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Customer relationship mining system for effective strategies formulation

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Abstract

Purpose – The purpose of this paper is to propose a customer relationship mining system (CRMS) to analyze the data collected from franchisees and formulates a marketing strategy based on customer demand and behavior.

Design/methodology/approach – The system makes use of cloud technology to collect and manage data among the franchisees. An integrated approach of association rule mining and the neural network technique is adopted to investigate customer behavioral patterns and to forecast sales demand, respectively.

Findings – The significance and contribution of this paper are demonstrated by adopting the CRMS in the education industry in Hong Kong. The findings led to the identification of student learning intentions such as course preferences, and the forecasting of enrolment demand in terms of demand forecast. It is believed that better resources allocation can be achieved and an increase in customer satisfaction is foreseeable.

Research limitations/implications – The proposed CRMS could be applied to various franchising industries for effective marketing strategy formulation. However, since the data in this study are extracted from a specific industry, modifications may be required before the CRMS can be applied to other franchising industries.

Originality/value – This study presents a new application to convert data into useful knowledge, and provides useful insights for delivering strategic promotional plans under a franchising business model. Through the pilot study conducted in a franchising education center, the results demonstrate that the proposed CRMS is valuable in providing effective promotion to attract more customers, better preparation in resources allocation and more standardized methods to formulate marketing strategies in the franchising industry.

Keywords Customer relationship management, Neural network, Marketing strategy, Association rule

Paper type Research paper

1. Introduction

Franchising has become a popular strategy in various industries for expanding the business network and increasing profit (Campbell *et al.*, 2009; Dant and Kaufmann, 2003; Inma, 2005; Pine *et al.*, 2000). According to Watson *et al.* (2005), a franchising relationship refers to the legal agreement between the products or services provider (the franchisor) and another party (the franchisee) who would like to operate the business using the same brand name and types of products/services. In such a relationship, the franchisee has to pay a franchise fee to join the franchising business

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for a given period of time. In return, the franchisor provides continual support and management to the franchisee, including advertising, promotion, knowledge and resources (Sigue and Chintagunta, 2009; Lindblom and Tikkanen, 2010). However, this franchising model brings challenges to the franchisor due to increasing customer expectation and competition in the market. In order to survive using a customer-oriented franchising business model, it is critical for the franchisor to manage the intangible knowledge resources for sustainable competitive advantages (Chadam and Pastuszak, 2005; Wong, 2005).

One of the important knowledge assets that can maintain a business network is the formulation of marketing strategy through managing valuable data (Xu and Walton, 2005; Zanon *et al.*, 2013). In general, marketing strategy refers to the allocation of limited resources in an organization for promoting the products/services provided so as to achieve the organizational goals. Organizations usually have their unique goals and hence they deploy different strategies according to their specific needs (Cadez and Guilding, 2008). An effective marketing strategy can help franchisees to attract customers and maximize business performance, while resources can be minimized. According to Cadez and Guilding (2012), an effective marketing strategy must be aligned with organizational goals and the overall business strategy. In doing so, the franchisor has to analyze customer behavior based on a large amount of information collected from all franchisees, including sales data and customer particulars.

In formulating an effective marketing strategy, there is a practical need for the franchisees to attract more customers, so it is vital to provide support to the franchisor in order to be able to analyze past sales records for identifying customer behavior and forecasting future sales demand. In order to fulfill practical needs in the franchising industry, the applicability of data mining and forecasting techniques, through the use of association rule mining and neural networks (NNs), are promising tools in data analysis, from the theoretical perspective. Thus, it allows the franchisor to plan responsive marketing strategies based on analysis of the results obtained. In this paper, a customer relationship mining system (CRMS) is developed, aiming at formulating marketing strategy based on customer demand and behavior. Through cloud technology, data from each franchisee are gathered in a centralized database for analysis. The system then integrates association rule mining and NN techniques to investigate the behavior of customers and to forecast the demand, respectively. With the help of the CRMS, the franchisor can formulate an effective marketing strategy to meet customer requirements. The rest of the paper is organized as follows. Section 2 reviews the literature related to customer relationship management (CRM), marketing strategy, data mining and forecasting techniques. Section 3 presents the system architecture of the CRMS. In section 4, a case study is conducted in the education industry to formulate a marketing strategy based on student learning intentions and the forecasting of demand for courses. Section 5 presents the results and discussion while the conclusions are drawn in Section 6.

2. Literature review

2.1 Overview of franchising business

In a franchising relationship, the franchisor and franchisee are independent entities in that they run a business separately under a contractual agreement. Based on the agreement, the allocation of responsibilities, decision rights and profits are defined between the franchisor and franchisees (Combs *et al.*, 2004). However, successful franchisors do not only sell products and services but they also need to provide

intangible knowledge support to franchisees (Paswan and Wittmann, 2009). According to Grewal *et al.* (2011), providing franchise resources, including market knowledge and marketing capability, is the key factor that would affect both the strategic and financial performance. White (2008) investigated the impact of the marketing strategy creation style in a franchise system and concluded that the business performance would positively increase if there is trust between the franchisor and franchisees. Viera and Slongo (2007) stated that a good marketing plan can enhance customer satisfaction and the market performance of the franchise system. Thus, to further develop the franchise business, it is crucial for the franchisor to provide management support and appropriate resources in maintaining customer relationships and in formulating good marketing strategies.

From the past literature, a number of research studies related to managing knowledge have been conducted in the educational sector, with most focussed on retaining teaching or administrative knowledge in higher educational institutions (Kevin and Evaristo, 2004; Yeh, 2005; Uzunboylu *et al.*, 2011). Ramachandran *et al.* (2007) examined the relationship between organizational culture and knowledge management in a higher education institution in order to formulate proper strategies on how to manage the useful knowledge. Later, Ramachandran *et al.* (2009) further compared the practices in knowledge management processes in public and private higher education institutions, and significant differences were found between the public and private sector in creating and capturing useful knowledge. Sedziuviene and Vveinhardt (2009) also concluded that knowledge management in higher educational institutions is necessary for disseminating institutional knowledge. However, it is found that studies concerning managing useful knowledge to attract target students in a franchising education business are limited. Aurini and Davies (2004) studied the franchising form of private tutoring in Canada and found that franchisors controlled their services by standardization in order to secure stable revenues. Offering such kind of standardized strategy to every franchisee would limit the growth of business as customer perception may be different across various locations. Thus, it provides a room to explore the use of customized knowledge for promotion, in order to attract target students in the education sector, especially for the case of private education centers operating under franchising models.

2.2 CRM

CRM has been recognized as a set of customer-focussed business strategies to increase customer satisfaction and loyalty by offering a more customized and responsive service (Croteau and Li, 2003). CRM can be divided into four major processes, which are customer identification, customer attraction, customer retention and customer development. It aims at extracting and understanding customer behavior through meaningful communication in order to improve customer acquisition, and retain customers by enhancing customer loyalty, as well as increasing the profitability of the company. By analyzing customers' characteristics, the appropriate marketing strategies for specific types of customers can be formulated. Marketing strategy planning refers to the decision-making process that helps a company to achieve the business targets and produce excellent performance through the formulation of the marketing mix (Varadarajan and Jayachandran, 1999; Slater *et al.*, 2010). In order to maintain the competitive position of the business, Michael (2002) considered coordinating a hybrid form of marketing mix that included price, quality and advertising in the franchise chain. Generally, marketing mix is a conceptual framework

that can help marketing managers develop a suitable long-term or short-term marketing strategy for consumers (Palmer, 2004; Mason and Staude, 2009). According to Baker and Hart (2008), the concept of 4Ps, product, price, place and promotion, should be emphasized in designing marketing strategies. However, the basic concept of marketing mix mainly focusses on the production process. The process to maintain long-term customer relationships and to increase the customer satisfaction is neglected (Chen and Popovich, 2003). In order to have better understanding of customers' needs and to respond quickly to their demands, there is an emerging trend of applying the data mining approach in discovering interesting knowledge to improve customer service support (Hui and Jha, 2001).

