CHAPTER 1
INTRODUCTION

1.1. OVERVIEW

In today’s dynamic marketplace, telecommunication organizations, both private and public, are increasingly leaving antiquated marketing philosophies and strategies to the adoption of more customer-driven initiatives that seek to understand, attract, retain and build intimate long term relationship with profitable customers (Asiedu and Safo, 2013; Kotler and Kelvin, 2006). This paradigm shift has undauntedly led to the growing interest in Customer Relationship Management (CRM) initiatives that aim at ensuring customer identification and interactions, customization and personalization that unreservedly lead to customer satisfaction, retention and profitability, among other additional business benefits (Thompson, 2004; Ryals and Knox, 2001).

In the 21st century, organizations are increasingly being more customer-centric and are much interested not in just acquiring new customers, but, more importantly, also in retaining existing customers. The reason behind is the fact that it costs more to attract new customers than to retain existing ones (Ozdemir and Caliskan, 2013). It is believed that an average business spends six times more to attract new customers than to retain old customers (loyal customers) (Lakshmi et al., 2011). Consequently, it is more profitable to direct an old customer to re-use the company services and recommend them to others. Retaining old customers require the identification of weak customers, who might move to competitors.

Telecommunication industry is one of the many companies that are experiencing more and more competitions in recent years. The battle over valuable customers along with massive industry deregulation across the world, each customer is facing an ever-growing number of choices and freebies. As a result, an increasing number of customers are switching from one service
provider to another. This phenomenon is called customer “churning” or “attrition,” which is a major problem for these companies and makes it hard for them to stay profitable (Yang et al., 2005).

Identification of churners is a challenging task and as markets have become increasingly saturated, global telecommunications service companies have acknowledged that managing customer churn is of great concern. It is becoming a more serious problem as the market matures. It has been estimated that the annual churn rate ranges from 20% to 40% in most of the global mobile telecommunications service companies (Ahn et al., 2006; Kim et al., 2004). Customer churn adversely affects these companies because apart from losing potential customer, they also stand to lose a great deal of price premium, thus decreasing the profit levels.

The urgent market requirement, is to identify automated methods that can assist businesses in the complex task of predicting customer churning. Studies indicate that a five percent improvement in customer retention can increase profits by 85% (Parker et al., 2009). This highlights the supreme importance of encouraging customer loyalty and avoiding customer churns.

Maintaining customer loyalty and churn have become necessary articles of trade in telecommunication industries, so that proactive retention campaigns can be deployed in a bid to retain them. As retention campaigns are costly and time consuming, careful planning is required. To a great extent, this cost can be reduced by using data mining techniques that perform actions based on discovered knowledge. The immediate requirement of the market is to have systems that can perform accurate

(i) identification of loyal customers (so that companies can offer more services to retain them)

(ii) prediction of churners to ensure that only the customers who are planning to switch their service providers are being targeted for retention
(iii) Knowledge discovery to suggest actions that changes customers from an undesired status (such as churners) to a desired one (such as loyal) while maximizing an objective function which is the expected net profit.

To design and develop such systems, this research work combines data mining algorithms and decision making by formulating the decision making problems directly on top of the data mining results in a post processing step. These systems can discover loyal customers, churning customers and can produce a set of actions that can be applied to transform churning customers to loyal customers. These systems can effectively produce intelligent CRM for telecommunication industries. This chapter presents an introduction to the various topics related to the topic of research.

1.2. CUSTOMER RELATIONSHIP MANAGEMENT (CRM)

Customer Relationship Management (CRM) is a broadly recognized and widely implemented strategy for managing and nurturing a company’s interactions with customer’s clients and sales prospects. It is defined as the approach of identifying, establishing, maintaining and enhancing lasting relationships with customers (Zentes et al., 2012). CRM is mainly concerned with the formation of bonds between a company and its customers.

