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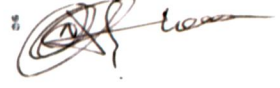
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**DEVELOP AN ERP INTEGRATED CRM APPLICATION
WITH DATA MINING**

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ÖZET

Geleneksel firma yapıları incelendiğinde, firmaların ağırlıklı olarak iş süreçlerine ve kullandıkları teknolojilere odaklandıkları, bunların takibi içinse Kurumsal Kaynak Yönetimi (ERP) ve Malzeme İhtiyaç Yönetimi (MRP) sistemlerinden faydalandıkları görülmektedir.

Diğer taraftan Müşteri İlişkileri Yönetimi (CRM) uygulamalarının yapısı incelendiğinde, CRM uygulamalarının bağımsız çalışan, sadece müşterilerle ilgili gerçekleştirilen aktivitelerin takibini kolaylaştırmak amacıyla tüm müşteri aksiyonlarının kaydedilmesine ve izlenmesine olanak sağlayan yapılar olduğu görülmektedir.

Firmaların üretim, pazarlama ve satış işlemlerinin bir bütünlük içinde ele alınmasının daha faydalı olacağı fikrinden hareketle, bu tezde CRM uygulamalarının en temel kavramlarından olan müşteri sadakatini sağlamak üzere, ERP sistemleriyle bütünleşik çalışabilecek CRM uygulamaları geliştirilmesi hedeflenmiştir.

Belirtilen hedef doğrultusunda CRM uygulamalarının kendi başlarına çalışan uygulamalar olmanın ötesine taşıyarak:

Pazarlamaya yönelik bazı adımların uygulama içinde barınmasını sağlamak

Üretim ve muhasebeleştirme açısından ERP sistemiyle senkronizasyonu temin ederek CRM uygulamamızın ERP sistemiyle entegrasyonunu sağlamak

CRM uygulaması kaydedilmiş olan geçmiş bilgiler üzerinde veri-madenciliği yaparak müşteri profil grupları oluşturmak amaçlanmıştır.

Müşterileri gruplarına göre öngörülen aktiviteler sayesinde CRM uygulamasının müşteri sadakatinin arttırılmasında daha fazla katkı sağlayabilecek bir yapı haline getirilmesi hedeflenmiştir.

Bu tez kapsamında CRM, ERP ve veri madenciliği kavramlarını da dikkate alarak yukarıda belirtilen hedefleri gerçekleştirebilmek amacıyla bir veritabanı mimarisi ve onun üzerinde gerçekleştirilmiş web tabanlı bir uygulama yapısı geliştirilecektir. Mümkün olduğunca yeni teknolojilerin kullanılmasına özen gösterilerek hem CRM konusunda öngörülen ihtiyacı karşılamaya, hem de en az kodlama ile en yüksek verim elde edilmesi amaçlanmıştır.

Sonu olarak tezde vurgulanan temel nokta, CRM uygulamalarının kendi başlarına alıřan uygulamalar olarak deęil, üretim, pazarlama, muhasebe ve satıř sistemleriyle bütünüleřik kurgulandıklarında daha olumlu sonuçlar elde edilebileceęini gösterebilmektir.

Mart 2007

Ahmet HOSO

ABSTRACT

Companies traditionally focused on processes and technologies, with the objective of optimization by using MRP and ERP systems. The focus was always inside the company.

On the other hand, when the general structure of CRM applications are analyzed, it seems that CRM applications providing a chance for the enrolling and following of all customer actions in order to facilitate the follow up of activities, actualized related to independent workers.

As a result, production, marketing and selling departments of companies will benefit more by discussing within the totality. In this thesis, customer loyalty as one of the basic concepts of CRM is aimed by developing CRM applications that will be integrated with ERP systems.

In the direction of improving integrated CRM applications:

Provide for applying some steps devoted to marketing.

Enable integration with ERP systems by assuring synchronization with ERP system in terms of the production and accountancy.

Constitute the customer profile groups by data mining upon past information recorded by CRM application.

With the help of anticipated activities per customer groups, CRM systems target at providing higher increase in customer loyalty.

In the scope of this thesis, database architecture and a web-based application will be developed to achieve the targeted benefits. The aim is both to meet the anticipated needs in respect to the CRM issues and to obtain the highest output with the least coding by applying new technological opportunities.

As a conclusion, the main point of this thesis to show that designing CRM applications integrated with production, marketing, accounting and selling systems will generate better results.

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Ahmet HOSO

LIST OF ABBREVIATIONS

CRM : Customer Relationship Management

ROI : Return on Investment

ERP : Enterprise Resource Planning

MRP : Material Requirements Planning

PAC : Production Activity Control

MES : Manufacturing Execution System

APS : Advanced Planning and Scheduling

APICS : American Production and Inventory Control Society

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PART I. INTRODUCTION AND OBJECTIVES

When looked at the past, until the beginning of the 21st century, the most important objectives of companies were decreasing the cost of production and increasing the quality of products. Therefore, those companies traditionally focused on processes and technologies, with objective of optimizing these processes using MRP and ERP systems.

The purpose of ERP is to create a single computer system that can perform all of the functions of every department within an organization by linking all of the departments into one single database. With the integration into a single database, it enables everyone within different functional areas to share the same information as well as communicate with one another. "What ERP really does is to organize, codify, and standardize an enterprise's business processes and data. The software transforms transactional data into useful information and collates the data so that it can be analyzed". [1]

However, with the beginning of 21st century nearly all companies produce same quality products with almost the same cost. Therefore, companies understand the importance of the customer with consequences of managing customer relationships using CRM process.

The purpose of CRM, Customer Relationship Management, is analyzing customer behaviors and information in order to gain loyalty and as a result profitability. In other words, CRM is an enterprise approach to understanding and influencing customer behavior through meaningful communications in order to improve customer acquisition, customer retention, customer loyalty and customer profitability. [2]

However, when the general structure of CRM applications are analyzed, it seems that CRM applications run independently, and they simply store customers' information and activities and then show this information whenever needed.

Product configuration is a CRM function. It captures customer orders, their requirements and preferences. Based on predetermined rules, these order

requirements are converted into feasible configurations. This configuration then turns into a work order, which goes into production systems.

Product configuration requires integration with ERP system, as it needs to interact with the item master, bill of materials, routing, cost, price, work order, sales order, and quote in order to accept successful configured order. In order to configure the quote or sales order with specific features for the customer, configurator needs to get information like how long it takes-to-make the product, how much it costs or affects the price, delivery date and availability. All this requires integration with ERP systems. If this integration is not provided, purchase information needs to be duplicated on both CRM and ERP applications. This means data-repetition.

Additionally, configurations can add or change an operation or routing. They may change the work center where the operation is performing, or the run rate or the set-up time of an operation. A configurator is also required to produce any special instructions on the work order, sales order or invoice.

Another reason for companies to integrate CRM and ERP is that customer interacts with companies through a variety of channels like phone, fax, mail, email, web sites, and wireless devices. Ensuring high quality customer service and providing reliable information is the main challenge for businesses. CRM packages enable companies consolidate information across different channel and present consistent information irrespective of channel.

Another important issue that drives today's customer centric model is mass customization. Mass customization is the ability of an organization to communicate in a personalized manner with many people concurrently. CRM and Internet technology have enabled mass customization.

As a conclusion and the main point of this thesis, ERP and CRM applications are very important for a company and integration of production, marketing, accounting and selling systems with CRM applications will generate better results.

PART II. GENERAL BACKGROUND

II.1 CUSTOMER RELATIONSHIP MANAGEMENT

II.1.1 Introduction

In this section, fundamentals of Customer Relationship Management (CRM) are discussed. In order to understand the purpose of this study, one should focus on what CRM is and what its functions are.

The next section provides the definition and foundations of CRM. Following section will go through the new terms that have come along with rise of CRM, define strategic and tactical goals of CRM and continue with the term “customer loyalty”.

Later, the definition of customer loyalty, customer loyalty cycle and their relation with CRM will be explained. Advantages and benefits of CRM will be stated by explaining the CRM process, importance of channel management for CRM implementation and pointing at some of the CRM success stories throughout the world.

II.1.2 Definition of CRM

Generally accepted definition of CRM, Customer Relationship Management, is analyzing customer behaviors and information in order to gain loyalty and as a result profitability. In other words, CRM is an enterprise approach to understanding and influencing customer behavior through meaningful communications in order to improve customer acquisition, customer retention, customer loyalty and customer profitability. [2]

CRM is the technology that forms relation between a company and its clients through the customer relationship cycle [3]

Another accepted definition states that CRM is the variety of methods and contact strategies that the companies use to build lasting and profitable relationship in order to retain the best customers and generate profitable revenue.

Therefore, CRM is an interactive process that turns customer information into positive customer relationship.

The technology used for data transformation and analyses is very important. With a highly improved technology data, analyses can be made more rapidly and healthy, and as a result, it accelerates the decision making speed of the management. It empowers tight customer contacts, more efficient and useful marketing activities, thus the company becomes more informed about their customers.

CRM processes and relations cycle will be later discussed. Note that CRM needs to be associated with everything a company does, everyone it employs, and everywhere it transacts. When a company claims its goal as to implement CRM and to form good customer relationship with good customer services, it should be talking about the whole company.

In fact, the most useful definition of CRM is the term itself: the management of relationships with the customers. The keyword of the term is relationship. However, it is very important to comprehend the meaning of this word “relationship” clearly, because many companies believe that they have relationship with their customer although such a relationship does not exist. These companies conceive of a transaction done by the customer or a sale done as a relationship. In fact, the communication must be bilateral, integrated, recorded and managed in order to call it a “relationship”. Without historical data, transaction details and complete customer information it is impossible to talk about forming a stable and lasting relationship.

Finally, each company should determine what CRM means for its organization and for the future of it.

II.1.3 Foundation of CRM

Without a doubt, CRM or Customer Relationship Management has been one of the most popular terms throughout the world since the early 2000s. However, how did this term appear and where did it come from?

When looked at the past, one can see that until 1970s demand had been greater than supply, which meant that the companies were selling almost whatever they produced. However, since 1970s supply has begun to equalize with the demand, meaning that a competition has started among the companies. Until 1970s, quick and serial production had been the best way for production, but since 1970, with the competition, costs and marketing has become more important than ever.

Companies searched ways of increasing demand in these times. Promotions and advertisements have been developed aiming to gain better price advantage and as a result more profit. In 1980s, supply in the market became greater than demand and with the development of technology nearly all of the companies' cost was approximately the same with the others. This forced companies to find other ways to attract customers. One can say that the term "quality" in its real meaning was born in these years. With high quality products and marketing activities, companies were able to pass nearly ten years. However, with the beginning of 1990s these activities have become insufficient, too.

In 1990s, supply in the market was much greater than demand, which meant a heavy competition, as the costs were nearly the same, thus companies needed to find something else. Just in these years companies remembered that there is someone called customer. In fact, the term customer was discovered at the beginning of the twentieth century, but it took nearly 100 years to understand the meaning of it.

In 1990s, the roles of buyer and provider/supplier changed as mentioned. With the supply getting greater than demand, customers' role for the suppliers has changed from "hunted" to "special". Before, the leaders of global brands were deciding who the customer would be, the basic idea being "The public wants what the public gets". But the days of Henry Ford, telling everyone can get any color car that he wants as long as it is black has expired [2] when someone decided to listen to the customers and offer them a second color.

In 1990s, companies started making person-to-person marketing activities, being customer focused, listening and understanding customers. Activities like sending happy birthday card to customers started in these years. Banks began to offer education credit to their customers who have children.

These activities were the first steps of CRM implementation.

With the increase in competition, companies realized that they should focus on what the customer wants, producing the best product means nothing unless it matches what the customer needs, and every customer needs different products or services. However, how would they do this? How would the companies get what the customers need and want before even customers discover themselves? How would they find which product is best for which customer? In addition, most important of all, how would they still make profit? CRM is a technique born with seeking for the answers of these questions.

Today the customer requires flexibility, availability, creativity and price advantage from supplier. Therefore, organizations need new techniques to discover these attributes of customers for being successful in forever changing world of customer wishes, preferences, behaviors and loyalties.

Today companies need to make miracles for their customers by listening to them and by analyzing what they say, do, prefer and wish.

One must remember that information transformed into knowledge is the differentiator for success.

II.1.4 New Terms in CRM

With the discovery of the importance of Customer Relationship Management, companies needed to re-question the terms that they used to know as follows [4].

II.1.4.1 New Customer or Loyal Customer

Accepted by nearly all marketing authorities in the world that getting new customers costs nearly 5 to 15 times more than keeping present customers. With the understanding that satisfying current customers also brings profit, companies began to give equal importance to keeping present customers as the importance they give to new customers.

II.1.4.2 Market Share or Wallet Share

A new term, called wallet share, has appeared in the CRM world. The meaning of “wallet” share is: How much does a company use customer’s buying potential, in other words, how much of a customer’s money he has separated for buying a product, is spent for buying something from the company in question and how much of it from its competitors.

II.1.4.3 Account / Card or Customer Number

Being customer focused, companies realized that they had a very big problem about having real customer records. Before CRM, as companies were not interested in customers too much, a unique number for customers was not being used. Instead, product based analysis and account details used to determine the real number of their customers.

II.1.4.4 Customer Surveys or Real Customer Behaviors

Researches and examples show that surveys do not reflect complete thoughts of customers. In many surveys, although customers say that they are satisfied with a product or service of the company, in reality sales of the company may indicate the opposite. Surely, surveys are important and useful but in order to build a fruitful relationship with customers and to manage this relationship perfectly, companies need to analyze the customers behavior and they should be able to discover thoughts, needs and wishes of their customers without asking them. Customers usually give important hints about their life styles with the transactions they perform, but many companies had not been able to understand and comprehend these hints before using CRM. They could only ask their customers about their lifestyles and consuming habits.

II.1.4.5 Stealing Customer from Competitors or Decreasing Customer Abandon Rate

Before CRM age, companies were focused on stealing customers from competitors in order to gain advantage in the market. After CRM's appearance, they have realized that decreasing the abandon rate of present customers is also as important as taking competitors' customers, the cost of keeping a customer is much lower than getting a new customer.

II.1.4.6 Product Line Profitability or Customer Profitability

Product profitability never left its place to customer profitability, but with CRM, it has become possible for companies to measure the profitability of customers individually and in groups or segments. It will not be difficult for companies that can measure product profitability to measure customer profitability. However, companies that cannot measure product profitability will certainly experience problems with this new term, and CRM will not be a solution for these companies for measuring profitability. Customers gaining importance with CRM, measuring customer profitability has become a necessity.

II.1.5 Strategic and Tactical Goals of CRM

As CRM is the way of managing relations with the right customers, CRM's goal is to increase the opportunity of communicating with the right customer, and offering the right product at right price, through the right channel, at the right time.

Understanding the historical behavior of customers, information about their buying habits and their ideas, a company could catch the right customers.

The goals stated above can be characterized as follows:

Right Customers: Customer relationships must be managed throughout their life cycle and the customer potential must be realized by increasing “share of wallet”, which explained in previous section.

Right Offer: Customers must be introduced to the company and its products efficiently, and offers must be customized for each customer.

Right Channel(s): Communications must be coordinated across every customer touch point, each customer must communicate through the channel that he or she prefers, and the channel information must be captured and analyzed for continuous learning.

Right Time: Marketing during the communications with the customers must be, as near to real time marketing as possible and the customer communications must relate.

II.1.6 Real Customers

Who really knows their customers? This question is two sided. The first one is to form relationship with customers; organizations must first know their customer. What does this mean?

From a distance, we see that customers all have something in common; when we look closer, we see that they divide into groups, each group with different characteristics, behaviors and wishes. If we look even closer, we see that the groups of customers begin to divide in to smaller groups called segments, which have really very specific and common characteristics and nearly the same behaviors and wishes. In fact, closer and closer look to customers will never be enough because customers and their requirements will change day by day.

So companies must form customer groups or segments by using the behaviors, wishes and as much information as they can gain, of the customers in order to understand and know their customers. The foundation of a good relationship with the customers requires understanding and knowing the customers.

When we look to the question from second aspect, we face with another question: who really knows who their best customers are? Organizations must know their customers for first forming good relations with them and secondary for finding out which ones are best and profitable ones.

II.1.6.1 Best Customers

Who really know who their best customer is? In many cases, it is easier to find new customers than keeping the existing ones. In fact, companies must look at the long-term profitability of each customer to determine whether their marketing and development resources are use well or not.

Researches show that generally it costs less for the company to keep existing customers than try to win new ones. In the Accelerating Customer Relationships book, writer Ronald S. Swift claims that it is five times less expensive to keep customers than to find new ones. If a company can keep customers they become more profitable in long-term. New customers are generally attracted by price cuts or by other incentives, but these customers go to another competitor as soon as another incentive is available.

So companies must look for ways of keeping profitable customers, must try to increase these customers spending and then try to attract new customers. In addition, of course to do all these, companies must first find out who are their profitable customers. With the information they have, they must differ their best customers and they behave better to them.

Here we want to give example related to the main idea of our thesis. Think about a company sales some products or services to their customers. In addition, at a time two customers of this company want to take some service from this company. One of these customers profitable for company, the customer buys many product and services from company and the company make money from this customer. However, the other one buy one or two product or service from company. In addition, the company goes first to the second customer and than to the first one. Do you think there is a problem here? Yes there is a big problem here, that is the company does not know about its profitable customers and as a result cannot serve in special forms to them.

Maybe just at this moment while you are reading this thesis if a company uses an integrated / thought largely CRM application they can know their profitable customers and they keep their customers easily.

As we have mentioned above companies must know their profitable customers and must keep them, because keeping existing customers is less costly and more profitable than finding new customers. Here we have been talking about keeping existing customers; this issue takes us to a new term called "loyalty".

II.1.7 Customer Loyalty

As seen from different researches made, customer satisfaction is unreliable because there is no correlation between measure customer satisfaction by customer surveys etc. and customer is repeating purchase. Many researches show that customers leave the company although they are satisfied. Some of the findings are as follows:

A company called Forum Corporation reports that up to 40% of the customers in its study who claimed to be satisfied switched suppliers without hesitation. [5]

Harvard Business Review reports that between 65% and 85% of customers who chose a new supplier say that they were satisfied or are very satisfied with their former supplier [6]

DR. Peter Zan Dan, whose company Intelliquest makes market research studies for computer manufacturers, reports that in more than 30,000 interviews his company has found out that high level of customer satisfaction has no relation with repeat purchases [7]

Therefore, as you see customer satisfaction is not reliable on customers going on using the same product or service. If customer satisfaction is unreliable so what must be measure tied to repeat purchase? The answer is Customer Loyalty

II.1.7.1 Definition of Customer Loyalty

In the past efforts to gain customer satisfaction was realized in order to influence the attitude of the customer towards the company or the products of it. The concept customer loyalty is more interested in behavior than attitude. When a customer is loyal, he or she realizes buying behavior, which is nonrandom. Here the key word is nonrandom because a loyal customer has a specific idea about what to buy and from whom to buy.

Two important conditions related to loyalty are Customer Retention, which we have mentioned a little before in Definition CRM part 2.2, and will mention later and total share of customer. Customer retention very generally is the length of relationship with a customer. A customer retention rate is the percentage of customers who have made a specific number of buying activities in a defined time period. A firm's shared of customer is the percentage of a customer's budget spent with the firm. These two terms are essential for loyalty.

II.1.7.2 Loyalty and Profitability

The rewards of loyalty are long term. The longer a customer remains loyal, the more profit the company gains. Researches made in various industries show that customers generate more profit for the company if they stay longer.

One of the most important factors comes with the loyalty of the customer and effect the profit of the company is cost saving.

There are six areas that loyalty brings cost savings to the company [8]

Reduced marketing costs

Lower transaction costs, such as contact negotiation and order processing

Reduced customer turnover expenses (fewer lost customers to replace)

Increased cross-selling opportunity

More positive word of mouth

Reduced failure costs (reduction in rework, warranty claims, etc.)

But the benefits of loyalty are not only these cost savings. Basically, as the usage increases, the sales and profit increases, too. If we take Credit Card usage as an example, customers do not usually use their credit cards in the first year they own it. But in the following years if there is no dissatisfaction, the customer begins to trust the bank and starts using the card. The use of the credit card increases each year as a result of the bank increases the limit.

The main advantages of the lifetime loyalty are as follows:

Sales go up because the customer keeps on buying from the company

The company gains strength in the market because customers are buying from the company instead of competitors

Marketing costs decrease as the company does not need to attract the loyal customers who already belong to the company and besides this, loyal customers will talk to other people about their satisfaction with the company's product making a natural advertisement of the company.

Company will gain advantage in price competition because loyal customers will not leave the company with a little discount of competitors.

Cross-selling door opens to the company with the loyal customer.

When the company spends less for capturing customers, it can spend money for product or service improvement, which will turn with more customer loyalty and new loyal customers.

II.1.7.3 Loyalty and Purchase Cycle

Each time a customer buys something, he or she goes through a buying cycle. This cycle can be grouped in five main steps. First, the customer becomes aware of the product in a way, second he or she makes an initial purchase. Next the buyer goes through two steps; one called post-purchase evaluation and the other is called repurchase decision. If the decision to repurchase is positive, then last step “repurchase” follows. The order in which repurchase, post-purchase evaluation and decision follows each other goes on several times during the customer’s relation with the company and its products or services.

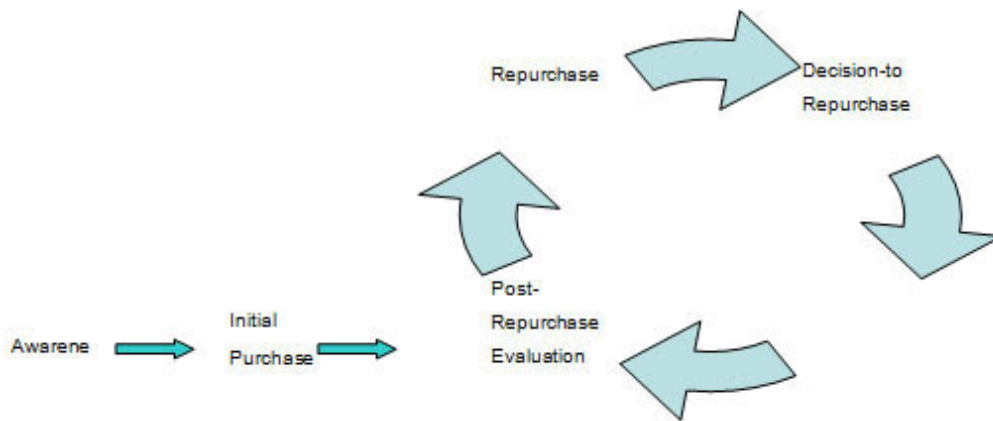


Figure II-1: Loyalty and Purchase Cycle. Swift, 2001

II.1.7.3.a Step1: Awareness

The first step of loyalty is awareness. Loyalty begins with the customer’s becoming aware of the quality of the product or service of the company. This step is important because taking this step the company puts its products or services one level above the competitors’ products or services in the customers’ minds. Customer can become aware of a product or service in different ways: advertisement, direct contact (mailing, calling or door-to-door promotion) and other marketing activities. At the awareness step a potential customers learns that the product and the company exists. But making aware of the product or service is not enough to catch customer, in this stage with a better advertisement or marketing activity competitors can steal the customers.

II.1.7.3.b Step2: Initial Purchase

The first time that a customer buys a product or service is maybe the most important step in building loyalty because first time will be a trial time for the customer. In this step the company can impress the customer positively or negatively by the quality of its product, its employees, services and even with its surrounding. After this step is taken than the company can start building relationship with the customer.

II.1.7.3.c Step3: Post Purchase Evaluation

After the customer makes purchase, the rest of the process becomes easier to maintain. If the customer is satisfied with the product or at least he or she is not disappointed to go to a competitor the next step, decision to repurchase, is strongly possible. As we have mentioned before customers usually consider them selves as satisfied but they don't go on with the product that they were satisfied with. So in order to take the next step satisfying the customer is as must but is not enough a lone.

II.1.7.3.d Step4: Decision to Purchase

This is the most critical part of loyalty. Decision to repurchase is more important than customer satisfaction as there won't be loyalty if the buying behavior doesn't repeat. For a customer to decide to buy a product again that product must have a real advantage or a favorable specification compare to alternatives. What we are talking about here is not that the product must be perfect to be bought again buy the customer; it must be advantageous and favorable. If the company can make an emotional bond between the customer and the product, it will be natural step for the customer to buy that product again. There are some companies that can do this very successfully, such as certain cigarette brands. Another powerful way to gaining customer's decision of repurchase is building the idea that it will be lost of time and money to buy the same product from a competitor. This can be made if and only if the company gives a clear quality and difference that the customers cannot give up and go to a competitor.

II.1.7.3.e Step5: Repurchase

The final step of the cycle is actual repurchase. In order to call a customer a loyal customer, he or she must make repurchase again from the same company,

repeating step 3 to 5. a truly loyal customer will repurchase from the same company whenever he or she needs an item. These kinds of customers are the ones that companies need.

In order to make repurchase companies must prevent customers, who have once bought from them; to forget them must be in contact with the customer in a way (mailing, calling, sending card, inserts etc). Making the customers to gain extra advantages at each repurchase can also be a good way of making the customers to repurchase. For example think about a bank where there is a commission for the first 5 money transfer transaction in a year, but after the sixth transaction it is free.

II.1.8 Competitive Advantage of CRM by Serving Customers the Right Way

We will return to our main topic CRM with talking about the competitive advantage that it provides for the companies.

The main differentiation of competitiveness today is service. Many competitors have nearly same prices so only the service is left to attract the customers. With the implementation of CRM customers are not only sold to buy, they are also served to. They are offered something extra, which makes them pleasant and happy. Service adds value to the basic product or service that the competitors cannot provide. Serving to customer means understanding what they say or do and satisfied their exact needs. Handling the right customers the right way the right product or service at the right time through the right channel means serving them and this will give them enough reasons to call back. There is no need to tell what we are talking about here is just the normal output of CRM and it is clear that it provides real competitive advantage to companies.