2.3 Data mining techniques in formulating marketing strategies

Data mining is a process of business intelligence that can be used to search for useful information and to support decision-making processes in the company (Lee and Siau, 2001; Giudici and Passerone, 2002; Wang and Wang, 2008). Sugumaran and Bose (1999) and Shaw *et al.* (2001) suggested that data mining contains three different functions for discovering unknown patterns and information from databases, which are selecting, exploring and modeling. Ngai *et al.* (2009) reviewed the application of data mining techniques in CRM and suggested that the CRM elements, i.e. customer attraction and development, can be supported by forecasting and association, respectively.

2.3.1 Association mining. Being one of the data mining techniques, association rule mining is able to expose the patterns and possible associations from a database (Snchez *et al.*, 2009). The rules generated disclose unknown relationships which help to establish effective analysis and decision making (Rajasethupathy *et al.*, 2009). Chen *et al.* (2005) applied association rule mining to identify the relationship between customer profiles and product items purchased by integrating customer behavioral variables, demographic variables and the transaction database. Liou and Tzeng (2010) predicted the behavior of airline customers by generating association rules between service quality, price, safety and different backgrounds of customers. Therefore, by knowing the critical factors that affect customer decision-making processes, the company is able to formulate specific sales strategies for target customers.

2.3.2 NN. With knowledge of customer behavior, a company can attract potential customers by providing enough resources for direct marketing (Prinzie and Poel, 2005). In doing so, the company has to forecast future demand in order to allocate the required resources. Forecasting aims to evaluate the value or events in the future with uncertainty according to the observed pattern from the previous record (Ahmed, 2004). The NN is a popular and common tool for forecasting (Chang *et al.*, 2009; Chan *et al.*, 2010; Yu *et al.*, 2011). It is an artificial intelligence technique to find out the multivariate correlation between the input and output variables. According to Paliwal and Kumar (2009), a NN has learning ability which tries to predict human's judgment based on a number of considered factors. Chou *et al.* (2010) applied web mining and NNs to visualize a user's action and to predict the intention to enhance buying willingness. Huarng *et al.* (2010) proposed a NN based fuzzy time series model to forecast tourism demand. The forecasting result was useful for a private organization to plan a marketing strategy which prevents shortage or surplus of goods and services.

In addition, from the past literature, it is found that the integration of association rule mining and NNs has been applied in various industries for decision support. Karabatak and Ince (2009) designed an automatic diagnosis system using association rules, and NNs to detect breast cancer, such that the dimension of the feature space can

be reduced before classification. Huang *et al.* (2008) proposed to apply a back-propagation NN to learn association rules for providing personalization in online shopping. Solomon *et al.* (2006) conducted data mining analysis by integrating decision trees, NNs, association rule mining and *K*-means models to improve traffic safety by reducing fatalities. This study provided an insight on applying a combination of various data mining techniques to examine predictable relationships between the demographic data of drivers and fatal accidents.

From the above studies, it is concluded that formulating an effective marketing strategy is necessary to maintain the competitiveness and satisfaction between franchisor, franchisees and customers. Since this study focusses on attracting more customers by providing an appropriate marketing strategy based on their needs, only the first two processes in CRM, i.e. customer identification and customer attraction, are considered for targeting potential customers, and for direct effort and resources to attract them. To summarize, this paper attempts to integrate association rule mining and NNs for investigating customer behavior and forecasting customer demands.

3. System architecture of the CRMS

In order to formulate an effective marketing strategy in a franchising business, a research model to link up the operations of franchisees to the design of the corresponding marketing strategy is developed, as shown in Figure 1. The CRMS is designed to analyze the data collected from each franchisee and then plan the marketing strategy based on the association rules generated and the forecasted enrollment demand. CRMS is a responsive data mining and forecasting system that involves the techniques of association rule mining and NNs. It consists of three tiers which are data collection and storage, data mining and forecasting, and marketing strategy formulation. In Tier 2, two modules, namely, the association rule mining module (ARM) and the neural network module (NNM), are included for data mining and forecasting. Association rule mining is applied to find out the courses that are frequently applied for at the same time, in order to analyze the buying habits of customers. NN is then adopted to forecast the needs of the courses by demand forecasting and system controlling. The system architecture of CRMS is shown in Figure 2.

3.1 Tier 1 – data collection and storage

Data collection and storage for CRMS is conducted in Tier 1. All the relevant data from different centers, such as financial records, operational and daily transactional records, are collected and stored in the cloud CRM system. In current practice, without the CRMS, each shop has to purchase sets of computer hardware and servers with

