Dr. Sudaporn Sawmong[1] and Dr. Mongkorn Klingajay[2]

Store Loyalty Classification Using a Neural Network Model

Abstract

This paper aimed to study and classify the store loyalty and demographics of Thai retail consumers from grocery stores in Thailand, by taking into consideration the difference in store loyalty of the retail consumers. This is based on Oliver's' four-stage loyalty model which consist of cognitive, affective, co native and action. Data collected naires in 2007 from 500 shoppers while they were doing shopping at the five leading grocery stores in Thailand including Markro, Tops, Casino-Big C, Tesco-Lotus, and Carefour. The Neural Network is applied.

Keywords: store loyalty, Oliver's four stage loyalty model, Neural Network

บทคัดย่อ

การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อศึกษาคุณลักษณะทางประชากรศาสตร์ และจำแนกระดับความจงรักภักดีของผู้บริโภคค้าปลีกในประเทศไทย ว่ามีลักษณะเป็นอย่างไร มีความแตกต่างกันหรือไม่โดยการใช้แบบจำลองของโอลิเวอร์ แบบจำลองของโอลิเวอร์ได้แยกผู้บริโภคที่มีความจงรักภักดีออกเป็น 4 ประเภท ได้แก่ (1) ผู้บริโภคที่คำนึงเรื่อง ราคา และประโยชน์ที่ได้รับ (2) ผู้บริโภคที่คำนึงถึงความพึงพอใจเป็นหลัก (3) ผู้บริโภคที่แนะนำคนอื่น และมีการซื้อซ้ำ และ (4) ผู้บริโภคที่มีความถี่ในการซื้อเก็บรวบรวมข้อมูลด้วยแบบสอบถามในปี พ.ศ. 2550 จากผู้ที่มีกำลังซื้อสินค้าปลีก จำนวน 500 คน ในร้านค้าปลีก 5 แห่ง ที่เป็นธุรกิจค้าปลีกนานาชาติ ได้แก่ Markro, Tops, Casino-Big C, Tesco-Lotus, และ Carefour. การจำแนกใช้ Neural Network

คำสำคัญ: ผู้บริโภคค้าปลีก

[1]อาจารย์ประจำบัณฑิตวิทยาลัยและผู้อำนวยการหลักสูตรบริหารธุรกิจดุษฎีบัณฑิต มหาวิทยาลัยอีสเทิร์นเอเชีย

[2]อาจารย์ประจำบัณฑิตวิทยาลัย มหาวิทยาลัยอีสเทิร์นเอเชีย

Introduction

There is an old truism that you "can't please all of the people all of the time". In other words, as regards retailing it is not possible to cater for all types of customer. If this is attempted no one will be served adequately. The objective of segmenting is to identify segments that offer the retailer an opportunity to serve that segment and thus truly and precisely satisfy the customer's needs. There are many variables in segmentation in general, such as: demographic, geo-demographic,geographic,psychocographic, and behavioural (Cox and Britain, 2000). But for retail segmentation, marketing literature suggests that the multi retailers should be more creative on grocery consumer markets segmentation. Samli (1976) suggests that consumers should be scrutinised for more important variables. If the consumers of certain products or customers of certain retail establishments are to be analysed and categorised after the information is received, segmentation will be more realistic. Omar (1999) emphasised the basic factors influencing the shopping process including personal factors (demographics, economic and situational), social factors (family, group, and culture). Demographic information or parameters is includes age, sex, income, education, etc… These parameters are the personal factors, which influence shopping behaviour.

This paper has classified demographics of Thai consumers, divided into four groups in terms of Oliver's four stages of loyalty (Oliver, 1997), in which the first one is cognitive loyalty (consumers who base their shopping choices on cost and benefit), the second one is affective loyalty (consumers who base their shopping choices on satisfaction), the third one is conative loyalty (consumers who make repurchases and recommend to other people), and the last one is action (consumers who have loyalty and do their shopping at the store frequently). This paper utilizes Oliver's (1997) four stage loyalty model, which classifies the loyalty of THAI consumers into four groups:

1) Cognitive loyalty, consumers focus on costs and benefits.
2) Affective loyalty, consumers focus on satisfaction.
3) Co-native loyalty, consumers repurchase and recommend store to other people.
4) Action loyalty, consumers have loyalty and frequently shop at these stores.

Demographic Characteristics of the Consumers

The Demographic characteristics of the consumers can affect the performance and competitive position of most retail operations (Collin, 1993). Demographic features commonly used for marketing purposes include age, sex, race, ethnicity, income education, occupation, family, religion, and social class (Lucas, Bush and Gresham, 1994). Recently, research; (Child et al.) has studied retail grocery stores in the UK, France and Germany. By comparing more than 1,500 consumers' rating of how well the stores performed with the store choices these consumers actually made, they found that British, French, and German shoppers differ in certain broad ways. They found that consumers for both groceries and apparel fall into one of three segments: the first one, service/quality customers care most about the variety and performance of products in stores as well as the service they provide. The second one price/value customers, are most concerned about spending their money wisely, The last one, affinity customers, primarily seek stores that suit people like themselves, or the members of groups they aspire to join. Child, Heywood, and Kliger (2002) also found that consumers of both groceries and apparel fall into one of the following three categories (Child, Heywood and Kliger, 2002):

- Service/quality, customers care mostly about the variety and performance of products in stores as well as the service they provide.
- Price/value, customers are mostly concerned about spending their money wisely.
- Affinity customers, primarily seek stores that suit people like themselves, or the members of groups they aspire to join.