II.1.9 Costs and Benefits of CRM

The benefits of CRM can be classified as follows:

II.1.9.1 Lower Costs of Catching Customers

As we have talked about this benefit of CRM, we won't repeat what we have said before. It is clear that CRM makes savings on marketing activities, contact and follow up costs and so on.

II.1.9.2 No Need to Recruit So Many Customers

CRM helps to maintain a steady volume of business, which can be very important in some market. With CRM implementations companies will have enough and profitable customers and won't deal with non-profitable ones.

II.1.9.3 Reduced Cost of Sales

Existing customers shall be informed about the company's channels or distributors and this will make the relationship of the organization with the customers more effective. CRM will also provide higher ROI, return on investment, in marketing and customer communications, as it will reduce marketing campaign costs.

II.1.9.4 Higher Customer Profitability

The most important output of CRM is higher customer profitability.

With CRM there will be larger wallet-shared, more continuous and following sales, more customer satisfaction with personalized service, cross-selling opportunity and as a result more profitability.

II.1.9.5 Increased Customer Retention and Loyalty

CRM makes the customers stay longer, and buy more. With the good implementation of CRM customers finding a service that is worth staying with the company and as they don't want to waste their time and money with competitors they go on and on buying from the company.

II.1.9.6 Evaluation of Customer Profitability

CRM makes it is possible for company to know which customers are profitable, which low profited customers can be made profitable ones with cross-selling, which might never become profitable, and customers should be served by which channel and other information such as these.

With CRM, excellent customer service, turnover and profit might be gained.

II.1.10 Targeting Profitable Customers

Targeting profitable customers is a worthy objective. With efficiency companies can do saving from financial and human resources but having the right customers, and providing them the right product or services is the best way of profitability.

One of the ways used to achieve the targeted profitable customers is specialized campaign management, which means campaign management divided in to customer segments or even maybe specialized for each customer.

Figure 2.2 shows that there are many aspects for creating ROI, return on investment. The ROI curve doesn't accelerate until the company gains the ability of keeping present profitable customers and migrate preferred customers to preferred products, services and channels.

The ROI increase is possible is and only if customer loyalty, which means repetitive purchases of a product from the same company, as explained before, is gained. With customer loyalty the company can have opportunity to gain new customers with the referral of the present ones. Nothing is more effective than a happy and loyal customer's referral to a potential customer who desires to have the same product or service too.



Figure II-2: Customer Focus Levels and Potential ROI. Swift, 2001

It is seen from figure2.2 that high ROI is achieved at the last stages of customer relationship and customer focus.

When a company becomes the customer's advisor, then it gains the customer's understanding, belief, loyalty and increasing wallet-share.

II.1.11 CRM Is A Process Not A Project

CRM is an interactive process that turns customer information into customer relationship by learning from information. CRM begins with building customer

knowledge and results with customer interactions that forms long-term, manageable and profitable customer relationships. Figure 2.3 shows the CRM process cycle.

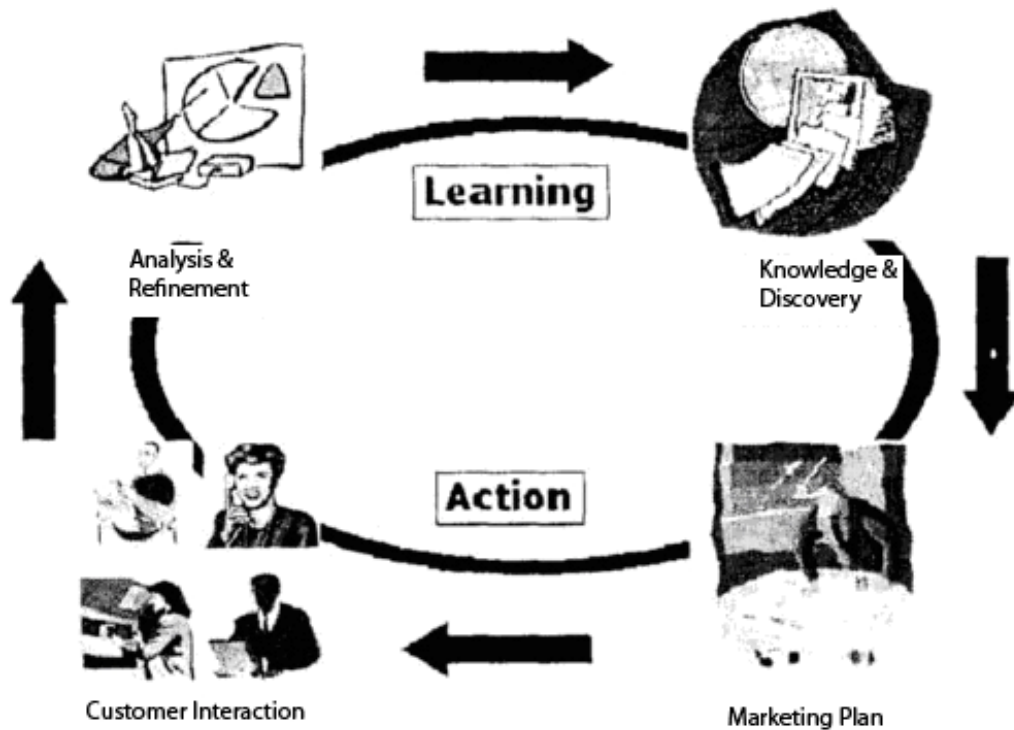


Figure II-3: CRM Process Cycle. Swift, 2001

II.1.11.1 Elements of CRM Process

The elements of CRM process cycle are as follows;

II.1.11.1.a Knowledge Discovery

This is the process of analyzing customer information in order to find out specific marketing opportunities and investment strategies. This process goes through customer identification, customer segmentation, and customer prediction. With knowledge discovery marketing personnel becomes stronger with access to detailed customer information for better analysis of historical customer information and customer characteristics for better decision-making. Of course a very well designed system is needed for this process. The system must collect detailed data from customer transactions from sources and transform it into information and knowledge that will be useful for management and planning. The sources that we

tare talking about can be internet accesses, customer care applications and surveys, complaint files, direct marketing contacts or customer denials.

With the knowledge and information gained company must customized offers, reduce costs by making targeted campaigns, and integrate various marketing activities. With the time saved by executing new campaigns, the business units of the company become more proactive, as a result the customers appreciate the company's contacting them with the right message at the right time. CRM also uses the knowledge to understand the customer's buying behaviors.

II.1.11.1.b Marketing Planning

This process group defines specific customer offers, delivery channels, and schedules. This process empowers the marketing personnel, service management team; manufacturing planning team and it also improves distribution chain, investment opportunities in channels, products and service of the company. With marketing planning, strategic customer communication plans and specific campaigns can be made.

II.1.11.1.c Customer Interaction

This is the key phase of managing customer communications. Here, different interaction channels, customer case applications, sales applications, customer contact applications and other interactive applications are used. This phase is the action phase of plan and messages created by the Knowledge Discovery and Marketing Planning phases.

Customer interaction must map the connections of the company to customers and strategies for sales and customer's purchase behaviors. Figure2.4 shows different interaction points for customers.

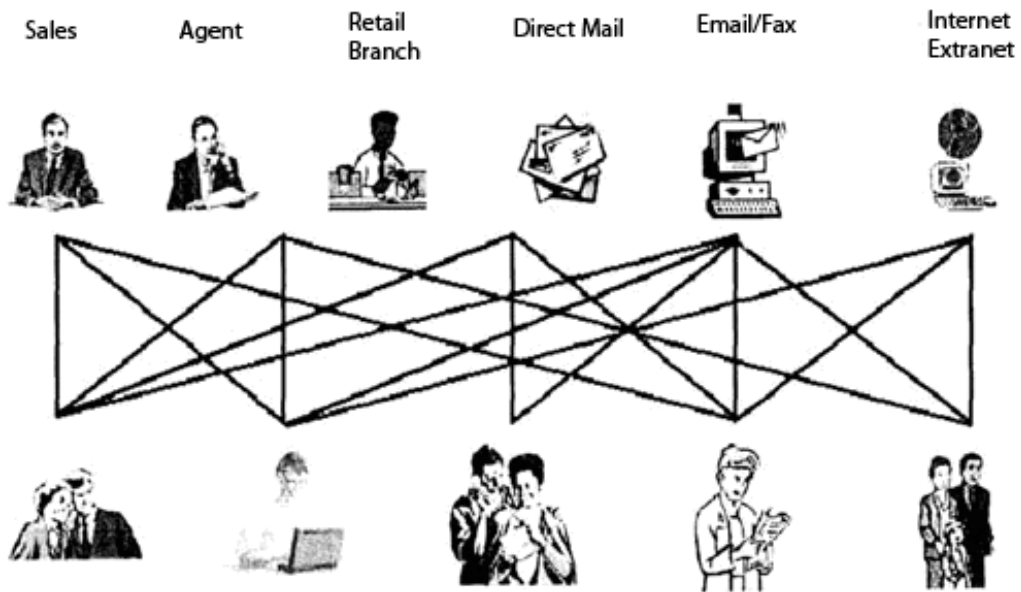


Figure II-4: Different Interaction Points for Customers, Swift, 2001

With the help of technology, the channels of the company will be collecting information about the customers. Through these channels the company will have the opportunity of making sales, delivering marketing messages and capturing service issue. The company must calculate the estimated costs of sales and interaction in this phase.

II.1.11.1.d Analysis and Refinement

This is the process phase of continuous learning from customers by capturing and analyzing data from customers' interactions and refining messages, prices, volumes, locations, approaches and timings.

II.1.11.2 Major Objectives and Benefits of A CRM Process

There are three main objectives and benefits of a CRM process. We have discussed each term before in different parts so we will just go through them.

Customer Retention: Ability to retain loyal and profitable customers and channels to grow the business (profitability)

Customer Acquisition: Acquiring the right customers, based on learned characteristics, which helps growth and increasing profits.

Customer Profitability: Increasing individual customer margins by offering the right product as the right time.

II.1.11.3 From Product Focus To Customer Focus with CRM Process

Before CRM, customers used to come last throughout the process of selling a product or service. Generally, the sales person used to listen to the customer and used to offer him/her what he feels is appropriate. In this type of selling process, the relationship is not based on knowledge but usually it based on the price. In many product-focused sales, process the sales representatives drives the customer to the product that he or the company wants to sell, not to the product that the customer really needs. In this situation, even if the customer buys the product, he or she feels as if he pr is taken. So not only before CRM but event now many companies do not understand customers, their needs and behave product focuses.

Customers do not appreciate this type of relation and generally reject to buy again from the same company.

II.1.11.4 Tactical Integration of CRM Process

At the beginning of CRM, implementation surely there will be a learning stage. To reach the goals of CRM companies may need to learn and use of others', who have passed the same way before, experiences, too.

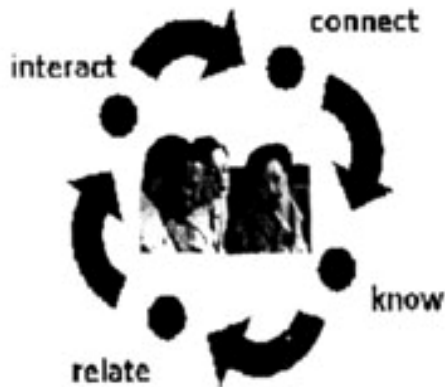


Figure II-5: Tactical strategies for the CRM Process, Swift, 2001

The four elements of tactical strategies for CRM process include:

Interact; This is the series of transactions that make a dialog between the customer and the organization. This is the data collected from every communication point

Connect; The management of interaction points between the customer and the organization.

Know: The Captured and analyzed information that will be used for continuous learning (about customers, products, channels, markets, competitors)

Relate: The application of building communications with customers

II.1.12 Stages of CRM Implementation

A CRM implementation process can be divided in to four main stages, these are operational success, analysis of customer behaviors, integration of service channels, and operational process. We will discuss here each stage. As you see in this part we are just going through the meaning of CRM and its implementation.

II.1.12.1 Operational Success

This stage takes place in the very beginning of CRM implementation. A company, which hasn't done anything about relationship management, or even hasn't collected some data about customers and its products or services, must start with this stage.

In the first stage of CRM, implementation customers must be able to make their transactions through any of service channels of the company effectively and correctly. The service channels or we can call contact points of the customers can be branch, Internet, email or phone call. In this stage the system used by both customers and personnel must be link to a common service line. When, a customer or one of the personnel makes a transaction the data kept in common service line must be updated online and real-time.

Again, in the stage the information obtained from customer surveys, request / complaint forms or the customer feedbacks collected in a way must be take. This information must be filter by marketing, or related departments must be start and the customers must inform about this.

With a successful first stage, with the investment made in the technology and operational system a company achieves an effective operational process with no errors in service channels.

Of course, in this stage every personnel in every department must be inform about the importance of service quality and other similar terms and must be train about being customer focused.

II.1.12.2 Analysis of Customer Behaviors

If a company has passed the previous step successfully then this step will be easy but if the first step has not implemented very successfully this does not mean that the company cannot go on with this step. If the first step has not implemented successfully then in this step the company can make the requirements of both steps at the same time.

During this stage of CRM implementation, the details of different transactions performed by customers through different service channels must be stored in a central system. By doing this the company will gain advantages about the following stages of CRM

Choosing Customer

Capture Customer

Keeping Customer

Improving customer

The company will be able to see from these points of view a specific customer or a customer segment on customer basis. This will help the company to understand easily the behaviors, the changes in the behaviors, reason of the behaviors, next behavior and the loyalty of a customer or a customer segment.

So the company will be able to get prepared for the possible changes in customer behaviors will be able to separate profitable and unprofitable customers, will be able to develop different approaches for every kind of customers or customer groups and will be able to direct the market.

A company that has solved collecting and analyzing data problem can make more specific and customer focused marketing activities. If true customer segmentation is made, the sales activities made through different channels can be very successful.

Generally, this type of marketing is called as target focused marketing.

With target-focused marketing the priority of the customer will pass from price to privilege gained by selling the right product at the right time and with this kind of marketing the marketing costs will decrease as the success of the activity will be high. So with taking the customers' priority from price and decreasing marketing costs, this strategy will have a direct effect on profitability.

The determination of data warehouse and data analysis method type must be done in this step; the costs of the investment in technology needed must be calculated, too.

The most possible problem that a company can face in this stage of CRM implementation is the insufficient technological infrastructure. Generally, the system infrastructures, especially if it is old, are not designed suitable for CRM so the companies can need to make developers in their system. Because that system infrastructure used is very important for this step.

II.1.12.3 Integration of Service Channels

This step is necessary for CRM implementation. If a customer can reach you through several channels internet, email, telephone etc. this channels output must be integrated. When personnel want to see one of customer' behaviors, he/she can be seeing this information from a screen and data, which displayed on screen, must be real-time and true data. So integration is other important step of CRM.

II.1.12.4 Operational Process

In order to achieve success in CRM implementation, there are some points, which should also be taken into consideration within operational process.

With CRM implementation operational structure must be:

Fast moving

Authorized and responsible

Fast in problem solving (especially the representatives working with customers)

Able to measure productivity

Able to make budget, planning and reporting

Focused on customer behavior

Storing the details of customer transactions

For a good CRM implementation, the operational process has to be suitable for taking, storing and transferring customer transaction details. Every part of operational process and systems must be integrated with each other such as defining a key field (as customer number) for each customer and using that data in each department to refer a customer.

So very briefly the most important issue of CRM implementation process are; measuring success financially (measuring profitability), collecting, storing and analyzing customer behavior details, depending on these analysis deciding how to serve to each customer, focusing on customers or customer segments, giving importance to wallet share, developing the relationship in long term and being open to continuous improvement.

II.1.13 Importance of Integration

In our CRM application, we believe that for all CRM applications, maybe the most important concept is integration. The reason is, if a CRM application might be integrated in its current system for our case with an ERP system, we could manage our customer relationship better. We might know who our best customer is and which customers are profitable for us.

II.1.14 CRM Examples in the World

One of the best-known examples of companies that have implemented CRM successfully is Sam's direct, a division of Wal-Mart stores in United States. Sam's Direct is a division containing more than 200 employees that work as direct contact force. They contact with small and medium sized companies to foster customer orientation in its discount club stores. With CRM approach, the sales of this division grew approximately \$16 billion in a \$40 billion industry [2]. Of course, this remarkable success resulted from the use of very detailed and analytical queries using the information and behaviors of the customers. It is known that Sam's Direct uses a technique called Market Basket Analysis that means understanding which products are bought with what others by analyzing customer behaviors. This techniques enables the company can offer another product that will be needed, to the customers that have already bought something.

Some of the companies that take place in researches or articles as successfully CRM implementers or last successful companies at analyzing customer information and behaviors are as follows:

- Bank of America (US)
- Barclays Bank (UK)
- Royal Bank (UK)
- Union Bank (Norway)
- Western Digital (US)

Migros (Europe)
Wal-Mart Stores (US)
Continental Airlines
British Airlines
American Airlines

II.1.15 Summary

In this part, we have got through Customer Relationship Management, CRM. We have explained its definition and foundation. We have tried to understand new customer and profit related terms that appeared with CRM.

After determining the strategies and tactical goals of CRM, we continued with defining the real and best customers for a company and the term “customer loyalty”. In this part of our thesis, we have seen clearly that there is a strong relationship between customer loyalty and profitability. The costs of the company increase while the profit increases with more customer loyalty and customer loyalty increases with understanding and implementing customer relationship management.

Lastly, we have mentioned stages of CRM process, integration of channels, the importance of current system integration, maybe an ERP, for CRM implementation and successful CRM examples in the world.

II.2 DATA WAREHOUSE & DATAMINING

II.2.1 Introduction

This section will be complementary section for part II.1. In the last section we have talked about Customer Relationship Management, in this chapter we will go through Data Warehousing and Data Mining, which are must for CRM implementation as you can't manage any relationship with your customers if you don't have any information about them, and as the information you have doesn't mean anything if you don't know how to use.

Firstly, we will see the relationship between CRM, Data warehouse and sales activities. Then we will define data mining, its definition, roles, classes of it and types of data mining algorithms. Lastly, we will end this section with explaining the process of data mining.

II.2.2 CRM and Data Warehouse

Data Warehouse can be called the relationship engine. For an effective CRM implementation, companies need superior data warehouse. Data Warehouses are the drivers and enablers for customer relationship management. By the presence of data-warehouse, companies have the opportunity to examine the information they have and to offer personalized products or services to their customers. A central data warehouse keeps all the detailed history about every customer, besides includes each customer's usage of products and services, his paying bills, his preferences about being contacted his reactions to previous marketing campaigns and so on. So from the information of the customer that is kept in a central data warehouse, the company can guess about the customers' needs or behaviors, for example, from customer hardware or software knowledge we may visit with true products or we may make true presentation to our customer.

II.2.3 Requirements of Data Warehouse

What a data warehouse is required to do are as follows.

It must hold every detailed data. Every transaction, email, phone calls, events, bills and every complaint needs to be logged.

Data-warehouse needs to be updated continuously. Not long ago, monthly updates were acceptable.

Data warehouse must be suitable for being used by large numbers of people at the same time because it will be used by different departments as CRM is not just about only one department, but it is about how the whole company will treat to its customers.

Just being accessible by large number of users will not be enough for a data warehouse. These users will wish to query and scan the information in the data warehouse in order to find out new patterns or make new analysis. So data warehouse must be suitable for the access and scan of large number of users at the same time.

The system must be also available for use any time.

It must be growing in parallel with the success and the new needs of the company

And as it will keep very detailed and private data, it must be protected very sensitively.

II.2.4 CRM, Data Warehouse and Sales

By understanding the customer better, a company with a strong data warehouse will be able to target more effectively the offer to the right customer at the right time through the right channel, which is already the goal of CRM. By using different combinations of the information, the company will be able to make more efficient marketing activities and as a result will be able to reduce customer acquisition.

So for increasing sales and income CRM is a must in our century and for implementing CRM successfully a strong data warehouse is needed.

II.2.5 Active Data Warehouse

Active Data Warehouse is an advanced data warehouse, which enables linking the warehouse to users' operational systems. For example analyzing inventories based on the previous day's information might make you give an order that was already given before. In Active Data Warehouse when some chosen transactions are performed, the related fields of Data Warehouse are automatically updated. Or in further levels of Active Data Warehouse users are linked to the Data Warehouse and every transaction is added to data warehouse online.

II.2.6 Learning from Information: Data Mining

Generally, data mining is the process of extracting and presenting new knowledge, previously undetectable, selected from databases for actionable decisions [2]

Some other definitions for data mining are follows:

Data mining is the process of analyzing detailed data to extract and present actionable, implicit and novel of information to solve a business problem. [8]

Data mining is the process of extracting valid, previously unknown, and ultimately comprehensible information from large databases and using it to make crucial business decisions. [9]

Data mining is the process of selecting, exploring and modeling large amounts of data to uncover previously unknown patterns for business advantage. [10]

So we can say that data mining is the process of analyzing detailed data and forming actionable information to solve a business problem.

Many business managers and people with less technical information define data mining as one of the following. The applications of the technology of data warehousing or data mining to solve business problems are as follows;

- Customer Profitability
- Customer Retention
- Customer Segmentation
- Customer Propensity
- Channel Optimization
- Targeted marketing
- Risk management
- Fraud prevention
- Market-basket Analysis
- Demand forecasting
- Price optimization

II.2.7 The Role of Data Mining

The two roles of data mining are:

Converting data into information and knowledge so that the right decision can be made

Provide the mechanism to put knowledge into operational systems so that the right actions occur

For example, by data-mining models can be build that predict the profile of customers who are likely to switch to a competitor, and then these models can be put in to CRM system to provide guidance to sales representatives while they are in direct contact with customers.

II.2.8 Classes of Data Mining

The term data mining was firstly used for traditional types of knowledge discovery such as query languages. Therefore, it is not easy to classify data mining methods. If we take the most popular data mining methods very generally, we can divide data mining methods in to two groups.

First group is Verification Driven Data Mining; the second group is Discovery Driven Data Mining.

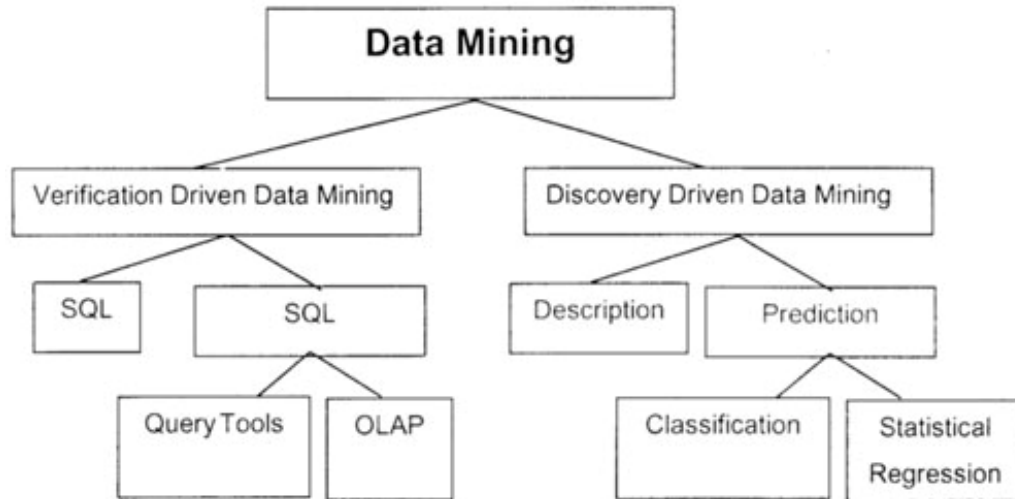


Figure II-6: Data Mining Taxonomy. Swift, 2001

II.2.8.1 Verification Driven Data Mining

Verification Driven Data Mining can be seen as SQL or SQL generators used to verify hypothesis. Here the analyst develops a hypothesis and uses the query language to explore and hopefully confirm his hypothesis. Here the most important point is that the analyst must know what to look for, if this technique is being used. As seen from figure II-6 SQL Generators broke in two classes: Query Tools and Online Analytical Processing (OLAP) tools. OLAP tools present the use with a multidimensional view of data. In fact, SQL Generators is a very deep wide the topic.

II.2.8.2 Discovery Driven Data Mining

Discovery Driven Data Mining involves the usage of intelligent software. Here the software plays a significantly more active role in the discovery of new knowledge, but the system is not fully automatic of course, it still involves analysts in its process.

II.2.8.2.a Prediction

Prediction involves building a model that will predict an outcome variable based on other variables in the data set.

Predict models can be built using traditional **Statistical Regression** techniques (such as SAS or SPSS) or with newer **Classification** techniques.

The most popular Classification technique is **Decision Tree Induction**, consists of a decision tree that takes variable, implements a condition on it and

selects the next condition to implement depending on the result of first condition, at the end predicts a decision depending on the results of conditions.

Both Decision Tree Induction and Rule Induction are examples of Machine Learning. They both have advantages of being understood easily humans.

A final Classification technique is **Neural Networks**. Neural Networks technique is less understandable but usually more accurate model. This technique mimics the neutral structure of the brain. Neutral Networks consist of collection of collected nodes with inputs and outputs organized into layers. Between the visible input and output-layers of nodes are one or more layers hidden nodes. The input variables are presented to the input layer and values are propagated from each node to every node in the next layer, continuing until a result is delivered from the output layer. The values that pass through the network are modified at each node based on a simple mathematical transformation and on the node's weight. Weights initially are assigned randomly but are continually adjusted by the network based on the accuracy of the outputs for each case it processes. Thus initial results are not meaningful but the network learns through training, using the training data producing more and more accurate answers. [2] The resulting neutral network model can then be put in a similar manner to a Decision Tree or Rule Induction model to predict outcomes.