The main goal of CRM is to aid organizations in better understanding of each customer's value to the company, while improving the efficiency and effectiveness of communication. CRM captures, analyzes, and distributes all relevant data from customer and prospect interactions to everyone in the organization. This distribution of information helps an organization better meet customer, product, and service needs. In IT sector, CRM is defined as methodologies, software and internet capabilities that help an organization to manage customer relationship in an organized manner. It is one of the most helpful analysis task used by companies to maintain loyal customers.
CRM has replaced traditional marketing techniques that focused on key marketing mix of elements, such as product, price, promotion and place. By being too functionally-based, traditional marketing techniques neglected the customer in the after-sales process and failed to meet customers' desires. CRM emphasizes customer retention over customer acquisition and is recognized as one of the most viable tools used to further a company's success in the highly competitive business world by improving customer satisfaction.

There are three major areas that focus on customer satisfaction: sales, marketing, and service. The functionality of and between these three fields is essential to successfully connect a company's front and back offices to facilitate effective, enterprise-wide coordination. The professional sales force predicts and proposes the real-time analysis of information and distributes this information to the company and business partners. Marketing concentrates on personalizing customer preferences and offering them satisfying experiences. Service is associated with the companies' call centers and coordinates interaction between Web, e-mail, and other communication medium. These fields are developed further with the help of CRM automation. A well-designed CRM includes the following characteristics (http://en.wikipedia.org/wiki/Customer_relationship_management#Characteristics_of_CRM):

- **Relationship management**: This feature is a customer-oriented feature with service response based on customer input, one-to-one solutions to customers’ requirements, direct online communications with customer and customer service centers that help customers solve their questions.

- **Sales force automation**: This function can implement sales promotion analysis, automate tracking of a client’s account history for repeated sales or future sales, and also coordinate sales, marketing, call centers, and retail outlets in order to realize the sales force.

- **Use of technology**: This feature is about following the technology trend and skills of value delivering using technology to make “up-to-the-second” customer data available. It applies data warehouse technology in order to...
aggregate transaction information to merge the information with CRM solutions, and to provide (Key Performance Indicators) KPI.

- **Opportunity management**: This feature helps the company to manage unpredictable growth and demand and implement a good forecasting model to integrate sales history with sales projections (Zeng et al., 2003).

The bottom-line of CRM work flow (Figure 1.1) is to initiate marketing, process sales, schedule orders and provide support.

![Figure 1.1: Work Flow of Customer Relationship Management (CRM)](http://www.zoho.com/crm/how-crm-works.html)

CRM strategies involved customer acquisition, customer retention, customer loyalty, customer evangelism and cost reduction through improved productivity. For these strategies, the CRM compiles information from various sections of a company and analyzes them so as to identify two groups of customers, such as the best and potential (loyal) customers and the weak customers (churners) who might move their businesses to competitors and using this information to build strategies (actions) to maximize net profits. Identification of these two groups of customers can then be used by the companies to
maximize repeat business opportunities by anticipating the existing customers’ needs.

- identify complementary products that can be sold to the customers.
- target marketing campaigns/materials and promotions

There are three aspects of CRM that can be used. They are operational CRM, Analytical CRM and Collaborative CRM. Operational CRM is concerned with analyzing and improving operations like (i) marketing automation, (ii) sales force automation and (iii) customer service and self-service. Analytical CRM, uses data warehousing and data mining techniques, to improve company-customer relationships. Collaborative CRM, as the name suggests, integrates operation CRM with analytical CRM.

Data mining techniques like classification and clustering are currently used to construct customer profiles to predict the characteristics of customers of certain classes. However, to improve customer relationship, the enterprise must know what actions to take to change customers from an undesired status (such as churners) to a desired one (such as loyal customers). In current scenario, telecom industries focus more on customer knowledge than actionable knowledge. This research work focuses on both these tasks and proposes techniques to improve the process of customer loyalty and actionable knowledge extraction. This chapter presents the introductory materials related to the research topic.

