BPM for supporting customer relationship and profit decision

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Abstract

Purpose – As a response to increasing global market competition, companies in various industries tend to identify and manage customer relationship to increase profit performance. Companies commit more resources to identify their VIP customers and retain them by all means. The purpose of this paper is to develop a customer relationship management (CRM) business process management (BPM) model to identify airline customers with different degree of relationship and profit potential, and select the highly profitable customers for developing retention strategy and processes, and convert the less profitable into profitable corporate accounts.

Design/methodology/approach – This study innovatively apply the well-known techniques including CRM and relationship marketing models, fuzzy analytic hierarchy process (FAHP), and technique for order preference by similarity to ideal solution (TOPSIS) in the BPM research. This novel approach analyzes longer term customer profit and value potential, and prioritizes corporate accounts as the basis for setting appropriate customer service levels and improving the CRM process. This hybrid model is able to capitalize on the benefits of these methods and offset their deficiencies. Most importantly, it can be customized to various industries without complex modification.

Findings – This study uses data of an airline company to validate feasibility of the proposed CRM BPM model. The results indicate that this model is able to classify the customers based on various criteria and sub-criteria, thus allowing companies to introduce appropriate service levels to deal with different categories of customers, and improve CRM process so as to maximize customer profit and value potential.

Practical implications – This CRM BPM model and analysis provide managers extensive customer knowledge, more analytical and fact-based decision-making support, and a stronger focus on return on investment in sales and marketing. Knowing the profit and value potential generated by individual corporate customer makes it easier to establish the link between the CRM and the profit outcome. This model also benefits the organization and its stakeholders by allocating more resources to the targeted customer relationships that are profitable or valuable, and makes marketing more accountable in its marketing programs.

Originality/value – This study makes the first move to innovatively apply the well-known techniques including CRM and relationship marketing models, FAHP, and TOPSIS in the BPM research.

Keywords CRM, Decision support systems, Relationship marketing, Analytical hierarchy process, Business process re-engineering, Cross-functional integration

Paper type Research paper

1. Introduction

To develop superior performance, best performing companies must possess specific process knowledge in customers, supply chain, technology, or any strategic dimension in their industry, and protect core process competences from emulation by competitors (Stonehouse and Pemberton, 2005; Stonehouse *et al.*, 2001; Stonehouse and Snowdon, 2007). The most critical processes of supply chain management (SCM) are the customer relationship management (CRM) and supplier relationship management (Simon *et al.*, 2014). CRM is an example of business process management (BPM) that integrates people, processes, and technology to understand a company's customers, and manages customer relationships to retain existing profitable and valuable

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customers. Companies that successfully implement CRM with a company-wide, cross-functional, customer-focussed business process re-engineering approach would benefit from increased customer loyalty and profitability. These companies can sustain competitive advantage, especially in today's hypercompetitive, global, dynamic, and turbulent business environment.

Airline industry is one of the hypercompetitive global industries that struggle for survival and growth. Similar to the machinery, food products, hotels, restaurants, and leisure, media, construction materials, road and rail, and electric utilities industries, the airline industry could not achieve high value and returns between 2007 and 2011 (Bradley and Hoshino, 2013). 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). Similarly, the weighted average cost of capital has always been above the return on invested capital of the airline industry for at least three decades (Pearce, 2014). 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 rivalry to limit price and profits. From an industry perspective, almost no company earns attractive returns on investment in the airline industry, mainly due to the five unfavorable competitive forces influencing the industry (Porter, 2008). Each airline is in a constant search for ways to improve profit and firm value.

Though most companies are familiar with formulating good strategies, they may overlook critical building blocks and thus could result in unsatisfactory profitability and value proposition. For example, Bradley *et al.* (2013) report that a technology company that prided itself on analytical rigor but never accurately diagnosed and identified a targeted customer group to generate reasonable returns remains a key strategic problem issue. This study develops a CRM BPM model to identify airline customers with different degree of relationship and profit potential, and select the highly profitable customers for developing retention strategy and processes, and convert the less profitable into profitable corporate accounts.

To achieve this objective, a relationship marketing model is developed to extract relevant data from the CRM systems, corporate survey database, and other external databases to assess the longer-term prospect of customer relationship and 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 categorize corporate accounts. The next section presents a literature review, followed by the research methodology. Thereafter, a case study including numerical result and research finding are presented. Finally, conclusion and future direction are drawn.

