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Interorganizational Support and Strategies for the ASEAN Aviation Sector: An Application of Canonical Correlation Analysis

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ABSTRACT: The international and political bargaining process in the aviation sector is heavily influenced by the views of stakeholders, especially regulators, airlines and airport authorities. These views are diverse and often complex to synthesise. We use the method of non-linear canonical correlation to analyse the views of ASEAN officials sampled from aviation authorities, airline executives, airport executives, industry coordinators, air transport consultants, and international organisations in a systematic way so as to reveal the primary positions of vested interests. In so doing we have a very powerful policy tool for qualitatively predicting likely future organisational responses to initiatives in the reform of the aviation sector such as liberalisation and strategic alliances.

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Introduction

The aviation sector of the ASEAN economy[1] has grown significantly over the last two decades. Major factors influencing such development include the continuing expansion of the region's economy and the introduction of a liberal approach to domestic and international aviation in many member countries. Prior to 1997 we saw an average annual growth rate as high as 10% in ASEAN economies; however the Asian currency devaluation and the decline of the ASEAN economy since late 1997 (at least up to December 1999) has resulted in a drastic drop in air travel demand throughout the region and created a sharp increase in airline costs and excess air service supply. Most airlines have sought to reduce their capacity and costs. The economic recession and the negative growth of intra-regional traffic has also delayed the progress of air service liberalisation within the region, a vital part of establishing the ASEAN Free Trade Area (AFTA). The economic downturn is still unfolding and its experience supports the need for developing the strategic opportunities available to aviation stakeholders.

The objective of this study is to provide directions and a framework for strategic planning and policy management of the ASEAN aviation sector post the economic downturn. Strategies proposed for airline stakeholders include developing strategic route network and airline alliances and setting the criteria to achieve maximum support in liberalising air services within the region.

Developing strategies for the ASEAN aviation sector is studied within a market research framework using a survey of stakeholders to gain information on the potential initiatives that are likely to take place. A stakeholder is defined as one who has an influence (to varying degrees) on air transport policy in ASEAN, one who may be affected by the change in air transport policy, and one who is interested in air transport policy. Therefore, respondents in the study included ASEAN government officials from aviation authorities, airline executives, airport executives, industry coordinators, air transport consultants, and international organisations.

Respondents were invited to rate their perception of the worthiness of the initiatives related to airline strategies (e.g. route strategies, airline alliances, and equity investment), and regulatory strategies (e.g. the effect of economic stability, maturity of the airline industry, the size of the domestic market, and experience of participating nations in entering an open skies agreement with the US on the liberalisation of air service agreements within the ASEAN region).

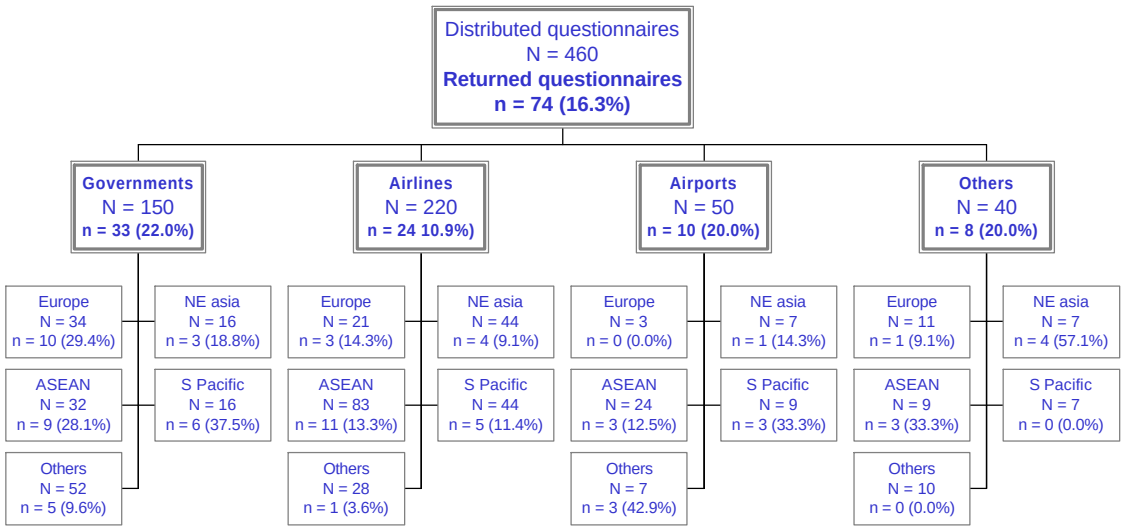
The following sections present the evidence. An optimal scaling approach using nonlinear canonical correlation is implemented to search for structural relationships between the underlying strategic initiatives and the stakeholder categories. This framework provides a very powerful mechanism for identifying initiative priorities supported or otherwise by stakeholder classes, which can feed directly into aviation policy development in the ASEAN region.

[1] ASEAN comprises the member countries of Brunei, Cambodia, Indonesia, Malaysia, Philippines, Singapore, and Thailand.

The Empirical Context

The questionnaire survey was distributed between December 1998 and February 1999 to a quota sample of 460 stakeholders. The distribution of respondents by the stakeholder type and region was pre-determined (Figure 1). The study sought more responses from airlines and governments than airports and other stakeholders. Contact details were drawn from many sources such as the APEC transport working group, International Civil Aviation Organisation (ICAO), International Air Transport Association (IATA), and the website. By the end of February 1999, 74 completed questionnaires were received (return rate of 16.3%). The relatively low effective return rate was considered a reasonable level of response to an international survey. The return rate from airlines was relatively low compared to type other stakeholders. The profile of respondents by region shows that the response rate was also high among ASEAN, Europe, and South Pacific participants.

Figure 1: Distribution of Questionnaire Survey and Sample Size by Stakeholder Type and Region



Of the survey response, there were 33 governments, 24 airlines, 10 airports, and 8 other stakeholders. The governments and airlines represent three quarters of all respondents. The profile of respondents by region shows that 65 respondents were from ASEAN, South Pacific, Europe, and Northeast Asia, accounting for 86.7 percent of the sample. The rest are evenly distributed among Africa, North America, South America, South Asia, and the Middle East.

In this paper, we concentrate on the responses to a series of attitudinal questions in which each respondent was asked to respond on a 5-point scale, indicating whether they thought a specific initiative was a good or bad idea. Each item is discussed below where we use non-linear canonical correlation to map attitudes and stakeholder type in the search for priorities in the formulation of air transport strategy. Before presenting the findings, we describe the analytical approach used to assess opinions.

Methodology

The empirical study focuses on the attitudes of stakeholders towards hypothetical aviation initiatives using a Likert scale with ordered response categories (1) very bad idea, (2) bad idea, (3) no opinion, (4) good idea, and (5) very good idea. In analysing these data, three issues common to attitude data have to be taken into account. First, attitudes can only be measured on scales that are ordinal, not cardinal. That is, agree or disagree is monotonically related to the scale value, but it should not be presumed that the intervals between adjacent scale points are equal. Consequently, linear statistical analyses applied to the raw data (such as product-moment correlations, linear regression, and principal components factor analysis) will not necessarily yield accurate conclusions about relationships in the data because such methods assume equal intervals on the measurement scales.