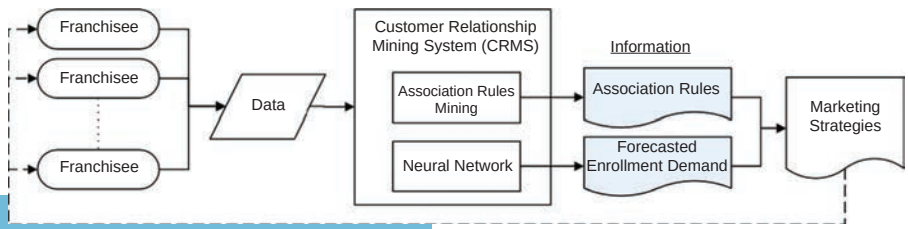


Figure 1.
Research model for effective marketing strategy formulation

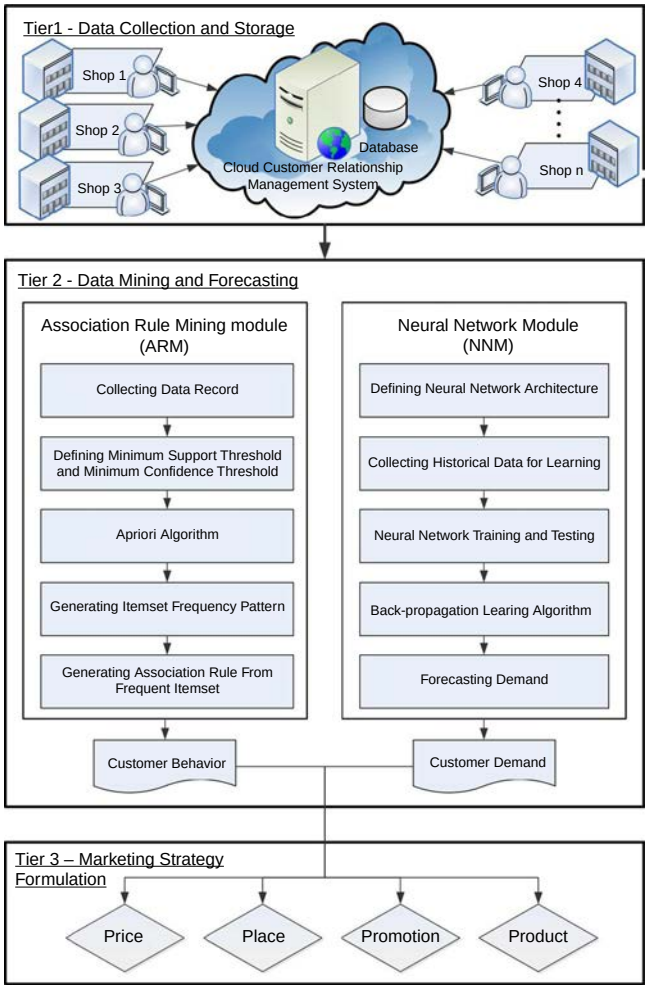


Figure 2.
System architecture of the customer relationship mining system

high technical specification in order to deal with lots of sales records and store huge amounts of data in the shop. In such cases, the investment cost increases due to the high purchase cost of computer hardware. Furthermore, although each shop holds large amount of sales data, staff do not have relevant knowledge to manage the data. Through the cloud technology of CRMS, the franchisees do not need to have high investment on computer hardware but they can access the CRM system easily by the internet. The sales data is then stored in the cloud-based server instead of a local server installed in each shop. Therefore, the franchisor can manage all the sales data and inventory records collected from each shop as a whole in order to provide data analysis and knowledge support in the marketing strategy formulation. The application of cloud technology not only can help the franchisor to integrate data for providing value-added support to the franchisees, but it is also beneficial to the franchisees for minimizing the investment cost.

3.2 Tier 2 – data mining and forecasting

A two-step-approach is proposed in this tier for parallel decision-making processes. It consists of two modules, which are the ARM and the NNM. ARM is used to study customer behavior by discovering the sales pattern from past records while NNM is used to forecast the future sales demand based on the current business environment.

3.2.1 ARM. In this module, association rule mining is used to discover the unknown relationships and sales patterns based on past sales records. In order to figure out which items are frequently booked at the same time, the Apriori algorithm is proposed to present the relationship in the form of If-Then rules. Figure 3 shows the logic of the Apriori algorithm. It considers all the itemsets and is able to figure out the itemsets that meet the minimum support criteria. Let D be a set of all transactions where each transaction T contains a number of items, and A and B are the items that belong to a set of transaction items X. To start up, a minimum support threshold should be defined to ensure the quality of the information obtained. Support refers the percentage of records containing an item or a combination of items to the total number of records, which is shown in Equation (1). It represents that $Support\ (A \rightarrow B) = P(A \cup B)$ such that the support $(A \rightarrow B)$ is the probability of the presence of both A and B within the total transaction. After that, the frequent itemsets are identified and the support count is calculated to show the frequency of occurrence in the record. When the support count of an item $(k = 1)$ is smaller than the minimum support threshold, the item is pruned. The residual items are then combined to form itemsets with $(k + 1 = k')$ items. The itemsets with a support count less than the minimum support count threshold are discarded. The process continues until there is no itemset in which support count are less than the minimum support count threshold. The association rules are then generated by using the frequent itemsets that consist of a condition and a result. The confidence of each generated rule is calculated using Equation (2) to reflect the probability that a result with a certain combination of items will occur under a particular condition. The confidence measures the ratio of A occurring together with B, where $Confidence\ (A \rightarrow B) = P(B \mid A) = Support\ (A \cup B)/Support(A)$. The confidence of rule $A \rightarrow B$ equals to c if c percent of the total transaction that contain A also contain B. If the confidence of a possible rule is greater than the defined minimum confidence threshold, it can be regarded as an association rule. Thus, the customer preference showing the items that are considered at the same time can be observed. For the generated association rule to be recognized as valid, the support and confidence of an

```
F1 = {large 1-itemsets};
For (k = 2; Fk-1 ≠ ∅; k++)
    Ck= Set of New Candidates;
    For all transactions t ∈ D
        For all k-subsets s of t
        If (s ∈ Ck) s.count++;
    Fk = { c ∈ Ck | c.count ⩾ min_sup};
Set of all frequent itemsets = Uk Fk;
```

Figure 3.
Logic of the Apriori algorithm

association rule has to be equal to or larger than the minimum support threshold and the minimum confidence threshold respectively:

$$Support = \frac{\text{Number of transactions which can fulfilled Condition } IF}{\text{Total number of transaction sets}} \quad (1)$$

$$Confidence = \frac{\text{Support of fulfilling both Condition } IF \text{ and Result } THEN}{\text{Support of fulfilling both Condition } IF} \quad (2)$$

3.2.2 NNM. A NN is applied in this module to predict the sales pattern by learning from the past record. Figure 4 shows the flow for designing a NN model. In the first step, past data are identified and collected in designing the model. After that, data pre-processing process has to be carried out in order to train the NN model more efficiently. This process includes to solve the problem of missing data by replacing the missing data by the average value obtained during the same period of time and to normalize data by presenting the data in standard form. Then, the NN model is built for training and testing.

Generally, a NN system consists of three compulsory layers, input, hidden and output layer, which forms a multi-layered perception (MLP) network. In each layer, there are a number of neurons associated with an adjustable weighting to predict the output value. Therefore, the users can train the NNs by adjusting the network size, the number of hidden neurons, etc., to perform a specific target output. Figure 5 shows a basic structure of a NN model. In the input layer, the values of the input factors range between 0 and 1.

Each input node is then multiplied by its weighting, which is randomly assigned, according to Equation (3):

$$Input = \sum (\text{Weight of node})(\text{Value of node}) \quad (3)$$

These values are then transferred to the hidden nodes as their inputs. The hidden layer contains one or more layers with a number of nodes for learning. The computation

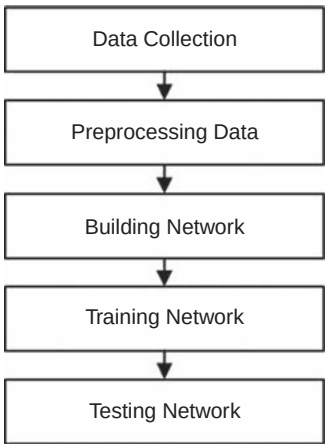


Figure 4.
Flow of designing a neural network model

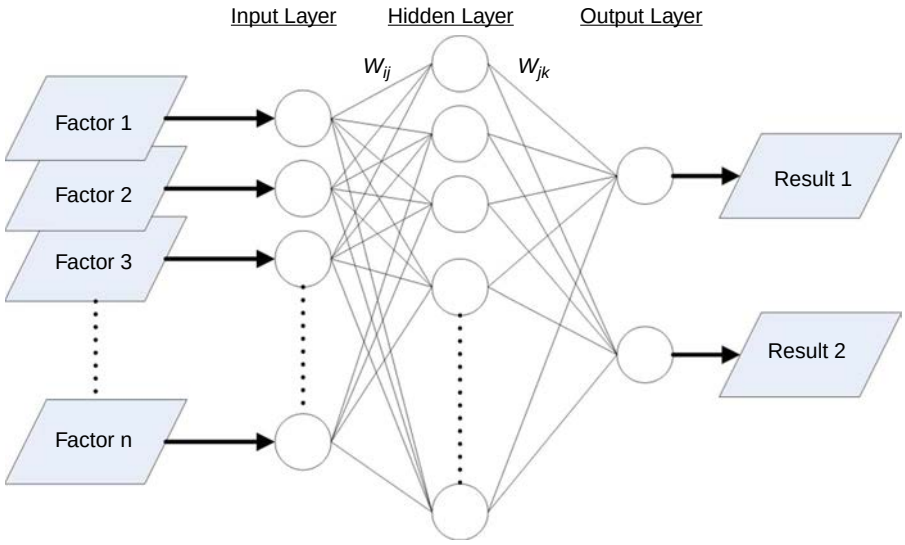


Figure 5.
Basic structure of a NN model

result from the hidden layer is then transferred to the output layer and the result can be obtained using Equation (4):