2. Literature review and problem description

BPM and CRM have been researched widely in the literature. However, these management methods have not been rigorously applied as multi-disciplinary theoretical framework to identify the criteria and sub-criteria for prioritizing customer relationship and profitability. The next sub-sections will discuss the findings of the important research studies on BPM and CRM. Justifications for applying these methods for corporate customer classification are presented, followed by extracting the quantitative and qualitative aspects as inputs to the fuzzy multiple criteria decision-making (FMCDM) process.

2.1 BPM

BPM consists of four major process components (Margherita, 2014):

(1) process strategy that links business processes to company goals;

(2) process model that represents the process and activity architecture;

(3) process execution that implements the process model to deliver the expected process outcomes; and

(4) process performance that verifies whether the optimized process model delivers the expected process outcomes at its highest level.

Customers' needs and value deliverables are the starting point of process re-engineering in BPM (Chen *et al.*, 2009; Trkman, 2010), followed by the transformation of customer requirements into actual goods and services (Smart *et al.*, 2009). In achieving the prime goal of delivering customer value, the BPM literature accords customer relationship improvement and satisfaction as the finale goal (Neubauer, 2009; Schmiedel *et al.*, 2014). Though BPM is largely linked to methods and software tools for process modeling, automation, productivity improvement, performance analysis, and re-engineering, it requires a multi-disciplinary approach to integrate strategic alignment, governance, methods, information technology (IT), people, and culture (vom Brocke and Rosemann, 2010) and manage complex business processes (Margherita, 2014; Margherita and Petti, 2010).

In this transformation process, the full benefits of BPM can only be reaped via an integrated and multi-disciplinary approach to manage the complexity of business processes. Therefore, any seemingly single functional business process, e.g. role of marketing in CRM, requires process dialog with and inputs from multi-disciplinary functions in customer services, accounting, IT, operations, and SCM, organization development, human resources. Since organization is a system of interlinked business processes, integration in BPM to map and reengineer business processes play a pivotal role in driving superior organizational performance that sustains competitive advantages in costs, time, quality, productivity, product, and service complexity (Benner and Tushman, 2003). Our study adopts an integrated and multi-disciplinary BPM approach to Margherita's (2014) first two components of process strategy and model in the CRM business process of an airline company.

Before formulating such CRM process strategy and model development, companies can gauge the voice of customer and re-engineer their business processes for customer satisfaction (CS) (Lee *et al.*, 2010). However, apart from the lack of customer knowledge due to the possible historical absence of a CRM system, concentrating excessively on CS may not converge on a CRM configuration that yields sufficient profitability. Therefore, the CRM should be structured uniquely for a win-win solution for both the company and its customers. CS is still a central strategic issue for BPM, however, the business processes must also serve the profitability objective and economic interests of the company that owns the CRM process. Our study reviews the CRM and relationship marketing literature in search for a set of criteria that satisfies these process requirements. This balanced and multi-disciplinary approach must be configured into the CRM system. This set of win-win customer relationship criteria will be discussed in the next two sections.

2.2 CRM

Though CRM does not have an agreed definition, and academics and practitioners view CRM from a number of perspectives (Elbeltagi *et al.*, 2014), CRM has the characteristics

of a business process to identify, select, acquire, develop, retain, and better serve customers as in IBM; a data mining tool to leverage data to develop more effective and profitable customer interactions as in Hewlett-Packard; a way of segmenting customers into groups and manage them in the most profitable way as in Bain & Company (Dickson *et al.*, 2009). They utilize IT to manage customer relationship knowledge systematically to improve customer loyalty and increasing overall business profit (Cheng and Chen, 2009). This makes marketing more accountable and results in more effective budget allocation in marketing programs. However, CRM is not a technology-only application solution for sales and marketing, but represents a multi-disciplinary approach with CRM strategy and BPM leveraging on marketing, sales, customer service, operations, human resources, R&D, accounting, and finance, as well as IT and the internet to maximize profitability of customer interactions. A successfully implemented CRM must be an integrated and balanced BPM approach to mobilize technology, process, and people for company-wide, cross-functional, customer-focussed business process re-engineering (Chen and Popovich, 2003).