11.2.8.2.b Description

Description techniques characterize data, separates into groups or segments and unlikely prediction techniques; do not predict an outcome based on other values. Some of the Description techniques are as follows:

Data Visualization reduces large amount of data in to more easily understood picture.

Clustering, segments large populations

Association finds rules that correlate the presence of one set of items with another set it items.

Sequential Association finds associations that link events over time.

Summarization reduces large amount of data down to easily understood, meaningful summaries.

Of course, there are also other data mining techniques, which we have not mentioned, too, such as Time Series, Forecasting, Case Based Reasoning, Logistic Regression, and Genetic Algorithms and so on.

II.2.9 Data Mining Algorithms

Central to the data mining process, data mining algorithms determine how the cases for a data mining model are analyzed. Data mining model algorithms provide the decision-making capabilities needed to classify, segment, associate and analyze data for the processing of data mining columns that provide predictive, variance, or probability information about the case set.

Many data mining algorithms are goal-oriented; given a case set, a data mining algorithm will predict usually an attribute about the case. Most algorithms require a training set of cases where the attributes to be predicted are already known, at which point the algorithm constructs a data mining model capable of predicting these attributes for cases in which the attributes are unknown.

By simple definition, a set of data analyzed and generated a set of grouping rules, which can be used to classify future data. For example, one way classify diseases and provide the symptoms, which describe each class or subclass. This has much in common with traditional work in statistics and machine learning.

There are six data mining algorithms:

- Statistical Algorithms
- Neural Network Algorithms
- Decision Tree Algorithms
- Clustering Algorithms
- Generic Algorithms
- Rule Induction Algorithms

II.2.9.1 Statistical Algorithms

The first methods of data mining to be used extensively were statistics. In fact, they were the only methods available for analyzing data for many years and remain in wide usage today. [11] The reason for this is that they are well understood and have a proven track record. Statistical methods such as linear regression, combined with conditional probability, can be used to accurately predict many variables, and linear discriminate analysis can be employed for classification. [12] While these methods are best used to find linear patterns, other techniques, such as multiple nonlinear regression models, can be used to find patterns that are not linear in nature [12]

While statistics can be used in this manner, often one of the other data mining techniques provides better results. The statistical methods not useless, though. Many statistical techniques are used in accordance with other data mining techniques. For instance, calculation of R^2 value is often used to determine how well a trained neural network is performing on a set of test data. Many mathematicians would actually say that the other data mining techniques are simply complex statistical methods in disguise. [12]

II.2.9.2 Decision Tree Algorithms

A decision tree, as the name implies, is a model that can be viewed as a tree. At each branching point within the tree, the data is divided into segments based on certain characteristics. By looking at how the data becomes segmented, it is possible to see how these characteristics can help predict a behavior (of a customer, for instance) and the necessary action can be taken to either promote the behavior or to circumvent the behavior before it takes place.

Decision trees are best suited for classification of data, however. The branches in the tree divide the data into related groups. At each node, the records within that node contain all of the same characteristics as the qualifiers and values of the previous nodes and branches. This method can be used to find useful classifications such as “Which customers are purchasing from our new product line?” and can, as stated previously, also be used to perform prediction based on historical records.

II.2.9.3 Neural Networks Algorithms

One of the most fascinating data mining techniques is the use of neural networks. They are the offspring of one of Hollywood’s favorite fields of computer science, artificial intelligence. Neural networks are computer programs that attempt to mimic the structure of neurons and electrical patterns found in the human brain. While they were originally developed in an effort to endow computers with reasoning and learning abilities, they have found use in many fields include data mining.

Neural networks are composed of a series of layers of nodes and weighted links connecting them, similar to the way neurons are connect in biological neural networks. All neural networks contain at least layers of nodes, an input and an output layer, and many contain one or more “hidden” layers. Then the nodes are connected by links that carry weights. Once the model is completed, data is fed into the input nodes. The data then undergoes a complex mathematical calculation as it

passes along the weighted links and travels from node to node. The original values fed into each node is multiplied by the weights in the links connected the nodes. This new value is then passed to a transfer function. A typical transfer function would compare the value (A) to the default value (B) and pass the original value (A) along if it meets or exceeds the default value (B). The results of this calculation then appear in the nodes of the output layer. It can be seen, then, that the powerful predictive abilities of neural networks depend on many factors.

Much time and effort need to be spent in the initial development of the structure of a neural network. The ability of the model to make accurate predictions depends on the structure and training data used to build the model. The important factors that must be considered are how many, if any, hidden layers will exist, how many nodes will be in each layer, and how the nodes will be connected. These factors are determined based on the problem that the neural network is being built to solve. Once these decisions have been made and implemented, the links in the neural networks are set with random values. At this point, the neural network is ready to “learn”.

Like many data mining models, neural networks required a training session before they can be used. Historical data must be carefully selected and fed into the input nodes of the model. When the first record is input, the values travel along the weighted links and the results of the calculation are displayed in the output nodes. Assuming that the output is not the links are initially random), the difference between the desired output and the actual output is used to adjust the weights. A second record is then input, and the process begins again. In this manner, the network begins to “learn” how to predict based on the historical data.

II.2.9.4 Clustering Algorithms

Clustering is a data mining techniques used primarily for data classification. In essence, clustering is grouping records, which are most similar according to certain attributes. Most often this is an unsupervised process, meaning the clustering software determines the parameters for forming clusters and not the user of the software. This allows for the discovery of patterns which are not immediately obvious to the user but which may be of great interest.

Clustering is actually a broad term referring to data mining techniques, which work in the manner described above. There are many ways to performing clustering, but one of the most common is the k-nearest neighbor techniques.

Finding the k-nearest neighbor of a record is a multi-part process. First, it is necessary to determine the characteristics for which distance will be measured. These characteristics may be things such as pay rate of an employee, net purchases of a customer, or any other feature of interest to the problem at hand (note: these characteristics can be weighted as well allowing some features to be more important in the computations than others). The algorithm itself determines most of the time the characteristics used for clustering. This is an important process since poor selection of clustering criteria can result in the algorithm of $O(n^2)$ can become entirely too slow when n becomes sufficiently large. In the case of determining clustering criteria, n can be seen as either the number of fields in a record or as the total number of records in the warehouse (whichever is larger or depending on the algorithm chosen).

Once the clustering criteria are determined, a training data set is needed. Training of clustering algorithms is simple. In the case of k-nearest neighbor (and with most clustering algorithms), selecting the training data set itself is the training process since k-nearest neighbor simply uses these records as a table from which to calculate the next nearest neighbor.

These steps completed, the model is now ready for new records to be introduced. When a new record is introduced, the algorithm refers to the training data set and finds the record closest to the new record based on the clustering criteria chosen. Having found this record, it then finds the second closest record in the training data set to the new record. These k records represent the records to which the new record is most similar. This forms an initial cluster of records around the new record. These nearest records are recorded, and the new record is added to the "training" data set.

The above step repeated until all new records have been added. With each new record, the k-nearest neighbors are calculated (note that this can change the nearest neighbors for records already existing in the data set), and the new record is added the cluster in which most of its nearest neighbors reside.

II.2.9.5 Genetic Algorithms

In nature, a species advances as the individuals best suited to their environment reproduce and the weaker of the species is culled. Genetic algorithms work in a similar manner. Initially, several possible solutions (techniques) are produced at random to solve a specific problem. The solutions are then run against test data. The solutions that performed best are then selected and slightly altered to

produce a new set of solutions. These new solutions are then run against the test data, and the process continues until a desired level of accuracy is achieved. Since the solutions that will be used to generate future generations of solutions are selected based on their performance against the test data, the overall error associated with the solutions will continue to dwindle (though it will be leveling off as finding an perfect solution to a complex problem is unlikely with any model).

II.2.9.6 Rule Induction Algorithms

Rule induction is the data mining technique that most closely resembles the analogy of mining for “gold” in a database. In the most general terms, it is the systematic process of generating all possible rules from a data set. This is both its strength and its weakness.

Rules developed through rule induction are represented in “if, then” form. For instance, a rule generated from the database of an arts and crafts store’s sales might be “if paint brushes, then paint”. This rule captures the fact that many customers who are in the store to buy a paint brush (an item which does not need to be replaced frequently) are likely to buy paint as well (an item which does need to be replaced frequently). Note that while rules are represented in this way, they do not necessarily represent causality.

There are two statistics that can be calculated for all rules, which are useful to consider: accuracy and coverage. These are calculated to select the best useful rules for data mining.

For purposes of discussion, the earlier rule “if paint brushes, then paint” will be used.

Here is the information needed to calculate the accuracy and coverage of this rule

- $T = 100$ = total number of customers shopping baskets in the database
- $B = 5$ = number of baskets with paint brushes in them
- $C = 4$ = number of baskets with both paint brushes and paint in them

The accuracy of a rule can be thought of as how often the consequent (“then”) occurs in the database when the antecedent (“if”) occurs. To calculate this for our paint and paint brushes and paint in them, by B , the number of the baskets with paint brushes in them. In this case, result $4/5$ or 80%.

The coverage of a rule gives an idea of how often the rule can be applied to the database. To calculate this for this example, the number of baskets with paint

brushes in them, B, divided by the total number of shopping baskets, T. In this case, result 5/100 or 5%.

II.2.10 Process of Data Mining

Very simple the steps of data mining are shown in the following figure.

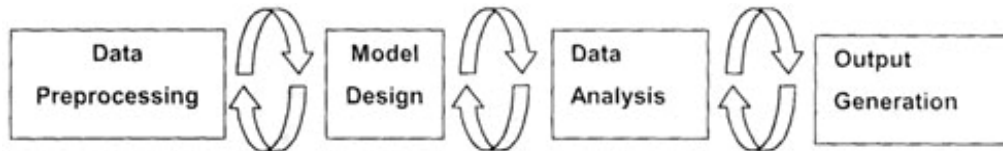


Figure II-7: The Data Mining Process, Swift, 2001

In the first step of all the business problem must be defines clearly. Based on basic knowledge about the problem, the data required to solve the problem must be identified, selected and prepared in a well-designed data warehouse.

In the second step, the data obtained in previous step must be examined and the fields that are most relevant to the problem must be selected. This step also includes selection of appropriate data mining method to apply to the data (such as neural network, rule induction, etc.). Lastly segmented will be made in this step of the process. For segmentation, clustering techniques can be used in order to separate data into small groups having some characteristics.

The third step includes a further preparatory (data transformation) to reorganize data in order to best fit the selected technique and problem. For example, in this part new fields can be derived from the present fields if the present ones are not enough, such as forming a new field including incomers less outgoings. Then selected data mining tool will be implemented to the data in this step. After the verification of the model with a set of tests, the rightness and the validity of the model will be evaluated.

In the last step, the reports and outputs will be prepared. If the initial model does not fit the problem completely different data mining techniques on different data sets can be implemented until the successful output is achieved.

The knowledge of system analysts is very important in the whole data mining process. They must have the ability to interpret and evaluate the results otherwise the results can be of little value or worse they can be wrong.

II.2.11 Summary

In this section we have explain the definition of data warehouse, and its relation with CRM and sales activities. As CRM implementation can be possible if and only if needed customer information is present in the suitable form, we tried to show the important role of data warehouse for CRM implementation in this section. After understanding what a data warehouse is and its relation with CRM we explained Data Mining as the way of transforming the data present in the data warehouse into valuable information. We defined different data mining methods and data mining process generally

II.3 ENTERPRISE RESOURCE PLANNING

II.3.1 Introduction

This section will also be complementary section for part II.1. In this section, we will go through ERP, Enterprise Resource Planning, which is main part of a company which company provides some thing. In addition, for this thesis ERP is the most important application. Cause we want to integrate CRM to ERP system.

Firstly, we will see the overview of production planning systems, definition of MRP, problems with MRP, ERP definition, ERP evaluation, relationship between CRM, purpose of ERP. Lastly, we will end this section with explaining the reasons for acquiring an ERP system.

II.3.2 Overview to Production Planning Systems

Business planning and accounting systems have been around in manufacturing for 25 to 30 years. They were first applied to the accounting function to handle the immense amount of data collection and computations required as accounting practices became more complex. Then during the 1970s computers were being used on a broad scale to applications such as inventory control, order processing, purchasing and production planning. These systems were designed to model the business processes of that time and as a result create a more efficient, effective operation. Surprisingly enough today's business systems are very much like those original systems in terms of how they function. The American Production and Inventory Control Society (APICS) began its efforts in the 1970s to "professionalize" the function of production and inventory control. They did this by

educating and certifying the practitioners of this rather obscure set of activities. In order to accomplish a widespread presence throughout industry, APICS established local chapters and created a standard curriculum of courses, segmented into specific areas of study, focusing on distinct aspects of the planning/scheduling process. The computer industry recognized the strength of APICS, realizing that APICS members were often in a position to influence decisions on computer purchases and quickly developed allegiances to the group. By the early 1980s this allegiance had developed a standard model of an integrated business system for manufacturing called material requirements planning (MRP). This model completely dominated the manufacturing industry for nearly 15 years. It led to a multi-billion dollar software and services industry. More than 60,000 MRP systems were implemented worldwide and over 4,000,000 manufacturing employees were educated on the theory and practice of MRP [13].

The fundamental problem with MRP is that it was modeled after a typical 1978 manufacturing organization and designed to operate on an IBM 360 mainframe computer. Manufacturing practices in the 1970s bore a close resemblance to those in use since the late 1800s and early 1900s, when through the contributions of individuals like Samuel Colt, Henry Ford and Alfred Sloan, the concepts of division of labor were enhanced and reinforced. These are concepts whose origin date back to Adam Smith's theories on the division of labor, published in *The Wealth of Nations* in 1776 [14]. Although MRPII evolved over the next decade to meet changing business needs and to take advantage of higher performance computer systems, the underlying concepts never really changed. Contrast this with the staggering amount of change in the manufacturing industry resulting from global competition during the same period. Manufacturers today, who hope to be here tomorrow, are in a constant state of change in their production areas. Forces in today's market are demanding that manufacturers become the lowest cost, highest quality, and most agile producer of mass customized products in their industry.

As a result of their heritage, planning systems today are, in many aspects, counter productive to the execution process. Not only do they no longer model the business processes, but also in many cases they actually dictate inefficient business practices in order to support the planning and accounting functions. Many manufacturers are suffering the effects of being constrained by the "system" which limits their ability to be agile, results in larger raw material and finished goods inventories, creates false manufacturing lead times and stifles efforts to become more integrated throughout their information systems. [15]

II.3.3 Definition of MRP

MRP is software based production planning and inventory control system used to manage manufacturing processes. Although it is not common nowadays, it is possible to conduct MRP by hand as well.

An MRP system is intended to simultaneously meet 3 objectives:

- Ensure materials and products are available for production and delivery to customers.
- Maintain the lowest possible level of inventory.
- Plan manufacturing activities, delivery schedules and purchasing activities.

All manufacturing organizations, whatever it is they produce, face the same daily practical problem - that customers want products to be available in a shorter time than it takes to make them. This means that some level of planning is required.

Companies need to control the types and quantities of materials they purchase, plan which products are to be produced and in what quantities and ensure that they are able to meet current and future customer demand, all at the lowest possible cost. Making a bad decision in any of these areas will lose the company money. A few examples are given below:

- If a company purchases insufficient quantities of an item used in manufacturing, or the wrong item, they may be unable to meet contracts to supply products by the agreed date.
- If a company purchases excessive quantities of an item, money is being wasted - the excess quantity ties up cash while it remains as stock and may never even be used at all. This is a particularly severe problem for food manufacturers and companies with very short product life cycles. However, some purchased items will have a minimum quantity that must be met, therefore, purchasing excess is necessary.
- Beginning production of an order at the wrong time can mean customer deadlines being missed.

MRP is used by many organizations as a tool to deal with these problems. The questions it provides answers for are: WHAT items are required, HOW MANY are required and WHEN are they required by. This applies to items that are bought in and to sub-assemblies that go into more complex items.

- Bills of materials. Details of the materials, components and subassemblies required to make each product.

- Planning Data. This includes all the restraints and directions to produce the end items. This includes such items as: Routings, Labor and Machine Standards, Pull/Work Cell and Push commands, Lot sizing technique(s) (i.e. Fixed Lot Size, Lot-For-Lot, Economic Order Quantity), Scrap Percentages, and other inputs.

There are only two (2) outputs and a variety of messages/reports

- Output 1 is the "Recommended Production Schedule" which lays out a detailed schedule of the required minimum start and completion dates, with quantities, for each step of the Routing and Bill Of Material required to satisfy the demand from the MPS
- Output 2 is the "Recommended Purchasing Schedule". This lays out the dates that the purchased items should be both received into the facility AND the date(s) the Purchase orders, or Blanket Order Release should occur to match the production schedules.

II.3.4 Problems with MRP

The major problem with MRP systems is the integrity of the data. If there are errors in the inventory data, the bill of material data or the master production schedule then the output will also be incorrect. Most vendors of this type of system recommend at least 98% data integrity for the system to give useful results.

Another major problem with MRP systems is the requirement that the user specify how long it will take a factory to make a product from its component parts (assuming they are all available). Additionally, the system design also assumes that this "lead time" in manufacturing will be the same each time the item is made, without regard to quantity being made, or other items being made simultaneously in the factory.

A manufacturer may have factories in different cities or even countries. It is no good for an MRP system to say that we do not need to order some material because we have plenty thousands of miles away. The overall ERP system needs to be able to organize inventory and needs by individual factory, and intercommunicate needs so that each factory can redistribute components to serve the overall enterprise.

This means that other systems in the enterprise need to work properly both before implementing an MRP system, and into the future. For example systems like

variety reduction and engineering which makes sure that product comes out right first time(Without defects) must be in place.

Production may be in progress for some part, whose design gets changed, with customer orders in the system for both the old design, and the new one, concurrently. The overall ERP system needs to have a system of coding parts such that the MRP will correctly calculate needs and tracking for both versions. Parts must be booked into and out of stores more regularly than the MRP calculations take place. Note, these other systems can well be manual systems, but must interface to the MRP. For example, a 'walk around' stock take done just prior to the MRP calculations can be a practical solution for a small inventory. (especially if it is an "open store".)

The other major drawback of MRP is that takes no account of capacity in its calculations. This means it will give results that are impossible to implement due to manpower or machine or supplier capacity constraints. However this is largely dealt with by MRP II.

Generally, MRP II refers to a system with integrated financials. An MRP II system can include finite / infinite capacity planning. But, to be considered a true MRP II system must also include financials. [16]

II.3.5 Definition of ERP

ERP, Enterprise Resource Planning, is a system of integrated procedure, rules and algorithms designed to function consistently repeatedly. It is a new information system that was developed in the 1990s because of the various business decision support systems incorporated in to the Manufacturing Resource Planning (MRP II) system [17].

An enterprise-wide set of management tools that balances demand and supply, containing the ability to link customers and suppliers into a complete supply chain, employing proven business processes for decision-making, and providing high degrees of cross-functional integration among sales, marketing, manufacturing, operations, logistics, purchasing, finance, new product development, and human resources, thereby enabling people to run their business with high levels of customer service and productivity, and simultaneously lower costs and inventories; and providing the foundation for effective e-commerce [18].

However, different people may interpret ERP differently, but the key point in an ERP system is integration.

II.3.6 Evolution of ERP

To further explore the topic of ERP, it would be wise to look at the evolution of ERP. The evolution of ERP dates back to the 1960s, when the Material Requirements Planning (MRP) was first developed. The MRP covered what is called the universal manufacturing equation. The equation included the following four questions:

What are we going to make?

What does it take to make it?

What do we have?

What do we have to get?

After the development of the MRP was the development of the Closed-Loop MRP. The Closed-Loop MRP was a series of functions supporting both planning and execution as well as providing tools for addressing priority and capacity. Manufacturing Resource Planning (MRP II) was the next development, which was an extension of the Closed-Loop MRP. The MRP II provided three new functions including Sales & Operations Planning, Financial Interface, and Simulation. Finally, Enterprise Resource Planning (ERP) emerged from MRP II, which out performs MRP II capabilities and much more [18].

The figure shows the evolution of ERP with the latest evolution on the outer most circle and the earliest on the inner most circle.

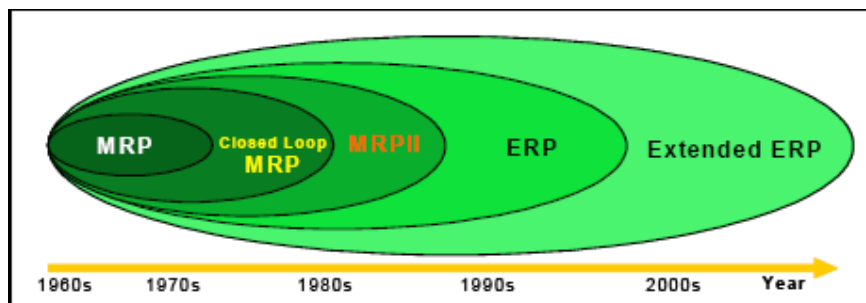


Figure II-8: The Evolution of ERP.

Although the terms MRP, MRP II and ERP are used throughout most organizations, often people are confused about these and cannot distinguish the differences between the three. MRP is an inventory control and production planning system designed for ordering and scheduling dependent demand of inventory, which includes the following components: Master Schedule, Bill of Material and Inventory

record file. MRP II is just an expansion of the MRP system with three new capabilities including financial analysis, feed back loops, and marketing plans. [22]

ERP is also an extension of MRP II with additional capabilities, such as better graphical user interface, the use of relational database, fourth language generation, open system portability, and more deeply integrated than MRPII.

ERP is far better than MRP II for three reasons:

ERP applies a single set of resource planning tools across the entire enterprise

ERP provides real-time integration of sales, operating, and financial data

ERP connects resource-planning approaches to the extended supply chain of customers and suppliers.

To understand the concept of ERP better, the system must be viewed from five different perspectives. The following figure shows the ERP sophistication hierarchy of the five different perspectives of an ERP system. The figure shows a bottom-up approach with the least sophisticated view at the bottom and the most complex and strategically advantageous view at the top.

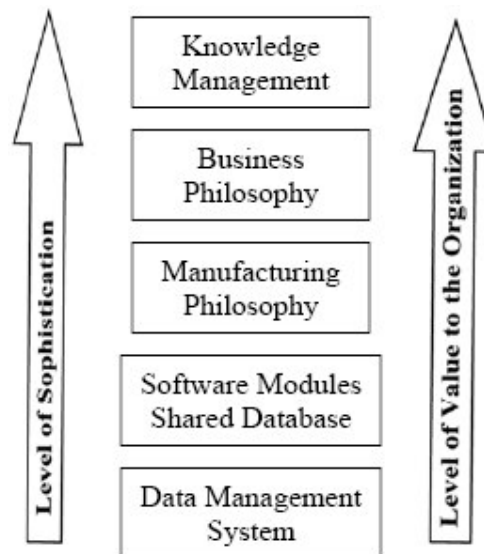


Figure II-9: Sophistication Hierarchy of the five perspectives of an ERP system.

To implement an ERP system successfully an organization must fully understand each of the five perspectives mentioned above. The three defined the first perspective of an ERP system as a large database that stores a large quantity of data. The second perspective of an ERP system is defined as a group of modules

all connected to a central database. The third perspective is to view ERP as a manufacturing philosophy rather than as a software program. The fourth perspective is to view the ERP system as a business philosophy communication tool. Finally, the fifth perspective of an ERP system is to view the information contained in an ERP system as knowledge that can be used by all employees.

The following is a list of different elements or modules that are contained in most of today's ERP systems

- Business and Strategic Planning Module
- Resource Planning Module
- Executive Decision Support Module
- Sales and Operations Planning Module
- Forecasting Module
- Customer Relationship Management (CRM) Module
- Order Entry, Quoting, and Product Configurator Modules
- Master Production Schedule Module
- Rough Cut Capacity Planning Module
- Material Requirements Planning (MRP) Module
- Detailed Capacity Planning Module
- Production Activity Control (PAC) Module
- Manufacturing Execution System (MES) Module
- Issuing Material to Jobs Module
- Advanced Planning and Scheduling (APS) Module
- Finance Module
- Costing Modules
- Engineering Modules
- Human Resource Modules
- E-Commerce Modules

II.3.7 ERP and CRM

Companies traditionally focused on processes and technologies, with objective of optimizing these processes using MRP and ERP systems. The focus was always inward. With companies becoming more customers oriented, they are realizing the benefits of including customers and business partners in the value

chain. Companies are become more outwardly focus. This has created this need of integrating ERP systems with CRM and Supply chain software. [19]

Companies use Enterprise resource planning systems to integrate and manage different operations and process. ERP system integrates functions like Accounting, Human Resources, Inventory Control and Manufacturing process to create an integrated enterprise. Companies have started to realize the “value of strategic extensions” like Supply chain management and Customer Relationship management applications. [20]

These softwares enable companies to collaborate. Companies are replacing materials requirement planning with supply chain planning software as it enables companies to create optimal plans for producing, delivering goods through collaboration. Companies are integrating CRM software and other Internet based applications with ERP packages to create what is being termed as “Extended enterprise ”. [20]

Enterprise Resource Planning systems manage core information related to company’s business, customers, products, orders and employees and financial data. Extended enterprise allows the company to share this single source of information with all relevant parties. ERP can reach out suppliers and customer by means of Internet. Applications like CRM and supply chain planning provide enhanced functionality. [21]

II.3.8 Purpose of ERP

The purpose of ERP is to create a single computer system that can perform all of the functions of every department within an organization by linking all of the departments into one single database. With the integration of a single database, it enables everyone within different functional areas to share the same information as well as communicate with one another. “What ERP really does is organize, codify, and standardize an enterprise’s business processes and data. The software transforms transactional data into useful information and collates the data so that it can be analyzed” [1]

II.3.9 Reasons for Acquiring an ERP System

Before 2000, the most important reason for any organization to implement their ERP system would be to solve the year 2000 problem. Due to limited space, early computer systems are programmed to store only the last two digits of the year.