1.3. CRM AND TELECOM INDUSTRY

Indian Telecom Market is one of the fastest growing markets worldwide and currently, there are around 926.55 million telephone connections (Gawad and Murumalla, 2013). It is considered as the second largest wireless network in the world offering various services like wire line services, mobile services, national/international long distance services, broadband and internet services and prepaid calling card services. Telecom is a huge and varied bastion of technologies, companies, services and politics that is truly global in nature. In
Telecom industries customer service is key to sales and loyalty and customer service has become the differentiator between its competitors (Rai, 2013).

There are several advantages provided by CRM strategies to telecom industries (Kumar et al., 2010). Some of them are listed below.

(i) tightly integrate front office (customer facing) and back-office (business processes) operations
(ii) deliver superior customer service
(iii) eliminate boundaries that stand between the company and its customers
(iv) add value across the company.

These advantages in turn help to increase revenue, cut costs, boost customer satisfaction and turn the company into a responsive, customer-centric player.

Telecom industries use data mining techniques with the aim of constructing customer profiles, which predict the characteristics of customers of certain classes. Examples of these classes are:

- What kind of customers (described by their attributes such as age, income, etc.) are likely attritors (who will go to competitors), and
- what kind are loyal customers?

This knowledge is useful but it does not directly benefit the enterprise. However, to improve customer relationship, the enterprise must know what actions to take to change customers from an undesired status (such as attritors) to a desired one (such as loyal customers). In current scenario, telecom industries focus more on customer knowledge than actionable knowledge. This research work focuses on both these tasks and proposes techniques to improve customer churn and loyalty analysis and to discover actionable knowledge from these results. An introduction to these areas is presented in the following sections.
1.4. CUSTOMER RETENTION

Customer retention is the activity that a telecom industry undertakes in order to reduce customer defections. Successful customer retention begins from the moment customer contacts an organization and continues throughout the entire lifetime of a relationship. A company’s ability to attract and retain new customers, is not only related to its product or services, but strongly related to the way it services its existing customers and the reputation it creates within and across the marketplace.

Customer retention is concerned both with providing services that the customers’ expect along with additional value added services that makes customers as loyal clients who indirectly market for their brand. Creating customer loyalty puts ‘customer value rather than maximizing profits and shareholder value at the center of business strategy’ (Frederick, 1996). The key differentiation in a competitive environment is often the delivery of a consistently high standard of customer service. Customer retention has a direct impact on profitability. Research by Fleming and Asplund (2007) indicates that engaged customers generate 1.7 times more revenue than normal customers, while having engaged employees and engaged customers returns a revenue gain of 3.4 times the norm.

Customer retention is defined as the practice of working to satisfy customers with the intention of developing long-term relationships with them (Hoyer and MacInnis, 2001). It is also defined as a commitment to continue to do business or exchange with a particular company on an ongoing basis (Zineldin, 2000). According to Clark (2001), long-term customer retention in competitive markets requires the provider going beyond basic satisfaction to creating loyalty in order to guard against competitor attacks. Day (1994) contends that the identification and satisfaction of customer needs leads to improved customer retention. This will help the provider to formulate strategies and plans.
1.5.  LOYALTY MANAGEMENT

The customer loyalty management is concerned with the building of customer loyalty business model and is defined as a business model that is used in strategic management where company resources are employed so as to increase the loyalty of customers and other stakeholders in the expectation that corporate objectives will be met or surpassed (Sanjeevkumar and Ramachandran, 2012). A typical example of this type of model is, quality of product or service leads to customer satisfaction, which leads to customer loyalty and which leads to profitability. It describes the customer commitment or attachment to a brand or service provider.

According to Zeithaml et al. (1996), customer loyalty is defined as the degree to which a customer exhibits three behaviours, namely, repeat purchase, positive attitudinal disposition towards the provider and ready to use the same provider when a need for the service arises. The study of this field improves customer satisfaction and faithfulness. Research has shown the importance of loyal customers in business enterprises and not excluding the telecom sector. Some of them are listed below (Bello, 2012).

