



Keep-Tracking, Intelligent Injection System (KiiS)  
Data Management Module  
for a Pest Control Business

by  
Mr. Sutee Leelayouthytin

A Final Report of the Three-Credit Course  
CE 6998 Project

Submitted in Partial Fulfillment  
of the Requirements for the Degree of  
Master of Science  
in Computer and Engineering Management  
Assumption University

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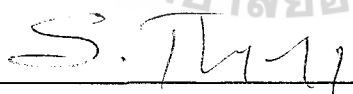
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The Graduate School of Assumption University has approved this final report of the three-credit course, CE 6998 PROJECT, submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer and Engineering Management.

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November 2006

## ABSTRACT

King Service Center Co., Ltd. was the first pest control company to receive Thailand's first pest control operating license from the FDA (Food and Drug Administration) in 1980. KiiS project started with a thought of wanting to improve King Service Center's work process of chemical treatment at customers' house, the management, and the utilization of information gathered from the customers' house.

After discussing with the company's executives, getting the user requirements, setting up the project objective and scope, this project came to an agreement of combining the information technology with a newly invented injection process in order to solve the company's classical problem of chemical smuggling and wastage.

The new injection process will be implemented to make sure that the chemical usage in the field work is correct with precision, and then the information technology will be used to store, manage and then utilize the data gathered from the field work. In order to accomplish this project, a co-development scenario with the company will be established, the student would be focusing on the software while the company on the hardware part.

After the new system has been developed, it will be put through several hardware and software tests to ensure full working capabilities and reliability. After tested, it will be implemented with the company's existing system in a direct cut over fashion. All the system users will be educated to make sure that they all know how to properly operate the new system. After all these steps have been followed, the system will be working efficiently to solve all the mentioned objectives and problems.

## ACKNOWLEDGMENTS

There are several people involved and contributed in the development of this project that I would like to express my gratitude to, without their contribution, this project would not have been successful.

The first person to be mentioned is the advisor of this project, Dr. Chamnong Jungthirapanich, for his generous guidance that has helped me along the path of finishing this project from the very beginning till the end.

The second group of people that I would like to send out my thanks to is the people involved and aided in the development of the project; they have been like a co-developer of the hardware part of the project. The managements and the staffs at King Service Center Co., Ltd have been very helpful and kind to us; their advice has always been valuable making this co-development very smooth.

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# **I.INTRODUCTION**

## **1.1 Background of the Project**

King Service Center Co., LTD was founded in 1977 by Mr. Suchart Leelayouthyotin, with a registered capital of 5,000,000 baht. It has become one of the leaders in the professional pest control in Thailand since then. King Service Center was the first pest control company in Thailand to receive an operating license from the food and drug administration of Thailand, numbered 1/2523. After almost 30 years of staying in the pest control business, it has more than 150 employees working full-time with more than 30 service trucks (Mobile Unit). There are many resources which are used in order to perform the company's processes. The first main resource is the employees in all the department of the company, this human resource is one of the most crucial parts to the company's success. The chemicals, or termiticide used is another important resource, without an effective chemical the pest control process will not be rendered effectively. Other tools such as the pressure pumps, the drills, the pipes, and the injection nozzles are also the resources of the company. Computers and the network is also an important resource of the company.

In the modern termite control process, one method that is widely used and accepted is to lay chemical injection pipe under the structure of the building. The pipe laying method was invented because the pest control companies wanted to eliminate the problem of having to send the employees to dig and then crawl under the foundation of the structure in order to perform the chemical injection. With the pipe laying method, the workers only have to dig and crawl under the structure once to lay the pipe, and then after that, the chemical injection can be done through the installed pipe. After the pipes and the injection nozzles are installed, the soil treatment using



termiticide for termite prevention under the structure, which is the most vulnerable place that termites will attack the structure, can be done without having to crawl underneath the basement of the building. The pipes under the structure are attached to the side wall of the foundation beam and the injection nozzles pointing towards the center of each foundation block. The injection process uses the pressure pump which is manually controlled, open and close, and is timed by human. The pipe laying method can eliminate the problem about the welfare of the employees; because they no longer need to crawl under the structure but other problems arise as the human errors would still occur. The human errors could be from the carelessness and the fallibility of the employees when they perform the injection through the pipe, the injection valves still have to be timed, and then open and close manually by human. This leads to a lack of accuracy in the injection, and is also hard for the management to be able to control one of the main costs of the company, which is the termiticide. Chemical under dosage and over dosage could happen if the employee doesn't carefully keep the time and then close the valve precisely.

After the operation is done, the operator will write a detailed report regarding the job date, the size of the treated area, the volume of the chemical used, and the operation starting time and the finished time, cosigned by the tenant or the owner of the house. Back at the office, the report will be checked for the operation accuracy in the fields related to chemical volume in ration to size of the building treated. The written detailed service report will be kept in the manual filing for reference, i.e. report card, service contract, and service slip. Even with the cosigned report card, it is still hard for the management to control the service rendered to the customer because the report card is manually written by the employee after the work is done, it can be easily fabricated.

The problems that the company faces have led and motivated them to find out a solution to solve those problems. After many discussion sessions among the company's executives and managements, and after a lot of thinking they have come up with an idea to solve the problems by using a microprocessor to control the chemical injection with the use of a removable storage media, or smart card, to record all the detailed information about each injection point. The removable storage media is then taken back to the company, and then load the information into the computer. The service information loaded into the computer will be like a new module to the existing customer database, which will enhance the overall performance of the company. The detailed service report will be printed out, signed by the management, and then send to the customer, the management can also acquire the reports generated from the new system to be designed.

In order to complete the proposed system, cooperation from the company in the aspects of the physical work such as the pipe, the injection nozzles, and the pressure pump will be needed. Since the new service database to be created will be added to the existing customer database as a module, the company will also be aiding in giving the detailed information about the existing customer database.

The executives of the company has a plan to use information technology to help minimize the expense and then to maximize the profit of the company improving its efficiency. The company aims to create the office that is paperless enhancing the working environment, the information that is stored must be easily accessible by all the departments while the system must still provide maximum level of security. The new proposed system will be able to help the company achieve those goals. At the work site, the microprocessor will take care of the injection timing, starting and stopping, and other injection calculation such as the area of the structure and the time

needed to inject the desired volume of chemical. After the injection at all the required points, the microprocessor will send the detailed information to the removable storage media, the information cannot be fabricated because it is recorded by the machine not by human. The wastage of chemical will be reduced because the timing by machine will be very precise.

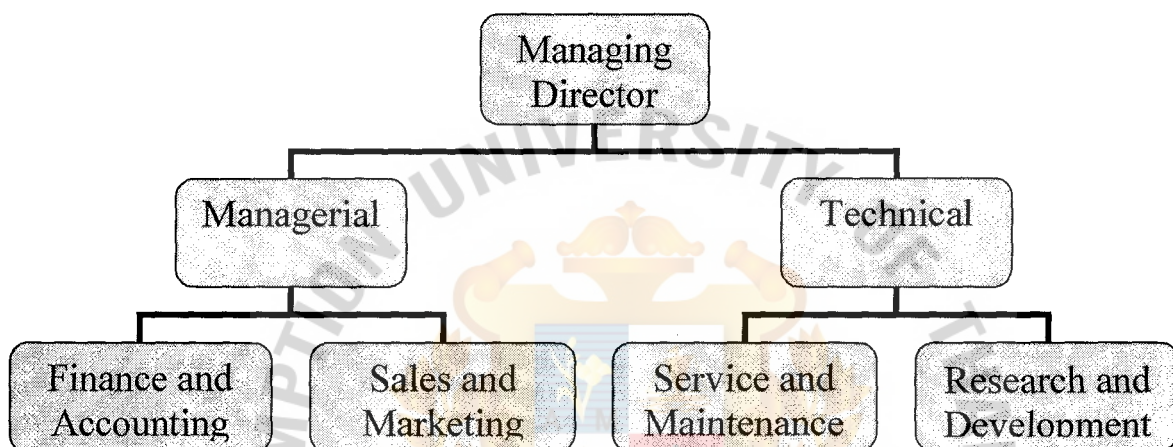


Figure 1.1: Organization Chart

## 1.2 Statement of Problem

- ❖ The classical work processes that the employees have to routinely perform such as the injection timing, report writing are very time consuming, error prone, and tedious.
- ❖ The existing system lacks the ability to perform analytical operation about the collected information of the services given to the customers. There is no computer-generated report, which makes it hard for the management to maximize the profit and optimize the company's performance.
- ❖ Chemical wastage and chemical smuggling often happen; it is very difficult for the management to have 100 percent control over chemical usage.
- ❖ The customers cannot be sure whether the treatment was performed honestly in an appropriate fashion according to the company's specification.



### 1.3 User Requirements

During the information gathering stage of this report, there have been many discussions with many individuals at King Service Center Co., LTD; they are Directors of the service and maintenance department, finance and accounting department, research and development department, the technical director, and the managing director of the company. Each director has different requirements for the new system but they all lead to the same destination, which is to improve the overall performance of the company in all aspects, to have a better employees' welfare, and to improve the profit of the organization. The details of the requirements from each director are listed and then described in the paragraphs below:

- ❖ **For the managing director** – the managing director is the top-level executive of the organization, the requirements and guidelines he had given to us are more about the strategic improvement to the company. First he stated that he would like to have a new injection invention that is high-technology, efficient, and effective rather than the old manual injection system, this is because when the customer sees it, they will create a good image of the company in their head. When the customers have good images of the company on their mind and the services they received are good, it is more likely that they will continue using the service from the company, or even recommend the company to their relatives, friends, or co-workers. He also said that he would like to increase the market share and gain competitive advantage over the others in the pest control business.

- ❖ **For the finance and accounting department** – the main requirement of the director of the finance and accounting department is to be able to control the cost of the chemical in order to increase the profit of the organization. Because the existing service report card is written by the employees it is hard to check whether the figures on the card are honestly filled. The new system should provide a way for the department to check the real chemical usage of each job done so that the problem of chemical smuggling will be eliminated.
  
- ❖ **For the service and maintenance department** – the director of this department stated that the department would like to improve the effectiveness of the piping system and the injection nozzles
  - **The Piping System** – the old method of spraying the termiticide away from the foundation beams is not very effective; the extensiveness of chemical coverage is poor.
  - **The Injection Nozzles** – the existing injection nozzles are attached along the pipe under the structure spraying the chemical away from the beam, which doesn't give good chemical coverage. So the newly invented nozzles should be able to provide extensive chemical coverage area.
  - **Injection Nozzles Identification** – the old piping system is also hard for the quality assurance personnel to determine whether the injection nozzles are in correct position. The director stated that there should be a method which the injection nozzles will be able to be identified by the quality assurance personnel.
  - **The Injection Process** – The quality of work given to the customer is not standardized because the injection process is done manually by the employees who can make many small mistakes, such as mistiming of the injection, that will lead to

poor termite prevention and eradication which will eventually result from moderate to severe termite destruction of the house. Above all those, the work processes that the employees have to perform daily are also tiring and should be improved.

- ❖ **For the research and development department** – the director said that he would like to have some kind of printed material containing the detail about the injection sent to the customer whose house has been given the service to inform them about the completion of the job and all the other details such as the start and stop time, the total chemical used, etc. Furthermore, he said that the injection should be divided into many identical points, each identifying a foundation block, for easier control and better chemical usage and coverage. The last thing he mentioned was about the requirement is that in the existing system, there was no printed report about the summary of the service to the internal individuals in the organization such as the service and maintenance director, and the finance and accounting director. He would like to have a report generated to display the information about the service given to the customer.

#### 1.4 Objectives of the Project

- ❖ To solve the problem of chemical wastage, both accidentally and intentionally, there will be a creation and implementation of information technology plus the newly invented instrument, and to store important field data (data from the customer's house) such as the volume of chemical used, the starting and stoppage time, and the complete or incomplete work notification.
- ❖ To put aside the problem about poor data sharing of the existing system. In the existing system, the manually written service report will be kept in cabinets in the office; there is almost no utilization or sharing of the collected data. The new developing system will allow the authorized workers to be able to access to the information about the service performed to the customer because it will be added into the existing customer database.
- ❖ To solve the operating problem about the inaccuracy of the chemical injection process that is timed and controlled manually by human. The new system will be self-timing, and will also be able to record the starting and stopping time of the injection at each point of the house.
- ❖ To improve the efficiency in obtaining information from the smart card using the card reader instead of writing them, the converted data will be well arranged into the Data Reader page in Visual Basic format for viewing and saving. The viewing and saving of the injection information will be done in a much easier way.



- ❖ To create a system that will be able to create reports by demand, the computer generated reports will be better for many reasons, they will be more understandable because there is no problem about bad hand-writing, the generated report will contain the information that is more accurate, etc. This will eliminate the time lack from the manually generated reports of the existing system.



## 1.5 Scope of the Project

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There are many components of the new developing system. They are the piping system, the newly designed injection nozzle, the injection nozzle detector, the control box, the smart card, smart card reader and data entry, the service database, and the report generator.

- ❖ The piping system, the injection nozzle, and the injection nozzle detector will be developed by the company themselves.
- ❖ For the control box, the cooperation from the company will be needed because there has to be the parts that must be connected to the mechanisms of the injecting system. The company will choose to hire electrical technicians from outside the company to create the circuit board, then the circuit board will thoroughly be studied and then there will be co-development of the software by using Assembly Language to operate that circuit board. As using Assembly sounded more on the machine controlling part for developing of the circuit board, this project will only cover the language interpretation part. The interactions between the information in the card reader and the data conversion module (in Assembly) which retrieved from the smart card will be studied in detail. This will greatly provide this project with the information on how to put it into the conversion part which is one of the focuses of the project.
- ❖ The circuit board might include a simple display screen, the input buttons, and the smart card recorder. The smart card will be purchased from the market, the smart card reader will be tailor-made from the market in order to fit with the control box, and it will also come with the software to perform the data reading and writing operation.

- ❖ The data conversion will be developed to convert the data from the field and then stored into the service database. The converted information will be placed into the Data Reader page which is provided within the KiiS Visual Basic. The user may only view the page or save the information of that particular customer's completed injection process (from the smart card) or he/she may save the updated information into the Database file. The service database will be created using Microsoft Access.
- ❖ Ultimately, the management report generator will be created by using VB and Crystal report generator. The software will also include users' login, search and edit function.



## 1.6 Project Plan

There are 6 main phases for this project development in which will be held as a guideline to keep the work smooth and organized when developing KiiS and other documents associated.

- ❖ Phase 1 (Collect Data) – during this stage, there will be meetings with the company's executives and the managements to see what the problems are and what can be done to solve the problem and also get the details about existing system, such as the existing work process. This includes seeing what's occurring in the business, identifying the problems of the old system, seeing what can be done to improve the existing system, getting the requirements from the users, setting up the objectives, and also the scope of the project.
- ❖ Phase 2 (Analyze the Existing System and the Proposed System) – this is a stage where the analysis of the existing system and the proposed system is done, draw the context diagram, data flow diagram level 0 and level 1, and the entity relationship diagram of both the existing and proposing system.
- ❖ Phase 3 (Prepare Proposal and Presentation) – the proposal is prepared including all the details about the existing and the proposing system. And then the presentation is prepared and then presented.
- ❖ Phase 4 (Design the Proposed System, H/W, S/W, and Database design) – after the proposal has been approved, the designing and creating part begins. First the hardware that will be used such as the components of the control box, and the smart



card and smart card reader will be found. Then the software code to work with the hardware will be created. The hardware will be carefully studied to see how to code the software to make them compatible with each other. The database associated with the new system will also be designed and created.