Previous research in the UK has also the demographic characteristics of the consumer, such as the gender of the head of the household and found that if the female head of household is in employment this has been found to predict higher store loyalty. The age of the principal (female) shopper was a predictor of loyalty in his study (East et al., 1995). The profiles of consumers in the UK are measured, as shown in four segments. See also the work of Uncle and Hammond (1997), which include: The age of the head of the household is classified into three groups (18-44 years, 45-64 years, and 65 and over), Household size is classified into four size (one-person, two-person, three-person, and four-person and over), Household income is classified into four segments (lowest third of households, low-medium average income, medium-high average income, and highest 15%), and Work status of the head of

household is classified into three segments (no work outside the home, part-time employment, and full-time employment). Demographic variables employed in this study include age, status, income, education, and occupation. Data was collected from 250 shoppers while they were doing shopping at the five leading grocery stores Tesco, Sain sbury, Mark&Spenser, Safeway and Asda (Gain report, 2000), (Key note, 2000).

Customer Loyalty to Grocery Stores

Most retailers would like to have a hard core of loyal customers who continue to frequent their outlets. Generally this is achieved, but it is questionable whether there are enough of these customers, and whether they are the right customers (Sullivan and Adcock, 2002). There are too many retailers in today's marketplace. It is necessary to create, evaluate, and retain the loyalty of their customers.

Omar (1999) has emphasised that store loyalty is the single most important factor in retail marketing success and store longevity. He further observed that without loyalty toward the retail organization, the competitive advantage for which retail management is striving, does not exist and the store is likely to be unsuccessful. Research evidence (Uncle and Hammond, 1997) suggests that customers differ widely in their individual store choices, their frequency of store visits, amount spent and levels of store loyalty. Research evidence provided by Uncle and Hammond (1997) suggests that customers differ widely terms of in:

- Their individual choices of stores,
- Their frequent visits to retail stores,
- Amount spent by customers at retail stores, and

The level of patronage and loyalty to individual stores has been shown to vary in line with the store's market share. (Uncles and Hammond 1995). Research into store choice has mostly concentrated on the behavioural aspects of store loyalty, such as: The average interval between store visits, the average expenditure, the average number of stores visited over a year, and how many customers shop at one store only once a year.

Theoretical Basis for Classification of Grocery Store Loyalty

The beginning of a behavioural perspective on loyalty appeared in the 1970s, after a period when the majority of researchers measured loyalty as a pattern of repeat purchasing. The most relevant of the models for measurement the grocery store loyalty is Oliver's four-stage loyalty model purchasing (Oliver, 1997). Oliver's four-stage loyalty model was produced in 1997 in a simplified form (see Figure 1). The objective a of developing model is for measuring the loyalty of the product or services. It has been generally modified for measuring consumer shopping

behaviour. This model is defined as a model, and consists of four stages: cognitive loyalty, affective loyalty, co native loyalty, and action loyalty.

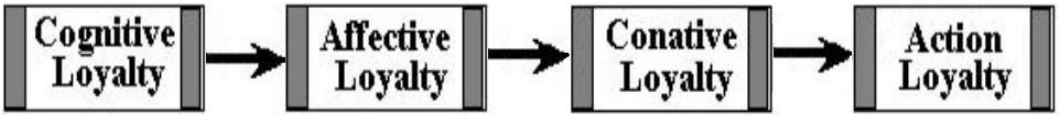

Figure 1 Shows the theory behind Olive's four-stage loyalty model Oliver's (1997).

Note. From *"Satisfaction A Behavioral Perspective on the Consumer,"* by Oliver, R. L, 1997, United States of America: The McGraw-Hill Companies, Inc.

The first stage is Cognitive loyalty. Loyalty at this stage is directed toward the services or products. The consumer in this stage has shallow loyalty. Because of this they are conscious of the store provision on costs and benefits. Their loyalty is not deep. For example, if another store is providing better prices, they will shop at that store. If satisfaction is processed, it becomes part of the consumer's experience and begins to take on affective overtones.

The second stage is Affective loyalty. The second stage of loyalty development, a linking or attitude toward the brand has developed on the basis of cumulatively satisfying usage occasions. This reflects the pleasure dimension of the satisfaction definition-pleasurable fulfillment-as previously described. Commitment at this stage is referred to as affective loyalty, and is encoded in the consumer's mind as cognition and affect. Whereas cognition is directly subject to counter argumentation, affect is not as easily dislodged towards the product or services. At the degree of affect (linking) for the brand is similar to cognitive loyalty. However, this form of loyalty remains subject to switching, as is evidenced by the data that show that large percentages of brand defectors claim to have been previously satisfied with their product or services. Thus, it would be desirable if consumers were loyal at a deeper level of commitment. In this stage we will use consumer evaluation of satisfaction to measure affective loyalty from the consumers.

The third stage: Conative loyalty**,** the next stage of loyalty development is the conative (behavioural intention) stage, as influenced by repeated episodes of positive affect toward the product or services. Conation, by definition, implies a product-specific commitment to repurchase. The consumer readiness to act is analogous with the deeply held commitment to rebuy or repatronise a preferred product/service consistently in the future. Co native loyalty, then, is a loyalty state that contains what, at first, appears to be the deeply held

commitment to buy, noted in the loyalty definition.

However, this commitment is to the intention to rebuy the product or services, and is more akin to motivation. In effect, the consumer desires to repurchase, but similar to any good intention, this desire may be an anticipated but unrealised action. In this stage we asked consumers how likely they are to recommend to other people and if they have an intention to repurchase measuring affective loyalty.