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 levels (first, business, premium economy, and economy classes), and offering discount at different times (seasonal, early bird, last minute). CRM is an ideal BPM tool for increasing an airline company's profitability by enabling it to identify the best corporate customers and satisfy their needs, so as to retain their loyalty to the firm's business activities. In search for strategic marketing information that are relevant for resources allocation decision to improve profitability, CRM has long been researched, where differentiation among customers based on: profitable customers (Jayachandran *et al.*, 2005; Payne and Frow, 2006), most valuable or strategically significant customers (Berger *et al.*, 2002; Kale, 2004). For companies operating successfully in competitive industries, their marketing function has to identify and retain customers with high profit or value potential (Chiliya *et al.*, 2009), and customize marketing strategies for customer retention.

Company should avoid the marketing approach to attend only to metrics of CS and loyalty because it may just attract and retain low profit customers and allocate excessive resources on building customer relationship with low value outcomes (Collings and Baxter, 2005). To increase customer profit and value potential, corporate customers should be financially contributing positively to the selling company. CRM system is an ideal tool to achieve this purpose, and in return benefit the organization and its stakeholders by allocating more resources to the targeted customer relationships that are profitable or valuable (Kale and Sudhir, 2004). A number of theoretical models have been proposed in the literature that link CS and loyalty to profitability (Anderson *et al.*, 1994; Garbarino and Jonhnson, 1999; Hallowell, 1996). Kumar *et al.* find that customer-focussed sales campaign that improves the quality of customer relationship can increase profits and return of investment.

In practice, CRM provides managers with extensive customer knowledge, more analytical and fact-based decision-making support, and a stronger focus on return on investment in sales and marketing. Knowing the profit and value potential generated by individual corporate customer makes it easier to establish the link between the CRM and the profit outcome. Research studies find that institutionalizing formal systems to identify and manage high profit and value potential customers lead to higher economic performance (Becker *et al.*, 2009; Jayachandran *et al.*, 2005; Reinartz *et al.*, 2004).

2.3 Relationship marketing

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). As such, customer knowledge is the pre-requisite for higher customer profitability and business success. Utilizing the customer knowledge, marketing can communicate and deliver value to customers to achieve CS, avoid short-term myopic perspective on revenue growth, and build lifelong relationships with customers (Peppers and Rogers, 2004).

Customer behaviors are always vague and difficult to express in exact number. A literature survey reveals a number of relationship marketing criteria that link the CRM with the profit outcome and of relevance to the airline industry. These factors, as listed in Table I, can be used as criteria to assess the longer term profit and value potential of corporate customers. These factors contribute positively to the future revenue streams and contribution margins, and should be strategically monitored and managed (Wang and Hong, 2006). Majority of the successful companies invest heavily in building and maintaining lifetime customer relationships. By applying the mechanisms as listed in Table I, these high-performing companies maximize customer loyalty and retention, which result in revenue growth and superior profitability. This set of criteria is consistent with the marketing relationship literature and more broadly aligned with longer term customer profit and value potential than the theoretical framework suggested by Alotaibi and Liu (2014) that focusses on payment history and feedback on the business performance areas: service quality, business process time, business process cost, and CS applied to the mobile service industry.

Building on prior research, this study proposes these relationship marketing 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 profit and value potential for the selling company.

3. Research methodology

The methodology involves two stages: development of a hybrid model, based on CRM and relationship marketing model and FAHP and TOPSIS, a case study for testing the feasibility of the proposed model. The objective of this study is to assess longer term customer profit and value potential for an airline company. Referring to the relationship marketing model, the subjective qualitative and objective quantitative criteria and sub-criteria are measured, as listed in Table I, as the basis for identifying and ranking the profit and value potential of the top 100 corporate accounts of this airline company. A vast amount of previous studies on FMCDM techniques are relevant to address this research problem. However, majority of these studies concentrate on the problem domain of supplier selection (Chai *et al.*, 2013). Their application to the airline customer classification is rare. This study adopts the most popular method of FAHP, i.e. the extent analysis method, and uses linguistic evaluations of the pairwise comparison (not assuming a direct mapping between words and crisp numbers) of a group of experts as inputs. Once the accurate weights of the criteria and sub-criteria are calculated by the FAHP method, the TOPSIS method will combine the weights with the attribute values corresponding to the criteria and sub-criteria to determine the ranking of the customer profitability of the 100 corporate accounts. This study represents the first move to adopt the FAHP and TOPSIS methods to analyze the CRM data inputs of an airline company, with the purpose of