- ❖ Phase 5 (System Testing and System Evaluation) – in this stage the focus will be on trying to make sure that the new system works smoothly, this includes running the hardware and software together and see if there's any error. If any error or defect is found then it will be fixed. The hardware components will have to be run for a period of time to see whether it is durable or not. The software will also have to be tested for any bugs.
- ❖ Phase 6 (Final Report Preparation and Presentation) – the final report will be created and then the final presentation will also be prepared. The completed system and the completed final report will be presented.

## II. THE EXISTING SYSTEM

### 2.1 Existing System's Work Process

The prospect contacts the company and the company sends an inspector to the prospect's house for problem survey. The proposal containing service procedure and price is presented to the customer for the customer's approval. If not approved, the customer refusal file is stored. If the customer approves and signs a job authorization, the service appointment is made and then the sale is closed. Back at the office, input the customer information to the customer history file, and then print a document which are service contract and service card and then assign the job schedule to the service team. Then on the appointment date, the service team draws the chemical form the stock using the contract and service card and then goes out to the customer's house to perform the service.



Figure 2.1: Stop Watch

The injection pipe is installed along the foundation beam (spray form beam to center). After the installation, the employee calculates the area size of each injection point ( $W \times L = M^2$ ). Then calculate the volume of chemical to be injected in each particular square block and calculate the time of the opening and closing of the injection valve. Then the injection using pressure pump starts simultaneously with the stop watch which times the injection session. When the required time is fulfilled the valve is closed, and the employee moves to the next injection point, the process is repeated until all the injection points are covered, then the job is finished. The report card is filled up manually, total volume of chemical used, date, the job begin and finish time, the technician's signature and the customer's signature. Then the service slip which has two copies are filled up and signed, the original one is given to the customer and the copy is returned to the office. Then the service contract is signed, original is given to the customer and the copy to the office.

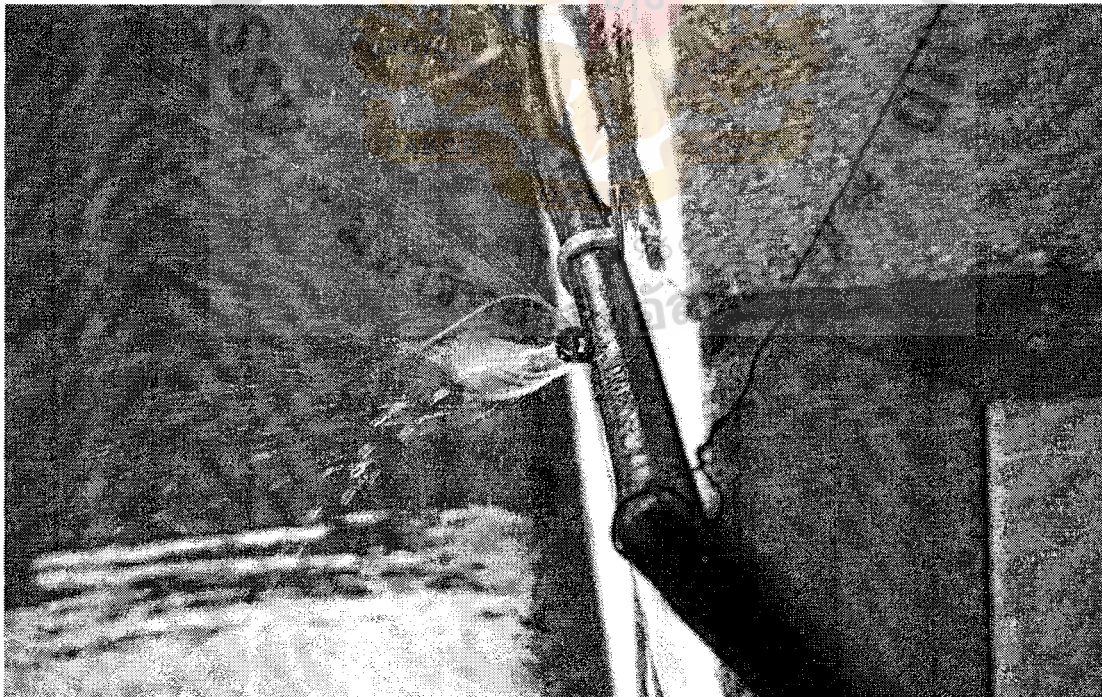


Figure 2.2: Existing System Injection Pipe &



Back at the office, the report card is classified into service zones and then kept in the customer in the service card cabinet. Service slip and the service contract are sent to the finance and accounting department for collection of money and filing.

## **2.2 Existing System's Problems**

The existing filing system has many problems or weaknesses that can be viewed from many perspectives, they are as follows:

- ❖ The operators' view point – the time consumption and the tedium from having to manually write each report by hand. The hand writing of the operator can be hard to read and also inaccurate because of human error prone. And while operating the pressure pump to inject the termiticide, the operator has to watch second by second and keep monitoring, which is error prone and also cause unnecessary stress to the operator.
- ❖ The managements' view point – the written field report form the operator is difficult to read, to keep, and requires mass storage area. It is also time consuming and costly for filing and retrieving for analyzing. It is also hard to authenticate because it is manually written, meaning that it can be easily fabricated. The stagnant reference files kept is difficult to share among the various departments, and is useless for other purpose, i.e., marketing, servicing, research & development, and technical. The written report gives only the summarized view of the operation but not the crucial analytical tools for further Information & Technology management. The manually written report can induce operator's dishonesty, i.e., reporting used

chemical amount higher than actual usage and then channeling the excess chemical in illegal selling, smuggling.

- ❖ The customers' view point – there is no guarantee that the treatment is performed according to the specification, i.e., the chemical volume, and the injection time. The report cannot be authenticated for bias, the tenant or the house owner signs the operation report without any detail or knowledge regarding the operation. Suspicion arises because of the unclear information in the report.





