CHAPTER 1
INTRODUCTION

This research aims to develop a profiling methodology with reference to customer lifetime value, relationship, satisfaction and behavior using data mining techniques. The information technology growth has resulted in widespread usage of computers ranging from scientific, business, engineering design, to geographic applications. This varied usage of computer systems has provided an enormous amount of data at one’s disposal. Data is the input that exists in its raw form resulting in information for further processing. With huge amount of data, organizations faced the crucial challenge of extracting very useful information from them. This has led to the concept of data mining. Prediction of customer lifetime value, relationship, satisfaction and behavior can be extracted from the data that is typically stored in the database.

1.1 INTRODUCTION TO DATA MINING

Data mining is the non-trivial process of extraction of hidden, previously unknown and potentially useful information from large databases. It is a diverse field and encompasses concepts from statistics, database systems, machine learning, neural networks, information science, and so on. It is described as knowledge or extraction of knowledge discovery in databases. The process of data mining operates on raw input data (input) resulting in processed information (output). The purpose of data mining is used to identify trends and patterns in data. Data mining techniques are widely used information technology for extracting marketing knowledge and further supporting marketing decisions, Bose and Mahapatra (2001), Shaw et al. (2001).

Data mining is primarily used today by companies with a strong consumer focus - retail, financial, communication, and marketing organizations. It enables these companies to determine relationships among "internal" factors such as price, product positioning, or staff skills, and "external" factors such as economic indicators, competition, and customer demographics. It enables them to determine the impact on sales, customer satisfaction, and corporate profits. Finally, it enables them to "drill down" into summary information and to view detailed transactional data. With data mining, a retailer could use Point of Sale (POS) records of customer purchases to send targeted promotions based on an individual's purchase history. By mining demographic data from comment or warranty cards, the retailer could develop products and promotions to appeal to specific customer segments. The analysis
process starts with a set of data, uses a methodology to develop an optimal representation of the structure of the data during which time knowledge is acquired.

1.1.1 PHASES OF DATA MINING

Data mining is also viewed as an important step in the overall process of knowledge discovery, which is composed of many phases as shown in figure 1.1.

![Fig.1.1: Stages in the Knowledge Discovery in Database (KDD) Process](image)

The phases depicted start with the raw data and finish with the extracted knowledge, which was acquired as a result of the following stages:

- The first four phases perform data preprocessing, wherein data is prepared in a format that is suitable for further mining operations.
• Data cleaning removes noise and other inconsistent data, which are present in the database.
• Since the input database could be composed of data from multiple sources, data integration is used to integrate or merge data from various sources.
• Data selection phase identifies the specific data mining task-relevant data in the input database.
• The input database is transformed into a format suitable for data mining in the data transformation phase. The data is made usable and navigable.
• The patterns are evaluated for their interest or usability in the pattern evaluation phase.
• The patterns identified by the system are interpreted into knowledge, which can then be used to support human decision-making e.g. prediction and classification tasks, summarizing the contents of a database or explaining observed phenomena.
• The last step of the Knowledge Discovery in Database (KDD) process is the presentation of the discovered knowledge in a user-friendly format, referred to as the knowledge presentation phase.

1.1.2 IMPORTANCE OF DATA MINING

Large amount of data can be retrieved from various websites and databases. It can be retrieved in the form of data relationships, co-relations and patterns. With the advent of computers, Internet and large databases, it is possible to collect large amount of data. The data collected may be analyzed steadily and helped to identify relationships and find solutions to the existing problems. Governments, private companies, large organizations and all businesses are after large volume of data collection for the purposes of business and research development. With comprehensive customer data, data mining technology can provide business intelligence to generate new opportunities, Bortiz and Kennedy (1995), Fletcher and Goss (1993), Langley and Simon (1995), Salchenberger et al. (1992), Tam and Kiang (1992), and Zhang et al. (1999). The data can be stored for future use. Data mining services can be used for the following functions:

• **Research and surveys.** Data mining can be used for product research, surveys, market research and analysis. Information can be gathered that is quite useful in driving new marketing campaigns and promotions.
- **Information collection.** Through the web scraping process, it is possible to collect information regarding investors, investments and funds by scraping through related websites and databases.

- **Customer opinions.** Customer views and suggestions play an important role in the way a company operates. The information can be readily found on forums, blogs and other resources where customers freely provide their views.

- **Data scanning.** Data collected and stored will not be important unless scanned. Scanning is important to identify patterns and similarities contained in the data.