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 Jr (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 Jr (1999), Rao and Perry (2002)
	Legal bonds	Binding contractual agreements that both parties have to comply	Bowman and Narayandas (2001), Cannon and Perreault Jr (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 Perreault Jr (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 Jr (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 Jr (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), 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 Perreault Jr (1999)
	Complexity of supply	The capability of the selling company, relative to other suppliers, to meet the complex requirements	Cannon and Perreault Jr (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)

Table I.
Relationship marketing criteria that influence profit and value potential of corporate customers

(*continued*)

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 Jr (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 Jr (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 I.

achieving the research objective of identifying and managing the profitable and unprofitable corporate accounts so as to initiate marketing actions to improve profit potential, value proposition, and firm performance.

3.1 FAHP

The analytic hierarchy process (AHP) is an appropriate method for analyzing this type of unstructured problem with subjective qualitative criteria (e.g. relationship connectors, communication, customer factors, conflict, commitment, competitive dynamics) at the upper level, and specific sub-criteria (e.g. operational linkages, co-operative norms, legal bonds, relationship specific adaptations, information exchange for the corresponding parent criterion relationship connectors) at the lower level, as shown in Figure 1.

The AHP enables decision-maker to structure a complex problem in a simple hierarchy and to evaluate systematically a large number of quantitative and qualitative factors. An optimal procedure follows three stages, i.e. decomposition, comparative judgments, and synthesis of priorities (Saaty, 1980). However, there

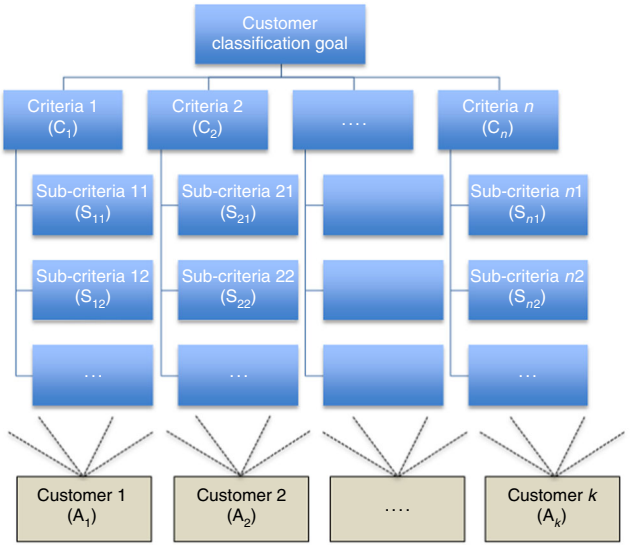

Figure 1.
Conceptual structure of analytic hierarchy process

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; Hauser and Tadikamalla, 1996). Second, the inability to handle uncertainty associated with the mapping of one's judgment to a number, and the vagueness of subjective judgment, selection, and preference of decision-makers 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 multi-criteria decision making (Chen, 1996; Cheng and Mon, 1994; Hauser and Tadikamalla, 1996; Jung and Lee, 1991; Levary and Ke, 1998) in the 1990s, and with more current specific applications in supplier selection (Amid *et al.*, 2011; Chamodrakas *et al.*, 2010; Chan *et al.*, 2008; Kahraman *et al.*, 2003; Kilincci and Onal, 2011; Lee, 2009; Sen *et al.*, 2010; Sevkli *et al.*, 2008; Shaw *et al.*, 2012). This study is the first adopter of FAHP in the airline industry for determining the top 100 customers that maximize the overall longer term profits.