$$Output = \frac{1}{1 + e^{-\text{input of node}}} \tag{4}$$

To minimize the error in the result, a back-propagation algorithm is adopted to modify the weighting value, starting at the output layer. Through the training process of the NN, the system can learn from the historical data and adjust the weighting between each node. The trained NN model is then used to forecast the future demand.

3.3 Tier 3 – marketing strategy formulation

The results obtained by CRMS are used to design marketing strategies. In addition, CRMS can study customer behavior, such as the buying habits and purchasing power of each customer. Gathering all is related information, a new marketing strategy can be designed based on four key dimensions which are price, place, promotion and product. Moreover, the forecasting function of CRMS helps companies to forecast the sale of each product, the demand of customers and also the inventory of the company. The company can order the product units by considering the result of the forecast.

4. Case study

4.1 Background of education industry in Hong Kong

Due to the reform of the educational system, which started in 2012, the Hong Kong Diploma of Secondary Education (HKDSE) replaced both the Hong Kong Certificate of Education Examination (HKCEE) and Hong Kong Advanced Level Examination (HKALE). In the knowledge-based economy and with the changes of the educational system, many parents send their children to tutorial centers to improve their academic performance and results. The great demand resulted in a lot of tutorial centers springing up, so an effective marketing strategy is necessary to gain a greater market share in this industry. Tutorial centers have to make improvements on different aspects

in order to improve customer satisfaction, such as small class teaching, interactive teaching and intensive classes.

4.2 Company background

The Dr I-Kids Education Center is a profit-making and franchised organization in Hong Kong. From 2004 to 2013, the Dr I-Kids Education Center had 23 units in different districts in Hong Kong, all are operated by franchisees. The organizational goal of Dr I-Kids Education Center is to become the most well established education center in the local market, and its target is to be able to act as an ideal learning partner to enable children to learn and grow. In order to achieve the organizational goal, Dr I-Kids Education Center defines its own business strategies to be applied in its franchising business. These strategies include to: (i) provide knowledge support and management to ensure teaching quality by providing standard guidelines and teaching materials; (ii) formulate promotion packages for each franchisee with data collection and analysis; and (iii) provide long-term support and consultation to franchisees in daily operations. Meanwhile, the teaching purpose of Dr I-Kids Education Center is to provide excellent tutorial education in a comfortable learning atmosphere to all kindergartens, primary schools and junior forms students. Dr I-Kids Education Center provides diversified tutorial classes, such as English Phonics, Olympic Mathematics and Cambridge English courses in order to cultivate the all-round development of students. Moreover, Dr I-Kids Education Center also publishes academic exercise books, and develops innovative teaching multimedia software to raise the student's learning quality. Dr I-Kids Education Center is a member of the British Council Exams Partnership program. In addition to the teaching quality, Dr I-Kids Education Center also emphasizes on effective management, in which they were certified to ISO 9001:2008 in 2012. With sustainable development of the education industry, the needs and expectations of customers has increased rapidly, leading the Dr I-Kids Education Center to see the need to amend their operation and marketing strategies. Therefore, a systematic marketing strategy formulation approach could be a key to execute the aforementioned strategies (ii) and (iii).

4.3 Problem identification

Currently, the education center has a CRM system to gather data from different centers. However, the system is mainly used for course registration, recording student's information and attendance, which cannot provide useful information for further analysis. There are three major problems that are faced by the education centre. They are unable to find out the relevant relationships in customer behavior, unable to forecast and analyze the demand, and unable to design a marketing strategy. First, as the system can only show the total number of students, and the course and teaching materials for referencing, it is difficult for managers to find relationships in customer behavior from the database. Second, managers cannot estimate the student demand or the usage of teaching materials for next monthly period based on the historical data. Thus, the education center has difficulty in allocating resources properly for marketing and promotion. Third, the current CRM system is adopted to assist the daily operation process only. No information on student learning intentions and demand forecasting is provided. The managers still need to design marketing strategies and promotion methods based entirely on experience and knowledge. Therefore, the CRMS is proposed for the Dr I-Kids Education Center to determine the relationships in customer behavior, to enable demand forecasting using CRM data, and to provide decision support functionality in designing marketing strategies.

4.4 Implementation of CRMS

4.4.1 Data collection and storage. The Dr I-Kids Education Center uses the CRM system as a centralized database to store all the data within all the out-centers. In the ARM Module, three inputs, "course applied," "primary school" and "district" are used to generate the association rules. Since the goal of this module is to help the Dr I-Kids Education Center in investigating student learning intentions, "course applied" is one of the significant factors to determine which courses are usually applied for by students. "Primary school" is another key factor to show the background of students. With such information, the education center can determine suitable course combinations in response to the need of students from a particular primary school. For the "District," students in different districts may have varying course needs. As there are 23 centers operated by franchisees in different districts, knowing student needs in different districts could help to formulate a customized marketing strategy for each franchisee. Thus, with the above three inputs, the Dr I-Kids Education Center is able to provide appropriate marketing strategies based on the association rules generated, which are useful in helping franchisees attract more students. In addition, data from internal and external environmental sources are also collected. Table I shows the types of data to be collected for demand forecasting, and their definition. Six types of secondary data, from macro and micro points of view, composite consumer price index (composite CPI), real gross domestic product (real GDP), unemployment rate, real index of payroll per labor, course applied per student and promotion/profit (in percent) are collected. The macro data of composite CPI, real GDP, unemployment rate and real index of payroll per labor are obtained from the Hong Kong Census and Statistics Department. These factors at the macro level are defined because of their impact on the private educational business. As the Dr I-Kids Education Center is a private educational business, operations development and financial support are not provided by the Government. It is a value-added business to parents and students in which it is not compulsory for students to apply for courses. Thus, external factors are important in influencing customers' intention of enrolling on courses and in determining the business performance of the Dr I-Kids Education Center. From the micro point of view, course applied per student and promotion/profit (in percent) are included as they are the immediate factors that directly impact on the Dr I-Kids

Type of data	Definition
Composite consumer price index (composite CPI)	It reflects the whole impact of consumer price change on the household sector. Lower CPI indicates a higher consumption ability
Real gross domestic product (real GDP)	It is a measure of the total production value of all resident producing units in Hong Kong. Higher GDP indicates a better economic environment
Unemployment rate	It is the proportion of underemployed persons in the labor force. A lower unemployment rate indicates a better economy
Real index of payroll per labor	It indicates the changes in purchasing power of labor earnings. Higher income for purchasing results in a higher index
Course applied per student	The number of courses that each student has applied for in the education centers. A higher number of courses indicates the higher demand of each student
Promotion/profit (in%)	The proportion of profit used in promotional activities. The higher percentage of promotion cost, the better reputation of the I-Kids Education Center, so parents may be willing to pay more

Table I.
Types of data collected for demand forecasting

Education Center, and are obtained from the past registration records. Data in the recent five years (2007-2012) are selected for the training process in the NNM. The number of enrolled students between the years of 2007 and 2012 is also collected for the prediction process in the module.

