Customer Relationship Management: The Application of Data Mining Techniques in the Telecommunications Sector

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Abstract:
It is widely recognized that organizations of all sizes need to form one-to-one relationships with their customers in order to achieve a respectable reputation in the business market and make continuous profits. This particular need stems from the fact that customers are the core of every business. Customer Relationship Management (CRM) is based on this understanding. The study examines the feasibility of applying data mining techniques in the telecommunications industry and to define the different factors involved in the fields of data mining and CRM. These factors include the need for a large budget to purchase the data mining software and hardware, the need for data mining experts to handle installation procedures and employee training. Nevertheless, the complexity and the enormity of data mining techniques might act as a repelling agent to the adaptation of the new technology, and strategic integration of processes might be time-consuming and costly. The findings suggest that CRM and data mining are valuable tools for direct marketing, which can generate a further return on investment and be used to identify the targeted and potential customers who are responding to the new product offerings. By using the historical purchasing data, data mining techniques can predict the likelihood that a customer is serious and will respond to the promotion.

Keywords: Bahrain, CRM activities large budget, data mining experts, installation procedures, employee training, software and hardware

1 Introduction
The Kingdom of Bahrain has recently experienced a significant breakthrough in technology; this is widely seen from the management’s perspective of the ever-evolving introduction of new
products and services. The telecommunication market is one of the fastest adapters to innovative technologies. This is true, particularly with the widespread of less expensive mobile telephony and associated multimedia services. The enabling technology has allowed major telecom operators to maintain a sizeable market share and foothold. It is widely recognized that organizations of all sizes need to form one-to-one relationships with their customers in order to achieve a good reputation in the business market and make continuous profits. This particular need stems from the fact that customers are the core of every business. Customer relationship management (CRM) is based on this understanding.

While small enterprises can learn about their customers through regular interactions, by noticing customer needs and preferences, and physical observations of customer buying behavior, larger firms need to rely on other means to understand their customers and to build sustainable fruitful relationships with those customers. When a certain company has over half a million customers, it becomes almost unmanageable to have knowledge of the preferences of each customer or what stimulates these customers to buy the company’s products or services.

One of the means used to create long-term relationships with customers is analyzing customer data produced by nearly every customer interaction. Customer data is scattered around every large organization, present in transaction processing systems, data warehouses and in shipping systems. Therefore, organizations must collect relevant data and produce significant information about every customer. This is the point where data mining techniques become useful.

Laudon et.al (2002) stated that for every organization to survive, “it needs to find ways of providing more value and service to customers at lower cost”. Logically, this objective can be achieved by improving means of corporate/customer interaction and by providing products and services of high quality. Thus, CRM acts as the golden solution for many businesses who struggle to survive in today’s complicated business market. Laudon et.al (2002) also defined CRM as “a business and technology discipline that uses information systems to coordinate all the business processes surrounding the firm’s interaction with its customer in sales, marketing, and services. The ideal CRM system provides end-to-end customer care from the receipt of an order acquisition through product delivery.”

Organizations across the Kingdom of Bahrain have long been using CRM activities to target and maintain their customers. Therefore, the only question that arises in this study is whether data mining technology has been put into practice in order to enhance CRM activities.

Data mining is a term with countless definitions. Laudon et.al (2002) provided an interesting definition for data mining as a tool. They claim that “data mining software tools find hidden patterns and relationships in large pools of data and infer rules from them that can be used to predict future behavior and guide decision making. Data mining helps companies engage in one to one marketing where personalized or individualized messages can be created based on individual preferences.”

The literature available on the Internet and in many books and magazines has made the disciplines of data mining and CRM appear to be two sides of the same coin. The objective of this study is to explore and investigate the application of data mining techniques in CRM activities within the telecommunications sector in the country.

1.1 Theoretical Motivation of the Study

The literatures in Europe and the United States indicate that many organizations have been using data mining as a catalyst or an advocate in CRM practices.
This study seeks to investigate and explore whether Bahrain’s largest and leading Telecommunications Company – Company-A – uses data mining techniques for its CRM practices. The telecommunications industry worldwide is an industry where there is an escalating rivalry between different companies to approach the top of the market more forcefully. This need to be at the top of the list has become a target for every business. Therefore, telecommunications companies focus all their efforts on retaining existing customers and attracting new ones.

The vast nature of the marketing data has always been one of the most important aspects for this industry; marketing data resides across the company but in a form that might not serve to be purposeful. Therefore, this study is intended to shed light on data mining and how it can be applied in CRM.

CRM is the key weapon that organizations use to create a boulevard of trust between them and their customers. For that reason, the range of data mining techniques is an interesting field of study and has become an inspiration for investigating its applicability in the telecommunication market in the Kingdom of Bahrain. This is due to that fact that the telecommunication industry in the Kingdom of Bahrain is witnessing fierce competition between three mobile operators (Company-A, Company B and Company-C). In consequence, Company-A (the company under study) is likely to be employing innovative means of attracting and retaining its customers. In addition, these means are facilitated by state of the art technologies, and therefore, data mining might be one of the many utilized for this purpose.

1.2 Research Scope

The purpose of this study is to focus on how data mining techniques in CRM can be effectively used by Company-A. The study examines the feasibility of applying data mining techniques in the telecommunications industry and tries to define the different factors involved in the fields of data mining and CRM. In addition, the study aims to develop an understanding of the current business environment in Company-A and how data mining techniques can contribute to the company’s profits.

Visits to Company-A and conduction of personal interviews with 30 staff members in the Information Technology, Human Resource Management, and CRM departments helped in getting hold of information needed for the study. As a final point, the results of the interviews will be analyzed because of the research questions.

1.3 Basis of the Study

Based on the review of relevant literature and on the preliminary motivations of the study, the following sub-objects for the study were established:

1. Analyze the application feasibility of data mining technique in CRM.
2. Explain the different aspects and techniques of data mining.
3. Highlight the importance of integrating data mining and CRM from a telecommunications industry perspective.
4. Draw attention to the benefits of applying data mining techniques in CRM to the telecommunication sector in the Kingdom of Bahrain.

1.3.1 Detailed Basis of the Problem

The basis of the problem was:

1. Study aimed at understanding the different stages of data mining.
2. Suggestion of the best models in data mining technique that can be used in CRM.
3. The value addition perceived with applying data mining in CRM.
4. Extraction of the effect that data mining can bring to the current CRM system of the company under study.

1.4 Improving the Research Validity

To achieve reliability of the study material, the author used internal and external validity techniques to reduce bias and present information that can be described as dependable. According to Knapp (2001), “One of the most difficult decisions that authors, reviewers, and editors of research reports have to make is how much and what kinds of information to give to readers concerning the methodological aspects of a study.” This is where reliability concerns come into view.

Reliability “addresses whether repeated measurements or assessments provide a consistent result given the same initial circumstances” (NATCO, 2009). In addition to reliability, validity concerns are also present in every study. To improve the validity of the study, internal and external validity measures are used.

(NATCO, The Organisation for Transplant Professionals: 2009)

1.4.1 Internal Validity

CSU (2015) defines internal validity as “(1) the rigor with which the study was conducted (e.g., the study's design, the care taken to conduct measurements, and decisions concerning what was and wasn't measured) and (2) the extent to which the designers of a study have taken into account alternative explanations for any causal relationships they explore. In studies that do not explore causal relationships, only the first of these definitions should be considered when assessing internal validity.” Establishing the internal validity of a study is usually based on a logical process: “for a research report, the logical framework is provided by the report's structure. The methods section describes what procedures were followed to minimize threats to internal validity, the results section reports the relevant data, and the discussion section assesses the influence of bias.” (Slack and Draugalis, 2001).

To achieve internal validity in this study, the aim is to obtain a substantial amount of data of data from multiple sources. To accomplish that, data will be collected from all entities that are responsible for implementing the data-mining project in the target company. These entities include the IT, the HRM and the CRM departments. The study sought to find the feasibility of applying the data mining techniques for CRM in Company-A.

1.4.2 External Validity

Johnson and Christensen (2000) define external validity as “the extent to which the results of a study can be generalized to and across populations, settings and times”. They also claim that if a particular research finding has a high rate for internal validity, this still does not imply that the study can be generalized outside the context of the study. However, for the purpose of this present study, the sample of the study was selected to understand the data mining techniques in a telecom industry and to get a complete overview of the CRM practices in the target company. Furthermore, the assumptions were, the selected sample of the participants in the interviews is in
close interaction with the researcher and the selected sample of the team is familiar with the application of data mining techniques in CRM.

1.5 Delimitations

The study falls within the following parameters:

1. The study will not undertake the technical issues involved in adapting the data mining techniques.
2. The study will not discuss any financial matters involved in implementation of data mining technologies.
3. The understanding of the data mining technologies by the IT department in the target company does not imply that there is an acceptance by the whole of the management team within the company.
4. The study does not encompass the views of other experts in this area. The researcher’s own views and interpretations are only expressed.

1.6 Limitations

The limitations of this study are summarized as follows:

1. The main concern is the extent of willingness on the part of the participant to share information. To deal with this problem, the participants were promised complete confidentiality.
2. Interviews as a data collection method have been criticized for external reliability. To overcome this problem, interview guides were used in this study to ensure a systematic data gathering process, thus enhancing the external reliability of the interview process.