To overcome the above traditional AHP weaknesses, this study implements a fuzzy modified AHP approach using interval judgments approximated by triangular fuzzy numbers (TFNs), which represent the preferences of one criterion over another. Using the extent analysis method (Chang, 1992, 1996), the synthetic extent values is calculated in the following steps:

(1) construct the fuzzy comparison matrices of criteria with respect to the overarching goal;

(2) determine the fuzzy synthetic extent value with respect to each criterion;

(3) determine the degree of possibility of the superiority of each fuzzy synthetic extent value with respect to each other;

(4) decide the minimum degree of possibility of the superiority of each criterion over another;

(5) determine the weight vectors of the criteria from the minimum degree of possibility of superiority of each criterion;

(6) normalize this weight vectors and determine the final weight of the decision criteria with respect to the overarching goal; and

(7) repeat this process to calculate the weights of all the sub-criteria with respect to their parent criterion.

As such, the first two steps in the procedure of fuzzy AHP 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. Once the AHP construct has been established, the judgment matrix A and weight vector W will then be fuzzified with TFNs $\tilde{1},\tilde{3},\tilde{5},\tilde{7},\tilde{9}$. 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.

A TFN $x = (l, m, u)$ and its membership function $\mu(x)$ is defined and shown in Figure 2.

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 (Chang, 1996), 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

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

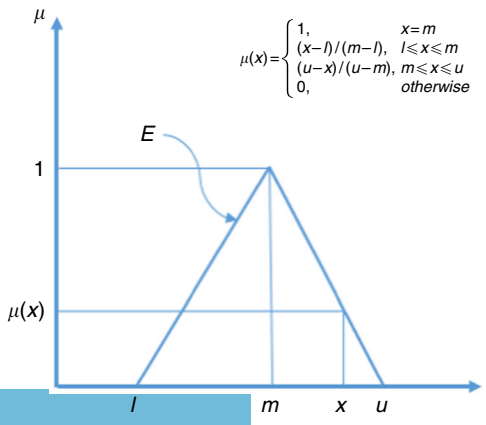

Figure 2. A triangular fuzzy number E, and its membership function $\mu(x)$

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:

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

Let r_1 and r_2 be two TFNs 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 the ith object for nth criterion. The value of the fuzzy synthetic extent E_i with respect to the ith object is calculated as:

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

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

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

and:

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

and:

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

The next step is to compute the degree of possibility D for the fuzzy synthetic extent for $E_i \geqslant E_j$, as shown in Figure 3:

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

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

$$D(E_i \geqslant E_j) = \begin{cases} 1, & m_i \geqslant m_j \\ \frac{(u_i - l_j)}{((u_i - m_i) + (m_j - l_j))}, & l_j \geqslant u_i \\ 0, & \text{otherwise} \end{cases} \quad (8)$$

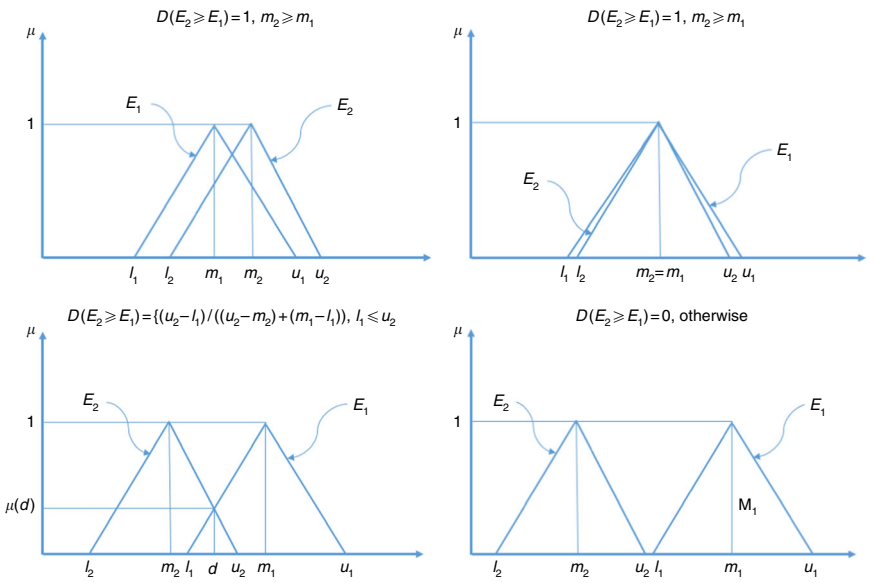

Figure 3.
A triangular fuzzy number E, intersection of E_1 and E_2, and the degree of possibility for the fuzzy synthetic extent for $E_2 \geqslant E_1$

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 $D(E_i \geqslant E_j)$.