4.4.2 Deployment of ARM. The records of courses which students applied for and their relevant primary school are collected from the CRM system. It is assumed that students apply for courses in the education center which is nearest to their primary school. In this case study, 360 student records are collected and used in the deployment of association rule mining. Figure 6 shows the sample transaction records of students. With the data collected from the cloud CRM system, XLMiner is used on Microsoft Excel to generate the association rule report. The minimum support count is set to be 4 and the minimum confidence is set to be 80 percent. The results of the ARM module includes the association rules generated, showing the correlation between the courses applied for, the primary school students are studying in and the education center district. The association rule generated is presented in the following format: **IF** students study in (*Primary_School*) in (*District*) and apply (*Courses_Applied*), **THEN** apply (*Course_Applied*) together. The performance of the association rules generated is then validated based on key performance indicators defined after the marketing strategy is carried out, after a trial run of three months. The indicators include the confidence and support of the association rules generated, the percentage of students who applied for the courses promoted together, and the number of students enrolled.

4.4.3 Deployment in NNM. The monthly data of internal (micro) and external (macro) environmental factors from the year 2007 are collected as the inputs for the process of learning by using the toolbox in MatLab. Hence, by inputting the data of the environmental factors from the previous month to the targeted month forecasted, an output is generated, which can be referred as the forecast demand of a month.

(i) Training of NN with historical data. To forecast the enrollment demand in January 2013, the monthly data of six attributes composite CPI, Real GDP, unemployment rate, real index of payroll per labor, courses applied per student and

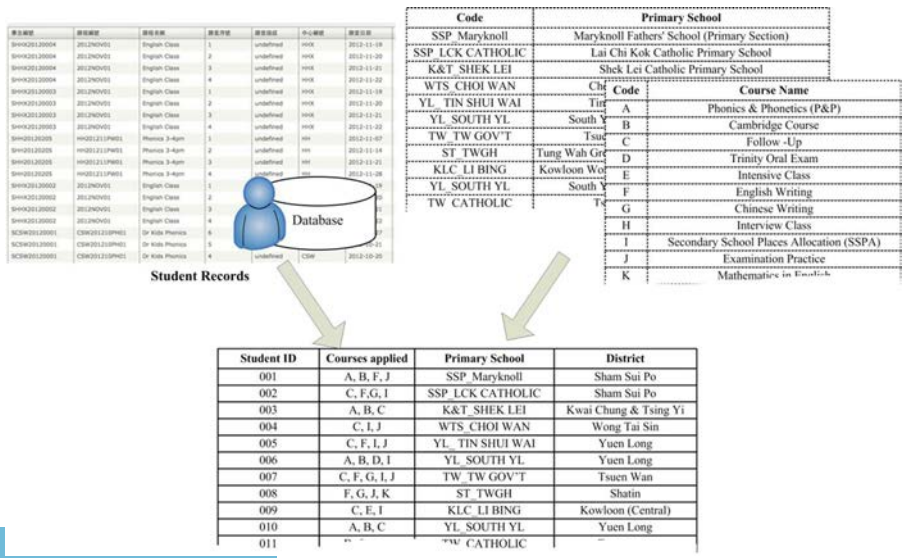


Figure 6.
Sample transaction records of enrolled students

percentage of promotion cost over profit from January 2007 to November 2012 are recorded as inputs. In total, there are 71 samples of data input which are presented in a 71 × 6 matrix. At the same time, the historical data of the monthly enrollment demands from January 2007 to November 2012 are recorded as output. There are totally 71 samples of the target output, presented in a 71 × 1 matrix. The entered input and output data are considered for the learning process. After data entry, it is required to define appropriate percentages of training, validations and testing. Within the 71 samples, 70 percent of the samples (i.e. 49 samples) are set to be used for training; 15 percent of the samples are assigned to be used for the processes of validation (i.e. 11 samples) and the rest are for testing (i.e. 11 samples). In order to find the optimal setting, an empirical study has been conducted with different NN configurations. In the empirical study, 20, 25, 30 and 35 hidden neurons have been used in the NN model. Thus, four sets of configurations are tested and they are represented by the number of input variables, hidden neurons and output variables, i.e. NN1: 6-20-1, NN2: 6-25-1, NN3: 6-30-1, NN4: 6-35-1. The average error rate of NN1, NN2, NN3 and NN4 are found to be 5.43, 5.19, 4.79 and 4.94, respectively, which shows that the optimal result is obtained using 30 hidden neurons in this case. Figure 7 shows the data performance of training, validation, test and overall result by setting 30 hidden neurons in the NN. The fit line is used for illustrating the relationship between the input and output data. Therefore, it is better for the plotted points to be near to the best-fit line drawn.

As shown in Figure 7, only the data for validation is dispersed all around, which means the data easily fluctuated. The data performance of training, testing and overall result are relatively more stable in the moderate range of 100-300, since they are concentrated on the fit lines, which indicates that the trained NN model is suitable for prediction.

(ii) Evaluation on effectiveness of NN. As the system has already learnt from data from January 2007 to November 2012 in the previous learning process, the forecast demand in January 2013 can be observed after inputting the data of December 2012. The system generates the predicted enrollment demands at January 2013 to be 384, as shown in Figure 8.

In order to validate the effectiveness of the NN, a backward forecast test is carried out to compare the actual and forecast demand in January, February and March 2013, and is shown in Table II. On average, the average deviation is about 4.79 percent. The forecasting of future enrollment demands is said to be acceptable by using the NN approach.

4.5 Proposed marketing strategy

In this section, the marketing strategy to be adopted in January to March 2014 is formulated after implementing CRMS. Through the association rules between courses and the primary school in which students are studying, managers can design a tailor-made promotion package for their centers to attract more target customers. Based on the output of the NNM, the forecast enrollment demand can be observed. The operations manager can have a better allocation of teaching materials and staffing. The results generated by XLMiner are shown in Figure 9. In total, 18 rules that fulfill the minimum support count are generated. As the purpose of association rule mining in this study is to find out the relationship between the courses and the relevant primary school, only the rules containing the information on courses and primary school are useful. Therefore, as shown in Table III, ten out of 18 rules are selected for further analyzing. The districts in Hong Kong where the generated association rules