- **Extraction of information.** This is the processing of identifying the useful patterns in data that can be used in decision-making process. This is so because decision-making must be based on sound information and facts.

- **Pre-processing of data.** Usually the collection of data is stored in the data warehouse. This data needs to be pre-processed. It means some data that may be deemed unimportant may therefore be removed manually by data mining experts.

- **Web data.** Web data usually poses many challenges in mining. This is so because of its nature. For instance, web data can be deemed as dynamic meaning it keeps changing from time to time. Process of data mining should be repeated in regular intervals.

- **Competitor analysis.** There is a need to understand how competitors are faring on in the business market. We need to know both their weaknesses and strengths. Their methods of marketing and distribution can be mined. Overall cost reduction is also quite important.

- **Online research.** The Internet is highly regarded for its huge information. It is evident that it is the largest source of information. It is possible to gather a lot of information regarding different companies, customers and their business clients. It is possible to detect frauds through online means.

- **News.** Nowadays with almost all major newspapers and news sources posting their news online, it is possible to gather information regarding trends and other critical areas. In this way, it is possible to be in the better position of competing in the market.

- **Updating data.** This is quite important. Data collected will be useless unless it is updated. This is to ensure that the information is relevant so as to make decisions from it.
1.2 DATA MINING FUNCTIONS

Data mining functions may be classified by the function they perform or according to the class of application they can be used in.

1.2.1 CLASSIFICATION

Data mining tools have to infer a model from the database, and in the case of supervised learning, this requires the user to define one or more classes. The database contains one or more attributes that denote the class of a tuple and these are known as predicted attributes whereas the remaining attributes are called predicting attributes. A combination of values for the predicted attributes defines a class.

When learning classification rules the system has to find the rules that predict the class from the predicting attributes. So firstly, the user has to define conditions for each class, the data mine system then constructs descriptions for the classes. Basically the system should be given a case or tuple with certain known attribute values so as to predict what class this case belongs to.

Once classes are defined, the system should infer rules that govern the classification therefore the system should be able to find the description of each class. The descriptions should only refer to the predicting attributes of the training set so that the positive examples should satisfy the description and none of the negative. A rule is said to be correct if its description covers all the positive examples and none of the negative examples of a class. The categories of rules are:

- Exact rule - permits no exceptions so each object of left hand side (LHS) must be an element of right hand side (RHS).
- Strong rule - allows some exceptions, but the exceptions have a given limit.
- Probabilistic rule - relates the conditional probability $P (\text{RHS}|\text{LHS})$ to the probability $P (\text{RHS})$.

Other types of rules are classification rules where LHS is a sufficient condition to classify objects as belonging to the concept referred to in the RHS.
1.2.2 ASSOCIATIONS

Another data mining technique that is used to identify new customers is association. Given a collection of items and a set of records, each of which contain some number of items from the given collection, an association function is an operation against this set of records which return affinities or patterns that exist among the collection of items. Associations can involve any number of items on either side of the rule. The data about a customer consistently revealing preferences to a certain mix of goods or services provides information about which associated products the customer is more likely to buy. The classic case of market basket analysis is an example for identifying associations. For example, an online store, which analyzes the shopping baskets of their customers can better personalize their advertisement campaigns and increase sales. On the other hand, an online store can anticipate what its customers would need and suggest other products. While association allows organization to cross-sell, it also helps in deciding warehouse layouts, which is a very popular application of data mining with the grocery and retail store chains.

1.2.3 SEQUENTIAL / TEMPORAL PATTERNS

Sequential / temporal pattern function analyses a collection of records over a period of time. The records are related by the identity of the customer who did the repeated purchases. A sequential pattern function will analyze such collections of related records and will detect frequently occurring patterns of products bought over time.

Sequential pattern mining functions are quite powerful and can be used to detect the set of customers associated with some frequent buying patterns. For example, a set of insurance claims can lead to the identification of frequently occurring sequences of medical procedures applied to patients, which can help identify good medical practices as well as to potentially detect some medical insurance fraud.

1.2.4 CLUSTERING AND SEGMENTATION

Clustering and segmentation are the processes of creating a partition so that all the members of each set of the partition are similar according to some metric. A cluster is a set of objects grouped together because of their similarity or proximity. Objects are often decomposed into an exhaustive and/or mutually exclusive set of clusters. When learning is unsupervised, then the system has to discover its own classes i.e. the system clusters the data in the database. The system has to discover subsets of related objects in the training set and
then it has to find descriptions that describe each of these subsets. There are a number of approaches for forming clusters. One approach is to form rules, which dictate membership in the same group based on the level of similarity among members. Another approach is to build set functions that measure some property of partitions as functions of some parameter of the partition.

