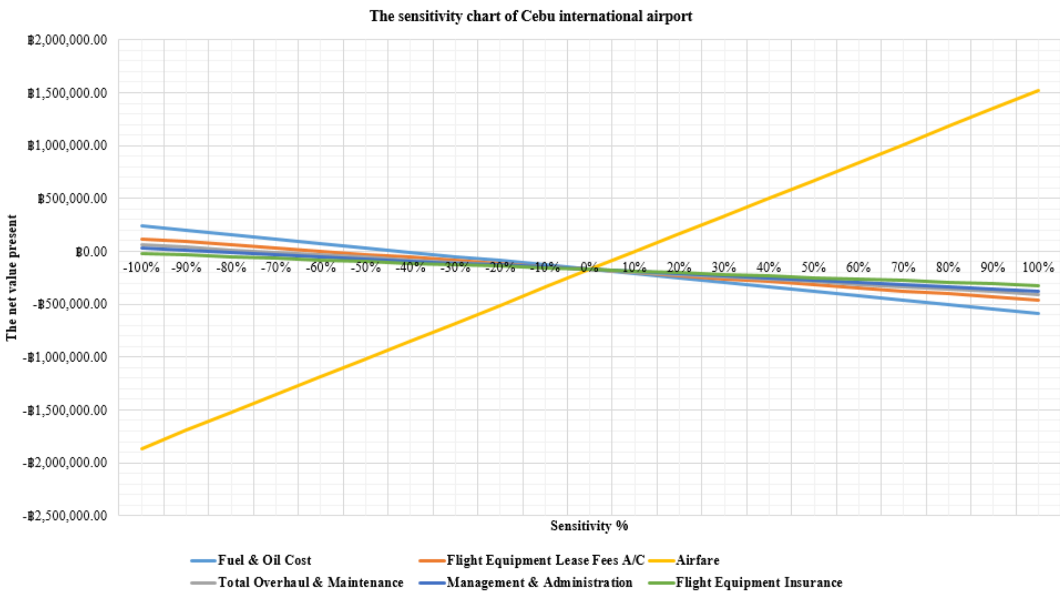

Figure 68: The sensitivity chart of Cebu international airport

4.4.5 Recommendation for action to the director and the fleet planning manager

This dissertation is accomplished by Phitthawat Taweewattanapaisan. The statement is to investigate and analyze the airline international potential route for a subsidiary airline. The result would lead to the new route selection which requires a huge investment; where, the airline must focus on the profit. From the result of the studied, Singapore, Hong Kong, Mactan-Cebu, Kaohsiung and Wuxi international route are found to be the top 5 positive weight potential. However, only Mactan-Cebu route is the outstanding airport that has both operating and profitable potential under the competitive environment; whereas, other potential routes are incompatible due to the insufficient demand, high competition and high macro-environment risk. Several obstacles have found during the study which perhaps preventing the result to be accomplished. The author would concurrently address the issue and recommendation that would include the market strategy, operation cost and fleet resource planning.

4.4.5.1 The marketing strategy and business model

The primary issue that was found during the project was the inappropriate marketing strategy to counter the low-cost airline. According to the literature review in section 2.2. The purpose of subsidiary airline establishment was discussed. Where, many example airlines had failed to implement the low cost subsidiary airline due to the different culture and strategy. This uncorrelation between the full-service and low-cost mindset led the LCS to the high operation cost. During the studied, the author found that the Thai subsidiary airline case studied was currently operated in the hybrid model which was the mix between the full service and low-cost service trying to capture both business and leisure passengers; where, both business and economy class were available in the same flight. In this case, the Thai subsidiary would require to prepare resources and services such as meal & drink, general consumption goods and baggage handling more than the actual number of passenger on board. The cost of excessive goods carried would decrease the cost efficiency and was one of the causing high airfare. For the price sensitive market, the airline would lost economic passenger demand to competitors. The first recommendation is to implement the airline in airline strategy, AinA, in order to separate and differentiate the business strategy and structure between the low-cost subsidiary airline and the parent airline. The Thai subsidiary airline needs to select the distinguish market position whether to be the differentiation and low cost, and the passenger would be captured by the produced value. The AinA strategy is also discussed in the literature review in section 2.2.

4.4.5.2 The operation cost

Once the AinA model and the low-cost strategy have been fully set, the Thai subsidiary could begin to manage and reduce the operation cost in order to create the competitive advantage in the market. The second issue that was found in during the project was the high operation cost. The author had discriminated the impact and value of each fix and variable cost which was shown in the given cost structure template. The fuel & oil, overhaul & maintenance and flight equipment leasing fees were found to be the dominating cost according to the sensitivity analysis. The recommendation is the lean concept because the lean concept is inexpensive and less risk comparing to the fuel holding, outsourcing maintenance and procurement of the flight equipment. These solutions would increase the short-term cost as well as the investing risk, and the long-term benefit would be fixed. However, the lean concept is the long-term and continuous improvement that requires the effort and time. The appropriate implementation would help to reduce and eliminate the unnecessary activity and waste; where the cost would be followingly reduced.

Regardless of the premium service quality, the author would suggest 4 lean tools to be implemented which are 5S, 7 wastes elimination, Kanban and the total productive maintenance, TPM. The 5S would increase and maintain the effectiveness and efficiency of the workplace in term of sort, straighten, shine, standardize and sustain as shown in Figure 60 (Juncosa, 2012). The 7-waste elimination would reduce the waste in both ground and in-flight operation as shown in Figure 61 (Anon, n.d.);

however, this tools is commonly used in the manufacturing production. 4 wastes such as the motion, inventory, waiting and transportation are clearly reflected to the airline business operation; whereas, other 3 wastes such as the overproduction, over processing and defect are difficult to be determined the application area. In the case, the author would be referred the overproduction as the excessive seat capacity, the over processing as the excessive flight organization procedure and the defect as the emergency flight cancellation and landing. The Kanban, third tools, is the managerial tools which would increase the efficiency and balance in the internal organization; where, the concept is to provide the needed resource just in time to reduce the excessive work and waste. In the manufacturing process, the Kanban is applied by using the visually signal card to indicate and check the requirement material which would be intermediately transferred between processes (Rahman et al., 2013). Therefore, the Thai subsidiary airline could use the visual card or paper that would determine the requiring source for both ground and in-flight operation. Fourthly, the total productive maintenance is the technical maintenance program that keep the machine and equipment at the best condition to retain the effectiveness and efficiency. The TPM is the second tier improving method that has been effectively supported by the 5S as shown in Figure 62 (Anon, n.d). By implementing the TPM, the airline business would benefit the increasing of available aircraft, maximum quality & performance and overall effectiveness and efficiency, OEE. These tools are primary focusing on increasing the performance of process in each airline function which would lead to the reducing unit cost.

Figure 69: The 5S (Juncosa, 2012).

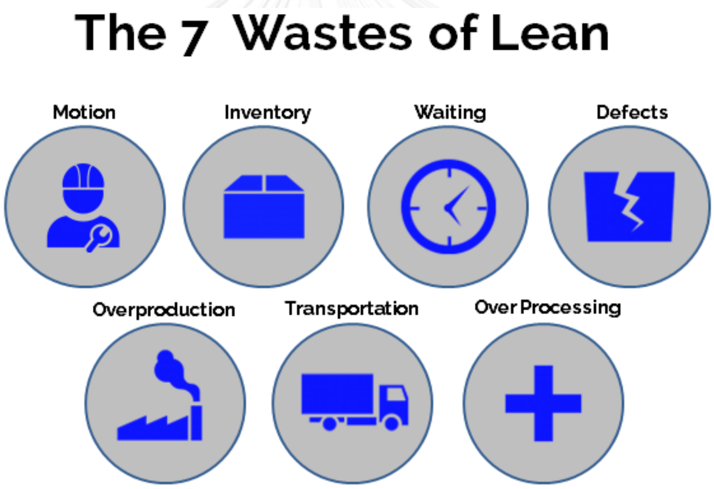

Figure 70: The 7 waste of lean (Anon, n.d.)

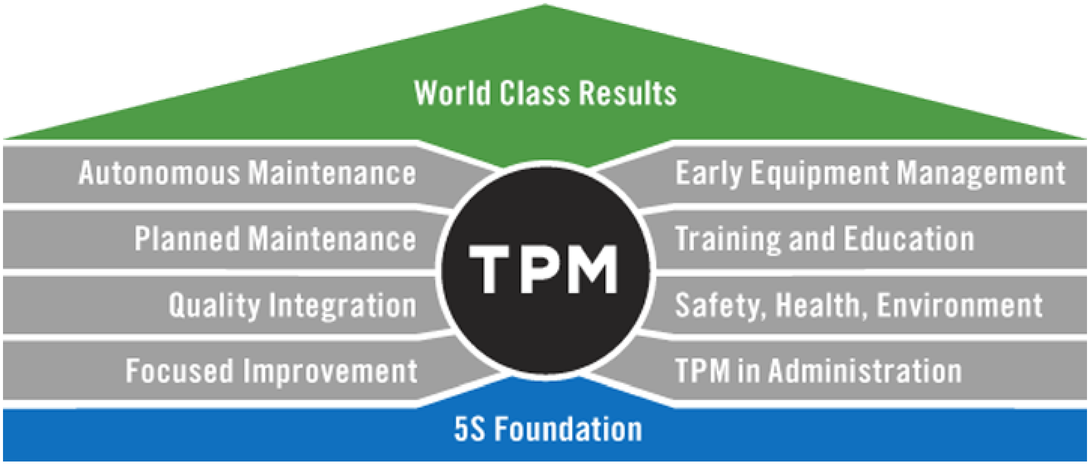

Figure 71: The total productive maintenance structure (Anon, n.d)

4.4.5.3 The fleet resource planning

From the operation cost recommendation, most of issues and wastes can be clearly eliminated by the suggested tools. However, the overproduction waste is difficulty to be manage and eliminate because this waste is occurred from the uncorrelation between the supply and demand. The demand factor is uncontrollable due to the external factor. Therefore, the author would recommend the demand driven dispatch; where the airline is required to be responsive to the change of demand in order to reallocate the capacity and resource. This concept would increase the overall profitability of the route which can be helped by above tools.

The primary focus for this recommendation is the forecasting because the error and inconsistency of forecast demand would impact the planning effectiveness.

In summary, the objective of recommended tools and strategy is to reduce the processing cost and risk by the elimination of waste and unnecessary activity. Where, each of application would be suitable with specific tools which are mentioned in the above section. Every tool would help and support one another to achieve the goal and objective. The expected improvement which would help the subsidiary airline to successfully implement the new route are the increasing demand competitive, increasing the profit operation, reducing cost per unit preventing from the route suspension.

Chapter 5: Discussion

5.1 Research Overview

To remind, the statement of the project is to investigate the international potential route study for the subsidiary airline. The case studied airline is supported by the Thai subsidiary which operates the mixing strategy of full-service and low-cost service. The specific aircraft, Airbus 320, is given and fixed in the study. The scope of the project is the flight duration of 4 hours from Suvarnabhumi international airport, Bangkok, Thailand. In overview, each destination route has its own characteristic and unique potential which may be in effect depending on the airline business strategy and network. The potential has found to be described into 4 categories which are the customer, competitor, airport and macro-environment. However, the scope of potential study is very diverse which perhaps difficult to simply determine the potential of route study. The decision-making tools has arrived and been playing the important role of choice selection which are MOA and AHP. Each of the potential route has the strength and weakness point which perhaps beneficial to the airline business. In the airline operation, the potential has been regarded upon two considerations which are the operation and profitability.

5.2 Stage 1

5.2.1 A consideration of the operating potential route selection in Stage 1

In the beginning of Stage 1, the author began to understand the given information which were given from the Thai subsidiary airline. The scope was found to be very wide and ineffective to construct the concise route study; where, 13 countries and 167 international airports were found to be studied. The numerous of airport choices and information led to the complexity and difficult of the analysis and evaluation. The author decided to develop the criteria that would differentiate and filter the number of airport to be lower. During the criteria selection, there were 2 main constraints that were derived from the aircraft capability and flight duration. The author had derived the project scope to 2 limitations which were the runways specification and distance travel. Several airports had failed to meet such limitations. However, the problem had arisen; where, the number of airports was still numerous. The fleet manger suggested the author to investigate the air traffic demand. The sufficient demand was told to be 25% of the loading factor for the 4 years average historical demand, and the market capacity ratio was recommended to be equal or above 60% or 0.6. At the end of Stage 1, 22 airports were found to be operational.

5.2.2 The examination of operating potential route selection in Stage 1

From the interview 1, the initial hypothesis of potential route was believed that the airport that had the high demand would likely to have the high route potential as well. However, the finding result of potential route selection in section 4.2.5 has shown that the high demand hypothesis is unaccepted because the list of potential route is composed of both low and high demand routes.

5.2.3 The limitation of operating potential route selection in Stage 1

To achieve the result, the author went through several online researches, interview and investigation of historical data. However, the data analysis was found to be difficult to understand the demand behavior due to the inexperience of airline field and the variation of demand behavior. The peak and drop of demand were shown on the data, but the cause was not described; so, the author discussed with the fleet planning manager and assumed that the huge change of demand was caused from the added or changed capacity which would referred to the correspondence between the airline supply and passenger demand. The assumption may lead to the uncertainty and risk of wrong analysis in the route study. Throughout the research and studied, another 2 limitations of research were found to be the criteria 4 and the source of historical data. The criteria 4 was set as the market capacity ratio equal to or above 60% which would overlook the potential of new opening market. Second, the source database was the private information from the Star alliance group; where, the data of non-star alliance airline would not be studied in this studied. The above of limitation in Stage 1 could have affected the result.

5.3 Stage 2

5.3.1 The consideration of operating potential route decision making process in Stage 2

Once Stage 1 was completed, the author proceeded to Stage 2. Stage 2 was composed of the analytic process of Stage 1's information and the adding research. To begin with the AHP analysis, the MOA was used to develop the AHP criteria such as customer, competitor, airport and macro-environment. The customer and competitor factor were straightly taken from the MOA; however, the author changed from the customer channel and opportunity factor into the airport and environment in order to suit with the airline application. The AHP criteria and sub-criteria selection and weight evaluation went very well throughout the interview of 3 experts from different organizations. The level of inconsistency of criteria and sub-criteria were found to be lower than 10%. The priority of the potential criteria was addressed as the customer, competitor, airport and macro-environment respectively. As the result, the AHP analysis has shown the operating potential value for 22 potential airports, and the top 5 potential routes are Hong Kong, Singapore, Cebu, Kaohsiung and Wuxi.

5.3.2 The examination of operating potential route decision making process in Stage 2

According to the literature review in section 2.6.1, the result of criteria and sub-criteria weight evaluation has proven that the experience and suggestion of 3 interviewed experts is reliable which also supports the concept of the AHP pairwise comparison. Whereas, the top 5 potential routes have provided the second evidence which confirms that the demand has the heavy impact to the potential because the SIN and HKG are top 2 potential route result from AHP analysis; however, the demand potential does not indicate the feasibility of route; where, the top 2 route were rejected by the Thai subsidiary airline upon 2 reasons which were the high competitive market and the recent suspended secondary airport, the Macau route. Both Singapore and Hong Kong route have been suspended from the study. This finding has supported that the different market strategy of business would see the potential in different perspective. Due to the recent state of independence, the high competitive market is the risk rather than the potential; even though, the demand is high.

5.3.3 The limitation of operating potential route decision making process in Stage 2

From the pairwise comparison approach in Stage 2, the primary drawback has been realized to be the expert rating methodology. The concept of AHP is heavily relied on the operator or expert's judgement and experience; where, the value of pairwise comparison may results in different solution based on the perspective of operator. The inconsistency level is only used to check the effectiveness of the pairwise comparison but cannot be used to determine the correction of the weighted result.

5.4 Stage 3

5.4.1 The consideration of profit potential route analysis in Stage 3

During Stage 3, the author focused on the profitability and cost structure. The analysis was done by the subtracting revenue and total expense. The information of cost structure was provided from the Thai subsidiary airline. According to the methodology and result of Stage 3, the airfare estimation was firstly produced which was derived from the average of breakeven airfare to identify the net present value. This used estimating method is the same as in the Thai subsidiary case studied in order to reflect the company performance. Also, the fleet planning mange could clearly and easily check the result without the further knowledge and understanding. The net present value of Cebu, Kaohsiung and Wuxi have been found to be 87.9, 81.75 and 87.13 million THB respectively. The operating and profit potentials are different. The Cebu has the high operation and profit potential than Kaohsiung and Wuxi. Whereas, Both Kaohsiung and Wuxi route have the lowest potential in term of operation; however, the Wuxi produced the higher NPV than Kaohsiung route. From the graphical comparison between Cebu, Kaohsiung and Wuxi, the expected net present value has shown that the Cebu route has the higher operating potential at approximately 2.03 times but only 0.9% of producing profit higher than Wuxi. From this analysis, the Mactan-Cebu route has been the most appropriate potential route in this study. Furthermore, the cost sensitivity of Cebu's cost structure has been heavily impacted by the fuel & cost and overhaul & maintenance cost.

5.4.2 The examination of profit potential route analysis in Stage 3

The result of operating and profit potential route have found to be different which is a major evidence that the high operating potential route would not always be the success operation; whereas, the profitability is also equivalently important. By assessing both operating and profit potential, the highest success rated potential route can be concluded. According to the literature review in section 2.3.2, the fuel & oil cost and overhaul & maintenance cost have been discussed to be the majority of operation cost, and also the fuel & cost is also found to be the airfare driver in section 4.4.1; where, the airfare would be increased as the distance is further. The finding of sensitivity analysis has supported that the non-loading variable has the greater impact to the cost of operation than any other variables.

5.4.3 The limitation of profit potential route analysis in Stage 3

The problem and difficulty were rarely distinguished due the prompt template and cost structure. However, the limitation of benefit was found to be concerned. The cost estimate was constructed based on the internal methodology which was lack of the competition consideration and incomparable to the external market performance. The actual implementation perhaps would be slightly different from the proposed result, and the Thai subsidiary should be aware.

Chapter 6: Conclusion

6.1 Conclusion and summary

The dissertation statement is to develop the international potential route study for the subsidiary airline which has been done throughout Stage 1, 2 and 3. Stage 1 has focused on the information gathering and operating potential route selection. Stage 2 has focused on the analytic decision making to identify the operating potential route selection, and Stage 3 focuses on the profitability estimation of the selected route indicating the profit potential of the route study. The result has been developed from several methodologies and tools such as the market opportunity analysis, the analytic hatchery process, Porter's value chain, the Holt-Winter model, the net value present, the ABC classification analysis, PESTLE analysis and the interview. The information is primary gathered from Thai subsidiary airline, the Star alliance, Center of aviation database and online research. The author has accomplished the objective of this potential route study project as following.

First, the operating potential route study is greatly important to the Thai subsidiary airline to expand the operation in order to increase the profit by rising the loading factor of the aircraft. However, the wide scope of project has directed to the difficulty and massive of raw information facing with 160 airport options within 13 countries. The partial concept of AHP criteria has found to be adaptive initialing the notion of filtering the airport and narrow the scope of study. The criteria are simplistic enough which can be directly developed from the constraint of project which are the distance and the aircraft specification. The list of raw airports would be able to be minimized to 137 functional airports. Within 2 constraints, the effect of criteria is yet insufficient to draw out the potential airport. The demand and supply influence has been further studied with the collaboration with the interview method. The demand has been found to be a great potential indicator for the potential route selection because the airline would be making the revenue by carrying the passenger demand throughout the flight. However, the amount of made profit would be also influenced from the supplying capacity. The relationship between demand and supply has led to 2 additional constraints which are the loading factor and the market capacity ratio. The load factor has been acting as the minimum requiring demand based on the assigned aircraft specification. The list of functional airport could be minimized by focusing on the sufficient demand airport. Whereas, the market capacity ratio has shown the comparison between current demand and capacity of the market allowing the market condition to be assessed. The airport that has been saturated with demand closing to the capacity could lead to the spill of available demand. Within the first objective, the criteria selection, demand & supply influence and interview have been well collocated to identify key potential and leading to precise focus of the route study; where, the operating potential route has been resulted in 22 alternatives within 7 different countries. The airline could firstly benefit and be selective about the future route expansion throughout these alternatives.

Second, the examination of markets between Thailand and 7 different countries has been conducted to reveal the highest route expansion potential. The decision-making process of the potential route selection has been firstly difficult due the unidentified value of important of airport characteristic and the right focusing scope of decision. The completed analytic hierarchy process has been powerful decision making technique that allow 22 potential airports to be evaluated and indicating the value of potential in the numerical term. According to literature review in section 2.5 and 2.6, the market opportunity analysis concept which has been found to well collaborate with the AHP analysis. The MOA has helped as the guideline to develop the AHP framework and produced 4 main key opportunity criteria which are customer, competitor, airport and macro-environment and 15 sub-criteria.