The second objective is to evaluate a large number of strategic statements. Respondents are likely to judge many of the statements as being similarly agreeable or disagreeable and they may not have formed attitudes towards many of the statements. Thus, high levels of association among groups of statements are expected. A key task is to summarise these associations by identifying patterns in responses. Because the attitude scales are ordinal, associations need to be measured without simply using product-moment correlations calculated from the raw data.

The third objective is to determine how similarities in attitudes are related to segment membership by each organisation. Respondents from the same industry, or those serving similar markets might be expected to have similar attitudes. Thus, the patterns in attitude interrelationships will be a function of selected segment criteria, so the method used for determining these patterns must account for attitudes as a function of segmentation criteria. The mapping between attitudes and segment criteria is one foundation for the identification of the extent of commonality of aviation strategy.

An appropriate statistical method to analyse these data is non-linear canonical correlation analysis (CCA) that maps the agreement-disagreement responses of each segmented class of stakeholders in respect of the statement set. The mapping between the set of strategic initiatives reveals the extent of reinforcement.

A nonlinear CCA problem involves an explanatory variable matrix defined by a single nominal (segment) variable and a dependent variable matrix defined by a series of ordinal attitude scales. The linear combination on the explanatory variable side is undefined, because we have no metric to quantify the categories of each nominal variable. The linear combination of the variables on the dependent side is also undefined, because the categories of each variable can be re-scaled by any nonlinear function that preserves monotonicity. Thus, we need to optimally scale or quantify the variables while simultaneously solving the traditional linear CCA problem of finding weights for each explanatory variable.

A solution to the nonlinear CCA problem was first proposed by researchers at Leiden University (De Leeuw 1984, Van der Burg 1988 and Gifi 1990). The method simultaneously determines both (1) optimal re-scaling of the nominal and ordinal variables and (2) explanatory variable weights, such that the linear combination of the weighted re-scaled variables in one set has the maximum possible correlation with the

linear combination of weighted re-scaled variables in the second set. Both the variable weights and optimal category scores are determined by minimising a loss function derived from the concept of "meet" in lattice theory (see Gifi 1990).

A nonlinear CCA solution involves, for each canonical variate, weights for all the variables, optimal category scores for all ordinal and nominal variables, and a canonical correlation. Graphical representations are very important in interpreting this plethora of results. Several authors have argued that graphical representations are even crucial in understanding the results of linear multivariate methods, because patterns in the data can best be detected visually (Cailliez and Pagès, 1976; Ter Braak, 1990).

Graphical display and interpretation

The interpretation of non-linear CCA is based on graphs displaying the relationship between two or more sets of variables. By using a matrix approximation approach (Rao 1980) in conjunction with the biplot technique (Gabriel 1971, 1981) the plot yields (by way of scalar inner products) approximate values of the correlations between the variables of the one set and the other set, and that the approximation is best in a weighted least-squares sense.

To interpret the results of a non-linear CCA solution with p dimensions (canonical variates) it is useful to examine two types of a p dimensional plot. The first is a plot of component loadings that describes the weights of the optimally scaled strategic statements. The second is a plot of category scores that displays the weights of the nominal segment variable quantified for each canonical variate.

Since we have only one nominal variable on the explanatory variables side, the axis of this p dimensional plot can coincide with the weights of this nominal variable on the canonical variates, because the vector of weights will be orthogonal and the p dimensional space can be arbitrarily rotated. The upper bound on p, the number of dimensions, is the minimum of the number of strategic statements and segments. However, analysts generally aim for a two-dimensional canonical solution ($p = 2$) due to the convenience of two-dimensional plots (Gifi 1990).

The square of the length of the vector from the origin of the component loadings plot to the coordinates of a given variable indicates how much of the dependent variable is explained by all canonical variates in total. The square of the projections of the vector on the axes reveals how much of the explanation is due to each canonical variate. For any two vectors, the inner product is an approximation of the correlation between the two optimally scaled variables. The inner product of the vectors for two variables on the component loadings plot indicates the degree of correlation between two strategic statements. The correlation between these vectors is positive if the angle is sharp, negative if the angle is obtuse, and zero if the arrows are perpendicular.

A plot of category scores provides the remainder of the information we need to interpret a non-linear CCA solution. Multiple treatment of the segment variable (nominal variable) results in different category scores on each canonical variate for this nominal explanatory variable. So a plot of the category scores in the space of the canonical variates allows us to visualise which segments are associated with high or low values of each canonical variate. By comparing the component loadings and category scores

plots, we can then relate the segments to the initiatives. For the convenience of the analysis of the interaction between strategic initiatives versus segments, we incorporate the results of component loadings (statements) and category scores (segments) into one perceptual map. Then, we use the vector representation from the technique of multidimensional scaling to portray the relationship of an individual's preferences towards specific statements.

To calculate the preference ordering, perpendicular lines can be drawn from the objects to the vector representation. Preference increases in the direction the vector is pointing. Then the preferences can be read directly from the ordering of the projections (Hair *et al.*, 1992). In summary, the four features of particular relevance are:

- the angle between each of the strategic initiatives as a measure of correlation,
- the distance and direction of the intersection of a perpendicular line from the segment identifier to the extended vector of a strategic initiative as a measure of the strength of support for an initiative in each segment,
- the length of the vector associated with each strategic initiative as a measure of the amount of explanation by the two canonical variates and
- the location of segment identifiers (or objects) relative to the origin, with higher frequencies closer to the origin.

Results

The empirical investigation divides the aviation strategies into two classes - (1) airline strategies, and (2) regulatory strategies. A total of seventeen aviation initiatives, listed in Table 1, were evaluated. The optimal scaling method was implemented separately in each of two classes of initiatives.

Table 1 Proposed aviation initiatives tested in the survey

Aviation Initiatives (scale: 1 = a very bad idea, … 5 = a very good idea)
1. Airline Strategies
Hubbing Strategies (1a)
• ***Initiative 1a_1 (route concentration)***: Major ASEAN airlines should maintain high seat capacity on the dense intra-regional routes linking their current hub airports.
• ***Initiative 1a_2 (hub and spoke)***: Intra-regional operations between thin markets in ASEAN should rely more on the hub and spoke system than on direct connections.
• ***Initiative 1a_3 (multiple hub airport)***: Hubbing activities in ASEAN should grow more rapidly at the secondary airports than at current primary airports.
Airline Alliances (1b)
• ***Initiative 1b_1 (alliance growth)***: As a result of economic downturn, ASEAN carriers can secure more benefit from alliance growth.
• ***Initiative 1b_2 (codesharing strategies)***: Expanding ASEAN carriers should prefer a codeshar with holding equity to codeshare without holding equity.
• ***Initiative 1b_3 (frequent flyers activities)***: There should be more frequent flyer programs by carriers from the ASEAN region.
Equity Investment (1c)
• ***Initiative 1c_1 (investment for low operating profit carriers)***: ASEAN carriers with low operating profit should enter into equity alliances.
• ***Initiative 1c_2 (investment for low production level carriers)***: ASEAN carriers with low production levels should enter into equity alliances.
• ***Initiative 1c_3 (investment for low access to international market carriers)***: ASEAN carriers with low access to international markets should enter into equity alliances.