1.3 DATA MINING TECHNIQUES

Data mining techniques can be broadly classified as being either descriptive or predictive. Descriptive tasks are those that perform characterization of properties of the input database. Predictive data mining techniques are those that perform inference on input data to arrive at hidden knowledge and make useful predictions.

1.3.1 CLUSTER ANALYSIS

In an unsupervised learning environment, the system has to discover its own classes. Figure 1.2 shows the clusters and descriptions in a database. The first step is to discover subsets of related objects and then find descriptions e.g. D1, D2, D3 etc. which describe each of these subsets.

![Diagram of clusters and descriptions](image)

**Fig.1.2: Discovering Clusters and Descriptions in a Database**

Clustering and segmentation basically partition the database, so that each partition or group is similar according to some criteria or metric. Clustering according to similarity is a concept, which appears in many disciplines. If a measure of similarity is available, there are a number of techniques for forming clusters. Membership of groups can be based on the level of similarity between members and from this the rules of membership can be defined. Clustering according to optimization of set functions is used in data analysis e.g. when setting
insurance tariffs, the customers can be segmented according to a number of parameters and
the optimal tariff segmentation achieved.

Clustering and segmentation in databases are the processes of separating a data set
into components that reflect a consistent pattern of behavior. Once the patterns have been
established, they can then be used to "deconstruct" data into more understandable subsets and
also they provide sub-groups of a population for further analysis or action, which is important
when dealing with very large databases. For example, a database could be used for profile
generation for target marketing where previous response to mailing campaigns can be used to
generate a profile of people who responded and this can be used to predict response and filter
mailing lists to achieve the best response.

1.3.2 INDUCTION

A database is a store of information but more important is the information, which can
be inferred from it. There are two main inference techniques available i.e. deduction and
induction.

- Deduction is a technique to infer information that is a logical consequence of the
  information in the database e.g. the join operator applied to two relational tables
  where the first concerns employees and departments and the second departments and
  managers infers a relation between employee and managers.
- Induction has been described earlier as the technique to infer information that is
  generalized from the database as in the example mentioned above to infer that each
  employee has a manager. This is higher-level information or knowledge in that it is a
  general statement about objects in the database. The database is searched for patterns
  or regularities.

Induction has been used in the following ways within data mining:

1.3.2.1 DECISION TREES

Decision trees are simple knowledge representation and they classify examples to a
finite number of classes, the nodes are labeled with attribute names, the edges are labeled
with possible values for this attribute and the leaves labeled with different classes. Objects
are classified by following a path down the tree, by taking the edges, corresponding to the
values of the attributes in an object.
1.3.2.2 RULE INDUCTION

A data mine system has to infer a model from the database that is it may define classes such that the database contains one or more attributes that denote the class of a tuple i.e. the predicted attributes while the remaining attributes are the predicting attributes. Class can then be defined by condition on the attributes. When the classes are defined the system should be able to infer the rules that govern classification, in other words the system should find the description of each class.

Production rules have been widely used to represent knowledge in expert systems and they have the advantage of being easily interpreted by human experts because of their modularity i.e. a single rule can be understood in isolation and doesn't need reference to other rules.

1.3.3 NEURAL NETWORKS

Neural networks are an approach to computing that involves developing mathematical structures with the ability to learn. The methods are the result of academic investigations to model nervous system learning. Neural networks have the remarkable ability to derive meaning from complicated or imprecise data and can be used to extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques. A trained neural network can be thought of as an "expert" in the category of information it has been given to analyze. This expert can then be used to provide projections given new situations of interest and answer "what if" questions.

Neural networks have broad applicability to real world business problems and have already been successfully applied in many industries. Since neural networks are best at identifying patterns or trends in data, they are well suited for prediction or forecasting needs including:

- Sales forecasting
- Industrial process control
- Customer research
- Data validation
- Risk management
- Target marketing etc.,
Neural networks use a set of processing elements (or nodes) analogous to neurons in the brain. These processing elements are interconnected in a network that can then identify patterns in data once it is exposed to the data, i.e. the network learns from experience just as people do. This distinguishes neural networks from traditional computing programs that simply follow instructions in a fixed sequential order. The structure of a neural network is shown in figure 1.3.