### 2.3 Dataflow Diagrams of the Existing System

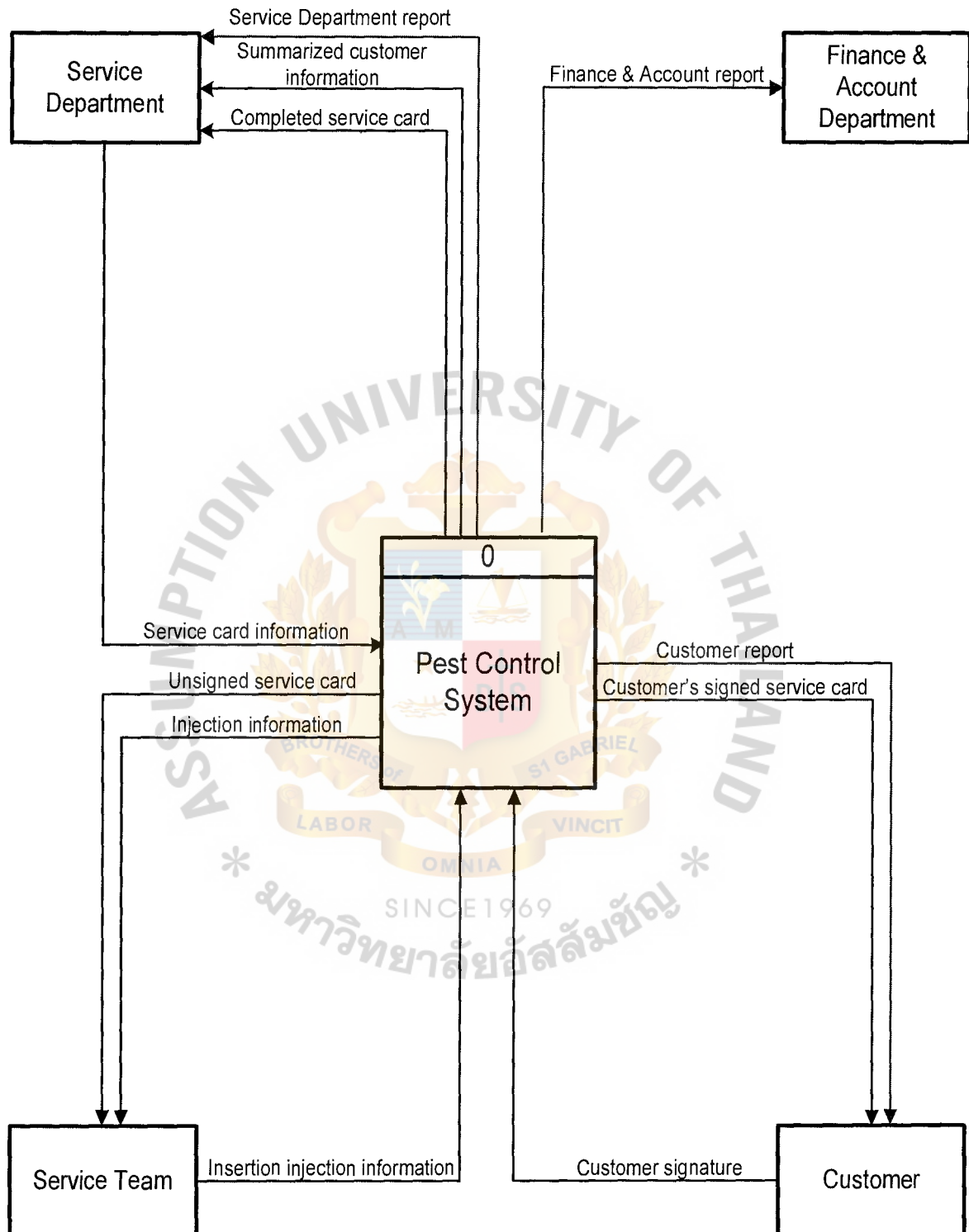


Figure 2.3: Existing System Context Diagram

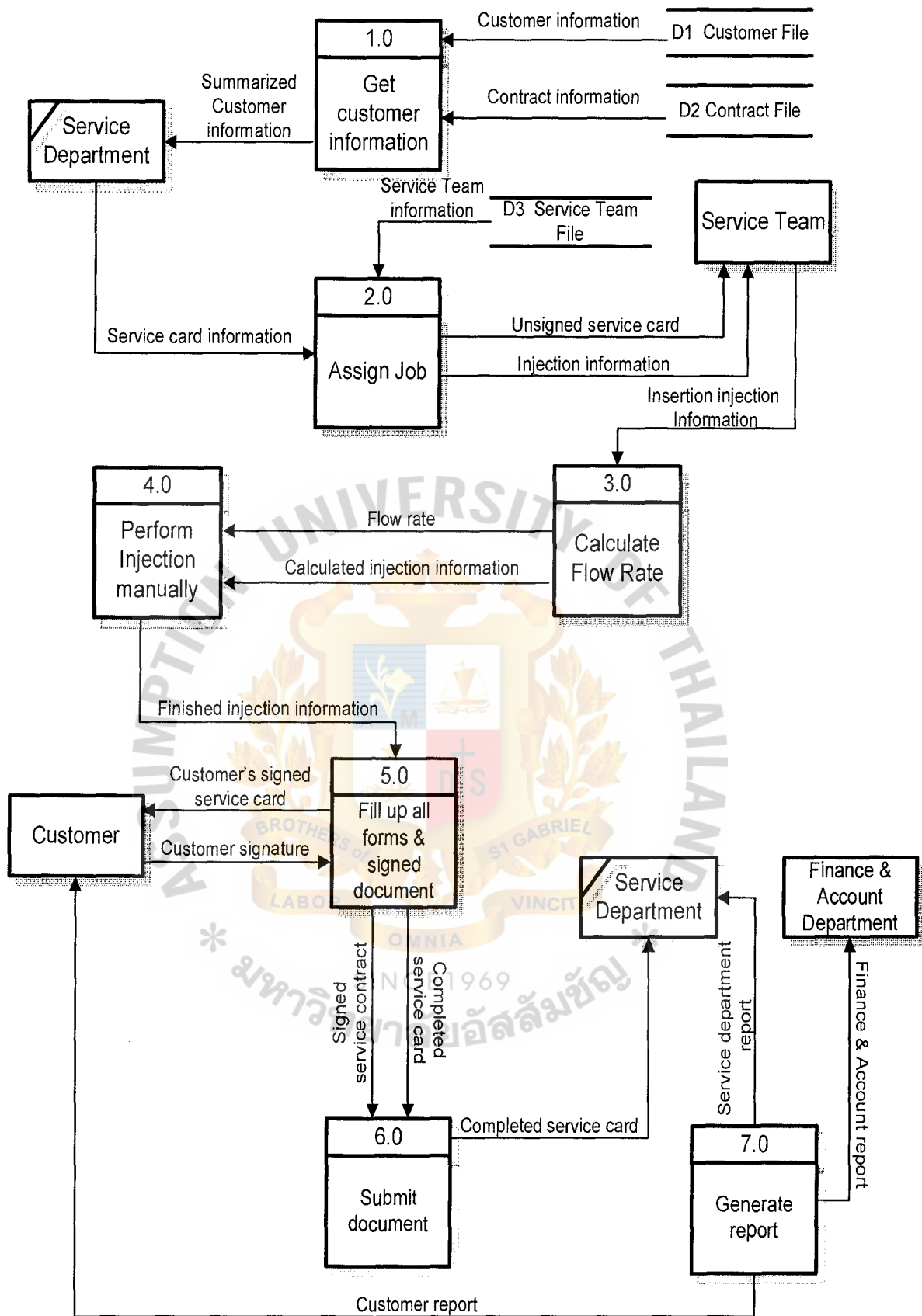


Figure 2.4: Existing System DFD Level 0

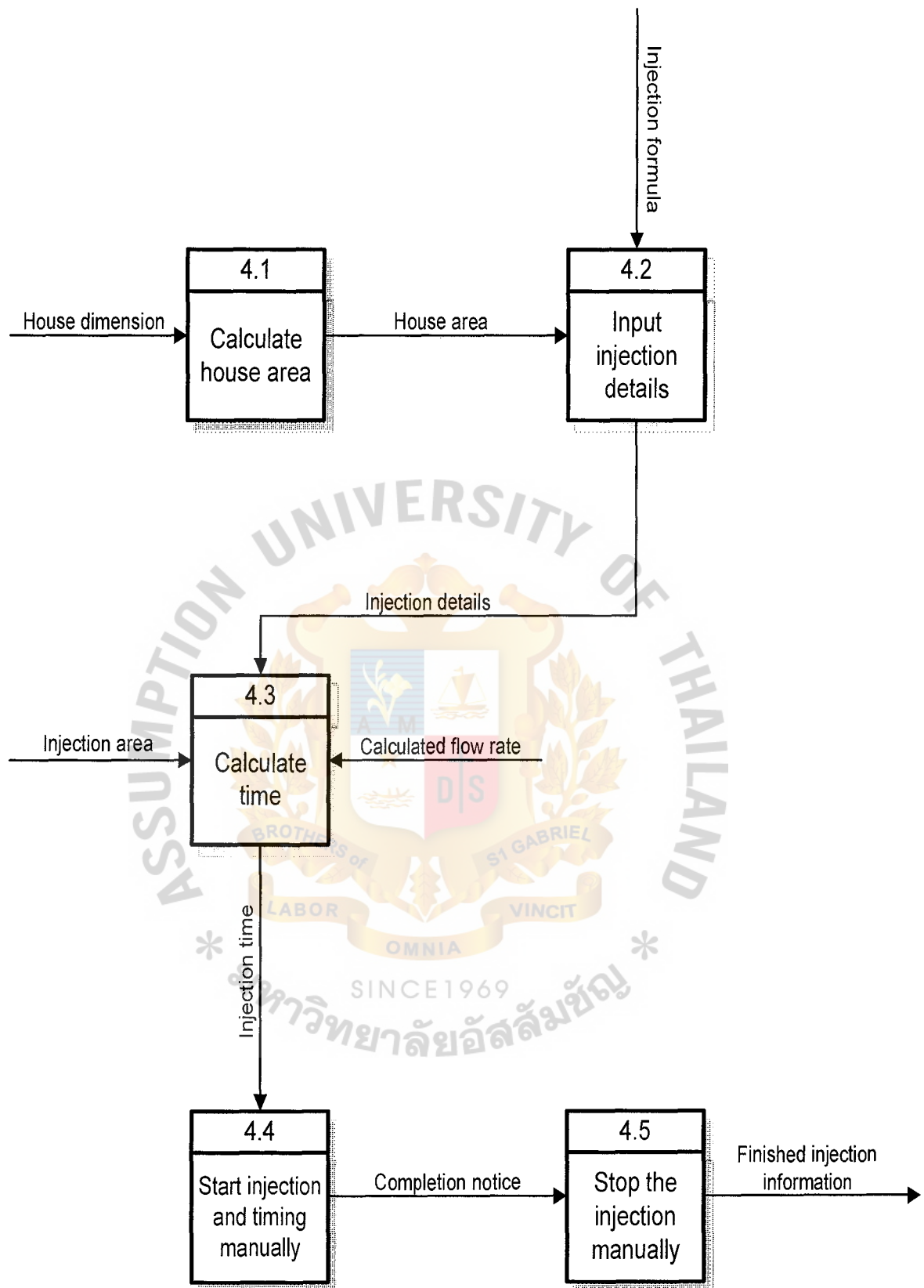


Figure 2.5: Existing System DFD Level 1 Process 4

## 2.4 ER Diagram of the Existing System

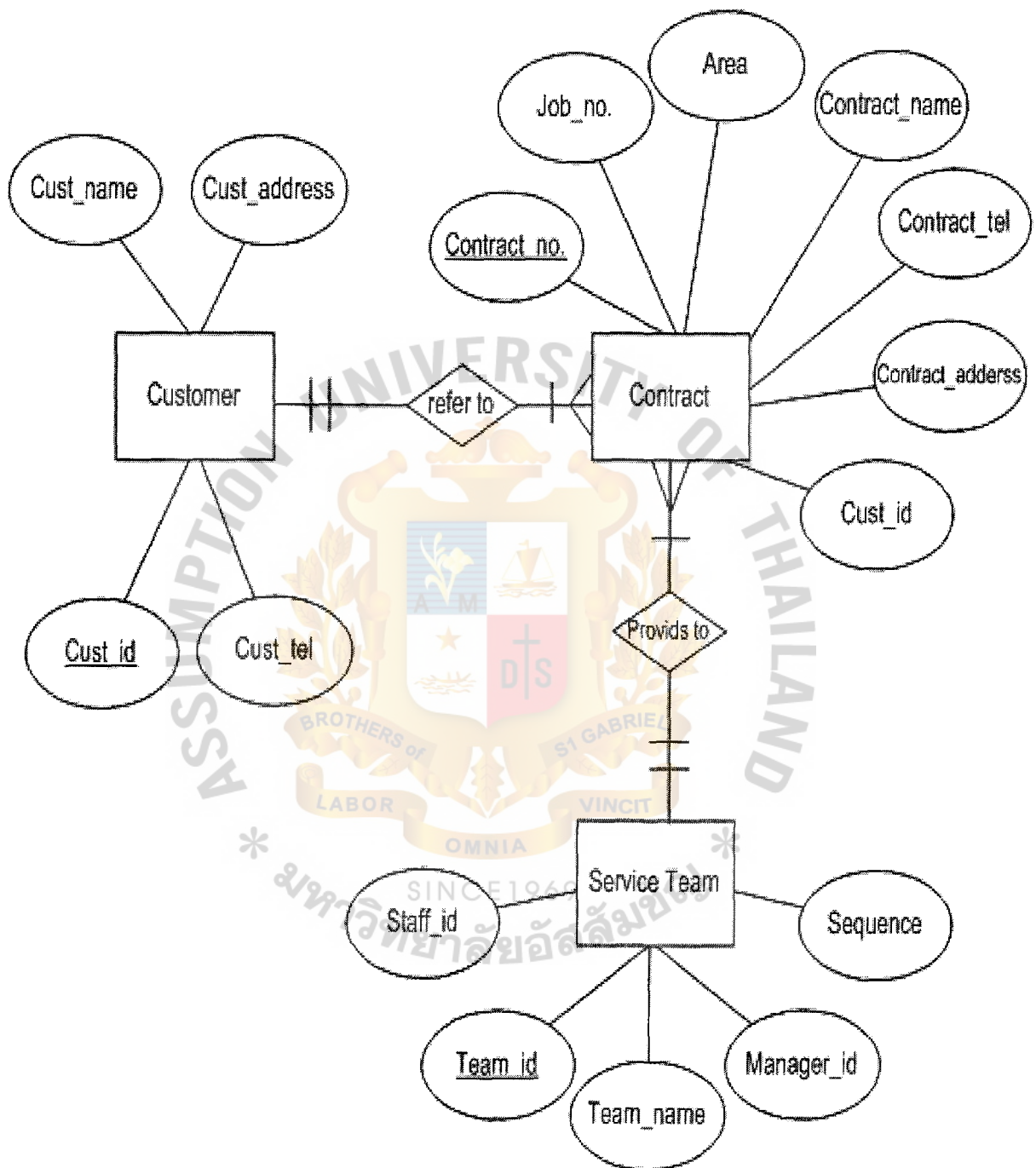


Figure 2.6: ER Diagram of Existing System

### III. THE PROPOSED SYSTEM

#### 3.1 System Specification

In order to solve the existing problems mentioned above, there's a solution to these problems, the system named "KiiS" (Keep-Track, Intelligent Injection System. KIIS encompasses the hardware, the software, the storage media, data entry, information transfer, manage, and report. Here are the details about the components required in the new developing system.

##### ❖ The Piping System

To inject the termiticide under the building structure, very similar to the traditional piping system, but the pattern will be different. The traditional pipes were laid along the foundation beams and walls with the nozzles pointing towards the center of the foundation block, but the company will be using a new pattern by laying the pipe towards the center of the foundation block to spray the chemical out in all directions giving better chemical coverage area.

##### ❖ The Injection Nozzle

The injection nozzles are attached to the end of the pipe. It will look very much like a sprinkler that will be used to spray the termiticide under the structure at each injection point. There will also be a piece of special metal attached to the top of the nozzle that is detectable by the metal detector in order that the nozzles can be identified and verified from above the floor using a metal detector.



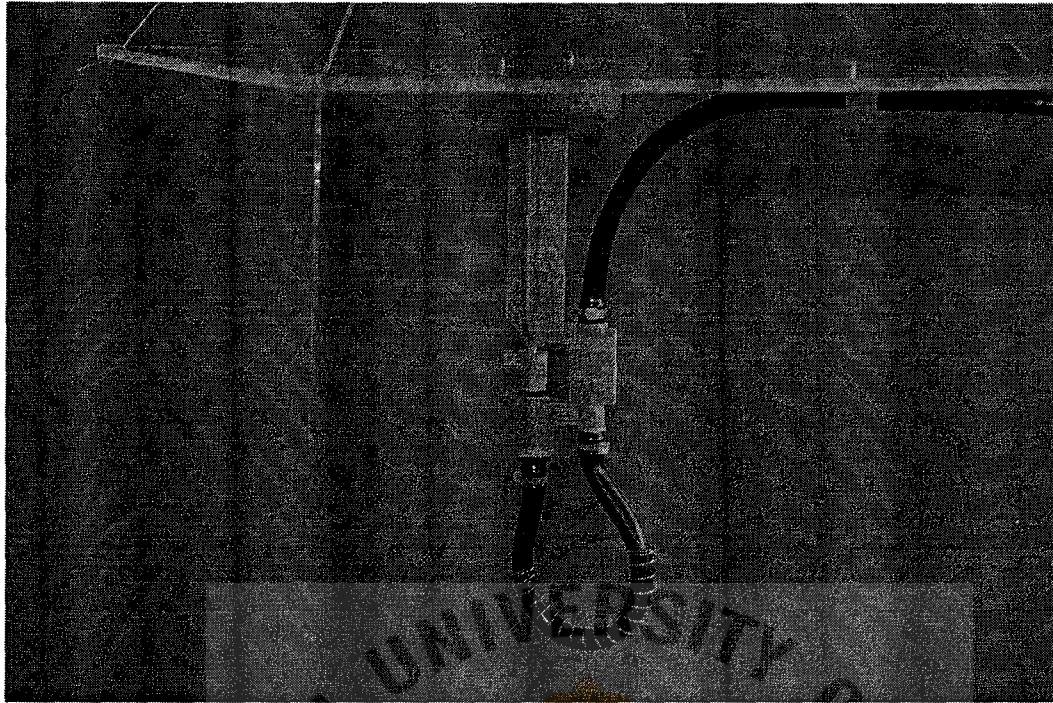


Figure 3.1: Injection Nozzle

❖ The Injection Nozzle Detector

A metal detector will be used to detect the presence of the embedded metal on the injection nozzle. The purpose of this is for the management's control, quality control can be done by checking if all the injection nozzles are installed according to the specification.

❖ The Control Box

This is an important part of the system; it contains mainly two parts, which are the microprocessor and the solenoid valve. The microprocessor controls the solenoid valve, the card reader, the display screen, etc. The microprocessor will take input from the user and then calculate the values necessary for the injection such as the injection volume. The solenoid valve will take the chemical from the pressure pump and then control the flow, open and close the valve, of the chemical. There is also a slot for inserting a smart card.