- The typical company gets 65% of its business from its existing customers
- It costs five times more to find a new customer than to keep an existing customer happy
- It takes 12 good service experiences to overcome a single bad one
- Seven out of ten customers who switch to the competitor do so because of poor service
- 91% percent of unhappy customers won't buy again from the company that displeased them
- Unhappy customers will not only defect, but they will grumble to nine of their friends.
The same author also noted that when a customer rates a service provider as five (on a scale of 1 to 5), the same customer is six more times likely to return. Also, dissatisfied customers whose complaints are taken care of are very likely to remain loyal and often become 'customer advocates'. All these point to the fact that identification of loyal and dissatisfied customer is important and helps to improve the net worth of the telecom company in the long run. Customer loyalty is thus one of the most domineering factors that drive the profits of the operators in the telecom industry.

1.6. CUSTOMER CHURNING

Customer, churn also known as customer attrition, customer turnover, or customer defection, is the loss of clients or customers (http://en.wikipedia.org/wiki/Customer_attrition). Churn management involves making necessary reactions in order to retain customers who are at the risk of leaving a service provider, for example by offering them better services and deals. However, companies do not have enough time and resources to contact the entire customer base and not everyone needs attention at each time.

By forecasting the customer’s decision of moving to a competitor, churn prediction provides company information which makes them able to focus on a target group of customers with high risk of churn. Besides that the time aspect is also important. Knowing in advance before the customers really churn will give operator more room to react, and more chances of success in keeping loyal customers. The more accurate the churn prediction is, the more money and resources the company will save.

1.6.1. Effects of Customer Churn

As mentioned earlier, the mobile telephony market is one of the fastest-growing service segments in telecommunications and more than 75% of all potential phone calls worldwide can be made through mobile (Taiwo and Adeyemo, 2012). Owing to the overwhelming competition, churning, a major
hurdle faced by these companies, has to be handled carefully. This fact is confirmed by the following statistical facts.

- Telecommunication sectors ensures an annual rate of churn ranging from 25% to 30% and is predicted to increase in correlation with the growth of the market (SAS Institute, 2000)
- According to a report by Anand Rathi Financial Services, the move will lead “to churn rates higher than the current 4.5% to 8.0% per month and approximately lose around 48 percent of customers annually (http://knowledge.wharton.upenn.edu/article/how-will-indias-telecom-industry-manage-the-fallout-from-falling-rates)
- The ratio of customer acquisition costs / customer retention (or satisfaction costs) is approximately equal to eight per cent for the wireless companies (Jahromi, 2009)
- According to Groth (1999), customer churning costs around US$ 4 billion per year and thus makes churn prediction and management vital to telecom industries.

1.6.2. Categories of Churns

In the telecommunications industry, the broad definition of churn is the action that a customer’s telecommunications service is canceled. This includes both service-provider initiated churn and customer initiated churn (Nie et al., 2009). An example of service-provider initiated churn is a customer’s account being closed because of payment default. Customer initiated churn is more complicated and the reasons behind vary. Customer initiated churn can be either voluntary or involuntary. Voluntary churn occurs due to a decision by the customer to switch to another company or service provider, involuntary churn occurs due to circumstances such as a customer's relocation to a long-term care facility, death or the relocation to a distant location.

In this research, only customer initiated involuntary churns are considered. The reason behind such a decision is due to the fact that these
churns typically occur due to factors of the company-customer relationship which companies control as a series of reason codes. Examples of such codes include unacceptable call quality, more favorable competitor’s pricing plan, misinformation given by sales, customer expectation not met, billing problems, moving or change in business due to additional services provided by competitors. The main goals behind customer churn prediction are

- Detect soon which customers are about to abandon and to know them in depth, answering to questions such as: Who are they? or How do they behave?
- Know the real value of the potential loss of those customers, with the aim of establishing priorities and distributing business efforts and resources efficiently, optimizing resources and maximizing the value of the current customers’ portfolio.
- Put into practice personalized retention plans in order to reduce or avoid their migration, increasing the capability to react and anticipating to possible non-predicted fugues