1. Customer
    a. Inbound passenger demand

b. Outbound passenger demand

c. The market capacity ratio

2. Competitor

a. The number of operating Thai airline

b. The number of operating Foreign airline

c. The number of direct flight frequency

3. Airport

a. The airport ranking by the market share in Asia Pacific

b. The number of international connecting destination

c. The number of domestic connecting destination

4. Macro-environment

a. Political

b. Economic

c. Social

d. Technological

e. Legal

f. Environmental

The customer potential has been interchangeably referred to the incoming or future demand. The passenger demand has behaved according to 3 demand components which are level, trend and seasonality. The concept of Holt-Winter model has allowed the passenger demand to be forecasted regarding to 3 variations and capable for the demand component to be updated by the smoothing constant in order to gain the higher forecasting accuracy. Throughout the Centre for Aviation and Star Alliance private database, the information of competitor in the market and airport characteristic have been collected indicating the current situation. Lastly, the PESTLE analysis has been reviewed and studied to assess the impact of macro-environment which is composed of 6 areas, political, economic, social, technology legal and environment. From the above assigned criteria and sub-criteria from the MOA, the AHP framework has been eventually constructed regarding to the route opportunity and potential.

Applying the pairwise comparison method of AHP according to the literature review in section 2.6.1 and the methodology in section 3.3.2.2, the close-ended interview has been constructed with 3 aviation experts providing the weight score for each criterion. The expected result of interview is mainly focused on the given 1-9 rating scale. The result is primary focusing on the customer at 0.5347; whereas, the secondary focus is the competitor at 0.2007. As in the discussion of Stage 2, the process of completion has been straight forward and systematically show the clear step of calculation. Throughout the AHP evaluation, the top 5 potential route have found to be Singapore, Hong Kong, Cebu, Kaohsiung and Wuxi which have the total AHP score of 0.0518, 0.0502, 0.0318, 0.0162 and 0.0156 respectively. Each of airport has the specific strength and weakness which has been analyzed in red to green shade using the conditional formatting of Microsoft Excel. The visual conditional indicator has illustrated that Hong Kong and Singapore are the high competitive market due to the high direct flight frequency; whereas, the strength of both airports is the customer due to the high passenger traffic for the inbound and outbound flight. On the other hand, the Mactan-cebu and Kaohsiung have been similarly equivalent in both strength and weakness. The strength is the low competitive market, and the weakness is the medium customer potential. However, Cebu has the high customer potential than Kaohsiung. The Wuxi airport has the lowest potential among alternative. For the Thai subsidiary airline, the high competitive market is inappropriate due to the low availability market share, high competency requirement and incorrect market strategy. Thai subsidiary airline has offered both business and economic class which can be implied as the full-service carrier. Due to the lack of price competitive and brand service loyalty, the low competitive market has seen to be more appropriate. From the request of the airline, Singapore and Hong Kong airport are removed from the profitability study. At the end, the top 5 potential airports have been found for 5 unassigned aircrafts.

Third, the profitability is one of the feasibility potential indicating the return of investment. The purpose is to identify the most potential route among 3 alternatives which are Cebu, Kaohsiung and Wuxi. To be completed, the profit estimation has been developed attempting to achieve the most appropriate potential route in the study. The cost structure and airfare estimation methodology have been given from the Thai subsidiary airline; so that, the estimate result would have been corresponding to the Thai subsidiary airline's infrastructure. The revenue estimation has been developed from the average breakeven airfare when the loading factor has reached at 50%, 60%, 70%, 80% and 90%. Two primary factors have been found to impact the airfare price which are the loading factor and the distance travel. The estimating airfare of Cebu, Kaohsiung and Wuxi are 8, 365 THB, 7,776 THB and 8,325 THB. The increasing in loading factor only leads to the increasing consumption goods such as meal & drink and disposable utensils. Whereas, the increasing of distance has resulted in the higher fuel consumption and the cost of overhaul & maintenance. With the estimated airfare, the profitability of Cebu, Kaohsiung and Wuxi have been developed using the net present value concept as in the literature review in section 2.3.3. The strength of NPV allows each potential route to be assessed from the return of investment and compared to find the most appropriate potential route. With the dynamic loading factor at 60%, 65%, 69%, 72%, 74% and 75% that is set from the Thai subsidiary airline, Cebu could produce the highest returning profit at 87.88 million THB; whereas, Kaohsiung and Wuxi could produce the returning profit at 81.75 and 87.13 million THB respectively. From this result, the non-loading variable cost has higher impact than the loading variable cost. To conclude the final appropriate potential route for the study, both operational potential and profitability has been plotted together showing the expected net present value of route.

According to Figure 58 in section 4.4.3, Mactan-Cebu route has shown the significant returning profit and the highest operation potential and become the most appropriate route for the network expansion. In the sensitivity analysis, the NPV of Cebu operation has mainly found to be 24.06%, 16.85%, 13.49%, 11.89%, 8.77% decreasing as the 10% increasing of 5 non-loading variable cost which are the fuel, overhaul & maintenance, flight equipment lease fees, management & administration and flight equipment insurance cost. According to the literature review in section 2.3.2, the result in section 4.4.4, discussion and recommendation, the non-loading factor has been concluded to be the critical cost factor for the airline industry.

In conclusion, the potential route study has initially found to be wide in scope of research. However, the collaboration of several decisive methodology and tools have been beneficial to narrow the scope and information into two aspects which are the operational and profitability potential. Each of decisive methodology and tool has the unique advantage that would fulfil the gap of one another. The MOA and AHP are the main project approach that has provided the completed set of continual analysis steps with the simplicity and keys of potential study which have found to be the customer, competitor, airport and macro-environment. Where, 160 candidate airports have been screened into 22 potential airports which further be evaluated into the top 5 potential routes as the recommended route for 5 unassigned aircrafts, and the most appropriate route is concluded to be Mactan-Cebu. However, the effectiveness of information has shown the great impact to the result. In fact, the mislead or misuse of information could lead the result into the different ways.

6.2 Project contribution

The major contribution of this project is the integration of route study. The scope and objective of the project is not only covering the operating potential route but also the profitability of route potential. From several case studies in the literature review, the process of either aircraft or route selection were concluded as the best solution has been produced regardless of the cost consideration. However, the potential that had been found were analyzed and evaluated based on the general and standard information, but each individual airline would have different strategy and infrastructure capability. The actual potential could be referred to the correspondence between the ideal potential and business structure. This project could be beneficial to any airline industry that has been studying the route selection regardless of the business strategy because the researching methodology is adaptive allowing the firm to analyze from the beginning of service value creation to route selection. Throughout the methodology and approach, the cost of analysis is cheap comparing to the third-party analysis provider; where, the participating airline would reduce the initial cost and generate more profit. This research is limited to non-airline business that cannot be straightly used; however, the concept of decision-making process has found to adaptive. To apply this research to non-airline business, the criteria and sub-criteria selection must have been reestablished regarding to the scope of interested.

The weakness and limitation of this research is the flexibility that allow the firm to assess different route alternatives because the entire information gathering must be redone. Also, the information has been rapidly changing throughout the period, and the tremendous effort of updated information would be necessary and could be difficult and decreasing the efficiency of the entire planning process. Secondly, the risk and uncertainty has not been critically investigated; where, the risk and uncertainty of study has been heavily relying on the criteria and sub-criteria examination.

6.3 Recommendation for further research

The future research recommendation would be the flight timetable development to investigate the appropriate time of the Cebu flight in the airline network system. The connectivity would be the important performance indicator for the flight time slot and maximum loading factor. However, the slot time can only be selected based on the availability of time schedule. The actual slot time perhaps different from the intention. Therefore, the statement of future research would be the development of flight timetabling for Cebu route in the airline network system.

6.4 Thai subsidiary airline's feedback and comment

According to the received feedback in Appendix 10, the overall outcome has found to be positively pleased by the Thai subsidiary airline; where, the result has been satisfied. The fleet planning manage has discussed and commented between the academic result and the actual planning process. In term of academic, the result of this route study is well researched and constructed; however, the approach method is lack of the uncertainty and risk evaluation. At the end, the fleet manager concluded that the result of this project would be beneficial for the future route planning.

The Thai subsidiary is currently working on opening the Mactan-Cebu route using the aircraft A320. The planned selling price is at 8,100 THB or £180. The first version of available time tabling is shown in Figure 72. The airline is planning to operate 7 flight per week with 2 flight periods, the morning and afternoon flight. The morning period will be operated on Wednesday, Friday and Sunday; whereas, the afternoon flight will be operated on Monday, Tuesday, Thursday and Saturday.

Aln	Flt Nbr	Ops Suffix	Eff Date	Dis Date	Freq	Dep	DepT	Arr	ArrT	Aircraft Owner	Aircraft Type	Service Type
WE	0626		30OCT16	25MAR17	3 5 7	BKK	800	CEB	1250	WE	32S	J
WE	0626		30OCT16	25MAR17	12 4 6	BKK	1405	CEB	1850	WE	32S	J
WE	0627		30OCT16	25MAR17	3 5 7	CEB	1350	BKK	1640	WE	32S	J
WE	0627		30OCT16	25MAR17	12 4 6	CEB	1940	BKK	2230	WE	32S	J

Figure 72: The planned time tabling of Mactan-Cebu route

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APPENDIX

Appendix 1: The aircraft specification (Airbus A320) (Anon, 2016a)

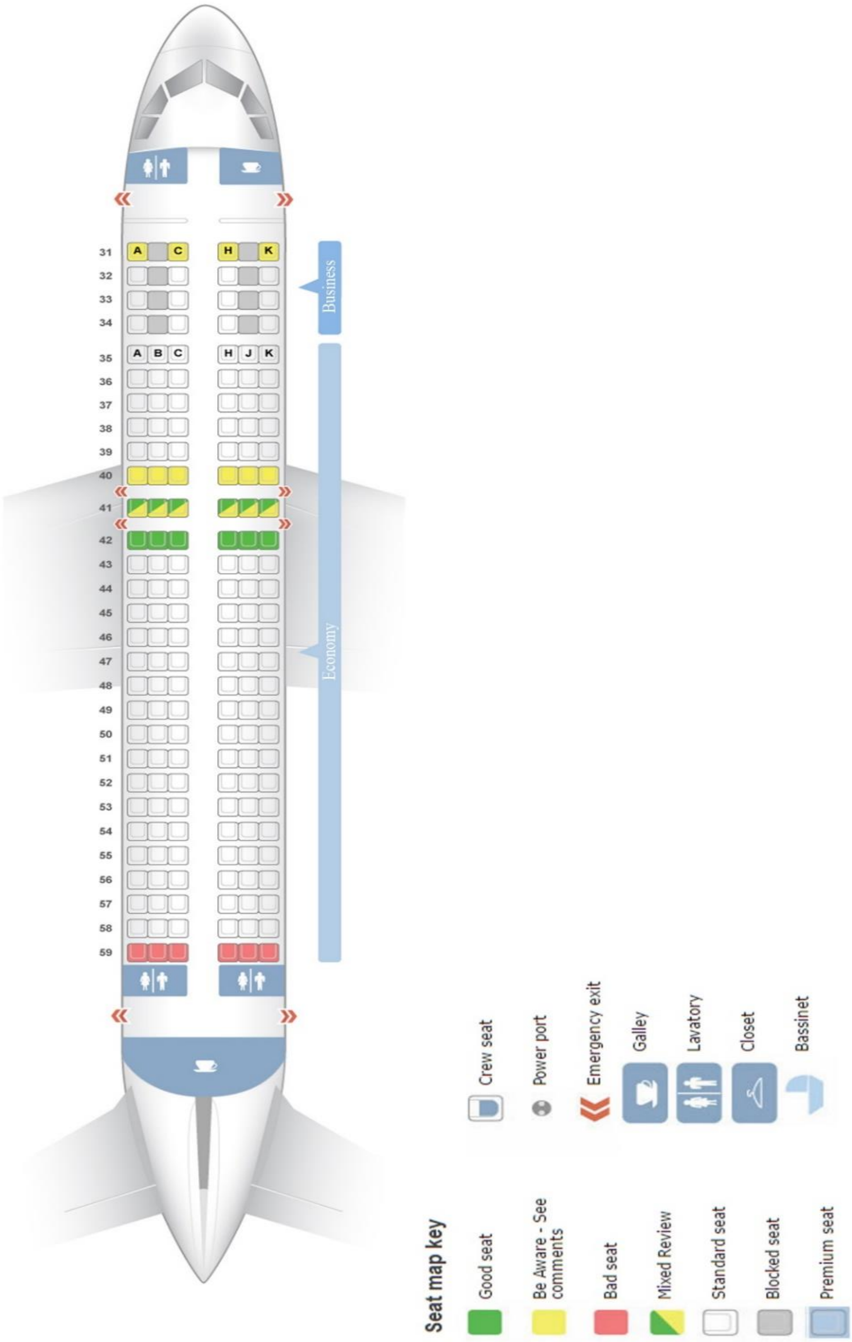

Figure 73: The aircraft A320 specification

Appendix 2: Interview form 1 and 2

Table 45: The result of interview 1

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Faculty of Engineering, Chulalongkorn University
Phayathai Road, Bangkok 10330, Thailand
Tel. (662)2186804, Fax (662)2186805,E-mail: cuse.chula@gmail.com

Date: 7 March 2016

Interview 1

Cadidate's name: Wutcharin Thatap
Interviewed by: Phitthawat Taweewattanapaisan

1. Is the collected information appropriate to be used in the evaluation?

The information is sufficiently enought to identify the capa ility of the airport whether the A320 would be able to operate or not. However, this information would not be able to reveal the great opportunity airport because there are too many airports to be investigated.

2. What is the most and least important information for the evaluation?

In term of airline opportunity operation, the customer is primary source that provides revenue to the airline. The airport that has shown the great amount of passenger interest would indicate the probability of success. however, the high passenger traffic airport would be very attractive to other as well which must be considered on your jostification.

3. Is there any other possible criteria?

From the experience, the first suggestion would be the loading factor to measore the amount of interest passenger and the aircraft capacity to indicate the possibility of airline to operate in the certain route without the negative contribution. Normally, if the number of passenger is lower than 60% of cabin, the route would likely be unprofitable. However, I would suggest 25% of loading factor due to the average of 4 demand in case that there is a growth demand in a recent year.

The second suggestion is to observe the competitor performance throughout the current market capacity ratio. If the market capacity is very much higher than the passenger demand, then the potential market availability would even less. However, the market that has closed number between passenger demand and capacity would have the possibility that the passenger demand would growth in futher. In this case, I would recommend to look for the market that has ratio at 60% because the market would also grow corresponding to the increase capacity. Therefore, the flight would be operatable. Every criteria information is equally important.

(Interviewee Signature)

Table 46: The result of interview 2

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Date: 30/6/2016

Interview 2: AHP criteria and sub-criteria evaluation form

Cadidate's name: Wutcharin Thatan

Interviewed by: Phitthawat Taweewattanapaisan

Scoring methodology

AHP evaluation forms are to be completed by the interviewee to rank the criteria and sub-criteria in the pairwise comparison based on the experience of interviewee. The numerical scoring methodology is 1-9 score as the following:

Scale	Degree of preference
1	Equal importance
3	Moderate importance of one factor over another
5	Strong or essential importance
7	Very strong importance
9	Extreme importance
2,4,6,8	Values for inverse comparison

A. 4 main criteria

A.1.

Customer	9	8	7	6	5	(4)	3	2	1	2	3	4	5	6	7	8	9	Competitor

Briefly explain

The airline operation is driven by the passenger demand

A.2.

Customer	9	8	7	6	5	4	(3)	2	1	2	3	4	5	6	7	8	9	Airport

Briefly explain

The customer focus is important to provide the right route

A.3.

Customer	9	8	(7)	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Macroenvironment

Briefly explain

-

A.4.

Competitor	9	8	7	6	5	4	3	2	1	2	(3)	4	5	6	7	8	9	Airport

Briefly explain

The airline can provide competitive advantage to the airline network

A.5.

Competitor	9	8	7	6	5	4	(3)	2	1	2	3	4	5	6	7	8	9	Macroenvironment

Briefly explain

Depend on situation, the competition perhaps difficult between airlines, but the microenvironment could affect the entire market

A.6.

Airport	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	Macroenvironment

Briefly explain

Airport provides the accessibility; whereas, the microenvironment oftenly provides threat.

B. Customer

B.1

The number of outbound passenger	9	8	7	6	5	4	3	2	(1)	2	3	4	5	6	7	8	9	The number of inbound passeng

Briefly explain

The flight always operates as the roundtrip

B.2

The number of outbound passenger	9 8 7 6 5 4 3 2 1 2 (3) 4 5 6 7 8 9	The market capacity ratio

Briefly explain

High competitive market does not have potential

B.3

The market capacity ratio	9 8 7 6 5 4 (3) 2 1 2 3 4 5 6 7 8 9	The number of inbound passenger

Briefly explain

C. Competitor

C.1

Thai airline operating direct flight	9 8 (7) 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Foreign airline operating direct flight

Briefly explain

Thai passenger usually has loyalty toward the national airline

C.2

Thai airline operating direct flight	9 8 7 6 5 4 3 2 1 (2) 3 4 5 6 7 8 9	Direct flight frequency

Briefly explain

Direct flight is the most preferable option for both business and leisure passenger and also indicate the current capacity in the particular route.

C.3

E. Macroenvironment

E.1

Political	9	8	7	6	5	4	3	(2)	1	2	3	4	5	6	7	8	9	**Economic**

Briefly explain

Political situation affect the direction of economic

E.2

Political	9	8	(7)	6	5	4	3	2	1	2	3	4	5	6	7	8	9	**Social**

Briefly explain

-

E.3

Political	9	8	(7)	6	5	4	3	2	1	2	3	4	5	6	7	8	9	**Technological**

Briefly explain

-

E.4

Political	9	8	7	6	5	4	(3)	2	1	2	3	4	5	6	7	8	9	**Legal**

Briefly explain

Legal is definite factor which is applied to every airline; however, legal sometime be changed according to the government decision

E.5

Political	9	8	7	6	5	4	(3)	2	1	2	3	4	5	6	7	8	9	**~~Macro~~environmental**

Briefly explain

The risk of environmental can be forecasted, but political situation is complicate.

E.6

Economic	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	Social

Briefly explain

-

E.7

Economic	9	8	(7)	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Technological

Briefly explain

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E.8

Economic	9	8	7	6	5	4	3	(2)	1	2	3	4	5	6	7	8	9	Legal

Briefly explain

The legal can be changed sometime to increase the air transportation market.

E.9

Economic	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	Environemental

Briefly explain

The travelling decision would be made upon the purchase power and state of income which provide the greater impact than the environmental

E.10

Social	9	8	7	6	5	4	(3)	2	1	2	3	4	5	6	7	8	9	Technological

Briefly explain

The travelling trend is propaganda that influence the potiential passenger

E.11

Social	9	8	7	6	5	4	3	2	1	2	3	4	(5)	6	7	8	9	Legal

Briefly explain

The certain location can not be accessed without rights.

E.12

Social	9	8	7	6	5	4	3	2	1	2	(3)	4	5	6	7	8	9	Environemental

Briefly explain

Environmental hazard could pull down the travelling trend.

E.13

Technological	9	8	7	6	5	4	3	2	1	2	3	4	(5)	6	7	8	9	Legal

Briefly explain

-

E.14

Technological	9	8	7	6	5	4	3	2	1	2	(3)	4	5	6	7	8	9	Environmental

Briefly explain

-

E.15

Legal	9	8	7	6	5	4	(3)	2	1	2	3	4	5	6	7	8	9	Environmental

Briefly explain

Environmental hazard can decrease the number of passenger, but the flight cannot be operated without rights.

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(Interviewee Signature)

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Date: 14/06/2016

Interview 2: AHP criteria and sub-criteria evaluation form

Cadidate's name: Pansorrat Chantranon

Interviewed by: Phitthawat Tanveewattanapaisan

Scoring methodology

AHP evaluation forms are to be completed by the interviewee to rank the criteria and sub-criteria in the pairwise comparison based on the experience of interviewee. The numerical scoring methodology is 1-9 score as the following:

Scale	Degree of preference
1	Equal importance
3	Moderate importance of one factor over another
5	Strong or essential importance
7	Very strong importance
9	Extreme importance
2,4,6,8	Values for inverse comparison

A. 4 main criteria

A.1.