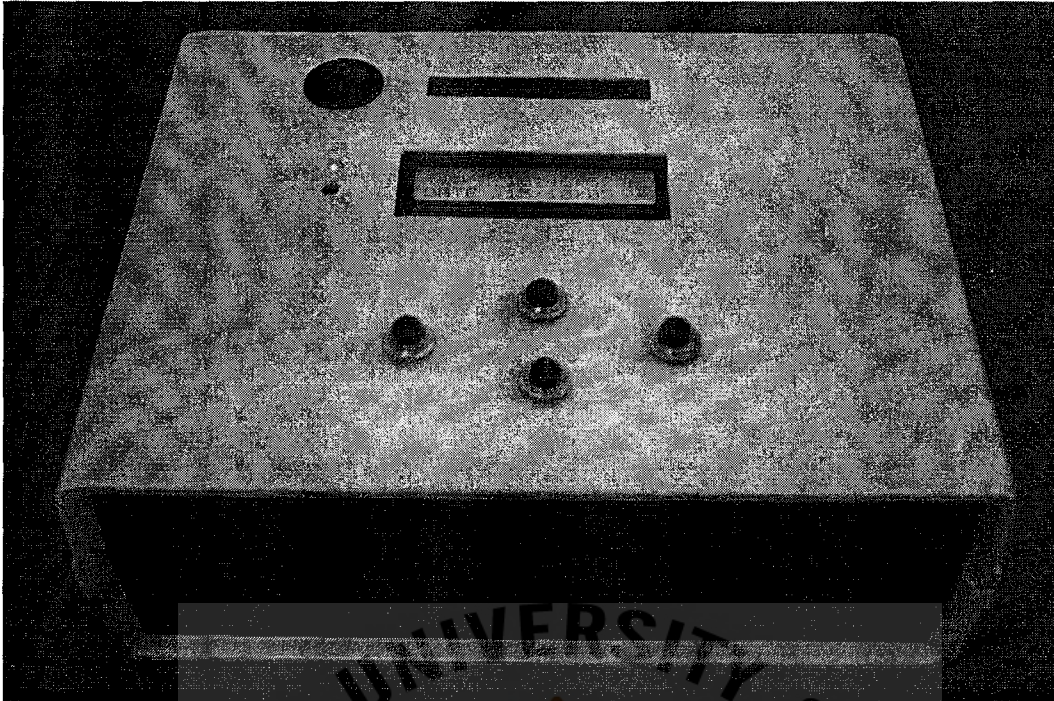


Figure 3.2: Control Box

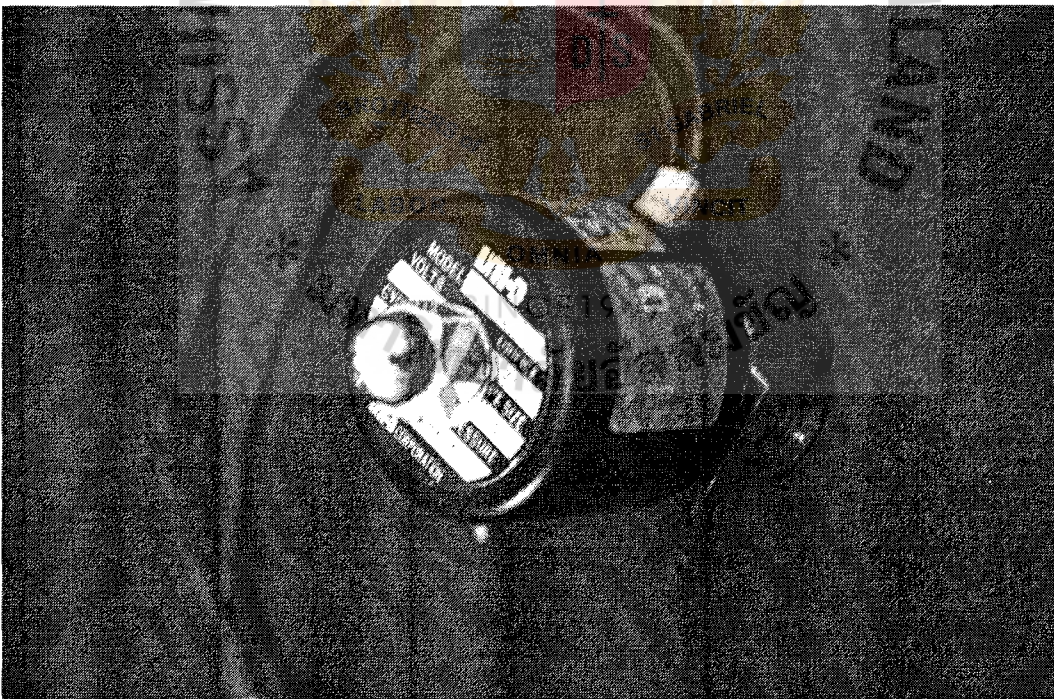


Figure 3.3: Solenoid Valve

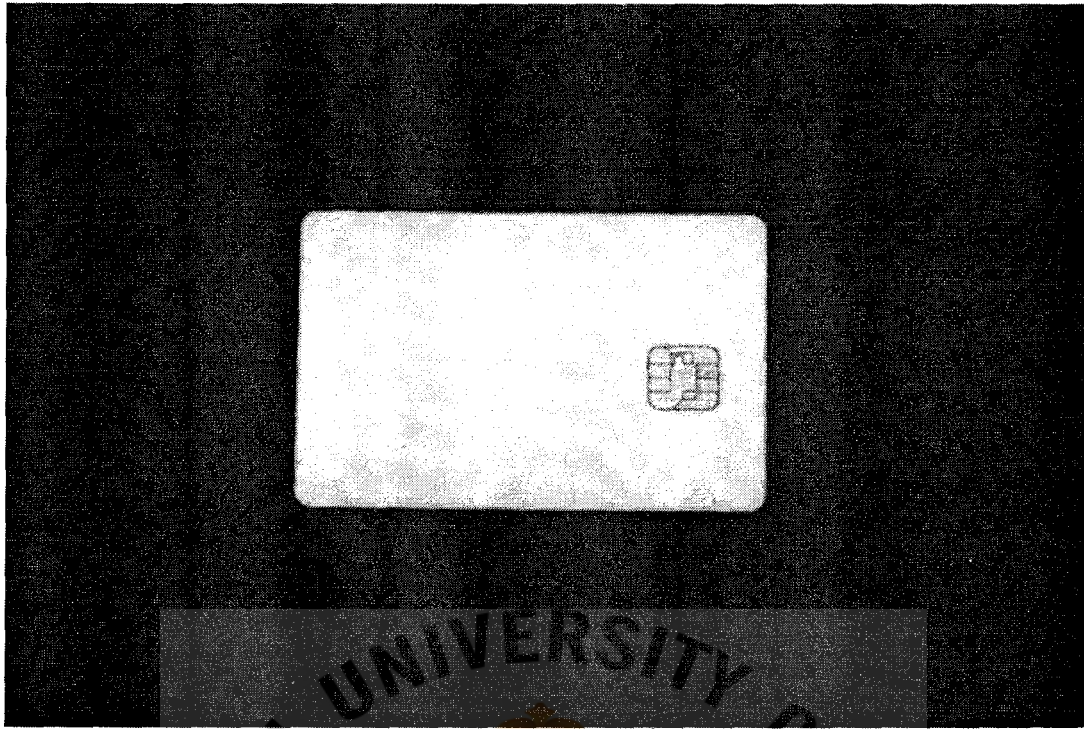


Figure 3.4: Smart Card

❖ The Smart Card

The card will be taken to the customer's house empty and then inserted into the slot on the control box before the injection takes place. After the injection is finished, the control box will record all the detailed data about the injection. The smart card is then taken back to the office for data entry and further processes. The information recorded in the smart card is listed below:

- Work Date
- Start Time
- Stop Time
- Dimension of the Foundation Square Block
- ID Number of the Square Block
- ID Number of the Injection Point
- Hose Length for In-Line Compensation



- Contract Number
- Standard Volume per Square Meter
- Pump Flow Rate per Second
- Injection Times

❖ The Smart Card Reader and Data Entry

When the smart card is taken back to the office it will be put into the smart card reader to transfer the data from the smart card to the database in the computer. The data will also be converted from the machine language to the human-understandable language.



Figure 3.5: Smart Card Reader

❖ User Login and Logout

This is used to control the access to the system and to classify the users; each staff using the system will have different username and password.

#### ❖ The Service Database

The new database module that will be added to the existing customer database, called the service database, will contain the detailed information about the service given to the customers.

#### ❖ The Report Generator

After all the detailed service data gathered from the work site has been added to the service database, this information will be extracted by the report generator to create the management reports.

#### ❖ Search Function

The information stored in the service database can be searched by the users. The job, contract, customer, team, and staff information can be searched. But not all the users can enter every single search page; accesses to some search pages are controlled and limited to specific types of user.

#### ❖ Edit Function

The edit function is used when there is any change regarding the records in the database. The contract, customer, team, and staff information can be modified, only the job information is not editable because it must be real work information obtained from the customer's house. Same as the search function, access control is applied.



### 3.2 Hardware and Software Requirement

#### Hardware Requirements

There are many hard wares required, including the new field equipments in the KiiS system. Therefore, the specification will only cover the parts which are required in the co-development of KiiS. The hardware components include:

- ❖ Control Box containing a printed circuit board and solenoid valve
- ❖ The Smart Card and the Smart Card Reader
- ❖ A set of Computer which include:
  - CPU Intel Celeron. 1.8 GHz or above
  - RAM 256 MB or more
  - HDD 40 GB or larger
  - Keyboard, Mouse, Monitor
  - Laser Printer
  - UPS 500 VA

#### Software Requirements

For the software in the KiiS system, only the main features which will be required to run the system will be mentioned. Any additional features may be added to the system software later on as desired. Software requirements are the following:

- ❖ Operating System, Microsoft Window XP Professional with SP2
- ❖ Microsoft Visual Basic
- ❖ Microsoft Access
- ❖ Crystal Report

### **3.3 Security and Control**

#### **The Unchangeable Smart Card Information**

As this KiiS has been implemented mainly to prevent the corruptions which might be done by the employees in the company, the high security in the field operation will be the most demand. The function in the control box will control and request the user's inputs before the operation, and these inputs are required for the injection operation. Therefore, after the operation has completed, the information will be immediately stored into the smart card. Then the card reader will interpret the obtained information from the smart card. Later on, the transferred information will be stored into the exact provided columns in the Visual Basic Reader page. Now, all users will have the ability only to view or save the injected information from the Reader page. By this way, no information can be edited or changed by any user even the admin.

#### **The Username and Password Requirements**

All system entrants will require the username and password. The username and password are uniquely given for different authorities to access the KiiS system. These usernames and passwords will be initially distributed to all users. For further security, the user will also be able to log out after he or she has interacted with the system. The username and password then can be changed only by the system Admin in case of the user's request.

## Access Control

The persons who will obtain the username and password are classified into three groups which are Admin, Manager and Staff. Each of the username and password will represent the status of who you are (Admin or Manager or Staff) so that the pages to be retrieved will be recognized by the system individually. This will prevent the unauthorized status to enter certain pages. This means that the access pages are provided according to your job. For instance, after the staff has already log in, he or she will not have the page which provides function of editing the team members for each service team. This is to confirm the accessing ability and thus increase the logical security.



### 3.4 Costs and Benefits

#### Cost of the Proposed System

- ❖ The estimated hardware cost of the proposed system consists of the following:
  - Smart Card (20 cards) – 2,000 Baht
  - Smart Card Reader (2 readers) – 1,500 Baht
  - The Control Box and the Solenoid Valve (10 sets) – 25,000 Baht
  - A computer set (according to the specifications in the hardware requirements) plus all the peripherals needed – 15,000 Baht
- ❖ The estimated software cost of the proposed system will be as follows:
  - Microsoft Windows XP Professional with SP2 (Microsoft Access already included) – 14,500 Baht
  - Microsoft Visual Basic Programming – 6,000 Baht
  - Crystal Report – 10,000 Baht
- ❖ The basics training session has to be organized in order to educate the service workers, so that they can familiarize them selves with the new system. The training will be held before the new system is implemented.
- ❖ There will be a long-term maintenance cost of the tools and equipment which needs to be in a good shape in order to perform what they were meant to, the estimated annual maintenance cost for all the equipment is 15,000 Baht

#### Benefit of the Proposed System

- ❖ The new system will improve the quality of service given to the customers because the chemical will be injected at the proper volume in each injection point of the customers' house.

- ❖ The customer will receive a detailed service report that will ensure them that the proper treatment has been given to the house, eliminating the problem about the customer's doubt.
- ❖ The service operation will require less time which means that the service employees will not have to be in the house for a long period of time, as the KiiS is almost totally automated process. For this case, the customer will be less disturbed, and more work can be done.
- ❖ The chemical wastage and smuggling problems will be eliminated because the new system will record the volume of chemical being used, the injection beginning and stoppage time, and also the dimensions of the house.
- ❖ The company currently services about 300 customer houses per month; each house generates around 10,000 Baht income for the company. And during a month, there's u around 30 complaints from the customers about the service quality, each of these complaints have to be fixed individually by the service department. It cost around 3,000 Baht to fix a complaint, which adds up to 90,000 Baht per month; with KiiS implemented the company expects to reduce the complaints by 70%. It would be beneficial for the company if this complaint fixing cost can be saved.
- ❖ The good image of the company as a leader in quality pest control will be maintained, and the image of being an innovator of high-technology tools and equipment will also be achieved.
- ❖ The new system will ensure that the employees, especially the service employees, will have a better welfare. The new work processes will reduce the stress and the tediousness that the employees have to endure.