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

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

$$D(i)^{norm} = \frac{D(i)}{\sum_j D(j)} \quad \text{for } j = 1,\ 2,\ \ldots,\ n \quad (10)$$

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 multiple criteria decision-making (MCDM) methods. It is intuitive and easy to understand and implement. TOPSIS has been reported for successfully implemented in nine application areas (Behzadian *et al.*, 2012), represents the rationale of human choice (Shih *et al.*, 2007). Moreover, TOPSIS is a proven best method in rank reversal (Zanakis *et al.*, 1998). It does not require attribute preferences to be independent and provides a cardinal ranking of the alternatives (Yoon and Hwang, 1995). 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 calculate the accurate weights, and input into the TOPSIS to generate the best precise ranking outcome that maximizes customer profitability of this case study airline company.

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:

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

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:

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

where:

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

and the negative ideal solution can be calculated as:

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

where:

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

Next, calculate the separation measures for each alternative. The separation from the positive ideal alternative is:

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

And separation from the negative ideal alternative is:

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

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

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

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 case study airline company has a ratio of cumulative net post-tax profits to revenue of less than 1 percent over the last decade. It is losing money in the international markets due to fierce competition in pricing by state-owned airlines, and the international customers are relatively price sensitive while the world economy is still in recession. Therefore, this airline company is searching for ways to increase its longer term customer profit and value potential, one of which is to identify airline customers with high profit and value potential. Identifying and understanding the most profitable and valuable customers is essential for retaining valued customers and increasing profitability. This study surveys the CRM and relationship marketing literature to define a set of criteria that links to longer term customer profit and value potential, and adopts FAHP and TOPSIS to assess the criteria and prioritize the corporate accounts in terms of the degree of their customer relationship, profit, and value potential.

The result directs this case study airline company to target those corporate customers with high profit and value potential for developing retention strategy, and convert the low profit and value potential into profitable corporate accounts. The latest Gartner surveys show that improving business process performance is still a top priority of CIOs (Hill and McCoy, 2011; Lopez, 2011). This airline company has already implemented necessary business process changes in CRM and relationship marketing. Given this background, analysis of the customer profit and value potential is the next step to prioritize corporate customers, and design further business policy and process changes to improve business process, longer term customer profit and value potential, and firm performance.

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

This study applies the relationship marketing model to assess the longer term profit and value potential of the top 100 corporate accounts. A project team is responsible for defining this customer profit and value problem, identifying the overall objective, criteria, and sub-criteria for the selected corporate accounts. The whole hierarchy can be visualized in Figure 4.

Based on the collective judgment of the expert team, the priority weights of each criteria and sub-criteria are calculated using the fuzzy AHP approach. The computational procedure follows the steps as listed in sub-section 3.1. Let p_{ij} be the input set of the decision-makers (four experts from the relationship marketing function) collected to form the six Ps pairwise comparison matrix as shown in Table III.

The above Ps preference input is consolidated by the geometric mean method suggested by Buckley (1985) in the following equation, as shown in Table IV:

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

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

$$d_1 = (4.5, 5.1, 5.6) \otimes (26.9, 31.0, 35.8)^{-1} = (0.108, 0.181, 0.283)$$