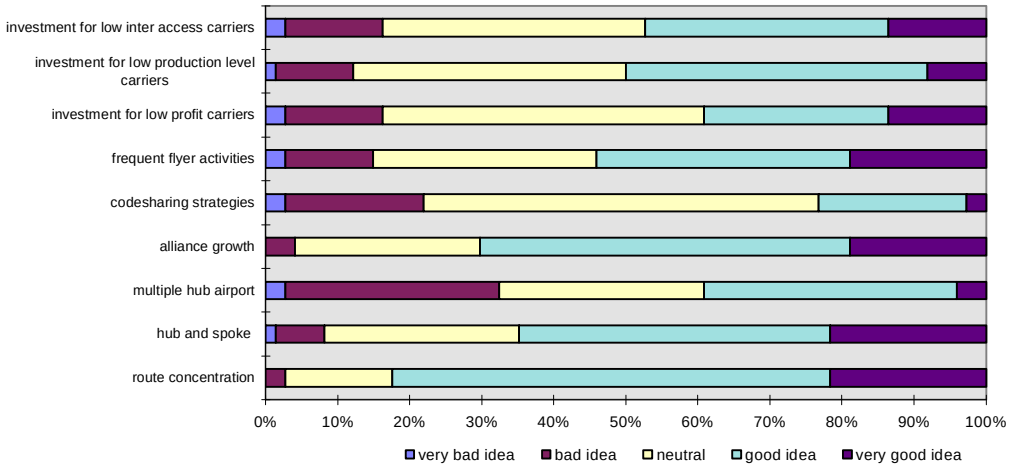
Table 1 continued

2. Regulatory Strategies
Economic Stability (2a)
• ***Initiative 2a_1 (effect of economic stability on opening 3rd and 4th freedoms)***: ASEAN countries having the greatest prospect of economic stability should liberalise 3rd and 4th freedom rights within the region.
• ***Initiative 2a_2 (effect of economic stability on opening beyond rights)***: ASEAN countries having the greatest prospect of economic stability should liberalise beyond rights within the region.
Maturity of Airline Industry (2b)
• ***Initiative 2b_1 (effect of maturity of airline industry on opening 3rd and 4th freedoms)***: ASEAN countries with a stronger airline industry should liberalise 3rd and 4th freedom rights within the region.
• ***Initiative 2b_2 (effect of maturity of airline industry on opening beyond rights)***: ASEAN countries with a stronger airline industry should liberalise beyond rights within the region.
Size of Domestic Market (2c)
• ***Initiative 2c_1 (effect of domestic market size on opening 3rd and 4th freedoms)***: ASEAN countries with a small domestic market should liberalise 3rd and 4th freedom rights within the region.
• ***Initiative 2c_2 (effect of domestic market size on opening beyond rights)***: ASEAN countries with a small domestic market should liberalise beyond rights within the region.
U.S. Open Skies Experience (2d)
• ***Initiative 2d_1 (effect of open skies experience with the USA on opening 3rd and 4th freedoms)***: ASEAN countries that already have an open skies agreement with the USA should liberalise 3rd and 4th freedom rights within the region.
• ***Initiative 2d_2 (effect of open skies experience with the USA on opening beyond rights)***: ASEAN countries that already have an open skies agreement with the USA should liberalise beyond rights within the region.

Airline strategies

The responses to nine airline strategic initiatives are graphed in the bar charts of Figure 2. Overall, the positive responses to each of the initiatives outnumber the negative responses. In particular, there were reasonably high levels of support for ìroute concentrationî, ìalliance growthî, and ‘hub and spoke’. The ‘multiple hub airport’ initiative drew the highest number of negative responses. In addition, a higher proportion of the stakeholders were undecided on whether equity investment for low profit carriers and code sharing strategies would be a good or bad idea compared to those who viewed it as a bad idea and those who viewed it as a good idea.

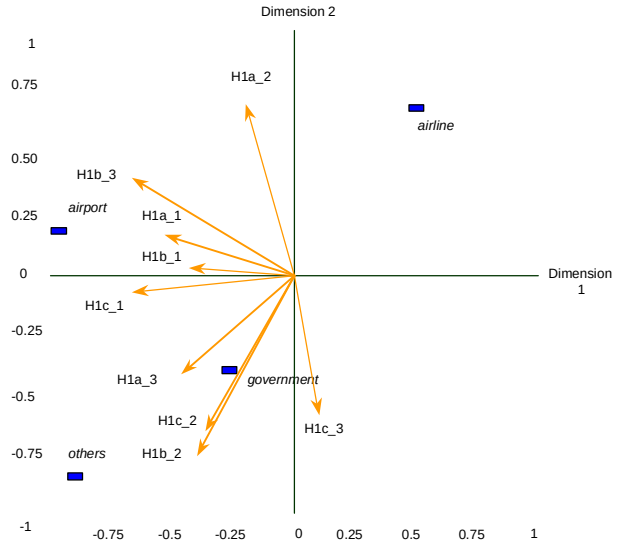
Figure 2 Attitudes towards Airline Strategies



We conducted a non-linear canonical correlation analysis (NCCA) to determine differences in attitudes towards the airline strategic initiatives among the categories of stakeholder sectors. The key results are graphed in Figure 3 to 6. Figure 3 displays the results of the NCCA linking stakeholder type and attitudes towards nine airline strategy initiatives. The variables were divided into four sets. The first contains the ordinal attitudinal data of initiatives related to route strategies: 1a_1 (route concentration), 1a_2 (hub and spoke), and 1a_3 (multiple hub airport). The second set are the initiatives associated with airline alliances: 1b_1 (alliance growth), 1b_2 (code sharing strategies), and 1b_3 (frequent flyer activities). The third set are the initiatives related to equity investment: 1c_1 (equity investment for low operating profit carriers), 1c_2 (equity investment for low production level carriers), and 1c_3 (equity investment for low access to international market carriers). Stakeholder type is defined by a nominal variable (coded 1= government, 2 = airline, 3 = airport, and 4 = other stakeholders).

The two dimensional non-linear generalised canonical analysis yielded a canonical correlation of 0.56 for the first dimension and 0.53 for the second. These statistics suggest that a two-dimensional solution is acceptable because of a small drop-off in explanatory power for the second orthogonal dimension. The component loadings of the proposed initiatives are shown as the vectors. We can see from Figure 3 that nine initiatives are divided into three groups. The first involves 1a_1, 1b_1, and b_3, all pointing in the same direction. The second set consists of 1a_3 and 1c_1. The third set includes 1b_2 and 1c_2. The close alignment between these variables suggests that attitudes towards these initiatives are highly positively correlated. The third set running almost perpendicular to the first indicates a minimal correlation between them. 1c_3 does not belong to any cluster and located in the direction opposite to 1a_2. The directional difference indicates that attitudes towards both initiatives are highly negatively correlated.

Figure 3 Attitude towards Airline Strategies Versus Stakeholder Type



The patterns on the category scores plot (objects) contrasts airports, governments, and other stakeholders against airlines. To determine the preference order of each individual towards each initiative vector, we need to estimate the projections by drawing a perpendicular line from the object of each stakeholder to the vector. Preference

increases in the direction the vector is pointing with the preferences read directly from the order of the projections. For example, 1a_2 has the direction of lower preference in the bottom right hand corner to higher preference in the upper left-hand corner. When the projection for objects of each stakeholder is made, the preference order (highest to lowest) is airlines, airports, governments, and others.

An interpretation of the key resulted plotted in Figure 3 is provided in Table 2.

