Industrial Management & Data Systems

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Henry Lau Dilupa Nakandala Premaratne Samaranayake Paul Shum

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Henry Lau, Dilupa Nakandala, Premaratne Samaranayake and Paul Shum
School of Business, The University of Western Sydney, Penrith, Australia

Received 1 October 2015
Revised 14 December 2015
Accepted 3 February 2016

Abstract

Purpose – Strategic analysis of customer profitability for assessing market segmentation and reconfiguring customer relationship management (CRM) activities remains the key factor for achieving high return on CRM investment. The purpose of this paper is to map the profit-based ranking of corporate customers into the current market segments, with a view of determining the relative profitability of each market segment.

Design/methodology/approach – This study develops a novel model that combines activity-based costing (ABC), CRM, fuzzy analytic hierarchy process (AHP), and technique for order preference by similarity to ideal solution (TOPSIS) methods to evaluate strategically customer profitability and prioritizing corporate accounts. This case study airline company has invested heavily in CRM over the past seven years on integrating multi-functional departments that touch customers. The airline operations management and marketing functions provide key inputs. Results of the hybrid model validate feasibility of the proposed model.

Findings – The airline management makes use of the ranking results to optimize customer profitability by reconfiguring marketing programs, integrated schedule design, fleet assignment, maintenance routing, crew scheduling, and real-time optimization of schedule recovery in the aftermath of disruptions or irregularities. The proposed model also directs the marketing function to customize service offerings and introduce appropriate service levels to engage customers of different segments for the purpose of maximizing corporate profitability.

Research limitations/implications – Significant amount of investment is necessary to design and implement the extensive CRM database and systems to assure customer data quality and availability so as to bear fruits in the proposed hybrid model. These data requirements can especially be a critical barrier for small to medium-sized companies.

Practical implications – This hybrid model is able to capitalize on the benefits of the ABC, CRM, fuzzy AHP, and TOPSIS methods and offset their deficiencies. Most importantly, it can be applied to various industries without complex modification.

Originality/value – This study represents the first move to adopt the fuzzy AHP and TOPSIS methods to analyze the ABC and CRM data inputs of an airline company. In mapping the profit-based ranking of corporate customers into the current market segments, the relative profitability of each market segment can be determined.

Keywords CRM, AHP, TOPSIS, MCDM, ABC

Paper type Research paper

1. Introduction

Airline industry is one of the global industries that struggle for survival and growth. During the last four decades to 2010, the ratio of cumulative net post-tax profits to revenue of the airline industry was only 0.1 percent, which was among the least profitable of all industries (Bisignani, 2011; Ramsay, 2013). The unique characteristics of perishable seat availability, high aircraft sunk costs, and low marginal costs for adding passengers within the capacity constraints combined to intensify competitive

Industrial Management & Data Systems
Vol. 116 No. 6, 2016
pp. 1105-1130

0263-5577
DOI 10.1108/IMDS-10-2015-0410

rivalry to limit price and profits. From an industry perspective, there is almost no airline company earning attractive return on investment, mainly due to the intense competitive forces influencing the airline industry (Porter, 2008). Each airline is in a constant search for ways to improve profit.

Though most companies are familiar with formulating good strategies, they might overlook critical building blocks and thus could result in unsatisfactory profitability. For example, Bradley *et al.* (2013) report that a technology company that prided itself on analytical rigor but never accurately diagnosed how to identify a targeted customer segment to generate reasonable returns has a strategic issue. This study aims to develop a hybrid model to analyze an integrated data for identifying airline customers with varying profit potential for market segmentation. By selecting the most profitable customers for developing retention strategy, and converting the unprofitable into profitable customers, higher profit outcome can be achieved.

To achieve this objective, activity-based costing and management (ABC&M) method, as reviewed in the following section, will be used for customer profitability analysis (CPA). However, though the quantitative results are more precise than the traditional cost accounting method, management cannot draw inference for the longer term future customer profit potential. To compensate for this backward looking quantitative approach, a relationship marketing (RM) model is developed to extract relevant data from the customer relationship management (CRM) system, corporate survey database, and other external databases to assess the longer term prospect of customer profitability. The customer profiles generated are then analyzed and prioritized with the fuzzy analytic hierarchy process (FAHP) and the technique for order preference by similarity to ideal solution (TOPSIS) to rank the corporate accounts. The next section presents a literature review, followed by the research methodology. Thereafter, a case study including numerical results and research finding are presented. Finally, conclusion and future direction are drawn.

2. Literature review and problem description

Added to the unprecedented competitive pressure, the internet technology has reduced intermediaries and distribution costs substantially, thus making airlines even more price competitive. However, results of the survey piloted by this airline company indicate that its corporate customers are still attracted by service quality. Airlines have traditionally segmented its customers into classes (first, business, and economy) for designing service quality levels. However, this simple segmentation logic no longer matches the ever more complex and heterogeneous choices of trading off flexibility and price with other product offerings in the current airline business environment. New airline market segmentation has been proposed, for example Teichert *et al.* (2008) segment the airline market on the basis of seven attributes, namely total fare and frequent flyer program (sales and marketing), flight schedule, flexibility, punctuality, catering, and ground services (operations and supply chain). Similarly, a few other studies have deliberated various combinations of clustering attributes and/or methods in airline market segmentation such as cross-national consumer preferences and demographics factors (Bruning *et al.*, 2009), fare class (Cizaire and Belobaba, 2013), passengers' value-driven needs and service requirements (Holloway, 2008; Prokesch, 1995), and price, product and schedule sensitivity (Drabas and Wu, 2013). Though these alternative segmentations generate insight into customer preferences for redesigning product and service offerings, it still has not solved the puzzle of discovering the best segments that maximize profitability.

The main purpose and key contribution of this study is to map the profit-based ranking of corporate customers into the current market segments, with a view of determining the relative profitability of each market segment, and thence invigorate restructuring of corporate strategy for improving the overall company profit position. The literature review is presented under the four key market segment classifications, including customer-focussed profitability, product/market (e.g. fare class, customer service), performance-focussed (e.g. cost, productivity), and strategy-oriented (e.g. RM) classifications. Although various closely related processes and methods such as CPA, CRM, and ABC&M have been researched extensively in the literature, these processes and methods have not been rigorously applied as an integrated multi-disciplinary theoretical framework to identify the criteria and sub-criteria for prioritizing customer profitability. The next sub-sections will discuss the relevant research studies on CPA, CRM, RM, and ABC&M under these key four market segment classifications.

2.1 Customer-focussed profitability classification

Since airplane seats are perishable, and customers are willing to pay different prices, airlines are targeting different passenger classes via the product differentiation strategy with different service classes (first, business, premium economy, and economy), and offering discount at different times (seasonal, early bird, last minute). Though marketing plays a crucial role that best meets the customer needs, however without measuring the profit of each customer segment, it becomes more difficult to justify the rationale for the implementation of various marketing programs and strategies. Due to the inability to demonstrate the causal linkage from marketing expenses to profits, the influence of marketing function in an organization has been diminishing (Verhoef and Leeflang, 2009). Furthermore, company should avoid concentrating excessively on the metrics of customer satisfaction and loyalty because this may only attract and retain low profit customers (Collings and Baxter, 2005). To increase customer profitability, the customers should be financially contributing positively to the selling company. For companies operating successfully in competitive industries, their marketing function has to identify and retain customers with high value or profit potential (Niraj *et al.*, 2001). In search for strategic information that are relevant for operations and resources management decisions to improve profitability, CPA is a pivotal decision support tool (Cardinaels *et al.*, 2004).

2.2 Product/market classification

In general, product/market classification can be based on various measures, with the most commonly published categories like fare class, customer profiling, and service levels. CRM is recognized as a key approach in managing some of those measures (Bruning *et al.*, 2009; Cizaire and Belobaba, 2013; Drabas and Wu, 2013; Holloway, 2008). Xu *et al.* (2002) defines CRM as an "all embracing approach, which seamlessly integrates sales, customer service, marketing, field support, and other functions that touch customers." The purpose of CRM is to embrace a complex set of interactive processes to engage customers across all communication channels, and respond quickly to shifting customer needs in order to maximize profit and ROI (Rigby, 2013; Schierholz and Kolbe, 2007). Companies are utilizing traditional and novel CRM methods to continually generate deeper insights into customer needs, preferences, experiences and opinions on their airline products or services (Liau and Tan, 2014) and tailor their product and service offerings to the targeted customer segments.