The bottom layer represents the input layer, in this case with 5 inputs labels X1 through X5. In the middle is something called the hidden layer, with a variable number of nodes. It is the hidden layer that performs much of the work of the network. The output layer in this case has two nodes, Z1 and Z2 representing output values we are trying to determine from the inputs. For example, predict sales (output) based on past sales, price and season (input). Each node in the hidden layer is fully connected to the inputs which mean that what is learned in a hidden node is based on all the inputs taken together.

1.3.4 ON-LINE ANALYTICAL PROCESSING

A major issue in information processing is how to process larger and larger databases, containing increasingly complex data. The client/server architecture gives organizations the opportunity to deploy specialized servers, which are optimized for handling specific data management problems. Until recently, organizations have tried to target Relational Database
Management System (RDBMS) for the complete spectrum of database applications. It is however apparent that there are major categories of database applications which are not suitably serviced by relational database systems.

1.3.5 DATA VISUALIZATION

Data visualization makes it possible for the analyst to gain a deeper, more intuitive understanding of the data and as such can work well alongside data mining. Data mining allows the analyst to focus on certain patterns and trends and explore in-depth using visualization. On its own data the volume of data in a database can overwhelm visualization but in conjunction with data mining can help with exploration.

1.4 CUSTOMER RELATIONSHIP MANAGEMENT

The concept of Customer Relationship Management (CRM) has pervaded several industries in the past decade. The focus of companies has shifted from treating customers as just an entity involved in the business process to treating them as a crucial component of their success. Companies have been interested in actively developing relationships with targeted customers because they are becoming increasingly aware of the potential benefits provided by CRM. Customer Relationship Management is often considered as database marketing of the organization with the database of the customers. It takes a holistic view over customers.

The focus of CRM is to build closer and deeper relationships with customers. Existing customers are more profitable than new customers; that it is less expensive to cross-sell incremental products to existing customers. Since attracting new customers is expensive, retaining customers is essential. Matching products and levels of service more closely to customers’ expectations would maximize customer retention. The central objective of CRM is thus to maximize the lifetime value of a customer to the organization. CRM puts emphasis on the coordination of such measures, also implying the integration of customer-related data, meta-data and knowledge and the centralized planning and evaluation of measures to increase customer lifetime value. It comprises a set of processes and enabling systems supporting a business strategy to build long term, profitable relationships with specific customers. It gains in importance for companies that serve multiple groups of customers and exploit different interaction channels for them. This is due to the fact that information about the customers, which can be acquired for each group and across any channel, should be integrated with existing knowledge and exploited in a coordinated fashion.
The customer life cycle has three stages. Data mining can improve the profitability in each of these stages through integration with operational CRM systems or as independent applications.

a) Acquiring customers.

b) Increasing the value of customer.

c) Retaining good customers.

1.4.1 SCOPE OF CRM

The scope of customer relationship management is as follows:

- Acquiring and continuously updating knowledge about customer needs, motivations and behavior over the lifetime of the relationship.
- Measuring both inputs across all functions including marketing, sales and service costs and outputs in terms of customer revenue, profit and value.
- Applying customer knowledge to continuously improve performance through a process of learning from successes and failures.
- Implementing appropriate systems to support customer knowledge acquisition, sharing and measuring CRM effectiveness.
- Constantly flexing the balance between marketing, sales and service inputs against changing customer needs to maximize profit.

1.4.2 CRM DIMENSIONS

CRM consists of four dimensions, which can be seen as a closed cycle of a customer management system. They share the common goal of creating a deeper understanding of customers to maximize customer value to the organization in the long term.

- Customer Identification
  This phase involves targeting the population who are most likely to become customers or most profitable to the company. Moreover, it involves analyzing customers who are being lost to the competition and how they can be won back. Elements for customer identification include target customer analysis and customer segmentation. Target customer analysis involves seeking the profitable segments of customers through analysis of customers’ underlying characteristics, whereas customer segmentation involves the subdivision of an entire customer base into smaller customer groups or segments, consisting of customers who
are relatively similar within each specific segment.

- **Customer Attraction**
  
  After identifying the segments of potential customers, organizations can direct effort and resources into attracting the target customer segments. An element of customer attraction is direct marketing. Direct marketing is a promotion process, which motivates customers to place orders through various channels. For instance, direct mail or coupon distributions are typical examples of direct marketing.