Early engineering failed to realize that the year 2000 would pose a threat, in which the last two digits of the year will become zeroes causing confusion and leading to system malfunction. Therefore, implementation must take place before the year 2000 to prevent system failure.

Five other reasons for acquiring an ERP system are:

To integrate financial information

To integrate customer order information

To standardize and speed up manufacturing processes

To reduce inventory level

To standardize Human Resources information [23]

Operating the business in a rapidly changing and highly competitive environment is the primary purpose of implementing an ERP system. In addition, companies with the following characteristics had successfully implemented ERP or MRP II

Make-to-stock

Make-to-order

Design-to-order

Complex product

Simple product

Multiple plants

Single plant

Contract manufacturers

Manufacturers with distribution networks

Sell direct to end users

Sell through distributors

Business heavily regulated by the government

Conventional manufacturing (fabrication and assembly)

Process manufacturing

Job shop

Flow shop

Fabrication only (no assembly)

Assembly only (no fabrication)

High-speed manufacturing

Low-speed manufacturing

Although implementing an ERP system may be costly and time consuming, the benefits are worthwhile. With careful planning and selection of the right ERP system, a company may expect to gain significant benefits including dramatic increases in responsiveness, productivity, on-time shipments and sales, as well as decreases in lead times, purchase costs, quality problems, and inventories. According to Meta Group, the median annual saving for a fully implemented ERP system is \$1.6 million per year. [24]

II.3.10 Summary

In this section, ERP systems, their purpose, their evaluation and the importance of ERP and CRM integration have been briefly discussed.

PART III. THESIS STUDY

III.1 INTRODUCTION

This thesis study can be divided into four parts.

The first part is the database design. The RDBMS used is SQL Server 2005 based on .NET technology.

The second part of the thesis study is the CRM application. A web based CRM application developed over ASP.NET 2.0 Atlas and ADO.NET technologies. Atlas technology is used for better performance of the application. ADO.NET technology is used for database connection. With SQL Server 2005 database, ADO.NET increased the performance of the queries.

The third part is ERP integration. An XML Web Service developed for ERP integration. XML Web Service technology chosen since it is simple, secure and independent way of sharing data between applications. XML Web Services do not need any open ports on the system. These services use http ports and data traffic in XML format.

The fourth part is data mining. An Analysis Services project developed for data mining. SQL Server Business Intelligence Development Studio is the tool for this development. This tool came with SQL Server 2005. All data mining algorithms are contained in this tool.

This part of the thesis explains database concept, database design, table structure, CRM mentality, application screens, ERP integration module and data mining project. In addition, the CRM application named as "*INFOCUST*".

III.2 Database

In this section, design of the database structure could be explained. At the beginning, a short overview describes the logical database structure and then all the table definitions are given.

III.2.1 Database Overview

This section is a Database structure overview. Some of the database main items told shortly. Detail

Users is the main item of the database structure. It represents who can use this application. There are three type of users exist. These are Employees, Suppliers and Customers.

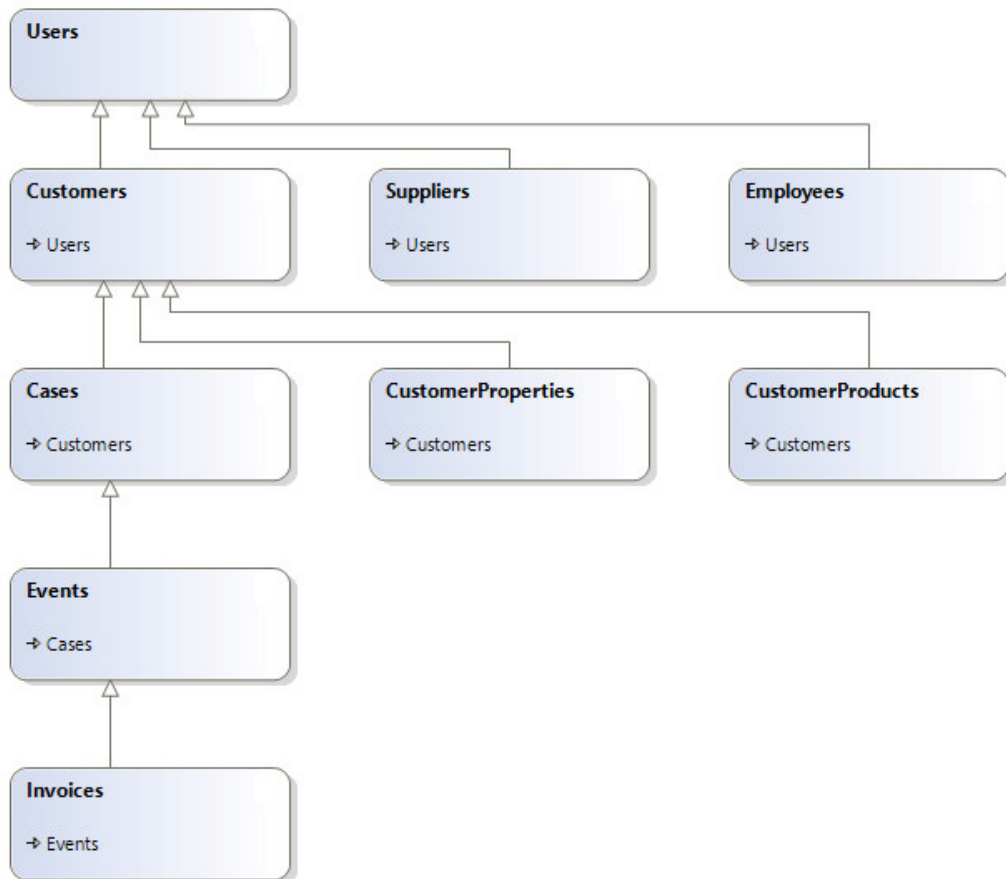


Figure III-1 : Database Overview

Customers is the main item of the application. All things build on customers. Customers information's separate into two groups. These are Customer Properties and Customer Products.

Customer properties means that what kind of data that can we collect about customer.

Customer products means that which of our products that a customer use

Cases is the another main item of the application. When a customer interested with one or more product that means a case start with this customer. Case

can be contains one or more products and one customer may have many cases at the same time. After a case start, all activities occurred for this case named as event. An event can be a phonecall or demo or sales etc. When a sales events occurred for a case after this event employee insert an invoice

Invoice is important step because the ERP integration necessary at this step. XML web services used for this integration. When an employee try to prepare an invoice firstly the quantity check occurred. If there is no problem with quantity check invoice prepared and stocks updated according to invoice lines.

III.2.2 Database Structure

In the database schema, the most important table is Users table. User names and passwords are stored in this table.

Column Name	Data Type	Length
UserID	Int (Identity)	4
UserName	nvarchar	50
Password	nvarchar	50
UserTypeID	Int	4
IsActive	Bit	1

Table III-1: Users Table

The figure below shows the users table relationship with other tables.

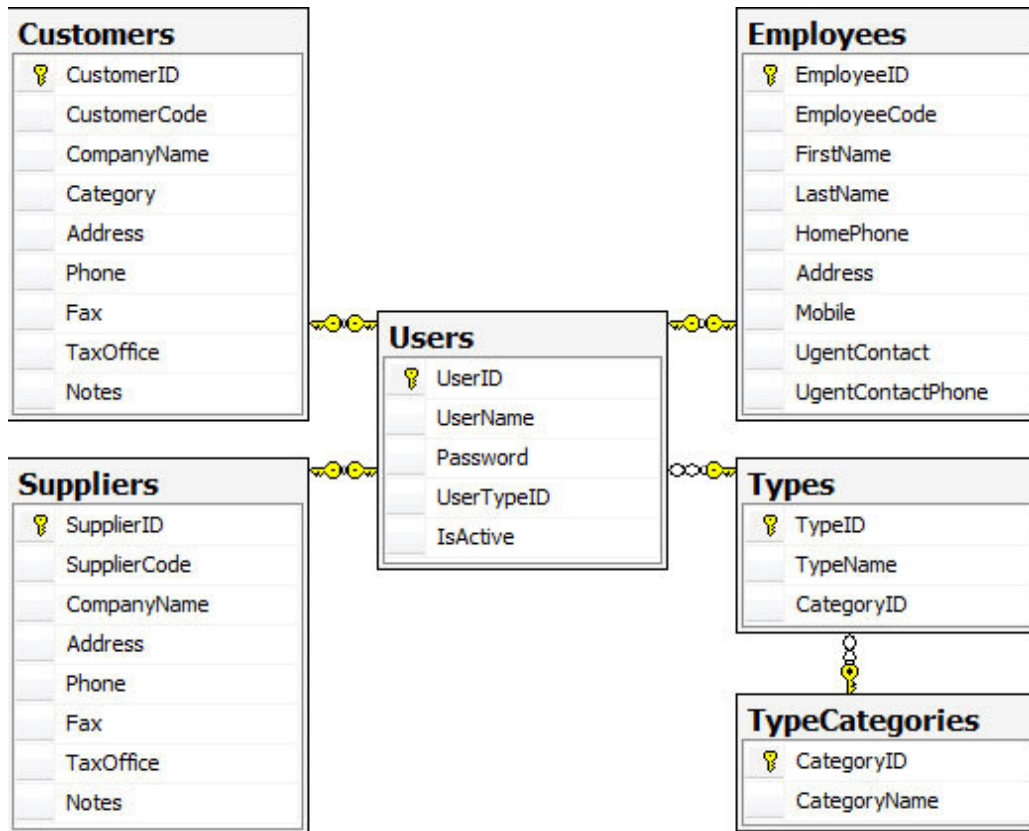


Figure III-2 : Users Table Relations

If a user is to be deleted, all data about him must be deleted from database. In that situation, system would lose valuable data. Therefore, a user record is not actually deleted from the table, instead the "IsActive" column is used to deny a user from login.

UserTypeID is another column in users table to indicate the type of user.

There are three types of users. They are Employees, Customers and Suppliers. These three user types have different functions, thus they see different screens etc. Consequently, the essential redirection depends on the user type.

Why are these three types of users login information' stored in the same users table? It has many answers, but one of the basic answers is this: in the application, employees, customers, or suppliers can do some of the process. So, when a user id is assigned to all users, and this data is stored in a single users table, this kind of situations can be managed easily.

The UserID column in this table is identity and primary key. Therefore, all users have unique UserID in this table.

The data about type of the user is stored in Types table.

Column Name	Data Type	Length
TypeID	Int (Identity)	4
TypeName	Varchar	30
CategoryID	Int	4

Table III-2: Types Table

When this database structure is designed and analyzed, types are used several tables. Therefore, all types thought to be stored at a table, Types. In addition, expect the event types all types stored at this table.

In this case, what needs to be known is the type related with each table. TypeCategories table used for store the category of types. For example user types, contact types, permission types etc.

Column Name	Data Type	Length
CategoryID	Int (Identity)	4
CategoryName	Varchar	30

Table III-3: TypeCategories Table

As mentioned, there are three types of users using this application. In addition, these three user types are three major part of this application.

The most important user-type of this application is the employees. In addition, employees' data are stored in the employees table.

Column Name	Data Type	Length
EmployeeID	Int	4
EmployeeCode	Varchar	16
FirstName	Nvarchar	70
LastName	Varchar	35
HomePhone	Nvarchar	30
Address	Nvarchar	510
Mobile	Nvarchar	30
UgentContact	Nvarchar	510
UgentContactPhone	Nvarchar	30

Table III-4 : Employees Table

When the employees table analyzed, EmployeeID column, one of the features of this table, is the primary key but is not identity. At the same time when a new employee is added to this table by application interface, an EmployeeID from this user is not needed. So how can this EmployeeID column be kept unique on employees table?

When Figure III-1 is analyzed, there is a One-to-One relationship defined between Users table UserID column and Employees table EmployeeID column. When a new employee inserted into employees table, first a user is inserted into users table. The user is given a randomize password. If an employee does not insert into the users' table, he or she cannot login this application. In addition, when a record inserted into the users table, a new UserID created in the users table. At the same time, this UserID is the new employees' EmployeeID. The same situation is valid for customers and suppliers too. By this way, all users (employees, customers and suppliers) have unique UserID in our application.

The next field in this table is EmployeeCode. This column holds the specific codes that companies assign to their employees.

Another user group that can use this application is Suppliers. The aim of adding suppliers to this application is this: Customers may tell us some problems with products, which is got them from a supplier. In addition, suppliers may be required to be able to see this problem and can answer problems or we may want suppliers comes a part of process.

Column Name	Data Type	Length
SupplierID	Int	4
SupplierCode	Varchar	16
CompanyName	Nvarchar	80
Address	Nvarchar	200
Phone	Nvarchar	48
Fax	Nvarchar	48
TaxOffice	Nvarchar	60
Notes	Nvarchar	1000

Table III-5 : Suppliers Table

The SupplierID column is primary key but not identity like EmployeeID. And as employees table, if a new supplier is to be added, first a new user record is inserted into the users table, and the new UserID is the SupplierID for this new supplier.

In addition, the other important part of this application is customers. Essentially, customers are the most important term in our application because customer relationships are managed with this application.

Column Name	Data Type	Length
CustomerID	Int	4
CustomerCode	varchar	16
CompanyName	nvarchar	80
Category	Char	1
Address	nvarchar	120
Phone	nvarchar	48
Fax	nvarchar	48
TaxOffice	nvarchar	60
Notes	nvarchar	1000

Table III-6 : Customers Table

The figure below shows customers table relations.

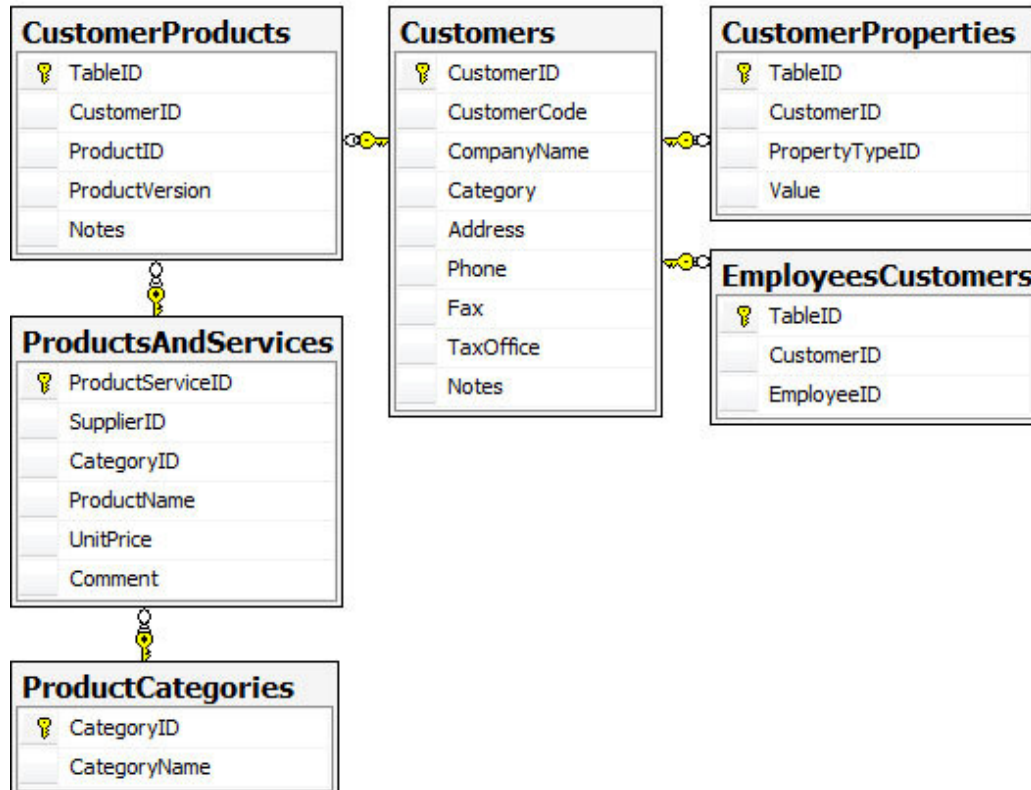


Figure III-3 : Customers Table Relations

Similar to employees and suppliers table, the CustomerID in the customers table is primary key but not identity. Likewise, to add a new customer to customers table first a new user inserted into the users table for this new customer and the new UserID is new customers CustomerID. As employees and suppliers, we can assign a code to their customers. These codes are stored on CustomerCode column. Another major column is the Category column, which takes a category value in the range of one to five. Data mining used for categorized the customers. Customer categories are periodically updated depending on customer purchases. The aim is to discover which customers are profitable. Moreover, this information is used for determining the period and content of the customer visits.

When the structure of CRM applications analyzed, there are many knowledge stores about customers. Customers table include columns like CompanyName, Address, Phone, Fax and TaxOffice.

Column Name	Data Type	Length
TableID	Int	4
CustomerID	Int	4
Value	Varchar	100

Table III-7 : CustomerProperties Table

PropertyTypeID column contains the properties defined for customers. This property definitions stored in types table like the other type information. By this way, new properties for its customers can be defined whenever needed.

Another information store about customers is customer's products table that contains information about which customers use which products, and which version of product runs on customer system. This information is important for announcing the new version of products to the customers.

Column Name	Data Type	Length
TableID	int	4
CustomerID	int	4
ProductID	int	4
ProductVersion	varchar	50
Notes	varchar	100

Table III-8 : CustomerProducts Table

Information about products and services are stored in ProductAndServices table.

Column Name	Data Type	Length
ProductServiceID	int	4
SupplierID	int	4
CategoryID	int	4
ProductName	nvarchar	510
UnitPrice	money	8
Comment	nvarchar	2000

Table III-9 : ProductsAndServices Table

SupplierID value comes from the Suppliers table. However, a company may produce some of its products meaning that, for some records in this table SupplierID

can be empty. Therefore, the relation with Suppliers table is defining as not enforced foreign key. In addition, SupplierID column allow nulls.

Product category information is stored in ProductCategories table.

Column Name	Data Type	Length
CategoryID	int	4
CategoryName	Varchar	50

Table III-10 : ProductCategories Table

Both for customers and suppliers, there are many contacts. The contact information is stored in Contacts table.

Column Name	Data Type	Length
ContactID	int	4
UserID	int	4
ContactTypeID	int	4
ContactName	varchar	50
ContactTitle	varchar	50
Phone	varchar	50
Email	varchar	50

Table III-11 : Contacts Table

The figure below shows the contacts table relations.

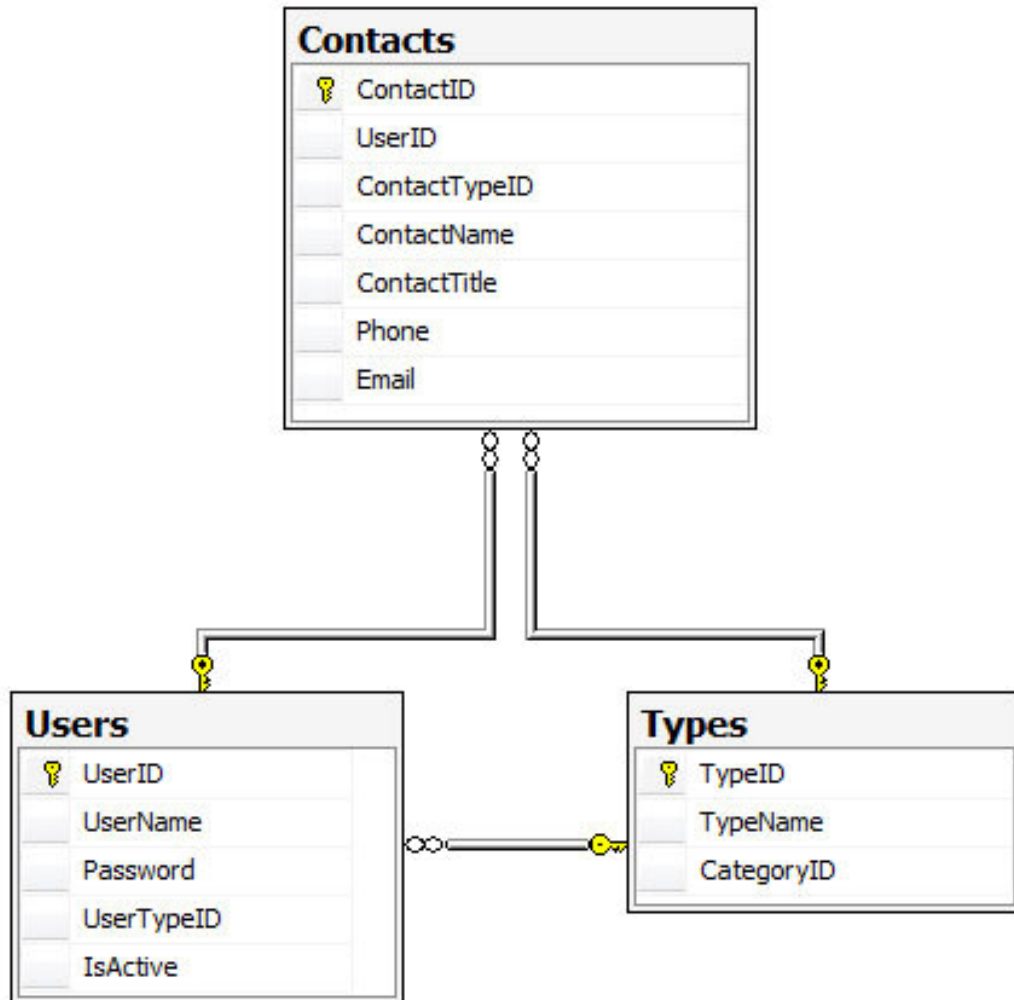


Figure III-4 : Contacts Table Relations

When Contacts table is examined, this table is not related neither customers nor suppliers. It is associated with users. As mentioned, contacts may belong to customers or suppliers. So defining the relation with users handles this situation. Another column in this table is ContactTypeID. This column is used to understand this is a customer or supplier contact.

One of the most important terms in this application is “Case” which means that: Duration spent with a customer interested in one or more products. For example, if customer A is interested in product B, this means that, customer A’s product B case. Cases stores in cases table

Column Name	Data Type	Length
CaseID	int	4
CustomerID	int	4
CaseDate	datetime	4
ContactID	int	4
EmployeeID	int	4
Priority	smallint	2
Comment	varchar	100
IsApproved	bit	1
IsPublic	bit	1

Table III-12 : Cases Table

In addition, the figure below shows the cases table relations.

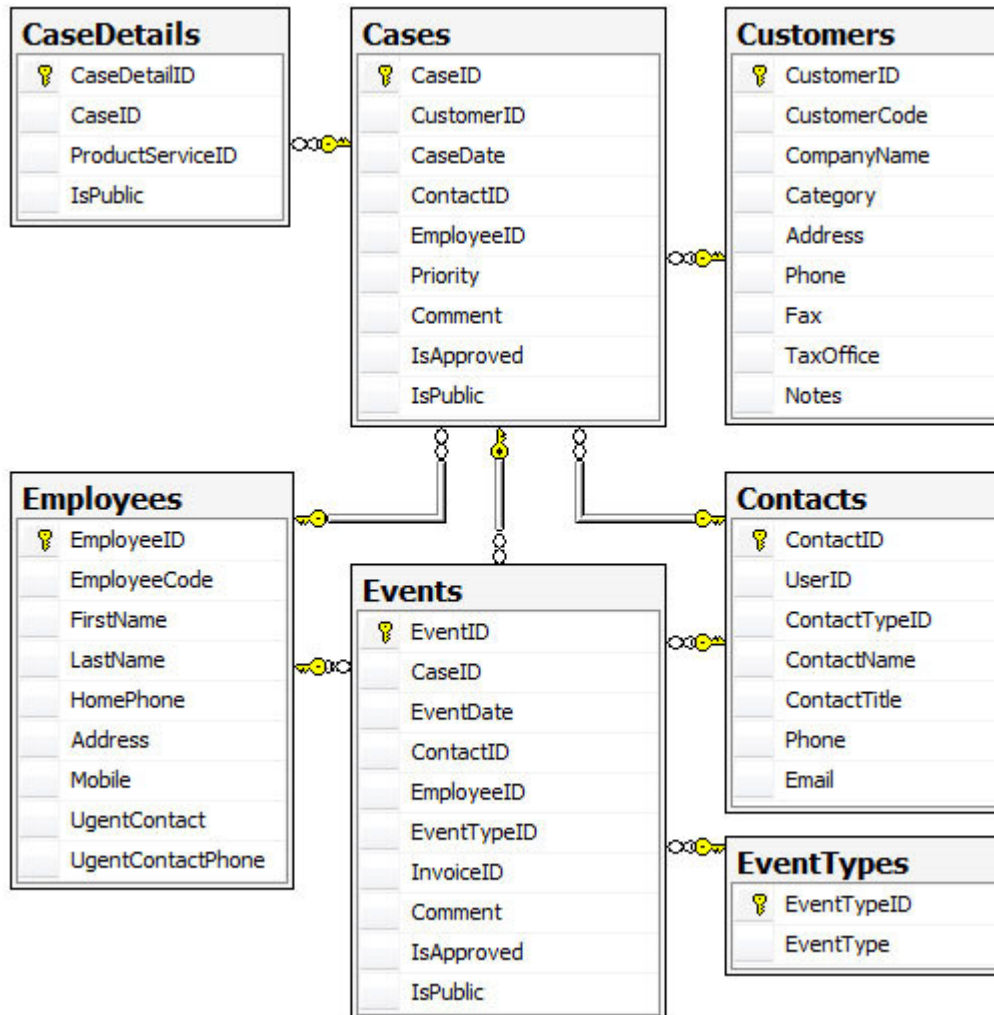


Figure III-5 : Cases Table Relations

CustomerID shows which customer belongs this case, ContactID shows who's related with this case at customer side, EmployeeID shows who's related with this case at our organization, Priority shows the priority level of the case. In this application, customers can start a case. However, the organization should approve the case. IsApproved column stores this information. Finally, sometimes suppliers may be required to follow some cases. In that situation, IsPublic field is used to show or hide a case from supplier.