Modern CRM systems combine the information technology (IT), knowledge management and CRM to maximize both the strategic and operational efficacy to serve targeted customer segments, and create profitable, long-term relationships (Liau and Tan, 2014). The CRM system of the case study airline company is a platform example for achieving these objectives.

2.3 Performance-focussed classification

ABC&M is a strategic activity-based management type activity-based costing (ABC) with applications published for a variety of purposes, including market segmentation, product and customer mix, supplier and customer relationships (Thyssen *et al.*, 2006). Besides its superior routine in allocating overhead that hides wasteful activities (Plenert, 1999), ABC is a more accurate costing system (Ruiz-de-Arbulo-Lopez *et al.*, 2013), and also supports JIT principles and identifies non-value-added activities in processes for elimination (Cooper, 1996).

In additional to the uncompromising lean and efficient operations (Wanke *et al.*, 2015), one of the key success factors in the airline industry is to minimize the costs of serving customers to avoid profit erosion. The costs to serve include pre-sale services, queries and adjustments of orders and distribution, and post-sale services to continue with the exchange relationship (Kaplan and Narayanan, 2001; van Triest *et al.*, 2009). Depending on the demand for such services, these costs to serve can differ from one airline customers to the next. If pricing is charged on the basis of conventional accounting standard average, imbalances in these customer-driven-specific costs to serve are rarely reflected in the pricing. If customers acquire non-standard products and services, with excessive inquiries, order cancellation, expedition, exchange, return, special delivery requirements that add burdens to the production, logistics, and sales administration systems of the selling company, seemingly high profit margin purchases can still be unprofitable.

If these unprofitable customers can be identified earlier, then corrective actions can be taken to convert them into profitable customers, not only from repricing or surcharge, but also offering a reduced level of service operations. ABC&M can supplement CRM to generate customer profitability knowledge from past revenues and costs history, compiled by the accounting department with inputs primarily sourced from service operations.

The ABC&M methodology traces the varying customer consumption of resources accurately and efficiently from the expenditure pools, by reassigning the costs based on the cause-and-effect relationships of the resource usage as represented by the activity and its drivers, to the channels and customer segments. As shown in Table I, profit of each customer can then be determined after the costs of goods sold and the ABC&M derived "costs to serve" have been deducted from the sales revenue, which is directly attributable to the aircraft flying over a scheduled route.

2.4 Strategy-oriented classification

The fundamental goal of CRM is to strive for achieving steady revenue streams and maximization of customer lifetime value (Berger and Nasr, 1998; Kumar and Rajan, 2009). However, customer behaviors are always vague and difficult to express in exact

Conventional Income Statement	Activity-based Costing Income Statement
Sales revenues (total)	Sales revenues (by aircraft route)
−Expenses	−Expenses (direct aircraft costs)
1. Fuel	1. Fuel
2. Labor	2. Labor
3. Ground handling and landing	3. Ground handling and landing
4. Ownership	4. Lease and depreciation
	−Expenses (indirect aircraft costs)
	1. Repairs and maintenance
	2. Administration
= Gross profits	= Gross margin (by aircraft route)
−Period costs	−Expenses (indirect costs to serve customer)
1. Sales and marketing	1. Customer relationship management
2. Administration	2. Non-standard customization
	3. Additional customer services
	= Gross margin (by customer)
	−Expenses (Indirect business sustaining costs)
= Operating profit before tax	= Operating profit before tax

Table I. Conventional vs activity-based costing income statement

number. A literature survey reveals a number of RM criteria and sub-criteria that link the CRM with the profit outcome and of relevance to the airline industry (Bolton *et al.*, 2004; Bowman and Narayandas, 2001; Cannon and Perreault, 1999; Gupta *et al.*, 2004; Leonidou *et al.*, 2006; Purinton *et al.*, 2007; Rao and Perry, 2002; Reinartz and Kumar, 2003; Reinartz *et al.*, 2005; Rust *et al.*, 2011; Venkatesan and Kumar, 2004), as shown in Table AI and Figure 4. Only several small subsets of these factors have been empirically validated in the literature. This study has integrated all these empirically significant factors to represent the criteria and sub-criteria for assessing the longer term profit and value potential of corporate customers, as summarized in Figure 4. They all contribute positively to the future revenue streams and contribution margins, and should be strategically monitored and managed (Wang and Hong, 2006).

Building on prior research, this study proposes these RM criteria as a higher construct that contributes to the selection of a category of profitable customers that supports the ultimate objective of maximizing the longer term customer profitability for the selling company. Though this RM model does not comprise of customer satisfaction (a short-term transactional measure) or service quality in SERVQUAL scales (a long-term attitudinal measure) because higher scores in these two perceptual measures may not be accompanied with high level of objective profitability measures. The objective of this study is to enhance the value for both sides of the relationship, i.e. not only for the customer, but also the case study airline company in terms of profitability.

3. Research methodology

The methodology involves two stages: first, development of a hybrid model, based on the ABC method, CRM and RM models as well as FAHP and TOPSIS; and second, a case study for testing the feasibility of the proposed model. The objective of this study is to assess customer profitability for an airline company. Referring to the RM model, the subjective qualitative and objective quantitative criteria and sub-criteria are measured to form the basis for identifying and ranking profitability of the top 100 corporate accounts. A vast amount of previous studies on FMCDM techniques are relevant to address this problem. Many of the surveyed publications in the FMCDM literature (Chai *et al.*, 2013) that combine both analytic hierarchy process (AHP) and TOPSIS methods develop their hybrid decision models for uncertain decision environment, similar to this study. They used the pairwise comparison of FAHP to determine the accurate weights of criteria, and then TOPSIS multiplies the decision matrix with this set of weights to determine the optimal and worst alternatives. Ranking of the alternatives can be performed efficiently, especially for a large number of alternatives under consideration, by deriving from their differential values as measured against these two reference alternatives. Other reasons for choosing FAHP and TOPSIS are detailed in sections 3.1 and 3.3, respectively.

However, majority of these previous studies concentrate on the problem domain of supplier selection (Chai *et al.*, 2013). Application to the airline customer classification is rare. Building upon previous application of MCDM methods in market segmentation (Güçdemir and Selim, 2015), but with an emphasis on customer profitability, this study represents the first move to adopt the most popular method of FAHP, i.e. the extent analysis method. Once the accurate weights of the criteria and sub-criteria are calculated by the FAHP method, the TOPSIS method will combine these weights with the decision matrix to determine the ranking of the customer profitability of the 100 corporate accounts.

3.1 FAHP

The AHP is an appropriate method for analyzing this type of unstructured problem with a mix of subjective qualitative and objective quantitative criteria at the upper level, and specific sub-criteria at the lower level, as shown in Figure A1. An optimal procedure follows three stages, i.e. decomposition, comparative judgments, and synthesis of priorities (Saaty, 1980). However, there are pitfalls associated with the AHP method. First, the requirements of nearly crisp value instead of the linguistic and vague patterns commonly found in representing the experiences and judgments of humans (Chen, 1996). Second, the inability to handle uncertainty associated with the mapping of one's subjective judgment, selection, and preference to a number that can have impact on the AHP method and decision (Cheng and Mon, 1994). In order to overcome the above weaknesses, fuzzy set theory was integrated in the AHP for MCDM (Chen, 1996; Cheng and Mon, 1994).