Table 2 Summary of Results of Non-linear Canonical Correlation of Attitudes towards Airline Strategies Versus Stakeholder Type (most outstanding results are underlined)

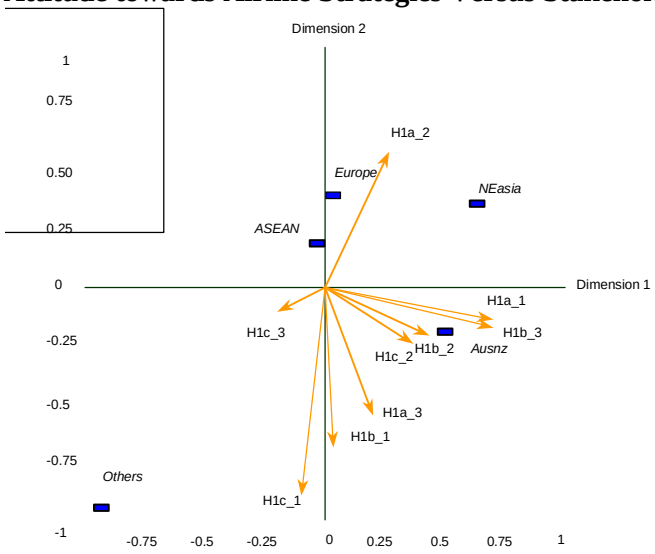
Initiatives	Cluster			Strongest support			Weakest support
	1st	2nd	3rd				
1a_1 : Route concentration	*			Airport	Others	Governments	Airlines
1a_2: Hub and spoke				Airlines	Airports	Governments	Others
1a_3: Multiple hub airport		*		Others	Airports	Governments	Airlines
1b_1: Alliance growth	*			Airport	Others	Governments	Airlines
1b_2: Codesharing strategies			*	Others	Governments	Airports	Airlines
1b_3: Frequent flyer activities	*			Airport	Others	Governments	Airlines
1c_1: Investment initiative for carriers with low operating profit		*		Others	Airports	Governments	Airlines
1c_2: Investment initiative for carriers with low production level			*	Others	Governments	Airports	Airlines
1c_3: Investment initiative for carriers with low international access				Others	Governments	Airports	Airlines

Except for 1a_2, the airline stakeholder gives least support to the overall airline strategy initiatives, in particular initiatives concerning equity holding. We underline the initiatives in the table that have relatively large differences in their degree of support revealed by stakeholders. The degree of support is calculated by the distance between one who is most in favour and one who is least in favour of a given initiative (i.e. a best - worst scenario). For example, the difference in degree of support for 1a_2 (hub and spoke) is larger than for 1B_3 (multiple hub airport) because, when drawing the perpendicular line from the object to the vector, the distance between airline and other stakeholders along the vector 1a_2 is greater than the distance between airport and airline stakeholders along the vector 1B_3. To ensure that overall stakeholder support is maximised, the underlined strategic initiatives should not be adopted. Therefore, 1a_1(route concentration), 1b_1 (alliance growth), and 1b_3 (frequent flyer activities) are the most appropriate airline strategies to be implemented in the ASEAN post economic downturn. In other words, ASEAN carriers are encouraged to secure benefits from alliance growth, in particular the cooperation of frequent flyer programs. The implementation of airline alliances can help major ASEAN carriers to reduce costs and allow them to focus on operations on the dense intra-regional routes.

We investigated how stakeholders from different regions judged airline strategic initiatives. We replaced stakeholder type by stakeholder region (coded 1 = Europe, 2 = Northeast Asia, 3 = ASEAN, 4 = Ausnz, and 5 = others) as reported in Figure 4. A two-dimensional solution produces canonical correlations of 0.57 for the first dimension and 0.51 for the second. Figure 4 shows the two clusters of initiatives. The first includes 1a_1, 1b_2, 1b_3, and 1c_2. This arrangement is somewhat similar to Figure 3. The second cluster contains 1a_3, 1b_1, and 1c_1 and is negatively correlated with 1a_2. As the second cluster rotates almost perpendicular to the first, the correlation between both

sets is low. 1c_3 does not fit in any cluster and has the direction of higher preference in the bottom left hand corner, indicating a separate dimension.

Figure 4 Attitude towards Airline Strategies Versus Stakeholder Region



There are two similarities between Figures 3 and 4. First, we find a positive high relationship between two groups of initiative: (a) 1a_1 and 1b_3 – route concentration and frequent flyer activities and (b) 1b_2 and 1c_2 – codesharing and investment initiatives for carriers with low production levels. While both (a) and (b) have zero correlation to each other in Figure 8.2, they have a strong correlation to each other in Figure 4. Second, we observe that 1a_2 (hub and spoke) is located separately in both pictures. However, we cannot see a unique variable that has a negative relationship with it. The results of this analysis are summarised in Table 3.

Table 3 Summary of Results of Non-linear Canonical Correlation of Attitudes towards Airline Strategies Versus Stakeholder Region (most outstanding results are underlined)

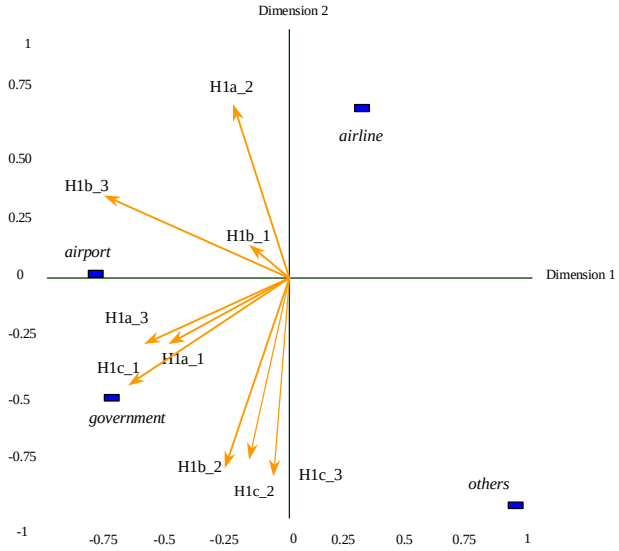
Initiatives	Cluster		Strongest support			Weakest support	
	1st	2nd					
1a_1 : Route concentration	*		Ausnz	NEasia	Europe	ASEAN	Others
1a_2: Hub and spoke			NEasia	Europe	ASEAN	Asunz	Others
1a_3: Multiple hub airport		*	Others	Ausnz	NEasia	ASEAN	Europe
1b_1: Alliance growth		*	Others	Ausnz	ASEAN	NEasia	Europe
1b_2: Codesharing strategies	*		Ausnz	NEasia	Others	ASEAN	Europe
1b_3: Frequent flyer activities	*		Ausnz	NEasia	Europe	ASEAN	Others
1c_1: Investment initiative for carriers with low operating profit		*	Others	Ausnz	ASEAN	Europe	NEasia
1c_2: Investment initiative for carriers with low production level	*		Ausnz	NEasia	Others	ASEAN	Europe
1c_3: Investment initiative for carriers with low international access			Others	ASEAN	Europe	Ausnz	NEasia

The first cluster is most favoured by respondents from South Pacific (Ausnz) and Northeast Asia and least favoured by stakeholders from Europe, ASEAN, and other regions. The second cluster is most favoured by stakeholder from other regions and South Pacific (Ausnz) and least favoured by stakeholders from Northeast Asia, Europe

and ASEAN. By using the stakeholder region as the criterion, the airline strategies contained in the first cluster (1a_1, 1b_2, 1b_3, and 1c_2) would minimise the conflict between various stakeholders.