The fourth stage: Action loyalty, the finality of consumer loyalty, there exists action loyalty, which includes habit and routine response behaviour. Action is perceived as a necessary result of engaging both these stages. To measure consumer loyalty in the final stage we will ask the consumer about how often they do shopping at the grocery store.

Neural Networks Applications

Nowadays, only humans are the most intelligent living creatures in this earth. We could consider and compare their brains as the most complex and powerful computing system. It is truly amazing that, the power and speed of modern digital computers could to compute a billion operations a second (GHz). However, there are some tasks for which even the most powerful computers cannot compete with the human brain, perhaps not even with the intelligence of a worm snake

Until now, no one knows exactly how the brain has trained itself to process useful information, so many theories abound. In our human brain, a common ***neuron*** will collect many signals from other parts of the brain through a host of structures that are called "***Dendrites***". At the same time, the neuron will send out spikes of electrical activity through a long, thin stand known as an "***Axon***", which splits into thousands of branches. At the end of each branch, a structure called "***a Synapse***" converts the activity from the axon into electrical effects that inhibit or excite activity from the axon, into electrical effects that inhibit or excite activity in the connected neurones. When a neuron receives excitatory input that is sufficiently large compared with its inhibitory input, it sends a spike of electrical activity down its axon. Learning occurs by changing the effectiveness of the synapses, so that the influence of one neuron on another changes.

The common biological neurones can be divided into Dendrites, Cell body (soma), and Axons. Therefore, we could compare the operation system of the computer with the human brain by considering of the brain as an Input, Process, and Output function. The input functions will send signal into the central nervous system, which is the central processing unit. The signals from its environment will be sent to the human senses as the sensor, and

then to convert these signature signals into the impulse, as the electrical platform, before converging with the processing operation or the central nervous system.

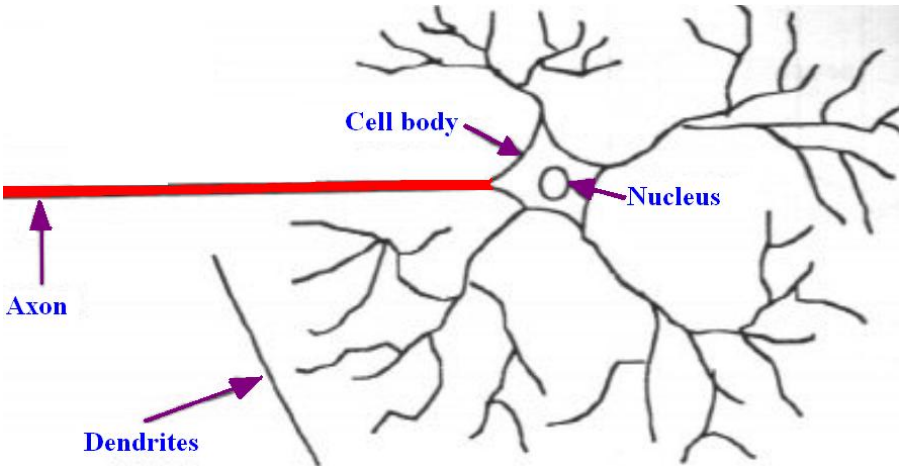

Figure 2 A drawing pattern of the typical neuron

Note. From *"Screw insertion Monitoring using Neural Network,"* by Poranut Wisuwan, 1999, Doctor of philosophy Thesis, King's College London, pp. 40-100.

During the last decade, the Artificial Neural Networks (ANNs) gained a lot of popularity. Although this use is new to a lot of application areas, the first ANNs were developed in 1958 by Frank Rosenblatt. This network was called the perceptron as Michiel C. Van Wezel and Walter R.J. Baets (1995) were present. Currently, ANNs are a successful simulation model that can be used to simulate the operating functions of the human brain. This ANNs has been used to present in the form of a training, learning, and testing process. The first generation of neural network aims to understand the ability of the human brain and compare its function as a set of interfaced nerve cell functions which are programmed to seek human knowledge. It is acquired by the ANNs through a process of learning from examples of brain (see Figure 2.)

The more sophisticate of ANNs.

At the early ANNs, the human neuron is not included in the conventional computers. A more sophisticated neuron in Figure 3 is the McCulloch and Pitts model (MCP). The difference from the previous model is that the inputs are 'weighted'; the effect that each input has at decision making, is dependent on the weight of the particular input. The weight of an input is a number which, when multiplied with the input, gives the weighted input. These weighted inputs are then added together, and if they exceed a pre-set threshold value, the neuron fires. In any other case, the neuron does not fire.

McCulloch and Pitts McCulloch and Pitts (1943), have introduced a logical calculus of the ideas immanent in nervous activity based upon the following:

1. beginnings of single cell recordings
2. no intracellular recordings
3. ionic and electrical basis of neural activity unclear
4. dominant observation: ``all or none action potential"
5. no understanding of how thought, intelligence, reasoning, etc., occurred in the neural substrate
6. models of intelligence largely based on logic

The addition of input weights and of the threshold makes this neuron a very flexible and powerful one. The MCP neuron has the ability to adapt to a particular situation by changing its weights and/or threshold. Various algorithms exist that because the neuron to 'adapt' and the almost every algorithm are the Delta rule and the back error propagation. Therefore, the former is used in feed-forward networks and the latter in feedback networks.