This study implements a fuzzy modified AHP approach using interval judgments approximated by triangular fuzzy numbers (TFN), which represent the preferences of one criterion over another. The steps of the extent analysis method (Chang, 1992, 1996) are implemented to calculate the synthetic extent values. The first two steps in the FAHP procedure are similar to that of AHP. FAHP extends the AHP approach in step 3 by representing the elements of the pairwise comparison matrices with TFN. The judgment matrix A and weight vector W are fuzzified with TFN $\tilde{1},\tilde{3},\tilde{5},\tilde{7},\tilde{9}$. The definition of fuzzy number is listed in Table II. Each membership function is defined by three parameters of the symmetric TFN, but can flexibly be characterized by other fuzzy distribution.

Graphically, a TFN $x = (l, m, u)$ and its membership function $\mu(x)$ is defined and shown in Figure 1.

The elements l, m, u are the lower, mean, and upper bounds of the TFN. The membership function $\mu(x)$ represents the degree of any element x belonging to that fuzzy number. This study adopts the fuzzy extent analysis, which has simpler interpretation and easier computation than other FAHP approaches (Erensal *et al.*, 2006).

3.2 Fuzzy extent analysis

Following the steps of fuzzy extent analysis implemented by Chang (1996), expert judgments are collected as linguistic inputs in the comparison matrix R. The elements r_{ij} are then converted into TFN, as shown below:

$$R = [r_{ij}]_{nxn} = \begin{bmatrix} (1,1,1) & (l_{12}, m_{12}, u_{12}) & \cdots & (l_{1n}, m_{1n}, u_{1n}) \\ (l_{21}, m_{21}, u_{21}) & (1,1,1) & \cdots & (l_{2n}, m_{2n}, u_{2n}) \\ \vdots & \vdots & \ddots & \vdots \\ (l_{n1}, m_{n1}, u_{n1}) & (l_{n2}, m_{n2}, u_{n2}) & \cdots & (1,1,1) \end{bmatrix} \quad (1)$$

and:

$$r_{ij}^{-1} = \left(\frac{1}{u_{ji}}, \frac{1}{m_{ji}}, \frac{1}{l_{ji}}\right) \text{ for } i,\ j = 1, 2,\ \ldots,\ \text{n and } i \neq j \quad (2)$$

Let r_1 and r_2 be two TFN parameterized by the triplets (l_1, m_1, u_1) and (l_2, m_2, u_2), respectively, the extended addition and multiplication operations of two fuzzy numbers are defined as in (Zimmermann, 1993). Define R_i^n as the value of the extent analysis of

Fuzzy Number	Linguistic variable	Membership function	Reciprocal number
$\tilde{1}$	Equal importance	(1, 1, 3)	(1/3, 1, 1)
$\tilde{x}$	Higher value indicates more importance	(x−2, x, x+2) for x = 3, 5, 7	(1/(x+2), 1/x, 1/(x−2))
$\tilde{9}$	Absolute importance	(7, 7, 9)	(1/9, 1/7, 1/7)

Table II. The membership function of fuzzy number

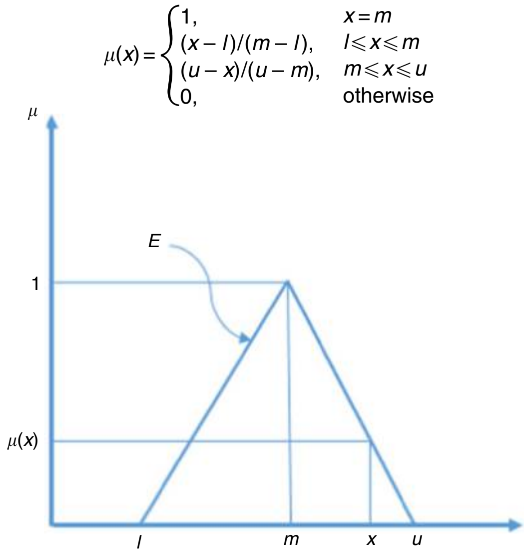

Figure 1. A triangular fuzzy number E, and its membership function $\mu(x)$

the ith object for nth criterion. The value of the fuzzy synthetic extent E_i with respect to the ith object is calculated as:

$$E_i = \sum_{j=1}^{n} R_i^j \otimes \left[\sum_{i=1}^{m} \sum_{j=1}^{n} R_i^j \right]^{-1} \text{ where I} = 1,\ 2,\ \ldots,\ n. \tag{3}$$

To determine E_i, the individual components are calculated as follow:

$$\sum_{j=1}^{n} R_i^n = \left(\sum_{j=1}^{n} r_{1i}, \sum_{j=1}^{n} r_{2i}, \sum_{j=1}^{n} r_{3i} \right) \tag{4}$$

and:

$$\sum_{i=1}^{m} \sum_{j=1}^{n} R_i^j = \left(\sum_{i=1}^{m} \sum_{j=1}^{n} r_{1i}, \sum_{i=1}^{m} \sum_{j=1}^{n} r_{2i}, \sum_{i=1}^{m} \sum_{j=1}^{n} r_{3i} \right) \tag{5}$$

and:

$$\left[\sum_{i=1}^{m} \sum_{j=1}^{n} R_i^j \right]^{-1} = \left(\frac{1}{\sum_{i=1}^{m} \sum_{j=1}^{n} r_{3i}}, \frac{1}{\sum_{i=1}^{m} \sum_{j=1}^{n} r_{2i}}, \frac{1}{\sum_{i=1}^{m} \sum_{j=1}^{n} r_{1i}} \right) \tag{6}$$

The next step is to compute the degree of possibility D for the fuzzy synthetic extent for $E_i \geqslant E_j$:

$$D\left(E_i \geqslant E_j\right) = height\left(E_i \cap E_j\right) = \sup_{a \geqslant b}\left\{\min\left[E_i(a), E_j(b)\right]\right\} \tag{7}$$

where $E_i = (l_i, m_i, u_i)$. Equivalently:

$$D\left(E_i \geqslant E_j\right) = \begin{cases} 1, & m_i \geqslant m_j \\ (u_i - l_j)/((u_i - m_i) + (m_j - l_j)), & l_j \leqslant u_i \\ 0, & \text{otherwise} \end{cases} \tag{8}$$

Next, the value of E_i will be compared with all the other E_j where $i \neq j$, and calculate the minimum degree possibility $D(i)$ of $D(E_i \geqslant E_j)$:

$$D(i) = D\left(E_i \geqslant E_j\right) = min\, D\left(E_i \geqslant \text{all } E_j,\ \text{where } i = 1, 2,\ \ldots,\ n \text{ and } i \neq j\right) \tag{9}$$

Once all the $D(i)$s are calculated, the priority weight vector $W = [D(1), D(2), \ldots, D(n)]$ can be obtained by normalizing W element-wise, i.e.:

$$D(i)^{norm} = D(i)/\sum_{j} D(j) \text{ for } j = 1, 2,\ \ldots,\ n \tag{10}$$

and the resulting normalized priority weight vector $W^{norm} = [D(1)^{norm}, D(2)^{norm}, \ldots, D(n)^{norm}]$.

3.3 TOPSIS

The TOPSIS method was first developed by Hwang and Yoon (1981), is one of the best classical MCDM methods. It is intuitive and easy to understand and implement. TOPSIS has been successfully applied in nine application areas (Behzadian *et al.*, 2012), represents the rationale of human choice (Shih *et al.*, 2007). Olson (2004) finds that precision of the weights plays a critical role for enhancing the accuracy in TOPSIS. Therefore, this study makes use of FAHP to increase accuracy of the weights, as input into the TOPSIS to generate the best precise ranking outcome that maximizes customer profitability.

Assumes there are m criteria and n alternatives, the project team collects the score of each alternative with respect to each criterion. Let r_{ij} be the score of alternative i with respect to the criterion j. Also, let J be the set of benefit criteria (more is better), and J' be the set of negative criteria (less is better).