Next, we consider how airline strategy initiatives were viewed by the stakeholders who were likely to influence a change in ASEAN aviation policy or who are affected by such a change. Variables were partitioned into four sets but the sample was limited to stakeholders from ASEAN member countries. The results of attitudes towards airline strategies by stakeholder types from the ASEAN member countries are summarised in Figures 5 and 6 respectively.

Figure 5 Attitudes towards Airline Strategies Versus Type of ASEAN Stakeholder



The canonical correlations of the two dimension solution are 0.68 and 0.64. There are three distinct groups of initiatives. The first group, closely aligned with the negative side of the second dimension, comprises 1b_2, 1c_2, and 1c_3, which is in the direction opposite to 1a_2. The association of 1b_2, 1c_2, and 1c_3 hints that equity holding is an important investment strategy for the minor expanding ASEAN carriers. The second grouping - 1a_1, 1a_3, and 1c_1 - is rotated about 40 degrees from the first. This implies that both clusters are moderately positively correlated. The third set consists of two airline alliance initiatives: 1b_1 and 1b_3. The rotation about 90 degrees from the first set indicates that such initiatives are uncorrelated with the first cluster.

There are two identical results in Figures 3 (all respondents) and 5 (ASEAN respondents). First, we find a strong positive relationship between two groups of initiative regardless of segment of stakeholders: (a) 1b_1 and 1b_3, and (b) 1a_3 and 1c_1. Second, we find that 1a_2 is located separately in the joint space and is negatively correlated with 1b_2, 1c_2, and 1c_3.

An interpretation of major results in Figure 5 is given in Table 4. Other stakeholders and governments are most in favour of the first cluster whereas airlines are least in favour of these initiatives. The second cluster is strongly supported by governments and airports and weakly supported by airlines. Airports, governments, and airlines are more in favour of the initiatives in the third cluster while the weakest support for this is from other stakeholders. To maximise overall support in this analysis, the initiatives related to

alliance growth (1b_1) and frequent flyer activities (1b_3) should be implemented. In other words, ASEAN carriers are encouraged to have more alliance activities, specifically the joint frequent flyer programs and to maintain alliance growth.

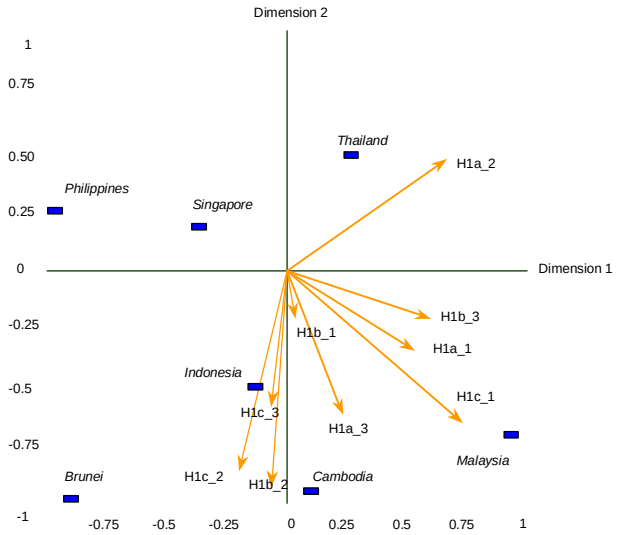
Table 4 Summary of Results of Non-linear Canonical Correlation of Attitudes towards Airline Strategies Versus Type of ASEAN Stakeholder (most outstanding results are underlined)

Initiatives	Cluster			Strongest support			Weakest support
	1st	2nd	3rd				
1a_1 : Route concentration		*		Governments	Airports	Others	Airlines
1a_2: Hub and spoke				Airlines	Airports	Governments	Others
1a_3: Multiple hub airport		*		Governments	Airports	Others	Airlines
1b_1: Alliance growth			*	Airports	Governments	Airlines	Others
1b_2: Codesharing strategies	*			Others	Governments	Airports	Airlines
1b_3: Frequent flyer activities			*	Airports	Governments	Airlines	Others
1c_1: Investment initiative for carriers with low operating profit		*		Governments	Airports	Others	Airlines
1c_2: Investment initiative for carriers with low production level	*			Others	Governments	Airports	Airlines
1c_3: Investment initiative for carriers with low international access	*			Others	Governments	Airports	Airlines

Next, we are interested in how airline strategies were perceived by stakeholders from various ASEAN countries. The results of NCCA linking stakeholders from ASEAN countries and attitudes towards aviation initiatives are depicted in Figure 6. In this analysis, the stakeholder type variable was replaced with country variable (coded 1= Brunei, 2 = Cambodia, 3 = Indonesia, 4 = Malaysia, 5 = Philippines, 6 = Singapore, and 7 = Thailand). A two-dimensional solution yielded canonical correlations of 0.72 for the first dimension and 0.64 for the second.

In this analysis, nine initiatives are divided into three groups. The first includes 1a_1, 1b_3, and 1c_1. The second consists of 1b_1 and 1a_3. The third comprises 1b_2, 1c_2, and 1c_3. The attitude towards 1a_2 has the direction of higher preference in the upper right hand corner indicating a separate dimension. Again, we find that 1a_2 is negatively correlated with 1b_2, c_2, and 1c_3. In other words, there is a uniform relationship between these variables across Figures 3 to 6.

Figure 6 Attitude towards Airline Strategies Versus Country of ASEAN Stakeholder



The results of preference ordering are reported in Table 5.

Table 5 Summary of Results of Non-linear Canonical Correlation of Attitudes towards Airline Strategies Versus Country of ASEAN Stakeholder (most outstanding results are underlined)

Initiatives	Cluster			Strongest support						Weakest support
	1st	2nd	3rd							
1a_1 : Route concentration	*			Malaysia	Cambodia	Indonesia	Thailand	Brunei	Singapore	Philippine
1a_2: Hub and spoke				Thailand	Malaysia	Singapore	Indonesia	Cambodia	Philippine	Brunei
1a_3: Multiple hub airport		*		Malaysia	Cambodia	Brunei	Indonesia	Singapore	Thailand	Philippine
1b_1: Alliance growth		*		Cambodia	Brunei	Malaysia	Indonesia	Singapore	Philippine	Thailand
1b_2: Codesharing strategies			*	Brunei	Cambodia	Malaysia	Indonesia	Singapore	Philippine	**Thailand**
1b_3: Frequent flyer activities	*			Malaysia	Cambodia	Indonesia	Thailand	Singapore	Brunei	Philippine
1c_1: Investment initiative for carriers with low operating profit	*			Malaysia	Cambodia	Indonesia	Brunei	Thai	Singapore	Philippine
1c_2: Investment initiative for carriers with low production level			*	Brunei	Cambodia	Indonesia	Malaysia	Philippine	Singapore	**Thailand**
1c_3: Investment initiative for carriers with low international access			*	Brunei	Cambodia	Malaysia	Indonesia	Philippine	Singapore	**Thailand**