- **Customer Retention**
  
  This is the central concern for CRM. Customer satisfaction, which refers to the comparison of customers’ expectations with his or her perception of being satisfied, is the essential condition for retaining customers. Loyalty programs involve campaigns or supporting activities, which aim at maintaining a long-term relationship with customers.

- **Customer Development**
  
  This involves consistent expansion of transaction intensity, transaction value and individual customer profitability. Elements of customer development include customer lifetime value analysis, cross selling and market basket analysis. Customer lifetime value analysis is defined as the prediction of the total net income, a company can expect from a customer. Market basket analysis aims at maximizing the customer transaction intensity and value by revealing regularities in the purchase behavior of customers.

### 1.5 CUSTOMER PROFILING METHODOLOGY

One part of the profile contains facts about a customer, and the other part contains rules describing that customer’s behavior. The data mining methods are used to derive the behavioral rules from the data.

Applications use various kinds of data about individual customers. Many applications classify the data into two basic types: factual—who the customer is— and transactional—what the customer does. For example, the factual data includes demographic information such as name, gender, birth date, address, salary, etc. Transactional data consists of records of the customer’s purchases during a specific period. A purchase record might include the purchase date, product purchased, amount paid, coupon use, coupon value, and discount applied etc.
Personalization begins with collecting customer data from various sources. This data might include histories of customers’, web purchasing and browsing activities, as well as demographic and psychographic information. After the data is collected, it must be prepared, cleaned, and stored in a data warehouse. A key issue in developing personalization applications is constructing accurate and comprehensive customer profiles based on the collected data. Statistical customer profiling along with demographic, geographic, and psychographic variables is a widely practiced technique in business. For example, it can be used to determine premium rates in insurance industry. Or it can be used to identify top customers who provide highest revenues or to identify customers who may be on risk of losing in customer retention. Better understanding through profiling can lead to better marketing plans. In customer profiling, we need to identify the following parameters:

- What benefit does the customer seek?
- What factors influence demand for the product?
- What are the important criteria for customers’ choosing this particular product?
- How do customers buy?
- How much are they willing to spend?
- How often do they buy?
- How much do they buy?
- Where do customers seek information about the product?
- Where do customers buy the product?
- Why do customers buy this product?
- Why do customers choose one brand as opposed to another?
- Who buys our products and why?
- Who buys our competitors' products and why?

Customer profiling helps to find out the potential customers. This will help the client to move 'no purchase' level to 'little purchase' level and 'little purchase' level to 'heavy purchase' level. Purchase pattern helps the client to understand the influential factors and barriers of purchase. From the customer profiling methodology, we can:

- Get the list of prospective customers.
- Send information / communication only to relevant people.
- Identify top customers.
- Increase customer retention and sales.
• Find out unwanted (unprofitable) customers.
• Formulate better plans.

Potential customers can be identified which will help the client to increase the effectiveness of promotional activities targeted towards them. The customer profiling methodology contains 4 important steps.

**Step 1:** Profiling information consists of many variables from five face model. The figure 1.4 shows the five face model of customer profiling.

- **Demographic profiling variables** describe characteristics of customers and include age, gender, education, occupation, income, religion, marital status, family size, children, home ownership, socioeconomic status, and so on.
- **Geographic variables** include various classifications of geographic areas, for example, zip code, state, country, region, climate, population, and other geographical census data.
- **Psychographic profiling variables** describe customers’ life style, personality, values, attitudes, and so on.
- **Behavioral variables** include product usage rate, brand loyalty, benefit sought, decision-making units, ready-to-buy stage, and so on. This information can be extremely useful for marketing purposes.
- **RFM:** Recency, frequency and monetary values.

**Step 2:**
- Patterns are formulated using the identified characteristics from the five face model. We need to segregate primary and secondary characteristics influencing buying behavior.

**Step 3:**
- Evaluate each customer on these key characteristics.

**Step 4:**
- The customer model is designed. It identifies the type of customers.
- The Z Customer: Contributes highest profits and having high growth opportunity.
- The Y Customer: This is large customer base in the business with stable growth rate or with long term potential to grow.
- The X Customer: Shrinking or no growth is expected out of this pool of customers who will fade away from the segment.
1.6 CUSTOMER LIFETIME VALUE

Customers of the company should be loyal. They have to buy the products or services of the company repeatedly. The core parts of CRM activities are to understand customers’ profitability and retain profitable customers. To cultivate the full profit potentials of customers, many companies already try to measure and use customer value in their management activities. The most critical factors that determine a company’s success or failure are evaluating customer’s lifetime value and retaining the most valuable customers. The CLV is the Net Present Value (NPV) of the future profit that can be created at a particular duration. CLV is used to identify profitable customers and to develop good strategies to target customers.