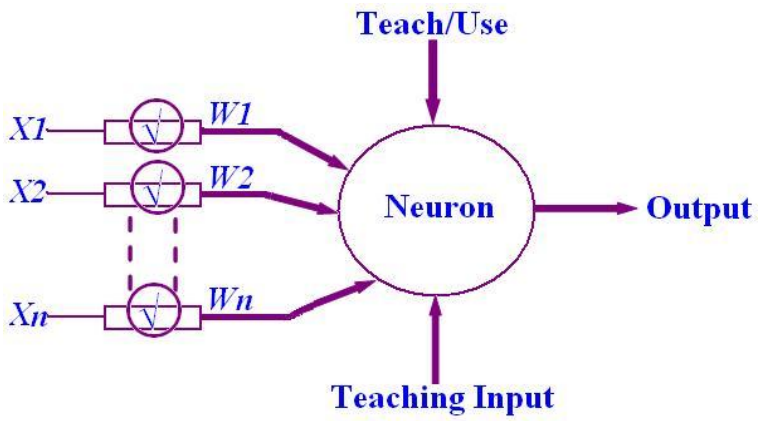

Figure 3 A McCulloch and Pitts's Neuron

Note. From *"Parameter estimation from real-time monitoring of threaded fastening,"* (p. 60-70), by Mongkorn Klingajay, 2005, octor of philosophy Thesis, King's College London.

In mathematical terms, the neuron fires if and only if; ***X1.W1 + X2.W2 +... Xn.Wn*** **> T**

The McCulloch-Pitts form had been generalised by the linear threshold law. His technique is present on the weights adjusted during the training of perceptron. It can be considered such as the following set of training vectors $\boldsymbol{X_1}$, $\boldsymbol{X_2}$, and $\boldsymbol{X_3}$, which are to be used later in training a Rosenblatt's perceptron:

$$x_1 = \begin{bmatrix} 1 \\ -2 \\ 0 \\ -1 \end{bmatrix}; \quad x_2 = \begin{bmatrix} 0 \\ 1.5 \\ -0.5 \\ -1 \end{bmatrix}; \quad x_3 = \begin{bmatrix} -1 \\ 1 \\ 0.5 \\ -1 \end{bmatrix}$$

With weights initialised as:

$$w = \begin{bmatrix} 1 \\ -1 \\ 0 \\ 0.5 \end{bmatrix}$$

The learning rate constant, γ, for the perceptron is set equal to 0.1. Therefore, the desired responses for the three vectors are expected to be:

Input	Desired
x_1	$d_1 = -1$
x_2	$d_2 = -1$
x_3	$d_3 = 1$

In Figure 3 Describes the learning, according to Rosenblatt's perceptron rule for each of the inputs x_1, x_2, and x_3 respectively. Show clearly the activation for each of the input patterns and, where necessary, show how the weights are being updated.

Research Methodology

This paper has classified demographics of Thai consumers into four groups, in terms of Oliver's four stages of loyalty: cognitive, affective, conative, and action. Demographic variables employed include age, status, income, education and occupation. Data collected from 250 shoppers in Thailand. Data was collected while they are doing shopping at the five leading grocery stores in Thailand such as Macro, Tops, Casino-BigC, Tesco-Lotus, and Carrefour. The technology is the application of artificial intelligence neural networks to marketing mix modeling. There is a compelling body of analysis which demonstrates the added value of neural net works when these neural nets are contrasted and compared to traditional statistics.

Bruce Greay Tedesco (1998), said that it was realistic to except any consumer purchase decision to be the result of the convergence of the relevant (to each individual consumer) elements of the marketing mix, e.g. product, image, price, etc. Models designed with neural networks are mathematically attuned to this type of relation

This classification has applied the Neural Network methodology in identifying its class. The hypothesized were formed that there are linked between demographic variables, where classified into four groups of loyalty variables by Oliver's four stages of loyalty. This model is shown in Figure 4.

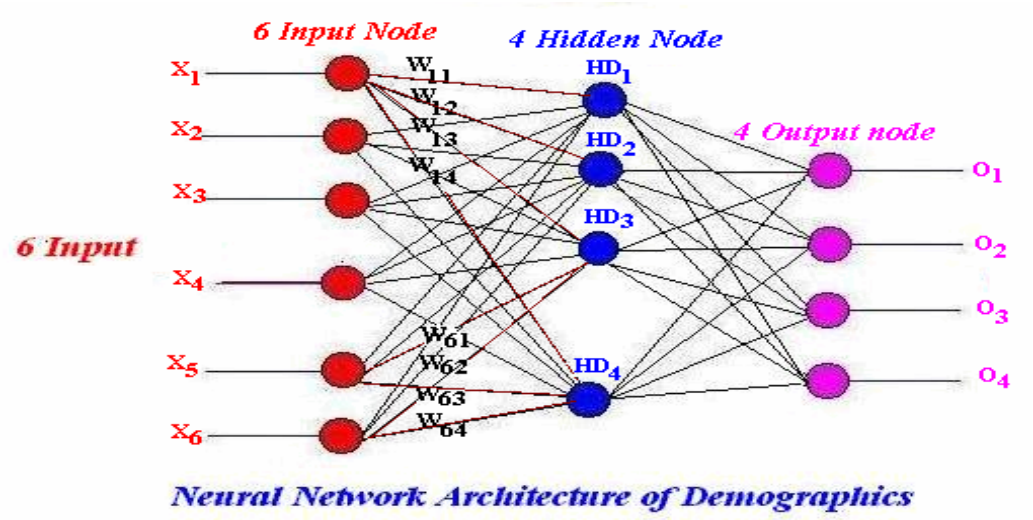

Figure 4 A Neural network model

Note. From *"Satisfaction A Behavioral Perspective on the Consumer,"* by Oliver, R. L, 1997, United States of America: The McGraw-Hill Companies, Inc.