### 3.5 Dataflow Diagrams of the Proposed System

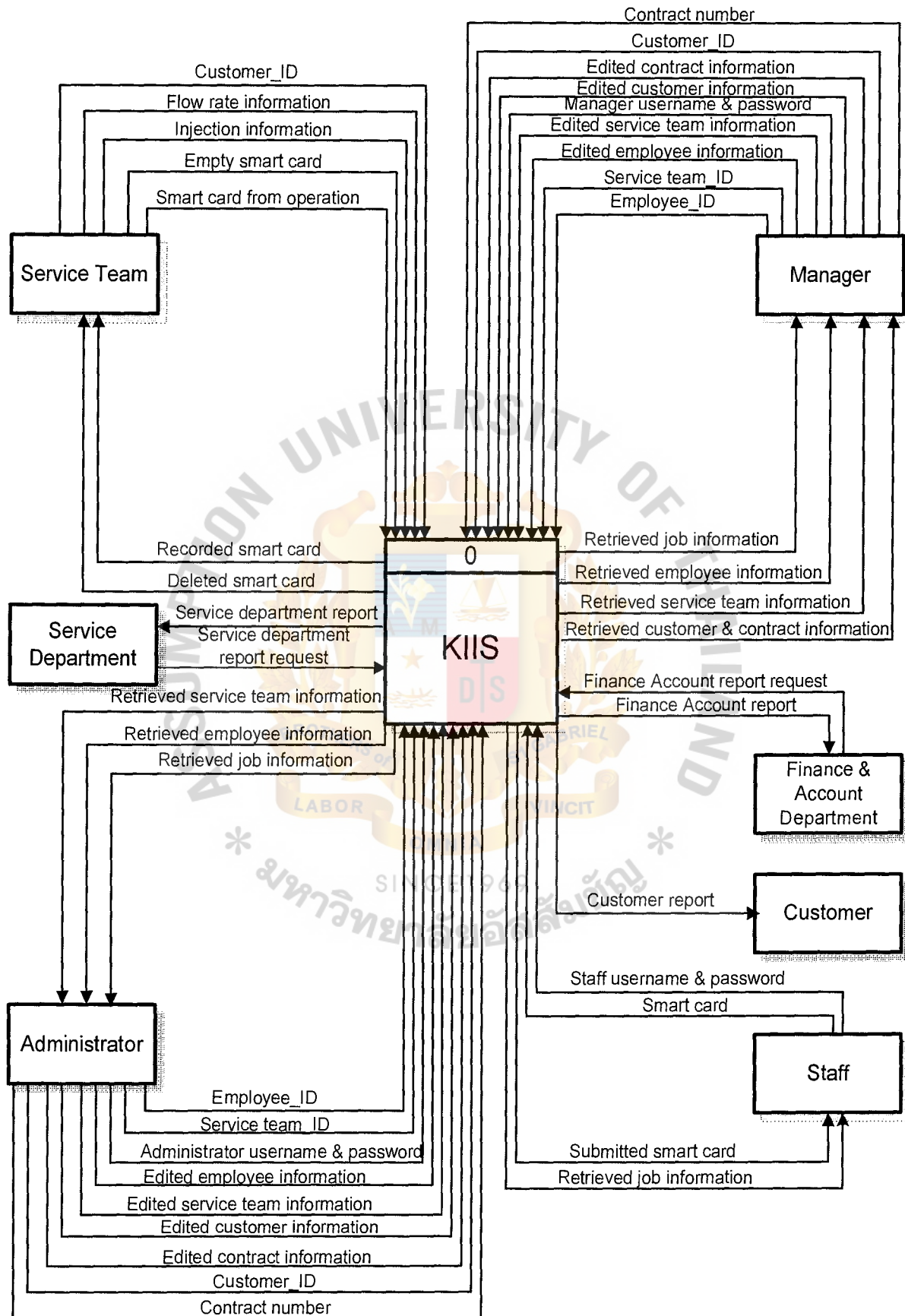


Figure 3.6: Proposed System Context Diagram

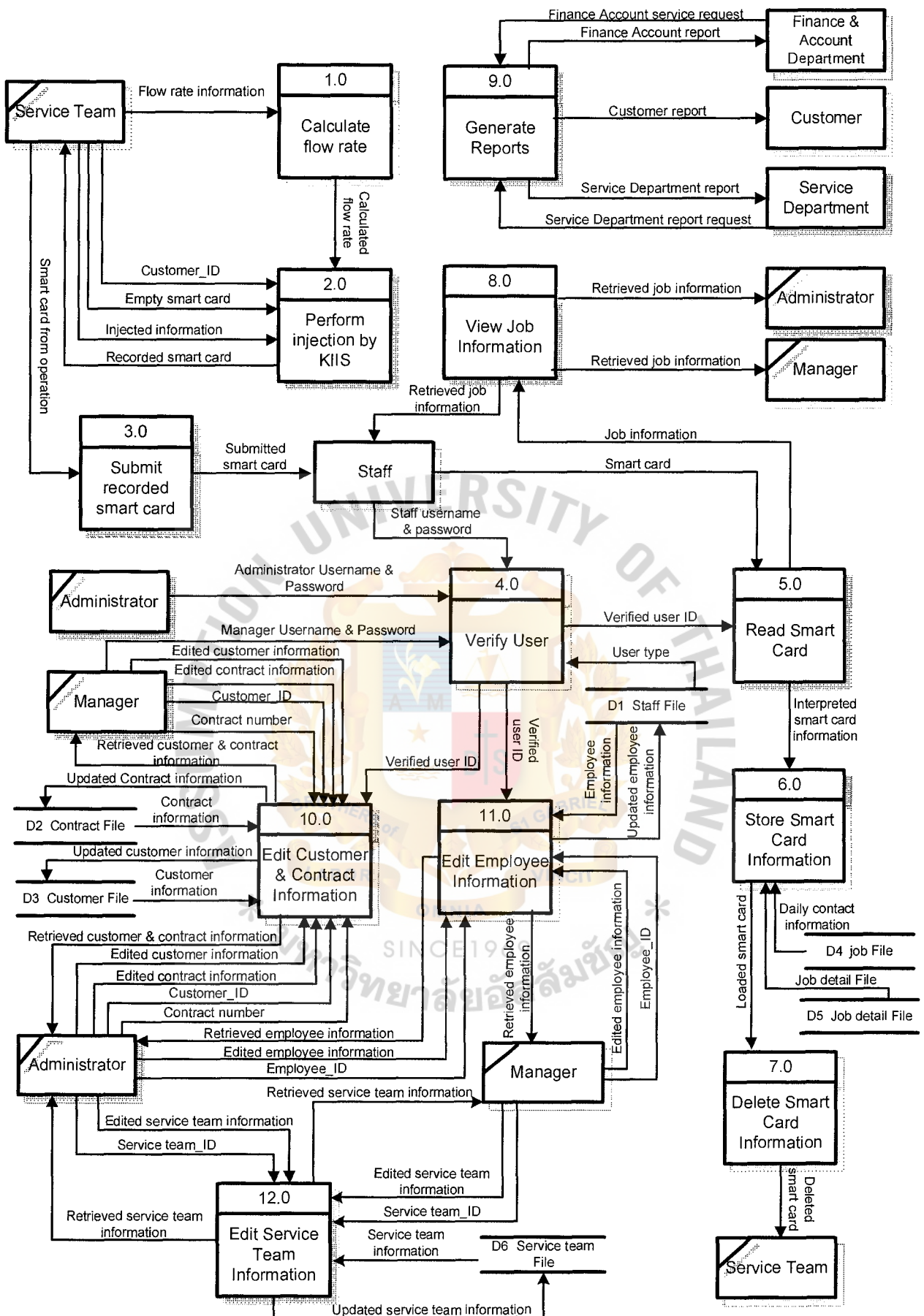


Figure 3.7: Proposed System DFD Level 0

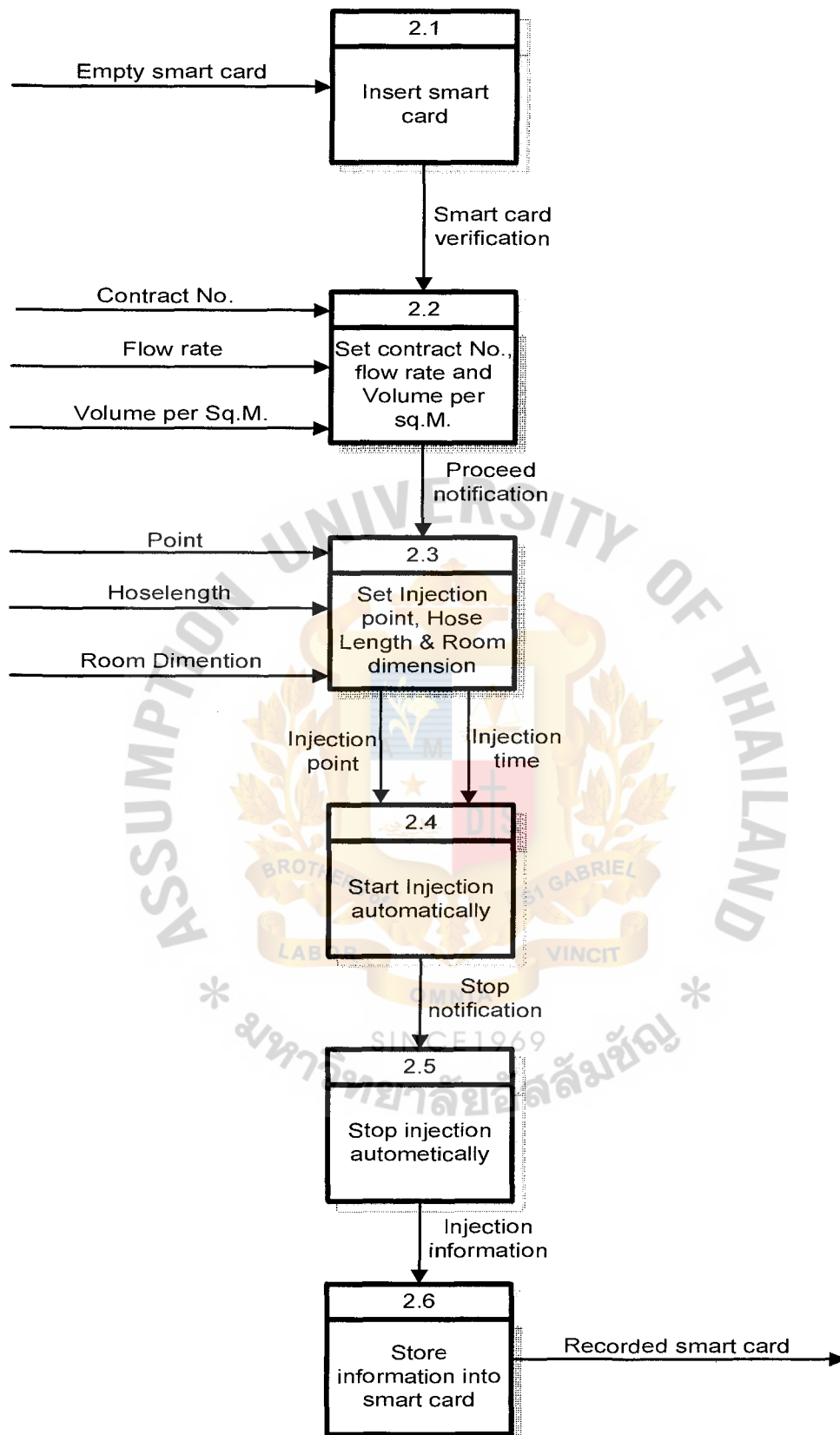


Figure 3.8: Proposed System DFD Level 1 Process2

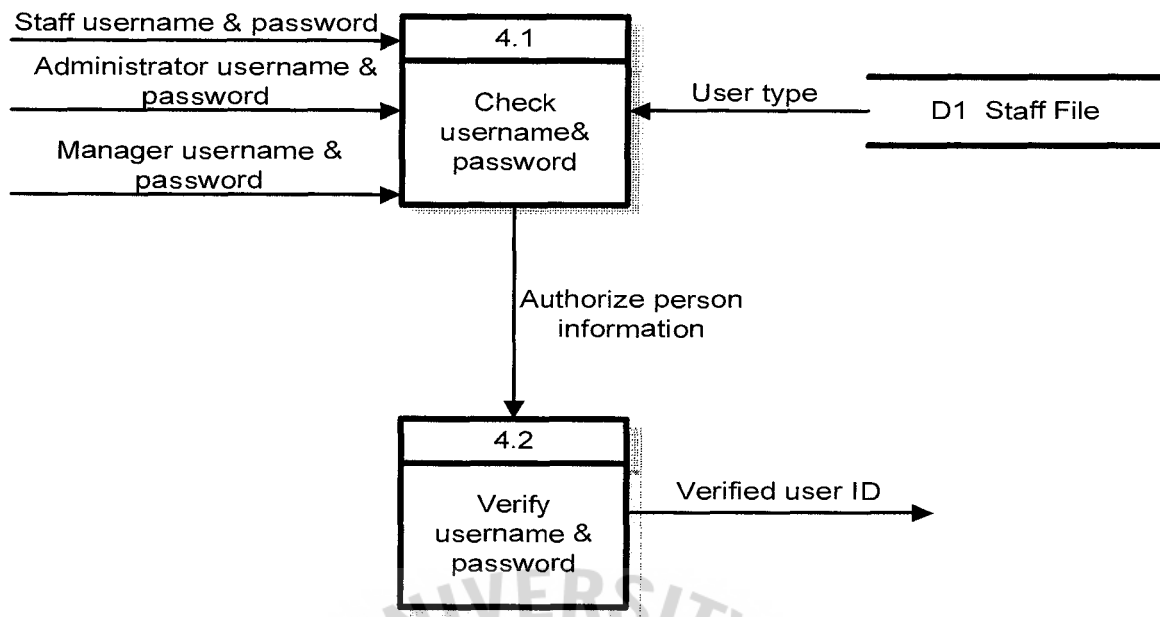


Figure 3.9: Proposed System DFD Level 1 Process4

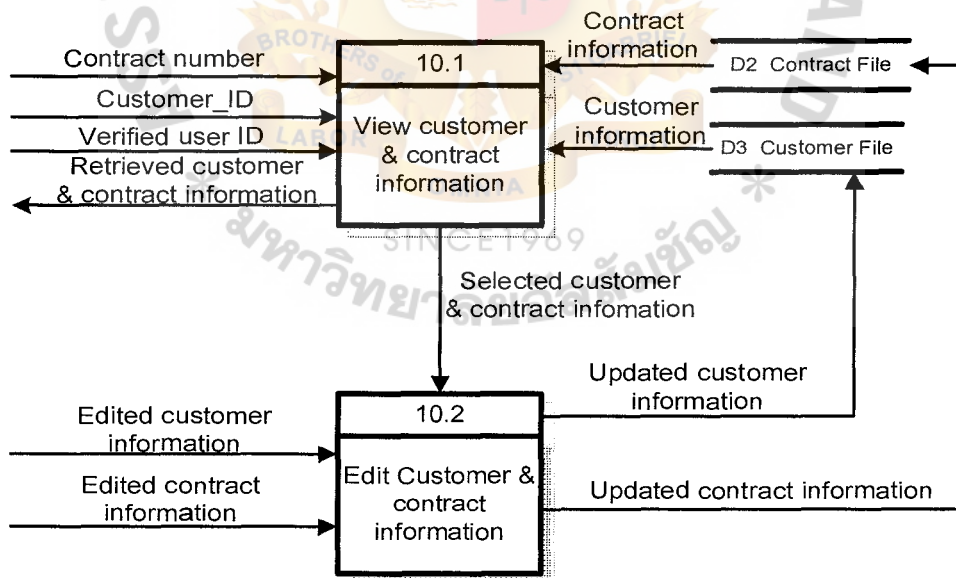


Figure 3.10: Proposed System DFD Level 1 Process10

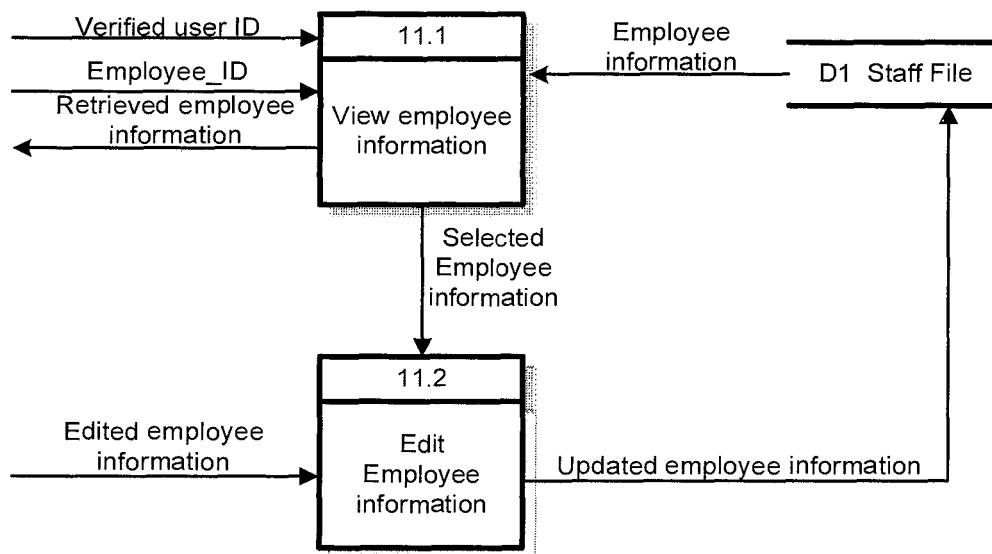


Figure 3.11: Proposed System DFD Level 1 Process 11

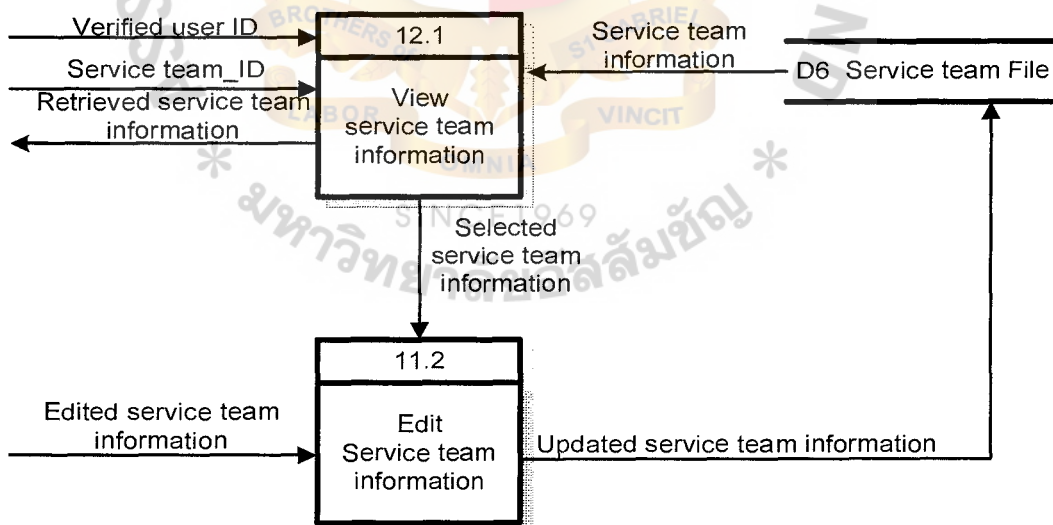


Figure 3.12: Proposed System DFD Level 1 Process 12



### 3.6 ER Diagram of Proposed System

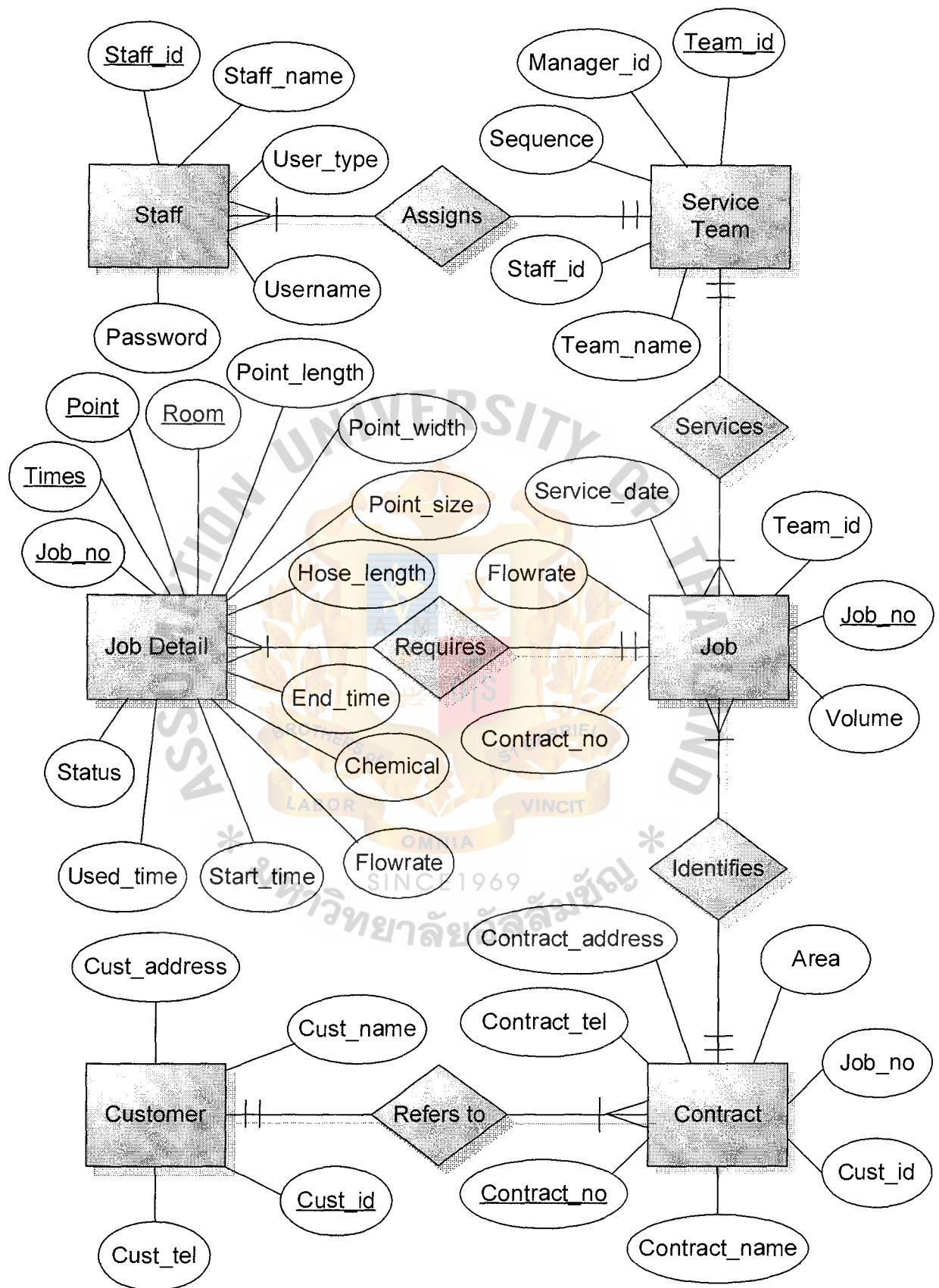


Figure 3.13: ER Diagram of Proposed System

## **IV. PROJECT IMPLEMENTATION**

### **4.1 Testing Plan**

#### **Hardware Testing**

After all the hardware components including the piping system, injection nozzle, and the control box are completed, they will be put together and then run for a period of time. The hardware must continue running without showing any problem, any defective that occurred during this test will be documented and fixed.