The value of a customer changes during their established relationship with an organization. Customers vary extensively in a range of attributes including product preferences, price sensitivity, cost-to-serve, and retention rates. As a result of these factors, customers differ widely in the value they represent to an organization. CLV represents the present value of the expected benefits less the costs of initializing, maintaining and
developing the customer relationship. CLV measurement is essential for developing and maintaining long-term profitable customer relationships. It is fundamental for customer acquisition and retention decisions.

Customer lifetime value using Recency, Frequency and Monetary (RFM) method is used to find target customers. Customer data usually consists of many variables. There is a large amount of research that suggests RFM variables appear to be a good source for predicting customer behavior. Recency variables store information regarding the timeframe between purchases or use of service. A lower value suggests a higher probability of the customer making a repeat purchases. Frequency variables are those connected to how often the service is used. In general it can be assumed that the higher the frequency, the more satisfied the customer is with the service. A monetary variable for a customer would be the total sum of money a customer spends on his/her services over a certain time period. Those customers with high monetary values are the ones and organization should be most interested in retaining.

1.7 SCOPE OF THE PRESENT WORK

This research aims to develop a customer profiling methodology with reference to customer lifetime value, relationship, satisfaction and behavior using data mining techniques. The proposed methodology helps to maximize the customers and identifies a potential loss of customer at the earliest possible point.

Content analysis has been used to analyze text data. It is used to transform unstructured customer service information into structured customer service data. ANFIS model is used to discover customer knowledge. CLV using recency, frequency, monetary and term method is used to find target customers. Clustering analysis can locate high value customers. Based on the result of clustering analysis, the number of target customers with high loyalty, high interest, and a high amount of purchase can be identified. Customer satisfaction can be improved with the help of the expert system developed by using Artificial Neural Networks. The expert system’s role is to capture the knowledge of the experts and the data from the customer requirements, and then, process the collected data.

Prediction is done using the previous transactions of the customers and data is estimated using clustering and association rules. The customers with similar purchasing behavior are first grouped by means of clustering techniques. Finally, for each cluster, an
association rule extractor is used to identify the products that are frequently bought together by the customers from each segment. CARMS architecture has been proposed to predict sales at different location. The system involves different consecutive stages communicating with one another in generating rules as the data pre-processing and data partitioning, data transformation, and association rule mining.

1.8 ORGANIZATION OF THE THESIS

Chapter 1 provides the background to this research and briefly describes the context of this research. The scope of the present work is defined.

Chapter 2 provides a literature survey. An extensive literature survey is carried out as part of this research in order to analyze the profiling methodology using data mining techniques. The literature moves into a discussion regarding customer lifetime value, relationship, satisfaction and behavior.

Chapter 3 discusses about content analysis, which transforms unstructured textual content into structured data. This is used to find ways to analyze text data in order to discover more latent knowledge. ANFIS model is used to discover the customer knowledge effectively.

Chapter 4 discusses a framework for customer lifetime value. Customer lifetime value using RFMT method is used to find target customers. Based on the result of clustering analysis, the number of target customers with high loyalty, high interest, and a high amount of purchase can be identified. Clustering customers into different groups not only improves the quality of recommendation but also helps decision-makers identify market segments more clearly and thus develop more effective strategies.

Chapter 5 discusses about customer satisfaction. Customer satisfaction can be improved with the help of the expert system developed by using Artificial Neural Networks. In order to identify the hidden pattern of the customer’s needs, the Artificial Neural Networks technique has been applied to classify the products based upon a list of selected information. In addition, the expert system has been validated with a different customer types.

Chapter 6 discusses about the customer behavior. The customers with similar purchasing behavior are first grouped by means of clustering techniques. Finally, for each cluster, an association rule extractor is used to identify the products that are frequently bought
together by the customers from each segment. Clustering analysis is a data mining technique that maps data objects into unknown groups of objects with high similarity.

Chapter 7 discusses the methodology based on the integration of data mining approaches such as clustering and association rule mining.

Chapter 8 discusses the profiling methodology with reference to customer lifetime value, relationship, satisfaction and behavior using data mining techniques.

Chapter 9 concludes with a discussion on the generality of this research, contribution to knowledge, and limitations of the research methodology. Future research directions that could follow from this research are discussed and finally conclusions are presented.