Customer	9	8	7	6	5	4	(3)	2	1	2	3	4	5	6	7	8	9	Competitor

Briefly explain

Customer give the business the revenue, but Competitor can make the revenue decrease.

A.2.

Customer	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	Airport

Briefly explain

Choose the airport that customer want to go
Not choose the airport that hope customer would go

A.3.

Customer	(9)	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Macroenvironment

Briefly explain

Customer travel for the specific purpose, and macro-environment maybe delay the passenger, but can't stop them

A.4.

Competitor	9	8	7	6	5	4	3	2	1	(2)	3	4	5	6	7	8	9	Airport

Briefly explain

Airport is chosen by customer. If choose low competitive airport then would be less passenger traffic also.

A.5.

Competitor	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	Macroenvironment

Briefly explain

Macroenvironment only delay customer from travelling, but competitor reduce the market share.

A.6.

Airport	9	8	7	6	5	4	(3)	2	1	2	3	4	5	6	7	8	9	Macroenvironment

Briefly explain

– no comment.

B. Customer

B.1

The number of outbound passenger	9	8	7	6	5	4	3	2	(1)	2	3	4	5	6	7	8	9	The number of inbound passenger

Briefly explain

Travelled and business passenger usually return due to the immigration

B.2

The number of outbound passenger	9 8 7 6 5 4 3 2 1 2 (3) 4 5 6 7 8 9	The market capacity ratio

Briefly explain

the market capacity ratio implies the competitiveness

B.3

The market capacity ratio	9 8 7 6 5 4 3 2 1 2 (3) 4 5 6 7 8 9	The number of inbound passenger

Briefly explain

Same as above

C. Competitor

C.1

Thai airline operating direct flight	9 8 7 6 5 4 3 (2) 1 2 3 4 5 6 7 8 9	Foreign airline operating direct flight

Briefly explain

Thai airline has more advantage than foreign airline

C.2

Thai airline operating direct flight	9 8 7 6 5 4 3 2 1 2 (3) 4 5 6 7 8 9	Direct flight frequency

Briefly explain

Passengers would prefer the shortest flight duration

C.3

Foreign airline operating direct flight	9 8 7 6 5 4 3 2 1 2 (3) 4 5 6 7 8 9	**Direct flight frequency**

Briefly explain

Same as above C.2

D. Airport

D.1

Airport ranking	9 8 7 6 5 4 3 2 1 2 3 4 (5) 6 7 8 9	**Domestic connecting destination**

Briefly explain

Passenger would prefer to use the same airline for the entire journey

D.2

Airport ranking	9 8 7 6 5 4 3 2 1 2 3 4 (5) 6 7 8 9	**International connecting destination**

Briefly explain

Accessibility to any location can be a competitive advantage

D.3

Domestic connecting destination	9 8 7 6 5 4 3 2 (1) 2 3 4 5 6 7 8 9	**International connecting destination**

Briefly explain

International connectioning destination would attract local passenger.
Domestic connectioning destination would attract the foreign passengers

E. Macroenvironment

E.1

Political	9	8	7	6	5	4	3	(2)	1	2	3	4	5	6	7	8	9	Economic

Briefly explain

economic is influenced by the political matter

E.2

Political	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	Social

Briefly explain

The political situation can lead to the unexpected incident.

E.3

Political	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	Technological

Briefly explain

Technology doesn't affect passenger decision much.

E.4

Political	9	8	7	6	5	4	3	2	1	2	(3)	4	5	6	7	8	9	Legal

Briefly explain

As Aviation State Agency, every flight is operated under the rule and regulation

E.5

Political	9	8	7	6	5	4	(3)	2	1	2	3	4	5	6	7	8	9	~~Ma~~croenvironmental

Briefly explain

Political risk stay much longer than environmental

E.6

Economic	9	8	(7)	6	5	4	3	2	1	2	3	4	5	6	7	8	9	**Social**

Briefly explain

The growth of economics is heavily impact the travelling behavior

E.7

Economic	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	**Technological**

Briefly explain

Same as E.6

E.8

Economic	9	8	7	6	5	4	3	2	1	2	3	4	(5)	6	7	8	9	**Legal**

Briefly explain

No comment

E.9

Economic	9	8	7	6	5	4	(3)	2	1	2	3	4	5	6	7	8	9	**Environemental**

Briefly explain

economic has lagree scale than environmental

E.10

Social	9	8	7	6	5	4	3	2	(1)	2	3	4	5	6	7	8	9	**Technological**

Briefly explain

not diffirent low impact

E.11

Social	9	8	7	6	5	4	3	2	1	2	3	4	5	6	(7)	8	9	Legal

Briefly explain

Legal is definite.

E.12

Social	9	8	7	6	5	4	3	2	1	2	3	4	(5)	6	7	8	9	Environemental

Briefly explain

environmental hazard can cause loss of property and life

E.13

Technological	9	8	7	6	5	4	3	2	1	2	3	4	5	6	(7)	8	9	Legal

Briefly explain

Same as E.11

E.14

Technological	9	8	7	6	5	4	3	2	1	2	3	4	(5)	6	7	8	9	Environmental

Briefly explain

Same as E.12

E.15

Legal	9	8	7	6	5	4	(3)	2	1	2	3	4	5	6	7	8	9	Environmental

Briefly explain

Legal is the bigger constraint than environmental like limitation

Paramat Chantranon.
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(Interviewee Signature)

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Date: 17/06/2016

Interview 2: AHP criteria and sub-criteria evaluation form

Cadidate's name: Khaninphit Phalavaddhana
Interviewed by: Phittharat Tarreewattanapaisan

Scoring methodology

AHP evaluation forms are to be completed by the interviewee to rank the criteria and sub-criteria in the pairwise comparison based on the experience of interviewee. The numerical scoring methodology is 1-9 score as the following:

Scale	Degree of preference
1	Equal importance
3	Moderate importance of one factor over another
5	Strong or essential importance
7	Very strong importance
9	Extreme importance
2,4,6,8	Values for inverse comparison

A. 4 main criteria

A.1.

Customer	9	8	7	6	5	4	3	(2)	1	2	3	4	5	6	7	8	9	Competitor

Briefly explain

Lower Profit and price war

A.2.

Customer	9	8	(7)	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Airport

Briefly explain

Focus on direct flight operation, high loading factor and lower the unit cost

A.3.

Customer	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	Macroenvironment

Briefly explain

The primary purchasing decision is from customer.

A.4.

Competitor	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	Airport

Briefly explain

Price is the main competitive advantage.

A.5.

Competitor	9	8	(7)	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Macroenvironment

Briefly explain

/

A.6.

Airport	9	8	7	(6)	5	4	3	2	1	2	3	4	5	6	7	8	9	Macroenvironment

Briefly explain

Airport can increase passenger demand

B. Customer

B.1

The number of outbound passenger	9	8	7	6	5	4	3	2	(1)	2	3	4	5	6	7	8	9	The number of inbound passenger

Briefly explain

The total loading factor is reffered to both ways

B.2

The number of outbound passenger	9	8	7	6	5	4	3	2	1	2	3	4	(5)	6	7	8	9	**The market capacity ratio**

Briefly explain

Indicate the availability of demand

B.3

The market capacity ratio	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	**The number of inbound passenger**

Briefly explain

/

C. Competitor

C.1

Thai airline operating direct flight	9	8	7	6	5	4	3	(2)	1	2	3	4	5	6	7	8	9	**Foreign airline operating direct flight**

Briefly explain

Price is only matter. Culture perhaps important at the same price

C.2

Thai airline operating direct flight	9	8	7	6	5	4	3	(2)	1	2	3	4	5	6	7	8	9	**Direct flight frequency**

Briefly explain

Culture is more fluencial in the purchasing decision

C.3

Foreign airline operating direct flight	9 8 7 6 5 4 3 2 1 (2) 3 4 5 6 7 8 9	Direct flight frequency

Briefly explain

Focus on Thai passenger

D. Airport

D.1

Airport ranking	9 8 7 6 5 4 3 2 1 2 (3) 4 5 6 7 8 9	Domestic connecting destination

Briefly explain

May increase the local passenger

D.2

Airport ranking	9 8 7 6 5 4 3 2 1 2 3 4 (5) 6 7 8 9	International connecting destination

Briefly explain

Increase the variety of route and accessibility, route expansion

D.3

Domestic connecting destination	9 8 7 6 5 4 3 2 1 2 (3) 4 5 6 7 8 9	International connecting destination

Briefly explain

International connecting has higher demand than domestic

E. Macroenvironment

E.1

Political	9	8	7	6	5	4	3	(2)	1	2	3	4	5	6	7	8	9	Economic

Briefly explain

the economic is changed upon political

E.2

Political	(9)	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Social

Briefly explain

Political incedent affects the direction of travelling trend

E.3

Political	(9)	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Technological

Briefly explain

/

E.4

Political	9	8	7	6	5	4	(3)	2	1	2	3	4	5	6	7	8	9	Legal

Briefly explain

Political stability, low risk. Legal maybe changed by the goverment

E.5

Political	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	~~Macro~~environmental

Briefly explain

/

E.6

Economic	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	Social

Briefly explain

Passenger demand increase as the economic growth

E.7

Economic	9	8	7	6	(5)	4	3	2	1	2	3	4	5	6	7	8	9	Technological

Briefly explain

Technology is littlely affecting the passenger demand

E.8

Economic	9	8	7	6	5	4	3	2	1	(2)	3	4	5	6	7	8	9	Legal

Briefly explain

Legal maybe adopted to the economic situation

E.9

Economic	9	8	7	6	5	4	(3)	2	1	2	3	4	5	6	7	8	9	Environemental

Briefly explain

Suspected location can be avoided

E.10

Social	9	8	7	6	5	4	3	2	1	2	(3)	4	5	6	7	8	9	Technological

Briefly explain

/

E.11

Social	9	8	7	6	5	4	3	2	1	2	3	4	5	6	(7)	8	9	Legal

Briefly explain

/

E.12

Social	9	8	7	6	5	4	3	2	1	2	3	4	(5)	6	7	8	9	Environemental

Briefly explain

May lead to decline market

E.13

Technological	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	(9)	Legal

Briefly explain

/

E.14

Technological	9	8	7	6	5	4	3	2	1	2	(3)	4	5	6	7	8	9	Environmental

Briefly explain

/

E.15

Legal	(9)	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental

Briefly explain

High impact to airline operation

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(Interviewee Signature)

Appendix 3: The list of Airports and specification

Table 47: The list of airport and specification (CAPA, 2016)

No.	Airport	Country	Origin	CODE	Distance (KM)	Runway (Meter)	Type of flight
1	Jiamusi	China	BKK	JMU	4613	2200	Non-direct
2	Mudanjiang	China	BKK	MDG	4386	2600	Non-direct
3	Hulunbuir Hailar	China	BKK	HLD	4320	2600	Non-direct
4	Qiqihar	China	BKK	NDG	4312	2600	Non-direct
5	Harbin Taiping	China	BKK	HRB	4289	3200	Non-direct
6	Manzhouli	China	BKK	NZH	4270	2820	Non-direct
7	Yanji	China	BKK	YNJ	4257	2600	Non-direct
8	Changchun	China	BKK	CGQ	4125	3200	Non-direct
9	Shenyang	China	BKK	SHE	3810	3200	Non-direct
10	Urumqi	China	BKK	URC	3595	3600	Non-direct
11	Dalian	China	BKK	DLC	3478	3300	Non-direct
12	Weihai	China	BKK	WEH	3375	2600	Direct
13	Yantai Penglai	China	BKK	YNT	3340	3400	Non-direct
14	Beijing Capital	China	BKK	PEK	3321	3200	Direct
15	Sri Guru Ram Dass Jee	India	BKK	ATQ	3320	3289	Non-direct
16	Tianjin Binhai	China	BKK	TSN	3268	3200	Direct
17	Hohhot	China	BKK	HET	3211	3600	Non-direct
18	Qingdao Liuting	China	BKK	TAO	3187	3400	Direct

19	Ahmedabad	India	BKK	AMD	3142	3489	Direct
20	Shijiazhuang Daguocun	China	BKK	SJW	3065	3400	Non-direct
21	Jinan	China	BKK	TNA	3056	3601	Non-direct
22	Chhatrapati Shivaji	India	BKK	BOM	3034	2871	Direct
23	Lombok	Indonesia	BKK	LOP	3030	2750	Non-direct
24	Manado Sam Ratulangi	Indonesia	BKK	MDC	2984	2650	Non-direct
25	Jaipur	India	BKK	JAI	2978	3505	Non-direct
26	Linyi Shubuling	China	BKK	LYI	2967	2300	Non-direct
27	Bali Denpasar Ngurah Rai	Indonesia	BKK	DPS	2961	3000	Direct
28	Indira Gandhi	India	BKK	DEL	2953	2813	Direct
29	Makassar Sultan Hasanuddin	Indonesia	BKK	UPG	2945	2500	Non-direct
30	Yancheng Nanyang	China	BKK	YNZ	2943	2200	Non-direct
31	Taiyuan Wusu	China	BKK	TYN	2926	3600	Direct
32	Goa	India	BKK	GOI	2905	3430	Non-direct
33	Huai'an Lianshui	China	BKK	HIA	2903	2400	Non-direct
34	Shanghai Pudong	China	BKK	PVG	2901	3400	Direct
35	Nantong	China	BKK	NTG	2900	3400	Non-direct
36	Shanghai Hongqiao	China	BKK	SHA	2868	3300	Non-direct
37	Xuzhou Guanyin	China	BKK	XUZ	2829	3400	Non-direct

38	Wuxi	China	BKK	WUX	2823	3200	Non-direct
39	Davao Francisco Bangoy	Philippines	BKK	DVO	2820	3000	Non-direct
40	General Santos	Philippines	BKK	GES	2812	3227	Non-direct
41	Yinchuan Hedong	China	BKK	INC	2809	3600	Non-direct
42	Changzhou	China	BKK	CZX	2808	2800	Non-direct
43	Mangalore	India	BKK	IXE	2801	2450	Non-direct
44	Ningbo Lishe	China	BKK	NGB	2787	3200	Non-direct
45	Hangzhou Xiaoshan	China	BKK	HGH	2734	3400	Direct
46	Nanjing Lukou	China	BKK	NKG	2731	3600	Non-direct
47	Calicut	India	BKK	CCJ	2708	2860	Non-direct
48	Surabaya Juanda	Indonesia	BKK	SUB	2655	3000	Direct
49	Cochin	India	BKK	COK	2679	3400	Non-direct
50	Zhengzhou	China	BKK	CGO	2668	3400	Direct
51	Trivandrum	India	BKK	TRV	2665	3389	Non-direct
52	Wuhan	China	BKK	WUH	2660	3400	Direct
53	Yiwu	China	BKK	YIW	2644	2500	Non-direct
54	Hefei Xinqiao	China	BKK	HFE	2629	3400	Non-direct
55	Luoyang	China	BKK	LYA	2621	2500	Non-direct
56	Yogyakarta Adisucipto	Indonesia	BKK	JOG	2618	2199	Non-direct
57	Wenzhou	China	BKK	WNZ	2617	3200	Non-direct

58	Solo City Adi Sumarmo	Indonesia	BKK	SOC	2605	2600	Non-direct
59	Coimbatore	India	BKK	CJB	2594	2585	Non-direct
60	Mactan-Cebu	Philippines	BKK	CEB	2555	3300	Non-direct
61	Tunxi	China	BKK	TXN	2537	2600	Non-direct
62	Semarang Achmad Yani	Indonesia	BKK	SRG	2533	1850	Non-direct
63	Taipei Songshan	Taipei	BKK	TSA	2521	2605	Non-direct
64	Lanzhou Zhongchuan	China	BKK	LHW	2514	4000	Non-direct
65	Kempegowda	India	BKK	BLR	2494	4000	Direct
66	Taipei Taoyuan	Taoyuan	BKK	TPE	2492	3660	Direct
67	Hualien	Taiwan	BKK	HUN	2477	2745	Non-direct
68	Zamboanga	Philippines	BKK	ZAM	2451	2609	Non-direct
69	Xian Xianyang	China	BKK	XIY	2449	3000	Direct
70	Bacolod–Silay	Philippines	BKK	BCD	2443	2002	Non-direct
71	Balikpapan Sultan Aji Muhamad Sulaiman	Indonesia	BKK	BPN	2437	2495	Non-direct
72	Rajiv Gandhi	India	BKK	HYD	2426	3707	Direct
73	Tiruchirapalli	India	BKK	TRZ	2419	2480	Non-direct
74	Fuzhou	China	BKK	FOC	2400	3600	Direct
75	Taichung Ching Chuan Kang	Taiwan	BKK	RMQ	2398	3659	Non-direct
76	Iloilo Mandurriao	Philippines	BKK	ILO	2394	2500	Non-direct

77	Wuyishan Fujian Province	China	BKK	WUS	2375	2447	Non-direct
78	Kalibo	Philippines	BKK	KLO	2359	2187	Non-direct
79	Nanchang	China	BKK	KHN	2304	2800	Non-direct
80	Jakarta Soekarno-Hatta	Indonesia	BKK	CGK	2299	3600	Direct
81	Tainan	Taiwan	BKK	TNN	2297	3050	Non-direct
82	Kaohsiung	Taiwan	BKK	KHH	2295	3150	Direct
83	Lal Bahadur Shastri	India	BKK	VNS	2284	2206	Non-direct
84	Quanzhou Jinjiang	China	BKK	JJN	2243	2580	Non-direct
85	Chennai	India	BKK	MAA	2229	3658	Direct
86	Manila Ninoy Aquino	Manila	BKK	MNL	2190	3737	Direct
87	Xiamen Gaoqi	China	BKK	XMN	2188	3400	Direct
88	Tarakan Juwata	Indonesia	BKK	TRK	2179	2250	Direct
89	Tawau	Malaysia	BKK	TWU	2175	2682	Non-direct
90	Laoag	Philippines	BKK	LAO	2175	2780	Non-direct
91	Clark	Philippines	BKK	CRK	2143	3200	Non-direct
92	Changsha Huanghua	China	BKK	CSX	2068	2600	Direct
93	Lhasa	China	BKK	LXA	2013	4000	Non-direct
94	Puerto Princesa	Philippines	BKK	PPS	2011	2600	Non-direct
95	Jieyang Chaoshan	China	BKK	SWA	2005	2800	Direct

96	Mei Xian	China	BKK	MXZ	2005	2578	Non-direct
97	Zhangjiajie Dayong	China	BKK	DYG	1987	2600	Non-direct
98	Visakhapatnam	India	BKK	VTZ	1931	3200	Non-direct
99	Chengdu	China	BKK	CTU	1909	3600	Direct
100	Palembang Mahmud Badaruddin II	Indonesia	BKK	PLM	1896	2500	Non-direct
101	Chongqing Jiangbei	China	BKK	CKG	1886	3200	Direct
102	Kota Kinabalu	Malaysia	BKK	BKI	1885	2987	Non-direct
103	Pontianak Supadio	Indonesia	BKK	PNK	1811	2249	Non-direct
104	Miri	Malaysia	BKK	MYY	1788	2745	Non-direct
105	Kuching	Malaysia	BKK	KCH	1721	2454	Non-direct
106	Guangzhou Baiyun	China	BKK	CAN	1708	3600	Direct
107	Shenzhen	China	BKK	SZX	1703	3400	Direct
108	Hong Kong	Hong Kong	BKK	HKG	1692	3800	Direct
109	Netaji Subhash Chandra Bose	India	BKK	CCU	1638	2399	Direct
110	Guilin	China	BKK	KWL	1611	2800	Non-direct
111	Padang Minangkabau	Indonesia	BKK	PDG	1611	2749	Non-direct
112	Dhaka Hazrat Shahjalal	Bangladesh	BKK	DAC	1570	3200	Direct
113	Guiyang	China	BKK	KWE	1565	3200	Non-direct