Once the scores for the decision matrix have been decided, they are normalized as:

$$r_{ij}^{norm} = \frac{r_{ij}}{\left(\sum_i r_{ij}^2\right)^{1/2}} \text{ for } i = 1, 2, \ldots, n \tag{11}$$

Given a set of weights derived from FAHP for each criterion or sub-criterion w_j for $j = 1$, 2, m, each column of the normalized decision matrix is multiplied by the weight vector, i.e.:

$$h_{ij} = w_j r_{ij}^{norm} \tag{12}$$

Then the positive ideal solution can be calculated as:

$$H^+ = \left\{h_1^+, h_2^+, \ldots, h_m^+\right\}$$

where:

$$h_j^+ = \left\{max\left(h_{ij}\right) \text{ if } j \in J;\ min\left(h_{ij}\right) \text{ if } j \in J'\right\}, \text{ for } j = 1, 2, \ldots, m \tag{13}$$

and the negative ideal solution can be calculated as:

$$H^- = \left\{h_1^-, h_2^-, \ldots, h_m^-\right\}$$

where:

$$h_j^- = \left\{min\left(h_{ij}\right) \text{ if } j \in J;\ max\left(h_{ij}\right) \text{ if } j \in J'\right\}, \text{ for } j = 1, 2, \ldots, m \tag{14}$$

Calculate the separation measures for each alternative. The separation from the positive ideal alternative is:

$$S_i^+ = \left[\sum_{j=1}^{m}\left(h_{ij} - h_j^+\right)^2\right]^{1/2}, \text{ for } i = 1, 2, \ldots, n \tag{15}$$

And separation from the negative ideal alternative is:

$$S_i^- = \left[\sum_{j=1}^{m}\left(h_{ij} - h_j^-\right)^2\right]^{1/2}, \text{ for } i = 1, 2, \ldots, n \tag{16}$$

Then the relative closeness to the ideal solution, which is the overall performance score for the alternative, can be derived as:

$$C_i = \frac{S_i^-}{\left(S_i^+ + S_i^-\right)}, \text{ for } i = 1, 2, \ldots, n \text{ and } C_i \in [0, 1] \tag{17}$$

The project team will then rank the preference order by the C_i performance score (or the closeness coefficient) of all the alternatives in descending order. The alternative with the highest value of the performance score C_i has the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution.

4. Case study

Consistent with the development of the global airline industry, this Asia-based airline company has a ratio of cumulative net post-tax profits to revenue of less than 1 percent over the last decade. Therefore, this airline company is searching for ways to increase its profitability, one of which is to identify airline customers with high profit potential. In general, customers of this case study airline company do not rate loyalty highly because customer relationship has not been managed prudently to optimize customer loyalty and profitability in the past. Though this case study company has sophisticated software applications in its ERP, CRM, and SCM systems, these legacy systems were not designed originally to synchronize in business logics and data sharing. Time was wasted and the full information captured by these systems has not been exploited for CRM analytics.

Furthermore, minimization of operational costs by means of flight scheduling, fleet assignment, crew scheduling, maintenance and routing were accomplished by practical sequential process of schedule optimization. However, the optimization routine could not capture the complex interactions between aircraft, crew and passenger, and thus resulted in suboptimal schedule plans, especially in the aftermath of disruptions or irregularities such as adverse weather conditions, mechanical failure, crew illness, airport limitations, and regulatory constraints. This effects economic loss, average 2 percent of annual revenues, associated with flight delays, cancelations, aircraft swaps and the use of reserve crews to minimize the impact of disruptions or irregularities.

However, as competitive pressure intensified, management acknowledged that operations of the ERP, CRM, and SCM systems in isolation undermine competitive advantage. Integrated solutions are critical for minimizing these operational and recovery costs. These driving forces toward systems integration are influencing the traditional airline operations control silo to be replaced by an integrated command center that has access to all the necessary multi-functional data for more responsive optimal operations decisions in passenger re-accommodation, aircraft rerouting, ground resource management, and crew re-deployment. In recent years, the airline operations managers are assigned a broader range of multiple competing objectives without explicit guidance on their relative importance. The OM department expands the integrated schedule planning models to incorporate pricing, revenue management, competition, and align with airline alliances, customer relationship and profitable segments. When making decisions on when to delay or cancel flights, which flights to delay or cancel, the operations managers can prioritize the recovery program optimally only if more profitable customers for each flight can be identified. These choices depends on the relative costs/benefits of quickly canceling a flight (less costly to the airline caused by less network disruption), or delaying the flight (better outcome from the customer perspective). These trade-offs are routinely weighed by the airline operations managers, but preferably with the assistance of decision support models.

To achieve this vision, this case study airline company invested in systems integration over the past seven years. The different functional data formats have been standardized by mapping the data distributed among different functional systems, and this new interface design allows seamless data transmission and information sharing.

A number of dynamic tools and interfaces were introduced. The business policies and rules of these systems were centralized so that their business logics are synchronized among these applications, and their application interfaces are consistently integrated to interact seamlessly. Furthermore, the customer interface and information collected previously reflect the transactional mode of activities. The lack of relevant customer information and poorly integrated information systems make it difficult for this airline company to validate and justify allocation of marketing resources and personalized its product or service operation offerings to increase customer value. Though this airline company appreciates the contributions of CRM on financial performance, and could have escalated utilization of the CRM system to its full extent by taking advantage of the CRM analytics to segment customers more rigorously on the basis of value instead of flown miles or yielded revenue (Xu and Walton, 2005), and identify the most profitable customers in the value-based customer segments. To achieve this objective, this study proposes the ABC&M method for CPA and target those high profit corporate customers for developing retention strategy, and convert the unprofitable into profitable corporate accounts.

4.1 Application of ABC&M to calculate customer profitability

Apart from the dual purpose of using the ABC&M method to: first, formulate process improvement and cost reduction programs that direct the reallocation of resources from non-value-added to value-added activities; second, measure more accurate and relevant product, process, service and activity costs, this airline company also applies the ABC&M method to calculate customer profitability. The ABC&M roadmap can be visualized in Figure 2, with the accounting revenues and expenses data of this airline company at the top level to be allocated to each corporate customer account at the bottom level. Revenues can be attributed directly to individual corporate customer via aircraft type (different aircraft type are priced differently), as indicated by the arrow. However, allocation of expenses to corporate customers is far more complex. Using the ABC technique, some expenses can be attributed directly to individual corporate customer via direct activities consumed. Majority of the overhead expenses can only be allocated to indirect activities first via appropriate cost drivers. More details of the allocation process will be explained below. These indirect activities will be attributed to aircraft type (different aircraft type are operated with different costs), and the channel (with different usage intensity and thus costing) that corporate customers interact with, and each corporate customer is charged accordingly. Given the total revenues and expenses at the top level can be attributed separately to individual corporate customer at the bottom level, profitability of each corporate customer can be revealed.

As a preliminary planning stage of embarking on the ABC, the cross-functional project team with leaders from the associated functional departments (accounting and finance, schedule, crew and ground services OM, sales and marketing, engineering, and IT) mapped the baseline cost model against the cost objects and activities within the context of the airline's policies, processes, business logics and rules. For this airline, the multi-functional activities include OM in fleets, maintenance, special response; strategic alliance in the airport operations and global hub networks; network and flight scheduling; human resources training and development; selling and yield management in different classes of fares, channels. The costing information was captured in process-specific data marts, which is under a centralized multi-functional repertoire. The data marts store the micro-level transactions as well as a diverse set of cost/activity driver tables and dependence matrices.