The Figure4, shown the 6 Input nodes, 4 Hidden nodes, and 4 Output nodes. Neurons will depend on three main sections as follows:

1) W_{ij} is the Weights, which has the links to connect the unit either to other units or to the external environment. Each link is characterised by a W_{ij}. This will be associated with the i^{th} link of unit j. Therefore, the W_{ij} represents the way the network stores knowledge, and has a direct effect on the activation level of the neuron.

2) HD_k is the Activity point that every neurons has to combine the input information to form the weighted sum. Thus HD_k for neuron *k* can be described as:

$$HD_j = \sum_{i=1}^{n} X_i W_{ij} = X_{nj} W_{nj} \qquad (1)$$

Where $\boldsymbol{X_{nj}}$ will represent the vector of m (6 inputs) and $\boldsymbol{W_{nj}}$ the weights's vector, which are connected to neuron j. $\boldsymbol{HD_j}$ represents its internal process of activity.

3) The function $f(\cdot)$ is the activation function, that the internal process of activity will be pass on the third component of the unit. The activation function will produce the output for neuron j. Thus, the output is described in the above equations and replaced in the next equation.

$$O_j = f(HD_j). \quad (2)$$

The output information is passed on to other neurons or to the external environment. The sum in the $\boldsymbol{HD}_j$ equation is over all nodes j in the previous layer. Therefore, the output function is a non-linear function, which allows a network to solve problems that a linear network cannot solve. In this case the Sigmoid function, given in the equation, is used to determine the output state.

$$f(X_i) = \frac{1}{(1+\exp(-X_i)} \quad (3)$$

This is designed to reduce an error between the actual output and the desired output of the network in a gradient descent manner. The summed squared error (SSE) is defined as:

$$SSE = \frac{1}{2} (\sum_x \sum_y O_{xy} - C_{xy})^2 \quad (4)$$

Where x index stands for all the training patterns and y indexes stand for the output nodes of the network. O_{xy} and node of C_{xy} or the weight between Output ($\boldsymbol{O}_k$) and the Hidden node ($\boldsymbol{HD}_j$) denote the actual output and the desired output of node, respectively when the input vector x is applied to the network.

A set of representative input and output patterns is selected to train the network. The connection weights Wij are adjusted when each input pattern is presented. All the patterns are repeatedly presented to the network until the SSE function is minimized and the network "learns" the input patterns. An application of the gradient descent method yields the following iterative weight update rule:

$$\Delta W_{ij}(n+1) = \eta(\delta_i O_i + \alpha \Delta W_{ij}(n) \quad (5)$$

Where

Δ : is a factor of the learning.

α : is a factor of the momentum.

δi : is the node error for the output node, it is given as

$$\delta_i = (C_i - O_i) O_i (1-O_i) \quad (6)$$

Demographic Parameters

This model have used Demographic parameters as the 6 input

- *Age* is divided into 6 groups: 0-24, 25-34, 35-44, 45-54, 55-64, and 65+

- *Status*: is described as: single, married, divorced.

- *Income*: is measured into 5 groups:0-6000,6001-12,000, 12,001-30,000, 30,001-50,000, and over.

- *Education*: is described as primary-secondary-high school, diploma, bachelor, master, and doctoral.

- *Occupation*: is described as working full-time, part-time, owner, student, housewife, and unemployed.

- *Accommodation type*: is described as own house, rental, and stay with family, and other.

Characteristic of Loyalty Consumers

The Output will be characteristic of differences of Loyalty of consumers.

- *Group 1*: who are conscious of costs and benefits.

- *Group 2*: who are conscious of satisfaction.

- *Group 3*: who like to recommend to other people and repurchase.

- *Group 4*: who frequently visit.

Figure 5 presents the Artificial Intelligent Neural Networks (ANNS) to apply for Demographic Classification, based on Radial Basic Function (RBF) techniques. This schema is used to implement this application for four classification outputs on the Cognitive loyalty, Affective loyalty, Conative loyalty, and Action loyalty. These loyalties are against the four hidden nodes in hidden layers for statistic minimum value in each node, for the characteristic identification of each royalty on Cost & Benefits, Satisfaction, Recommend &Repurchase, and Frequencies of visit.

This paper has implemented the program using Matlab Software version 6.5 with Artificial Neural Networks (ANNs) technique based on Radial Basic Function (RBF) method. This Demographic Classification model has applied the technique on the schematic representation of Demographics in Figure 5 in implementation. The figures 6, 7, and 8 have presented the sequential input from the first data input to n number of inputs. In this experimental testing, the selected data set from questionnaires is being used in this input from 250 shoppers, who have visited the five superstores in Thailand (Macro, Tops, Casino-BigC, Tesco-Lotus, and Carefour).