Whilst the interview technique is considered the most appropriate strategy for this study, it is time consuming and may pose a problem as to the number of participants who can be interviewed.

3. Another concern is the validity of the result. Because the study is exploratory, there is no right or wrong answer. The description and comments made by the participants are useful in informing us on Company-A’s utilization/un-utilization of data mining techniques.
4. Due to the nature and small size of the sample population, it is not possible to generalize the findings beyond this sample population. However, this study is intended to provide understanding rather than generalization of applicability of data mining technologies in the target company.

1.7 Definition of Terms

1. DM: Data Mining
3. CRM: Customer Relationship Management
4. HRM: Human Resource Management
5. IT: Information Technology.
6. IS: Information Systems
7. OLAP: Online Analytical Processing.
8. TRA: Telecommunications Regulatory Authority (TRA)
1.8 Overview of the Study

This study consists of five sections. Section 1 basically describes the background of the study. The section includes an introduction, theoretical motivation of the study, research description, basis of the study, research validity, delimitations, limitations, and definition of terms. Section 2 discusses the theoretical framework underpinning this study. It also explores the relevant literatures associated with the study objectives. Section 3 documents the important features of the research design methodology, which includes identification and criteria of the sample, data collection, instruments used to conduct the research, data analysis procedures and credibility issues. Section 4 presents a case study on Company-A. It also reports and summarizes the research findings. Section 5 discusses the conclusion and the implication of findings for the application of data mining techniques in CRM in the telecommunication business. It also includes the author’s reflection on the results of the study, as well as recommendations for future research.

2 Review of Relevant Literature

A summary of the relevant literature review is given in this section to demonstrate the conceptual framework of the present study, to present a backdrop of CRM definitions and to develop a background for interview questions. To achieve this, literature pertaining to CRM and data mining was reviewed. Many references were drawn from CRM and data mining publications and a number of scientific textbooks.

The section is divided into three parts, as illustrated in Figure-01. Part one provides an overview of the theoretical framework in which the study is embedded: data mining techniques and CRM activities. This section explains how the core elements are interrelated in the conduct of this study. The second part provides an overview of the application of data mining techniques in CRM and the likelihood of this application in the telecom industry in the Kingdom of Bahrain. The final part of this section provides a brief overview of the telecommunications industry within the country.
2.2 Theoretical Framework of the Study

The purpose of this study is to investigate the applicability and presence of using data mining technology in CRM activities within Bahrain’s telecommunications industry. Company-A, as a major telecommunication company, has been selected for this purpose. In order to achieve this, the present study was designed to investigate whether data mining technologies were present in this company and if so, how has data mining been applied in CRM. In addition, the sophistication of technology is very evident in the telecommunication industry within the Kingdom of Bahrain; therefore, the possibility of data mining to exist is very high. In addition, effective and exceptional CRM activities have long been proven to distinguish Company-A from any other telecommunication company in the region. Furthermore, data mining and CRM are strongly believed to be intertwining fields of study.

Couldwell (1999) states that “CRM involves using existing customer information to improve company profitability and customer service”. This particular information applies to any organization but every organization uses different means for digging or mining essential data related to every prospective customer. Although many organizations do not use data mining technologies in their CRM initiatives and practices, a few rely on this technology to turn their daily profits into huge lump sums.

Drawn from those theoretical influences, the conceptual framework of the present study consists of an Overview of Data Mining, an Overview of CRM, and an Overview of Bahrain’s Telecommunications Industry.

2.2.1 Overview of Data Mining

Data mining is a sophisticated field of information systems that has been the subject of study for many researchers worldwide. The term “data mining” has a lot of definitions but all these definitions fall within the same parameters. Table-01 shows the most commonly found definitions in literatures across the globe.

Table-01 illustrates that the major purpose of data mining is pattern discovery in data. According to Rygielski et al. (2002), data mining seeks to find meaning in data, and usually the data mining approach is paired with other data analysis techniques such as online-analytical processing (OLAP), statistics, spreadsheets and other methods of analyzing corporate and customer data. While, Abu Ellaban (2013) reports that “DM is dependent essentially on different analytical software that support statistics and machine learning”. Thus, such technology provides greater assistance for the company by transforming large volumes of data into information that is useful for managers in making accurate and effective decisions regarding active marketing programs and building effective CRM activities.

Many researchers state that data mining is a sub-process of a bigger process known as “knowledge discovery”. According to Rygielski et al. (2002), knowledge discovery is the process used in describing what steps must be taken in order to achieve meaningful results. They also claim that the use of data mining software cannot function solo without knowing the
business, understanding the data at hand, or being potentially conscious to other general methods of statistics. Consequently, we can infer that the use of data mining software comes as a step after understanding business needs and the data mining approach can answer business questions but does not validate these answers.

Jason et al. (2012) suggested that DM is conducted as a mechanism to explore huge amounts of data, and either leads to an overwhelming number of decisions to be made or, due to the complexity and size of data, to extract patterns from the selected data that may be unclear from the view of users. Ionita, (2015) pointed out that DM tools have the ability to estimate future trends and behaviors, so that companies have acquired knowledge in order to make proactive decisions. Moreover, these techniques are widely used today in both the private sector, such as banks, insurance companies and other financial institutions, along with commercial companies (retail and wholesale) on one hand, and the public sector on the other hand for detecting fraud. Rice and Hung, (2015) believe that the fundamental process of data mining is “the application of algorithms for extracting patterns”. Suhirman et al. (2014) mentioned that DM and knowledge discovery in databases are used interchangeably; however, data mining is only a part of knowledge discovery. Additionally, the fundamental role underlying data mining techniques is discovering and extracting data from storage mainly through various algorithms.

Table-01: The most commonly found definitions in literature across the globe.

<table>
<thead>
<tr>
<th>Author names</th>
<th>Year of published</th>
<th>Page used</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>Shaw et al.</td>
<td>2001</td>
<td>4</td>
<td>The process of searching and analyzing data in order to find implicit, but potentially useful, information. It involves selecting, exploring, and modeling large amounts of data to uncover previously unknown patterns, and ultimately comprehensible information, from large databases.</td>
</tr>
<tr>
<td>Newton et al.</td>
<td>2002</td>
<td>2</td>
<td>A sophisticated data search capability that uses statistical algorithms to discover patterns and correlations in data</td>
</tr>
<tr>
<td>Berry and Lincoff</td>
<td>2004</td>
<td>7</td>
<td>The exploration of and analysis of large quantities of data in order to discover meaningful patterns and rules</td>
</tr>
<tr>
<td>Hand et al.</td>
<td>2005</td>
<td>2</td>
<td>The analysis of (often large) observational data sets to find unsuspected relationships and to summarize the data in novel ways that are both understandable and useful to the data owner</td>
</tr>
<tr>
<td>Simoudis et al.</td>
<td>2005</td>
<td>2</td>
<td>An interdisciplinary field bringing together techniques from machine learning, pattern recognition, statistics, databases, and visualization to address the issue of information extraction from large databases</td>
</tr>
<tr>
<td>Hart</td>
<td>2006</td>
<td>4</td>
<td>The process of extracting knowledge from large amounts of data</td>
</tr>
<tr>
<td>Strinivas et al</td>
<td>2010</td>
<td>250</td>
<td>Data mining is the core step, which results in the discovery of hidden but useful knowledge from massive databases.</td>
</tr>
<tr>
<td>Janson et al.</td>
<td>2012</td>
<td>2</td>
<td>Data mining, often also referred to as machine learning, might help determine the types of symptoms that may be most useful in accurately diagnosing chronic fatigue syndrome.</td>
</tr>
<tr>
<td>Wady</td>
<td>2013</td>
<td>3</td>
<td>The process of discovering interesting knowledge from large data</td>
</tr>
</tbody>
</table>
According to Berry and Lincoff (2004), Duchamp and Green (2009), and Woo and Hu (2009), data mining falls within the following two categories:

a) **Directed Data Mining**: Seeks to give an explanation for or put some particular target field into a classification.

b) **Undirected Data Mining**: Seeks to uncover patterns or relationships among groups of records without making use of a particular intended field or an assortment of predefined cases.

Data mining performs pattern and relationship discovery on data that exist within the organization. Data from all organizational sources are stored in the corporate data warehouse, which, in turn, is examined by data mining technologies. Data mining as a process has a number of architectures. An example is provided in the following diagram in Figure-02.

![Figure-02: An Integrated Data Mining Architecture.](image-url)
2.2.2 How Data Mining Evolved

According to Rygielski et al. (2002), data mining techniques came into existence with the performance of a lengthy process of research and product development. This progression of data mining techniques originated when the process of storing business data on computers first started; it then continued with developments in data access, and in recent times, it continues to progress with the continuous introduction of technologies that permit users to navigate through their data in real time. “Data mining takes this evolutionary process beyond retrospective data access and navigation to prospective and proactive information delivery” (Thearling, 2009). Therefore, data mining today is dependent not on user, but rather on automated data mining algorithm (Ben-Zvi, 2010).

In the process of evolving from business data to business information and knowledge, every new step in the evolution of data mining is constructed from the preceding one. Figure-03 shows the evolutionary stages in data mining.