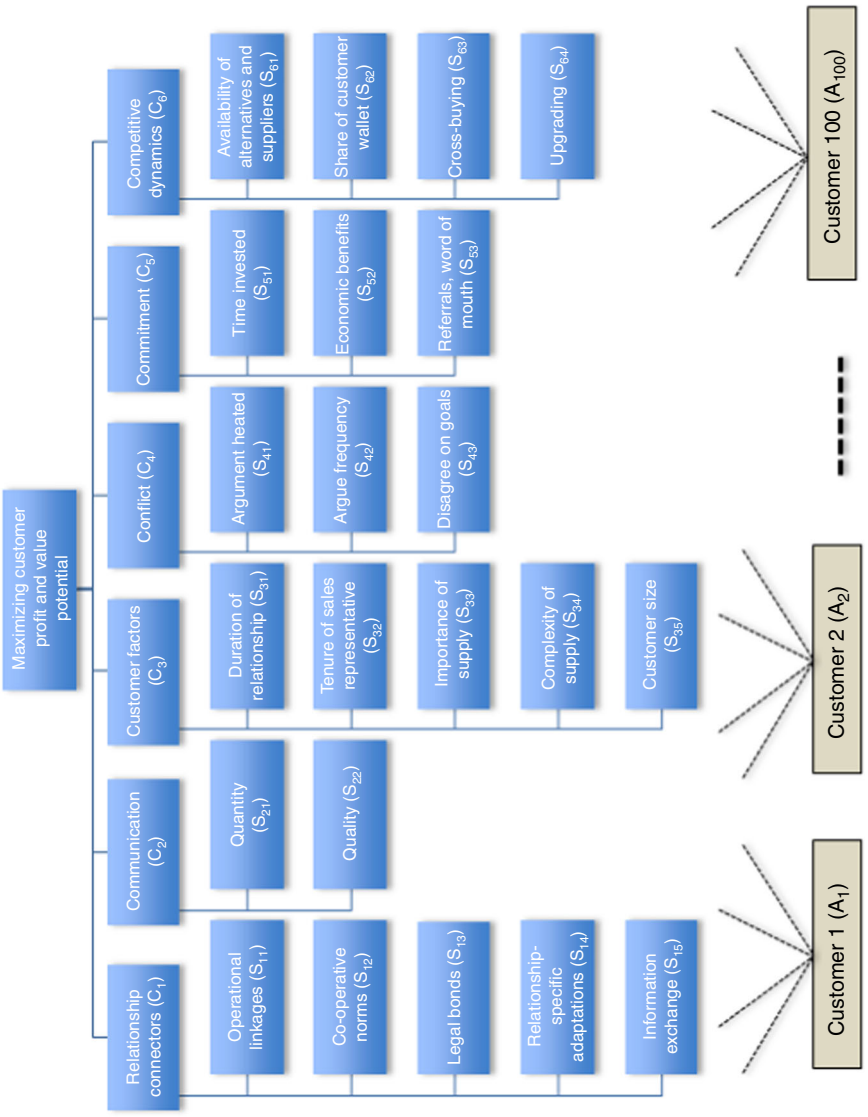

Figure 4.
Hierarchy for the customer profit and value potential analysis

	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 III.
The six Ps pairwise comparison matrix

Table IV.
The geometric means of 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	0.61	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

$$d_2 = (4.9,\ 5.8,\ 6.7) \otimes (26.9,\ 31.0,\ 35.8)^{-1} = (0.130,\ 0.256,\ 0.444)$$

$$d_3 = (3.9,\ 4.6,\ 5.4) \otimes (26.9,\ 31.0,\ 35.8)^{-1} = (0.075,\ 0.129,\ 0.224)$$

$$d_4 = (3.9,\ 4.4,\ 5.0) \otimes (26.9,\ 31.0,\ 35.8)^{-1} = (0.065,\ 0.100,\ 0.170)$$

$$d_5 = (4.7,\ 5.6,\ 6.6) \otimes (26.9,\ 31.0,\ 35.8)^{-1} = (0.098,\ 0.170,\ 0.318)$$

$$d_6 = (4.9,\ 5.6,\ 6.4) \otimes (26.9,\ 31.0,\ 35.8)^{-1} = (0.101,\ 0.164,\ 0.295)$$

The degree of possibility of d_i over d_j ($i \neq j$) can be calculated as per Equations (9) and (10):

$$D(1) = D(E_1 \geqslant E_j) = min\, D(E_1 \geqslant all\ E_j, \text{where } j = 1,\ 2,\ \ldots,\ 6 \text{ and } i \neq j) = 0.67$$

$$D(2) = D(E_2 \geqslant E_j) = min\, D(E_2 \geqslant all\ E_j, where\ j = 1, 2,\ \ldots,\ 6 \text{ and } i \neq j) = 1.00$$

$$D(3) = D(E_3 \geqslant E_j) = min\, D(E_3 \geqslant all\ E_j, \text{where } j = 1,\ 2,\ \ldots,\ 6 \text{ and } i \neq j) = 0.43$$

$$D(4) = D(E_4 \geqslant E_j) = min\, D(E_4 \geqslant all\ E_j, \text{where } j = 1,\ 2,\ \ldots,\ 6 \text{ and } i \neq j) = 0.21$$

$$D(5) = D(E_5 \geqslant E_j) = min\, D(E_5 \geqslant all\ E_j, \text{where } j = 1,\ 2,\ \ldots,\ 6 \text{ and } i \neq j) = 0.69$$

$$D(6) = D(E_6 \geqslant E_j) = min\, D(E_6 \geqslant all\ E_j, \text{where } j = 1,\ 2,\ \ldots,\ 6 \text{ and } i \neq j) = 0.64$$