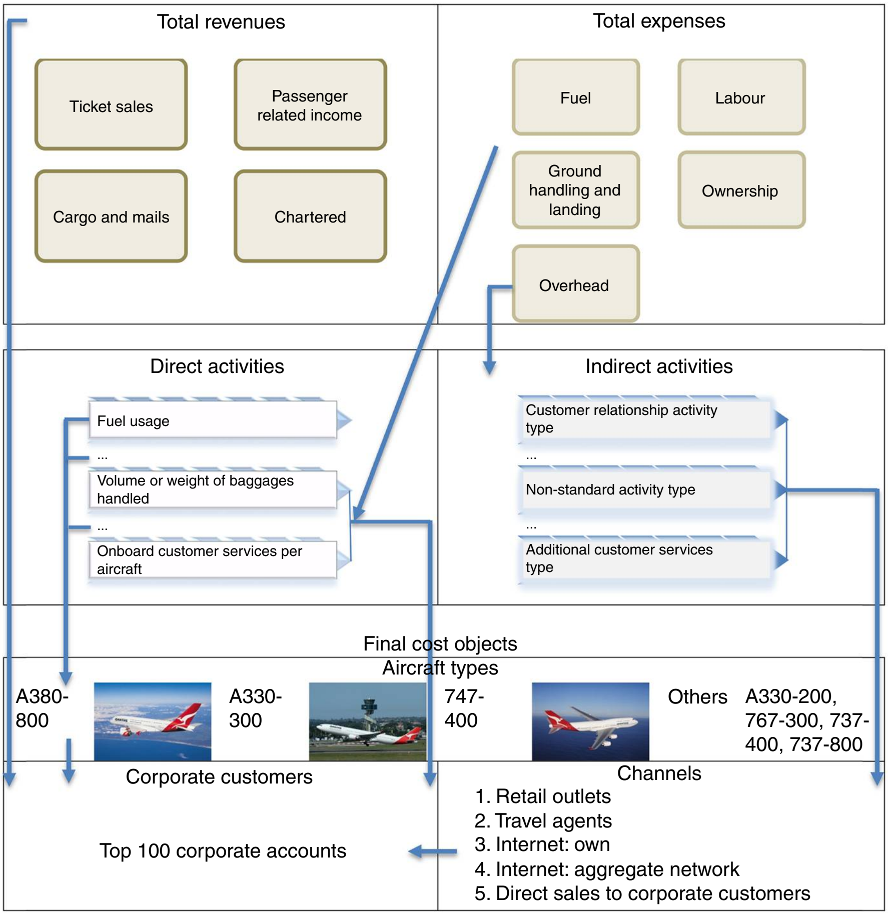

Figure 2.
The roadmap for calculating customer profitability within the ABC&M framework

The ABC model in these data marts is dimensioned into the customers, products, locations, and resources perspectives so that specific cross-functional costing and profit information can be traced to each customer or other perspectives. Based on the internal financial information, the revenues are sourced from ticket sales, passenger-related income, cargo and mails, chartered passenger or freight contracts departments. As shown in Figure 2, these revenues can be attributed directly to the individual corporate account.

The expenses consist of fuel, direct labor (serving onboard or in the airports), ground handling and landing, ownership (leases and depreciation), and overhead (administration, sales and marketing) costs. However, some of these expenses cannot be directly assigned to the cost objects, i.e. the corporate customers via aircraft types and channels. For those expenses that can only be traced directly to the aircraft cost object, the Expense-Aircraft-Dependence matrix links the fuel consumed, catering materials, staff serving passenger onboard (attributable to the aircraft type and passenger class), aircraft-specific airport charges, aircraft-specific capital charges to the aircraft cost object on a pro-rata basis. Other expenses can be traced directly to the corporate account cost object using the Expense-Customer-Dependence matrix, e.g. customer-specific RM activity types, non-standard service types, additional passenger service types. These costs are assigned directly to the cost objects as the resources are consumed.

Similarly, using the ABC&M method, value chain analysis, and Expense-Activity-Dependence matrix, all the value chain activities which consume (cause) the overhead costs can also be identified, including activities that are indirectly related to the aircraft or customer, e.g. maintenance staff who conduct routine checks to and service the aircraft (depend on the aircraft type), check-in baggage, routine vs special handling of baggage, non-customer-specific CRM activity types, non-standard service types, additional passenger service types. Using the Activity-Aircraft-Dependence or the Activity-Customer-Dependence matrix, these activity costs are then assigned to the cost objects in proportion to the consumptions of the cost drivers, which include volume and weights of baggage handled, amount of fuel pumped, time spent to complete the activity, space occupied, number of visits to manage corporate accounts, number of parts maintained, number of catering materials prepared, etc. Once all the direct and overhead costs are assigned to the cost objects, costs of a preceding cost object, e.g. aircraft, are analyzed and assigned to the succeeding cost object, e.g. corporate account.

Based on the ABC&M model, the revenues and expenses assigned to individual corporate accounts reveal the customer profit diversity. The 20-80 Pareto rule states that the largest 20 percent customers account for 80 percent of revenues or profits, as determined by the traditional cost accounting method. However, using the ABC&M model, the top 20 percent customers of this case study airline company contribute 167.7 percent of profits, as shown in Figure 3. The bottom 41 percent of the customers is in fact unprofitable and loses the 148.5 percent of profits.

This exposes the weakness of the conventional economic marginal analysis. These unprofitable customers are still disguised as attractive and profitable since the marginal costs of serving an additional passenger is always far below the breakeven price. However, this is not a valid argument for the pricing and aircraft capacity expansion decisions. The airline company cannot continue to produce until marginal

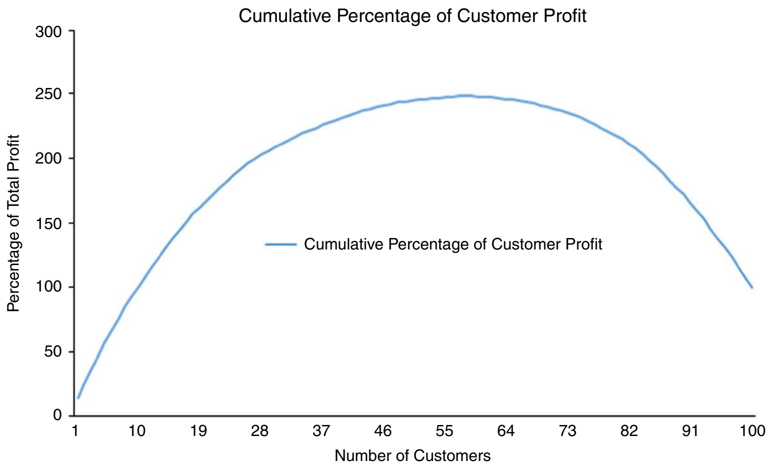

Figure 3.
Cumulative customer profitability

costs equal to prices charged to an additional passenger because such operating strategy would not even recover the huge incremental capital expenditure expansion, let alone making any normal profit. Therefore, besides accounting for customer-driven-specific costs to serve, ABC with its full cost recovery capability is a more superior method for cost accounting, passenger class mix, seat volume, pricing, and capability expansion decisions in the airline industry.

4.2 Application of fuzzy AHP to calculate weights of the criteria and sub-criteria

Apart from using the historical accounting data and ABC&M to calculate the short-term customer profitability, this study applies the RM model to assess the longer term profitability of the top 100 corporate accounts. A cross-functional project team is responsible for defining this customer profitability problem, identifying the overall objective, criteria and sub-criteria. The whole hierarchy can be visualized in Figure 4.

Though the customer relationship criteria and sub-criteria are largely sourced from literature review, this new and exploratory area of research is highly unpredictable, difficult to quantify, and constrained by available information sources. Therefore the Delphi approach is more appropriate iterative process than other research methods for defining the areas of disagreement and reaching a consensus among a panel of anonymous experts. The eligibility of the panel members satisfies the commonly adopted criteria including extensive work experience, direct involvement, and sound knowledge of CRM (Manoliadis *et al.*, 2006). Based on these panel selection criteria, seven experts (two from academic field specializing on CRM and airline industry, two from consulting firm, one from the airline industry association, and two from the