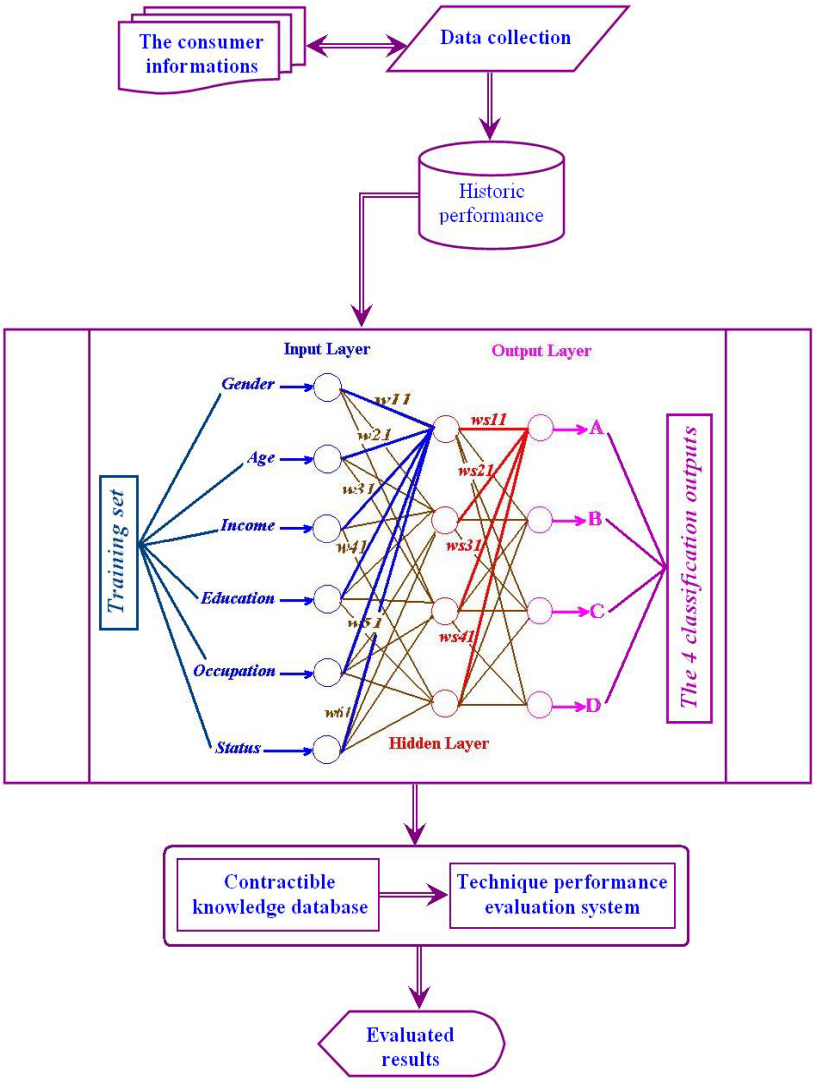

Figure 5 The schematic representation of the Demographics ANNs based on RBF technique

Note. From *"Satisfaction A Behavioral Perspective on the Consumer,"* by Oliver, R. L, 1997, United States of America: The McGraw-Hill Companies, Inc.

In Figures 6, 7, and 8 are presented the coding part for use in calculation by the Artificial Neural Networks (ANNs) algorithms in the implementation. This coding is followed from the Schema of the Demographic ANNs based on Radial Basic Function (RBF) technique. The user interface input for the number of data set has been used interactively in Figure 6.

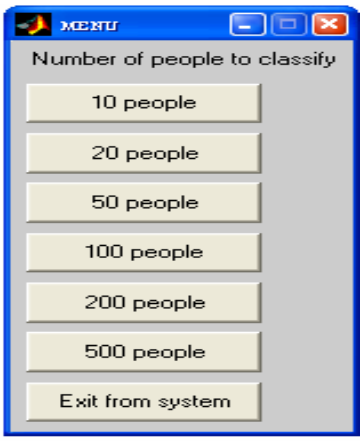

Figure 6 The number of data set

Note. From *"Satisfaction A Behavioral Perspective on the Consumer,"* by Oliver, R. L, 1997, United States of America: The McGraw-Hill Companies, Inc.

In Figure 7, the related significant inputs have been information from the selected data on their ages and incomes for this network for training and testing.

```
########   Process for Input for [1] person ###########
** Input Age ==> 45
** Input Income ==> 39000
########   Process for Input for [2] person ###########
** Input Age ==> 35
** Input Income ==> 24000
      :            :           :
      :            :           :
########   Process for Input for [200] person ###########
** Input Age ==> 200
** Input Income ==> 12000
```

Figure 7 The User interface for input details as Age and Income

Note. From *"Satisfaction A Behavioral Perspective on the Consumer,"* by Oliver, R. L, 1997, United States of America: The McGraw-Hill Companies, Inc.

The Graphic User interface (GUI) has been applied and represented as the menu, which is a choice of the data set during training and testing. The related significant input menu is presented in Figure 8, which has been selected from the data based on these network for training and testing tasks. These tasks are shown for Gender, Status, Education, and Occupation with following Figures 8 (a), (b), (c), and (d).