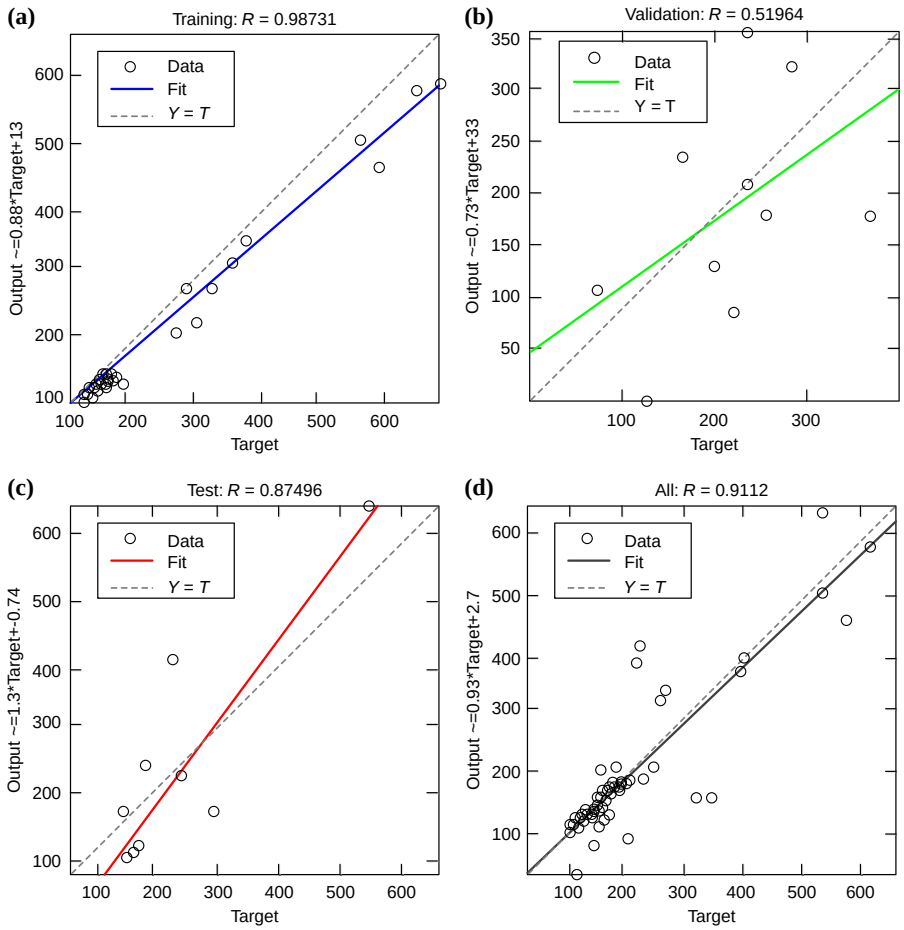


Figure 7.
Data performance

can be applied are also listed in Table III. In general, Hong Kong covers Hong Kong Island, Lantau Island, the Kowloon Peninsula and the New Territories. It can be further divided into 18 districts geographically to facilitate the planning of public construction and development, and administrative control. As shown in Table III, more than half of the generated association rules are applied to the Yau Tsim Mong district which includes the major areas of Yau Ma Tei, Tsim Sha Tsui and Mong Kok. Among all districts in Hong Kong, the Yau Tsim Mong district is located in the western Kowloon Peninsula. It is the core urban area of Kowloon, and this district has the third highest population density in Hong Kong. A number of primary schools are located within the district, thus, there is a need for Dr I-Kids Education Center to provide appropriate course in order to attract students to join its tutorial classes.

The marketing strategy of the Dr I-Kids Education Center is formulated based on the concept of 4Ps, product, promotion, price and place. The marketing plan formulated according to the output of CRMS is shown below.

4.5.1 Product. Product refers to the courses offered to the students and the academic exercise books published. For example, according to the association rule generated for

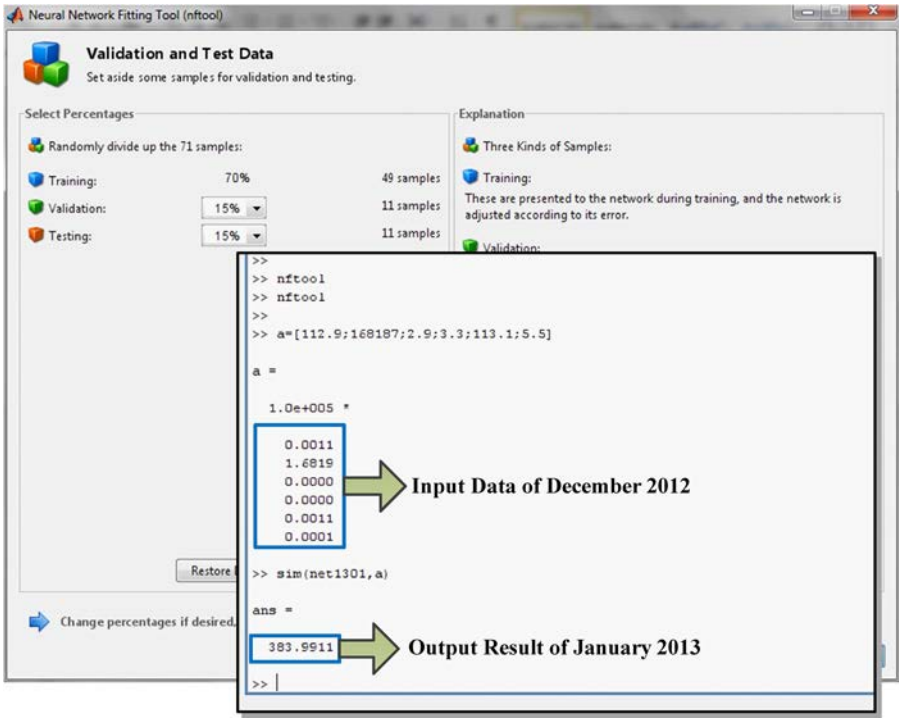


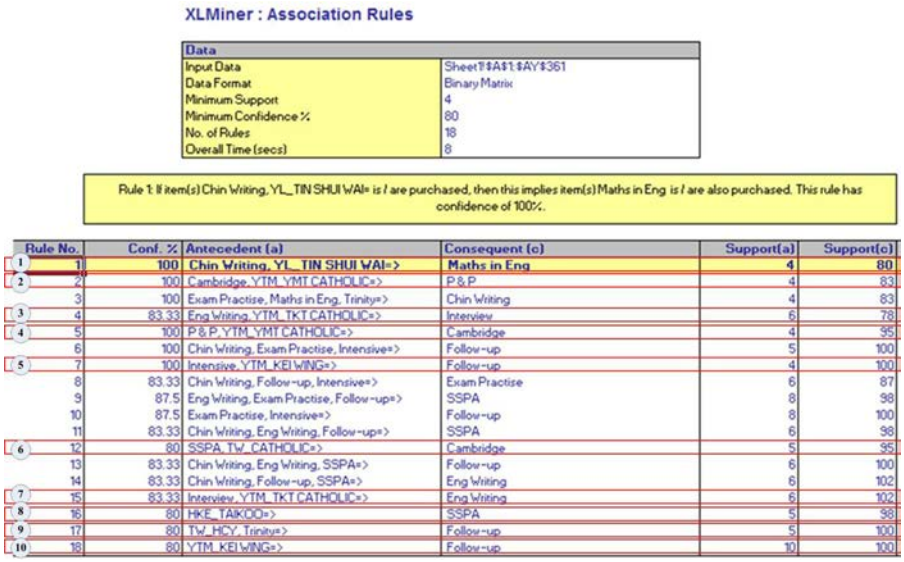
Figure 8.
Sample forecasted output for January 2013

Month (t)	Actual Demand (D_t)	Forecast (F_t)	Error (E_t)	Error Squared (E_t^2)	Absolute Error ($\lvert E_t \rvert$)
1	396	384	12	144	12
2	529	551	−22	484	22
3	417	387	30	900	30

Table II.
Effectiveness of neural network

the Dr I-Kids Education Center, most students in Yau Tsim Mong district (Yau Ma Tei Catholic Primary School, Tai Kok Tsui Catholic Primary School and Sheng Kung Hui Kei Wing Primary School) are interested in English. They favored joining the courses of Cambridge, Phonics & Phonetics and English Writing. The centers located in Yau Tsim Mong district should provide these courses at a higher frequency to fulfill the students' needs.