As mentioned above, a case can be related with one or more products or services. This information is stored in CaseDetails table.

Column Name	Data Type	Length
CaseDetailID	int	4
CaseID	int	4
ProductServiceID	int	4
IsPublic	bit	1

Table III-13 : CaseDetails Table

Another important term discover with case term is "Event". Event means any activities occurred about a case. All events are stored in Events table.

Column Name	Data Type	Length
EventID	int	4
CaseID	int	4
EventDate	datetime	8
ContactID	int	4
EmployeeID	int	4
EventTypeID	int	4
InvoiceID	int	4
Comment	varchar	200
IsApproved	bit	1
IsPublic	bit	1

Table III-14 : Events Table

CaseID shows to which case this event belongs, ContactID shows who's related with this event at customer side, EmployeeID shows who's related with this event at our side, EventType shown the type of the activity (demo, email, phone call etc.). This columns value comes from another table, EventTypes.

Column Name	Data Type	Length
EventTypeID	int	4
EventType	varchar	30

Table III-15 : EventTypes Table

Certainly, a very critical column is InvoiceID. This column used in ERP integration. One of the event types mentioned above is sales. If one or more products sold in a case, a sales event should be entered. After this step, Invoice interface comes to the screen. Invoice information stores in Invoices table.

Column Name	Data Type	Length
InvoiceID	Int	4
PO_Number	varchar	10
UserID	Int	4
Total	money	8

Table III-16 : Invoices Table

The figure below shows the invoices table relations.

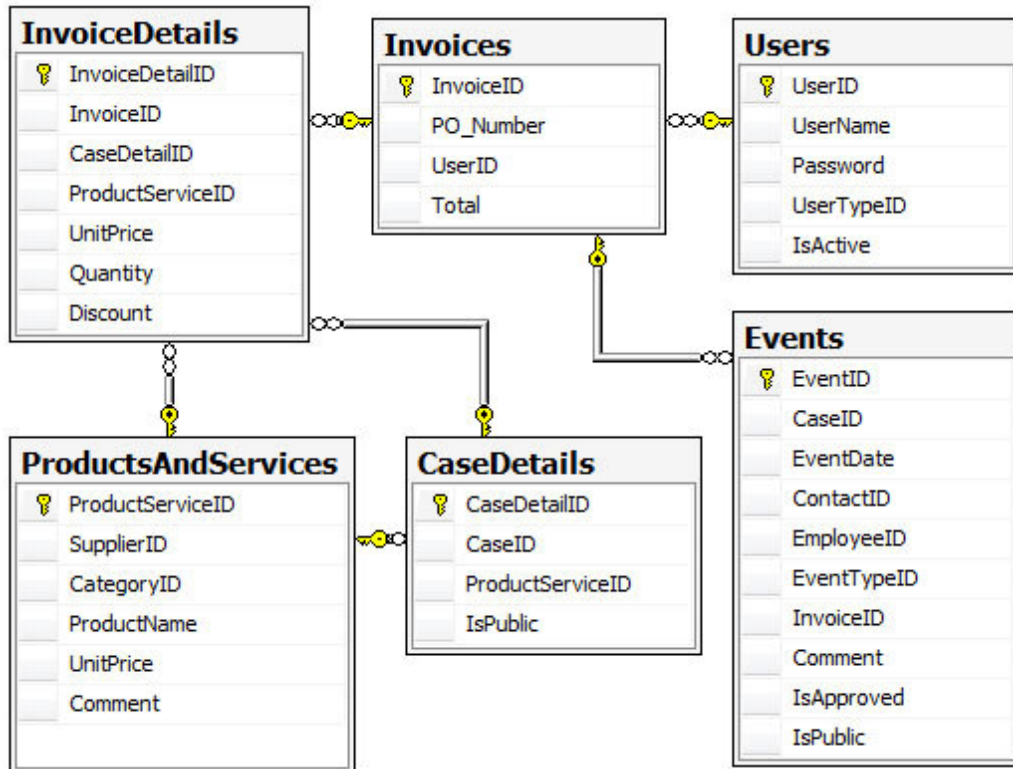


Figure III-6 : Invoices Table Relations

CustomerID column does not appear to be used. Instead, UserID column is used. If a sales event occurred than the invoice inserted into the invoices table. When invoices inserted into the invoice table an InvoiceID is generated. Then, the event updated and this InvoiceID added to this event.

An Invoice may relate with one or more products and services. These details are stored in InvoiceDetails table.

Column Name	Data Type	Length
InvoiceDetailID	int	4
InvoiceID	int	4
CaseDetailID	int	4
ProductServiceID	int	4
UnitPrice	money	8
Quantity	int	4
Discount	decimal	9

Table III-17 : InvoiceDetails Table

The InvoiceDetails table directly relates with the CaseDetails table over CaseDetailID. A case can be related with more than one product or service but at the end of the case, there may be no sales. Therefore, CaseDetailID shows which product or services sold.

Invoice table is important for ERP integration. When an invoice is produced, then all these products are decreased from product stocks from ERP system.

IsApproved and IsPublic columns exist in this table too like cases table. These columns are same with columns that are belongs to cases table. In other words, customers can insert an event but this event must approve. If we want, some events can see from suppliers, we check this field.

In addition, there is a Many-to-Many relation defined between customers and employees.

Column Name	Data Type	Length
TableID	int	4
CustomerID	int	4
EmployeeID	int	4

Table III-18 : EmployeesCustomers Table

The aim is, to define the relationship between employees and customers. With this relation, employees can see their customers' requests or events and they only focused their own customers.

Another table is Tasks table in our database.

Column Name	Data Type	Length
TaskID	Int	4
Owner	Int	4
Subject	Varchar	200
TaskDate	Datetime	8
StartDate	Datetime	8
EndDate	Datetime	8
AlertDate	Datetime	8
Priority	Int	4
IsOccured	Bit	1
ShowAlert	Bit	1

Table III-19 : Tasks Table

In addition, the figure below shows the tasks table relations.

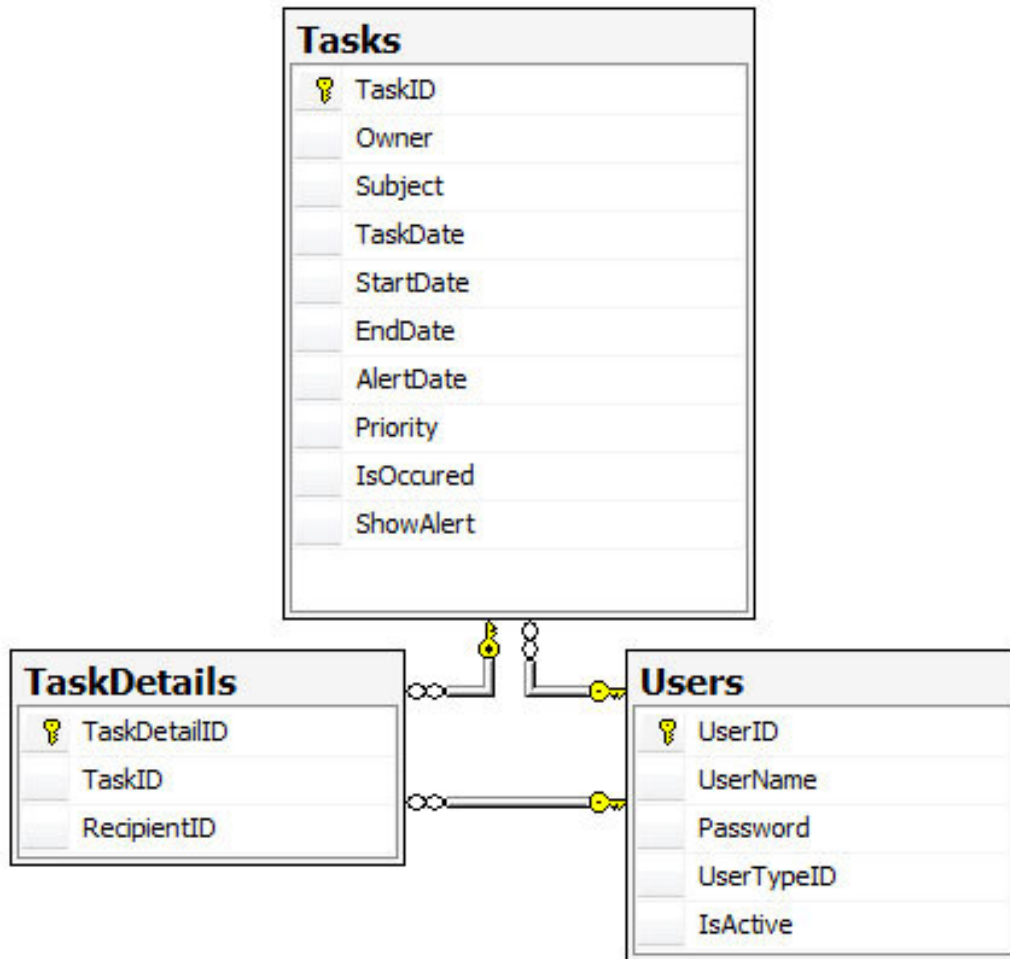


Figure III-7 : Tasks Table Relations

In this table, Customers, Employees or Suppliers can be assign tasks to another user or their selves. In addition, if they want, application can alert them when they want about this task. A task can assign to one or more user. And this information stores in TaskDetails table.

Column Name	Data Type	Length
TaskDetailID	int	4
TaskID	int	4
RecipientID	int	4

Table III-20 : TaskDetails Table

Role-based security is used in this application. All of the roles are stored in Roles Table.

Column Name	Data Type	Length
RoleID	int	4
RoleName	varchar	50

Table III-21 : Roles Table

In addition, the figure below shows the roles table relations.

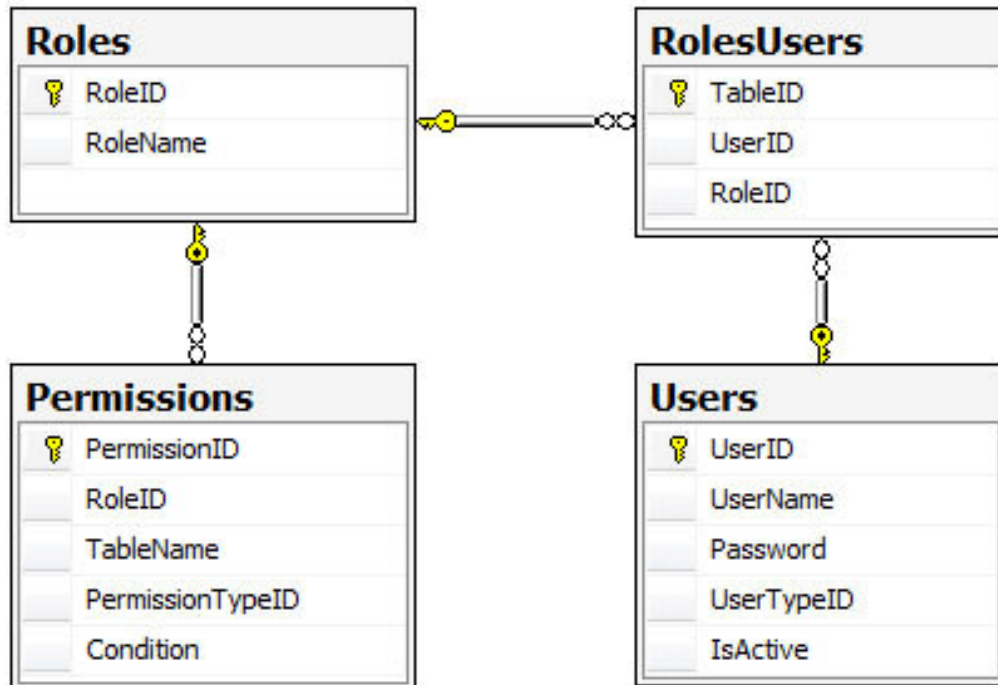


Figure III-8 : Roles Table Relations

In roles table, simply stores role names. In addition, the relation between roles and users stores in RolesUsers table.

Column Name	Data Type	Length
TableID	int	4
UserID	int	4
RoleID	int	4

Table III-22 : RolesUsers Table

The most important table about role-based security is permissions table.

Column Name	Data Type	Length
PermissionID	int	4
RoleID	int	4
TableName	varchar	255
PermissionTypeID	int	4
Condition	varchar	200

Table III-23 : Permissions Table

Manage permissions are thought to be on tables. It means, roles permissions are defined on tables. One of the columns in this table is TableName. In this table, on which table roles have Select, Insert, Update or Delete permissions are stored. These permission types stores in types table like many types. In addition, condition column. This column contains extra limitations about permission. For example, a role may have permission to select on events table, but may be we do not want to show the sales events to this role etc.

III.3 Application Screens

Login is first step of the application. When a user wants to use this application, first he/she must login. The following shows the login screen.



Figure III-9 : Login Screen

User must enter his user name, password and must choose a user type. As mentioned before, there are three types of users: Employees, Customers and Suppliers. After a user logs in the application successfully, the user is redirected to another page according to its user type.

If the user type is Employee, user redirected to the screen below:

The screenshot shows the 'infocust' application interface. On the left is a 'MENU' sidebar with categories like Tasks, Cases, Customers, Suppliers, etc. The main content area displays three tables:

- Last Five Tasks:** A table with columns Subject, StartDate, EndDate, and Priority. It lists two tasks: 'This is a trial task' and 'Second Trial Task'.
- Last Five Cases:** A table with columns Customer, Case Date, Contact Name, Contact Title, and Priority. It lists five cases from various customers like 'Working Smart Ltd.', 'Western Gas Resources', etc.
- Last Five Events:** A table with columns Customer, Employee, Event Date, Contact Name, and Event Type. It lists five events, all with 'Sales' as the event type, involving customers like 'Valsicol Chemical Corporation' and 'Tulenlian Import/Export'.

At the bottom of the interface, there is a copyright notice: © 2006 - Ahmet HOSO - Develop an ERP Integrated CRM Application with Data Mining. All Right Reserved - Best viewed on 1024x768 or higher resolution.

Figure III-10 : Employees Default Screen

Nearly all default screens as are for all type of users. When they login after that, firstly they see last five tasks, which tasks that user is owner or recipient of the task, last five cases and last five events.

After that according to user permissions, user can do many things. In this section we follow the below section's table sequence.

Users can do different things according to their types. Certainly, Employees can do every thing on application according to their permissions. Therefore, we tell employees screens'.

The first screen is category type screen. Our aim to add this screen only showed the content of the table.

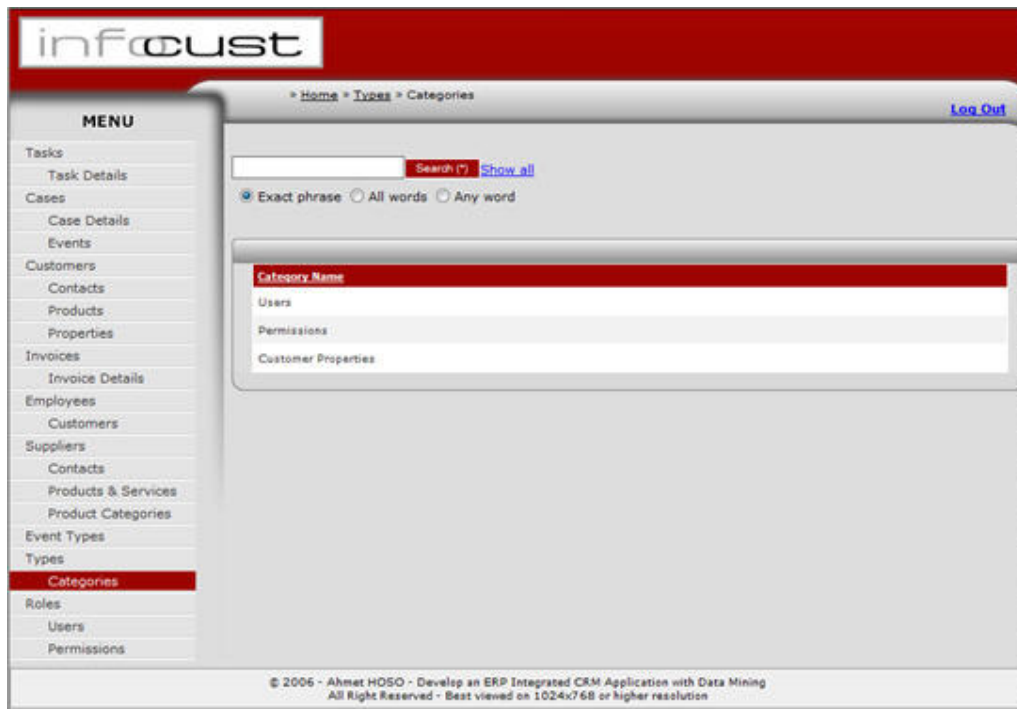


Figure III-11 : Type Categories Screen

The content of the table predefined. All of these type categories match with one or more tables' type categories. In addition, in types table some records predefined too which type categories are User types and Permission Types.

Users can insert or update new types only Customer Properties.

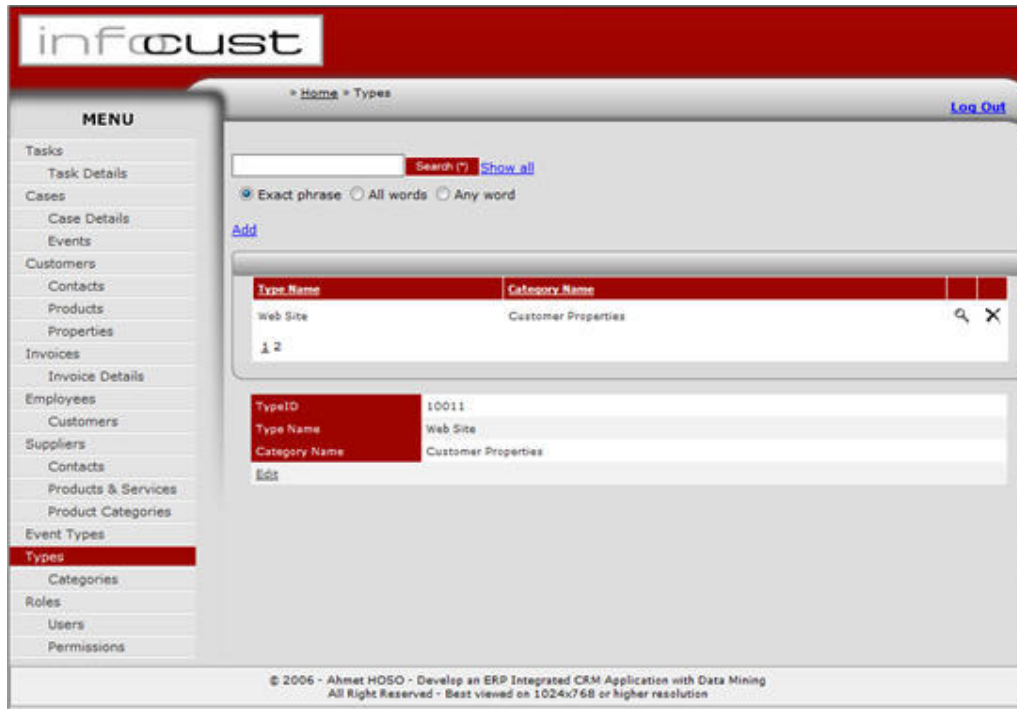


Figure III-12 : Types Screen

There are three types of users. Employees can add new employees or edit this employee's information.

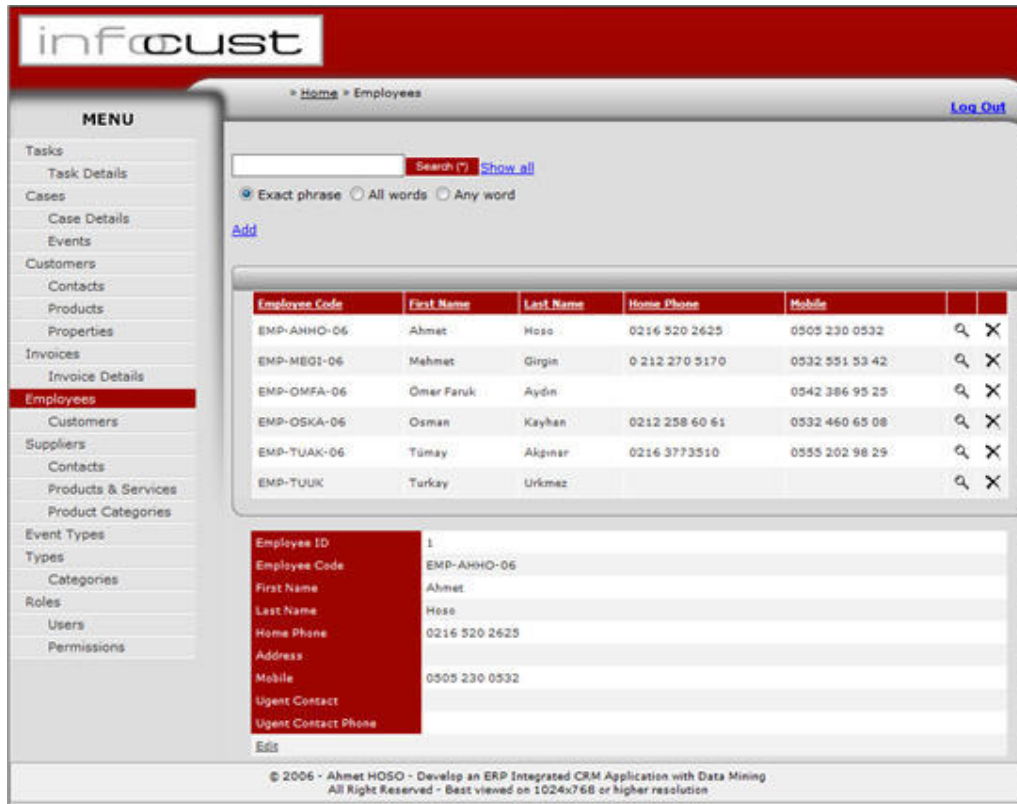


Figure III-13 : Employees Screen

As it has been mentioned, when a new employee, customer or supplier tried to insert the related table, firstly, a new user created in users table, by the way, a new UserID generated, and this new UserID is this new employee's EmployeeID. This new employee's username is first letter of combination of first name's first letter and surname, and password is 1.

Employees, customers and suppliers screens are nearly same. When a new supplier or a customer inserted then their company name their user name and passwords as 1 too.

Here is suppliers screen

The screenshot shows the 'infocust' web application interface. The top navigation bar is red with the 'infocust' logo. Below it, a breadcrumb trail reads 'Home > Suppliers' and a 'Log Out' link is visible. A left-hand menu titled 'MENU' lists various system functions, with 'Suppliers' highlighted in red. The main content area features a search bar with a 'Search (7)' button and a 'Show all' link. Below the search bar are radio buttons for search criteria: 'Exact phrase' (selected), 'All words', and 'Any word'. An 'Add' link is positioned below the search options. A table displays a list of suppliers with columns for 'Supplier Code', 'Company Name', 'Phone', 'Fax', and 'Tax Office'. Each row includes search and delete icons. Below the table is a form for editing a selected supplier's details, with fields for 'Supplier ID', 'Supplier Code', 'Company Name', 'Address', 'Phone', 'Fax', 'Tax Office', and 'Notes'. The footer contains copyright information: '© 2006 - Ahmet HOSO - Develop an ERP Integrated CRM Application with Data Mining All Right Reserved - Best viewed on 1024x768 or higher resolution'.

Supplier Code	Company Name	Phone	Fax	Tax Office		
SUP-INFO-06	Infocust Corp.				🔍	✕
SUP-APPW-06	Appworks	2544583	2355668	125369874	🔍	✕
SUP-READ-06	Readsoft	25412552	12545254	125421	🔍	✕
SUP-QUES-06	Quest	25412552	12545254	125421	🔍	✕
SUP-A21A-06	A2ia				🔍	✕

Supplier ID	0
Supplier Code	SUP-INFO-06
Company Name	Infocust Corp.
Address	
Phone	
Fax	
Tax Office	
Notes	

Figure III-14 : Suppliers Screen

In addition, here is customers screen

The screenshot shows the 'infocust' web application interface. On the left is a 'MENU' with various options like 'Tasks', 'Cases', 'Customers', etc. The main area displays a search bar and a table of customers. Below the table, a detailed view for a specific customer is shown.

Customer Code	Company Name	Category	Phone	Fax		
CUS-WORK-06	Working Smart Ltd.	3			🔍	✕
CUS-WYET-06	Wyeth Pharmaceuticals	3			🔍	✕

CustomerID	190
Customer Code	CUS-WYET-06
Company Name	Wyeth Pharmaceuticals
Category	3
Address	NJ - Cherry Hill
Phone	
Fax	
TaxOffice	
Notes	
Edit	

Figure III-15 : Customers Screen

There are few properties defined for customers.

Another screen Customer Products shows the customer products which sold from us.