1.6.3. Causes for Churns

In an intensely competitive environment, customers receive numerous incentives to switch and encounter numerous disincentives to stay. Geppert (2002) gave the price, service quality, fraud, lack of carrier responsiveness, brand disloyalty, privacy concerns, lack of features, new technology or products introduced by competitors and billing or service disputes as major causes for churn. Chu et al. (2007) identified price, coverage, quality, customer service as the main contributors to churn within the telecommunications service sectors. The significance of each of these contributors is given in Figure 1.2. According to Ranaweera and Neeley (2003), in addition to satisfaction, other emotional responses such as inertia and indifference may also have an impact on churning.
1.7. ACTIONABLE KNOWLEDGE

Actionable knowledge discovery is critical in promoting and releasing the productivity of data mining and knowledge discovery for smart business operations and decision making (Surekha and Satyanarayana, 2012). Here, the term 'actionability' measures the ability of a pattern to suggest a user to take some concrete actions to his / her advantage in the real world. It mainly measures the ability to suggest business decision-making actions.

In general, telecom industries use algorithms and tools which focus only on discovering patterns that identify loyalty and churners. In most of the companies, the processes of identifying loyal customers and predicting churners are performed by human experts. These human experts use the visualization results and interestingness ranking to discover knowledge manually. Human experts, apart from being costly, do not directly suggest actions that would lead to an increase in the objective function such as profit. Hence automated process of actionable knowledge discovery is needed.

Existing efforts in the development of effective interestingness metrics are basically on developing and refining objective technical interestingness metrics (Cao et al., 2010). They aim to capture the complexities of pattern
structure and statistical significance. Other work appreciates subjective technique measures (Liu et al., 2000) which also recognize to what extent a pattern is of interest to particular user preferences. However, there is very limited research on developing business-oriented interestingness, for instance profit mining (Wang et al., 2002). Existing work for knowledge discovery stops at pattern discovery which is based on customer significance and interestingness. As a result, the summarized actions do not reflect the genuine expectations of business needs and therefore, cannot support decision making with respect to improving net profit of an organization.

According to Song et al. (2006), a good loyalty and churn prediction system should not only pinpoint loyal and potential churners successfully, but further provide cost-effective actions that can convert churners to loyal customers. The process of discovering actionable knowledge consists of two steps, (i) data mining and (ii) extraction of actionable knowledge (Figure 1.3).

![Figure 1.3 : General Procedure for Actionable Knowledge Discovery](image)

In this framework, the data mining task is executed first and then, on the basis of the data mining results, the profitable actions are determined. Data Mining is an iterative process that uses a variety of data analysis tools to discover actionable knowledge and relationships in data.

### 1.8. DATA MINING

As data mining is the central point of the CRM systems, this section presents an introduction to this topic. The various stages/processes identified in data mining and knowledge discovery are given below (Figure 1.4). All the phases start with the raw data and finish with the extracted knowledge.
- **Define the problem** - Clearly define the business problem and consider ways to provide an answer to the problem by analyzing business requirements, defining scope of the problem and specifying objectives for the data mining project.

- **Collect the data** - Concerned with how the data are generated and collected.

- **Preprocessing** - this is the data cleansing stage where certain unimportant information, which may slow down the system, are removed. The data is also reconfigured to ensure a consistent format.

- **Transformation** - the data is not merely transferred across but transformed in that overlays may be added such as the demographic overlays commonly used in market research. The data is made useable and navigable.

- **Data mining** - this stage is concerned with the extraction of patterns from the data. A pattern can be defined as given a set of facts (data) $F$, a language $L$ and some measure of certainty $C$. A pattern is a statement $S$ in $L$ that describes relationships among a subset $F_s$ of $F$ with a certainty $C$ such that $S$ is simpler in some sense than the enumeration of all the facts in $F_s$. 
- **Interpretation and evaluation** - the patterns identified by the system are interpreted into knowledge which can then be used to support human decision-making.