Figure-03 shows that every successive step makes use of advancements in the previous step. In the first stage, Data Collection, specific application programs were created for the purpose of collecting data from different sites and for performing some basic calculations. The data collected was used to obtain answers for general business questions that were usually related to measuring overall the profits and yearly revenues. The second stage, Data Access, involved the use of large relational databases that employed sophisticated programming languages to store the corporate data. “At this stage, company-wide policies for data collection and reporting of management information were established” (Rygielski et al., 2002). Business data related to corresponding business units within the organization could be accessed at the specified periods. Data access during this stage was limited to the recorded level. However, further advancements in technology and the birth of new programming languages created a new paradigm for data access and enabled data to be navigated at general and detailed levels. In addition to that, the online-analytic processing and the introduction of data warehouses facilitated the evolution of data mining throughout the decades.
According to Thearling (2009), the significant building blocks of data mining technology have been under development for many years. These data-mining components have long existed in various research areas, such as statistics, artificial intelligence, and machine learning. Nevertheless, at the present time, these technologies are at their maturity and they are integrated with relational database engines perform at a high level. As a result, these technologies have become a practical and convenient environment for businesses to perform important knowledge management activities. Moreover, businesses can make use of these technologies to capture knowledge that was once hidden in hidden historical databases and had no use. This can serve as capital for many businesses which value knowledge as a capital (Al-Alawi, 2007).

On the whole, the concept and technologies of data mining are receiving ever-increasing acceptance in many business and science areas nowadays. This stems from the importance of continuously analyzing large amounts of data to discover hidden patterns and relationships that could lead to solving many questions that have been unanswered until now.

Zhang et al. (2010) proposed that cloud computing is a widespread concept, getting exceptional popularity. The issue of cloud computing has recently emerged as a resilient computing model which provides cloud services over the internet on the basis of cloud computing architecture of
three layers, namely: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). It is an effective paradigm since it has notable characteristics that are different from traditional computational model such as scalability, multi-tenancy, shared resource pooling, service oriented, dynamic resource provisioning and so on. It is a new computational model enabling end-users to lease the resources from rental infrastructure to effective utilization of data mining activities, without any upfront payments to the infrastructure for reaping benefits. Unlike grid computing, which merely concentrates on high quality of computational performance, cloud computing provides organizations with additional services that are extremely flexible to fit the needs of, and benefit, the organizations at large. Moreover, virtualization, which is viewed as a foundation of cloud computing, is leveraged at different levels by cloud computing to the intent to realize resource sharing and dynamic resource provisioning.

The National Institute of Standards and Technology (NIST) defined cloud computing as “a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction”. It brings together a combination of existing technologies with a role of running the business in better different ways. In fact, most of the technologies such as virtualization that are embedded on cloud computing are not new. Virtualization facilitates pooling activities on computing resources from clustering servers or allocating virtualized resources to application on-demand.

2.2.3 Data Mining Tasks

According to Berry and Linoff (2004), Bhardwaj and Pal (2011), Verma et al. (2012), Abu Ellaban (2013), Krishnaiah et al. (2013) and Suhirman et al. (2014), many intellectual, economic and business problems can be phrased in terms of the following six data mining tasks:

1. **Classification**: This is one of the most common data mining tasks and deals with discrete outcomes only: plants or animals; male or female, and so on. The process involves an examination of a newly presented object and its features in an attempt to assign it to a predefined set of classes. Berry and Linoff (2004) stated that “the objects to be classified are generally represented by records in a database table or file, and the act of classification consists of adding a new column with a class code of some kind”. While, Suhirman et al. (2014) suggested that classification has been viewed as a technique of data mining that is commonly used in developing a model for the purpose of classifying the population of records at large. This task is based on the presence of a well-defined definition of the classes, and a training set that consists of a number of predefined examples. The main objective is to construct a model that can be applied to unclassified data in order for the data to be classified.

2. **Estimation**: This data-mining task, unlike Classification, deals with continuously valued outcomes. However, it is often used to perform a classification task. Estimation comes up with a value for an unknown continuous variable when given some input data. This task is advantageous as it ranks individual records in a database according to the value of the estimate.

3. **Prediction**: This data-mining task is similar to the classification and estimation tasks but the only difference is that the records in the database are classified according to other measures, such as some predicted future behavior or some estimation of a future value. In this task, the single method to check for the correctness of the classification process is to wait for the results to occur. Berry and Linoff (2004) stated that “The primary reason for
treating prediction as a separate task from classification and estimation is that in predictive modeling there are additional issues regarding the temporal relationship of the input variables or predictors to the target variable”. Suhirman et al. (2014) described the method applied to conduct which is the regression model that addresses the relationship between a dependent variable and one or more independent variables. However, they outlined the fact that occasionally it is impossible to predict the real-world problems, therefore the need for other techniques such as “logistic regression, decision trees, or neural nets” increased. However, classification, estimation and prediction are all examples of direct data mining. The next two tasks are examples of indirect data mining.

4. **Affinity Grouping**: This data-mining task is based on the concept of putting things that go together within the same group. Affinity grouping is a technique to generate rules from data. According to Abu Ellaban (2013), the affinity grouping has the responsibility of identifying objects that go together "(e.g. what usually goes together in a shopping cart at the supermarket)".

5. **Clustering**: This data-mining task involves dividing a heterogeneous into a number of homogenous subgroups or, in other words, clusters. Clustering is differentiated from classification in the sense that the former does not rely on predefined classes of data. In clustering, database records on other basis of similarity such as self-similarity. This means that the user clusters the data according to the user’s own perception of what kind of cluster the data fits into. As stated by Verma et al. (2012), clustering is a method of DM that allow the collection of identical data into one cluster and dissimilar data into different clusters.

6. **Description and Profiling**: This data-mining task involves describing what is going on in a complicated database in a way that helps the user to gain better understanding of the different elements that produced the data in the first place.

### 2.2.4 Data Mining Applications

Data mining applications issues have been considered in many researches, such as those of Rygielski et al. (2002), Poncelet et al (2007), Buhardwaj and Pal (2011), Abu Ellaban (2013) and Ionita (2015). Rygielski et al stated that data mining tools build a representation of reality by taking the examined data and thus forming a model. This model can be used to describe the associations and patterns hidden within this data. The data mining tasks mentioned above represent models created by data mining tools that are aimed at solving business problems. From a process point of reference, data mining activities are classified according to three general categories (refer to Figure-04):

- **Discovery**: this process involves searching through a database to find patterns in data without using predestined hypothesis of what the hidden patterns might be.
- **Predictive Modeling**: this process involves making future predications based on the patterns discovered from the database.
- **Forensic Analysis**: this process involves finding abnormalities or irregularities among data elements based on the extracted patterns.
Businesses worldwide are making use of data mining tools to achieve countless objectives. These objectives range from building profits in a rapid manner to retaining the most valuable customers in the market. The following section will shed light on some business areas where data mining can be applied. There are many applications of data mining; however, only a few will be discussed.

### 2.2.4.1 Retail
Retailers collect data about dealings with customers through point-of-sale (POS) systems, credit cards and keeping records of shopping transactions. This enables them to better understand their customers and assign them to different market segments. Some retail applications include:

- **Basket Analysis** – this technique analyzes the collected customer data and reveals specific items that customers have a tendency to buy together. This can help retailers in using better stock layout strategies and improving promotion campaigns (Abu Ellaban, 2013). Poncelet et al (2007) added that in the retail sector, the detailed information concerned with each shopping transaction conducted by the customer can be retained through the use of POS terminal and store-branded credit cards.

- **Forecasting Sales** – this technique involves making future stocking decisions by using analysis of time-based patterns found in customer data.

- **Database Marketing** – this technique is used by retailers to develop profiles for customers with certain purchasing behaviors.

- **Planning and Allocating Merchandise** – retailers use data mining in making merchandise allocation decisions by examining different stores with comparable demographic characteristics (Rygielski et al., 2002).

### 2.2.4.2 Banking
According to Rygielski et al. (2002), banks make use of knowledge discovery for a variety of applications, including:
- **Card Marketing** – banks identify different segments and credit card issuers in order to enhance acquisition and retention programs to improve revenues.
- **Cardholder Pricing and Profitability** – card issuers use data mining tools in an attempt to increase profits and prevent customer losses.
- **Fraud Detection** – banks use data mining technologies to analyze historical transactions that were classified as fraudulent and search for similar patterns in present transactions.
- **Predictive Life-cycle Management** – data mining can aid banks in forecasting customers’ lifetime values and thus create different segments that can be serviced suitably.

### 2.2.4.3 Telecommunication

According to Rygielski et al. (2002), knowledge discovery in the telecommunications industry usually includes the following:

- **Analysis of Call Records** – telecommunication companies capture tremendous amounts of customer data through the thousands of services offered to their customers. As a result, detailed call records can be used in segmenting into different groups, and hence for each group, attractive promotions and offers can be developed.

- **Maintaining Customer Loyalty** – Berson et al. (2002, cited Hung et al. 2006) note that ‘customer churn’ is a term used in the wireless telecommunications service industry to denote the customer movement from one provider to another. Churn Management is a concept that is based on a service provider’s efforts to retain profitable customers. Data mining techniques are used in this field to identify the most profitable and loyal customers and focus companies spending on them. This is done by predicting customer decisions to move from one mobile operator to another.