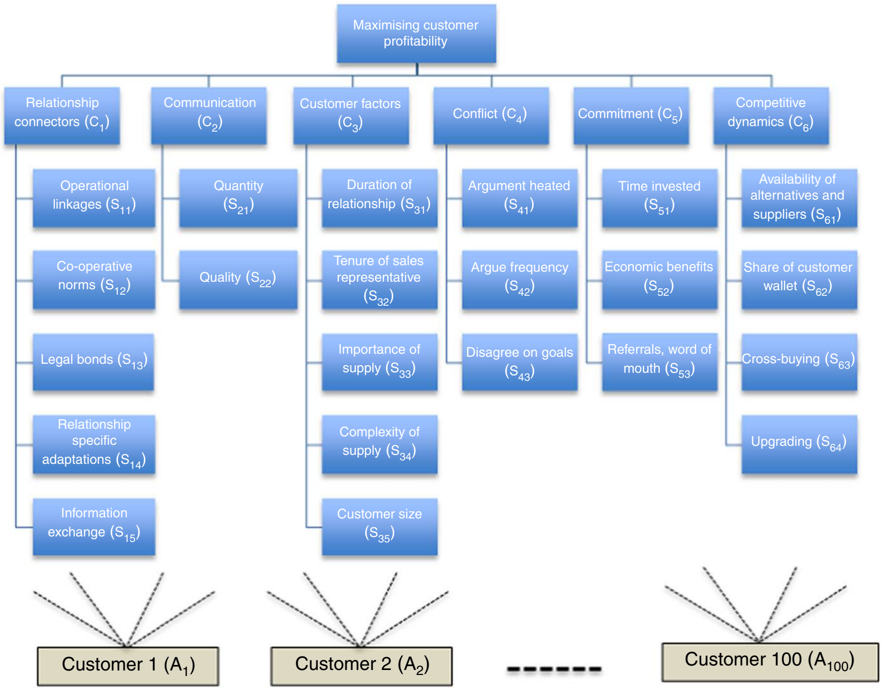

Figure 4.
Hierarchy for the customer-focussed profitability analysis

executive management team of this airline company) have been recruited for this purpose, and the final list is presented in Table AI.

For the determination of the priority weights of each criteria and sub-criteria, the computational steps of the FAHP approach are listed in sub-section 3.1. Based on the collective judgment of an expert team (four experts from the cross-functional team), the priority weights of each criteria and sub-criteria are calculated. Let p_{ij} be the input set of these decision-makers forming the six Ps pairwise comparison matrix, as shown in Table AII. All the Ps preference inputs are consolidated by the geometric mean method suggested by Buckley (1985) in the following equation, as shown in Table III:

$$r_j = \left(\prod_{i=1}^{n} p_{ij} \right)^{\frac{1}{n}}, \ j = 1, 2, \ \ldots, \ n \tag{18}$$

The different values of the fuzzy synthetic extent with respect to the 6Ps are denoted by $d_1, d_2, \ldots, d_6$:

$$d_1 = (4.5,\ 5.1,\ 5.6) \otimes (26.9,\ 31.0,\ 35.8)^{-1} = (0.108,\ 0.181,\ 0.283)$$
$$d_2 = (4.9,\ 5.8,\ 6.7) \otimes (26.9,\ 31.0,\ 35.8)^{-1} = (0.130,\ 0.256,\ 0.444)$$
$$d_3 = (3.9,\ 4.6,\ 5.4) \otimes (26.9,\ 31.0,\ 35.8)^{-1} = (0.075,\ 0.129,\ 0.224)$$
$$d_4 = (3.9,\ 4.4,\ 5.0) \otimes (26.9,\ 31.0,\ 35.8)^{-1} = (0.065,\ 0.100,\ 0.170)$$
$$d_5 = (4.7,\ 5.6,\ 6.6) \otimes (26.9,\ 31.0,\ 35.8)^{-1} = (0.098,\ 0.170,\ 0.318)$$
$$d_6 = (4.9,\ 5.6,\ 6.4) \otimes (26.9,\ 31.0,\ 35.8)^{-1} = (0.101,\ 0.164,\ 0.295)$$

The degree of possibility of d_i over d_j ($i \neq j$) can be calculated by equation (9) to (10):

$$D(1) = D(E_1 \geqslant E_j) = \min D(E_1 \geqslant \text{all } E_j, \ \text{where } j = 1, 2, \ldots, 6 \text{ and } i \neq j) = 0.67$$
$$D(2) = D(E_2 \geqslant E_j) = \min D(E_2 \geqslant \text{all } E_j, \ \text{where } j = 1, 2, \ldots, 6 \text{ and } i \neq j) = 1.00$$
$$D(3) = D(E_3 \geqslant E_j) = \min D(E_3 \geqslant \text{all } E_j, \ \text{where } j = 1, 2, \ldots, 6 \text{ and } i \neq j) = 0.43$$
$$D(4) = D(E_4 \geqslant E_j) = \min D(E_4 \geqslant \text{all } E_j, \ \text{where } j = 1, 2, \ldots, 6 \text{ and } i \neq j) = 0.21$$
$$D(5) = D(E_5 \geqslant E_j) = \min D(E_5 \geqslant \text{all } E_j, \ \text{where } j = 1, 2, \ldots, 6 \text{ and } i \neq j) = 0.69$$
$$D(6) = D(E_6 \geqslant E_j) = \min D(E_6 \geqslant \text{all } E_j, \ \text{where } j = 1, 2, \ldots, 6 \text{ and } i \neq j) = 0.64$$

Therefore, the resulting priority vector is (0.67, 1.00, 0.43, 0.21, 0.69, 0.64), and the normalized priority vector is (0.185, 0.275, 0.118, 0.057, 0.189, 0.177) for the top level criteria-relationship connectors, communication, customer factors, conflict,

	P1			P2			P3			P4			P5			P6		
	l	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*
P1	1.00	1.00	1.00	0.61	0.88	1.14	1.32	1.97	2.43	1.32	1.50	1.63	0.61	0.67	0.76	0.61	0.88	1.14
P2	0.88	1.14	1.63	1.00	1.00	1.00	1.32	2.59	3.64	1.32	2.59	3.64	1.73	2.24	2.65	1.32	1.50	1.63
P3	0.41	0.51	0.76	0.27	0.39	0.76	1.00	1.00	1.00	1.32	1.97	2.43	0.38	0.59	0.86	0.38	0.59	0.86
P4	0.61	0.67	0.76	0.27	0.39	0.76	0.41	0.51	0.76	1.00	1.00	1.00	0.38	0.59	0.86	0.61	0.88	1.14
P5	1.32	1.50	1.63	0.38	0.45	0.58	1.16	1.70	2.65	1.16	1.70	2.65	1.00	1.00	1.00	0.41	0.51	0.76
P6	0.88	1.14	1.63	0.61	0.67	0.76	1.16	1.70	2.65	0.88	1.14	1.63	1.32	1.97	2.43	1.00	1.00	1.00

Table III. The geometric means of the six Ps pairwise comparison matrix commitment, and competitive dynamics. The above calculations span the steps 1 through 6, and the next step is to repeat these six steps to calculate the weights of all the sub-criteria with respect to their top-level parent criterion, as shown in Table IV.

4.3 Application of TOPSIS to rank the customer profitability of the top 100 corporate accounts

Based on the net profit calculated from the ABC&M method and the data extracted from the CRM systems, various functional departments, corporate survey database of this airline company, and accessible external databases, the value for each sub-criterion of each corporate account are listed in Table AIII. Values of some of the subjective qualitative sub-criteria ranged from 1 to 10 Likert scale, e.g. S11 to S14 of the criteria C1 (relationship connectors). On the other hand, values of some of the more objective quantitative sub-criteria reflect the actual quantity, e.g. S21 (communication quantity) accounts for the number of contacts, interaction time, and inter-contact time, measured specifically by the CRM systems as designed by the expert team. Values for S31 (duration of relationship) and 32 (tenure of sales representative) sub-criteria are also objective quantitative, but can easily be extracted directly from the corporate CRM database. Due to large number of alternative corporate accounts, the pairwise comparisons for the FAHP method involve far too complex cognitive processing by the experts. Moreover, the criteria-based data extracted from the CRM systems have wide ranging values and thus not easily measured in simple format to match the FAHP scale. TOPSIS overcomes this problem by avoiding the tedious pairwise comparisons of large number of alternatives, and able to deal with the decision matrix of diverse values in an efficient computational routine.