  The knowledge discovery is an iterative process and once discovered is presented to the user for evaluation. The process of mining can be improved in several manners. The evaluation measures can be enhanced, the mining can be further refined, new data can be selected or further transformed, or new data sources can be integrated, in order to get different and more appropriate results.

1.8.1. Importance of Data Mining

The information and knowledge gained can be used for applications ranging from business management, production control, market analysis and exploration. The main motivations behind the popularity of data mining techniques in Customer Loyalty Identification and Churn Prediction are given below.

- **Growing Data Volume**

  The major reason that data mining has attracted a great deal of attention in the telecom industry in recent years is due to the wide availability of huge amounts of data and the imminent need for turning such data into useful information and knowledge.

- **Limitations of Human Analysis**

  Two other problems that surface when human analysts process data are

  (i) the inadequacy of the human brain when searching for complex multifactor dependencies in data and
  (ii) the lack of objectiveness in such an analysis.

  Usage of automated methods eliminates both these problems to a great extent.

- **Low Cost of Machine Learning**
One additional benefit of using automated data mining systems is its low cost. While data mining does not eliminate human participation in solving the problem of increasing customer loyalty and converting churners to loyal customer completely, it significantly simplifies the job and allows an analyst or expert, who is not a professional in statistics and programming to manage the process of extracting knowledge from historical data.

1.8.2. Data Mining Methods

The kinds of patterns that can be discovered depend upon the data mining tasks employed. By and large, there are two types of data mining tasks (Banerjee and Ghosh, 2002), namely,

- descriptive data mining tasks (produces the model of the system described by the given data set)
- predictive data mining tasks (produces new, nontrivial information based on the available data set)

Descriptive data mining tasks describe the general properties of the existing data. They find human-interpretable patterns that describe the data. Examples include association rule discovery, sequential pattern discovery, clustering, characterization, etc.

Predictive data mining attempts to do predictions based on inference on available data. They use some variable to predict unknown or future values of other variables. Some predictive data mining techniques are classification, regression, outlier detection, change/evolution analysis, etc.

It is known fact that the users do not have a clear idea of the kind of patterns they can discover or need to discover from the data at hand. It is therefore important to have a versatile and inclusive data mining system that allows the discovery of different kinds of knowledge and at different levels of abstraction. This also makes interactivity an important attribute of a data mining system. There are a number of data mining methods that are available
to businesses today. The various methods include data characterization, data discrimination, association analysis, classification, prediction, clustering etc. Data mining can be applied to different type of data respository like text data (both numbers and alphabets), web data (web links, web contents, etc.), multimedia data (images, audio, video, etc.).

The relative importance of prediction and description for particular data-mining applications can vary considerably. However, the common goals of prediction and description are achieved by using data-mining techniques, for the following primary tasks:

- **Classification** - discovery of a predictive learning function that classifies a data item into one of several predefined classes.
- **Regression** - discovery of a predictive learning function, which maps a data item to a real-value prediction variable.
- **Clustering** - a common descriptive task in which one seeks to identify a finite set of categories or clusters to describe the data.
- **Summarization** - an additional descriptive task that involves methods for finding a compact description for a set (or subset) of data.
- **Dependency Modeling** - finding a local model that describes significant dependencies between variables or between the values of a feature in a data set or in a part of a data set.
- **Change and Deviation Detection** - discovering the most significant changes in the data set.

Out of these, classification and prediction are two processes that are taken as the main topics of this research work. Classification analysis is the organization of data into predetermined classes. Also known as supervised classification, the classification uses given class labels to order the objects in the data collection. Classification approaches normally use a training set where all objects are already associated with known class labels. The classification algorithm learns from the training set and builds a model, which then is used to
classify new objects. Prediction has attracted considerable attention given the potential implications of successful forecasting in a business context of telecommunication companies. There are two major types of predictions where attempts can be made to

- predict some unavailable data values or pending trends, or
- predict a class label for some data.

The latter is tied to classification or categorization. Once a classification model is built based on a training set, the class label of an object can be foreseen based on the attribute values of the object and the attribute values of the classes.