### 2.2.5 Data Mining Techniques

Data mining techniques fall into two fields. The first field is ‘**data retention**’ and its concept is based on whether data is preserved or discarded after its use. “The retention-based techniques only apply to tasks of predictive modeling and forensic analysis, and knowledge discovery, since they do not distill any patterns.” The second field is ‘**pattern distillation**’ and it falls into three categories: logical, cross-tabulation, and equational. These categories use the patterns extracted from data sets for a range of purposes (Rygielski et al., 2002). Table-02 provides a summary of the advantage and the disadvantages of each category.
### Table-02 Pros and Cons to Data Mining Approaches

<table>
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<th>Logical Approach</th>
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<tbody>
<tr>
<td><strong>Pros</strong></td>
</tr>
<tr>
<td>• Successfully operate with multidimensional and OLAP data</td>
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<tr>
<td>• Has the ability to manage both numeric and nonnumeric data</td>
</tr>
<tr>
<td><strong>Cons</strong></td>
</tr>
<tr>
<td>• Not capable of working with smooth surfaces</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cross-tabulation Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros</strong></td>
</tr>
<tr>
<td>• Easy to be used with the availability of small amounts of nonnumeric data</td>
</tr>
<tr>
<td><strong>Cons</strong></td>
</tr>
<tr>
<td>• Inability to be changed in scale</td>
</tr>
<tr>
<td>• Capability of dealing with numeric data only</td>
</tr>
<tr>
<td>• Ability to handle conjunctions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equational Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros</strong></td>
</tr>
<tr>
<td>• Performs well when there is a large sets of data</td>
</tr>
<tr>
<td>• Operate actively with the presence of complex multidimensional models</td>
</tr>
<tr>
<td>• Ability to approximate smooth surface</td>
</tr>
<tr>
<td><strong>Cons</strong></td>
</tr>
<tr>
<td>• Involving in numeric data only</td>
</tr>
<tr>
<td>• Nonnumeric data must be coded</td>
</tr>
<tr>
<td>• System can quickly become a black box</td>
</tr>
</tbody>
</table>

Data mining applications consist of many technologies. According to Hung et al. (2006), in the field of CRM, the data mining techniques most commonly used include: associations, clustering, genetic algorithms, decision trees, neural networks, and rule induction. A thorough definition of each technique will be given below. On the other hand, other techniques that reside outside the parameters of this study will not be discussed.

Data Mining Techniques used in CRM are defined in the literature as in the following elements:

- **Associations**: Berry and Linoff (2004) indicated that “the task of association seeks to uncover rules for quantifying the relationship between two or more attributes.” On the other hand, Larose (2005) stated that association is usually paired with the term ‘basket analysis’, which investigates what items customers tend to purchase together, while Suhirman et al. (2014) acknowledged that one of the most popular techniques in data mining is association rules. Association rules can be divided into positive and least association rules. Such rules play a major function in discovering and detecting unusual cases, and irregular situations and events. Associations are usually used in the CRM domain to aid in decision making in problems like cross selling and product layout.

- **Clustering**: “Clustering refers to the grouping of records, observations, or cases into classes of similar objects” (Larose, 2005). Clustering is an undirected data mining technique that is
frequently utilized by businesses to learn about complex database structures. It is used in the CRM domain to aid in creating market segments, enhancing product promotion campaigns and targeting the appropriate customers

- **Genetic Algorithms:** “Genetic algorithms are optimization techniques that use processes such as genetic combination, mutation, and natural selection in a design based on the concepts of evolution” (Thearling, 2009). Genetic algorithms are usually used in the CRM domain to create market segments and manage customer churns, and in credit embezzlement

- **Decision Trees:** “A decision tree is a structure that can be used to divide up a large collection of records into successively smaller sets of records by applying a sequence of simple decision rules. With each successive division, the members of the resulting set become more and more similar to one another” (Berry and Lincoff, 2004). Decision trees are useful in classification and prediction activities. They are attractive to business problem solving approaches because they represent rules, which are expressed in English and thus can be easily understood.

Decision trees are usually used in the CRM domain to create market segments and manage customer churns, and in credit embezzlement.

- **Neural Networks:** Berry and Lincoff (2004) claimed that “A class of powerful, general purpose tools readily applied to prediction, classification, and clustering”. Neural networks have the ability to mimic the characteristics of the human brain as they can learn and generalize from data sets in the same manner that humans learn from experience. “A neural network consists of artificial neurons connected together, each neuron mimics its biological counterpart, taking various inputs, combining them and producing an output.” Suhirman et al. (2014) defined neural network as “a set of connected input/output units and each connection has a weight present with it”. They added that neural networks are most beneficial in discovering data patterns and trends, and are also useful for prediction or forecasting purposes.

Neural networks are usually used in the CRM domain to create market segments, forecast sales and estimate stock prices.

- **Rule Induction:** “Rule induction is the extraction of useful if-then rules from data based on statistical significance”. (Thearling, 2005)

Rule induction is usually used in the CRM domain to create market segments, forecast sales, predict fraud, and plan cross-selling activities.

**2.2.6 Overview of Customer Relationship Management**

According to Payne and Frow (2005), CRM as a scientific term actually came into view in the information technology (IT) vendor community and practitioner community in the mid-1990s. This term was frequently used to describe technology-based customer solutions, such as sales force automation (SFA). Despite the greater recognition by academics and practitioners for CRM, still the issue of CRM is highly disputed, as claimed by Payne and Frow (2006). Rababah, Mohd and Ibrahim (2010) stated that the purpose is to reach the customer centric approach in performing business through treating various customers in different ways in order to achieve shared benefits between the firm and customers.

Within the academic community, the terms “relationship marketing” and CRM are often used interchangeably (Parvatiyar and Sheth, 2001). However, CRM is further present within the context of technology solutions and has been described as “information-enabled relationship marketing” (Ryals and Payne, 2001). Zablah et al. (2003) claim that CRM is “a philosophically-
related offspring to relationship marketing which is for the most part neglected in the literature”, and they wrap this idea with the notation that “further exploration of CRM and its related phenomena is not only warranted but also desperately needed.”

Additionally, Abu Ellaban (2013) recognized that from the perspective of economists, business transactions have evolved into two-way communications between organizations and their customers. Such communications must be beneficial for both the organizations that seek to survive and grow, and customers who want to achieve benefit. Without satisfied customers, organizations encounter difficulties in developing and prospecting. Therefore, companies should develop strategies that have a role in meeting customers’ expectations and improving the organization’s relationship with its customers (Al-Alawi, 2006).

CRM is an attention-grabbing field of business and, similar to data mining, it has been the subject of study for many researchers worldwide. The term “CRM” has numerous definitions. For this reason, a number of definitions have been considered from a range of sources. Table-03 illustrated the most commonly definitions found in literatures across the globe.

**Table-03 Definitions of CRM in Literature**

<table>
<thead>
<tr>
<th>Author name(s)</th>
<th>Published year</th>
<th>Page No.</th>
<th>Definition of CRM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swift</td>
<td>2000</td>
<td>12</td>
<td>An enterprise approach to understanding and influencing customer behaviors through meaningful communications; to improve customer acquisition, customer retention, customer loyalty, and customer profitability.</td>
</tr>
<tr>
<td>Reygielski et al.</td>
<td>2002</td>
<td>491</td>
<td>CRM requires the firm to know and understand its market and customers. This involves detailed customer intelligence in order to select the most profitable customers and identify those no longer worth targeting.</td>
</tr>
<tr>
<td>Thompson</td>
<td>2002</td>
<td>1</td>
<td>A business strategy to select and manage the most valuable customer relationships. CRM requires a customer-centric business philosophy and culture to support effective marketing, sales, and service processes.</td>
</tr>
<tr>
<td>Al-Alawi</td>
<td>2004</td>
<td>380</td>
<td>CRM is a new weapon to satisfy customer and increase their loyalty.</td>
</tr>
<tr>
<td>Pivotal</td>
<td>2004</td>
<td>35</td>
<td>CRM is used by companies to connect data, people, and processes across the customer-facing front-office-typically, in sales, marketing, and service channels.</td>
</tr>
<tr>
<td>Payne and Frow</td>
<td>2005</td>
<td>168</td>
<td>A strategic approach that is concerned with creating improved shareholder value through the development of appropriate relationships with key customers and customer segments.</td>
</tr>
<tr>
<td>Kotler &amp; Keller</td>
<td>2006</td>
<td>152</td>
<td>The process of managing detailed information about individual customers and carefully managing all customer “touch points” to maximize customer loyalty.</td>
</tr>
<tr>
<td>Frow and Payne</td>
<td>2009</td>
<td>10</td>
<td>The strategic management of relationships with customers, involving the appropriate use of technology.</td>
</tr>
</tbody>
</table>
A managerial strategy that helps organizations collect, analyze, and manage customer-related information through the use of information technology tools and techniques in order to satisfy customer needs and establish a long term and mutually beneficial relationship.

Customer Relationship Management is a process of ascertaining customer needs; comprehending and inducing customer behavior, making use of quality communications strategies so as to obtain and maintain customers’ satisfaction.