114	Sylhet Osman	Bangladesh	BKK	ZYL	1564	2889	Non-direct
115	Pekanbaru Sultan Syarif Kasim II	Indonesia	BKK	PKU	1474	2600	Non-direct
116	Batam Hang Nadim	Indonesia	BKK	BTH	1446	4025	Non-direct
117	Singapore Changi	Singapore	BKK	SIN	1418	4000	Direct
118	Johor Bahru Senai	Malaysia	BKK	JHB	1378	3800	Non-direct
119	Chittagong Shah Amanat	Bangladesh	BKK	CGP	1343	2940	Non-direct
120	Zhanjiang	China	BKK	ZHA	1321	2400	Non-direct
121	Malacca Batu Berendam	Malaysia	BKK	MKZ	1280	2135	Direct
122	Kunming	China	BKK	KMG	1277	4000	Direct
123	Nanning	China	BKK	NNG	1267	3200	Direct
124	Beihai Fucheng	China	BKK	BHY	1260	3300	Non-direct
125	Haikou Hainan Meilan	China	BKK	HAK	1247	3600	Direct
126	Kuala Lumpur	Malaysia	BKK	KUL	1220	4124	Direct
127	Kuala Lumpur Sultan Abdul Aziz Shah	Malaysia	BKK	SZB	1178	3780	Non-direct
128	Kuantan	Malaysia	BKK	KUA	1135	2804	Non-direct
129	Medan Kuala Namu	Indonesia	BKK	KNO	1135	3750	Non-direct
130	Lijiang	China	BKK	LJG	1110	3000	Non-direct

131	Banda Aceh	Indonesia	BKK	BTJ	1079	2494	Non-direct
132	Sanya	China	BKK	SYX	1059	3400	Non-direct
133	Lokpriya Gopinath Bordoloi	India	BKK	GAU	1045	3110	Non-direct
134	Mandalay	Myanmar	BKK	MDL	1027	4268	Direct
135	Hai Phong Cat Bi	Vietnam	BKK	HPH	1018	3050	Non-direct
136	Ipoh Sultan Azlan Shah	Malaysia	BKK	IPH	1015	1798	Non-direct
137	Hanoi Noi Bai	Vietnam	BKK	HAN	997	3800	Direct
138	Nha Trang Cam Ranh	Vietnam	BKK	CXR	939	3048	Non-direct
139	Penang	Malaysia	BKK	PEN	934	3352	Direct
140	Jinghong Gasa	China	BKK	JHG	923	2200	Non-direct
141	Da Nang	Vietnam	BKK	DAD	844	3048	Non-direct
142	Langkawi	Malaysia	BKK	LGK	826	3810	Non-direct
143	Nay Pyi Taw	Myanmar	BKK	NYT	817	3657	Direct
144	Ho Chi Minh City Tan Son Nhat	Vietnam	BKK	SGN	715	3800	Direct
145	Luang Prabang	Laos	BKK	LPQ	708	2900	Direct
146	Attapeu	Laos	BKK	AOU	660	1850	Non-direct
147	Yangon	Myanmar	BKK	RGN	612	3414	Direct
148	Pakse	Laos	BKK	PKZ	567	1625	Non-direct
149	Savannakhet	Laos	BKK	ZVK	540	1633	Direct
150	Phu Quoc	Vietnam	BKK	PQC	520	3000	Non-direct

151	Vientiane Wattay	Laos	BKK	VTE	518	3000	Direct
152	Phnom Penh	Cambodia	BKK	PNH	504	3000	Direct
153	Sihanoukville	Cambodia	BKK	KOS	470	2500	Direct
154	Siem Reap	Cambodia	BKK	REP	332	2550	Direct
155	Subic Bay	Philippines	BKK	SFS	No flight operated		
156	Bandung Husein Sastranegara	Indonesia	BKK	BDP	No flight operated		
157	Northern Cagayan Lallo	Philippines	BKK	NCIA	No flight operated		
158	Yangzhou Taizhou	China	BKK	YTY	No flight operated		
159	Dawu Golog	China	BKK	Not registered for commercial operation			
160	Hefei Luogang	China	BKK	Not registered for commercial operation			

Appendix 4: The Holt-Winter forecast of inbound and outbound passenger

Table 48: The forecasted result of inbound and outbound passenger for top 4 potential routes

3.1 Mactan-Cebu International airport (CEB)

	Alpha	Beta	Grammar						
	0.9	0.1	0.1						
Inbound	Actual demand	Deseasonalized	Level	Trend	Seasonality	Forcast	Error	Accum error	MAPE
			403.4158	3.7187					
1	[redacted]	407.1345	366.7929	-0.3155	4.0036	1630.0000	0.0000	0.0000	0.00%
2	[redacted]	410.8532	369.7363	0.0104	3.5244	1291.6033	0.1080	0.1080	5.40%
3	[redacted]	414.5719	373.1157	0.3473	0.5958	220.2934	0.1081	0.2161	7.20%
4	[redacted]	418.2905	376.4962	0.6506	0.7483	279.4563	0.1072	0.3233	8.08%
5	[redacted]	422.0092	379.8734	0.9233	0.9147	344.9656	0.1063	0.4296	8.59%
6	[redacted]	425.7279	383.2474	1.1684	1.0030	381.9345	0.1055	0.5351	8.92%
7	[redacted]	429.4466	386.6188	1.3887	0.8779	337.4686	0.1049	0.6400	9.14%
8	[redacted]	433.1653	389.9876	1.5867	0.6995	271.4120	0.1043	0.7443	9.30%
9	[redacted]	436.8839	393.3542	1.7647	0.7119	278.7459	0.1037	0.8480	9.42%
10	[redacted]	440.6026	396.7188	1.9247	1.1280	445.6943	0.1032	0.9512	9.51%
11	[redacted]	444.3213	400.0816	2.0685	1.2266	488.9721	0.1028	1.0540	9.58%
12	[redacted]	448.0400	403.4428	2.1977	1.1450	460.4567	0.1024	1.1564	9.64%
13	[redacted]	451.7586	406.8026	2.3139	0.5822	236.1515	0.1021	1.2585	9.68%
14	[redacted]	455.4773	410.1610	2.4184	0.9177	375.4538	0.1018	1.3603	9.72%
15	[redacted]	459.1960	413.5182	2.5123	0.9974	411.5048	0.1015	1.4618	9.75%
16	[redacted]	462.9147	416.8744	2.5967	1.0434	434.0816	0.1013	1.5631	9.77%
17	[redacted]	466.6334	420.2297	2.6725	1.0501	440.4761	0.1011	1.6642	9.79%
18	[redacted]	470.3520	423.5841	2.7407	1.0290	435.1734	0.1009	1.7650	9.81%
19	[redacted]	474.0707	426.9377	2.8020	1.0800	460.4340	0.1007	1.8658	9.82%
20	[redacted]	477.7894	430.2906	2.8571	1.2369	531.5651	0.1006	1.9663	9.83%
21	[redacted]	481.5081	433.6430	2.9066	0.9512	412.0007	0.1004	2.0668	9.84%
22	[redacted]	485.2267	436.9947	2.9511	1.1706	511.0192	0.1003	2.1671	9.85%
23	[redacted]	488.9454	440.3460	2.9911	1.0574	465.1890	0.1002	2.2673	9.86%
24	[redacted]	492.6641	443.6968	3.0271	1.3194	584.9201	0.1001	2.3674	9.86%
25					0.6350	283.6712			
26					0.9370	421.4145			
27					1.0087	456.7182			
28					1.0501	478.6384			
29					1.0561	484.5774			
30					1.0372	479.0203			
31					1.0830	503.4939			
32					1.2243	572.8624			
33					0.9671	455.4461			
34					1.1646	551.9666			
35					1.0627	506.8915			
36					1.2985	623.2886			

Figure 74: The forecasted inbound demand of Cebu

Outbound	Actual demand	Deseasonalized	Level	Trend	Seasonality	Forcast	Error	Accum error	MAPE
	Alpha	Beta	Grammar						
	0.90	0.10	0.10						
			456.7827	-2.0382					
1	[redacted]	454.7445	409.0662	-6.6060	3.0259	1376.0000	0.0000	0.0000	0.0000%
2	[redacted]	452.7063	406.7751	-6.1745	2.6905	1082.8136	0.1110	0.1110	5.5495%
3	[redacted]	450.6682	404.9839	-5.7362	0.7145	286.2270	0.1111	0.2221	7.4029%
4	[redacted]	448.6300	403.1934	-5.3416	0.9496	379.1087	0.1101	0.3322	8.3040%
5	[redacted]	446.5918	401.3985	-4.9869	0.9024	359.0175	0.1091	0.4413	8.8260%
6	[redacted]	444.5537	399.5996	-4.6681	0.7851	311.2057	0.1083	0.5496	9.1599%
7	[redacted]	442.5155	397.7971	-4.3816	0.7051	278.4504	0.1075	0.6571	9.3875%
8	[redacted]	440.4773	395.9914	-4.1240	0.8445	332.2545	0.1068	0.7640	9.5496%
9	[redacted]	438.4392	394.1828	-3.8924	0.7686	301.2033	0.1062	0.8702	9.6687%
10	[redacted]	436.4010	392.3716	-3.6843	1.2191	475.7883	0.1057	0.9758	9.7585%
11	[redacted]	434.3628	390.5581	-3.4972	1.3330	518.1152	0.1052	1.0810	9.8273%
12	[redacted]	432.3246	388.7425	-3.3291	1.1959	462.8708	0.1047	1.1857	9.8808%
13	[redacted]	430.2865	386.9249	-3.1779	0.5740	221.2412	0.1043	1.2900	9.9230%
14	[redacted]	428.2483	385.1057	-3.0421	1.1255	431.9131	0.1039	1.3939	9.9564%
15	[redacted]	426.2101	383.2849	-2.9199	1.1027	421.3178	0.1036	1.4975	9.9832%
16	[redacted]	424.1720	381.4628	-2.8102	0.6766	257.3597	0.1033	1.6008	10.0047%
17	[redacted]	422.1338	379.6394	-2.7115	0.8528	322.9188	0.1030	1.7038	10.0221%
18	[redacted]	420.0956	377.8149	-2.6228	1.0188	384.0201	0.1028	1.8065	10.0362%
19	[redacted]	418.0574	375.9894	-2.5430	1.0094	378.7304	0.1025	1.9091	10.0476%
20	[redacted]	416.0193	374.1630	-2.4714	1.3172	491.9210	0.1023	2.0114	10.0569%
21	[redacted]	413.9811	372.3359	-2.4070	1.1836	439.9450	0.1022	2.1135	10.0645%
22	[redacted]	411.9429	370.5079	-2.3491	1.1215	414.8806	0.1020	2.2155	10.0706%
23	[redacted]	409.9048	368.6794	-2.2970	0.9832	361.9573	0.1018	2.3174	10.0755%
24	[redacted]	407.8666	366.8502	-2.2502	1.2406	454.5346	0.1017	2.4191	10.0795%
25					0.6278	228.9102			
26					1.1242	407.3415			
27					1.1037	397.4302			
28					0.7201	257.7043			
29					0.8787	312.4730			
30					1.0281	363.2868			
31					1.0197	358.0070			
32					1.2967	452.3548			
33					1.1765	407.7558			
34					1.1205	385.8580			
35					0.9960	340.7368			
36					1.2277	417.2385			

Figure 75: The forecasted outbound demand of Cebu

3.2 Hong Kong International Airport (HGK)

Inbound	Actual demand	Deseasonalized	Level	Trend	Seasonality	Forcast	Error	Accum error	MAPE
	Alpha	Beta	Grammar						
	0.9	0.1	0.1						
			94446.4421	3169.6469					
1	[redacted]	97616.0890	88171.4448	2225.1824	0.8609	84036.0000	0.0000	0.0000	0.00%
2	[redacted]	100785.7358	90929.6805	2278.4878	0.6260	56585.7139	0.1031	0.1031	5.15%
3	[redacted]	103955.3827	93787.6932	2336.4403	0.8230	76713.6579	0.1034	0.2065	6.88%
4	[redacted]	107125.0295	96646.1706	2388.6440	0.9037	86869.2734	0.1027	0.3092	7.73%
5	[redacted]	110294.6764	99504.0731	2435.5698	0.9401	93102.6065	0.1021	0.4112	8.22%
6	[redacted]	113464.3232	102361.4479	2477.7503	0.5570	56775.3247	0.1016	0.5128	8.55%
7	[redacted]	116633.9701	105218.3481	2515.6653	0.9531	99926.8808	0.1011	0.6139	8.77%
8	[redacted]	119803.6169	108074.8218	2549.7461	0.7633	82233.2818	0.1007	0.7147	8.93%
9	[redacted]	122973.2638	110930.9120	2580.3806	1.0746	118873.5000	0.1004	0.8151	9.06%
10	[redacted]	126142.9106	113786.6576	2607.9171	1.2348	140166.2042	0.1001	0.9152	9.15%
11	[redacted]	129312.5575	116642.0935	2632.6689	1.0644	123894.6282	0.0999	1.0151	9.23%
12	[redacted]	132482.2044	119497.2508	2654.9178	1.1705	139617.0332	0.0997	1.1148	9.29%
13	[redacted]	135651.8512	122352.1579	2674.9167	0.9360	114334.3103	0.0995	1.2143	9.34%
14	[redacted]	138821.4981	125206.8399	2692.8932	1.1362	142050.3709	0.0994	1.3137	9.38%
15	[redacted]	141991.1449	128061.3197	2709.0519	1.1228	143599.8236	0.0992	1.4130	9.42%
16	[redacted]	145160.7918	130915.6178	2723.5765	1.3292	173822.9289	0.0991	1.5121	9.45%
17	[redacted]	148330.4386	133769.7524	2736.6323	1.0505	140382.4546	0.0990	1.6111	9.48%
18	[redacted]	151500.0855	136623.7402	2748.3679	0.8986	122665.5593	0.0990	1.7101	9.50%
19	[redacted]	154669.7323	139477.5959	2758.9167	0.7869	109674.0633	0.0989	1.8090	9.52%
20	[redacted]	157839.3792	142331.3329	2768.3987	0.9303	132324.4529	0.0989	1.9079	9.54%
21	[redacted]	161009.0260	145184.9633	2776.9219	0.5391	78222.3948	0.0988	2.0067	9.56%
22	[redacted]	164178.6729	148038.4978	2784.5831	0.7123	105388.3223	0.0988	2.1054	9.57%
23	[redacted]	167348.3197	150891.9461	2791.4696	0.9005	135814.2359	0.0987	2.2042	9.58%
24	[redacted]	170517.9666	153745.3169	2797.6598	1.0005	153754.6465	0.0987	2.3029	9.60%
25					0.9533	149227.5873			
26					1.1334	180599.0554			
27					1.1214	181814.6324			
28					1.3072	215601.2297			
29					1.0563	177176.6356			
30					0.9196	156826.4663			
31					0.8191	141976.5150			
32					0.9482	166999.2367			
33					0.5961	106653.8576			
34					0.7519	136644.4687			
35					0.9213	170006.0834			
36					1.0113	189438.8852			

Figure 76: The forecasted inbound demand of Hong Kong

Outbound	Actual demand	Deseasonalized	Level	Trend	Seasonality	Forcast	Error	Accum error	MAPE
	Alpha	Beta	Grammar						
	0.9	0.1	0.1						
			83453.3721	4173.5972					
1	[redacted]	87626.9693	79281.6321	3339.0635	0.8598	75344.0000	0.0000	0.0000	0.0000%
2	[redacted]	91800.5665	82954.4162	3372.4355	0.7928	65500.3472	0.1000	0.1000	4.9999%
3	[redacted]	95974.1637	86713.9908	3411.1494	0.8824	76171.5740	0.1005	0.2005	6.6839%
4	[redacted]	100147.7608	90474.0997	3446.0454	0.8905	80252.3149	0.1001	0.3006	7.5149%
5	[redacted]	104321.3580	94233.8267	3477.4135	0.9890	92887.1828	0.0997	0.4003	8.0060%
6	[redacted]	108494.9552	97993.2010	3505.6096	0.5595	54669.5043	0.0994	0.4997	8.3282%
7	[redacted]	112668.5524	101752.2581	3530.9544	0.8646	87754.7633	0.0991	0.5988	8.5547%
8	[redacted]	116842.1495	105511.0300	3553.7361	0.7967	83882.6130	0.0989	0.6978	8.7220%
9	[redacted]	121015.7467	109269.5456	3574.2141	0.9986	108913.5853	0.0988	0.7965	8.8502%
10	[redacted]	125189.3439	113027.8309	3592.6212	1.2235	138066.8979	0.0986	0.8951	8.9513%
11	[redacted]	129362.9410	116785.9091	3609.1669	1.0916	127306.8643	0.0985	0.9936	9.0330%
12	[redacted]	133536.5382	120543.8011	3624.0394	1.1564	139226.0804	0.0984	1.0920	9.1004%
13	[redacted]	137710.1354	124301.5258	3637.4079	0.9038	112221.6135	0.0983	1.1904	9.1568%
14	[redacted]	141883.7326	128059.1001	3649.4246	1.0706	136977.0815	0.0983	1.2887	9.2048%
15	[redacted]	146057.3297	131816.5392	3660.2260	1.1519	151709.2439	0.0982	1.3869	9.2460%
16	[redacted]	150230.9269	135573.8568	3669.9352	1.2905	174826.4429	0.0982	1.4851	9.2820%
17	[redacted]	154404.5241	139331.0652	3678.6625	1.2784	178006.7895	0.0982	1.5833	9.3136%
18	[redacted]	158578.1213	143088.1754	3686.5073	0.8878	126960.7391	0.0982	1.6815	9.3416%
19	[redacted]	162751.7184	146845.1973	3693.5587	0.7163	105132.8511	0.0982	1.7796	9.3666%
20	[redacted]	166925.3156	150602.1399	3699.8971	0.9729	146464.8918	0.0982	1.8778	9.3891%
21	[redacted]	171098.9128	154359.0112	3705.5945	0.4790	73914.8429	0.0982	1.9760	9.4095%
22	[redacted]	175272.5100	158115.8184	3710.7158	0.8211	129780.3024	0.0982	2.0742	9.4280%
23	[redacted]	179446.1071	161872.5680	3715.3192	0.8092	130949.3192	0.0982	2.1724	9.4450%
24	[redacted]	183619.7043	165629.2658	3719.4570	0.9171	151868.1986	0.0982	2.2706	9.4606%
25					0.9242	156511.7309			
26					1.0744	185940.1810			
27					1.1475	202859.1853			
28					1.2722	229644.5782			
29					1.2614	232376.4549			
30					0.9098	170997.9214			
31					0.7555	144801.4957			
32					0.9865	192743.8849			
33					0.5420	107908.4192			
34					0.8498	172360.3944			
35					0.8391	173317.1780			
36					0.9363	196867.5187			

Figure 77: The forecasted outbound demand of Hong Kong

3.3 Subaraya International Airport (SUB)

	Alpha	Beta	Grammar						
	0.9	0.1	0.1						
	Actual demand	Deseasonalized	Level	Trend	Seasonality	Forcast	Error	Accum error	MAPE
Inbound			651.7698	9.9601					
1	[redacted]	661.7299	596.5529	3.4424	3.4349	2273.0000	0%	0.0000	0%
2	[redacted]	671.6900	604.8652	3.9294	3.3051	1983.0422	11%	0.1067	5%
3	[redacted]	681.6501	613.8780	4.4377	2.4265	1477.2188	11%	0.2136	7%
4	[redacted]	691.6101	622.8929	4.8954	0.2950	182.3808	11%	0.3196	8%
5	[redacted]	701.5702	631.9027	5.3069	0.6485	407.1491	11%	0.4248	8%
6	[redacted]	711.5303	640.9080	5.6767	0.8615	548.9710	10%	0.5292	9%
7	[redacted]	721.4904	649.9090	6.0091	0.6972	450.7781	10%	0.6330	9%
8	[redacted]	731.4505	658.9063	6.3080	0.5537	363.1782	10%	0.7363	9%
9	[redacted]	741.4105	667.9003	6.5766	1.0224	680.0988	10%	0.8391	9%
10	[redacted]	751.3706	676.8912	6.8180	0.9236	622.9774	10%	0.9414	9%
11	[redacted]	761.3307	685.8794	7.0350	1.0836	740.8871	10%	1.0434	9%
12	[redacted]	771.2908	694.8652	7.2301	0.9776	677.3807	10%	1.1450	10%
13	[redacted]	781.2509	703.8488	7.4054	0.7949	558.0809	10%	1.2463	10%
14	[redacted]	791.2110	712.8304	7.5631	0.8594	611.2818	10%	1.3474	10%
15	[redacted]	801.1710	721.8102	7.7047	1.1596	835.3342	10%	1.4482	10%
16	[redacted]	811.1311	730.7885	7.8321	1.3623	993.8147	10%	1.5488	10%
17	[redacted]	821.0912	739.7653	7.9466	1.0864	802.4073	10%	1.6492	10%
18	[redacted]	831.0513	748.7408	8.0495	1.2358	924.0105	10%	1.7495	10%
19	[redacted]	841.0114	757.7152	8.1419	1.0250	775.6770	10%	1.8497	10%
20	[redacted]	850.9714	766.6885	8.2251	0.7991	611.9863	10%	1.9497	10%
21	[redacted]	860.9315	775.6609	8.2998	1.0280	796.5773	10%	2.0496	10%
22	[redacted]	870.8916	784.6324	8.3670	0.8623	676.0365	10%	2.1494	10%
23	[redacted]	880.8517	793.6032	8.4274	1.0093	800.3351	10%	2.2492	10%
24	[redacted]	890.8118	802.5733	8.4816	0.8924	715.7677	10%	2.3488	10%
25					0.8036	651.7803			
26					0.8689	712.0890			
27					1.1723	970.6871			
28					1.3773	1152.0881			
29					1.0983	928.0450			
30					1.2494	1066.2907			
31					1.0362	893.1678			
32					0.8079	703.1925			
33					1.0393	913.4114			
34					0.8718	773.6395			
35					1.0203	914.0989			
36					0.9023	815.9583			