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 main criteria relationship connectors, communication, customer factors, conflict, commitment, and competitive dynamics.

The above calculations span 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 parent criterion, as shown in Table V.

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

Based on the data extracted from the CRM systems, corporate survey database, and external databases of this airline company, the value for each sub-criterion of each corporate account are listed in Table VI. 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 wide ranging 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 V.
The normalized weights of the sub-criteria with respect to their parent criterion

		Customer											
Parent criteria	Sub-criteria	1	2	3	4	5	…	96	97	98	99	100	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

Table VI.
Data of the relationship marketing model for each corporate account

Using the Equation (11), the normalized decision matrix is calculated. Then it is combined with the weights to calculate the weighted normalized decision matrix as per Equation (12). The next step is to determine the positive ideal and negative ideal solutions as per Equations (13) and (14). The separation of each corporate account from the positive and the negative ideal solution is calculated as per Equations (15) and (16). In the final step of the TOPSIS method, the normalized priority vector of the six main criteria (relationship connectors, communication, customer factors, conflict, commitment, and competitive dynamics) is multiplied by their individual normalized weight vector (0.185, 0.275, 0.118, 0.057, 0.189, 0.177), which is derived from the FAPH method, the relative closeness to the ideal solution is determined as per Equation (17), and shown in Table VII.

All the 100 corporate accounts are ranked on the basis of V are listed in Table VIII.

Corporate accounts 17, 45, 42, 18, and 7 have the highest profitable and valuable potential, while 95, 100, 28, 37, 5 have the lowest scores. Once the managers are informed about these results, they are more equipped to identify the causes of these diversities in the profit and value profile of different corporate accounts. This directs further formulation of appropriate strategy to retain those corporate customers with high profit and value potential, and convert the less profitable and valuable corporate customers into profitable and valuable accounts.

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, and returns are consistently below the cost of capital. All other entities of their value chain make higher returns than airlines, e.g. jet fuel supply, airplane manufacturers, and other suppliers. The costs of the airline have more than halved in real terms over the last four decades. However, cost savings from technology and productivity are passed onto customers in lower fares. Therefore, it is not appropriate to improve operations merely by becoming lean in all aspects of the supply chain. Measurement and identification of the profit and value potential of corporate customers is the first step to increase customer profitability and firm performance. This hybrid CRM BPM model can be applied to airline and other industries.

Table VII. The + and − ideal solutions, and relative closeness to the ideal solution of each corporate account

	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

Note: The positive ($D+$) and the negative ($D-$) ideal solution, and relative closeness to the ideal solution (V) of each corporate account

Table VIII. Ranking of the relative closeness to the ideal solution

	Customer										
	17	45	42	18	7	…	95	100	28	37	5
V	0.930	0.881	0.868	0.852	0.817	…	0.070	0.057	0.056	0.047	0.036

This study makes the first move to innovatively apply the well-known techniques including CRM and relationship marketing models, FAHP, and TOPSIS in the BPM research. By demonstrating the merit of this new hybrid model to determine the ranking of corporate accounts on the basis of the objective quantifiable and subjective qualitative corporate customer attributes, companies are in a better position to take advantage of their knowledge on customer relationship, profit, and value potential to improve firm performance. This proposed model has been validated for feasibility by using data of an airline company. This model can easily be customized without complex modification to various industries that are subject to competitive market forces, which undermine their return on investment and profitability. Companies can apply this novel CRM BPM approach to prioritize customers, develop and implement customized customer-centric marketing programs to increase profitability and firm performance.

Beyond the aforementioned benefits of the proposed FMCDM approach for customer profitability analysis, 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 relationship knowledge revealed by the proposed hybrid CRM BPM model.

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