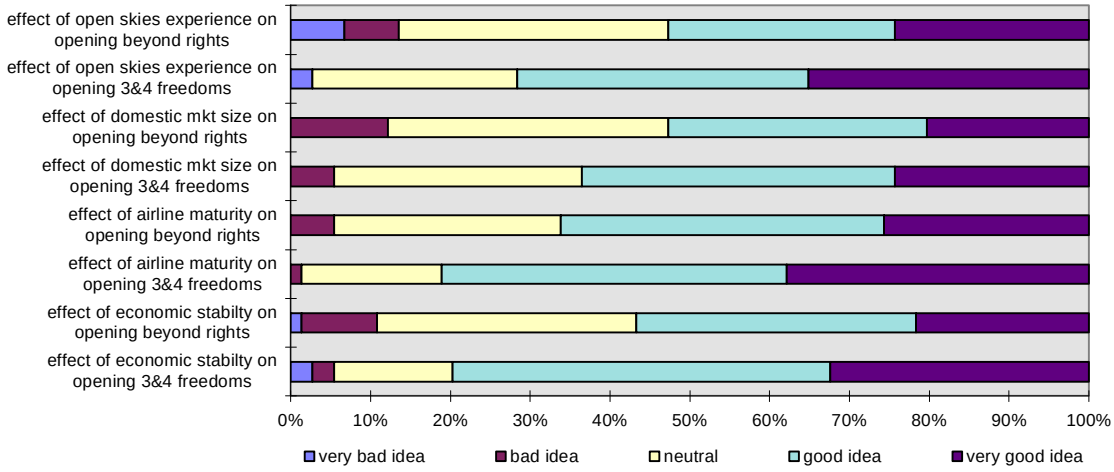
The first group is strongly supported by Malaysia and Cambodia and strongly opposed by the Philippines and Singapore. The second group is most in favour by Malaysia, Brunei, and Cambodia and least in favour by the Philippines and Thailand. The last group receives the greatest support from Brunei, Cambodia, and Malaysia but the lowest support from Thailand, Philippines, and Singapore. To maximise overall stakeholder support, the initiatives related to route concentration (1a_1), multiple hub airport (1a_3), alliance growth (1b_1), frequent flyer activities (1b_3), and equity investment for carriers with low operating profit (1c_1) should be implemented. Surprisingly, alliance

growth and frequent flyer activities are always rated as the appropriate airline strategies across different criteria.

Regulatory strategies

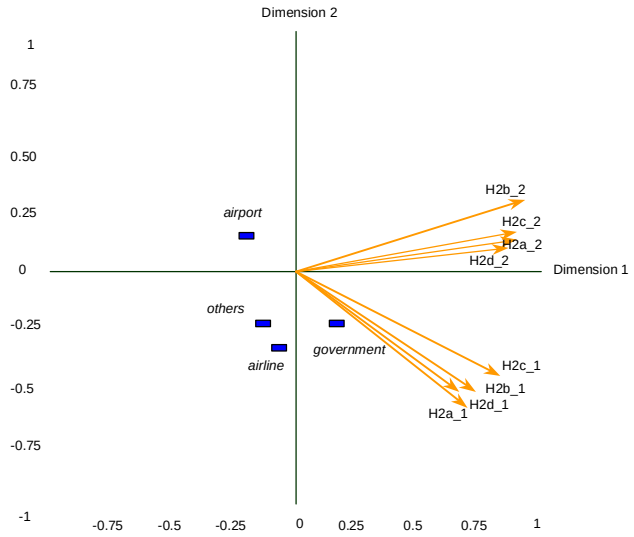
Figure 7 describes eight regulatory strategic initiatives presented for comment. The number of stakeholders indicating that the proposed initiatives were good and very good outnumber those indicating that they were bad and very bad ideas. The positive responses were extremely high for ASEAN countries having a strong airline industry and the greatest prospect of economic stability. They supported liberalised 3rd and 4th freedom rights within the region, with 80 percent of the respondents indicating that they were good and very good ideas. In addition, support for the proposals related to the liberalisation of 3rd and 4th freedom rights within the region that was generally higher than that for the proposals related to the liberalisation of beyond rights within the region. Not surprisingly, this finding is consistent with the analysis of an open skies understanding which suggests that most stakeholders understand an open skies agreement as the inclusion of the liberalisation of 3rd and 4th freedom rights rather than the beyond rights.

Figure 7 Attitudes towards Regulatory Strategies



The results of the non-linear canonical correlation analysis linking various stakeholder categories and attitudes towards regulatory strategies are presented in Figures 8 to 11. Figure 8 portrays a relationship between attitudes towards regulatory strategies and stakeholder type. Nine variables were partitioned into five sets. The first four sets were created by the ordinal data on attitudes towards the impact of economic stability (2a_1 and 2a_2), the maturity of the airline industry (2b_1 and 2b_2), the size of the domestic aviation market (2c_1 and 2c_2), and the experience of having an open skies agreement with the USA (2d_1 and 2d_2). The last set was formulated by stakeholder type. A two-dimensional solution yielded canonical correlations of 0.63 and 0.58 respectively.

Figure 8 Attitudes towards Regulatory Strategies Versus Stakeholder Type



We can see from Figure 8 that nine initiatives are clearly divided into two clusters. The first cluster, comprising 2a_2, 2b_2, 2c_2, and 2d_2, loads positively on the second dimension and can be interpreted as initiatives involving the liberalisation of beyond rights within the region. The second cluster, comprising 2a_1, 2b_2, 2c_1, and 2d_1, loads negatively on the second dimension and can be interpreted as initiatives involving the liberalisation of 3rd and 4th freedom rights within the region. The latter is located about 35 (deviation of 2c_1 from 2d_2) to 55 degrees (deviation of 2a_1 from 2b_2) from the first. This suggests that both clusters are moderately positively correlated. As the vector in both clusters points in the direction of a high score, it suggests a relatively strong support for each regulatory initiative. In other words, the hypothesis is supported that the enthusiasm of ASEAN countries to liberalise air service agreements within the region will vary directly with the economic stability, the maturity of the airline industry, and the experience in entering the USA open skies agreement of participating nations, but inversely with the size of the domestic market.

An interpretation of the key results plotted in Figure 8 is given in Table 6. Each regulatory initiative is strongly supported by government. The initiatives involving the liberalisation of beyond rights are most in favour by governments and least in favour by other stakeholders. The initiatives involving the liberalisation of 3rd and 4th freedom rights are also most in favour by governments and least in favour by airports. Although there are differences in degree of support among different stakeholder types, such differences are not critical in this analysis. This is because only a very small distance is observed from the order of positions along the perpendicular lines drawn from each stakeholder's objects to a given vector.

Table 6 Summary of Results of Non-linear Canonical Correlation of Attitudes towards Regulatory Strategies Versus Stakeholder Type (most outstanding results are underlined)

Initiatives	Cluster		Strongest support			Weakest support
	1st	2nd				
2a_1: Economic stability (3rd &4th)	*		Governments	Airlines	Others	Airports
2a_2: Economic stability (beyond right)		*	Governments	Airlines	Airports	Others
2b_1: Industry maturity (3rd &4th)	*		Governments	Airlines	Others	Airports
2b_2: Industry maturity (beyond right)		*	Governments	Airports	Airlines	Others
2c_1: Domestic market size (3rd & 4th)	*		Governments	Airlines	Others	Airports
2c_2: Domestic market size (beyond right)		*	Governments	Airlines	Airports	Others
2d_1: Open skies experience (3rd & 4th)	*		Governments	Airlines	Others	Airports
2d_2: Open skies experience (beyond right)		*	Governments	Airlines	Airports	Others

We further examine how stakeholders from different regions perceive the regulatory initiatives. Figure 9 presents the canonical loadings of attitude towards regulatory strategies and category scores for the stakeholder region variable. The analysis was formed by nine variables partitioned into five sets. Four sets of regulatory attitude variables were used again in this model with the stakeholder region in the last set (coded 1 = Europe, 2 = Northeast Asia, 3 = ASEAN, 4 = Ausnz, and 5 = others). The canonical correlation solutions are 0.62 and 0.57 for the first and second dimension respectively.