Figure 78: The forecasted inbound demand of Surabaya

	Alpha	Beta	Grammar						
	0.9	0.1	0.1						
Outbound	Actual demand	Deseasonalized	Level	Trend	Seasonality	Forcast	Error	Accum error	MAPE
			715.6578	5.6509					
1	[redacted]	721.3088	649.7430	-1.5056	2.3360	1685.0000	0%	0.0000	0%
2	[redacted]	726.9597	654.1132	-0.9181	2.3646	1532.8497	11%	0.1083	5%
3	[redacted]	732.6106	659.2578	-0.3118	2.3000	1502.3448	11%	0.2167	7%
4	[redacted]	738.2616	664.4042	0.2340	0.4172	274.9098	11%	0.3241	8%
5	[redacted]	743.9125	669.5446	0.7247	0.5942	394.8987	11%	0.4307	9%
6	[redacted]	749.5634	674.6795	1.1657	0.7991	535.6336	11%	0.5365	9%
7	[redacted]	755.2144	679.8095	1.5621	0.5032	340.0640	11%	0.6416	9%
8	[redacted]	760.8653	684.9350	1.9185	1.1316	771.0444	10%	0.7461	9%
9	[redacted]	766.5162	690.0564	2.2388	0.9184	630.8344	10%	0.8500	9%
10	[redacted]	772.1672	695.1743	2.5267	0.6436	445.5910	10%	0.9534	10%
11	[redacted]	777.8181	700.2889	2.7855	1.6726	1166.9939	10%	1.0564	10%
12	[redacted]	783.4690	705.4007	3.0181	0.6280	441.5141	10%	1.1590	10%
13	[redacted]	789.1199	710.5098	3.2272	0.8541	605.0718	10%	1.2613	10%
14	[redacted]	794.7709	715.6165	3.4151	0.6996	499.3109	10%	1.3633	10%
15	[redacted]	800.4218	720.7211	3.5841	0.8583	617.1430	10%	1.4649	10%
16	[redacted]	806.0727	725.8239	3.7360	0.7915	573.2817	10%	1.5664	10%
17	[redacted]	811.7237	730.9249	3.8725	1.4438	1053.3685	10%	1.6676	10%
18	[redacted]	817.3746	736.0244	3.9952	1.1720	861.2157	10%	1.7686	10%
19	[redacted]	823.0255	741.1225	4.1055	0.9878	731.0051	10%	1.8695	10%
20	[redacted]	828.6765	746.2194	4.2046	1.1561	861.5285	10%	1.9702	10%
21	[redacted]	834.3274	751.3151	4.2937	0.9469	710.5543	10%	2.0708	10%
22	[redacted]	839.9783	756.4099	4.3738	0.7000	528.9398	10%	2.1712	10%
23	[redacted]	845.6293	761.5037	4.4458	1.1766	895.1674	10%	2.2715	10%
24	[redacted]	851.2802	766.5968	4.5105	0.7800	597.4419	10%	2.3718	10%
25					0.8636	665.9020			
26					0.7073	548.6028			
27					0.8678	676.9868			
28					0.8002	627.9016			
29					1.4598	1152.0018			
30					1.1850	940.4867			
31					0.9987	797.1611			
32					1.1688	938.2016			
33					0.9573	772.7507			
34					0.7078	574.4838			
35					1.1896	970.9971			
36					0.7886	647.2373			

Figure 79: The forecasted outbound demand of Surabaya

3.4 Singapore Changi Airport (SIN)

Inbound	Actual demand	Deseasonalized	Level	Trend	Seasonality	Forcast	Error	Accum error	MAPE
	Alpha	Beta	Grammar						
	0.9	0.1	0.1						
			95187.2531	646.1167					
1	[redacted]	95833.3698	86314.6445	-305.7558	0.9681	92781.0000	0.0000	0.0000	0.00%
2	[redacted]	96479.4865	86800.9623	-226.5485	0.8325	71603.1375	0.1085	0.1085	5.43%
3	[redacted]	97125.6032	87390.3880	-144.9511	0.9755	84450.6435	0.1086	0.2172	7.24%
4	[redacted]	97771.7199	87980.0528	-71.4895	0.9217	80410.3766	0.1077	0.3248	8.12%
5	[redacted]	98417.8366	88568.9040	-5.4554	1.0250	90106.0251	0.1068	0.4316	8.63%
6	[redacted]	99063.9533	89157.0124	53.9010	0.9009	79783.4891	0.1060	0.5376	8.96%
7	[redacted]	99710.0700	89744.4531	107.2549	0.9840	87784.6940	0.1053	0.6429	9.18%
8	[redacted]	100356.1867	90331.2935	155.2135	1.0360	93088.1518	0.1047	0.7476	9.34%
9	[redacted]	101002.3034	90917.5944	198.3222	0.9134	82650.8199	0.1041	0.8517	9.46%
10	[redacted]	101648.4201	91503.4103	237.0716	0.9800	89290.5043	0.1036	0.9553	9.55%
11	[redacted]	102294.5368	92088.7902	271.9024	1.0855	99580.0604	0.1032	1.0585	9.62%
12	[redacted]	102940.6535	92673.7784	303.2110	1.1698	108043.5595	0.1028	1.1613	9.68%
13	[redacted]	103586.7702	93258.4142	331.3535	1.0017	93134.2714	0.1024	1.2637	9.72%
14	[redacted]	104232.8868	93842.7335	356.6501	0.8709	81506.0527	0.1021	1.3658	9.76%
15	[redacted]	104879.0035	94426.7682	379.3885	1.1157	105098.6975	0.1018	1.4676	9.78%
16	[redacted]	105525.1202	95010.5471	399.8276	0.9929	94136.7238	0.1016	1.5692	9.81%
17	[redacted]	106171.2369	95594.0960	418.1997	1.0380	99040.6922	0.1014	1.6705	9.83%
18	[redacted]	106817.3536	96177.4382	434.7140	1.0544	101236.0678	0.1012	1.7717	9.84%
19	[redacted]	107463.4703	96760.5947	449.5582	0.9864	95297.3575	0.1010	1.8727	9.86%
20	[redacted]	108109.5870	97343.5841	462.9013	0.8735	84910.6189	0.1008	1.9735	9.87%
21	[redacted]	108755.7037	97926.4235	474.8951	0.8367	81834.7788	0.1007	2.0742	9.88%
22	[redacted]	109401.8204	98509.1279	485.6761	0.9212	90651.8307	0.1006	2.1747	9.89%
23	[redacted]	110047.9371	99091.7110	495.3668	0.9897	97970.2608	0.1004	2.2752	9.89%
24	[redacted]	110694.0538	99674.1851	504.0775	1.0522	104789.7666	0.1003	2.3755	9.90%
25					1.0126	101440.2530			
26					0.8949	90097.5662			
27					1.1152	112843.4368			
28					1.0047	102169.6384			
29					1.0453	106824.9262			
30					1.0600	108863.5873			
31					0.9988	103080.2355			
32					0.8972	93044.4096			
33					0.8641	90047.5230			
34					0.9402	98450.8099			
35					1.0017	105402.3434			
36					1.0581	111862.9045			

Figure 80: The forecasted inbound demand of Singapore

Outbound	Actual demand	Deseasonalized	Level	Trend	Seasonality	Forcast	Error	Accum error	MAPE
	Alpha	Beta	Grammar						
	0.9	0.1	0.1						
			96353.6971	707.8317					
1	[redacted]	97061.5288	87426.1591	-255.7052	0.9882	95916.0000	0.0000	0.0000	0.0000%
2	[redacted]	97769.3606	87966.8540	-176.0652	0.8199	71474.5335	0.1084	0.1084	5.4204%
3	[redacted]	98477.1923	88611.8666	-93.9575	0.9774	85810.6325	0.1085	0.2169	7.2308%
4	[redacted]	99185.0240	89257.1259	-20.0358	0.9292	82253.7645	0.1075	0.3245	8.1118%
5	[redacted]	99892.8558	89901.5666	46.4119	1.0118	90292.2394	0.1067	0.4311	8.6229%
6	[redacted]	100600.6875	90545.2599	106.1400	0.8738	78593.0738	0.1059	0.5370	8.9506%
7	[redacted]	101308.5192	91188.2813	159.8282	0.9892	89673.8080	0.1052	0.6422	9.1747%
8	[redacted]	102016.3510	91830.6987	208.0871	0.9944	90832.9252	0.1046	0.7468	9.3350%
9	[redacted]	102724.1827	92472.5731	251.4658	0.9110	83848.4713	0.1040	0.8508	9.4536%
10	[redacted]	103432.0144	93113.9596	290.4579	1.0151	94126.1103	0.1035	0.9543	9.5435%
11	[redacted]	104139.8462	93754.9073	325.5069	1.0415	97281.9118	0.1031	1.0574	9.6131%
12	[redacted]	104847.6779	94395.4608	357.0115	1.2060	113461.6081	0.1027	1.1601	9.6678%
13	[redacted]	105555.5096	95035.6598	385.3303	1.0361	98172.9795	0.1023	1.2625	9.7113%
14	[redacted]	106263.3413	95675.5402	410.7853	0.8953	85426.3092	0.1020	1.3645	9.7465%
15	[redacted]	106971.1731	96315.1343	433.6662	1.1017	105853.6866	0.1018	1.4663	9.7751%
16	[redacted]	107679.0048	96954.4709	454.2332	0.9718	94022.7693	0.1015	1.5678	9.7986%
17	[redacted]	108386.8365	97593.5762	472.7204	1.0237	99718.5445	0.1013	1.6691	9.8180%
18	[redacted]	109094.6683	98232.4735	489.3381	1.0858	106479.4942	0.1011	1.7701	9.8342%
19	[redacted]	109802.5000	98871.1838	504.2753	0.9763	96386.4376	0.1009	1.8711	9.8477%
20	[redacted]	110510.3317	99509.7261	517.7020	0.8879	88238.0568	0.1008	1.9718	9.8591%
21	[redacted]	111218.1635	100148.1173	529.7709	0.7994	79962.1060	0.1006	2.0724	9.8688%
22	[redacted]	111925.9952	100786.3728	540.6194	0.8826	88862.0071	0.1005	2.1729	9.8770%
23	[redacted]	112633.8269	101424.5062	550.3708	0.9729	98580.6257	0.1004	2.2733	9.8840%
24	[redacted]	113341.6587	102062.5299	559.1361	1.0539	107470.6264	0.1003	2.3736	9.8900%
25					1.0436	107091.7456			
26					0.9168	94595.9179			
27					1.1026	114378.5170			
28					0.9857	102807.8757			
29					1.0324	108255.7194			
30					1.0883	114722.4794			
31					0.9898	104891.8789			
32					0.9102	96967.4661			
33					0.8305	88943.8315			
34					0.9054	97472.6111			
35					0.9867	106769.2798			
36					1.0596	115250.0943			

Figure 81: The forecasted outbound demand of Singapore

Appendix 5: The Freedom right score

Table 49: The freedom right score of 2015 (Aghekyan et al., 2015)

Country	PR	CL	Aggregate Score	Freedom Status	*Freedom of the Press* 2015 Status	*Freedom on the Net* 2015 Status
Afghanistan	6	6	24	Not Free	Not Free	
Albania*	3	3	67	Partly Free	Partly Free	
Algeria	6	5	35	Not Free	Not Free	
Andorra*	1	1	96	Free	Free	
Angola ↓	6	6 ▼	24	Not Free	Not Free	Partly Free
Antigua and Barbuda*	2	2	82	Free	Partly Free	
Argentina*	2	2	79	Free	Partly Free	Free
Armenia	5	4	46	Partly Free	Not Free	Free
Australia*	1	1	98	Free	Free	Free
Austria*	1	1	95	Free	Free	
Azerbaijan	7 ▼	6	16	Not Free	Not Free	Partly Free
Bahamas*	1	1	92	Free	Free	
Bahrain	7	6	14	Not Free	Not Free	Not Free
Bangladesh* ↓	4	4	49	Partly Free	Partly Free	Partly Free
Barbados*	1	1	98	Free	Free	
Belarus	7	6	17	Not Free	Not Free	Not Free
Belgium*	1	1	96	Free	Free	
Belize*	1	2	87	Free	Free	
Benin*	2	2	82	Free	Partly Free	
Bhutan*	3	4	56	Partly Free	Partly Free	
Bolivia*	3	3	68	Partly Free	Partly Free	
Bosnia and Herzegovina*	4	3	57	Partly Free	Partly Free	
Botswana*	3	2	73	Free	Partly Free	
Brazil*	2	2	81	Free	Partly Free	Free
Brunei	6	5	29	Not Free	Not Free	
Bulgaria*	2	2	80	Free	Partly Free	
Burkina Faso ↑	4 ▲	3	59	Partly Free	Partly Free	
Burundi ↓	7 ▼	6 ▼	19	Not Free	Not Free	
Cambodia	6	5	32	Not Free	Not Free	Partly Free
Cameroon	6	6	24	Not Free	Not Free	
Canada*	1	1	99	Free	Free	Free
Cape Verde*	1	1	90	Free	Free	
Central African Republic	7	7	7	Not Free	Not Free	
Chad	7	6	20	Not Free	Not Free	
Chile*	1	1	95	Free	Partly Free	
China (PRC)	7	6	16	Not Free	Not Free	Not Free
Colombia*	3	4	63	Partly Free	Partly Free	Partly Free
Comoros*	3	4	55	Partly Free	Partly Free	

Country	PR	CL	Aggregate Score	Freedom Status	*Freedom of the Press* 2015 Status	*Freedom on the Net* 2015 Status
Congo (Brazzaville)	6	5	28	Not Free	Partly Free	
Congo (Kinshasa)	6	6	25	Not Free	Not Free	
Costa Rica*	1	1	90	Free	Free	
Côte d'Ivoire*	4 ▲	4	51	Partly Free	Partly Free	
Croatia*	1	2	87	Free	Partly Free	
Cuba	7	6	16	Not Free	Not Free	Not Free
Cyprus*	1	1	94	Free	Free	
Czech Republic*	1	1	95	Free	Free	
Denmark*	1	1	98	Free	Free	
Djibouti	6	5	28	Not Free	Not Free	
Dominica*	1	1	95	Free	Free	
Dominican Republic*	3 ▼	3	70	Partly Free ▼	Partly Free	
East Timor*	3	3	65	Partly Free	Partly Free	
Ecuador*	3	3	59	Partly Free	Not Free	Partly Free
Egypt	6	5	27	Not Free	Not Free	Not Free
El Salvador* ↓	2	3	69	Free	Partly Free	
Equatorial Guinea	7	7	8	Not Free	Not Free	
Eritrea	7	7	3	Not Free	Not Free	
Estonia*	1	1	94	Free	Free	Free
Ethiopia	7 ▼	6	15	Not Free	Not Free	Not Free
Fiji*	3	3 ▲	62	Partly Free	Partly Free	
Finland*	1	1	100	Free	Free	
France*	1	1	91	Free	Free	Free
Gabon	6	5	34	Not Free	Not Free	
The Gambia	7 ▼	6	18	Not Free	Not Free	Not Free
Georgia*	3	3	64	Partly Free	Partly Free	Free
Germany*	1	1	95	Free	Free	Free
Ghana*	1	2	83	Free	Free	
Greece*	2	2	83	Free	Partly Free	
Grenada*	1	2	89	Free	Free	
Guatemala*	4 ▼	4	54	Partly Free	Partly Free	
Guinea	5	5	40	Partly Free	Not Free	
Guinea-Bissau	5	5	39	Partly Free	Partly Free	
Guyana*	2	3	74	Free	Partly Free	
Haiti	5	5	41	Partly Free	Partly Free	
Honduras ↓	4	4	45	Partly Free	Not Free	
Hungary* ↓	2	2	79	Free	Partly Free	Free
Iceland*	1	1	100	Free	Free	Free
India*	2	3	77	Free	Partly Free	Partly Free
Indonesia*	2	4	65	Partly Free	Partly Free	Partly Free
Iran	6	6	17	Not Free	Not Free	Not Free
Iraq	5 ▲	6	27	Not Free	Not Free	
Ireland*	1	1	96	Free	Free	
Israel*	1	2	80	Free	Free	
Italy*	1	1	89	Free	Partly Free	Free

Country	PR	CL	Aggregate Score	Freedom Status	*Freedom of the Press* 2015 Status	*Freedom on the Net* 2015 Status
Jamaica*	2	3	75	Free	Free	
Japan*	1	1	96	Free	Free	Free
Jordan	6	5	36	Not Free	Not Free	Partly Free
Kazakhstan	6	5	24	Not Free	Not Free	Not Free
Kenya*	4	4	51	Partly Free	Partly Free	Free
Kiribati*	1	1	91	Free	Free	
Kosovo*	3 ▲	4	52	Partly Free	Partly Free	
Kuwait	5	5	36	Partly Free	Partly Free	
Kyrgyzstan	5	5	38	Partly Free	Not Free	Partly Free
Laos	7	6	12	Not Free	Not Free	
Latvia*	2	2	86	Free	Free	
Lebanon	5	4	43	Partly Free	Partly Free	Partly Free
Lesotho*	3 ▼	3	67	Partly Free ▼	Partly Free	
Liberia*	3	4	61	Partly Free	Partly Free	
Libya	6	6	20	Not Free	Not Free	Partly Free
Liechtenstein*	1	1	98	Free	Free	
Lithuania*	1	1	91	Free	Free	
Luxembourg*	1	1	98	Free	Free	
Macedonia ↓	4	3	57	Partly Free	Partly Free	
Madagascar*	3 ▲	4	56	Partly Free	Partly Free	
Malawi*	3	3 ▲	64	Partly Free	Partly Free	Partly Free
Malaysia	4	4	45	Partly Free	Not Free	Partly Free
Maldives ↓	4	5 ▼	43	Partly Free	Partly Free	
Mali	5	4	45	Partly Free	Partly Free	
Malta*	1	1	96	Free	Free	
Marshall Islands*	1	1	92	Free	Free	
Mauritania	6	5	30	Not Free	Partly Free	
Mauritius*	1	2	90	Free	Free	
Mexico*	3	3	65	Partly Free	Not Free	Partly Free
Micronesia*	1	1	93	Free	Free	
Moldova* ↓	3	3	60	Partly Free	Partly Free	
Monaco*	2	1	88	Free	Free	
Mongolia*	1	2	86	Free	Partly Free	
Montenegro* ↓	3	3 ▼	70	Partly Free ▼	Partly Free	
Morocco ↓	5	4	41	Partly Free	Not Free	Partly Free
Mozambique	4	4 ▼	56	Partly Free	Partly Free	
Myanmar ↑	6	5 ▲	28	Not Free	Not Free	Not Free
Namibia*	2	2	77	Free	Partly Free	
Nauru*	2 ▼	2	84	Free	Partly Free	
Nepal*	3	4	51	Partly Free	Partly Free	
Netherlands*	1	1	99	Free	Free	
New Zealand*	1	1	98	Free	Free	
Nicaragua	4	3	54	Partly Free	Partly Free	
Niger*	3	4	52	Partly Free	Partly Free	
Nigeria* ↑	4	5	48	Partly Free	Partly Free	Partly Free