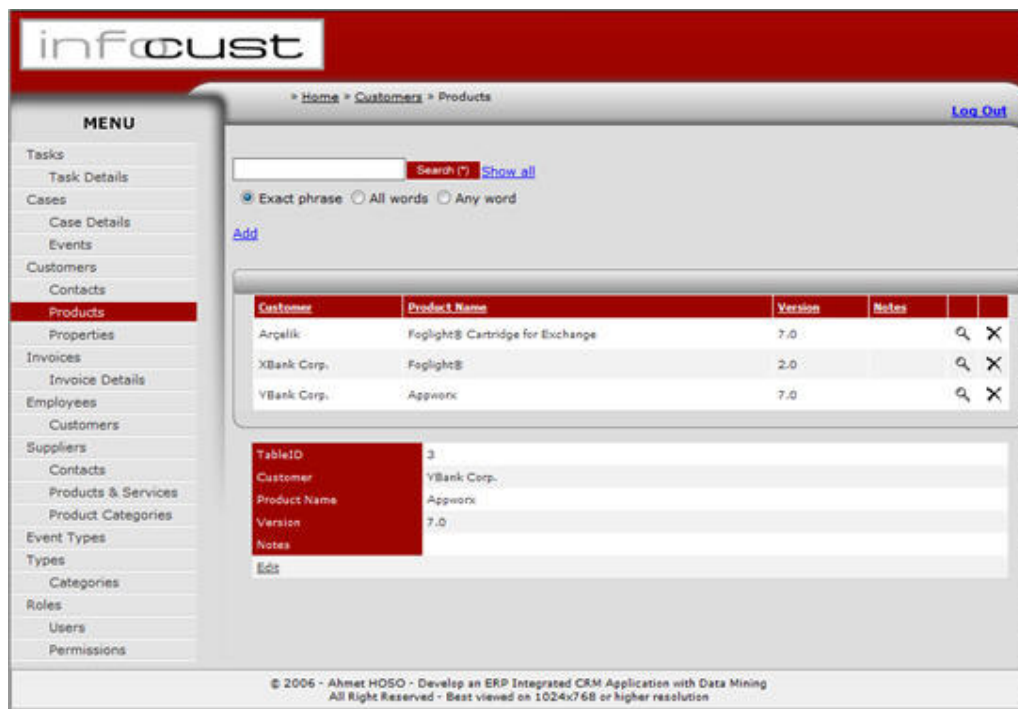


Figure III-16 : Customer Products Screen

However, these properties are not enough for a CRM application. One could need many properties expect these properties. May be you may want to store new information about your customers. For solving this problem, a properties table has been created and the screen below is that table's screen. As it is mentioned above, you may define new customer properties and you can set values to these new properties whenever you want.

The screenshot shows the 'infocust' web application interface. The main content area displays a table of customer properties. The table has columns for Customer, Property Type, and Property. Below the table, there is a summary section with fields for TableID, Customer, Property Type, and Property.

Customer	Property Type	Property		
Bosch	Operating System	Windows Server 2003	🔍	✕
XBank Corp.	Operating System	Windows Server 2003	🔍	✕
XBank Corp.	MailSystem	Exchange Server	🔍	✕
VBank Corp.	Hardware	IBM AS 400	🔍	✕
VBank Corp.	Operating System	Windows 2003	🔍	✕

TableID	17
Customer	VBank Corp.
Property Type	Operating System
Property	Windows 2003

Figure III-17 : Customer Properties

New products can be inserted, updated or deleted on Products and Services screen.

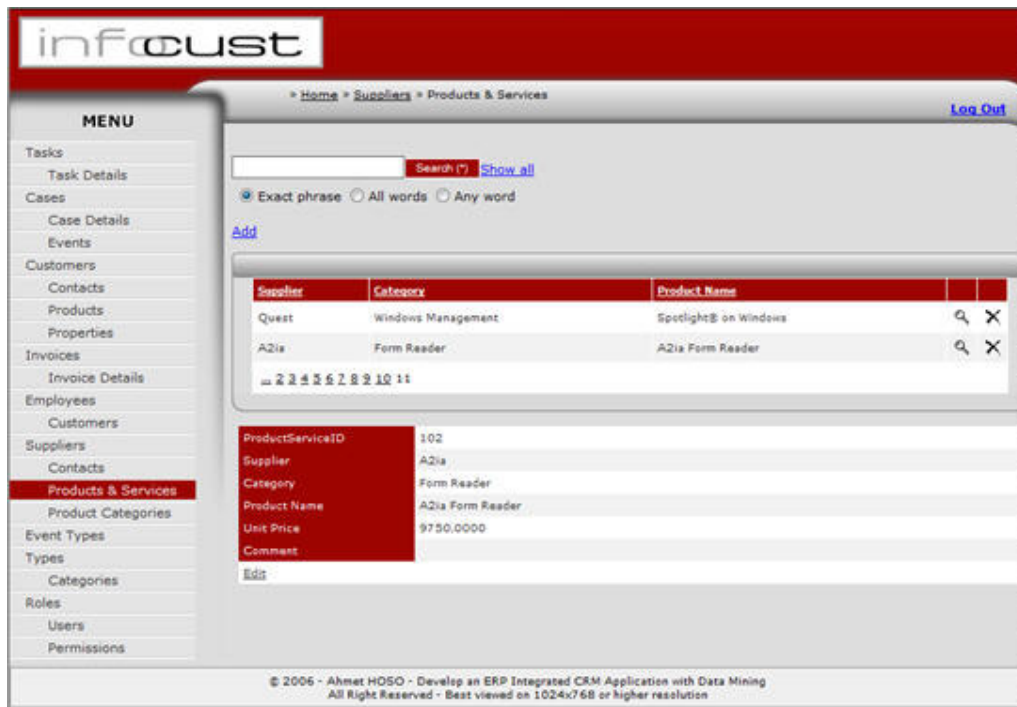


Figure III-18 : Products and Services Screen

All products have a product category. These categories are important. For example if a customer interested in a SQL Server Database Management tool than you may make different proposals to this customers easily.

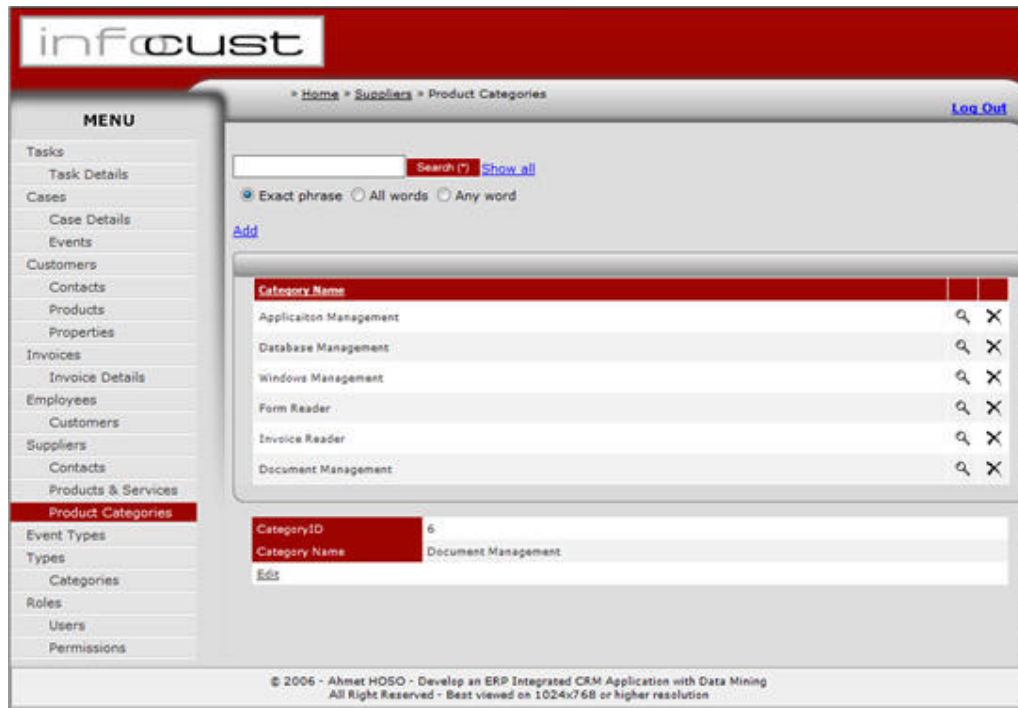


Figure III-19 : Product Categories Screen

All contacts are stored in contacts table. However, at application for easy management employees see two contacts link. One of them is under customers and other one under suppliers.

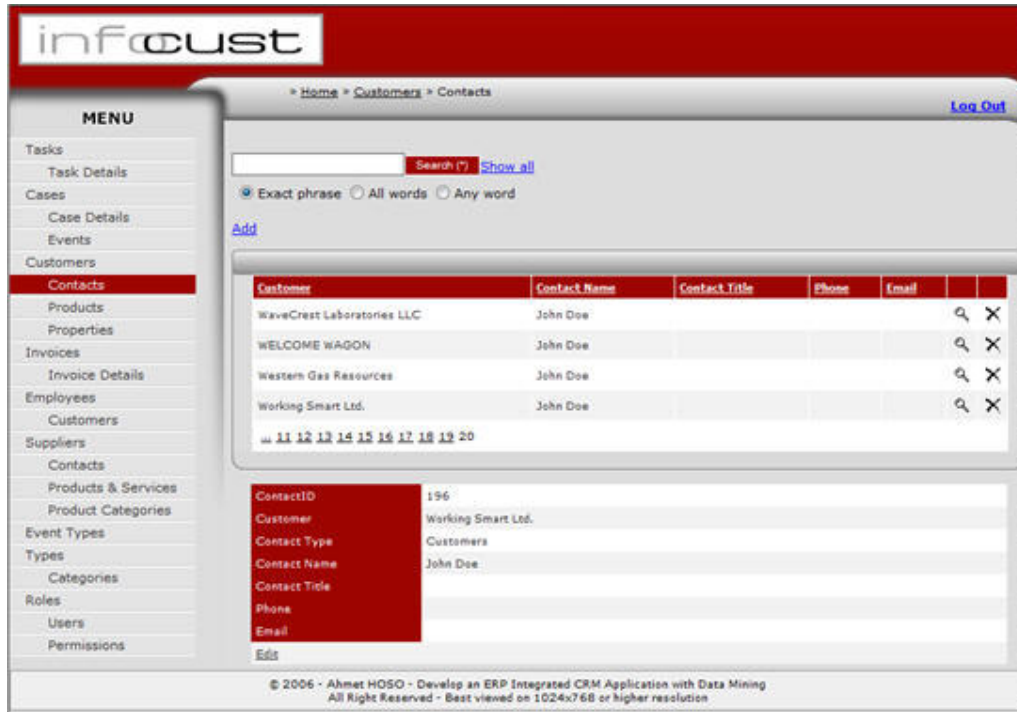


Figure III-20 : Customer Contacts Screen

One of the most important terms in our application is case. Employees can be insert update or delete new cases with this screen.

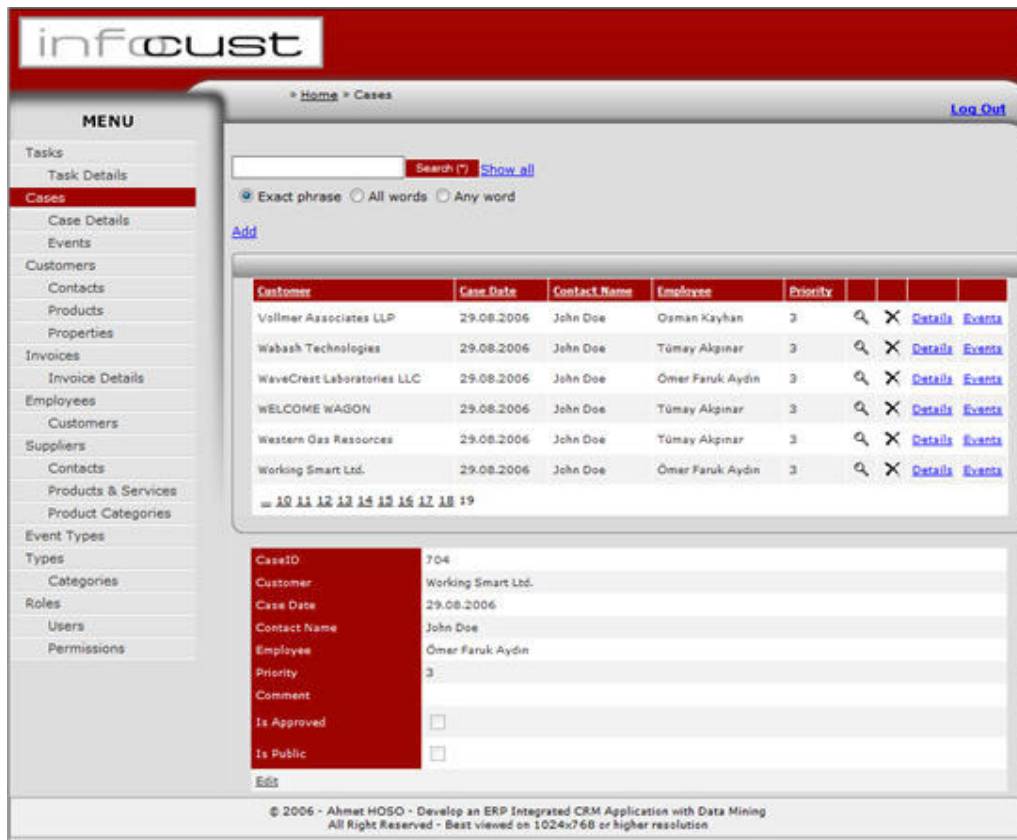


Figure III-21 : Cases Screen

As it is mentioned, when a customer start interested in a product or services that is a case for us.

One customer may have many cases at the same time. In addition, all cases may relate with one or more products.

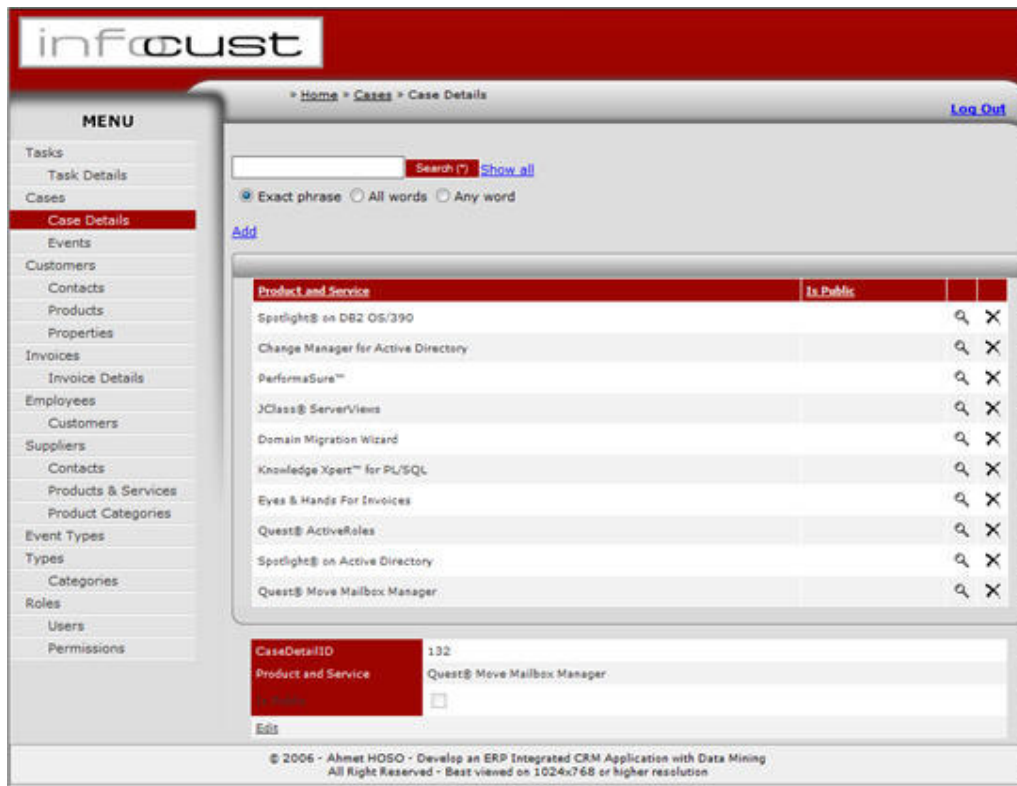


Figure III-22 : Case Details Screen

Other most important terms in our application are event. Events related with cases. So an event cannot directly insert. If an employee want to insert an event to a case he or she must be move on case.

The screenshot shows the 'infocust' application interface. The main content area displays a list of events with the following data:

EventDate	Contact Name	Employee Name	Event Type		
01.01.2006	Murat Vardar	Ahmet Hoso	Demo	🔍	✕
02.01.2005	Murat Vardar	Ahmet Hoso	Phone Call	🔍	✕
30.07.2006	Bilal Turkoglu	Ahmet Hoso	Sales	🔍	✕
29.08.2006	Murat Vardar	Osman Kayhan	Sales	🔍	✕

Below the table is a form for adding a new event:

EventID	29
EventDate	29.08.2006
Contact Name	Murat Vardar
Employee Name	Osman
Event Type	Sales
Comment	
IsApproved	
IsPublic	
ESG	

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Figure III-23 : Events Screen

All events must have types. New types can inserted, and current types can updated or deleted with event types screen.

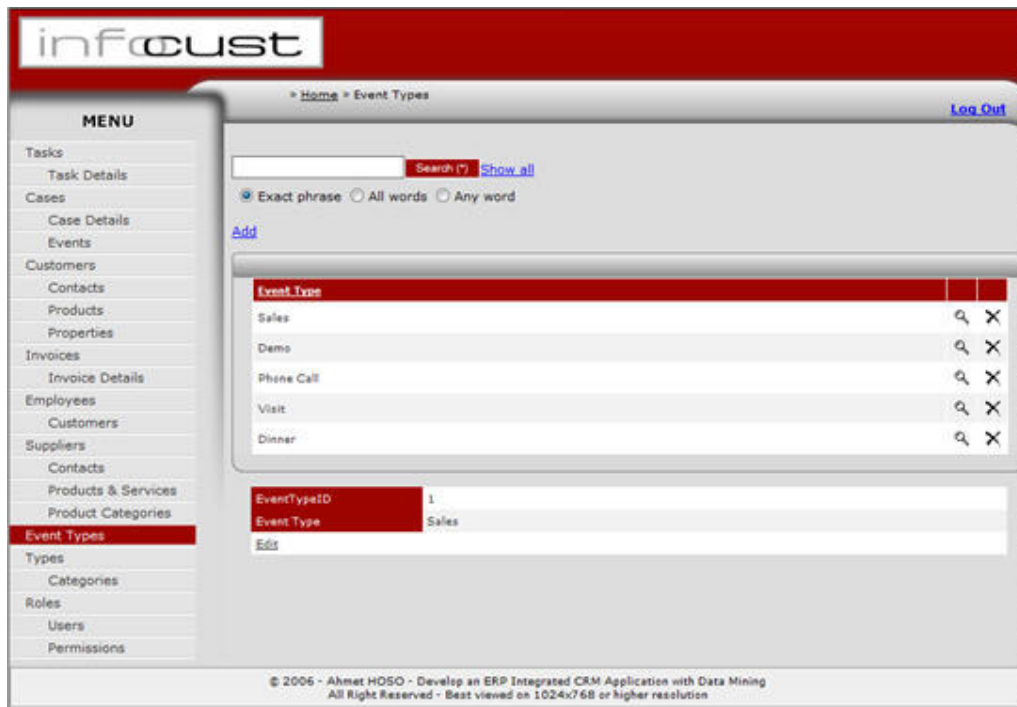


Figure III-24 : Event Types Screen

If user select Sales event type than invoice screen opens.

The screenshot displays the 'infocust' application interface. On the left is a 'MENU' sidebar with categories like Tasks, Cases, Customers, Invoices (highlighted), Employees, Suppliers, Event Types, Types, Roles, and Users. The main content area is titled 'Home > Invoices' and features a search bar with a 'Search (*) Show all' button and radio buttons for search criteria: 'Exact phrase' (selected), 'All words', and 'Any word'. Below the search bar is an 'Add' link and a table of invoice records. The table has columns for PO Number, Customer, Employee, and a 'Details' link. The first record is: PO Number: A-120168, Customer: WELCOME WAGON, Employee: Ahmet Hoso. Below the table is a detailed view of the selected invoice (InvoiceID: 190) with fields for PO Number, Customer, and Employee. At the bottom, there is an 'Edit' link and a footer with copyright information: '© 2006 - Ahmet HOSO - Develop an ERP Integrated CRM Application with Data Mining All Right Reserved - Best viewed on 1024x768 or higher resolution'.

PO Number	Customer	Employee		
A-120168	WELCOME WAGON	Ahmet Hoso	🔍	✕ Details

InvoiceID	190
PO Number	A-120168
Customer	WELCOME WAGON
Employee	Ahmet Hoso

Figure III-25 : Invoices Screen

An invoice may have more than rows so that users can add many rows to their invoices.

The screenshot displays the 'infocust' application interface. At the top, there is a navigation breadcrumb: Home > Invoices > Invoice Details. A search bar is present with a 'Search (*)' button and a 'Show all' link. Below the search bar are radio buttons for search criteria: 'Exact phrase' (selected), 'All words', and 'Any word'. An 'Add' link is located below the search options.

PO Number	Product & Service	Unit Price	Quantity		
TS_0003	Spotlight® on Web Servers	19000.0000	1	🔍	✕
TS_0003	JProbe® Suite	8000.0000	3	🔍	✕
TS_0003	Quest User Experience Monitor™	9500.0000	1	🔍	✕
TS_0003	Spotlight® on DB2 OS/390	21500.0000	2	🔍	✕
TS_0003	SQLab Vision / Quest Central® for Oracle SQL Tuning	16000.0000	1	🔍	✕

Below the table, a detailed view of a selected item is shown:

InvoiceDetailID	43
PO Number	TS_0003
Product & Service	SQLab Vision / Quest Central® for Oracle SQL Tuning
Unit Price	16000.0000
Quantity	1
Discount	
Edit	

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Figure III-26 : Invoice Details Screen

Role-based security is used in our application.

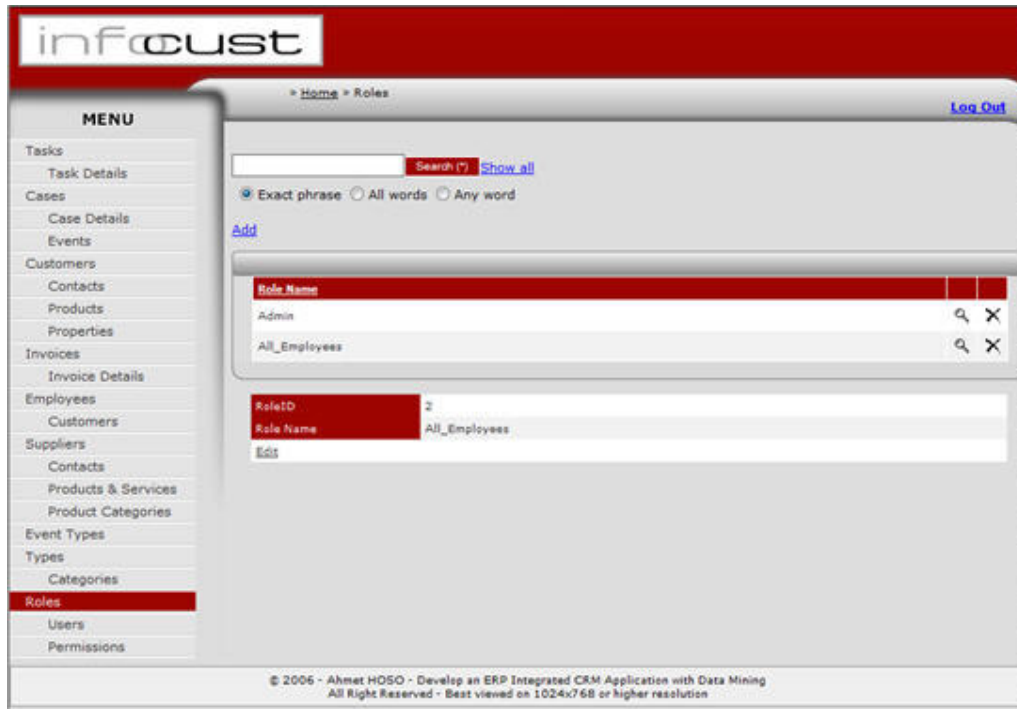


Figure III-27 : Roles Screen

Roles have users

The screenshot shows the 'infocust' web application interface. The top navigation bar includes 'Home > Roles > Users' and a 'Log Out' link. A search bar is present with a 'Search (*)' button and a 'Show all' link. Below the search bar are radio buttons for search criteria: 'Exact phrase' (selected), 'All words', and 'Any word'. An 'Add' link is located below the search options. The main content area features a table with the following data:

User Name	Role Name		
ahoso	Admin	🔍	✕
mgirgin	Admin	🔍	✕

Below the table is a form for editing a user's role assignment:

TableID	1
User Name	ahoso
Role Name	Admin

An 'Edit' link is located below the form. The left sidebar contains a 'MENU' with various categories, and the 'Users' category is currently selected. The footer contains copyright information: '© 2006 - Ahmet HOŞO - Develop an ERP Integrated CRM Application with Data Mining All Right Reserved - Best viewed on 1024x768 or higher resolution'.

Figure III-28 : Role Users Screen

In addition, roles have permissions.