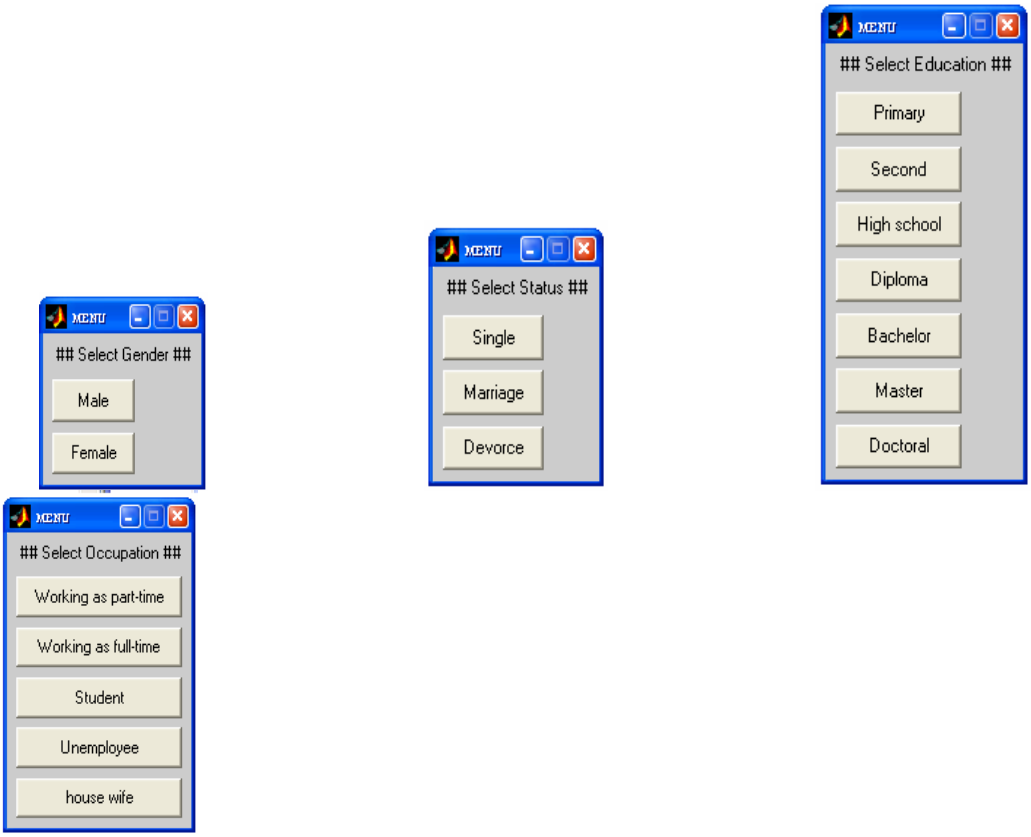

Figure 8 The GUI input for Gender, Status, Education, and Occupation.

Note. From *"Satisfaction A Behavioral Perspective on the Consumer,"* by Oliver, R. L, 1997, United States of America: The McGraw-Hill Companies, Inc.

(a):The gender input. **(b) The status input** **(c):The education input** **(d) The occupation input**

In Figures 9 and 10 are the achieved results after the ANNs training and testing process as RBF technique. The results from Hidden node1 – 4 are present in Figures 9 (a) and (b).

*	******** Hidden Node value ********		
	1.28		2.55
	2.26		1.03
Hidden Node [1]	0.89	Hidden Node [3]	2.27
	0.30		0.64
	0.66		1.18
	0.36		0.71
	1.39		1.21
	2.58		2.14
Hidden Node [2]	0.59	Hidden Node [4]	1.07
	0.09		0.31
	0.29		0.72
	0.12		0.34

Figure 9 The calculated Hidden nodes 1 - 4

Note. From *"Satisfaction A Behavioral Perspective on the Consumer,"* by Oliver, R. L, 1997, United States of America: The McGraw-Hill Companies, Inc.

(a):The calculated Hidden nodes 1 & 2 **(b): The calculated Hidden nodes 3 & 4**

The results for identifying the four classifications have been present in Figure 10. These output results will be used to predict the answer. The output shown that the results of 2.31, 0.17, 0.03, and 0.01* are classified as to Cognitive loyalty. The Affective loyalty is classified as the values of 0.18, 0.35, 0.07, and 0.03*. The results as 0.05, 0.09, 0.12, and 0.01* are included as to conative loyalty. The last result is present in the values of 0.02, 0.01, 0.14, and 0.05**, these values are classified in the Action loyalty class.

********** Output Node value **********

2.31 0.18 0.05 0.02
0.17 0.35 0.09 0.01
0.03 0.07 0.12 0.14
0.01 0.03 0.01 0.05

Figure 10 The results as Output Nodes

Note. From *"Satisfaction A Behavioral Perspective on the Consumer,"* by Oliver, R. L, 1997, United States of America: The McGraw-Hill Companies, Inc.

Table1 describes neural network weights between the six input nodes, four hidden nodes, and four output nodes. The values of the weights between the input, hidden and output as table 1 are presented as the results in Figures 9 and 10.

Table 1 Neural network Process

Input Node	Hidden Node				Output Node				Consumer Type
	1	2	3	4	A	B	C	D	
Age	1.28	1.39	2.55*	1.21	2.31*	0.18	0.05	0.02	1
Income	2.26*	2.58*	1.03	2.14*	0.17	0.35*	0.09	0.01	2
Status	0.89	0.59	2.27	1.07	0.03	0.07	0.12*	0.14	3
Education	0.30*	0.09*	0.64*	0.31*	0.01*	0.03*	0.01*	0.05**	4
Occupation	0.66	0.29	1.18	0.72					
Accommodation	0.36	0.12	0.71	0.34					

Note of table

The characters of output nodes (A, B, C and D), and hidden nodes number between 1 and 4, are Oliver's four stages of consumer loyalty, the name of which are the four stages of royalty are set out A, B, C, and D as follows :

A = Cognitive loyalty B = Affective loyalty

C = Conative loyalty D = Action loyalty

The type of consumer is following

1-Cost & Benefit 2-Satisfaction

3-Recommend & Repurchase - 4-Frequencies of visit -

The results in table 1 identifies on the customer in the Cognitive loyalty class. Costs are considered to be of great importance according to the values of 2.31. In the same way, they would not visit as frequently, we can see at the calculated value at 0.01. As they recognise, where they were shopping. Therefore, the customer in Cognitive loyalty is mapped in these behaviours. The customer in the affective loyalties will be group, who are satisfied with the products as the result of 0.35 is shown. However, there is no guarantee that they will visit more often according to value of 0.03. The value of 0.12 is present as Class C, which is shown that the customer in the Co native loyalty like to recommend their friends or repurchase again in the future. As the value of 0.14 and 0.01 in class D shown that the people in action loyalty will be a group. They are very like to recommend and repurchase without carring about their satisfaction as they already know this shop. This group will be sure to come back to visit again for buying.