Figure 9 Attitudes towards Regulatory Strategies Versus Stakeholder Region

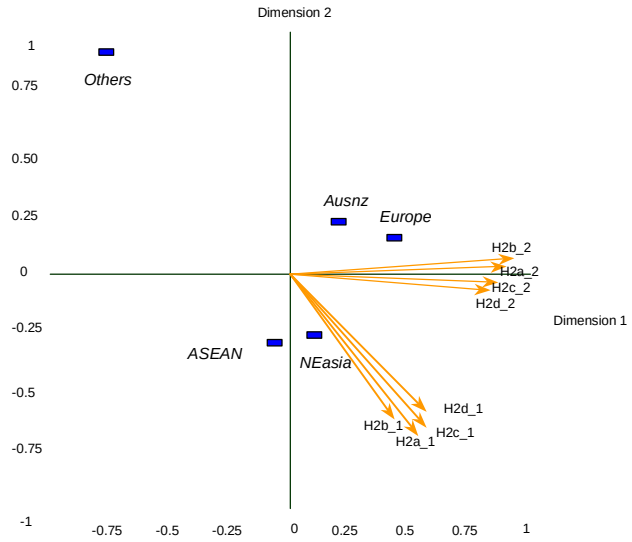


Figure 8 and 9 are quite similar to each other although the stakeholder category was set differently. Again, Figure 9 highlights that all initiatives are organised into two clusters. The first is closely aligned with the positive side of the first dimension. It consists of initiatives involving the liberalisation of beyond rights within the region. Below to the right, we discover a cluster of initiatives related to the liberalisation of 3rd and 4th freedom rights within the region. The second cluster, located about 40 to 55 degrees from the first, suggests that attitudes towards both groups of initiatives are moderately positively correlated. As the vectors in both clusters point in the direction of a high score, we can accept again that the enthusiasm of ASEAN member countries to liberalise air service agreements within the region will vary directly with economic stability, the maturity of the airline industry, and the experience in entering the USA

Open skies agreement of participating nations, but inversely with the size of the domestic market.

An interpretation of the results plotted in Figure 9 is summarised in Table 7. We cannot find a negative relationship among the proposed regulatory initiatives. The initiatives involving the liberalisation of 3rd and 4th freedom rights are most in favour of respondents from Northeast Asia and the ASEAN region while the liberalisation of beyond rights are most preferred by respondents from Europe and the South Pacific. All initiatives are least in favour of stakeholders from other regions. Although there are differences in degree of support among stakeholder from Ausnz, Europe, Northeast Asia, and ASEAN, such differences are not crucial as indicated by a very closed order of projections.

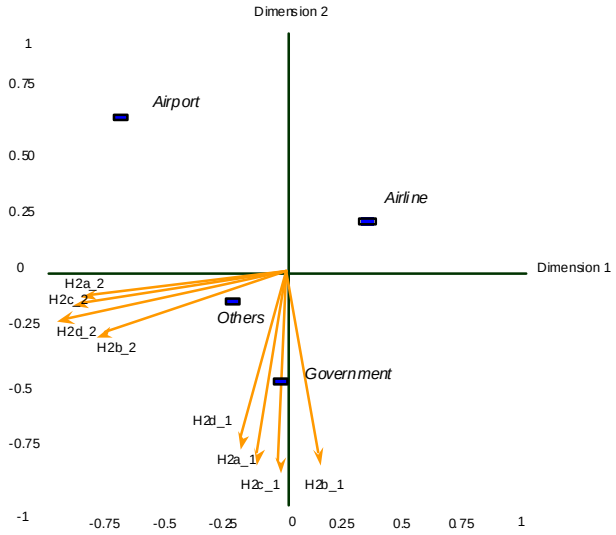
Table 7 Summary of Results of Non-linear Canonical Correlation of Attitudes towards Regulatory Strategies Versus Stakeholder Region (most outstanding results are underlined)

Initiatives	Cluster		Strongest support			Weakest support	
	1st	2nd					
2a_1: Economic stability (3rd &4th)	*		Neasia	ASEAN	Europe	Ausnz	Others
2a_2: Economic stability (beyond right)		*	Europe	Ausnz	NEasia	ASEAN	Others
2b_1: Industry maturity (3rd &4th)	*		Neasia	ASEAN	Europe	Ausnz	Others
2b_2: Industry maturity (beyond right)		*	Europe	Ausnz	NEasia	ASEAN	Others
2c_1: Domestic market size (3rd & 4th)	*		Neasia	ASEAN	Europe	Ausnz	Others
2c_2: Domestic market size (beyond right)		*	Europe	Ausnz	NEasia	ASEAN	Others
2d_1: Open skies experience (3rd & 4th)	*		NEasia	ASEAN	Europe	Ausnz	Others
2d_2: Open skies experience (beyond right)		*	Europe	Ausnz	NEasia	ASEAN	Others

Specifically, we are interested in exploring how regulatory initiatives were perceived by the ASEAN stakeholders. In this analysis, the procedure of partitioning the variables into five sets was maintained but the sample size included only data observed from ASEAN respondents. The results of the perceptions of ASEAN stakeholders on the proposed regulatory strategies are provided in Figure 10 and 11.

Figure 10 describes the results of the NCCA linking the types of ASEAN stakeholder and attitudes towards regulatory initiatives. The canonical correlations for the two dimensional solution are 0.72 and 0.55. Like Figures 8 and 9, Figure 10 shows that nine regulatory initiatives are categorised into two groups. On the left, we find the cluster of initiatives related to the liberalisation of beyond rights within the region. The other cluster is closely aligned with the negative side of the second dimension. However, the angle between both clusters is close to 90 degree. This reflects a relatively weak relationship between attitudes towards both groups of initiatives.

Figure 10 Attitudes towards Regulatory Strategies Versus Type of ASEAN Stakeholder



The key results on attitudes towards regulatory strategies against different types of ASEAN stakeholders are presented in Table 8. The set of initiatives related to the liberalisation of 3rd and 4th freedom rights are most favoured by governments and airports and least favoured by airports and airlines. The set of initiatives related to the liberalisation of the beyond rights within the region are most favoured by airports, governments, and others and least favoured by airlines. To ensure overall support from stakeholders is maximised, it is more appropriate to consider (a) economic stability, (b) the maturity of the airline industry, (c) the size of the domestic aviation market, and (d) the experience in entering an open skies agreement with the USA as the important criteria in liberalising the beyond rights within the region rather than the 3rd and 4th freedom rights.