<table>
<thead>
<tr>
<th>Author name(s)</th>
<th>Published year</th>
<th>Page No.</th>
<th>Definition of CRM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ogbadu and Usman</td>
<td>2012</td>
<td>60</td>
<td>Customer Relationship Management (CRM) concerned with customer data management, that is, managing detail information about individual customers, and carefully managing customer touch points in order to maximize customer loyalty, is now being focused on the overall process of building and maintaining profitable customer relationships by delivering superior customer value and satisfaction.</td>
</tr>
<tr>
<td>Chinje</td>
<td>2013</td>
<td>42</td>
<td>A business philosophy that is engrained in a company’s culture or way of doing business. As a result, its CRM strategy development and implementation approach must be aligned with the overall business strategy.</td>
</tr>
<tr>
<td>Abu Ellaban</td>
<td>2013</td>
<td>IX</td>
<td>Business philosophy that based on the strategic use and managing of technology, people, process and culture to increase the customer satisfaction and profitability and this investigated by managing and analysis of the customer data (demographic, behavior and financial) to acquire, develop and retain customer, with extra interest in valuable customers.</td>
</tr>
<tr>
<td>Nazir et al.</td>
<td>2014</td>
<td>84</td>
<td>Customer relationship management (CRM) is a unique and important business approach. CRM entails all the aspects of interaction with customers with the help of technology to streamline the processes that impact service quality, customer loyalty and customer satisfaction.</td>
</tr>
<tr>
<td>Mozaheb et al.</td>
<td>2015</td>
<td>43</td>
<td>CRM is the business strategy focused on the customer that increases the loyalty and satisfaction of customer by presenting him the personalized services and some know it as a managerial approach which includes identifying, attracting, developing and maintaining the successful relationship with customer in order to increase profitability.</td>
</tr>
</tbody>
</table>
CRM is an approach across the entire organization, not just in acquiring and applying knowledge about customers, but also to improve and automate business processes to customers, suppliers and employees as well.

The definitions presented above share a common factor, the focus of CRM, which is building long-term profitable relationships with customers. In other words, those definitions have a joint purpose, which is retaining, developing and attracting customers. Nevertheless, according to Payne and Frow (2005), there has been increase in CRM over the past ten years. Many academics and executives have been attempting to gain insight into the field of CRM. However, although there is a tremendous amount of published material, conformity of what CRM is and how its strategy can be developed has not yet been achieved.

In this study, a general overview of CRM will be provided. The concept will not be discussed in detail, as opposed to data mining, because the research focuses on introducing data mining into general CRM activities.

Companies worldwide adopt CRM approaches while being in some confusion about what CRM really means. This has led to many failures in CRM projects and in consuming business efforts in the wrong ways. Therefore, an important element must be taken into consideration while opting for CRM programs. This element is the realization that CRM is a business strategy and not a technology.

According to Payne and Frow (2005), and Payne and Frow (2009) indicated that CRM is not an information technology solution, that a company can use to increase its customer base by getting hold of new customers. CRM is crucially involved in analyzing strategic visions, having a clear idea of the customer value’s nature in the multi-channel environment, making use of information management and CRM applications, and providing high quality operations and services. They added that CRM “unites the potential of relationship marketing strategies and IT to create profitable, long-term relationships with customers and other key stakeholders. CRM provides enhanced opportunities to use data and information to both understand customers and co-create value with them. This requires a cross-functional integration of processes, people, operations, and marketing capabilities that is enabled through information, technology, and applications.”

According to Rygielski et al. (2002), the philosophy of CRM usually consists of two consecutive stages. The first stage involves mastering the basics of customer-focus. Customers focus is based on concentrating on the customer needs rather than the product’s features (i.e. the firm moves from product orientation to customer-orientation). Additionally, an outside-in marketing strategy should be developed. Once this stage is complete, the second stage begins with moving beyond the basics; CRM is integrated across the complete customer experience chain, and technology is utilized to attain real-time customer management. Moreover, companies in this stage are constantly seeking innovative ways to enhance their value proposition to their customers.

2.2.6.1 Components of Customer Relationship Management

According to Rygielski et al. (2002), CRM is a concept made up from a number of interrelated components. In order to make an accurate start in the CRM process, the organization must have
the right amount of essential customer information. Customer information can reside internally or externally. The sources available for internal customer data include the following:

- Descriptive Customer Summary tables (example: billing records)
- Informative Customer Survey (e.g. targeted and answered questionnaires)
- Behavioral Data captured by transaction systems (example: web logs and records of credit cards)

External data sources may include lookups for current customer addresses and telephone numbers, household hierarchies and profiles of web page viewing activities.

In relation to the internal sources mentioned above, an enterprise data warehouse serves as a vital component in a thriving CRM strategy. A data warehouse can be defined by Inmon & Hacknoll (1994) (the father of data warehouse) as “a subject-oriented, integrated, time-variant, non-volatile collection of data in support of management’s decision-making process”.

A data warehouse is organized around the major subjects of the organization and the data in the warehouse is refreshed from operational systems on regular basis. New data is integrated with old data and the size of the data warehouse increments with every data entry. Therefore, customer data residing in marketing, logistics, finance and accounting systems are sent to the corporate data warehouse where it is later used for decision-making purposes or for CRM activities. Generally, the data required for CRM is confined to marketing data marts, which are fed with limited amounts of data from associated corporate systems (Al-Alawi, 2004).

The other prominent component in customer relationship is statistical tools such as online analytical processing OLAP and data mining tools. The use of traditional tools or more sophisticated data-mining technologies is dependent on how the organization understands its business needs and how it deals with customer data. If the organization adopts data mining technologies in its CRM strategy, a careful selection of trained data mining experts should take place. The support of data mining experts is necessary in this case because these experts will ensure that the organization does not become tangled up in the CRM process and lose the original cause for using data mining. In addition, the organization can benefit from the CRM strategy if the correct individuals were involved in the process. The output of the process can range from creating market segments to applying one-to-one marketing (Al-Alawi, 2004).

The final component of CRM is campaign execution and tracking. Rygielski et al. (2002) define campaign execution and tracking as “the processes and systems that allow the user to develop and deliver targeted messages in a test and learn environment”. Campaign execution and tracking implement the decisions produced by statistical, data mining tools, and help companies deal with the massive information they receive as a feedback from customers. “Campaign management software manages and monitors customer communications across multiple touch points, such as direct mail, telemarketing, customer service, point-of-sale, e-mail, and the Web.” (Rygielski et al, 2002).

2.2.6.2 Three Perspectives of Customer Relation Management

CRM is a complicated field that can be interpreted from many angles. The major four perspectives of CRM are embedded in the CRM. The framework consists of strategic, analytical, operational, and collaborative aspects of CRM, which constitute the enterprise level CRM. According to Tanner Jr. et al, (2005) and Wahlberg et al. (2009), those aspects are explained as follows:
• **Strategic CRM** – refers to the managerial decision-making processes involved with defining and building a customer-oriented business strategy, business processes and culture, and requisite supporting technology models. Lambert (2009) asserted that top leaders inside the organizations who represent cross-functional business areas such as R&D, sales and marketing, finance, manufacturing and production, human capital development, and so on, will be responsible for directing the strategic CRM process.

• **Analytical CRM** – refers to the firm-level processes involved in analyzing customer and market-level information in order to provide the intelligence and insights that guide the firm’s strategic marketing, CRM, service, and go-to-market choices. Based on Chinje (2013), this perspective contains “the underlying data warehouse architecture, customer profiling and segmentation, systems, reporting, and analysis” (Oliveira, 2012). It concentrates on analyzing customer data for a wide range of trading purposes.

• **Operational CRM** – consists of the specification of suitable and replicable business processes designed to implement the firm’s desired customer relationship model in terms of customer access, customer interaction, sales and channel choices, and customer learning at the one-on-one level. Chinje (2013) argued that Operational CRM provides business technologies that facilitate customer interactions and provide greater assistance for the employees to better serve customers, for example, the collection of customer insights through customer touch points such as contact center, website, fax, and sales people.

• **Collaborative CRM** – refers to the interaction between various aspects such as vendors, customers, and manufacturers through customer channels in which the firm deals with marketing, sales, distributions and so on. The idea behind that is to improve relationships with customers, as viewed by Reinhold and Alt (2009). While Oliveira (2012) stated that connections among the organizations, suppliers, and customers can be obtained through the call center.

• Figure-05 below demonstrates the four different aspects of CRM at an enterprise level.
Figure-05 Enterprise-Level CRM Model and Processes
2.2.7 Overview of Bahrain’s Telecommunications Industry

The Kingdom of Bahrain encompasses a highly sophisticated and evolving telecommunications infrastructure that meets the various needs of the local people. The Kingdom of Bahrain first experienced telecommunications services in 1964. These services were provided by Cable & Wireless, which originated in the United Kingdom. The infrastructure was handled earlier by Cable & Wireless until the government of Bahrain decided to buy 80% of the shares. By then, Company-A was founded in 1981. Since that time, Company-A guided the revolution of telecommunication services within the kingdom.

The Bahrain Telecommunication’s Company (Company-A), previously a state-owned monopoly, used to be the sole provider of national and international telecommunication services, while the Ministry of Transport is the regulatory entity. Company-A was established in 1981 as a Bahraini shareholding company and is 39 percent government-owned. Cable & Wireless in the United Kingdom owns 20 percent and the remaining 41 percent is owned by investors on the Bahrain Stock Exchange.