4.5.2 Promotion. On the other hand, as a promotion package, Dr I-Kids Education Centers are pleased to offer and promote free trial courses to interested students. The center managers in Yau Tsim Mong district (e.g. centers in Tai Kok Tsui and Metro Harbor View) should design and provide free trial courses related to English to students. Meanwhile, the promotion package may include the course on Oral Practice or combining the courses of Cambridge and English Writing at a special price to attract more targeted students to join. Hence, the managers should make use of historical data to forecast the enrollment demand for the next month. Managers should pre-allocate the teaching materials and staffing in peak months and/or design



XLMiner : Association Rules

Data	
Input Data	Sheet1!$A$1:$AY$361
Data Format	Binary Matrix
Minimum Support	4
Minimum Confidence %	80
No. of Rules	18
Overall Time (secs)	8

Rule 1: If item(s) Chin Writing, YL_TIN SHUI WAI= is / are purchased, then this implies item(s) Maths in Eng is / are also purchased. This rule has confidence of 100%.

Rule No.		Conf. %	Antecedent (a)	Consequent (c)	Support(a)	Support(c)
1	1	100	Chin Writing, YL_TIN SHUI WAI=>	Maths in Eng	4	80
2	2	100	Cambridge, YTM_YMT CATHOLIC=>	P & P	4	83
	3	100	Exam Practise, Maths in Eng, Trinity=>	Chin Writing	4	83
3	4	83.33	Eng Writing, YTM_TKT CATHOLIC=>	Interview	6	78
4	5	100	P & P, YTM_YMT CATHOLIC=>	Cambridge	4	95
	6	100	Chin Writing, Exam Practise, Intensive=>	Follow-up	5	100
5	7	100	Intensive, YTM_KEI WING=>	Follow-up	4	100
	8	83.33	Chin Writing, Follow-up, Intensive=>	Exam Practise	6	87
	9	87.5	Eng Writing, Exam Practise, Follow-up=>	SSPA	8	98
	10	87.5	Exam Practise, Intensive=>	Follow-up	8	100
	11	83.33	Chin Writing, Eng Writing, Follow-up=>	SSPA	6	98
6	12	80	SSPA, TW_CATHOLIC=>	Cambridge	5	95
	13	83.33	Chin Writing, Eng Writing, SSPA=>	Follow-up	6	100
	14	83.33	Chin Writing, Follow-up, SSPA=>	Eng Writing	6	102
7	15	83.33	Interview, YTM_TKT CATHOLIC=>	Eng Writing	6	102
8	16	80	HKE_TAIKOO=>	SSPA	5	98
9	17	80	TW_HCY, Trinity=>	Follow-up	5	100
10	18	80	YTM_KEI WING=>	Follow-up	10	100

Figure 9.
Result generated by XLMiner

Rule no.	Association rule	District
Rule 1	**IF** students study in Tin Shui Wai Catholic Primary School and apply for Chinese Writing courses, **THEN** apply for Mathematics in English courses together	Yuen Long
Rule 2	**IF** students study in Yau Ma Tei Catholic Primary School and apply for Cambridge courses, **THEN** apply for Phonics and Phonetics courses together	Yau Ma Tei
Rule 3	**IF** students study in Tai Kok Tsui Catholic Primary School and apply for English Writing courses, **THEN** apply for Interview courses together	Yau Ma Tei
Rule 4	**IF** students study in Yau Ma Tei Catholic Primary School and apply for Phonics and Phonetics courses, **THEN** apply for Cambridge courses together	Yau Ma Tei
Rule 5	**IF** students study in Sheng Kung Hui Kei Wing Primary School and apply for Intensive courses, **THEN** apply for Follow-Up courses together	Yau Ma Tei
Rule 6	**IF** students study in Tsuen Wan Catholic Primary School and apply for Secondary School Places Allocation (SSPA) courses, **THEN** apply for Cambridge courses together	Tsuen Wan
Rule 7	**IF** students study in Tai Kok Tsui Catholic Primary School and apply for Interview courses, **THEN** apply for English Writing courses together	Yau Ma Tei
Rule 8	**IF** students study in Tai Koo Primary School, **THEN** apply for Secondary School Places Allocation (SSPA) courses	Hong Kong East
Rule 9	**IF** students study in Tsuen Wan Public Ho Chuen Yiu Memorial Primary School and apply for Trinity Oral Exam courses, **THEN** apply for Follow-Up courses together	Tsuen Wan
Rule 10	**IF** students study in Sheng Kung Hui Kei Wing Primary School, **THEN** apply for Follow-Up courses	Yau Ma Tei

Table III.
Association rules generated by CRMS

corresponding promotion strategies in non-peak months beforehand. Since all inputted data are influential to enrollment demand, they are valuable for the Dr I-Kids Education Center as a reference.

4.5.3 Price. For the pricing strategy, students who have taken two promotional subjects, such as Cambridge and English Writing, at the same time would have a 10 percent discount. The discount rate increases until the maximum discount rate reaches 50 percent when students are taking more promotional subjects.

4.5.4 Place. Since the marketing strategy is formulated based on the historical data in the Yau Tsim Mong district, the design of marketing plans is specialized and only applicable to the centers located in Yau Tsim Mong district.

5. Discussion

Through the pilot test of CRMS in the Dr I-Kids Education Center, it is suggested that the franchisor can formulate marketing strategies effectively based on student learning preference and forecasted enrollment demand. In order to ensure that the formulated marketing strategy based on the result of CRMS suits the requirement of the franchisees, the director of the Dr I-Kids Education Center and her management team are invited for an interview and consultation to review the operations outcome. It is found that the number of students enrolled and the profit earned during the period of the pilot test conducted from January to March 2013 increased by 14 percent, which shows a significant improvement after adopting the CRMS. In this section, the implications and advantages of CRMS are discussed and it is found that the system can be beneficial to both the staff and customers in the franchising business.

5.1 Implications

CRMS helps to determine suitable combinations of educational courses and to forecast the demand of each course. The franchisor can make use of the results to re-design some course packages for each center and offer these designed packages with promotion prices to attract more potential customers. In addition, with the help of the system, the franchisor can have better resource allocation. As the franchisor can determine the needs of each center from the system results, suitable and sufficient resources can be allocated to the centers. Moreover, based on the system results, the franchisor can provide promotion material, such as advertisements, correspondingly.