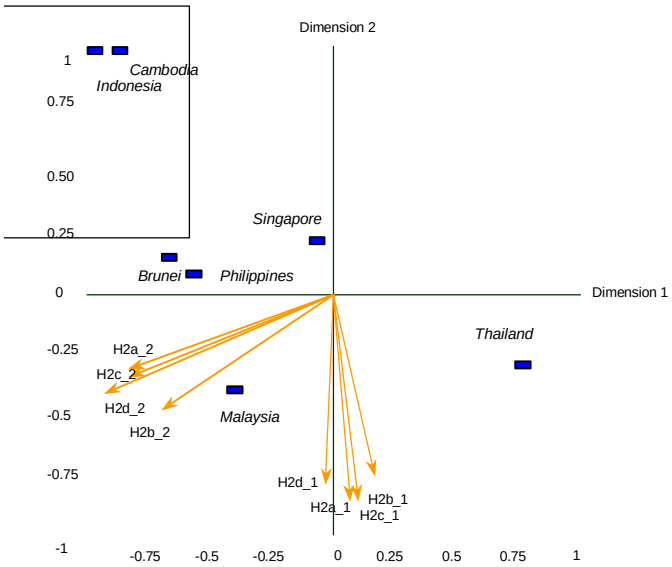
Table 8 Summary of Results of Non-linear Canonical Correlation of Attitudes towards Regulatory Strategies Versus Types of ASEAN Stakeholder (most outstanding results are underlined)

Initiatives	Cluster		Strongest support			Weakest support
	1st	2nd				
2a_1: Economic stability (3rd &4th)	*		Governments	Others	Airlines	Airports
2a_2: Economic stability (beyond right)		*	Airports	Others	Governments	Airlines
2b_1: Industry maturity (3rd &4th)	*		Governments	Others	Airlines	Airports
2b_2: Industry maturity (beyond right)		*	Airports	Others	Governments	Airlines
2c_1: Domestic market size (3rd & 4th)	*		Governments	Others	Airlines	Airports
2c_2: Domestic market size (beyond right)		*	Airports	Others	Governments	Airlines
2d_1: Open skies experience (3rd & 4th)	*		Governments	Others	Airlines	Airports
2d_2: Open skies experience (beyond right)		*	Airports	Others	Governments	Airlines

Next, we explore how stakeholders from different ASEAN countries perceive the regulatory initiatives. The results of the non-linear canonical analysis linking stakeholders from ASEAN countries and attitudes towards regulatory initiatives are graphed in Figure 11. This experiment is formed by nine variables partitioned into five sets. Four sets of attitude variables are used again in this experiment whereas the fifth set consists of a set of the nominal data defining stakeholders from ASEAN countries (coded 1 = Brunei, 2 = Cambodia, 3 = Indonesia, 4 = Malaysia, 5 = Philippines, 6 =

Singapore, and 7 = Thailand). Canonical correlations are 0.62 and 0.57 for the first and second dimension respectively. Figure 11 strengthens the notion that the pattern of the relationship between all regulatory initiatives is unique. Again, the initiatives are organised into two clusters. The nearly 90 degrees of the departure of both clusters implies that their correlation is weak.

Figure 11 Attitude towards Regulatory Strategies Versus Country of ASEAN Stakeholder



The results of the analysis are summarised in Table 9. The set of initiatives related to the liberalisation of 3rd and 4th freedom rights is most in favour by Thailand and Malaysia and least in favour by Indonesia and Cambodia. The set of initiatives related to the liberalisation of the beyond rights within the region is most in favour by Indonesia, Cambodia, and Brunei and least in favour by Thailand. Like the previous recommendation, to ensure that the overall support from stakeholders is maximised, it is most appropriate to consider (a) economic stability, (b) the maturity of the airline industry, (c) the size of the domestic aviation market, and (d) the experience in entering an open skies agreement with the USA as the important criteria in liberalising the beyond rights within the region rather than the 3rd and 4th freedom rights.

Table 9 Summary of Results of Non-linear Canonical Correlation of Attitudes towards Regulatory Strategies Versus Country of ASEAN Stakeholder (most outstanding results are underlined)

Initiatives	Cluster		Strongest support						Weakest support
	1st	2nd							
2a_1: Economic stability (3rd &4th)	*		Thailand	Malaysia	Philippines	Singapore	Brunei	Cambodia	Indonesia
2a_2: Economic stability (beyond right)		*	Indonesia	Brunei	Cambodia	Philippines	Malaysia	Singapore	Thailand
2b_1: Industry maturity (3rd &4th)	*		Thailand	Malaysia	Philippines	Singapore	Brunei	Cambodia	Indonesia
2b_2: Industry maturity (beyond right)		*	Malaysia	Brunei	Philippines	Indonesia	Cambodia	Singapore	Thailand
2c_1: Domestic market size (3rd & 4th)	*		Thailand	Malaysia	Philippines	Singapore	Brunei	Cambodia	Indonesia
2c_2: Domestic market size (beyond right)		*	Indonesia	Brunei	Cambodia	Philippines	Malaysia	Singapore	Thailand
2d_1: Open skies experience (3rd & 4th)	*		Malaysia	Thai	Philippines	Brunei	Singapore	Indonesia	Cambodia
2d_2: Open skies experience (beyond right)		*	Indonesia	Brunei	Malaysia	Philippines	Cambodia	Singapore	Thailand

Conclusion

We have analysed attitudes towards the proposed aviation initiatives of 74 stakeholders. The method of non-linear canonical correlation analysis succeeded in identifying some clear patterns in attitudes that revealed degrees of support for various initiatives across stakeholder sectors. We studied attitudes towards two aviation main strategies: (a) airline strategies, and (b) regulatory strategies.

In the study of airline strategies, we always found that governments and airports have the same profile and have opposite view to airlines. Stakeholders from ASEAN and Europe have similar attitudes towards airline strategies. The evidence suggests that, to minimise the differences among all stakeholders in terms of their support for airline strategic proposals, ASEAN carriers should maintain the current strategies based on existing route networks but increase airline alliances, particularly joint frequent flyer programs, but should avoid entering into equity alliances. Within the ASEAN context, we discovered that governments and airports always had opposite attitudes towards airline strategies to airlines.

In the study of regulatory strategies, all of the stakeholders appeared to have similar profiles of attitudes towards regulatory initiatives with governments being the strongest supporters. Stakeholders perceived that enthusiasm of ASEAN countries to liberalise air service agreements within the region would vary directly with economic stability, the maturity of the airline industry, and the experience in entering the USA open skies agreement of participating nations, but inversely with the size of the domestic market. With respect to the ASEAN perspective, ASEAN stakeholders perceived the liberalisation of the 3rd and 4th freedom rights and the liberalisation of the beyond rights as separate dimensions. Moreover, it is appropriate for them to consider economic stability, maturity of the airline industry, the size of the domestic aviation market, and experience in entering an open skies agreement as the important criteria in liberalising the beyond rights within the region rather than the 3rd and 4th freedom rights.

The NCCA technique enables us to uncover the structure and representation of the interdependencies presented in sets of categorical variable which are not well addressed in a simple (univariate) descriptive analysis. We believe that this method is new to the field of air transport research. The approach reinforces the importance of establishing a mapping between views on specific potential strategic scenarios and the stakeholder domain from which various degrees of support and opposition might evolve. Stakeholders can use this information in positioning specific strategies and developing strategic plans to assist in achieving maximum stakeholder support. Such a method will hopefully be seen to be useful to the international political and bargaining process.

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