#### **Software Testing**

The software testing will be taken place after the hardware testing is thoroughly done and made sure that there is no defective to the hardware components. The software testing includes the smartcard data capture, conversion, report generator, searching, and editing. The software has to be verified that there is no bug. Any bugs or errors will be documented and then debugged.

#### **Overall System Testing**

This overall system testing is to double-check the system's performance after the hardware and software test. During this test all the components of the KiiS system will be put together, run, and then watched, any bugs or defectives will be debugged, fixed and then documented.

## **4.2 Training**

### **1) Service Managers Training**

The Directing manager and all the service managers are put together as representatives to visit a set up scenario house (may be any manager's house) to get a real experience for the system installation and usage. Its purpose is to explore the actual settings of the newly developed equipments such as the injection nozzles and injection hose. The control box will be brought for this field scenario for real operation. The representatives will observe all the processes until their comprehension is thorough. From this field operation, each manager will learn exactly how to operate the control box and will realize how each of the new equipment is positioned and installed under the building foundation. Then the field managers will be given an evaluation survey for filling up and submit to the office. The whole process of automated injection will be watched carefully, and finally recorded down as a notification for the service managers to be explained to the field operators later on in the Field operator training.

### **2) Field Operator Training**

The knowledge workers (the managers in this case), will be responsible for conducting the Field operator training session. This training session will be for the field operators who will be performing the use of the control box with the smart card provided. This first meeting will be conducted to ensure that the field operators are aware of the steps about how to operate the control box. The steps include how to operate a control box, which buttons to press for various inputs of the control box in each operation, how to connect the control box to the injection hose, the insertion of

smart card, and the comprehension of the other functionalities provided in the control box display screen. The input method will include the following: set contract number, flow rate, volume per square meter, injection point, hose length, room dimensions, and how to execute the injection.

Later on after the theoretical practice, a scenario field operation will be conducted to help the field operators get an idea of how the field work is done, for this time it might be held in an office training room by letting the field operators handle the job by themselves with the use of the implemented tools and system. This is to make sure that the field operators have a crystal-clear idea of how the new system works. Then another follow-on training session may be conducted to look for certainty of comprehension from the field operator. Further Questions that arise may be asked in this session by any doubtful field operator.

### **3) Office Users**

Another training session has to focus on the KiiS in the Visual Basic program part. This program, which provides a user friendly interface, will read the information stored in the smart card by the card reader, convert it, and then keep those converted information in the databases. This will also include other several functions such as the view and edit employees and customers' information, also printing various forms of reports. Nevertheless, some processes are restricted only to those authorized users.

The KiiS VB program will include different accesses for different status login. They are classified as Administrator, Managers, and Staffs. For this case, we are well aware that the administrator is the one who has to be taking care of the system. Therefore, the administrator will be the host of the meeting who will provide the details for every accesses and processes in every single page. The relations and tables

of the Microsoft Access database will also be described clearly and carefully in detail. Step by step, the administrator will have to explain to all level of system related office users and questions are definitely allowed to extend the users' comprehension. The appropriate answers will be elaborately hit back to the users by the administrator. At the end of the session, the initial username and password will be provided to all level of system related users.

#### **4) The Weekly Conducted Meeting**

The implementing system will be discussed and analyzed by the weekly meeting. Weekly meeting will mainly discuss about what has been observed, and what problems have been encountered after the system has been operating for a period of time. This may include the structured problems or even the unstructured problems. This meeting will include representative from all fields, admin and officers. In this way, the useful information will be obtained, documented, and taken in consideration for further improvement and maintenance. And the answers or solutions for some problems that the solutions are already recognized will be told to the employees right away at the weekly meeting.



### 4.3 System Conversion

The main purpose of KiiS is to reduce the unnecessary risk of chemical under and over dosage which might occur by the employees' carelessness or their intended attempt, which will ultimately leads to poor treatment of the customer's house. If chemical smuggling really does occur each time the chemical has been used for each customer's location, then the company will certainly face a great trouble. The money will be drained out by these actions and will find it very hard to prevent and control. Therefore, the well analyzed and studied information about this new system will certainly be more effective comparing to the existing one. Facing the mentioned problems, leaving us with no better choice, the direct cutover conversion strategy will be implemented as considered to be the most effective way to handle this situation because the introducing system is brand new that it has never been used anywhere else, it is believed to be a perfect substitute for the existing system. And since the proposing system has a totally different workflow comparing to the existing one, therefore, two systems should not be running simultaneously in a parallel fashion.

The company should apply the direct cutover conversion strategy after it is certain about the system from our extensive testing which has been done before hand, and the delays in conversion can be tolerated to ensure full system functionality. The direct cutover date will be stated after all the testing and implementation works accordingly to what we have planned unless this project is defective or needed further approval.

## **V. CONCLUSIONS AND RECOMMENDATIONS**

### **5.1 Conclusions**

After the implementation of KIIS, there have been feedbacks that the stated problems which the company has been trying to solve are sorted out and overcome. Since KiiS has provided the users with automated functions, the users, both field operators and the office users will work much easier effort. Therefore, the tedious works will be simplified and the errors which are usually caused by the employees' carelessness will be dramatically reduced. Regarding to the company's benefits, the analytical methods for the field operation information gathered are greatly improved by the software developed; the software, which provides a generator for many kinds of report for the management individuals in different fields so that the management can keep a close eye on the company's performance.

The chemical smuggling and wastage problem will also be eliminated by the KiiS system. This has been one of the company's most serious problems and also one of the most influential factors for KiiS implementation. KiiS system will be able to solve the chemical smuggling and wastage problem by recording all information that have been processed by the control box and keep it in the smart card. As all the information in the smart card are certainly reliable and unchangeable, because they are recorded by the control box, this will be really difficult for the employees to create any false information regarding the chemical usage at a customer's house.

This will not only improve the company's profit but also the customers' satisfactions. The customer who will be receiving the new KiiS operation will find a much more relaxing environment with fewer nuisances since there are lesser field operators who need to perform the task within the operating area. The printed

customer's report which includes the information about the performed treatment will also ensure the customer about the performed treatment. The implementation of KiiS system will increase the efficiency and also the effectiveness of the company's treatment to the customers in many ways. The interpreted and captured information from the smart card by the data reader will be inserted into the tables provided in the Data Reader page, this will definitely reduce the time consumed comparing to the existing method of manual writing process which the injected information were recorded by the employee's hand writing. The above steps will also be followed by the process of saving information into related customer's contract database automatically. This will be done easily by only clicking on the save button.

Reaching to the final conclusion of this project, the KIIS system will be overcoming all of the stated problems and will also gloriously achieve the mentioned objectives. We are now in the Information Technology age; therefore, the application of Information Technology to the company's existing work or business process will certainly help the company keep the competitive advantage over the competitors.

## **5.2 Recommendations**

### **1) Complete Paperless Environment**

As the KIIS is already providing the company with an almost paperless environment, still some printed reports are requested and needed by the customers. For KiiS, the customer report is still being sent to the customer by the salesperson individually. This is because the company believes that most of our customers, especially the existing customers are still not very familiar with using computers. Therefore, getting them into the web pages and having e-mails sent to them

individually are still the out of hand process. In the future, it is almost certain that the company will develop the system to the full extension of sending the customer report through the use of the web application by e-mail or other ways which might be posting all customers' report information on the company's web-site. For the second case, the company could provide each customer with the username and password for the authorization to access their information relating to the treatment of their houses. For both mentioned cases, the company will have to wait for the upcoming generation people who are fully equipped with computer knowledge and familiarity with computer, armed with computer and a connection to the internet in order to have access to the websites.

## **2) Knowledge Management and E-Training**

The knowledge which resides within the employees of the organization, the tacit knowledge gained through real working experience, is very essential and should be well preserved. Tacit knowledge of the company in this case might be the know-how and the ability of the employees' to deal with problems when performing the field work. The know-how of the employees are discussed and shared during the weekly meeting, these knowledge should be captured and then put together in a computerized form so that when the new employees enter to the company they can use the computerized training to learn about the problems and solutions. The advantage of this computerized E-Training is that the knowledge will stay with in the organization even if the employees quit the job. In the future, this E-Training could be very interactive that it will aid more effective employees training. When the employees are equipped with good work information and solutions to problems, it is possible that they will be able to perform their work more effectively.



**APPENDIX A**  
**USER INTERFACE DESIGN**



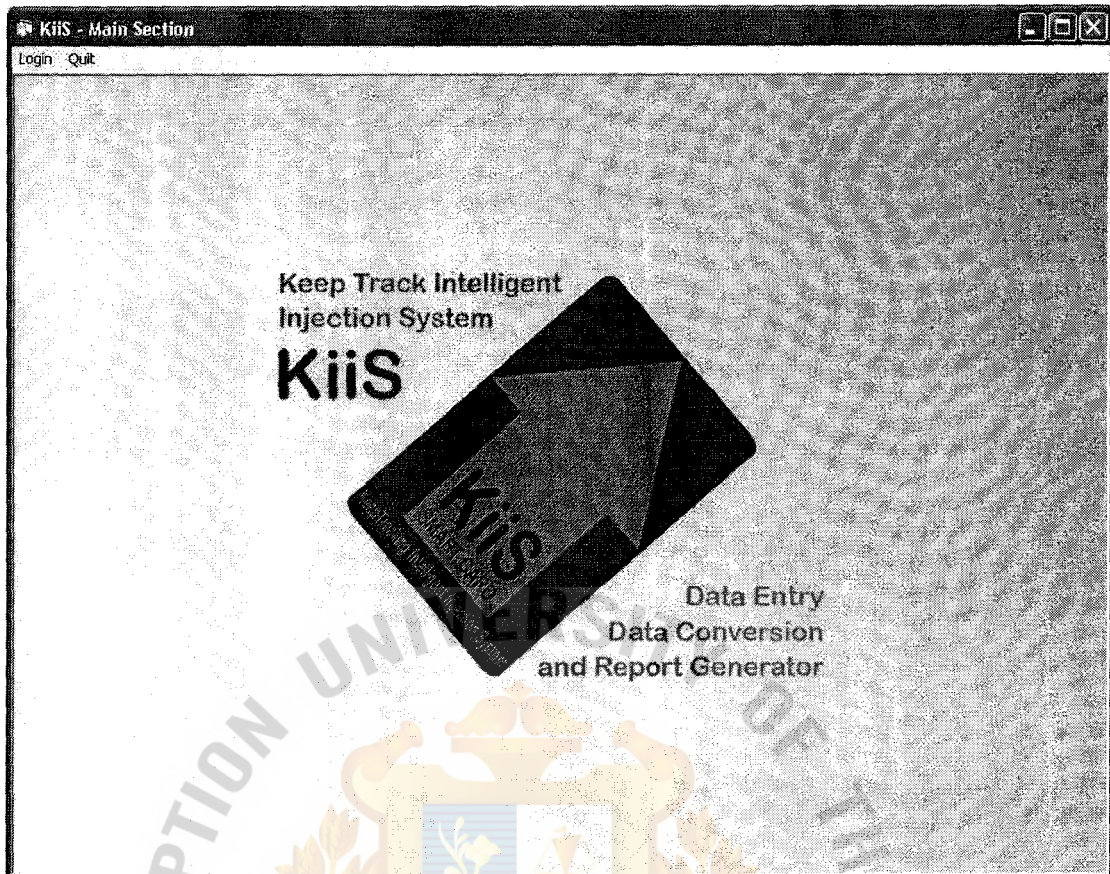


Figure A.1: Main Page

### Main Page

This page is the initial page of the program that shows up every time the program runs; it is available to all types of user, the administrator, the manager, and the staff. Only two functions can be performed in this page, login and quit.

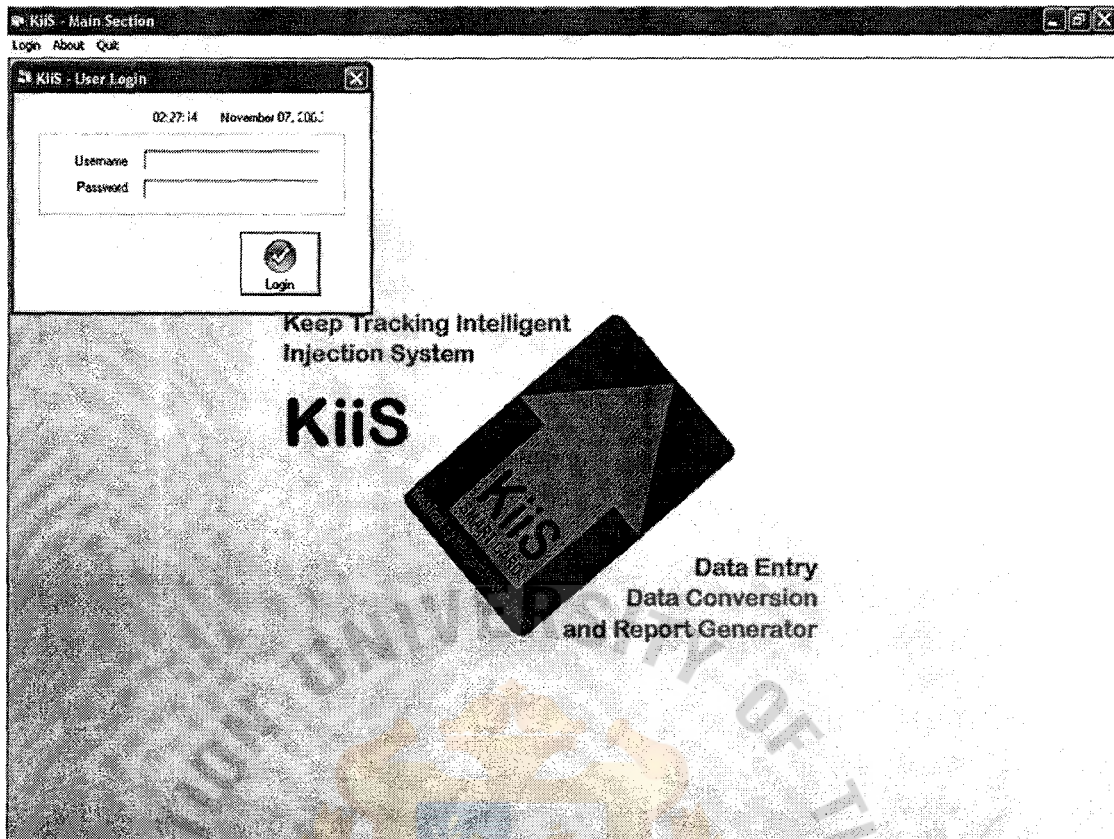


Figure A.2: User Login Page

### User Login Page

This is the page where the users login, it is linked from the main page of the program. The username and password entered by the users will be verified and then the users will be classified in to three categories as fore stated. Each type of user will be taken to a different page.