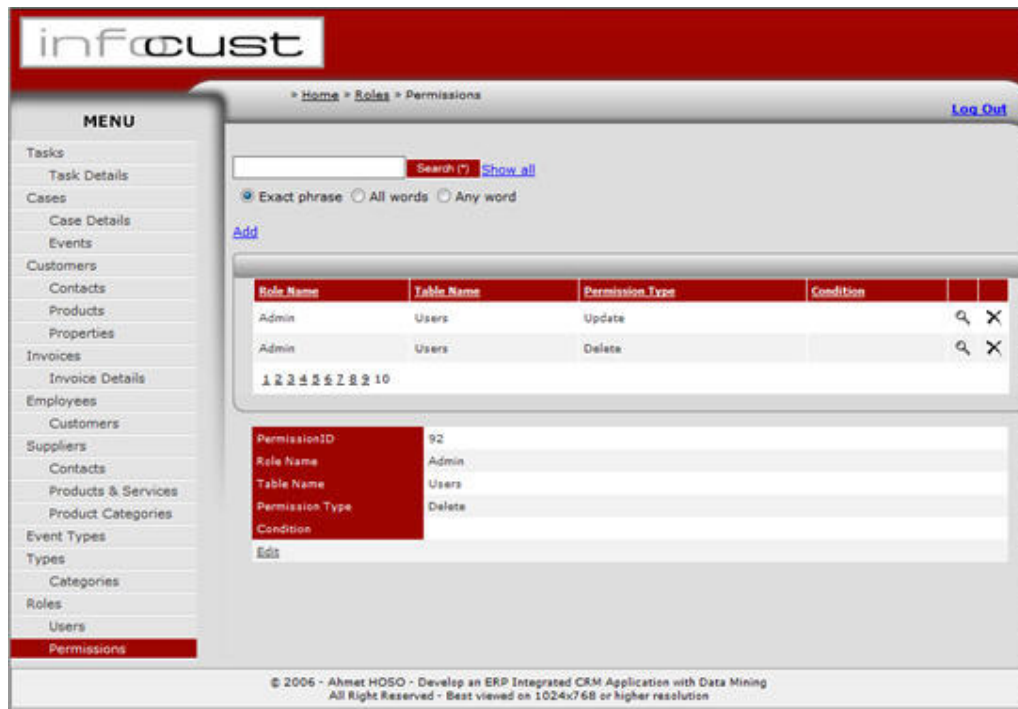


Figure III-29 : Permissions Screen

III.4 ERP Integration

For ERP integration, XML Web services are used. First, XML Web services are used for this integration because of security. XML Web services are a simple and secure way to share data among different applications. XML Web Services use the HTTP protocol, so we do not need to open a port on our server for remote access. In addition, XML is platform independent. ERP application can be coded with any programming language and it can be running on any operating system, these are not problems.

In addition, the other cause is processes. It means that, for example you have critical levels for product stock. In addition, when a product stock count reaches this critical level, some of the process automatically runs. By XML Web services, you can manage this situation.

Here is the XML Web Services test screen.

The screenshot shows a web page titled "WebService" with a blue header. Below the header, it lists supported operations: "CheckProductCount" and "EditProductCount". A section titled "This web service is using http://tempuri.org/ as its default namespace." includes a recommendation to change the default namespace before the XML Web service is made public. It explains that each XML Web service needs a unique namespace and provides a code example in C# and Visual Basic for setting the namespace to "http://microsoft.com/webservices/".

```
C#
[WebService(Namespace="http://microsoft.com/webservices/")]
public class MyWebService {
    // implementation
}

Visual Basic
<WebService(Namespace="http://microsoft.com/webservices/") > Public Class MyWebService
    ' implementation
End Class
```

Figure III-30 : XML Web Service

This XML Web Services, have two methods. One of these methods is "CheckProductCount" method.

The screenshot shows a web page titled "WebService" with a blue header. Below the header, it says "Click [here](#) for a complete list of operations." The main section is titled "CheckProductCount" and has a "Test" sub-section. It instructs the user to test the operation using the HTTP POST protocol by clicking the "Invoke" button. There is a table with two columns: "Parameter" and "Value". The "Parameter" column contains "ProductServiceID:" and the "Value" column contains an empty text input field. Below the table is an "Invoke" button. The "SOAP 1.1" section shows a sample SOAP 1.1 request and response, with placeholders for actual values.

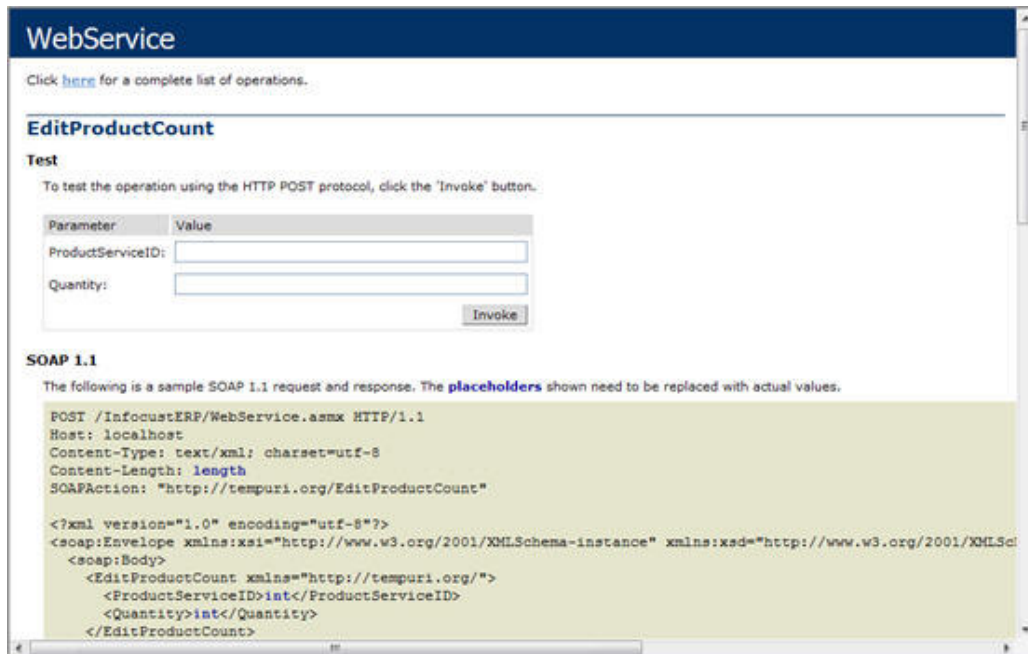
```
POST //InfocustERP/WebService.asmx HTTP/1.1
Host: localhost
Content-Type: text/xml; charset=utf-8
Content-Length: length
SOAPAction: "http://tempuri.org/CheckProductCount"

<?xml version="1.0" encoding="utf-8"?>
<soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema-instance" xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
  <soap:Body>
    <CheckProductCount xmlns="http://tempuri.org/">
      <ProductServiceID>int</ProductServiceID>
    </CheckProductCount>
  </soap:Body>
</soap:Envelope>
```

Figure III-31 : CheckProductCount Method

“CheckProductCount” method is used for checking the product stock count. When an employee tries to give an invoice to a customer, for all invoice lines products stock level checked. This method takes one parameter (ProductServiceID) and returns the stock count. If count greater than zero and user request count then this product can add the invoice line.

The other method is “EditProductCount” method.



The screenshot shows a web browser window titled "WebService". It contains a link for a complete list of operations. The main section is titled "EditProductCount" and has a "Test" section. The test section instructs the user to click the "Invoke" button after entering values for "ProductServiceID" and "Quantity". Below the test section is a "SOAP 1.1" section showing a sample request and response. The request is a POST to /InfocustERP/WebService.asmx HTTP/1.1 with headers for Host, Content-Type, Content-Length, and SOAPAction. The body is an XML document with the following structure:

```
<?xml version="1.0" encoding="utf-8"?>
<soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema-instance">
  <soap:Body>
    <EditProductCount xmlns="http://tempuri.org/">
      <ProductServiceID>int</ProductServiceID>
      <Quantity>int</Quantity>
    </EditProductCount>
  </soap:Body>
</soap:Envelope>
```

Figure III-32 : EditProductCount Method

“EditProductCount” method is used for editing the product stock count. When an employee gives an invoice to a customer, for all invoice lines products stock level edit according to requests quantity. This method takes two parameters (ProductServiceID and Quantity) and editing the product stock count according to the quantity. If you want, you may automatically make some jobs with this method. For example if product reaches the critical level, you can automatically send orders to your suppliers to produce new products and etc.

III.5 Data-Mining

For data mining, clustering algorithm is used. Microsoft SQL Server 2005 based on .NET technology.

III.5.1 Microsoft Clustering Algorithm

The Microsoft Clustering algorithm is a segmentation algorithm provided by Microsoft SQL Server 2005 Analysis Services (SSAS). The algorithm uses iterative techniques to group cases in a dataset into clusters that contain similar characteristics. These groupings are useful for exploring data, identifying anomalies in the data, and creating predictions.

Clustering models identify relationships in a dataset that you might not logically derive through casual observation. For example, you can logically discern that people who commute to their jobs by bicycle do not typically live a long distance from where they work. The algorithm, however, can find other characteristics about bicycle commuters that are not as obvious. In the following diagram, cluster A represents data about people who tend to drive to work, while cluster B represents data about people who tend to ride bicycles to work.

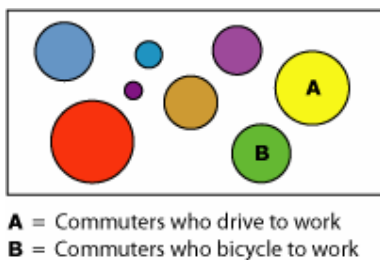


Figure III-33 : Data Mining - Clustering Algorithm

The clustering algorithm differs from other data mining algorithms, such as the Microsoft Decision Trees algorithm, in that you do not have to designate a predictable column to be able to build a clustering model. The clustering algorithm trains the model strictly from the relationships that exist in the data and from the clusters that the algorithm identifies. [25]

III.5.2 How Microsoft Clustering Algorithm Works

The Microsoft Clustering algorithm first identifies relationships in a dataset and generates a series of clusters based on those relationships. A scatter plot is a useful way to visually represent how the algorithm groups data, as shown in the following diagram. The scatter plot represents all the cases in the dataset, and each case is a point on the graph. The clusters group points on the graph and illustrate the relationships that the algorithm identifies.

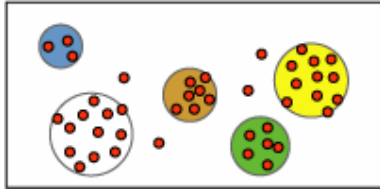


Figure III-34 : Data Mining – Clustering Algorithm Works Model

After first defining the clusters, the algorithm calculates how well the clusters represent groupings of the points, and then tries to redefine the groupings to create clusters that better represent the data. The algorithm iterates through this process until it cannot improve the results more by redefining the clusters.

The Microsoft Clustering algorithm offers two methods for calculating how well points fit within the clusters: Expectation Maximization (EM) and K-Means. For EM clustering, the algorithm uses a probabilistic method to determine the probability that a data point exists in a cluster. For K-Means, the algorithm uses a distance measure to assign a data point to its closest cluster.

Columns with a usage that is set to predict only are not used to build clusters. Their distributions in the clusters are calculated after the clusters are built. [25]

III.5.3 Data Mining Application

By “SQL Server Business Intelligence Development Studio” tool, “Analysis Services Project” can be accomplished. On our thesis, data mining is deployed as a different project. User makes analyses and according to the results changes the customer categories. But it is possible to integrate this process as a part of our CRM application.

A new project is created for data mining. Now, the steps of the data-mining project can be explained.

Firstly, we define a data source.

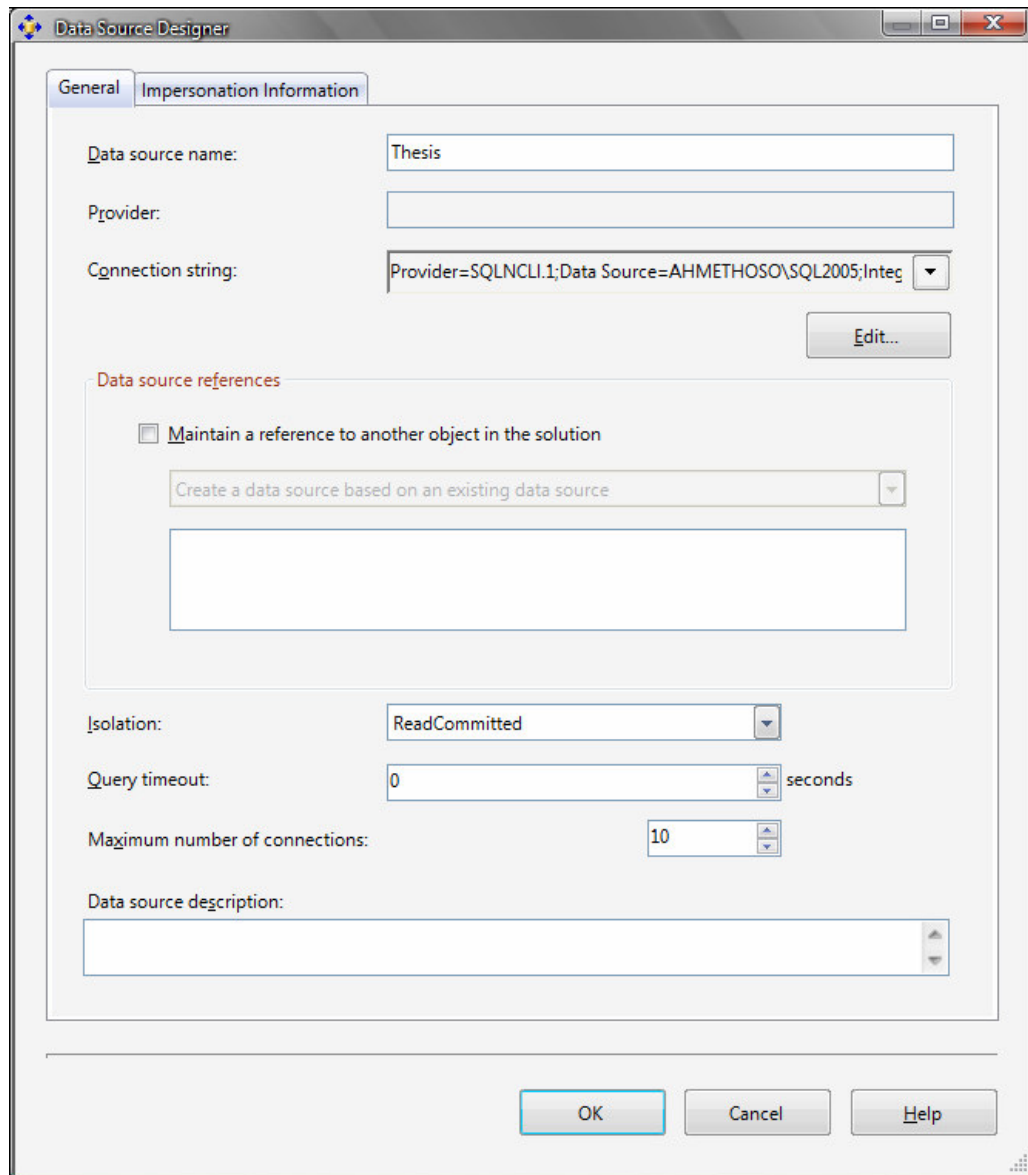


Figure III-35 : Data mining - Data Source Designer

A data source is defined. This data source defines the source database for using data mining.

A view is created on our source database. This view has two columns. One of the column is CustomerID and the other one is Customers' orders total. We use this view for data mining.

After data source definition, data source view is defined.

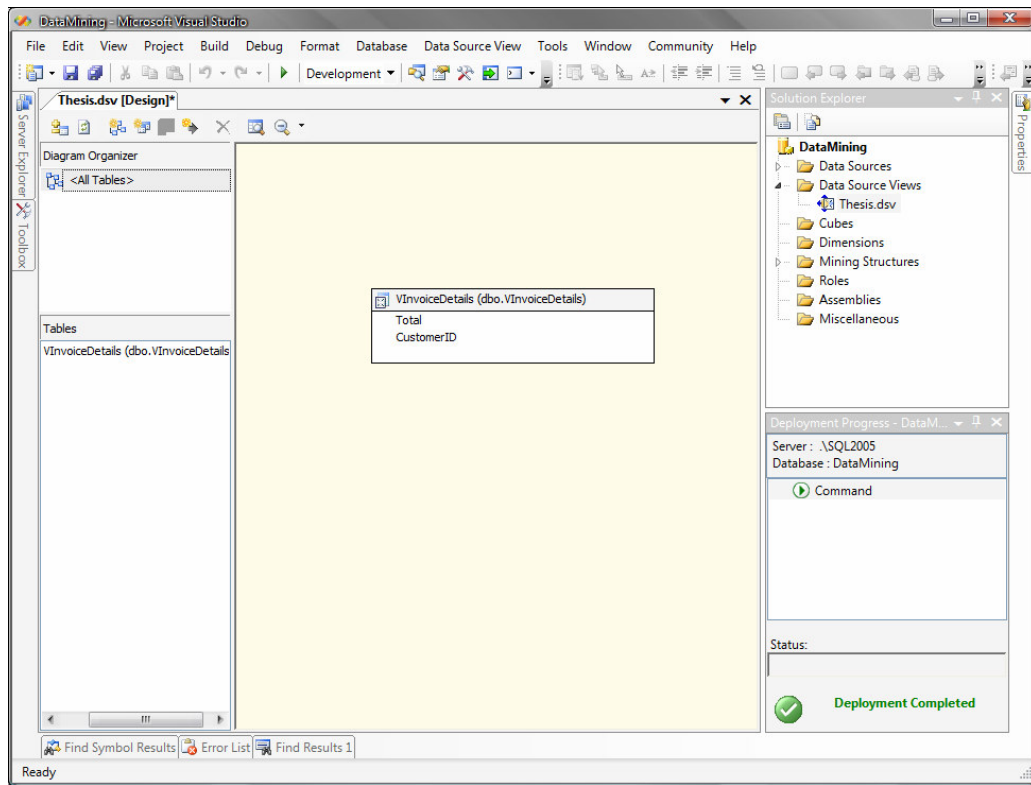


Figure III-36 : Data mining - Data Source View

Now, we have a data source, and data source view. After this step, Mining Structure needs to be defined. Mining structure definition wizard is used for defining the mining structure.

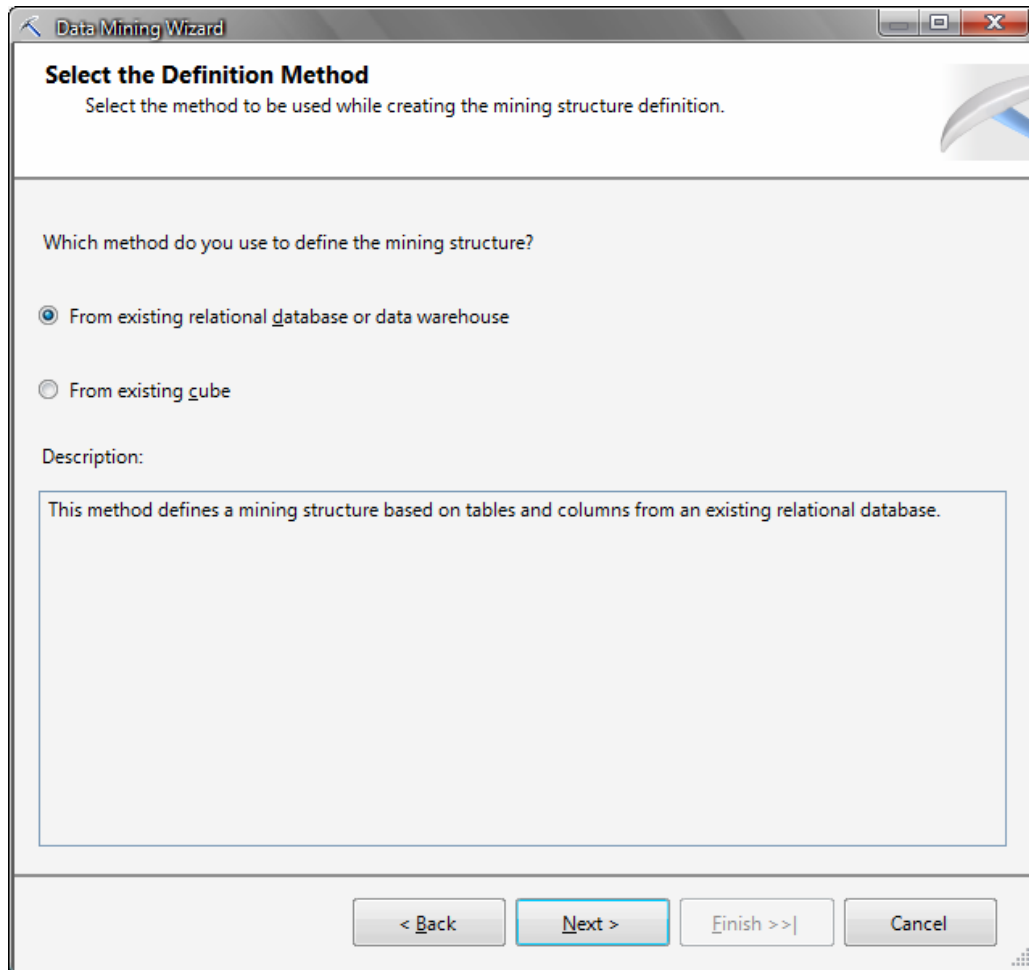


Figure III-37 : Data mining – Select the Definition Method

The first step of the wizard is selecting the definition wizard. We define the data source before, so we use the defined data source.

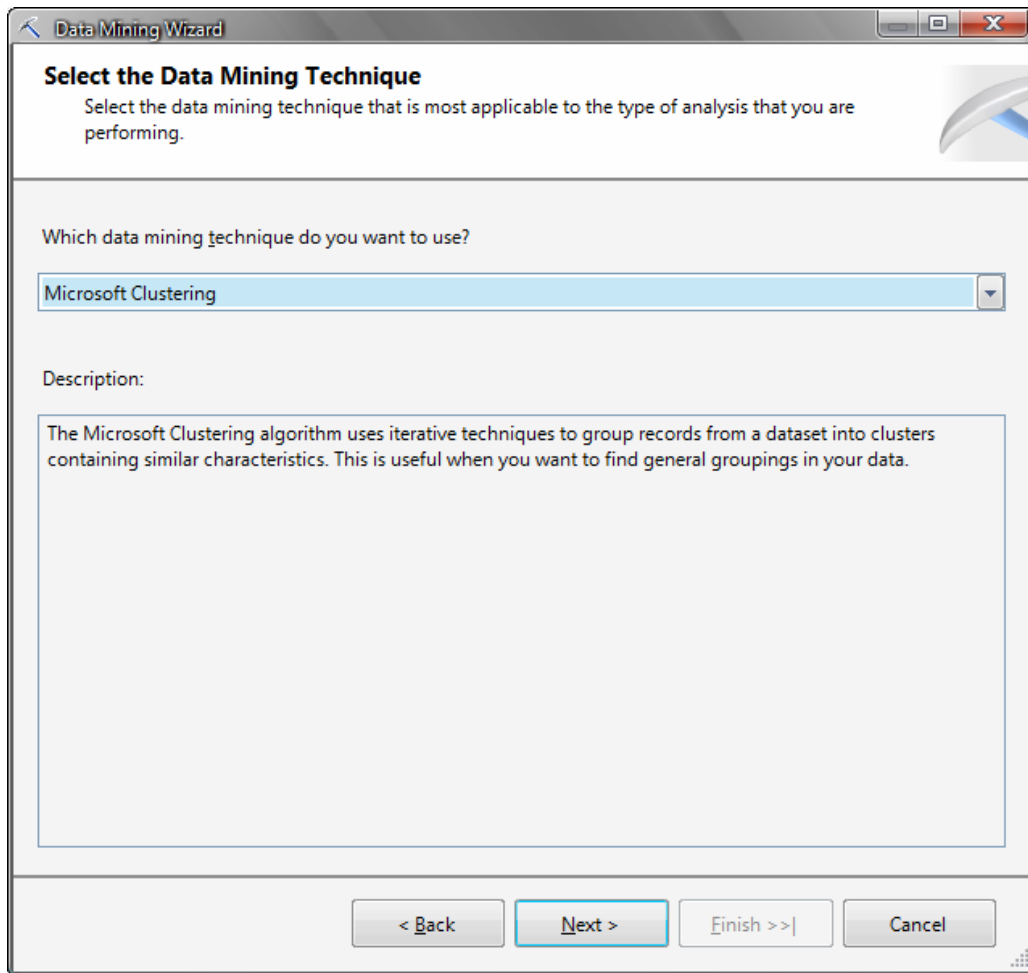


Figure III-38 : Data mining – Select the Data Mining Technique

The next step is choosing the data mining technique. As mentioned before Clustering Algorithm is used for data mining. Microsoft Clustering is selected from the list.

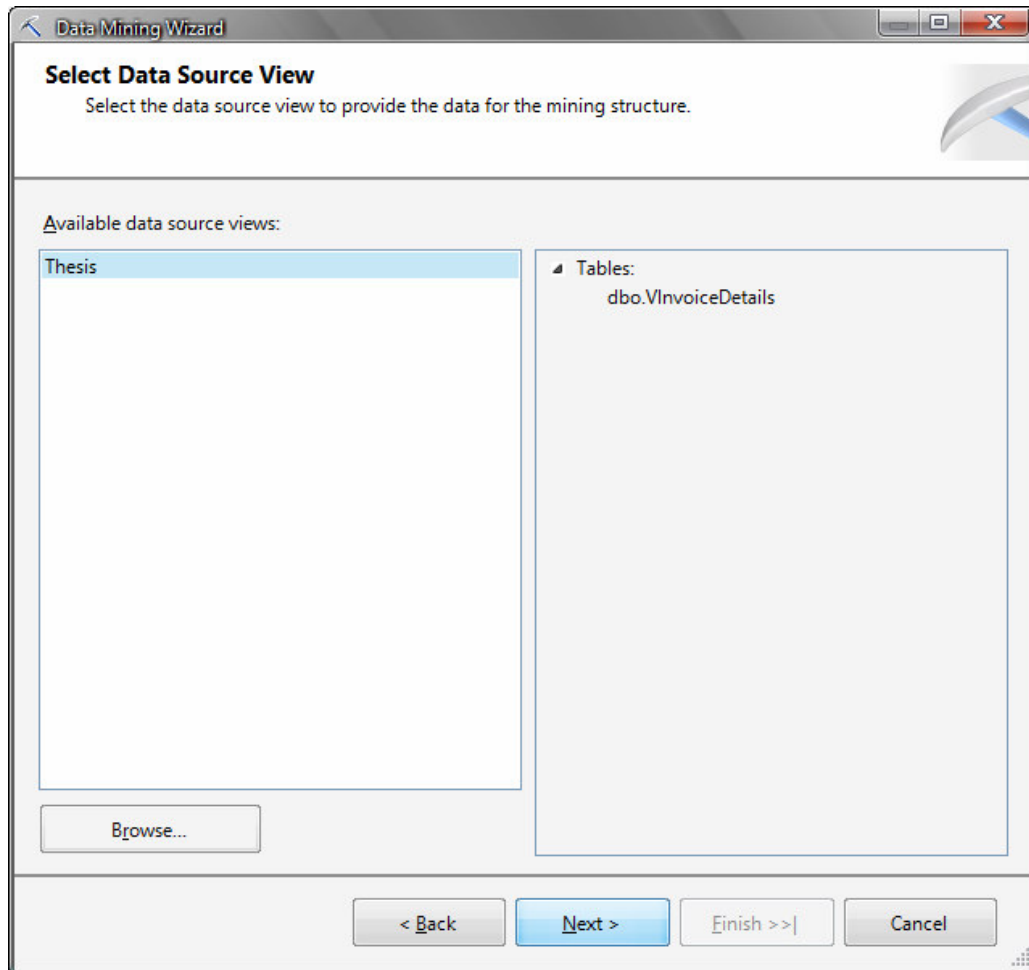


Figure III-39 : Data mining – Select the Data Source View

After choosing the data mining structure, next step of the wizard is selecting data source view. Data source view has been defined before. So when it comes to this step data source view can be seen on available data source views list. This data source view is selected and the next step comes.