Country	PR	CL	Aggregate Score	Freedom Status	*Freedom of the Press* 2015 Status	*Freedom on the Net* 2015 Status
North Korea	7	7	3	Not Free	Not Free	
Norway*	1	1	100	Free	Free	
Oman	6	5	25	Not Free	Not Free	
Pakistan*	4	5	41	Partly Free	Not Free	Not Free
Palau*	1	1	92	Free	Free	
Panama*	2	2	83	Free	Partly Free	
Papua New Guinea*	4	3	59	Partly Free	Free	
Paraguay*	3	3	64	Partly Free	Partly Free	
Peru*	2	3	71	Free	Partly Free	
Philippines*	3	3	65	Partly Free	Partly Free	Free
Poland*	1	1	93	Free	Free	
Portugal*	1	1	97	Free	Free	
Qatar	6	5	27	Not Free	Not Free	
Romania*	2	2	83	Free	Partly Free	
Russia	6	6	22	Not Free	Not Free	Not Free
Rwanda ↓	6	6	24	Not Free	Not Free	Partly Free
Saint Kitts and Nevis*	2 ▼	1	88	Free	Free	
Saint Lucia*	1	1	92	Free	Free	
Saint Vincent and Grenadines*	1	1	91	Free	Free	
Samoa*	2	2	80	Free	Free	
San Marino*	1	1	100	Free	Free	
São Tomé and Príncipe*	2	2	81	Free	Free	
Saudi Arabia	7	7	10	Not Free	Not Free	Not Free
Senegal*	2	2	78	Free	Partly Free	
Serbia*	2	2	78	Free	Partly Free	
Seychelles*	3	3	69	Partly Free	Partly Free	
Sierra Leone*	3	3	65	Partly Free	Partly Free	
Singapore	4	4	51	Partly Free	Not Free	Partly Free
Slovakia*	1	1	89	Free	Free	
Slovenia*	1	1	92	Free	Free	
Solomon Islands*	3	3	68	Partly Free	Free	
Somalia	7	7	2	Not Free	Not Free	
South Africa*	2	2	79	Free	Partly Free	Free
South Korea*	2	2	83	Free	Partly Free	Partly Free
South Sudan	7	6	14	Not Free	Not Free	
Spain*	1	1	95	Free	Free	
Sri Lanka* ↑	4 ▲	4 ▲	55	Partly Free	Not Free	Partly Free
Sudan	7	7	6	Not Free	Not Free	Not Free
Suriname*	2	3 ▼	77	Free	Free	
Swaziland	7	5	18	Not Free	Not Free	
Sweden*	1	1	100	Free	Free	
Switzerland*	1	1	96	Free	Free	
Syria	7	7	-1	Not Free	Not Free	Not Free
Taiwan (ROC)*	1	2	89	Free	Free	
Tajikistan ↓	7 ▼	6	16	Not Free	Not Free	

Country	PR	CL	Aggregate Score	Freedom Status	*Freedom of the Press 2015 Status*	*Freedom on the Net 2015 Status*
Tanzania*	3	4 ▼	60	Partly Free	Partly Free	
Thailand	6	5	32	Not Free	Not Free	Not Free
Togo	4	4	48	Partly Free	Not Free	
Tonga*	2	2	75	Free	Free	
Trinidad and Tobago*	2	2	81	Free	Free	
Tunisia*	1	3	79	Free	Partly Free	Partly Free
Turkey* ↓	3	4	53	Partly Free	Not Free	Partly Free
Turkmenistan	7	7	4	Not Free	Not Free	
Tuvalu*	1	1	94	Free	Free	
Uganda	6	5	36	Not Free	Partly Free	Partly Free
Ukraine*	3	3	61	Partly Free	Partly Free	Partly Free
United Arab Emirates	6	6	20	Not Free	Not Free	Not Free
United Kingdom*	1	1	95	Free	Free	Free
United States of America* ↓	1	1	90	Free	Free	Free
Uruguay*	1	1	98	Free	Free	
Uzbekistan	7	7	3	Not Free	Not Free	Not Free
Vanuatu*	2	2	78	Free	Free	
Venezuela	5	5	35	Partly Free	Not Free	Partly Free
Vietnam	7	5	20	Not Free	Not Free	Not Free
Yemen ↓	7 ▼	6	17	Not Free	Not Free	
Zambia*	3	4	60	Partly Free	Not Free	Partly Free
Zimbabwe	5	5 ▲	32	Partly Free ▲	Not Free	Partly Free

RELATED AND DISPUTED TERRITORIES

Country	PR	CL	Aggregate Score	Freedom Status	*Freedom of the Press 2015 Status*	*Freedom on the Net 2015 Status*
Abkhazia	4	5	42	Partly Free		
Crimea	7	6	9	Not Free	Not Free	
Gaza Strip	7	6	12	Not Free	Not Free**	
Hong Kong	5	2	63	Partly Free	Partly Free	
Indian Kashmir	4	4	51	Partly Free		
Nagorno-Karabakh	5	5	33	Partly Free		
Northern Cyprus	2	2	79	Free		
Pakistani Kashmir	6	5	28	Not Free		
Puerto Rico	1	1 ▲	91	Free		
Somaliland	5 ▼	5	40	Partly Free	Partly Free	
South Ossetia	7	6	11	Not Free		
Tibet	7	7	1	Not Free		
Transnistria	6	6	24	Not Free		
West Bank	6	5	30	Not Free	Not Free**	
Western Sahara	7	7	4	Not Free		

Appendix 6: The Inform: Index of risk management

Table 50: The index of risk management report 2015 (INFORM, 2016)

COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Somalia	SOM	6.2	10.0	8.8	7.7	8.8	8.3	9.3	8.8	9.1	8.7	1	8
Central African Republic	CAF	1.4	10.0	7.8	8.3	8.2	8.3	8.1	9.1	8.7	8.3	2	3
Afghanistan	AFG	5.5	10.0	8.6	6.9	7.4	7.2	7.4	8.5	8.0	7.9	3	2
South Sudan	SSD	2.4	9.0	6.8	7.8	8.6	8.2	8.3	9.4	8.9	7.9	3	10
Yemen	YEM	2.7	10.0	8.1	4.8	7.9	6.6	8.2	7.6	7.9	7.5	5	0
Iraq	IRQ	5.1	10.0	8.5	2.8	8.1	6.1	8.1	5.9	7.1	7.2	6	1
Sudan	SDN	3.5	9.0	7.1	5.4	8.3	7.1	6.7	7.8	7.3	7.2	6	4
Congo DR	COD	2.9	7.0	5.3	7.1	8.1	7.6	7.8	8.3	8.1	6.9	8	3
Myanmar	MMR	8.2	7.0	7.7	5.5	6.0	5.8	7.6	6.2	7.0	6.8	9	2
Mali	MLI	3.2	8.0	6.2	7.7	5.6	6.8	5.9	7.6	6.8	6.6	10	0
Syria	SYR	4.4	10.0	8.4	3.6	7.7	6.0	6.3	5.3	5.8	6.6	10	4
Uganda	UGA	3.1	8.0	6.1	5.9	6.5	6.2	6.8	7.4	7.1	6.5	12	1
Ethiopia	ETH	3.8	6.7	5.4	6.7	6.6	6.7	4.7	8.8	7.3	6.4	13	0
Pakistan	PAK	6.9	8.0	7.5	4.0	6.9	5.6	5.5	6.6	6.1	6.4	13	0
Nigeria	NGA	2.3	9.0	6.8	4.1	6.8	5.6	5.0	7.8	6.6	6.3	15	1
Kenya	KEN	4.2	7.0	5.8	5.1	7.0	6.1	5.4	7.5	6.6	6.2	16	0
Palestine	PSE	2.4	9.0	6.8	4.3	8.4	6.8	6.2	2.9	4.8	6.1	17	8
Chad	TCD	2.8	3.6	3.2	6.8	8.0	7.4	7.9	9.7	9.0	6.0	18	4
Haiti	HTI	6.1	2.7	4.6	6.9	5.6	6.3	7.4	7.8	7.6	6.0	18	1
Bangladesh	BGD	8.6	5.0	7.2	3.9	5.7	4.9	5.1	6.3	5.7	5.9	20	0
Libya	LBY	4.2	8.0	6.5	2.1	6.6	4.7	8.1	4.8	6.8	5.9	20	7
Mozambique	MOZ	6.0	3.0	4.7	7.5	4.6	6.3	4.4	8.4	6.8	5.9	20	0
Niger	NER	3.0	3.8	3.4	7.4	6.0	6.8	5.9	9.1	7.9	5.7	23	0
Colombia	COL	6.7	7.0	6.9	2.8	7.9	5.9	4.3	4.1	4.2	5.6	24	0
India	IND	7.8	6.9	7.4	4.0	5.3	4.7	3.8	6.1	5.1	5.6	24	0
Solomon Islands	SLB	6.4	0.0	3.9	8.1	3.6	6.4	6.7	7.3	7.0	5.6	24	9
Ukraine	UKR	2.8	9.0	6.9	1.6	6.4	4.4	6.9	2.7	5.2	5.4	27	2
Philippines	PHL	8.9	7.0	8.1	2.5	5.2	4.0	4.6	4.1	4.4	5.2	28	1
Guatemala	GTM	6.5	1.1	4.3	4.4	5.7	5.1	6.1	5.8	6.0	5.1	29	1
Guinea	GIN	3.1	3.9	3.5	6.2	3.8	5.1	6.3	8.6	7.6	5.1	29	1
Lebanon	LBN	4.1	4.8	4.5	4.2	8.5	6.9	5.7	2.6	4.3	5.1	29	5
Mauritania	MRT	4.5	2.0	3.4	6.2	5.1	5.7	5.9	7.9	7.0	5.1	29	0

COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Nepal	NPL	5.5	2.5	4.2	4.1	6.0	5.1	6.2	5.9	6.1	5.1	29	1
Papua New Guinea	PNG	5.2	0.2	3.1	6.4	3.7	5.2	6.9	9.0	8.1	5.1	29	4
Madagascar	MDG	5.7	0.7	3.6	5.3	3.0	4.2	6.0	9.1	7.9	4.9	35	1
Mexico	MEX	7.1	9.0	8.2	2.2	4.1	3.2	5.3	3.6	4.5	4.9	35	0
Algeria	DZA	3.6	8.0	6.3	3.3	3.6	3.5	4.9	4.9	4.9	4.8	37	2
Burkina Faso	BFA	2.4	2.7	2.6	7.3	6.2	6.8	4.7	7.7	6.4	4.8	37	0
Eritrea	ERI	2.9	2.0	2.5	6.3	4.9	5.6	8.2	7.5	7.9	4.8	37	7
Russian Federation	RUS	6.1	7.0	6.6	2.3	4.1	3.3	6.5	2.4	4.8	4.7	40	4
Turkey	TUR	5.9	6.7	6.3	2.8	6.5	4.9	3.5	3.1	3.3	4.7	40	1
Burundi	BDI	2.5	1.8	2.2	7.6	6.4	7.0	6.1	6.5	6.3	4.6	42	2
Cameroon	CMR	2.1	3.7	2.9	4.9	6.2	5.6	4.8	7.0	6.0	4.6	42	0
Côte d'Ivoire	CIV	1.5	2.7	2.1	5.9	6.0	6.0	7.4	7.8	7.6	4.6	42	0
Egypt	EGY	5.0	7.0	6.1	2.7	4.0	3.4	5.4	3.9	4.7	4.6	42	0
Indonesia	IDN	7.4	5.5	6.5	2.4	3.1	2.8	4.7	5.6	5.2	4.6	42	0
Iran	IRN	6.7	1.4	4.6	2.9	5.6	4.4	5.7	4.0	4.9	4.6	42	1
Tanzania	TZA	4.0	1.1	2.7	5.7	5.2	5.5	5.1	7.8	6.6	4.6	42	0
Vanuatu	VUT	5.8	0.0	3.4	5.5	3.2	4.4	5.4	7.1	6.3	4.6	42	7
Honduras	HND	5.9	1.0	3.9	4.2	4.2	4.2	6.0	4.8	5.4	4.5	50	1
Kiribati	KIR	4.7	0.1	2.7	6.9	2.7	5.2	6.7	6.3	6.5	4.5	50	12
Djibouti	DJI	4.5	0.5	2.7	4.9	4.4	4.7	6.3	7.2	6.8	4.4	52	5
Korea DPR	PRK	4.1	1.8	3.0	5.0	2.9	4.0	9.1	3.6	7.2	4.4	52	8
Peru	PER	7.6	1.3	5.2	2.3	4.3	3.4	4.7	4.7	4.7	4.4	52	0
Rwanda	RWA	2.9	2.2	2.6	6.6	5.1	5.9	4.1	6.5	5.4	4.4	52	0
China	CHN	8.2	5.1	6.9	1.7	4.0	2.9	4.2	3.8	4.0	4.3	56	0
Ecuador	ECU	7.1	0.2	4.5	3.3	4.5	3.9	4.7	4.2	4.5	4.3	56	1
Senegal	SEN	2.4	2.4	2.4	6.0	4.7	5.4	5.3	7.0	6.2	4.3	56	0
Sierra Leone	SLE	1.2	2.7	2.0	7.0	3.6	5.6	5.3	8.3	7.1	4.3	56	0
Sri Lanka	LKA	5.3	3.4	4.4	2.7	5.1	4.0	4.8	4.0	4.4	4.3	56	1
Thailand	THA	6.3	5.2	5.8	2.0	4.2	3.2	5.1	3.5	4.3	4.3	56	0
Angola	AGO	2.0	2.6	2.3	4.5	4.7	4.6	6.6	7.5	7.1	4.2	62	2
Lao PDR	LAO	4.4	1.1	2.9	4.2	3.3	3.8	6.6	6.4	6.5	4.2	62	0
Malawi	MWI	3.3	0.5	2.0	7.0	4.2	5.8	5.2	7.3	6.4	4.2	62	0
Marshall Islands	MHL	3.6	0.0	2.0	7.5	2.4	5.5	7.8	5.2	6.7	4.2	62	12
Zambia	ZMB	2.1	1.8	2.0	5.8	5.6	5.7	4.8	7.5	6.3	4.2	62	0

COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Zimbabwe	ZWE	2.5	2.2	2.4	5.3	5.4	5.4	5.1	6.2	5.7	4.2	62	4
Nicaragua	NIC	6.6	0.9	4.3	3.9	1.8	2.9	5.8	5.1	5.5	4.1	68	0
Timor-Leste	TLS	3.5	0.3	2.0	4.7	4.5	4.6	6.9	7.7	7.3	4.1	68	4
Bosnia and Herzegovina	BIH	3.8	1.8	2.9	2.6	6.5	4.8	6.0	2.8	4.6	4.0	70	3
Cambodia	KHM	4.4	1.1	2.9	4.1	2.2	3.2	7.1	6.4	6.8	4.0	70	0
Guinea-Bissau	GNB	1.7	0.6	1.2	7.8	4.9	6.6	7.9	7.8	7.9	4.0	70	4
Liberia	LBR	1.6	0.6	1.1	8.3	5.4	7.1	7.0	8.8	8.0	4.0	70	3
Micronesia	FSM	3.9	0.0	2.2	6.6	2.3	4.8	6.1	5.8	6.0	4.0	70	11
Serbia	SRB	4.6	1.7	3.3	2.0	6.4	4.6	5.3	2.7	4.1	4.0	70	2
Tajikistan	TJK	5.6	1.8	3.9	3.0	2.9	3.0	6.1	4.5	5.4	4.0	70	2
Georgia	GEO	3.9	3.7	3.8	3.0	5.7	4.5	4.6	2.2	3.5	3.9	77	3
Lesotho	LSO	2.0	1.3	1.7	6.4	4.0	5.3	7.0	6.2	6.6	3.9	77	2
Togo	TGO	1.3	1.6	1.5	5.4	4.3	4.9	8.3	7.9	8.1	3.9	77	0
Azerbaijan	AZE	3.8	0.5	2.3	1.8	6.5	4.6	6.5	2.9	5.0	3.8	80	3
Jordan	JOR	2.8	1.3	2.1	3.6	7.8	6.1	5.7	2.8	4.4	3.8	80	2
South Africa	ZAF	3.5	2.2	2.9	3.4	4.5	4.0	4.4	4.7	4.6	3.8	80	0
Venezuela	VEN	5.7	0.2	3.4	3.0	4.3	3.7	5.1	3.9	4.5	3.8	80	2
Namibia	NAM	3.2	0.6	2.0	4.8	4.5	4.7	4.6	6.3	5.5	3.7	84	0
Panama	PAN	5.5	1.2	3.7	3.1	3.2	3.2	4.9	3.9	4.4	3.7	84	1
Viet Nam	VNM	7.3	3.0	5.6	2.7	1.0	1.9	5.3	3.8	4.6	3.7	84	2
Dominican Republic	DOM	6.6	1.0	4.4	2.7	1.6	2.2	5.5	4.0	4.8	3.6	87	0
Turkmenistan	TKM	4.5	1.3	3.1	2.7	2.1	2.4	8.0	4.2	6.5	3.6	87	8
Benin	BEN	1.2	1.3	1.3	6.4	2.2	4.6	5.8	8.3	7.2	3.5	89	0
Congo	COG	1.9	0.2	1.1	4.1	6.0	5.1	7.6	7.3	7.5	3.5	89	1
El Salvador	SLV	5.8	0.3	3.5	3.7	1.3	2.6	5.5	3.8	4.7	3.5	89	1
Malaysia	MYS	4.3	3.2	3.8	2.4	4.2	3.4	3.2	3.3	3.3	3.5	89	1
Morocco	MAR	4.3	1.1	2.9	4.3	0.9	2.8	5.6	4.5	5.1	3.5	89	2
Brazil	BRA	3.7	3.6	3.7	2.5	2.5	2.5	4.9	3.3	4.1	3.4	94	0
Costa Rica	CRI	6.5	0.1	4.0	2.8	3.1	3.0	3.0	3.0	3.0	3.3	95	1
Kyrgyzstan	KGZ	5.4	1.1	3.5	3.4	1.0	2.3	5.3	3.8	4.6	3.3	95	2
Moldova Republic of	MDA	3.8	3.2	3.5	2.9	1.5	2.2	6.2	2.9	4.8	3.3	95	1
Tonga	TON	3.5	0.0	1.9	5.9	1.0	3.9	5.6	4.2	4.9	3.3	95	9
Uzbekistan	UZB	5.9	2.8	4.5	2.0	1.6	1.8	5.1	3.7	4.4	3.3	95	3
Armenia	ARM	3.8	0.1	2.1	2.4	3.6	3.0	6.6	2.7	5.0	3.2	100	0

COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Bolivia	BOL	3.4	0.7	2.2	3.4	2.2	2.8	5.9	5.1	5.5	3.2	100	0
Fiji	FJI	5.7	0.1	3.4	3.7	0.9	2.4	3.5	4.9	4.2	3.2	100	7
United States of America	USA	7.4	5.1	6.4	1.3	3.4	2.4	2.7	1.7	2.2	3.2	100	3
Belize	BLZ	4.8	0.0	2.7	3.2	1.0	2.2	5.4	4.4	4.9	3.1	104	4
Botswana	BWA	2.6	0.3	1.5	4.3	3.6	4.0	4.9	4.9	4.9	3.1	104	1
Chile	CHL	7.4	0.9	5.0	2.4	1.7	2.1	2.9	2.9	2.9	3.1	104	2
Mongolia	MNG	2.7	2.0	2.4	3.2	1.6	2.4	5.6	4.8	5.2	3.1	104	1
Swaziland	SWZ	1.8	0.8	1.3	4.6	3.4	4.0	5.1	6.1	5.6	3.1	104	2
Tuvalu	TUV	2.0	0.0	1.0	7.5	1.3	5.2	6.3	4.7	5.6	3.1	104	12
Ghana	GHA	1.3	1.2	1.3	4.1	3.3	3.7	4.3	6.4	5.4	3.0	110	0
Albania	ALB	5.1	0.3	3.0	2.3	1.0	1.7	6.2	3.1	4.8	2.9	111	2
Bhutan	BTN	2.8	0.1	1.5	4.9	1.2	3.3	4.2	5.7	5.0	2.9	111	0
Gambia	GMB	1.4	0.1	0.8	6.7	3.9	5.5	4.9	5.9	5.4	2.9	111	0
Italy	ITA	5.1	3.6	4.4	1.1	3.2	2.2	3.7	1.0	2.5	2.9	111	3
Oman	OMN	5.8	0.3	3.5	2.5	0.8	1.7	5.1	3.1	4.2	2.9	111	5
Romania	ROU	4.4	3.2	3.8	1.9	1.5	1.7	4.6	2.7	3.7	2.9	111	2
Cyprus	CYP	3.6	0.1	2.0	1.3	6.5	4.4	3.0	1.9	2.5	2.8	117	5
Guyana	GUY	2.8	0.1	1.5	4.1	1.0	2.7	6.2	4.9	5.6	2.8	117	4
Jamaica	JAM	3.9	0.2	2.2	3.3	1.3	2.4	4.5	4.0	4.3	2.8	117	2
Macedonia FYR	MKD	2.8	1.3	2.1	2.5	2.9	2.7	4.6	2.7	3.7	2.8	117	1
Tunisia	TUN	4.3	0.4	2.6	2.3	1.0	1.7	6.0	3.6	4.9	2.8	117	1
Cabo Verde	CPV	2.0	0.1	1.1	6.0	1.2	4.0	4.0	4.5	4.3	2.7	122	4
Canada	CAN	4.9	1.4	3.3	0.9	3.7	2.4	2.3	2.4	2.4	2.7	122	4
Comoros	COM	0.8	0.1	0.5	7.6	2.4	5.6	7.8	6.3	7.1	2.7	122	7
Equatorial Guinea	GNQ	1.3	0.2	0.8	4.2	2.3	3.3	8.2	6.7	7.5	2.7	122	7
France	FRA	3.8	3.3	3.6	0.9	4.0	2.6	2.8	1.2	2.0	2.7	122	4
Montenegro	MNE	3.9	0.1	2.2	2.2	2.8	2.5	4.7	2.4	3.6	2.7	122	4
Palau	PLW	2.2	0.0	1.2	5.1	0.8	3.2	6.1	4.0	5.1	2.7	122	9
Dominica	DMA	3.3	0.0	1.8	4.5	0.9	2.9	3.9	2.9	3.4	2.6	129	11
Gabon	GAB	1.5	0.2	0.9	3.0	3.0	3.0	6.6	6.0	6.3	2.6	129	1
Greece	GRC	5.3	1.7	3.7	1.3	2.4	1.9	3.6	1.0	2.4	2.6	129	3
Nauru	NRU	1.3	0.0	0.7	5.3	3.0	4.2	7.2	4.2	5.9	2.6	129	14
Suriname	SUR	3.0	0.0	1.6	3.0	1.1	2.1	5.7	4.2	5.0	2.6	129	2
Bulgaria	BGR	3.1	1.1	2.2	2.0	2.6	2.3	4.2	2.0	3.2	2.5	134	2

COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Cuba	CUB	5.1	2.3	3.8	2.3	0.2	1.3	4.1	2.4	3.3	2.5	134	6
Israel	ISR	3.3	2.4	2.9	1.2	3.2	2.3	3.3	1.1	2.3	2.5	134	4
Paraguay	PRY	2.1	0.1	1.2	3.7	1.3	2.6	5.5	4.0	4.8	2.5	134	1
Argentina	ARG	3.1	1.7	2.4	1.9	1.1	1.5	5.0	2.1	3.7	2.4	138	2
Croatia	HRV	5.3	0.1	3.1	1.6	1.2	1.4	4.4	1.7	3.2	2.4	138	3
Maldives	MDV	3.4	0.0	1.9	2.6	1.0	1.8	5.7	1.9	4.1	2.4	138	3
Saint Kitts and Nevis	KNA	3.1	0.0	1.7	4.2	0.8	2.7	3.6	2.2	2.9	2.4	138	11
Saint Lucia	LCA	3.2	0.0	1.7	3.5	0.8	2.3	4.1	3.3	3.7	2.4	138	8
Saudi Arabia	SAU	2.1	2.8	2.5	2.0	0.7	1.4	5.0	2.6	3.9	2.4	138	4
Antigua and Barbuda	ATG	3.7	0.0	2.0	2.0	1.3	1.7	4.7	2.1	3.5	2.3	144	10
Australia	AUS	5.7	0.1	3.4	0.6	2.7	1.7	2.2	1.9	2.1	2.3	144	5
Samoa	WSM	1.3	0.0	0.7	6.2	0.4	3.9	4.7	4.1	4.4	2.3	144	8
Seychelles	SYC	2.4	0.0	1.3	3.9	1.2	2.7	4.4	2.6	3.6	2.3	144	7
Mauritius	MUS	3.2	0.0	1.7	3.1	0.9	2.1	3.6	2.3	3.0	2.2	148	5
Japan	JPN	8.5	1.8	6.2	0.9	0.9	0.9	2.0	1.1	1.6	2.1	149	4
Kazakhstan	KAZ	3.5	0.6	2.2	1.5	0.5	1.0	5.2	2.6	4.0	2.1	149	3
Poland	POL	2.1	1.3	1.7	1.4	2.3	1.9	4.1	1.6	2.9	2.1	149	3
Saint Vincent and the Grenadines	VCT	2.4	0.0	1.3	3.1	0.9	2.1	3.3	3.5	3.4	2.1	149	9
Spain	ESP	4.4	2.4	3.5	1.1	1.7	1.4	2.8	0.8	1.9	2.1	149	3
Bahamas	BHS	3.2	0.0	1.7	2.3	0.9	1.6	3.1	2.8	3.0	2.0	154	7
Hungary	HUN	3.5	0.4	2.1	1.6	1.8	1.7	2.8	1.3	2.1	2.0	154	3
Kuwait	KWT	2.2	0.5	1.4	2.0	1.2	1.6	5.4	1.6	3.7	2.0	154	5
New Zealand	NZL	5.8	0.1	3.5	0.9	1.3	1.1	1.9	2.2	2.1	2.0	154	7
Trinidad and Tobago	TTO	2.5	0.1	1.4	1.8	1.5	1.7	4.9	2.1	3.6	2.0	154	3
United Arab Emirates	ARE	5.4	0.4	3.3	1.8	0.3	1.1	2.5	1.8	2.2	2.0	154	7
United Kingdom	GBR	2.2	2.0	2.1	1.2	3.3	2.3	2.2	1.0	1.6	2.0	154	4
Belarus	BLR	1.8	1.3	1.6	1.0	1.3	1.2	4.9	1.5	3.4	1.9	161	2
Germany	DEU	2.1	1.4	1.8	0.6	3.8	2.3	2.4	0.7	1.6	1.9	161	3
Grenada	GRD	1.8	0.0	0.9	2.9	1.3	2.1	4.6	2.8	3.8	1.9	161	11
Portugal	PRT	4.6	0.1	2.6	1.4	1.1	1.3	2.9	1.0	2.0	1.9	161	4
Slovakia	SVK	3.2	0.6	2.0	1.2	1.3	1.3	3.8	1.3	2.6	1.9	161	4
Uruguay	URY	1.1	0.8	1.0	2.4	1.3	1.9	3.8	2.0	2.9	1.8	166	2
Austria	AUT	2.3	0.1	1.3	0.8	3.4	2.2	2.2	1.2	1.7	1.7	167	4
Korea Republic of	KOR	5.9	0.4	3.6	0.8	0.5	0.7	2.6	1.4	2.0	1.7	167	4

COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Malta	MLT	1.6	0.1	0.9	1.7	3.0	2.4	3.5	1.0	2.3	1.7	167	6
Barbados	BRB	1.7	0.0	0.9	2.6	0.8	1.7	2.7	2.4	2.6	1.6	170	5
Czech Republic	CZE	2.0	0.4	1.2	0.9	2.0	1.5	3.3	1.1	2.3	1.6	170	3
Latvia	LVA	1.8	0.1	1.0	1.8	1.2	1.5	3.9	1.7	2.9	1.6	170	4
Ireland	IRL	2.4	0.1	1.3	0.8	1.8	1.3	2.4	1.5	2.0	1.5	173	5
Lithuania	LTU	1.5	0.1	0.8	1.3	1.2	1.3	3.8	1.3	2.6	1.4	174	4
Netherlands	NLD	1.7	0.1	0.9	0.5	3.5	2.1	1.7	1.0	1.4	1.4	174	4
Slovenia	SVN	2.6	0.1	1.4	0.7	1.2	1.0	2.3	1.4	1.9	1.4	174	3
Switzerland	CHE	1.8	0.9	1.4	0.5	3.5	2.1	1.2	0.6	0.9	1.4	174	4
Qatar	QAT	0.9	0.1	0.5	2.5	0.9	1.7	3.9	0.5	2.4	1.3	178	5
Sao Tome and Principe	STP	0.1	0.0	0.1	5.6	1.4	3.8	6.2	5.2	5.7	1.3	178	5
Belgium	BEL	1.4	0.0	0.7	0.8	2.7	1.8	2.1	0.8	1.5	1.2	180	6
Iceland	ISL	1.7	0.0	0.9	0.7	1.0	0.9	2.1	1.8	2.0	1.2	180	6
Brunei Darussalam	BRN	0.6	0.0	0.3	1.0	0.8	0.9	4.9	4.5	4.7	1.1	182	8
Estonia	EST	0.9	0.1	0.5	1.4	1.2	1.3	3.1	1.3	2.2	1.1	182	4
Liechtenstein	LIE	1.3	0.0	0.7	0.6	2.5	1.6	1.5	0.9	1.2	1.1	182	19
Sweden	SWE	0.7	0.1	0.4	0.5	4.3	2.6	1.9	0.9	1.4	1.1	182	4
Norway	NOR	0.2	0.3	0.3	0.2	3.5	2.0	1.9	1.3	1.6	1.0	186	5
Denmark	DNK	0.5	0.1	0.3	0.6	2.6	1.7	1.9	0.9	1.4	0.9	187	4
Bahrain	BHR	0.1	0.1	0.1	1.9	1.2	1.6	4.2	1.6	3.0	0.8	188	6
Luxembourg	LUX	0.3	0.1	0.2	1.1	1.3	1.2	1.8	0.7	1.3	0.7	189	6
Finland	FIN	0.1	0.1	0.1	0.8	2.4	1.6	1.6	1.0	1.3	0.6	190	5
Singapore	SGP	0.1	0.0	0.1	0.7	0.3	0.5	1.3	1.1	1.2	0.4	191	5

Appendix 7: The traffic right information of 7 countries

This legal information is confidential for airline uses only

China (CATC, 2016)

Commercial airlines from both territories are capable to operate to and from any location. Every route has been permitted to carry both goods and passengers with unlimited flight capacity and frequency.

Hong Kong (CATC, 2016)

Commercial airlines from both territories are capable to operate to and from any location. Every route has been permitted to carry both goods and passengers with unlimited flight capacity and frequency.

Indonesia (CATC, 2016)

Commercial airlines from both territories are capable to operate to and from major routes. The available routes in Thailand are Bangkok, Chang Mai, Chang Rai, Phuket and Hatyai; whereas, the available route in Indonesia are Jakarta, Denpasar, Surabaya, Medan and Makassar. Each route has been permitted to carry both goods and passengers with unlimited flight capacity and frequency.

Malaysia (CATC, 2016)

Commercial airlines from both territories are capable to operate to and from any location. Every route has been permitted to carry both goods and passengers with unlimited flight capacity and frequency.

Singapore (CATC, 2016)

Commercial airlines from both territories are capable to operate to and from any location. Every route has been permitted to carry both goods and passengers with unlimited flight capacity and frequency.

Taiwan (CATC, 2016)

Commercial airlines from both territories are capable to operate to and from any location. Every route has been permitted to carry both goods and passengers with unlimited flight capacity and frequency.

Philippines (CATC, 2016)

Commercial airlines from both territories are capable to operate to and from the 5 specific routes which has the limit capacity and flight frequency as shown in Table 48. The first 4 routes are available for the passenger transportation, and, the route 5 is only available for the goods transportation.

Table 51: The traffic right in Philippine (CATC, 2016)

Thailand			
Route	**Point in Thailand**	**Point in Philippines**	**Capacity/Frequency**
1	Thailand	Manila and Davao airport	3,790 seat per week
2	Bangkok	Manila	3050 seat per week
3	Any location except Bangkok	Any location	Unlimited
4	Any location	Any location except Manila	Unlimited
5	Any location	Any location	1,000 ton / week
Philippines			
Route	**Point in Philippines**	**Point in Thailand**	**Capacity/Frequency**
1	Philippines	Bangkok and Chang Mai	3,790 seat per week
2	Manila	Bangkok	3050 seat per week
3	Any location	Any location except Bangkok	Unlimited
4	Any location except Manila	Any location	Unlimited
5	Any location	Any location	1,000 ton / week

Appendix 8: The global information technology report 2015

Table 52: The technological infrastructure report 2015 (Dutta et al., 2015)

3.01 Electricity production

Electricity production (kWh) per capita | 2011 or most recent

RANK	COUNTRY/ECONOMY	VALUE
1	Iceland[2]	54,718.2
2	Norway[2]	29,246.0
3	Canada[2]	18,577.5
4	Kuwait	18,388.0
5	Sweden[2]	17,378.2
6	Qatar	16,081.4
7	United States[2]	13,641.5
8	Finland[2]	12,998.2
9	United Arab Emirates	11,107.7
10	Australia[2]	11,101.1
11	Taiwan, China	10,859.0
12	Bahrain	10,694.9
13	Korea, Rep.[2]	10,567.2
14	Bhutan[1]	10,084.5
15	New Zealand[2]	9,984.7
16	Estonia[2]	9,030.8
17	Saudi Arabia	9,008.0
18	Singapore	8,873.8
19	Paraguay	8,766.9
20	Switzerland[2]	8,501.5
21	France[2]	8,452.4
22	Czech Republic[2]	8,263.4
23	Japan[2]	8,041.5
24	Israel[2]	7,675.1
25	Austria[2]	7,647.5
26	Germany[2]	7,596.4
27	Slovenia[2]	7,547.8
28	Russian Federation	7,365.9
29	Oman	7,231.6
30	Belgium[2]	6,943.8
31	Bulgaria	6,807.4
32	Trinidad and Tobago	6,651.5
33	Spain[2]	6,276.5
34	Netherlands[2]	6,096.8
35	Ireland[2]	5,996.2
36	United Kingdom[2]	5,655.3
37	Hong Kong SAR	5,519.3
38	Denmark[2]	5,437.3
39	Puerto Rico	5,430.5
40	Malta	5,270.6
41	Serbia	5,256.2
42	Slovak Republic[2]	5,234.3
43	Kazakhstan	5,229.7
44	Greece[2]	5,189.4
45	Luxembourg[2]	5,164.4
46	South Africa	5,032.5
47	Italy[2]	4,944.0
48	Libya	4,524.5
49	Malaysia	4,523.5
50	Cyprus	4,414.6
51	Portugal[2]	4,330.6
52	Montenegro	4,279.4
53	Ukraine	4,265.2
54	Poland[2]	4,193.5
55	Venezuela	4,137.5
56	Chile[2]	3,915.6
57	Lebanon	3,733.9
58	Barbados	3,555.7
59	China	3,508.4
60	Hungary[2]	3,468.4
61	Macedonia, FYR	3,268.2
62	Turkey[2]	3,236.6
63	Argentina	3,180.9
64	Iran, Islamic Rep.	3,178.1
65	Seychelles[1]	3,152.5
66	Romania	3,077.3
67	Uruguay	3,057.2
68	Suriname[1]	2,990.7
69	Latvia	2,958.7
70	Kyrgyz Republic	2,748.7
71	Brazil	2,700.2
72	Armenia	2,507.7
73	Croatia	2,500.1
74	Mexico[2]	2,449.5
75	Jordan	2,369.7
76	Thailand	2,343.0
77	Georgia	2,273.7
78	Azerbaijan	2,212.3
79	Panama	2,100.6
80	Costa Rica	2,075.5
81	Tajikistan	2,075.4
82	Mauritius	2,043.5
83	Egypt	1,972.3
84	Jamaica	1,904.2
85	Mongolia	1,725.7
86	Moldova	1,625.3
87	Tunisia	1,511.2
88	Albania	1,470.0
89	Lithuania	1,402.2
90	Algeria	1,356.5
91	Peru	1,324.4
92	Colombia	1,313.2
93	Dominican Republic	1,278.6
94	Vietnam	1,129.1
95	Gabon	1,109.8
96	El Salvador	927.9
97	Honduras	916.3
98	Guyana[1]	890.4
99	India	861.7
100	Zambia	840.1
101	Morocco	775.8
102	Indonesia	748.1
103	Philippines	727.8
104	Bolivia	699.5
105	Mozambique	684.7
106	Zimbabwe	668.1
107	Nicaragua	647.7
108	Namibia	644.8
109	Cape Verde[1]	588.6
110	Lao PDR[1]	567.4
111	Sri Lanka	558.1
112	Guatemala	553.9
113	Pakistan	540.7
114	Ghana	451.2
115	Swaziland[1]	415.7
116	Côte d'Ivoire	314.5
117	Bangladesh	288.2
118	Cameroon	283.4
119	Angola	280.0
120	Yemen	266.3
121	Senegal	225.1
122	Mauritania[1]	194.2
123	Botswana	187.2
124	Kenya	186.8
125	Nigeria	164.6
126	Myanmar	140.0
127	Gambia, The[1]	136.9
128	Malawi[1]	131.4
129	Nepal	122.0
130	Timor-Leste[2]	114.6
131	Tanzania	114.4
132	Lesotho[1]	99.6
133	Guinea[1]	89.1
134	Cambodia	72.1
135	Haiti	71.6
136	Uganda[1]	70.8
137	Ethiopia	57.7
138	Madagascar[1]	57.4
139	Burkina Faso[1]	43.1
140	Mali[1]	37.2
141	Rwanda[1]	25.9
142	Burundi[1]	16.5
143	Chad[1]	8.4

3.02 Mobile network coverage rate

Percentage of total population covered by a mobile network signal | 2013 or most recent

RANK	COUNTRY/ECONOMY	VALUE
1	Albania	100.0
1	Armenia	100.0
1	Azerbaijan	100.0
1	Bahrain	100.0
1	Barbados	100.0
1	Bhutan	100.0
1	Bolivia	100.0
1	Colombia	100.0
1	Croatia	100.0
1	Guatemala	100.0
1	Hong Kong SAR	100.0
1	Indonesia[5]	100.0
1	Israel	100.0
1	Italy	100.0
1	Kuwait[5]	100.0
1	Lithuania	100.0
1	Malta	100.0
1	Montenegro[5]	100.0
1	Namibia	100.0
1	Netherlands[7]	100.0
1	Nicaragua[4]	100.0
1	Norway	100.0
1	Qatar	100.0
1	Slovak Republic	100.0
1	Suriname	100.0
1	Switzerland	100.0
1	Taiwan, China	100.0
1	Thailand[5]	100.0
1	Trinidad and Tobago	100.0
1	Turkey[5]	100.0
1	Uganda[7]	100.0
1	United Arab Emirates	100.0
1	Uruguay	100.0
34	Bulgaria	100.0
34	Estonia	100.0
34	Sweden[7]	100.0
37	Brazil	100.0
37	Cyprus	100.0
39	Belgium	99.9
39	Greece	99.9
39	Japan	99.9
39	Korea, Rep.	99.9
39	Luxembourg[5]	99.9
39	Macedonia, FYR[5]	99.9
39	Mexico	99.9
39	Romania	99.9
39	Ukraine	99.9
39	United States[7]	99.9
49	Czech Republic	99.8
49	Egypt	99.8
49	Spain	99.8
52	South Africa[2]	99.8
53	Saudi Arabia	99.7
54	Serbia	99.7
55	Paraguay	99.7
55	Slovenia	99.7
55	United Kingdom	99.7
58	Malawi	99.6
59	Poland	99.5
60	Finland[3]	99.5
61	China[4]	99.5
62	Rwanda	99.3
63	Algeria	99.2
64	Lebanon[7]	99.1
65	Georgia[5]	99.1
66	Australia	99.0
66	Austria	99.0
66	Bangladesh	99.0
66	Cambodia[4]	99.0
66	Canada	99.0
66	France[7]	99.0
66	Germany	99.0
66	Hungary	99.0
66	Iceland	99.0
66	Ireland	99.0
66	Jordan	99.0
66	Mauritius	99.0
66	Moldova	99.0
66	Morocco	99.0
66	Philippines	99.0
66	Portugal	99.0
66	Singapore	99.0
66	Tunisia	99.0
84	Latvia[2]	98.8
85	Libya[4]	98.0
85	Oman	98.0
85	Seychelles	98.0
85	Sri Lanka	98.0
89	Côte d'Ivoire	97.9
90	Kyrgyz Republic	97.5
91	Dominican Republic	97.4
92	Guyana	97.1
93	Denmark[3]	97.0
93	New Zealand[7]	97.0
95	Peru[7]	97.0
96	Swaziland[7]	96.8
97	Botswana[7]	96.0
97	Cape Verde[7]	96.0
97	Iran, Islamic Rep.[7]	96.0
97	Lao PDR	96.0
97	Panama	96.0
102	Malaysia	95.2
103	Chile[7]	95.0
103	El Salvador[2]	95.0
103	Jamaica[2]	95.0
103	Kazakhstan[5]	95.0
103	Russian Federation[1]	95.0
103	Tanzania	95.0
109	Argentina[2]	94.1
110	India	93.5
111	Madagascar	92.2
112	Pakistan[7]	92.0
112	Timor-Leste[7]	92.0
114	Senegal	91.6
115	Mongolia[7]	91.3
116	Nigeria	91.2
117	Angola	90.0
117	Venezuela[2]	90.0
119	Honduras[2]	89.9
120	Kenya	89.1
121	Ghana[7]	87.0
122	Gambia, The[2]	85.0
123	Yemen[5]	84.0
123	Zimbabwe	84.0
125	Burundi[4]	83.0
126	Lesotho[7]	81.0
127	Nepal	80.6
128	Guinea[3]	80.0
129	Gabon[2]	79.0
130	Zambia	78.0
131	Ethiopia[7]	73.0
132	Vietnam[1]	70.0
133	Costa Rica[4]	69.5
134	Puerto Rico[4]	68.4
135	Mauritania[3]	62.0
136	Burkina Faso[1]	61.1
137	Cameroon[1]	58.0
138	Chad	36.1
139	Mali[1]	20.0
140	Myanmar[5]	2.3
n/a	Haiti	n/a
n/a	Mozambique	n/a
n/a	Tajikistan	n/a