At present, the Bahrain telecommunications industry consists of four telecommunication service providers, that is, Company-B, Company-C, and Company-D in addition to Company-A. Until 2003, the telecommunication market was functioning on a monopolistic basis. However, another telecommunications company made its entry into the market. Company-B entered the market in 2003 as the first competitor to Company-A, creating competition inside the industry and breaking monopolistic competition held by Company-A. Company-B has proven to be an excellent telecommunications operator in the country. It aimed at improving the telecommunication industry by putting the Kingdom's telecommunications on the highest ranking of international standing. Its entry has created a foundation for severe acts of competition in the telecommunications sector, thus providing customers with better quality products and services on a daily basis (Al-Alawi & Al-Bassam 2018).

The second competitor is Company-D, which was established as a leading provider of telecommunications services in 2003. It entered the telecommunications market with a large volume of unique products and reaching out to 30 percent of its broadband subscribers within three years in Bahrain. It provides services such as 4G-LTE, Fiber-optic cable, IP Telephone services, and High Speed Internet that satisfy telecommunication demands and cover the full spectrum of telecommunication solutions. Today, Company-D broadband infrastructure intends to offer the latest and highest quality of fixed and mobile broadband products and services.

In March 2010, Company-C, which is one of the most challenging competitors, entered Bahrain’s telecom market and commenced its commercial services with the intention of converting the way the business, is conducted through introducing several high-level technological devices, which in turn is impacting on the telecommunications sector in the Kingdom of Bahrain positively. It is a fully owned subsidiary of the Saudi Telecommunications Company (STC). Once it began its operations, it became the market leader.

Bahrain’s telecommunications infrastructure is one of the most sophisticated in the Gulf. As of 2013, Bahrain had approximately 251,000 fixed lines with a fixed line density of 20%, while the mobile subscriptions were 2.21 Million with 173% mobile penetration and broadband subscriptions of 1.63 million. For international communications, the Kingdom of Bahrain relies primarily on satellite and cable links. The country is connected to Saudi Arabia via a 565 Mbps
fiber optic line and is connected to Qatar and the UAE via a 1,200 channel underwater cable (Sandal, 1997). The mobile phone market is growing 10 times faster than fixed-line telephony. Our mobile network is continually upgraded and expanded, with new features being added on a regular basis. Nevertheless, the country is poised to take advantage of technologies that will enable exciting new services – subject to demand – such as high-speed, high-volume Internet-access using a mobile phone or other hand-held device.

3 RESEARCH METHODOLOGY

This section describes the research design and methods employed in the study. It is divided into two parts, as shown in Figure-06 Part one provides a brief discussion of qualitative research design in the conduct of this study. Part two describes the population and sample selection processes, the data collection, the instrumentation and data analysis techniques.

3.1 Research Design

Different sources are available on the Web that cover nearly all aspects, technologies, developments and perspectives on both the sciences of data mining and CRM. This large amount of data, opinions and facts about data mining and CRM presented a problem in choosing the appropriate research approach to obtain the desired qualitative data that can help in tackling the themes of this area.

Friedman (2000) identifies four main approaches to researching:

- Press releases. This approach is based on researching the press archives on company websites, or by searching the press release database available through commercial vendors. Although this method may not cost money, it may require an enormous amount of time and
might prove frustrating and sometimes unsuccessful, especially when the search engine is out of service.

- **Research mentioned in articles.** This method involves searching the web-based archives of print and online publications where research references will most likely appear.

- **Quantitative research aggregators.** This approach involves visiting the websites of quantitative information aggregators that publish research carried out by several firms.

- **Universities, non-profit, and government agencies.** This involves tapping quantitative research available for free through university research centres, non-profit associations, or government agencies.

To choose an appropriate approach or a blend of approaches may require the consideration of several factors. These may include the limitations of the research, the area of study, and the time necessary for carrying out the research.

### 3.1.1 Choosing a Research method

It was decided that a successful approach would be a blend of the first two above-mentioned approaches. This can help in providing the qualitative data necessary to support the arguments presented in this study.

Due to the subject of the study, which investigates the application of data mining techniques in CRM within the telecommunication industry, a thorough search of examples on the internet was deemed necessary. Thus, this study, places great emphasis on the use of internet research centres (also called search engines) which provide infinite amount of data and information stored across numerous and massive databases.

However, the research in this study will also involve the study of other published information to obtain qualitative data. This includes books, government publications, journal papers, business magazines, publications of professional associations (e.g. Business Source Premiere and ScienceDirect), and information available on the target company’s website. Thus, the overall approach of this study is grounded in both the quantitative and qualitative research methodologies.

According to Miles and Huberman (1994), Patton (1990), and Berg (1989), qualitative research focuses on “qualitative data” or “descriptive data” that describe the social phenomenon under investigation with respect to the nature of people, objects, and events. They further highlighted that the emphasis is on discovering emergent findings, not on a measurement of predefined variables.

Interestingly, Denzin and Lincoln (1994) define qualitative research as multi-method in its focus, involving an interpretative, naturalistic approach to its subject matter. This means that qualitative researchers study things in a natural setting, attempting to make sense or interpret with minimum intervention. Miles and Huberman (1994) agree that due to the desire to discover the emergent findings rather than measurement of variables, qualitative research requires a minimum intervention of the study setting in order to allow the qualitative data to reveal themselves in a natural way.
3.1.2 Exploratory and Interpretative Research

This study started with the need to discover the existence of data mining technology in the telecommunication industry in the Kingdom of Bahrain and the CRM application within the sector. The study is problem driven rather than theory driven; Patton (1990) restates that not all questions are theory based. He further argues that a quite concrete practical question scan should addressed without placing the study in one of the theoretical frameworks and methods of qualitative enquiry that stand on their own as reasonable ways of finding what is happening in human settings.

In this case, the study can be classified as an exploratory interpretative research because it used interpretation to decipher and report back the findings to the interested audience (Patton, 1990). It means that the end product of this study is a narrative description and interpretation of the participants’ perception and views. Qualitative research might be more appropriate in labelling the study because it seeks to understand and describe the meaning, not the frequency of a phenomenon that occurs in a natural setting. However, quantitative research methods are also present.

The information contained in this study has been obtained from sources the researcher believes to be reliable. Opinions expressed are based on the researcher’s interpretation of the available information. Because of the research methodology used, it is hoped that this study might give some insight and contribution to application of data mining techniques in CRM activities in the Kingdom of Bahrain.

3.2 Research Method

Given the exploratory and interpretative nature of this study, a qualitative research design using semi-structured face-to-face interviews approach is well suited to examine the proposed research questions. In addition, a number of visits to the target company’s website have taken place to obtain background information about the company. A quantitative inference such as number of frequency and percentage was not utilized in this study because there was no distribution of any questionnaires. The researcher relied solely on interviews with 10 top management and 20 key staffs to obtain desired corporate data. Whilst the employment of an interview guide is used to ensure the consistency in the collection of data, flexibility is allowed in the interview. A pre-established interview guide was used to assist the researcher in gathering data at the same time to enhance the systematic collection of data. The interview guide was used to ensure consistency in data collection whilst allowing flexibility during each interview session. From this perspective, qualitative and quantitative approaches were used for this study.

3.2.1 Population and Sampling

The population for this study is only one targeted company. A Bahraini Telecommunication Company (Company-A) is selected to represent the case study for this research paper. Company-A is selected because it is the kingdom leading digital solutions provider, recognized for its continuous strengths to remain innovative of all evolving telecommunications services and IT around the globe and for being the first operator in the region. In 2017 the Company-A is the 1st company in the Middle East to be granted ISO 9001:2015 certification from the British Standards Institution. The targeted population consisted of 10 top management and 20 key staff, those who have CRM and Data Mining job responsibilities and others.
3.2.2 Data Collection

This study used face-to-face, semi-structured interviews as a means of data gathering. A summary of the main features of data gathering employed is found in Figure-07.

![Diagram of Data Gathering and Analysis Process]

Figure-07 Structure of Data Gathering and Analysis Process

The present study combined an interview or predetermined questions and probing with an informal style of interviewing. The interview was conversational, spontaneous and situational. Despite the predetermined set of issues and sequence, the actual interviews were highly responsive to individual differences. The questions were refined to suit the participant’s role, personality, education and experience and other background information that emerged during the interview. For some participants who have more experience and had a post-graduate qualification, although they were few, the researcher just posed a broad question, listened carefully and “went with the flow”, and sometimes getting the participant back on track. However, for other participants, the predetermined questions became handy for facilitating, probing and keeping the interview moving.

The data collection was done in two phases. Each phase used a different instrument. As mentioned earlier, background information on Company-A was gathered through the company’s website as well as by conducting interview at Company-A. A semi-structured face-to-face interview was employed to allow questions to be asked about data mining and CRM activities.

Phase One

The first phase of data collection involved accessing Company-A’s current website to obtain background information on the company. This information included the company’s history, mission and vision, values, and services provided. Once this information was obtained, a phone call was made to schedule an interview with some employees in both the Information Technology (IT) department and Customer Relationship Management (CRM) /Human Resource Management (HRM) sub-departments.