Discussion

From six Input nodes to four hidden nodes weight

1. Neural network analysis shown the height positive (+) value of weight in every input node to hidden node. This pattern

shows the six demographics of Thai consumer variables is significantly related with four types of consumer, in terms of Oliver's four-stage loyalty model.

2. There were two input nodes had a very height value of network weight, which were *age* and *income*.

3. Input node incomes had a very height value of network weight in every hidden node, which were, 2.58, 1.03 and 2.14.

This mean every type of consumer was related to income

4. Input node age had a higher value of network weight in the third hidden nodes, which were 2.55.

5. The highest network value of input income was 2.26 with the first hidden node (cost and benefit). This means, consumer

who are conscious of costs and benefits, were conscious of income.

6. Among six input node, education had the lowest value of weight in every hidden node, where are 0.30, 0.09, 0.64, and 0.31.

This pattern described that demographic variable in term of "Education" has not related to the store loyalty in every stage.

From Four Hidden Nodes to Four Output Nodes Weight

1. The value of weight connection between the hidden node and the out put node was positive (+) in every node.

2. The important positive values of weight between hidden node and the out put node were 2.31, 0.35, 0.12 and 0.05

3. The two patterns above show that; the characteristic of loyalty consumer has significance related with Oliver's four stage loyalty. This mean the result had supported the Oliver' four stage loyalty model which had described that consumer who are conscious of cost and benefit name cognitive loyalty, consumer who are conscious of satisfaction name affective loyalty, consumer who like to recommend to other people and repurchase name conative loyalty, consumer who have frequencies of visiting name action loyalty

4. Among four hidden nodes, action loyalty have a lowest value of weight in every output nodes, where were 0.01, 0.03, 0.01, and 0.05. This can be concluded that consumer had very less loyalty, easily to switching to another store which offer more costs and benefits.

Conclusions

This paper utilized Oliver's (1997) methodology to classify the customers' demographics by using the neural network approach. The result of this study has presented four types of retail customers, where their classification was based on six demographic variables and four different types of customer loyalty. Data analysis indicates that it would be beneficial for multi national grocery retail companies in Thailand if they focus on the customers' demographic variables including *age* and *income* more than *status*, *education*, *occupation*, and *accommodation*.

References

Child, P., N., Heywood, S., & Kliger, M. (2002). The grocery brands include hypermarkets, supermarket, and discounters, the clothing brands, both specialist and department stores. *The Mckinsey Quarterly.* 1.

Cox, R & Brittain, P. (2000). *Retail Management.* Henry Ling Ltd: England.

East, R., Harris, P., Willison, G. & Lomax, W. (1995). Loyalty to supermarket. *International Review of Retail Distribution and Consumer research.* 5, pp. 99-109

Feeny, A. ,Vongpatanasin, T. & Soonsatham, A. (1996). Retailing in Thailand. *International Journal of Retail & Distribution Management. 24,* (8), pp. 38-44.

Gain Report. (2000). *Thailand retail food sector 2000.* Foreign Agricultural Service Gain Report #TH0116, 11/21/2000.

Gain Report. (2000). *United Kingdom retail food sector 2000.* Foreign Agricultural Service Gain Report #UK0046, 11/17/2000.

Gurney, K. (1997). *An Introduction to Neural Networks.* London: Routledge.

Haykin, S. (1999). *Neural Networks: A Comprehensive Foundation.* New York: Prentice Hall.

Key Note. (2001). *Supermarket & superstore.* [n.p.].

Kim, J., O. & Jin, B. (2001). Korean consumers' patronage of discount stores: domestic vs. multinational discount store shoppers' profiles. *Journal of consumer marketing, 18,* (3), pp. 236-255.

Lamey, J. (1997). *Retail opportunities in Indinesia, Malasia and Thailand.* London: FT Retail and Commercial Publishing Pearson Professional.

Lucas, G., H., Jr., Bush, R., P. & Larry G. (1994). *Gresham. Retailing.* New York: Houghton Miffin Company.

Mongkorn Klingajay & Sudaporn Sawmong. (2003). Demographic classification of the consumer by using Neuro-Fuzzy (DecNeF). *American Society Business and Behavioural Science (ASBBS 2003), 1 (1), (February, 2003)*, pp. 1411-1417.

Mongkorn Klingajay & Sudaporn Sawmong. (2004, September). British Retail Consumer Demographics Classification by Using Neural Network. *International Academy of Business & Public Administration Disciplines (IABPAD04), 1*, (1), pp. 1-10.

Mongkorn Klingajay, Sudaporn Sawmong & Ogenyi Omar. (2004, March). The classification of British retail consumer demographics based on neural network. *Journal of the International Academy of Business and Public Administration Disciplines (IABPAD'04), 1*, (1), pp. 1-10.

Mongkorn Klingajay. (2005). *Parameter estimation from real-time monitoring of threaded fastening.* Doctor of philosophy Thesis, King's College London, pp. 60-70.

Oliver, R. L, (1997). *Satisfaction A Behavioral Perspective on the Consumer.* New York: McGraw-Hill Companies, Inc.

Omar O., E. (1999). *Retail Marketing.* Harlow, England: Pearson Education.

Poranut Wisuwan. (1999). Screw insertion Monitoring using Neural Network. Doctor of Philosophy Thesis, King's College London, pp. 40 - 100.

Samli, A. C. (1998). Strategic Marketing of success in retailing, Quorum Books, Westport, CT. [n.p.].

Uncle, M. D. & Hammond, K., A. (1997). Modeling The Impact of Socio-Demographic Segmentation on Grocery Store Patronage", Center For Marketing Working Paper, London Business School. July 1997, pp. 97-603.