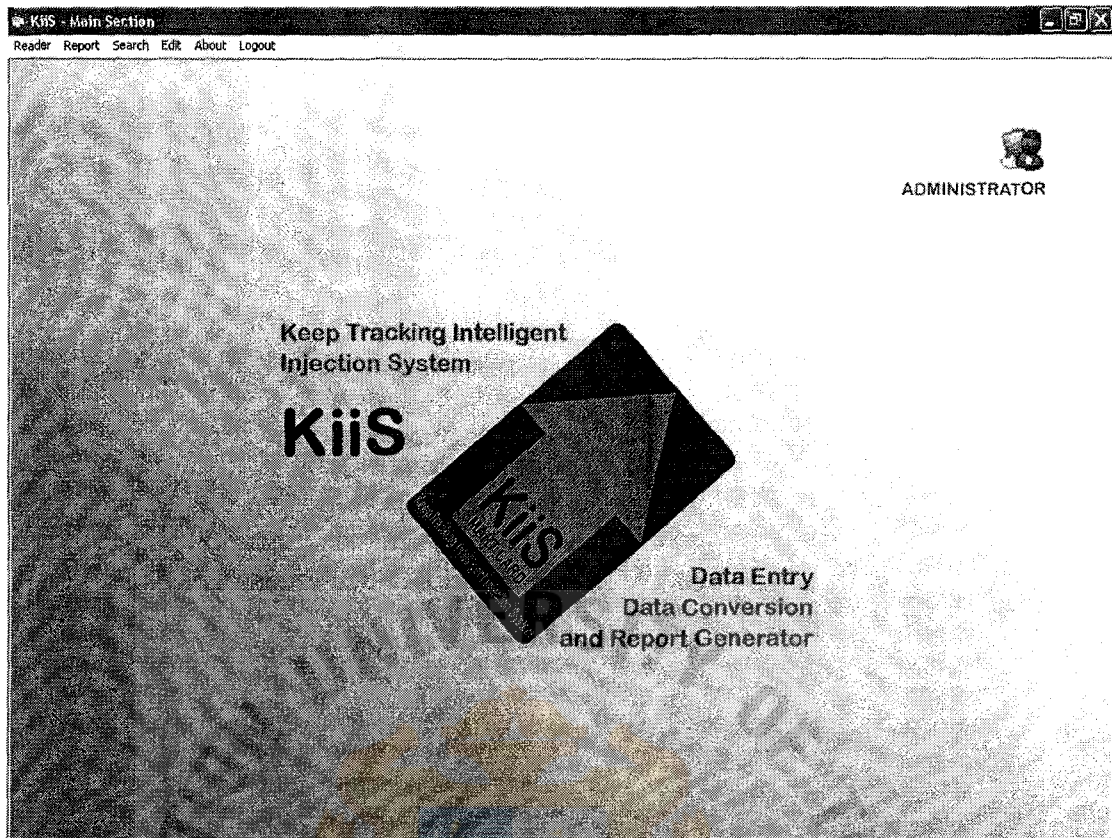


Figure A.3: Administrator Main Page

### Administrator Main Page

The user will be taken to this administrator main page when the username and password is verified and identified to be the administrator's. The administrator indicator is shown on the upper right corner of the page; the user identification is colored red with text identification below it. This page has links to Card Reader Page, Report Generator Page, Search Pages, and Edit Pages. The users can also logoff from the system and return to the program's main page.



Figure A.4: Administrator Search Menu Bar

#### Administrator Search Menu Bar

The administrator can search for all kinds of information available in the program, which are Job, Contract, Team, and Staff information.





Figure A.5: Administrator Edit Menu Bar

### Administrator Edit Menu Bar

The administrator is authorized to modify any information that can be edited in the program. They are Contract, Customer, Team, and Staff.



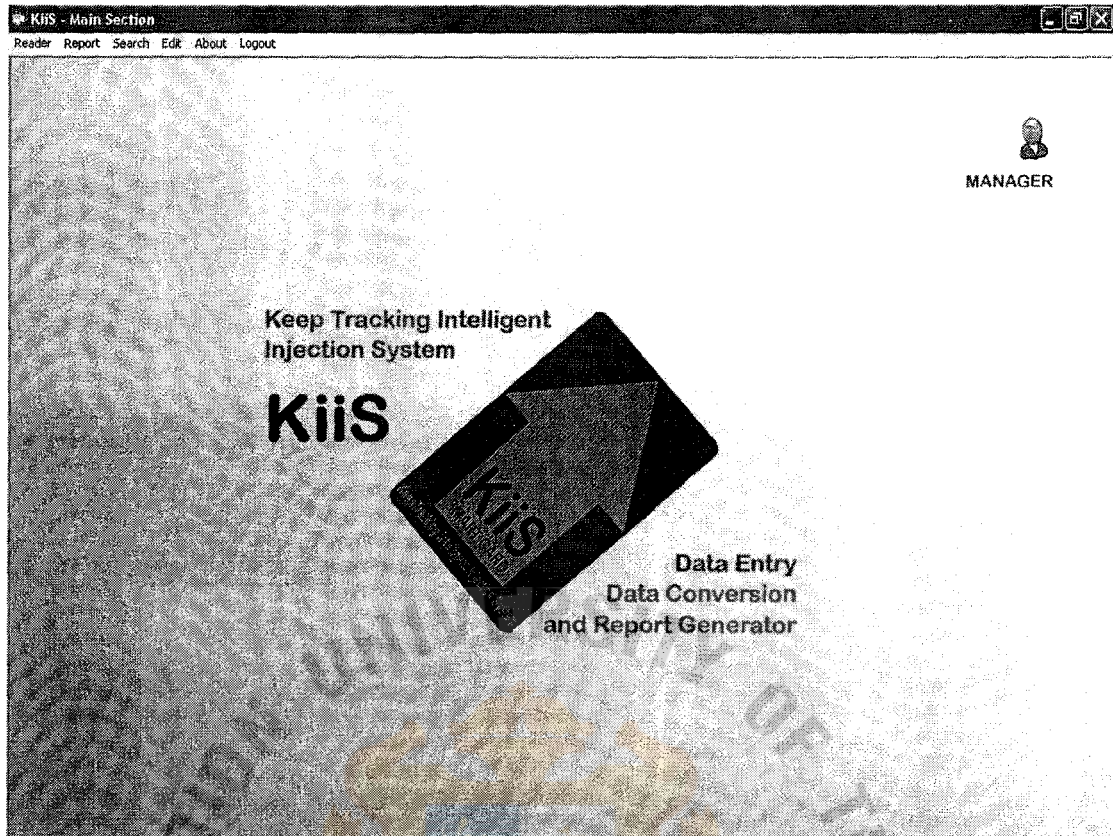


Figure A.6: Manager Main Page

### Manager Main Page

The user will be taken to this manager main page when the username and password is verified and identified to be the manager's. The manager indicator is shown on the upper right corner of the page; the user identification is colored green with text identification below it. This page has links to Card Reader Page, Report Generator Page, Search Pages, and Edit Pages. The users can also logoff from the system and return to the program's main page.

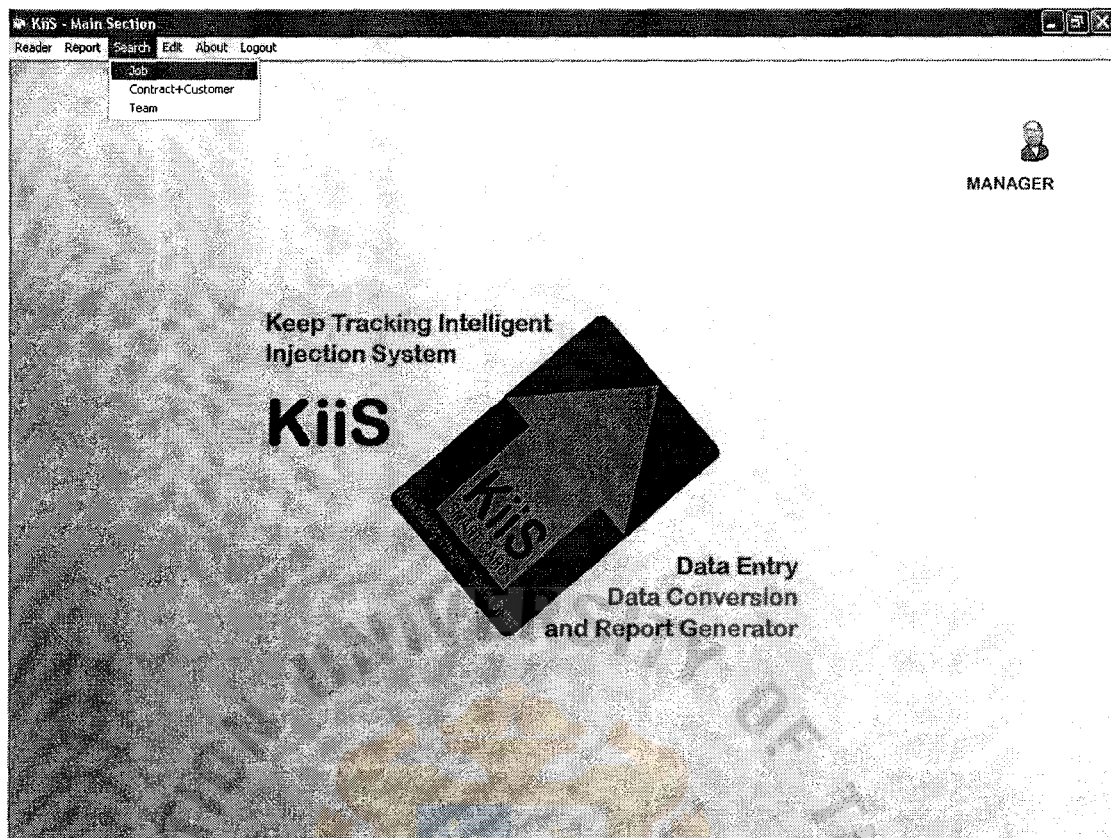


Figure A.7: Manager Search Menu Bar

### Manager Search Menu Bar

The manager can perform three types of searching. They are Job, Contract, and Team searching.





Figure A.8: Manager Edit Menu Bar

### Manager Edit Menu Bar

Three kinds of information modification can be edited by the manager. They are Contract, Customer, and Team.

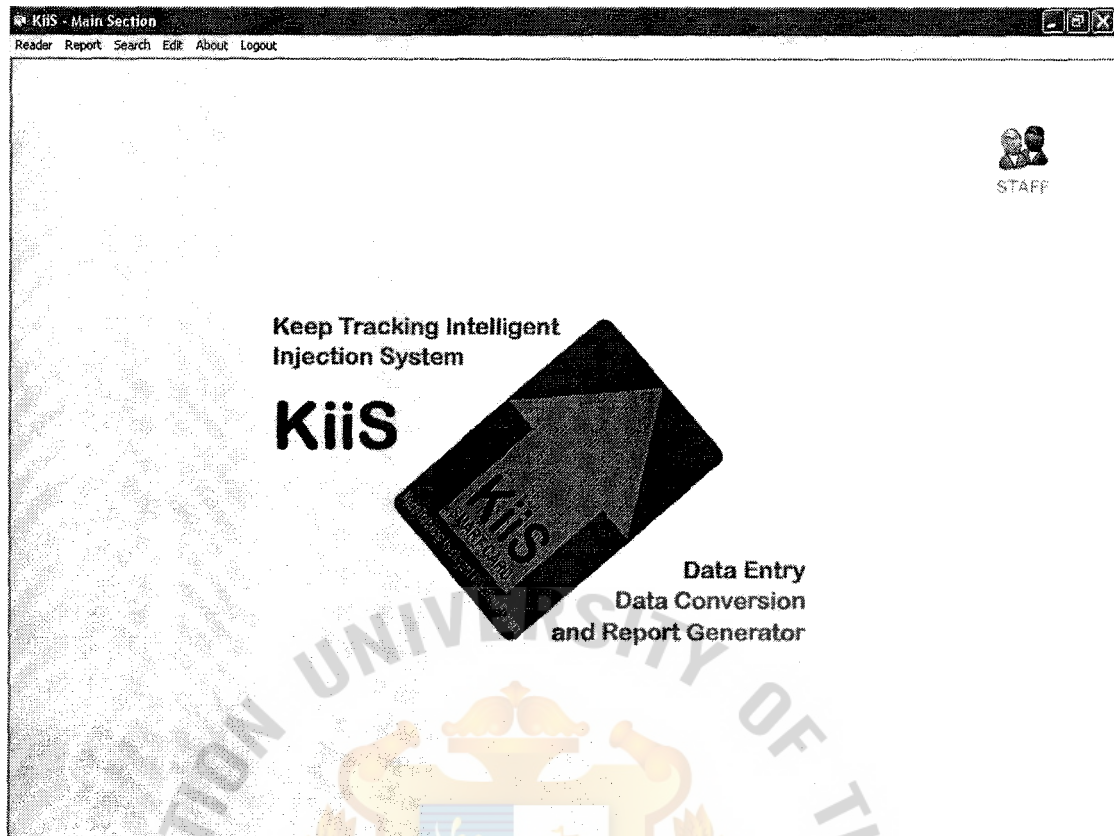


Figure A.9: Staff Main Page

### Staff Main Page

The user will be taken to this staff main page when the username and password is verified and identified to be the staff's. The staff indicator is shown on the upper right corner of the page; the user identification is colored yellow with text identification below it. This page has links to Card Reader Page, Report Generator Page, Search Pages, and Edit Pages. The users can also logoff from the system and return to the program's main page.