It is a well-known fact that, irrespective of the data mining method used, one important stage, that is common to all data mining methods, is the ‘Preprocessing’ stage, which is also given equal importance in the present research work.

1.9. MOTIVATION AND OBJECTIVES

In the present scenario, the customers have wide knowledge on current technological advancements and various services available to them (Amarnathan, 2003). Therefore, telecom industries needs crime analysis tools to identify and retain loyal customers in order to remain ahead in the eternal race between consumers and competitors. The industry should use the current technologies (Corcoran et al., 2003; Ozkan, 2004) to give themselves the much-needed edge. Availability of relevant and timely information is of utmost necessity in conducting of daily business and activities. The telecommunication organizations everywhere have been handling a large amount of such information and huge volume of records. There is an urgent need to analyze the increasing number of churning and maintain their loyal customer database.
An ideal analysis tool should be able to identify loyal customers and churn customers in an accurate and time efficient manner, so that customer retention plans and actions can be performed successfully. Data mining techniques have been applied extensively for this purpose. However, in the present scenario, the following major challenges are encountered.

- Increase in the size of customer information that has to be stored and analyzed, which complicates the problem of mining information regarding loyal and churn customers.
- Problem of identifying techniques that can accurately and efficiently analyze this growing volumes of crime data
- Lack of techniques that move beyond data mining for discovering actionable knowledge

All the above challenges motivated this research work to focus on providing solutions that can enhance the process of customer analysis for identifying loyal customers and reduce churners in telecommunication industry.

The primary objective is formulated as ‘To develop analytical CRM model, for extracting information about loyal and churning customers and then using this information, discover actionable knowledge that can be used to improve the net-profit of telecom industries’. The proposed framework is referred to as CLA-AKD (Customer Loyalty Assessment and Actionable Knowledge Discovery) system in this thesis. In order to design such a system, the sub-goals are formulated as below.

- To design and develop data cleaning techniques (that is to be used as preprocessing operations) to transform incomplete dataset into complete dataset using missing value handling procedures and to remove noise (or outliers) present in the customer database.
• To design and develop loyalty assessment models that performs churn prediction and group the rest of the customers as low, medium and high loyal customers using clustering and classification approaches
• To design and develop profit-oriented actionable knowledge extraction models for converting churn customers to loyal customers using optimized feature extraction and classification approaches.

1.10. LAYOUT OF THE THESIS

The underlying objective of this research work is to develop efficient CLA-CRM systems that can efficiently identify loyal and churn customers and derive actionable knowledge using data mining techniques. This chapter introduced the general concepts behind the research topic and outlined the specific objectives of the research. The rest of the thesis is organized as below.

In case of customer loyalty and churn prediction, several researchers have addressed the problem of using data mining techniques. A critical look at the various available literatures related to the present research work is given in Chapter 2, Review of Literature.

Chapter 3, Methodology, presents the research methodology and identifies the different steps of the proposed CLA-CRM system. The various methods and techniques used are introduced in this chapter. The three main steps of CLA-CRM system are preprocessing, customer loyalty assessment model and actionable knowledge discovery. The methodology used during the design and development of techniques for each of these steps are respectively presented in Chapter 4 (Design of Preprocessing Algorithms), Chapter 5 (Customer Loyalty Assessment Model) and Chapter 6 (Actionable Knowledge Discovery).

Chapter 7, Results and Discussion, tabulates and discusses the various results obtained while testing the proposed CLA-CRM systems. The findings
of the study are summarized along with future research directions in Chapter 8, Summary and Conclusion.

The work of several researchers are quoted and used as evidence to support the concepts explained in this dissertation. All such evidences used are listed in the Bibliography of the dissertation.

1.11. CHAPTER SUMMARY

This chapter provided a brief introduction to CRM, customer loyalty, customer churning and datamining, all of which forms important components in the proposed CLA-CRM systems. The research objectives formulated were also outlined. To achieve the objectives outlined in this chapter, a study on the various existing methods were studied and the result of the study is presented in the next chapter, Review of Literature.