Phase Two

The second phase of data collection was the administration of the face-to-face, semi-structured interviews (refer to Table-04). It was anticipated that some interviews would be conducted by telephone and e-mail. However, this never happened because all the participants agreed to be interviewed in person. The interviews were not audio taped, but instead, notes were taken down by the researcher to capture the participants’ answers. Some information was not given at the time and the participants agreed to be further contacted by e-mail to answer any additional inquires.
**Table-04: The Study Interview Questions**

<table>
<thead>
<tr>
<th>Interview Questions</th>
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<tbody>
<tr>
<td>1. What kind of database is your company using now?</td>
</tr>
<tr>
<td>2. What is the current system for handling this type of Database?</td>
</tr>
<tr>
<td>3. What is the volume of the database which your company is using at the moment?</td>
</tr>
<tr>
<td>4. How is the current data being generated? What techniques are being used?</td>
</tr>
<tr>
<td>5. What factors lead to the adoption of CRM in your Company?</td>
</tr>
<tr>
<td>6. What are the CRM techniques currently in use within your company?</td>
</tr>
<tr>
<td>7. Can all important and relevant customer information be collected and combined within this technology infrastructure?</td>
</tr>
<tr>
<td>8. Does the CRM solution integrate or connect to other systems and data sources?</td>
</tr>
<tr>
<td>9. Does CRM bring a high level of sophisticated analysis to a territory?</td>
</tr>
<tr>
<td>10. Have you established key business metrics?</td>
</tr>
<tr>
<td>11. How will you report on the key business metrics?</td>
</tr>
<tr>
<td>12. What are the data mining techniques currently in use within your company?</td>
</tr>
<tr>
<td>13. What are the reasons for not having a data mining solution within your company?</td>
</tr>
<tr>
<td>14. Are there any future plans for introducing data mining techniques to the company?</td>
</tr>
</tbody>
</table>

**3.2.3 Data Analysis**

Each interview was analysed for the relationship of data within and between the interview cases to develop a framework for a meaningful presentation of the study findings. It should be noted that although all participants are Bahraini, the language used in conducting the interviews was English. However, the amount of information obtained during the interviews was not quite sufficient in providing means for a thorough analysis of the research problem. Therefore, more research on the Internet was made to gather more information on international telecommunication companies in an attempt to relate the information in hand to Company-A’s CRM services and activities.

The study is based on both qualitative and quantitative research methodologies because of the exploratory and interpretative, and analytical nature of the research. Interviews with participant from Company-A were analysed to present the desired data in a form related to the present study. Although interviewing can provide a rich source of data, the information could be filtered through the views of the participants or it may be that some participants may not be so articulate and expressive of their experiences. Despite the fact that all those questioned have a technical background, some questions could maybe be raised concerning the validity of the participants’ answers.
4 Case Study: Company-A

4.1 Introduction

This section presents an overview of the target company in this study, which is a Bahraini Telecommunications Company (Company-A). In addition, the results of analysis derived from the study and from the answers to the interview questions will be discussed.

This study was organized to present the concepts of data mining and CRM and investigate whether data mining techniques are applied in Company-A’s CRM activities. The section is divided into two sections, as shown in Figure-08.

Section one provides a brief overview of Company-A and the services offered by company. Section two represents the results of the analysis with reference to the interview questions and the research questions guiding the data collection. The section is further divided into subsections that present the researcher’s interpretation of the study findings.

Figure-08 Overview of Study Findings

4.2 Overview of Company-A

Company-A is one of the leading companies of the world. Over the years, Company-A has proved excellence in operation by offering its customers the best products and the latest innovations in technology. The company is recognized for its continuous efforts to stay abreast of all evolving telecommunications services and information technology solutions around the world.

As per the latest release of the company’s literature, Company-A’s mission is “to deliver a simple and complete customer experience – offering a full range of reliable, competitively priced communications services and solutions”, while on the other hand, the company’s statement of vision notes that Company-A strives “to be familiar, trustworthy, confident and inspirational to our shareholders, customers, colleagues, suppliers, partners and the people of the communities we serve.”
4.2.1 History of Company-A

Company-A’s “roots trail as far back as 1864 when the Indo-European undersea telegraph cable was installed, signaling the beginning of Bahrain’s telecommunications industry. The new company operated as the Imperial and International Communications Company until another arm was created and came to be known as the Wireless Telegraph Company. Together, the two companies built up a range of international and national radio, telephony and telex services.” (BTC, 2015)

Company-A was established in 1981 as a Bahraini shareholding company. Over the years, the company has sustained an admirable reputation for providing world-class telecommunications and information services to its customers. Company-A’s “shareholders include the Government of Bahrain, quasi-government institutions, leading financial and commercial organizations, and Bahraini and GCC citizens. Between them, they own 80 per cent of the shares, with Cable & Wireless (U.K.) owning the remaining 20 per cent.”(BTC, 2015). The company maintains a strong association with Cable & Wireless, who provides proper support, advice and assistance as called for by Company-A.

Company-A’s activities are not restricted to the Bahraini market but are also conducted overseas. The company constantly takes part in major initiatives for developing regional and international telecommunications between the Gulf States and other countries. Company-A continuously hunt for new growth opportunities in the exciting field of multimedia and telecommunications.

4.2.2 Company-A’s Services

The company offers a wide range of innovative services and state-of-the-art IT solutions to its customers. Company-A targets two market segments. These are:

1. Customers at Home and On the Go.
2. Small and Large Organizations.

For Customers at Home and On the Go, Company-A provides various services such as Broadband and Internet Mobile Services, Account Management, and Telephony Services. For Small and Large Organizations, Company-A provides the following services for four business areas – Small and Medium Enterprise, Corporate, Government, and Business Solutions:

- Fixed Telephony
- Mobile Services
- Messaging
- E-Applications
- Data Services
- Telecom Services
- Business Solutions

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4.3 Study Findings

This section reports the major findings of the study, with particular attention to addressing the research questions.

Nevertheless, Data mining systems may be capable of supporting the telecommunications sector in resolving corporate difficulties by discovering the hidden business information in the organizational database. The corporation can also utilize data mining to analyze customer purchasing behavior to enhance and build relationship continuity. This will generate more economic value by offering products and services that customers prefer over competitors’, retaining existing customers and acquiring new customers to create customer loyalty. Furthermore, CRM and data mining are valuable tools for direct marketing, which can generate further return on investment and be used to identify the targeted and potential customers who are responding to the new product offerings. By using the historic purchasing data, data mining techniques can predict the likelihood that a customer is serious and will respond to the promotion. In addition, CRM can be used for customer analysis and segmentations.

Moreover, The implementation of data mining and CRM facilitates the recognition of new business opportunities and to drop the budget of marketing campaigns (below the line) and enhance the services by providing more innovative product and services (above the line) to existing and new customers. Hence, when the business identifies precisely who their customers are, they can subsequently pay close attention to that particular group of customers.

4.3.1 Company-A’s CRM Solution

In order for Company-A to sustain and increase its market share and remain competitive, a carefully planned business strategy is put into process. In addition to that, the company is constantly seeking new ways to keep its customers satisfied. One of the main approaches to customer satisfaction is adopting a CRM strategy. In response to answers given during the interview sessions, the researcher has come up with the following analysis of the company’s approach to handling customer data and incorporating it in CRM initiatives. Company-A handles large amounts of data and stores these large amounts in a massive data warehouse, which has a size of more than 2.6 Terabytes. This data warehouse holds historical data, which is detailed and summarized, to various levels.

For the purpose of the corporate data warehouse, an SQL Database is used for the retrieval of corporate and customer data and this data is then stored in the database schema. However, every department uses a different database system for handling specific data. The data warehouse integrates data from multiple incompatible systems to a format that provides one consistent view for the organization. The process of Manual Scripting is used for point-to-point interfacing. New data is always added as a supplement to the data warehouse rather than a replacement. The database is continuously updated once the new data is added and integrated with the previous data.

Data is sent to the warehouse from various points in the company. The sources of data include:

- **Operational Data:** Consists of data residing in networked and hierarchical databases.
- **Departmental Data:** Consists of data residing in relational databases such as Oracle and data contained in proprietary file systems.
- **Private Data:** Data residing on employee workstations and servers.
• **External Systems:** This data is captured through monitoring the company’s Web server log files and through databases associated with Company-A’s suppliers.

The data warehouse serves a means to increased competitive advantage for Company-A. This is evident in the fact that it is used for decision-making purposes and contains sophisticated analytical tools to provide statistics. In general, Company-A’s corporate data warehouse provides helpful information for its users through its various capabilities. These capabilities include:

- Reporting and Query Production Tools
- Online Analytical Processing (OLAP) Tools
- Executive Information System Tools

![Figure-09: The Data Warehouse Architecture](image)

In the process of CRM, the **Oracle CRM** software application is used. This database system is a human resource management system (HRMS) that incorporates data from three different sections. These sections include Sales (management of sales-related data; data retrieved from systems used by clerks and account managers), Faults, and Complaints. Faults and Complaints fall under the same umbrella as the management of customer complaints through the 196 Telephone service and other hotline numbers provided by Company-A for handling customer issues.