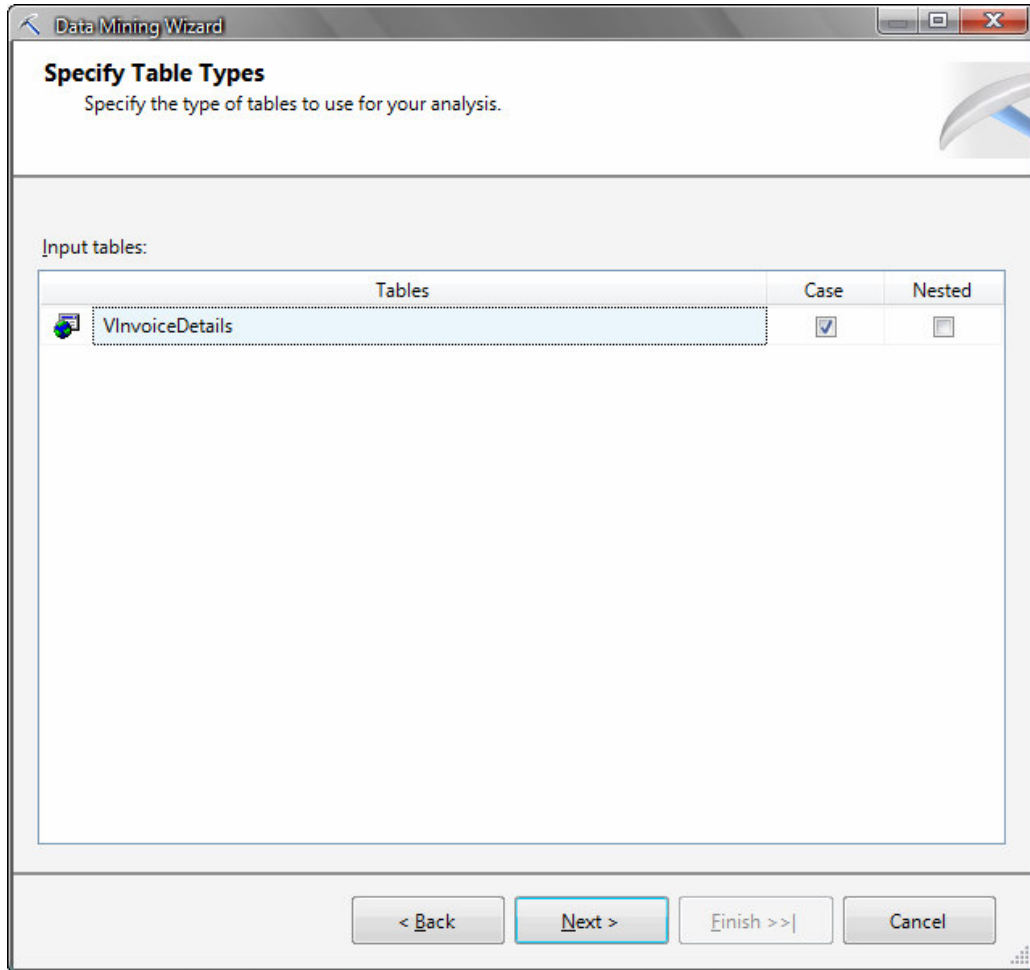


Figure III-40 : Data mining – Specify Table Types

After selecting data source view step, we define the type of our view. After some tests, we decided to select “Case” the type of our view.

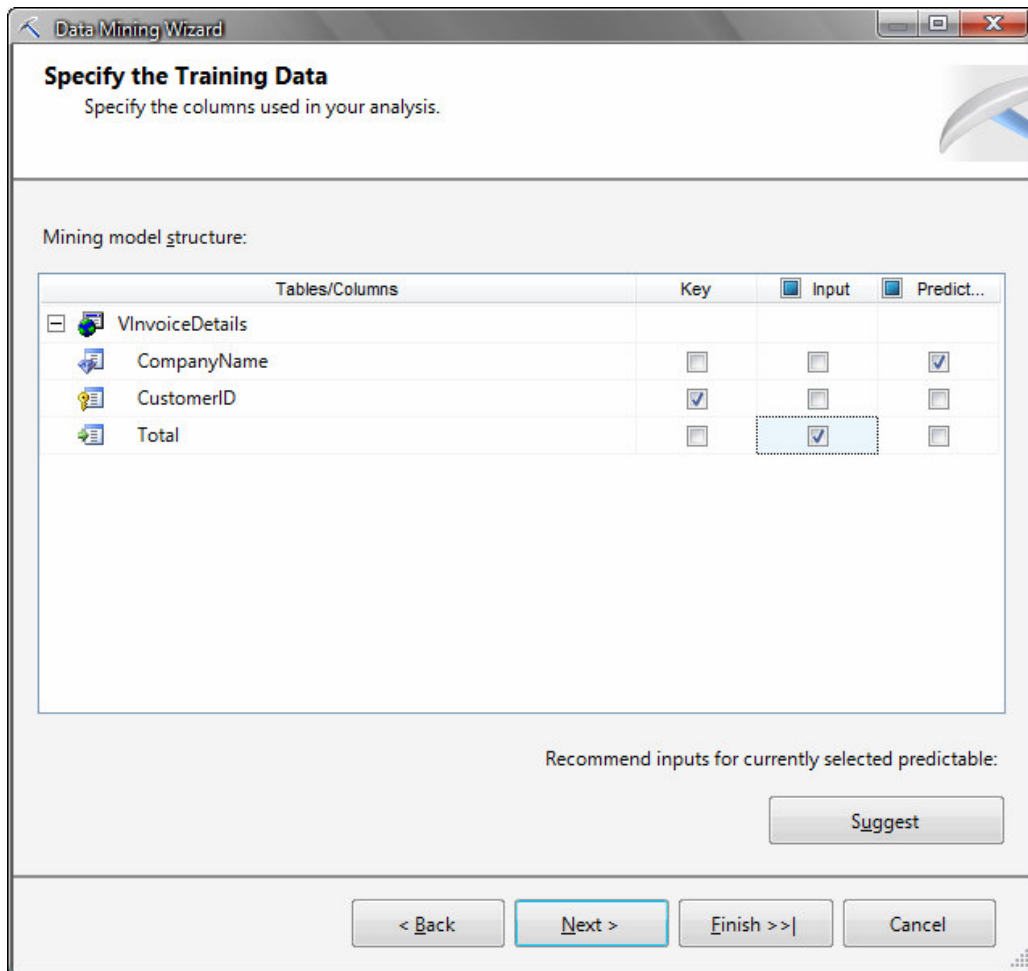


Figure III-41 : Data mining – Specify the Training Data

The next step of the wizard is “Specify the Training Data”. At this step, key and prediction fields are selected. CustomerID is chosen as key, because process the CustomerID is not required, and Total is chosen (total is an alias of the aggregate field) as predictable for processing.

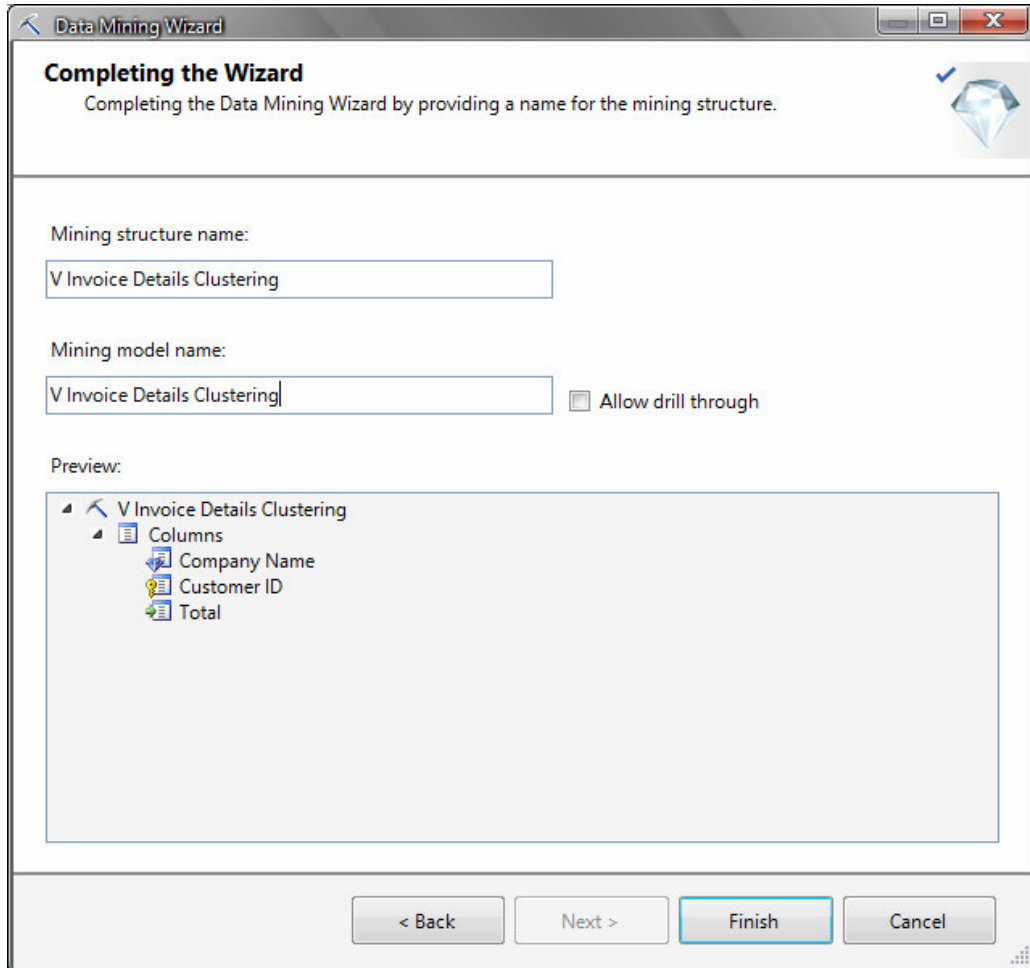


Figure III-42 : Data mining –Completing the Wizard

The last step of the wizard is naming the Mining Structure. We give same name the Mining structure and the Mining model. And the wizard shows a summary on this step.

After the naming step click the “Finish” button.

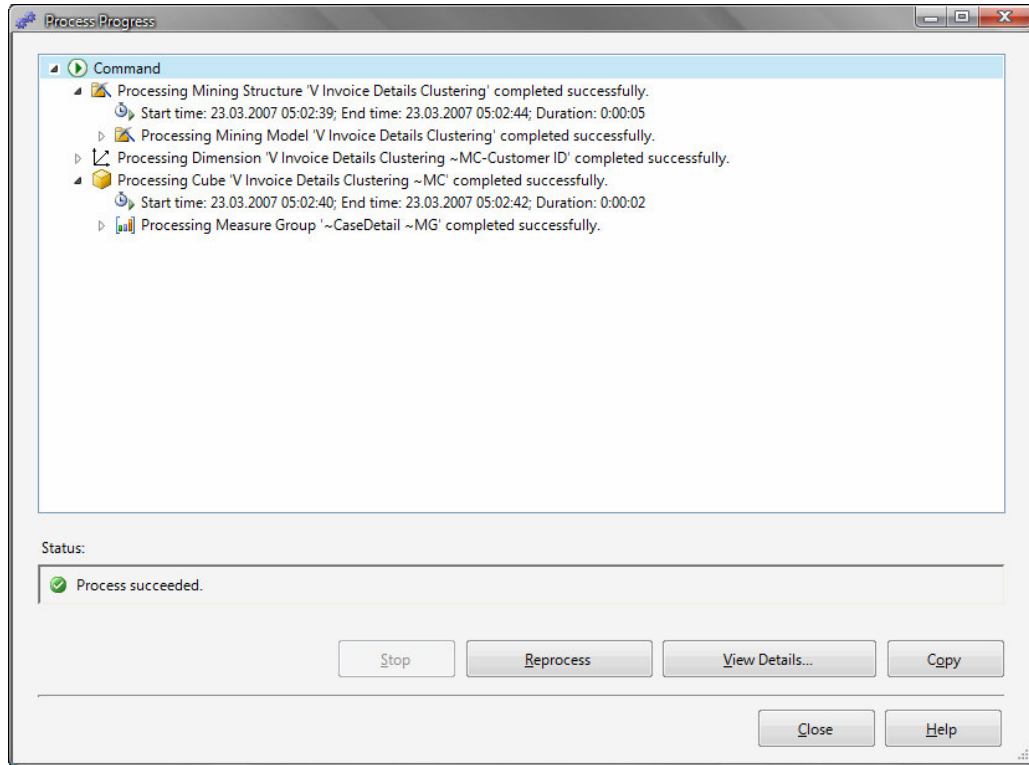


Figure III-43 : Data mining – Process Mining Structure

After finishing the wizard, Mining structure added to the solution explorer of project. Then, we right click our mining structure and click the “Process”. When the process button clicked, the “Process Mining Structure” screen shows the process status.

When the process status is complete, the results are shown on the next page.

There are four screens that show the distribution of the sales results. User can categorize customers according to these screens.

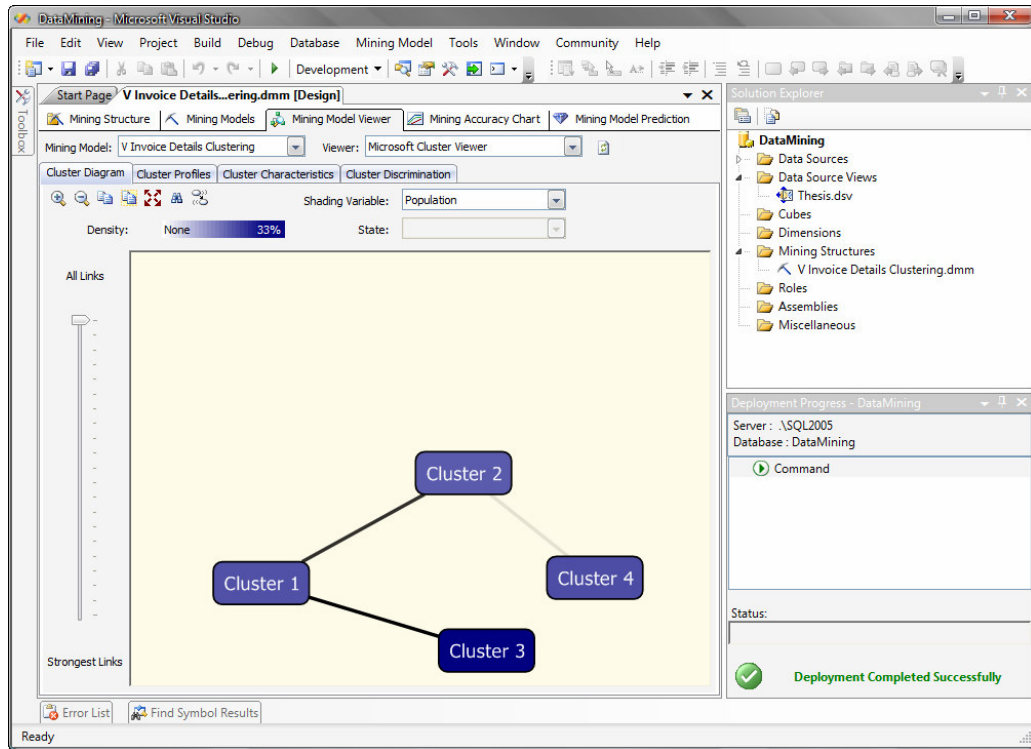


Figure III-44 : Data mining – Cluster Diagram

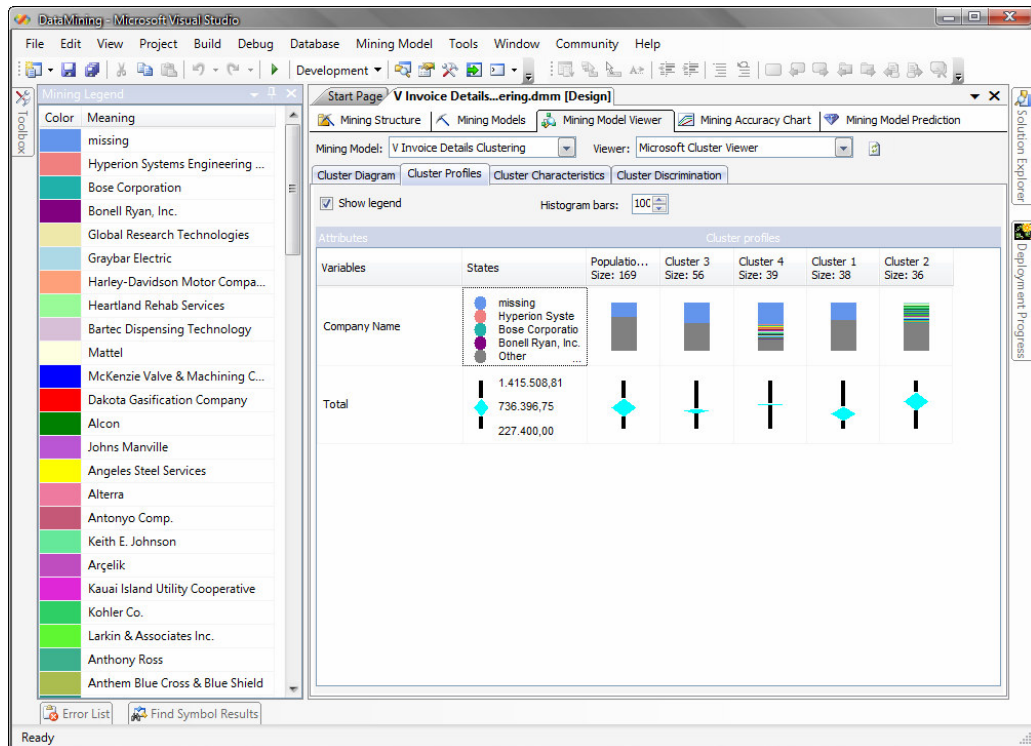


Figure III-45 : Data mining – Cluster Profiles

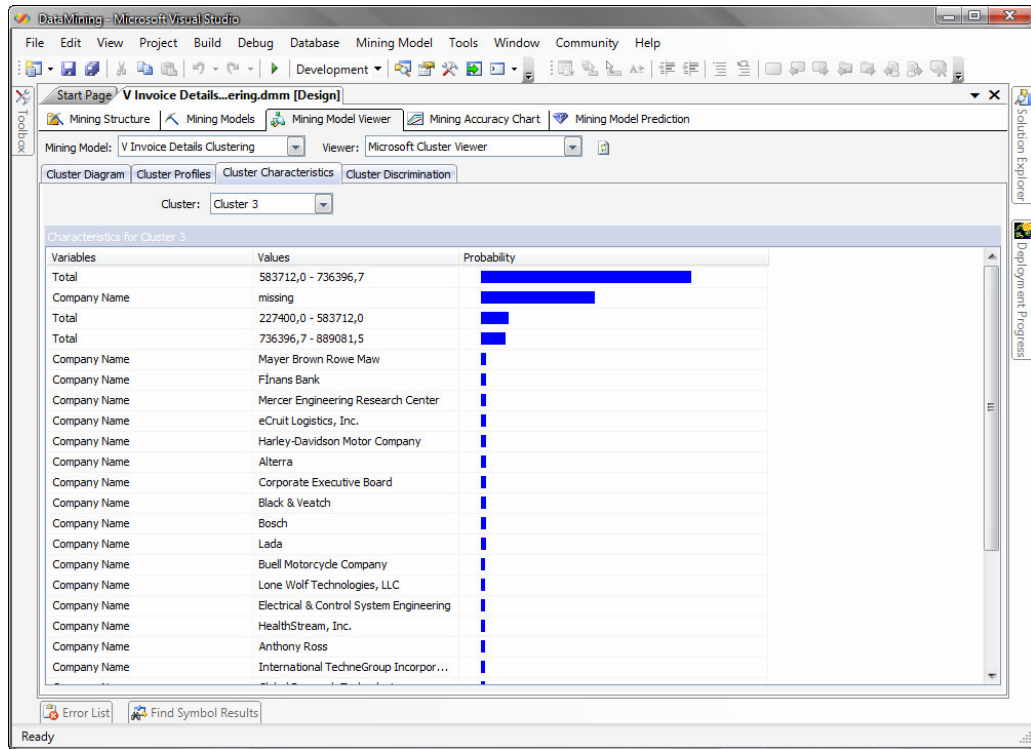


Figure III-46 : Data mining – Cluster Characteristics

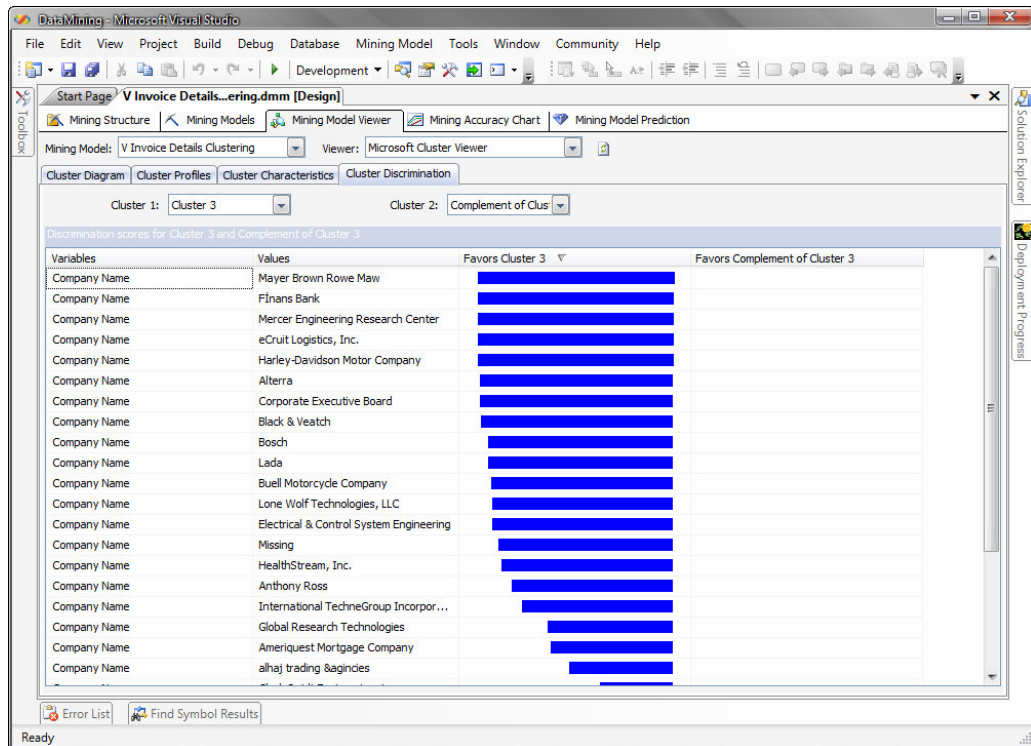


Figure III-47 : Data mining – Cluster Discrimination

PART IV. CONCLUSION

Companies are becoming more and more customer oriented. Providing excellent customer services and timely responses are no longer a matter of preference but a necessity for businesses. The winners will be those who can delight customers and smoothly collaborate with business partners. CRM solutions help companies achieve these objectives by leveraging the power of Internet, networking and ERP systems and building a seamlessly integrated enterprise.

In this thesis study, the aim was to show the importance of integration between CRM and ERP applications and with data mining processes customers' data and make meaningful customer categories.

CRM applications are generally used by company employees and closer to customers and suppliers. As an alternative of this general structure, we have developed a CRM application can be accessed by customers and suppliers too. The aim is that, Customer can insert their request and questions directly to the CRM application. With this opportunity, customers can find out their problem's solution which company publish the questions and answers to everyone. At the same time, suppliers can follow these questions and reply them. In this way, this CRM application is aimed to be a platform for employees, customers and suppliers.

Another difference from current CRM system is the ERP integration. By this ERP integration, duplication of product information like product components, stocks etc. stored in ERP application is prevented.

For this integration, XML Web Services uses. In this way, the companies, which use this CRM application, do not need to modify their current ERP system. Only with customization of the Web Service, this integration can be provided. Thus, creating new version for CRM application become easier with loosely coupled integration.

Our aim on data mining is twofold. One is to develop meaningful customer groups for increasing customer loyalty, and the other is to analyze customer profiles and making profile groups. In this way, company can make meaningful marketing

activities. The first aim has been reached at this thesis study, however the second one is left as a future work.

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Available upon request