3.02 Mobile network coverage rate

Percentage of total population covered by a mobile network signal | 2013 or most recent

RANK	COUNTRY/ECONOMY	VALUE
1	Albania	100.0
1	Armenia	100.0
1	Azerbaijan	100.0
1	Bahrain	100.0
1	Barbados	100.0
1	Bhutan	100.0
1	Bolivia	100.0
1	Colombia	100.0
1	Croatia	100.0
1	Guatemala	100.0
1	Hong Kong SAR	100.0
1	Indonesia[6]	100.0
1	Israel	100.0
1	Italy	100.0
1	Kuwait[5]	100.0
1	Lithuania	100.0
1	Malta	100.0
1	Montenegro[5]	100.0
1	Namibia	100.0
1	Netherlands[7]	100.0
1	Nicaragua[4]	100.0
1	Norway	100.0
1	Qatar	100.0
1	Slovak Republic	100.0
1	Suriname	100.0
1	Switzerland	100.0
1	Taiwan, China	100.0
1	Thailand[6]	100.0
1	Trinidad and Tobago	100.0
1	Turkey[5]	100.0
1	Uganda[7]	100.0
1	United Arab Emirates	100.0
1	Uruguay	100.0
34	Bulgaria	100.0
34	Estonia	100.0
34	Sweden[7]	100.0
37	Brazil	100.0
37	Cyprus	100.0
39	Belgium	99.9
39	Greece	99.9
39	Japan	99.9
39	Korea, Rep.	99.9
39	Luxembourg[5]	99.9
39	Macedonia, FYR[5]	99.9
39	Mexico	99.9
39	Romania	99.9
39	Ukraine	99.9
39	United States[7]	99.9
49	Czech Republic	99.8
49	Egypt	99.8
49	Spain	99.8
52	South Africa[2]	99.8
53	Saudi Arabia	99.7
54	Serbia	99.7
55	Paraguay	99.7
55	Slovenia	99.7
55	United Kingdom	99.7
58	Malawi	99.6
59	Poland	99.5
60	Finland[3]	99.5
61	China[4]	99.5
62	Rwanda	99.3
63	Algeria	99.2
64	Lebanon[7]	99.1
65	Georgia[5]	99.1
66	Australia	99.0
66	Austria	99.0
66	Bangladesh	99.0
66	Cambodia[4]	99.0
66	Canada	99.0
66	France[7]	99.0
66	Germany	99.0
66	Hungary	99.0
66	Iceland	99.0
66	Ireland	99.0
66	Jordan	99.0
66	Mauritius	99.0
66	Moldova	99.0
66	Morocco	99.0
66	Philippines	99.0
66	Portugal	99.0
66	Singapore	99.0
66	Tunisia	99.0
84	Latvia[2]	98.8
85	Libya[4]	98.0
85	Oman	98.0
85	Seychelles	98.0
85	Sri Lanka	98.0
89	Côte d'Ivoire	97.9
90	Kyrgyz Republic	97.6
91	Dominican Republic	97.4
92	Guyana	97.1
93	Denmark[3]	97.0
93	New Zealand[7]	97.0
95	Peru[7]	97.0
96	Swaziland[7]	96.8
97	Botswana[7]	96.0
97	Cape Verde[7]	96.0
97	Iran, Islamic Rep.[7]	96.0
97	Lao PDR	96.0
97	Panama	96.0
102	Malaysia	95.2
103	Chile[7]	95.0
103	El Salvador[2]	95.0
103	Jamaica[2]	95.0
103	Kazakhstan[5]	95.0
103	Russian Federation[1]	95.0
103	Tanzania	95.0
109	Argentina[2]	94.1
110	India	93.5
111	Madagascar	92.2
112	Pakistan[7]	92.0
112	Timor-Leste[7]	92.0
114	Senegal	91.6
115	Mongolia[7]	91.3
116	Nigeria	91.2
117	Angola	90.0
117	Venezuela[2]	90.0
119	Honduras[2]	89.9
120	Kenya	89.1
121	Ghana[7]	87.0
122	Gambia, The[2]	85.0
123	Yemen[5]	84.0
123	Zimbabwe	84.0
125	Burundi[4]	83.0
126	Lesotho[7]	81.0
127	Nepal	80.6
128	Guinea[3]	80.0
129	Gabon[2]	79.0
130	Zambia	78.0
131	Ethiopia[7]	73.0
132	Vietnam[1]	70.0
133	Costa Rica[4]	69.5
134	Puerto Rico[4]	68.4
135	Mauritania[3]	62.0
136	Burkina Faso[1]	61.1
137	Cameroon[1]	58.0
138	Chad	36.1
139	Mali[1]	20.0
140	Myanmar[6]	2.3
n/a	Haiti	n/a
n/a	Mozambique	n/a
n/a	Tajikistan	n/a

3.04 Secure Internet servers

Secure Internet servers per million population | 2013

RANK	COUNTRY/ECONOMY	VALUE
1	Iceland	2,922.6
2	Netherlands	2,382.1
3	Switzerland	2,212.8
4	Luxembourg	2,190.7
5	Denmark	2,103.1
6	Korea, Rep.	1,994.9
7	Norway	1,725.7
8	Finland	1,546.9
9	Malta	1,469.5
10	Sweden	1,439.1
11	United States	1,306.0
12	Australia	1,252.3
13	United Kingdom	1,193.5
14	New Zealand	1,100.9
15	Austria	1,079.3
16	Germany	1,070.9
17	Canada	1,035.3
18	Estonia	748.9
19	Belgium	737.5
20	Japan	736.7
21	Ireland	718.6
22	Hong Kong SAR	623.6
23	Cyprus	621.3
24	Seychelles	616.8
25	Singapore	609.3
26	Czech Republic	563.5
27	Slovenia	547.4
28	France	486.1
29	Barbados	340.8
30	Poland	309.0
31	Latvia	272.2
32	Israel	270.4
33	Spain	269.0
34	Slovak Republic	262.8
35	Lithuania	256.8
36	Hungary	249.5
37	Portugal	218.4
38	Italy	203.2
39	United Arab Emirates	194.2
40	Croatia	193.3
41	Kuwait	184.9
42	Qatar	161.9
43	Bulgaria	145.9
44	Bahrain	141.9
45	Greece	136.2
46	Mauritius	127.3
47	Puerto Rico	109.0
48	Chile	93.6
49	Trinidad and Tobago	93.2
50	Panama	89.8
51	South Africa	86.4
52	Costa Rica	79.0
53	Uruguay	75.1
54	Romania	69.0
55	Malaysia	66.8
56	Oman	62.8
57	Brazil	57.4
58	Macedonia, FYR	51.7
59	Russian Federation	51.1
60	Turkey	50.4
61	Jamaica	44.6
62	Lebanon	43.0
63	Argentina	42.9
64	Armenia	40.3
65	Montenegro	37.0
66	Serbia	34.8
67	Saudi Arabia	34.2
68	Colombia	33.5
69	Suriname	33.4
70	Georgia	28.8
71	Jordan	25.9
72	Ukraine	25.5
73	Mexico	25.5
74	Cape Verde	25.1
75	Moldova	24.7
76	Mongolia	22.2
77	Peru	21.4
78	Dominican Republic	20.4
79	El Salvador	18.8
80	Albania	18.4
81	Namibia	18.2
82	Thailand	18.1
83	Tunisia	17.0
84	Paraguay	15.4
85	Guatemala	13.3
86	Guyana	12.5
87	Venezuela	11.1
88	Botswana	10.4
89	Gabon	9.6
90	Kazakhstan	9.4
91	Bhutan	9.3
92	Honduras	9.1
93	Sri Lanka	9.0
94	Bolivia	8.9
95	Swaziland	8.8
96	Azerbaijan	8.5
97	Nicaragua	8.4
98	Vietnam	8.2
99	Philippines	8.1
100	Kyrgyz Republic	5.4
101	Kenya	4.8
102	Gambia, The	4.3
103	Indonesia	4.1
104	India	3.9
105	China	3.9
106	Angola	3.9
107	Morocco	3.6
108	Egypt	3.5
109	Libya	3.4
110	Zimbabwe	3.2
111	Zambia	2.8
112	Ghana	2.6
113	Rwanda	2.5
114	Nepal	2.4
115	Senegal	2.2
116	Mauritania	2.1
117	Cambodia	2.0
118	Côte d'Ivoire	2.0
119	Nigeria	1.7
120	Mozambique	1.6
121	Algeria	1.5
122	Cameroon	1.5
123	Pakistan	1.3
124	Iran, Islamic Rep.	1.3
125	Tajikistan	1.2
126	Uganda	1.2
127	Tanzania	1.1
128	Haiti	1.1
129	Mali	1.0
130	Lao PDR	1.0
131	Malawi	0.9
132	Timor-Leste	0.8
133	Burkina Faso	0.8
134	Bangladesh	0.8
135	Yemen	0.7
136	Madagascar	0.7
137	Lesotho	0.5
138	Burundi	0.3
139	Ethiopia	0.2
140	Myanmar	0.1
141	Guinea	0.1
n/a	Chad	n/a
n/a	Taiwan, China	n/a

Appendix 9: The cost structure

Table 53: The cost structure template of Thai subsidiary airline (Anon, 2016b)

	Amount	Unit
Schedules / Operations cost information		
Weekly Frequency		Round Trip
Overnight		Night
Distance per R/T		Km
Airborne Hour per R/T		Hour
Block Hour per R/T		Hour
Airport Fee BKK		THB / landing
Airport Fee DAD		THB / landing
Total		THB / landing
Ground Handling Fee BKK		THB / Flight
Ground Handling Fee DAD		THB / Flight
Total		THB / Flight
Total Cabin Configuration		
Total BC		Seat
Total EY		Seat
Total Cabin configuration		Seat
Assumption Cabin Factor		
BC Sold		%
EY Sold		%
Total Sold		%
Revenue Assumptions		
Fare/RT U Class		THB
Fare/RT Y Class		THB

Passenger Revenue U class		THB
Passenger Revenue Y class		THB
Total Passenger Revenue		THB
Other Revenue		THB
Total Revenue		THB

Load Dependable		
Liability Insurance-Load		THB
Direct PAX Service-Meal/Drinks		THB
Agent Commission-Passenger		THB
Agent Comm-Freight		THB
Communications		THB
Total reservation		THB
Booking Fee TG Channel		THB
Booking Fee WE Channel		THB
Cancellation/Irregularities		THB
Total Load Dependable		**THB**
Not Load Dependable		
Cockpit Crew - Route Expenses		THB
Cabin Crew - Route Expenses		THB
Hotel		THB
Total Fuel & Oil Cost		THB
Total Overhaul & Maintenance		THB

Total Airport Fees		THB
Navigation Fees		THB
Handling & Dispatch		THB
Direct PAX Service-Material		THB
Direct PAX Service-INFLT ENTER		THB
Total Load Dependable		**THB**
Direct Fixed		
Line Maintenance Organization		THB
Cockpit & Cabin Crew - Salaries & Others		THB
Station Organization		THB
Total Direct Fixed		**THB**

Flight Equipment		
Flight Equipment Lease Fees A/C		THB
Flight Equipment Depr./Int.		THB
Flight Equipment Insurance		THB
Lease Fee Freighter AC		THB
Flight Equipment Lease Fees Spare Part		THB
Total Flight Equipment		**THB**
Indirect Fixed		

Advertisting & Publicity		THB
Management & Administration		THB
Total Indirect Fixed		**THB**
Frequency / ASK / RPK		
No. of Round Trip per Day		Round Trip
No. of Round Trip per Week		Round Trip
No. of Round Trip per Month		Round Trip
Total Round Trip		Round Trip
ASK		ASK
RPK		RPK
Total Passenger		
Average BC Per R/T		Pax /Flight
Average EY Per R/T		Pax /Flight
Average PAX per R/T		Pax /Flight
Annual Pax U Class		Pax / RT
Annual Pax Y Class		Pax / RT
Total Annual Passenger		Pax / RT

External factor		
Exchange Rate (1 USD)		THB
Exchange Rate (1 Yuan)		THB
Exchange Rate (1 HKD)		THB
Fuel		
BBL / Liter Conversion		Litre
Fuel Price (1 BBL)		THB
Fuel price		USC/USG
Fuel consumption rate		USG/BH
LT:USG conversion Ratio		Ratio
Total Fuel burn (USG)		USG
Total Fuel expense		USD
Total Fuel expense		THB

Change of expense		
Liability Insurance-Load	0.0042	THB per RPK
Agent Commission-Passenger	0.0005	THB per Pax Rev
Agent Comm-Freight	0	RTK
Communications	0.0025	THB per ASK
Commission Booking TG Channel	5.5	USD/booking
Commission Booking WE Channel	1.25	USD/booking
Cancellation/Irregularities	0.000834	THB per RPK
Overhaul / Maintenance	800.4	USD/BH
Direct PAX Service-INFLT ENTER	0.0018	per ASK
Cockpit & Cabin Crew - Salaries & Others	8200	per Block Hour
Line Maintenance Organization	0	R/T

Station Organization	600	THB per U PAX
Flight Equipment Lease Fees A/C	1000	USD per BH
Flight Equipment Depr./Int.	0	USD per ASK
Flight Equipment Insurance	0.0025	THB per ASK
Lease Fee Freighter AC	0	THB per ASK
Flight Equipment Lease Fees Spare Part	0.01679	THB per ASK
Advertisting & Publicity	0.09305	THB per RPK
Management & Administration	0.1192	THB per ASK

Table 54: The summery of net present value for Cebu, Kaohsiung and Wuxi

CEB

	Assumption		2016	2017	2018	2019	2020	2021
Per Round Trip	Cabin Factor		60.0%	65.0%	69.0%	72.0%	74.0%	75.0%
	Yield include surcharge	THB	1.64	1.67	1.74	1.85	2.00	2.21
	Total Cost	THB	1,862,794	1,880,434	1,894,546	1,905,130	1,912,186	1,915,714
	Total Revenue	THB	1,690,674	1,868,195	2,063,280	2,284,768	2,541,804	2,844,281
	Average Fare	THB	8,365	8,533	8,703	8,877	9,055	9,236
	Profit /(Loss)	THB	-172,120	-12,239	168,734	379,638	629,618	928,567
	Cost per ASK (CASK)	THB	1.08	1.10	1.10	1.11	1.11	1.12
	Break-even Cabin Factor		66.1%	65.4%	63.4%	60.0%	55.7%	50.5%
	Revenue per ASK (RASK)	THB	0.98	1.09	1.20	1.33	1.48	1.66
Year Round	RT/Week	RT	7	7	7	7	7	7
	Week		52	52	52	52	52	52
	Total Profit /(Loss)	THB	-62,651,809	-4,455,139	61,419,277	138,188,349	229,181,015	337,998,367

IRR		10%
NPV 3 years	mTHB	87.9
NPV 5 years	mTHB	454.3

KHH

	Assumption		2016	2017	2018	2019	2020	2021
Per Round Trip	Cabin Factor		60.0%	65.0%	69.0%	72.0%	74.0%	75.0%
	Yield include surcharge	THB	1.70	1.73	1.80	1.91	2.07	2.28
	Total Cost	THB	1,731,047	1,747,825	1,761,247	1,771,314	1,778,025	1,781,380
	Total Revenue	THB	1,571,561	1,736,575	1,917,916	2,123,799	2,362,726	2,643,892
	Average Fare	THB	7,776	7,932	8,090	8,252	8,417	8,585
	Profit /(Loss)	THB	-159,486	-11,250	156,669	352,486	584,701	862,512
	Cost per ASK (CASK)	THB	1.12	1.13	1.14	1.15	1.15	1.16
	Break-even Cabin Factor		66.2%	65.5%	63.4%	60.1%	55.7%	50.6%
	Revenue per ASK (RASK)	THB	1.02	1.13	1.24	1.38	1.53	1.71
Year Round	RT/Week	RT	7	7	7	7	7	7
	Week		52	52	52	52	52	52
	Total Profit /(Loss)	THB	-58,052,966	-4,095,023	57,027,464	128,304,763	212,831,278	313,954,393

IRR		10%
NPV 3 years	mTHB	81.8
NPV 5 years	mTHB	422.1

WUX

	Assumption		2016	2017	2018	2019	2020	2021
Per Round Trip	Cabin Factor		60.0%	65.0%	69.0%	72.0%	74.0%	75.0%
	Yield include surcharge	THB	2.05	2.10	2.18	2.31	2.50	2.77
	Total Cost	THB	1,856,056	1,871,959	1,884,681	1,894,222	1,900,583	1,903,764
	Total Revenue	THB	1,682,516	1,859,180	2,053,324	2,273,743	2,529,539	2,830,556
	Average Fare	THB	8,325	8,949	9,621	10,342	11,118	11,952
	Profit /(Loss)	THB	-173,540	-12,779	168,643	379,521	628,956	926,792
	Cost per ASK (CASK)	THB	1.36	1.37	1.38	1.39	1.39	1.39
	Break-even Cabin Factor		66.2%	65.4%	63.3%	60.0%	55.6%	50.4%
	Revenue per ASK (RASK)	THB	1.23	1.36	1.50	1.67	1.85	2.07
Year Round	RT/Week	RT	7	7	7	7	7	7
	Week		52	52	52	52	52	52
	Total Profit /(Loss)	THB	-63,168,738	-4,651,485	61,386,185	138,145,661	228,939,816	337,352,366

IRR		10%
NPV 3 years	mTHB	87.1
NPV 5 years	mTHB	453.0

Appendix 10: The feedback and comments from Thai subsidiary airline

Project Feedback

Date: 1 NOV 2016

Project name: Airline international potential route study for a subsidiary airline

The author name: Phitthawat Taweewattanapaisan

Company name: Thai airline company A

1. Overall assessment	Poor		to		Excellent
1.1 How effective is the project toward the airline?	1	2	3	(4)	5
1.2 How the result of project has countered the problem?	1	2	3	4	(5)
1.3 How satisfy is the airline with the result?	1	2	3	(4)	5

2. Project assessment	Poor		to		Excellent
2.1 Approaching methodology	1	2	3	(4)	5
2.2 Project structure and content	1	2	3	4	(5)
2.3 Information sufficiency	1	2	3	(4)	5
2.4 Critical analysis	1	2	3	(4)	5
2.5 Clearness and conciseness	1	2	3	4	(5)

3. Student assessment	Poor		to		Excellent
3.1 Attitude	1	2	3	4	(5)
3.2 Communication	1	2	3	4	(5)
3.3 Effort	1	2	3	4	(5)
3.4 Performance	1	2	3	4	(5)

Comment and feedback

The given result will help our airline to widen the market perspective providing the knowledge of the current customer, competitor and other influences. The academic approaching method, information and analysis are sufficient to be evaluated in the route selection planning but still different to our actual airline analysis process. The result is well constructed in the academic purpose; however, many other risk and uncertainties are considered for the actual operation. Wholly, our airline would be pleased to accept and use this result as the route selection guideline for our operation.

Signature: .... Signature: ....

(Professor Dr.ParamesChutima) (WutcharinThatan)

Thesis advisor Manager of Corporate Strategy & Planning Department

VITA

Mister Phitthawat Taweewattanapaisan was born on 18th October 1992 in Bangkok, Thailand. In 2010, he firstly finished the high school from the King's Academy in Tennessee, Untied State. Then he continued his education in the dual bachelor degrees of Engineering as Industrial and Manufacturing and Management Engineer from Thammasat University, Thailand and University of Nottingham, United Kingdom between 2010-2014. After the bachelor graduation, he started the dual master degree of Engineering from Chula System Engineering Program which was cooperated between Chulalongkorn University, Thailand and University of Warwick, United Kingdom.