Parent criteria	Sub-criteria	Symbol	Normalized weights
Relationship connectors	Operational linkages	S11	0.359
	Co-operative norms	S12	0.321
	Legal bonds	S13	0.167
	Relationship-specific adaptations	S14	0.059
	Information exchange	S15	0.094
Communication	Quantity	S21	0.711
	Quality	S22	0.289
Customer factors	Duration of relationship	S31	0.519
	Tenure of sales representative	S32	0.263
	Importance of supply	S33	0.207
	Complexity of supply	S34	0.000
	Customer size	S35	0.010
Conflict	Argument heated	S41	0.289
	Argue frequency	S42	0.337
	Disagree on goals	S43	0.374
Commitment	Time invested	S51	0.420
	Economic benefits	S52	0.338
	Referrals, word of mouth	S53	0.241
Competitive dynamics	Availability of alternatives	S61	0.322
	Share of customer wallet	S62	0.281
	Cross-buying	S63	0.232
	Upgrading	S64	0.165

Table IV. The normalized weights of the sub-criteria with respect to their parent criterion

Using the Equation (11), the normalized decision matrix is calculated. It is then combined with the weights to calculate the weighted normalized decision matrix, according to Equation (12). The next step is to determine the positive and negative ideal solutions, based on Equations (13) and (14). The positive and negative ideal solution is calculated individually for each corporate account as in Equations (15) and (16). In the final step of the TOPSIS method, setting the weight for the ABC&M net profit to 0.5, and the normalized priority vector of the six top-level criteria (relationship connectors, communication, customer factors, conflict, commitment, and competitive dynamics) to 0.5 multiplied by the normalized weight vector (0.185, 0.275, 0.118, 0.057, 0.189, 0.200, 0.177), as derived from the FAPH method, the relative closeness to the ideal solution is determined as in Equation (17), as shown in Table V.

All the 100 corporate accounts are ranked on the basis of V, and the corresponding ABC&M net profit are listed in Table VI.

Customers 17, 45, 42, 18, and 7 are the most profitable, and 95, 100, 28, 37, 5 are the most unprofitable corporate accounts. Once the managers are informed about these results, they map the profit-based ranking of these 100 corporate accounts into the current market segments to determine the relative profitability of each market segment. Customer portfolio strategies are then redesigned to restructure the customer segments to maximize profit and firm performance. Management is better equipped to identify the causes of these profit diversities of different customers, and implement appropriate strategy to retain those high profit corporate customers, and convert the unprofitable into profitable corporate accounts within or across customer segments, or reluctantly turn their businesses away to competitors. However, prior changes not only in customer strategy, but also in enterprise-wide culture and cross-functional collaboration are pivotal for the successful CRM program.

5. Conclusion and future research

The case study company operates in the fiercely competitive global airline industry of which profit margins are the lowest compared with other industries. All other related entities of their value chain are capable of achieving higher returns than airlines, e.g. jet fuel supply, airplane manufacturers, and other suppliers. Therefore, it is not appropriate to improve operations merely by becoming lean in all aspects of the supply chain. The literature is relatively discreet in proposing a

Table V. Positive (D+) and negative (D−) ideal solution, and relative closeness to the ideal solution (V)

	Customer									
	1	2	3	4	5	96	97	98	99	100
D+	0.067	0.074	0.073	0.165	0.222	0.188	0.189	0.164	0.175	0.211
D−	0.157	0.149	0.151	0.058	0.008	0.035	0.034	0.058	0.048	0.013
V	0.699	0.669	0.674	0.259	0.036	0.156	0.153	0.262	0.215	0.057

Table VI. Ranking of the net profit and the relative closeness to the ideal solution

	Customer									
	17	45	42	18	7	95	100	28	37	5
Net profit	15,083	12,601	11,979	11,700	10,937	−7,865	−8,145	−8,218	−8,442	−9,316
V	0.930	0.881	0.868	0.852	0.817	0.070	0.057	0.056	0.047	0.036

workable solution to address this research issue. To bridge this research gap, the contribution of this study is to develop a novel hybrid MCDM model that integrates multi-disciplines (management strategy and systems – CRM and RM; accounting and financial techniques – ABC and CPA; MCDM methods – FAHP, and TOPSIS) to measure and identify profitable and unprofitable customers. Based on the results of ranking the top 100 corporate customers, management of this airline company is in better position to restructure market segmentation strategy toward increasing customer profitability and firm performance. Based on the integration and interface management of the multi-functional departments that touch customers, results of this proposed model demonstrate feasible and valid classification of the customers on the basis of various CRM criteria and sub-criteria, thus allowing this airline company to customize service offerings and introduce appropriate service levels to engage different categories of customers so as to maximize customer profitability.

This proposed model can easily be customized without complex modification to industries other than airline, which are subject to competitive market forces that undermine their return on investment and profitability. However, the data requirements can be a critical barrier for small to medium-sized companies. Significant amount of investment is necessary to design and implement the extensive CRM database and systems to assure customer data quality and availability so as to bear fruits in the proposed model. Beyond the aforementioned benefits of the proposed FMCDM and ABC approaches for CPA, this research study can also be extended to a comparative study across industries and longitudinal investigation of the managerial implications of the turnaround programs on the basis of the new customer knowledge revealed by the proposed hybrid model.

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Appendix

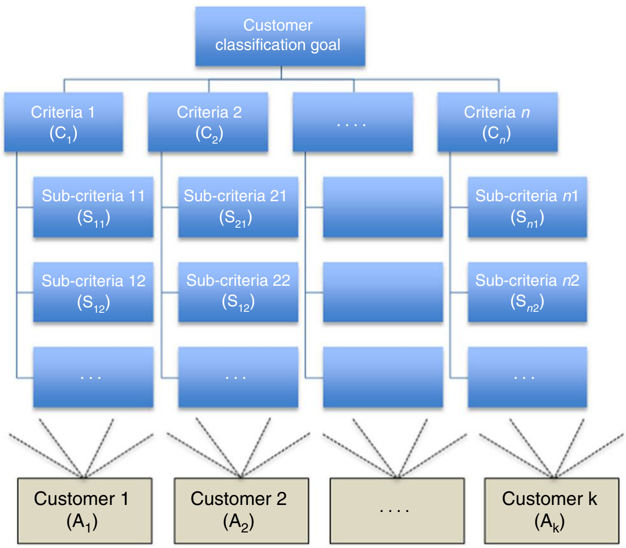

Figure A1.
Conceptual structure of analytic hierarchy process

Relationship marketing criteria	Sub-criteria	Definition	Literature references
Relationship connectors	Operational linkages	Linking the systems, processes, and procedures of both the buying and selling companies where rules and routines are specified and adhered to	(Bowman and Narayandas, 2001; Cannon and Perreault, 1999; Rao and Perry, 2002)
	Co-operative norms	Expected behaviors of the buying and selling companies to work jointly for mutual goals and benefits	(Bowman and Narayandas, 2001; Cannon and Perreault, 1999; Rao and Perry, 2002)
	Legal bonds	Binding contractual agreements that both parties have to comply	(Bowman and Narayandas, 2001; Cannon and Perreault, 1999; Rao and Perry, 2002)
	Relationship-specific adaptations	Involve changes to systems, processes, and procedures to match the requirements of the other party	(Anderson and Weitz, 1992; Bowman and Narayandas, 2001; Cannon and W.D. Perreault, 1999; Rao and Perry, 2002)
	Information exchange	Open sharing of important and even proprietary and confidential information	(Anderson and Weitz, 1992; Bowman and Narayandas, 2004; Cannon and Perreault, 1999)
Communication	Quantity	Number of contacts, interaction time, inter-contact time. A long time between contacts can lead to forgetfulness. Frequent contacts are highly relational and make recurring requirements known to each other	(Cannon and Perreault, 1999; Grewal *et al.*, 2001; Hibbard *et al.*, 2001; Morgan and Hunt, 1994; Rindfleisch and Heide, 1997; Rust *et al.*, 2011; Venkatesan and Kumar, 2004)
	Quality	Bi-directional communication, level of rich (face-to-face, business meetings) vs standard (direct mail, telephone, web-based) modes	(Mohr and Nevin, 1990; Mohr and Spekman, 1994; Morgan and Hunt, 1994; Venkatesan and Kumar, 2004)
Customer factors	Duration of relationship	Tenure of business relationship with a specific customer	(Gupta *et al.*, 2004; Mulhern, 1999; Y. Wang *et al.*, 2004)
	Tenure of sales representative	Time that the current sales representative spent to serve this specific customer	(Boles *et al.*, 2000; Bowman and Narayandas, 2004; Doney and Cannon, 1997; Palmatier *et al.*, 2007)
	Importance of supply	The positive (or negative) effect of having (or not having) the supply as planned	(Cannon and W.D. Perreault, 1999)
	Complexity of supply	The capability of the selling company, relative to other suppliers, to meet the complex requirements	(Cannon and Perreault, 1999; Kaplan and Narayanan, 2001; van Triest *et al.*, 2009)
	Customer size	Control variables that accommodate for customer heterogeneity	(Bowman and Narayandas, 2004; Niraj *et al.*, 2001; Venkatesan and Kumar, 2004)
Conflict	Argument heated	Use of harsh words in interactions, asymmetry in power	(Mohr and Spekman, 1994)