Data is sent from different transactional processing systems such as Sales, Orders (an E-Business Form is used to raise orders), Faults and Complaints systems. Large amounts of data are sent from the 196 system to on-site customer support staff. If data is not directly sent from the Faults and Complaints system to the designated on-site customer support staff member, the staff
member’s supervisor can handle this problem by routing the desired data to the employee. CRM activities are usually performed by analyzing data in the data warehouse.

The CRM team in Company-A is highly trained. The management team responsible for the CRM activities made sure that end-users were involved in the overall design of the CRM solution. A user-friendly interface is present to help employees in being more at ease when dealing with customer data. The information needed by CRM employees is available, on demand, and in real time. The CRM system also provides additional business intelligence that aids the sales force in understanding customer data and facilitates the processes of identification and pursue for cross-selling and up-selling opportunities in the market. In addition, it helps the employees in completing their work more efficiently.

The Oracle CRM Application system includes a built-in module called ‘Discoverer’. ‘Discoverer’ handles countless statistical responsibilities and performs report generation as well as sophisticated analysis of customer behavior and purchasing patterns.

### 4.3.2 Reasons for Adopting a CRM Solution

The major reasons behind Company-A’s CRM initiatives stemmed from the company’s need to automate the entire customer lifecycle, including lead generation, creating marketing campaigns, forecasting sales, managing the sales process, the launch of support contracts, configuration, creation of market segments, the commencement of products and services, and the delivery of customer service.

The CRM solution is designed to help the company in understanding its customers and thus creating long-term relationships with profitable customers. The result of the relationship should be reflected in increasing sales figures. Company-A has noticed an increase in sales as a result of carefully managing its CRM activities. The sales team plays a vital role in facilitating relationships between the customers and the company. Therefore, Company-A is always concerned with providing the right and continuous training to its employees to help them accomplish their jobs according to internationally accepted standards and practices.

“As your sales teams work with prospects, the ability to see where the customer is at in the sales cycle becomes critical to closing business. The ability to define a process that requires steps in a workflow helps your sales team ask the right questions to move that sales closer to a close. Not only does the collection of that information help the sales person to close the sale, it also enables management to provide accurate forecasts.” (Sciacca, 2005)

### 4.3.3 CRM Metrics

Company-A has a strict marketing strategy that focuses on improved customer support and employee effectiveness. The CRM team measures the effectiveness of the implemented CRM solution according to a set of standards. However, for confidentiality reasons, these standards or metrics were not given to the researcher during the interview. To form a general understanding of CRM performance standards, a list of common metrics used throughout the world in the CRM field is shown below.

According to Pivotal Corporation (2004), the Return on Investment (RIO) Metrics and CRM, best practices involve a number of steps that must be followed when creating a customer relationship strategy. These steps must be conducted in order as shown below:

1. Define CRM success for your organization.
2. Preset corresponding metrics and data requirements.
3. Determine the business processes required to capture the data.
4. Determine user interface implications and accessibility requirements.
5. Plan for end-user training if you are making changes to existing processes.
6. Consider data hygiene – ensure the data that is captured is clean.
7. Scope the CRM project clearly and budget for all costs.
8. Secure management buy-in for any expansion to the original scope of work.

4.3.4 Lack of Data Mining Technologies

According to the information gathered during the interviews, it has become apparent that there is no existence for data mining in Company-A. Although the company has a modern and sophisticated IT infrastructure, the need for data mining usage has not been addressed yet. The lack of data mining techniques does not, however, affect the CRM process. Statistical tools such as the Discover and OLAP are providing a solid foundation for Company-A’s CRM solution. In addition to these tools, the corporate data warehouse contains sophisticated statistical capabilities and this has been one of the reasons for the company to postpone the consideration for data mining.

The company attributes a number of factors to the absence of data mining technologies. These factors include the need for a large budget to purchase the data mining software and hardware, the need for data mining experts to handle installation procedures and employee training, the fact that the complexity and the enormity of data mining techniques might act as a repelling agent to the adaptation of the new technology, and a strategic integration of processes might be time consuming and costly.

In addition to the reasons mentioned above, Company-A has sustained a remarkable customer service rate and is focusing on the productions of new offerings and services rather than the introduction of new corporate technologies. However, from the analysis conducted on the interview results, there might be a promising future for data mining to take off and prosper in Company-A. Although the participants were not very precise on their prediction of future introduction of data mining, they stated that the company is conducting research in similar fields and data mining has always been of interest to the middle and top management.

5 Conclusion and Recommendations

As customer needs continue to grow every day, innovative companies worldwide need to move beyond traditional methods of servicing this evolving customer base. Old approaches to acquiring new customers and striving to sustain their existence are no longer useful in enhancing the company’s profits.

The Internet and other sophisticated technologies are providing easy access to massive amounts of customer information. However, the revolution in technology and in data capturing technologies can burden companies with data and thus excessive data might add confusions.

“As customers and businesses interact more frequently, businesses will have to leverage on CRM and related technologies to capture and analyze massive amounts of customer information” (Rygielski, 2002).
Organizations in Bahrain have been moving towards CRM in order to capture a reputable spot in the business market and create a base of loyal customers. The telecommunications industry in the Kingdom of Bahrain is characterized with its continuous adoption of new technologies and solutions. Although, the existence of CRM was very visible in Company-A, the lack of data mining technologies in this domain has provided an area for further research.

As different technologies differ in terms of their effectiveness and simplicity of use, business executives have to take the responsibility for determining how data can be utilized. Issues such as exploitation of customer privacy must be taken into consideration when planning for CRM initiatives. This is important because fruitful customer relationships must be based on grounds of trust and security. Therefore, the customer’s permission must be sought when disclosing private information.

Another interesting issue is measuring the importance of data mining technologies. For some companies, data mining has served as a means to solving most organizational problems. However, the lack of data mining technologies does not indicate that the company is not technologically driven. Nevertheless, data mining techniques would certainly enable executives to make faster and correct decisions, which would ultimately better serve the overall organizational goals and objectives.

Nevertheless, Company-A faced a high competitive pressure after the Telecommunications Regulatory Authority (TRA) regulations. Mainly the churn phenomenon has been very costly for them because of losing many customers. CRM should provide enough software applications to increase their revenue, productivity and customer satisfaction by improving their customer relationships across all the firm fields like the web...etc. The marketing strategies implemented in Company-A among their competitors that effects the service quality and their customer satisfaction. Relationships are the secret of life as CRM implies, but managing those relationships are very difficult in the business world. The role of the relationships is being discovered and realized by the organizations that keep them ahead in the market. Creating customers can be considered the main purpose for any business, which also measures the success of the business by gaining a sustained competitive advantage (Al-Alawi & Al-Bassam 2018).

Company-A benefited from CRM by gaining more customers which led to more profitability. Poor service result in driving the customer away, which can be avoided by implementing the CRM successfully. CRM also increase the sales and lead to customer satisfaction. Marketing is an important part of Company-A CRM database analysis. CRM could be an effective program through gathering valuable information about sales and marketing to enhance the top and bottom line. The top line could be enhanced through high sales and managing the data more effectively, and by introducing more innovative services to the customers where’s the bottom line could be enhanced by lower service times/costs and increased productivity.

When dealing with service provider, customers prefer friendly and good personality workers who are dedicated for their satisfaction. CRM software allow the employees to record the services provided for customers, to refer to them eventually regarding how the services where been done. Company-A seeks for participation and involvement in the active areas of work, they mostly support the youth generation from the society in many areas like; education, sport and health. They always try to evolve and keep improving their services and work to stay competitive and always be up-to-date. CRM benefits to customers with better customer interaction, more chances for achieving competitive advantage, and great cost reduction. The customers will be more satisfied with the service provided. The period of the services provided will be short that will save the customers time and effort. This had many
Company-A could better understand the needs and wants of their customers through CRM and e-CRM to provide different services for their customers to satisfy as much as possible multiple and unique needs, so they can have more loyal customers. Company-A should provide better services than their competitors regarding their customer base and customer loyalty programs. When customers suffer from problems Company-A managers and executives should help the customers and come up with a solution quickly.

5.1 Recommendations

Company-A has implemented a successful CRM solution, which is reflected in the remarkable range of products and services that are offered. However, it can be seen that the execution of the CRM strategy has been the result of a long process of carefully studying the market socioeconomic forces, the endless customer demands, the ever-changing business environment, and identifying business problems that require a CRM solution.

For Company-A, CRM has been a business aid rather than an enabling technology. Companies seeking to adopt CRM solutions should to a large extent follow Company-A’s lead.

Although data mining techniques are not fully implemented in Company-A, other organizations can try to create a competitive edge by introducing data mining technologies into their business processes. However, before any execution of integrating a complex new technology into any firm, the management must understand major business problems on one hand, and how the proposed technology matches the problems and the overall organizational strategy and corporate behavior on the other hand. This is essential because any introduction of new technology solutions or processes would certainly influence the production of the employees in the organization who usually fear change. Moreover, with careful and thorough analysis of the IT infrastructure in the company, as well as learning from others’ experience, with special emphasis on large service-oriented companies around the globe, the company seeking to adapt data mining technologies can dramatically reduce its capital and operating expenditures.

It is of paramount importance to the success of any technological implementation that the staff members involved should be provided with adequate training to enable them to efficiently and effectively operate and maintain the technological solutions.

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