Through the pilot study conducted in Dr I-Kids Education Center, it is found that the proposed CRMS can be successfully applied to a franchising education sector in the field of strategic promotion strategy planning. Moreover, the proposed CRMS is not only beneficial to the case company and the specific education center, it can also be applied to various franchising industries such as the retail sector or manufacturing industries which operate under a similar business model. Thus, it is vital to clarify the operation model of the franchising business so as to provide valuable insights for the franchisees for attracting more customers by formulating an effective marketing strategy. Figure 10 summarizes the role of CRMS and the relationship between the franchisor and franchisees, showing the concepts on how the CRMS can attract more franchisees to join the business. The franchisees have to pay a monthly franchise fee to the franchisor for using the brand name and the materials sold. Since the monthly franchise fee is directly proportional to the number of customers enrolled and also to the materials sold, increasing the number of customers and products sold would

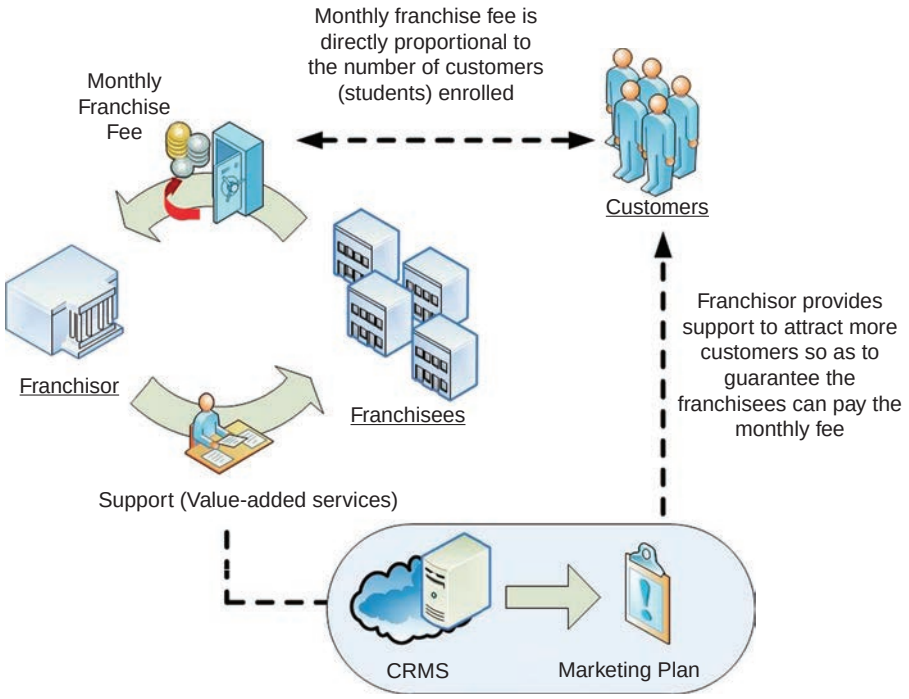


Figure 10.
Role of CRMS and relationship between franchisor and franchisees

further increase the income earned by the franchisor from the monthly franchise fee. Thus, in order to guarantee the income level, the franchisor is willing to invest on the cloud-based information technology system to attract more customers by formulating effective marketing strategies.

With the adoption of CRMS, it is believed that increase in customer satisfaction is foreseeable. Under such a business model, there are two types of customers involved. Take the case company, Dr I-Kids as an example. From the franchisee's point of view, the franchisees offer tuition courses while the parents and students pay tuition fee to them directly in order to attend the course. Therefore, the students who attend the course would be the customers of the franchisees. If the franchisee is able to offer courses based on the needs of students, the students may enjoy a discount rate to attend more courses. As a result, the satisfaction of students and their parents may increase. On the other hand, from the franchisor's point of view, the franchisees pay a monthly franchising fee to the franchisor for providing continual marketing support to attract more students. In such situations, the franchisee becomes the customer who pays for services. As the CRMS is able to formulate an effective market strategy, franchisees may offer appropriate combinations of courses to attract students. Thus, the satisfaction of franchisees may increase if the market strategy provided by the franchisor is useful to attract more students. Furthermore, an indirect relationship between the franchisor and students (customers) is observed. The franchisor increases income indirectly by providing an effective marketing strategy so as to attract the end users (students). Thus, the customer satisfaction may increase if the courses offered by the franchisees suit their needs.

5.2 Advantages of CRMS in educational franchising business

From the staff perspective, different courses have to be promoted to customers to raise the sales revenue. Without the help of the system, staff do not know which types of courses the customers actually want, and customers may feel annoyed when staff give wrong messages to them. By adopting CRMS, popular courses and potential customers for each center can be generated. Therefore, staff in each center can design their own promotion methods to customers, based on the results of the system. In addition, if staff recognize the forecast enrollment demand for the following month, they can prepare the related resources and staffing in advance.

From the customer perspective, the franchisor and each franchisee center re-design the packaged courses and provide promotion offers to the students, which can increase the sales revenue and improve customer satisfaction. Based on the requirement of customers, each center will provide suitable tailor-made package courses for them. The recognition of customer needs can raise customer satisfaction in the tutorial center and thus increases the loyalty to the service provided.

6. Conclusion

Due to increasing competition in the business environment, franchising is recognized as one of the organizational strategies for maintaining the market share and increasing the profit. In order to survive and expand a business, the franchisor has to provide continual management support, including advertising, promotion and resources allocation to franchisees so that they can operate the business effectively. In this study, a CRMS has been developed for the franchising business in order to attract more franchisees to join the business. The CRMS aims at investigating customer behavior and forecasting future sales demand by association rule mining and NN, respectively. Association rule mining can let the franchisor discover the relationships between different products and customer buying patterns. The NN approach predicts the future sales demand by learning from historical data so that the franchisor can prepare and deliver appropriate resources to franchisees to prevent out of stock. To validate the feasibility of the proposed system, CRMS has been applied in the Dr I-Kids Education Center, which is a franchising organization in the education industry. The results show that the student learning intention in terms of the courses applied and primary schools they are studying and next month's forecasted enrollment demand can be obtained effectively. Thus, the franchisees can promote the courses by offering discounts to the target students while the franchisor is able to prepare enough teaching materials for each franchisee based on the results obtained by CRMS. The results of the case study imply that the applicability of data mining and forecasting techniques from a theoretical perspective, through the use of association rule mining and NN, is able to fulfill the practical needs in the franchising industry. To conclude, the CRMS is valuable in providing effective promotion to attract more customers, better preparation in resources allocation and standardized methods to formulate marketing strategies.

There are some limitations in this study. First, training should be provided for all staff, which incurs extra training cost. Without training, staff may not know how to use the CRMS, and thus cannot fully utilize CRMS and cannot obtain support in formulating marketing strategies. Second, the accuracy of data collected would affect the performance of CRMS as it analyzes customer behavior mainly based on previous sales data. Third, maintenance of CRMS is incurred to avoid errors and to ensure effective system performance for franchisees. In addition, the pilot study was conducted in a franchising education center in Hong Kong, and the results and findings

are applicable and concerning the education sector only. The operations business model may be different in various franchising industries, and modifications may be required before CRMS can be applied to other franchising industries. Besides, due to the pilot study conducted, a limited data size was available for analysis. The results could be further improved if more data can be obtained from the franchising companies. For future research, various data sources that are influential to enrollment demand and customer behavior, such as the district where students live, study performance and the income of parents, ranges of courses, duration and other geographical and socioeconomic factors can be considered for developing a comprehensive marketing strategy.

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