(*continued*)

Table AI. Relationship marketing (RM) criteria that influence customer profitability

Relationship marketing criteria	Sub-criteria	Definition	Literature references
	Argue frequency	Number of complaints	(Purinton *et al.*, 2007)
	Disagree on goals	Incompatibility of goals, aims, ideas, and values, where one party deterring the other from gaining the resources or conducting an activity necessary for its own advancement	(Leonidou *et al.*, 2006)
Commitment	Time invested	Resources invested to maintain a relationship by both partners	(Cannon and Perreault, 1999; Morgan and Hunt, 1994)
	Economic benefits	Both parties are acting in benevolence, integrity and competence	(Doney and Cannon, 1997; Morgan and Hunt, 1994; Palmatier, 2008; Reinartz and Kumar, 2003)
	Referrals, word of mouth	Indirectly assist in recruiting other customers for the selling company	(Heskett *et al.*, 1997; Reinartz *et al.*, 2005)
Competitive dynamics	Availability of alternatives and suppliers	Accessibility of competitive offerings or substitutes in the market	(Bowman and Narayandas, 2004; Cannon and Perreault, 1999)
	Share of customer wallet	Percentage of products or services purchased from the selling company	(Bowman and Narayandas, 2004; Cooil *et al.*, 2007; Fink *et al.*, 2007; Garland, 2004)
	Cross-buying	Higher switching costs, trust, loyalty, and recurrent needs	(Bowman and Narayandas, 2001; Kumar *et al.*, 2008; Reinartz and Kumar, 2003)
	Upgrading	Higher switching costs with each upgrade, lead to lower propensity to leave and higher recurrent needs	(Bolton *et al.*, 2004)

Table AI.

Table AII. The six Ps pairwise comparison matrix

	P1			P2			P3			P4			P5			P6		
	l	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*
P1	1.00	1.00	1.00	0.14	0.20	0.33	1.00	1.00	1.00	3.00	5.00	7.00	1.00	1.00	1.00	1.00	1.00	1.00
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.14	0.20	0.33	1.00	3.00	5.00
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	5.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	1.00	1.00	1.00	1.00	3.00	5.00	3.00	5.00	7.00	1.00	1.00	1.00	1.00	1.00	1.00	0.14	0.20	0.33
P2	3.00	5.00	7.00	1.00	1.00	1.00	3.00	5.00	7.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	5.00	1.00	1.00	1.00	1.00	1.00	1.00
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	5.00	1.00	3.00	5.00	3.00	5.00	7.00	1.00	1.00	1.00
	0.20	0.33	1.00	1.00	1.00	1.00	1.00	3.00	5.00	3.00	5.00	7.00	3.00	5.00	7.00	3.00	5.00	7.00
P3	1.00	1.00	1.00	0.14	0.20	0.33	1.00	1.00	1.00	1.00	1.00	1.00	0.14	0.20	0.33	1.00	1.00	1.00
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	5.00	7.00	1.00	3.00	5.00	0.14	0.20	0.33
	0.20	0.33	1.00	0.20	0.33	1.00	1.00	1.00	1.00	1.00	3.00	5.00	1.00	1.00	1.00	1.00	3.00	5.00
	0.14	0.20	0.33	0.20	0.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.14	0.20	0.33	0.14	0.20	0.33
P4	0.14	0.20	0.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	5.00	0.14	0.20	0.33
	1.00	1.00	1.00	0.20	0.33	1.00	0.14	0.20	0.33	1.00	1.00	1.00	0.14	0.20	0.33	1.00	3.00	5.00
	1.00	1.00	1.00	0.20	0.33	1.00	0.20	0.33	1.00	1.00	1.00	1.00	0.14	0.20	0.33	1.00	1.00	1.00
	1.00	1.00	1.00	0.14	0.20	0.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P5	1.00	1.00	1.00	1.00	1.00	1.00	3.00	5.00	7.00	0.20	0.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	3.00	5.00	7.00	1.00	1.00	1.00	0.20	0.33	1.00	3.00	5.00	7.00	1.00	1.00	1.00	0.14	0.20	0.33
	1.00	1.00	1.00	0.14	0.20	0.33	1.00	1.00	1.00	3.00	5.00	7.00	1.00	1.00	1.00	0.20	0.33	1.00
	1.00	1.00	1.00	0.14	0.20	0.33	3.00	5.00	7.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	5.00	7.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.20	0.33	1.00	1.00	1.00	1.00	3.00	5.00	7.00	0.20	0.33	1.00	3.00	5.00	7.00	1.00	1.00	1.00
	1.00	1.00	1.00	1.00	1.00	1.00	0.20	0.33	1.00	1.00	1.00	1.00	1.00	3.00	5.00	1.00	1.00	1.00
	3.00	5.00	7.00	0.14	0.20	0.33	3.00	5.00	7.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table AIII.
Data of the ABC&M net profit and the RM model for each corporate account

Parent criteria	Net profit	Customer 1 7,890	2 7,067	3 7,127	4 −2,997	5 −9,316	96 3,751	97 548	98 15,083	99 11,700	100 −3,695	Weight
C1	S11	9	3	9	1	2	5	2	1	8	4	0.262
	S12	2	3	2	2	3	6	5	5	8	3	0.232
	S13	6	4	3	1	4	8	6	6	6	2	0.196
	S14	6	9	4	1	2	8	3	2	8	1	0.149
	S15	614	107	63	102	179	364	353	734	450	265	0.161
C2	S21	12	206	261	16	59	6	177	153	221	81	0.585
	S22	9	1	9	3	3	6	6	2	7	2	0.415
C3	S31	36	11	40	22	12	11	23	25	32	16	0.400
	S32	13	8	3	4	4	2	4	10	7	3	0.165
	S33	4	5	6	4	4	6	5	3	2	4	0.221
	S34	6	3	3	5	1	5	7	3	6	2	0.092
	S35	2,660	2,174	2,387	243	882	499	456	964	1,250	1,360	0.122
C4	S41	3	7	2	1	2	6	3	6	5	1	0.217
	S42	16	4	1	13	1	12	1	26	17	14	0.338
	S43	6	7	4	1	1	7	6	3	6	2	0.445
C5	S51	263	221	216	50	67	4	190	4	24	45	0.371
	S52	6	2	9	1	3	6	4	2	2	2	0.333
	S53	95	62	131	42	43	18	5	131	92	51	0.296
C6	S61	6	7	2	4	4	4	6	3	4	4	0.269
	S62	0.63	0.88	1.00	0.63	0.25	0.75	0.50	0.50	0.25	0.25	0.249
	S63	0.20	0.33	0.20	0.33	0.07	0.33	0.40	0.60	0.53	0.13	0.251
	S64	2	1	7	5	2	6	7	2	4	1	0.231

Corresponding author
Paul Shum can be contacted at: p.shum@uws.edu.au