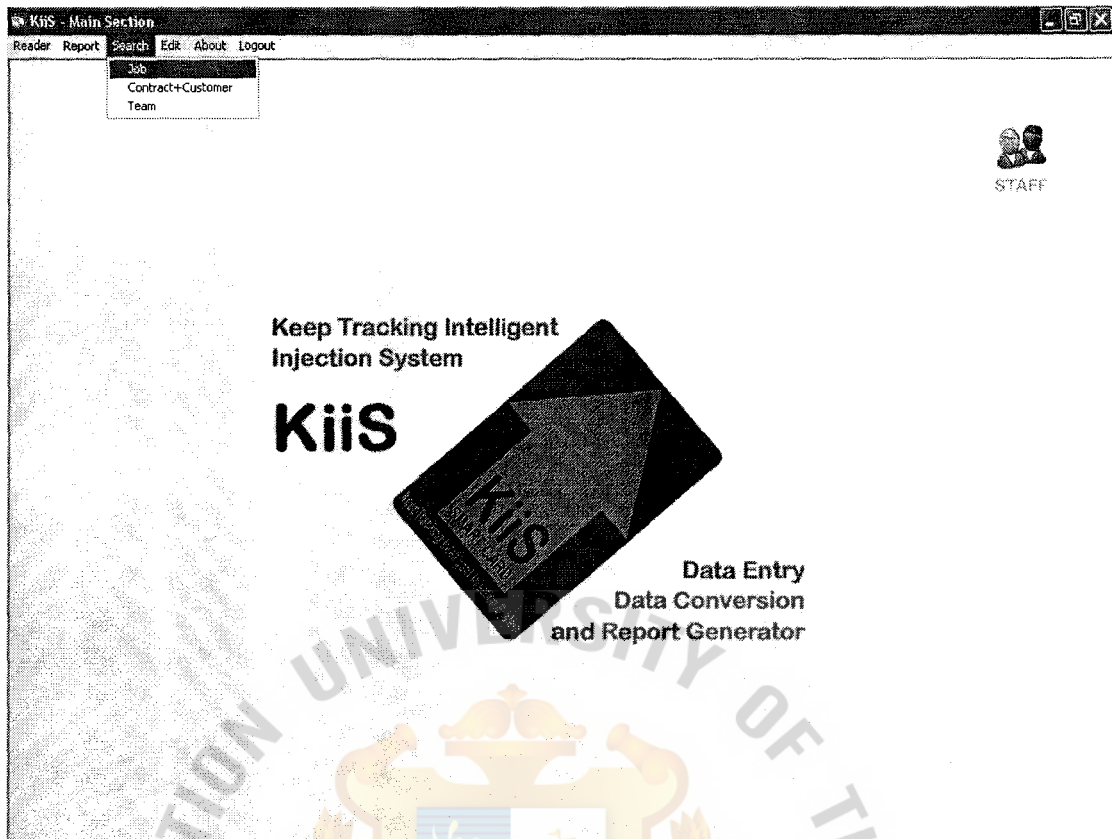


Figure A.10: Staff Search Menu Bar

### Staff Search Menu Bar

The staff can perform three types of searching. They are Job, Contract, and Team searching.



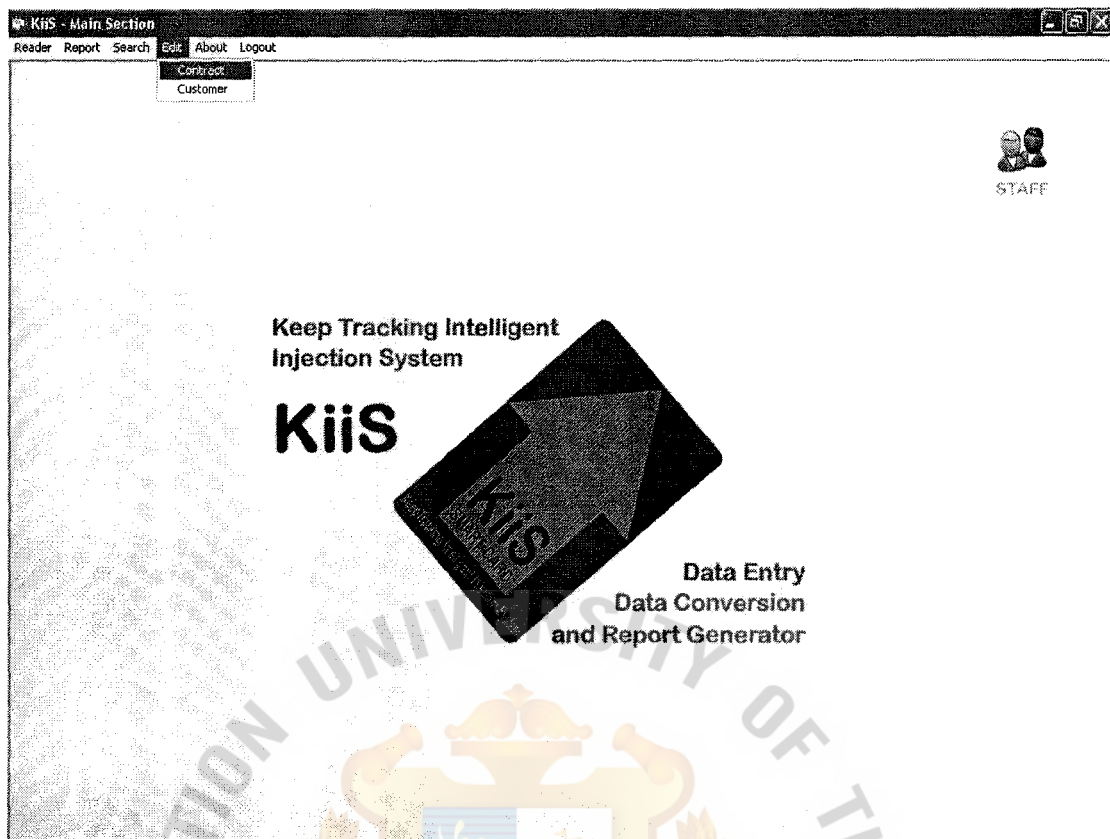


Figure A.11: Staff Edit Menu Bar

### Staff Edit Menu Bar

Only Three kinds of information modification can be edited by the staff. They are Contract and Customer.



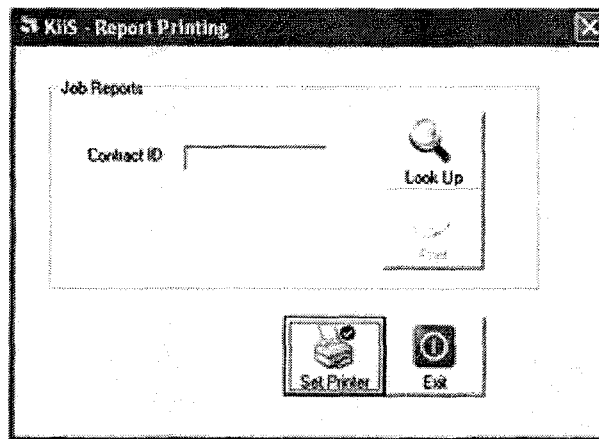


Figure A.13: Report Generator Page

### Report Generator Page

This page is used by any user to print out many kinds of report, which are, periodic report (daily, weekly, and monthly report), job report, exceptional report (incomplete injection, and chemical over usage report), and the last kind of report, team report. The staff can only print out the first two reports, while the administrator and the manager can print all of the reports.

Figure A.14: Job Search Page

### Job Search Page

This job searching page can be used by all users. Search can be performed by entering either contract number or customer name, after clicking search button, the rough search result (contract number and job date) will be shown in the result section. The users can select the result and then click on the detail button to view the detailed search information of the job.

KIIS - Contract Search

Enter Search Information

Contract Number

Customer Name

Clear Search

Contract no	Cust name
-------------	-----------

Detailed Search Result

Contract Number

Contract Name

Contract Address

Contract Tel.

House Area

Customer ID

Customer Name

Customer Address

Customer Tel.

Exit

Figure A.15: Contract Search Page

### Contract Search Page

All kinds of user can access this page to search for the contract information by using the contract number or customer name. The rough search result will be shown and then the users can select the result and then click on the detail button to view the detailed search information.







Figure A.18: Contract Edit Page

### Contract Edit Page

This page is used by the administrator, the manager, and the staffs to edit the information about the customer's contract. There are three main functions that can be performed, add new, delete existing, and modify existing. After performing any editing function, the user has to click on the save button to save the edited information to the database. To add new record, the user can simply click on new button and then enter all the information in the fields. For deleting and modifying, the user has to search for the intended record and then selecting it for further operation on the record.

Figure A.19: Customer Edit Page

### Customer Edit Page

This page, similar to the contract edit page, can be used by all the users. It is used to edit the customers' information. There are three main functions that can be performed, add new, delete existing, and modify existing. After performing any editing function, the user has to click on the save button to save the edited information to the database. To add new record, the user can simply click on new button and then enter all the information in the fields. For deleting and modifying, the user has to search for the intended record and then selecting it for further operation on the record.





Figure A.21: Staff Edit Page

### Staff Edit Page

This page is authorized only to the administrator. It is used to edit the staffs' information which are, staff ID, staff name, username, password, and user type. There are three main functions that can be performed, add new, delete existing, and modify existing. After performing any editing function, the user has to click on the save button to save the edited information to the database. To add new record, the user can simply click on new button and then enter all the information in the fields. For deleting and modifying, the user has to search for the intended record and then selecting it for further operation on the record.



**APPENDIX B**  
**DATABASE DESIGN**

## The Existing System

1. Customer File = {Customer Record}

Customer Record = Cust\_id + Cust\_name + Cust\_address + Cust\_Tel

ENTITY	ENTITY'S ATTRIBUTE	ATTRIBUTE TYPE	FIELD SIZE	ATTRIBUTE DESCRIPTION
Entity	Entity's Attribute	Attribute Type	Field Size	Attribute Description
Customer Record	<u>Cust_id</u>	Number	12	Sequential code to identify the customer
	Cust_name	Text	100	First Name + Middle Name + Lastname
	Cust_address	Text	270	Address No. + Moo + Soi + Village + Road + Amphur + Province + Zip
	Cust_Tel	Number	20	The available number for contacting the customer

Table B.1: Customer File of Existing System

2. Contract File = {Contract Record}

Contract Record = Contract\_no. + Contract\_name + Contract\_address + Contract\_tel + Area + Cust\_id + Job\_no

ENTITY	ENTITY'S ATTRIBUTE	ATTRIBUTE TYPE	FIELD SIZE	ATTRIBUTE DESCRIPTION
Contract Record	<u>Contract_no.</u>	Number	12	Sequential code to identify the Contract no. for each customer
	Contract_name	Text	50	The name of the contact given by the owner
	Contract_address	Text	270	Address No. + Moo + Soi + Village + Road + Amphur + Province + Zip
	Contract_tel	Number	20	The provided number for contacting the customer



				phone number the house has the contract
	Area	Number	16	The total house area
	Cust_id	Number	12	Sequential code to identify the customer
	Job_no	Number	12	Sequential code to identify each task in doing

Table B.2: Contract File of Existing System

3. ServiceTeam File = {Team Record}

ServiceTeam Record = Team\_id + Team\_name + Manager\_id + Staff\_id

ENTITY	ENTITY'S ATTRIBUTE	ATTRIBUTE TYPE	FIELD SIZE	ATTRIBUTE DESCRIPTION
Team Record	<u>Team_id</u>	Number	12	Sequential code to identify the mobile team in order to process the injection
	Team_name	Text	80	Name of each service team
	Manager_id	Number	12	Identify who is the manager of each service team
	Staff_id	Number	12	Identify the staff in the service team

Table B.3: Service Team File of Existing System

## The Proposed System

1. Customer File = {Customer Record}

Customer Record = Cust\_id + Cust\_name + Cust\_tel + Cust\_address

ENTITY	ENTITY'S ATTRIBUTE	ATTRIBUTE TYPE	FIELD SIZE	ATTRIBUTE DESCRIPTION
Customer Record	<u>Cust_id</u>	Number	12	Sequential code to identify the customer
	Cust_name	Text	100	First Name + Middle Name + Lastname
	Cust_tel	Number	20	The available number for contacting the customer
	Cust_address	Text	270	Address No. + Moo + Soi + Village + Road + Amphur + Province + Zip

Table B.4: Customer File of Proposed System

2. Contract File = {Contract Record}

Contract Record = Contract\_no. + Contract\_name + Contract\_address + Contract\_tel + Area + Cust\_id + Job\_no.

ENTITY	ENTITY'S ATTRIBUTE	ATTRIBUTE TYPE	FIELD SIZE	ATTRIBUTE DESCRIPTION
Contract Record	<u>Contract_no.</u>	Number	12	Sequential code to identify the Contract no. for each customer
	Contract_name	Text	50	The name of the contact given by the contract owner
	Contract_address	Text	270	Address No. + Moo + Soi + Village + Road + Amphur + Province + Zip
	Contract_tel	Number	20	The provided phone number

				the house having the contract
	Area	Number	16	The total house area
	Cust_id	Number	12	Sequential code to identify the customer
	Job_no	Number	24	Sequential code to identify each task in doing job

Table B.5: Contract File of Proposed System

3. Service Team File = {Service Team Record}

Service Team record = Team\_id + Team\_name + Sequence + Manager\_id + Staff\_id

ENTITY	ENTITY'S ATTRIBUTES	ATTRIBUTE TYPE	FIELD SIZE	ATTRIBUTE DESCRIPTION
Service Team Record	<u>Team_id</u>	Number	12	Sequential code to identify the mobile team order to process the injection
	Team_name	Text	80	Name of each service team
	Sequence	Text	5	Sequence of staff in the team
	Manager_id	Number	12	Identify with the manager of each service team
	Staff_id	Number	12	Identify the staff in the service team

Table B.6: Service Team File of Proposed System

4. Staff File = {Staff Record}

Staff record = Staff\_id + Staff\_name + Username + Password + User\_type

ENTITY	ENTITY'S ATTRIBU	ATTRIBU TYPE	FIELD SIZ	ATTRIBU DESCRIP N
Staff recor	<u>Staff_id</u>	Number	12	Identify ea staff in the
	Staff_name	Text	80	Name of ea staff in the
	Username	Text	10	Used to log to the syste for each sta
	Password	Text	10	Used to prevent unauthoriz access to th system
	User_type	Text	2	Identify the type of staf perform different functions

Table B.7: Staff File of Proposed System

5. Job File = {Job Record}

Job record = Job\_no. + Contract\_no. + Service\_date + Flowrate + Volume + Team\_id

ENTITY	ENTITY'S ATTRIBU	ATTRIBU TYPE	FIELD SIZ	ATTRIBU DESCRIP N
Job Record	<u>Job_no.</u>	Number	12	Sequential code to identify ea task in doing job
	Contract_n	Number	12	Sequential code to identify the Contract no for each customer
	Service_da	DateTime	8	Date + Mo + Year wh

	Flowrate	Number	5	doing the t The flow r measured f the pressur pump
	Volume	Number	12	Volume of Chemical u per square meter
	Team_id	Number	12	Sequential code to identify the mobile tea order to process the injection

Table B.8: Job File of Proposed System

6. Job Detail File = {Job Detail Record}

Job Detail record = Job\_no. + Room + Point + Times + Point\_width + Point\_length + Point\_size + Hose\_length + Start\_time + End\_time + Used\_time + Chemical + Flowrate + Status

ENTITY	ENTITY'S ATTRIBUTE	ATTRIBUTE TYPE	FIELD SIZE	ATTRIBUTE DESCRIPTION
Job Deta Record	<u>Job_no.</u>	Number	12	Sequential cod identify each t in doing job
	<u>Room</u>	Number	2	Identify the injection room
	<u>Point</u>	Number	2	Identify the po of injection in each room
	<u>Times</u>	Number	2	Number of tim that the injecti was attempted
	<u>Point_width</u>	Number	4	The width of t area
	<u>Point_lengt</u>	Number	4	The length of area
	<u>Point_size</u>	Number	4	PointWidth *



				PointLength
	Hose_length	Number	4	The length of hose form the control box to injection nozz
	Status	Text	2	Injection complete or incomplete notification
	Start_time	DateTime	8	Hours + Minute + Seconds when starting the injection
	End_time	DateTime	8	Hours + Minute + Seconds when stopping the injection
	Used_time	Number	8	EndTime - StartTime
	Flowrate	Number	5	The flow rate measured from the pressure p
	Chemical	Number	5	Volume of chemical injected

Table B.9: Job Detail File of Proposed System



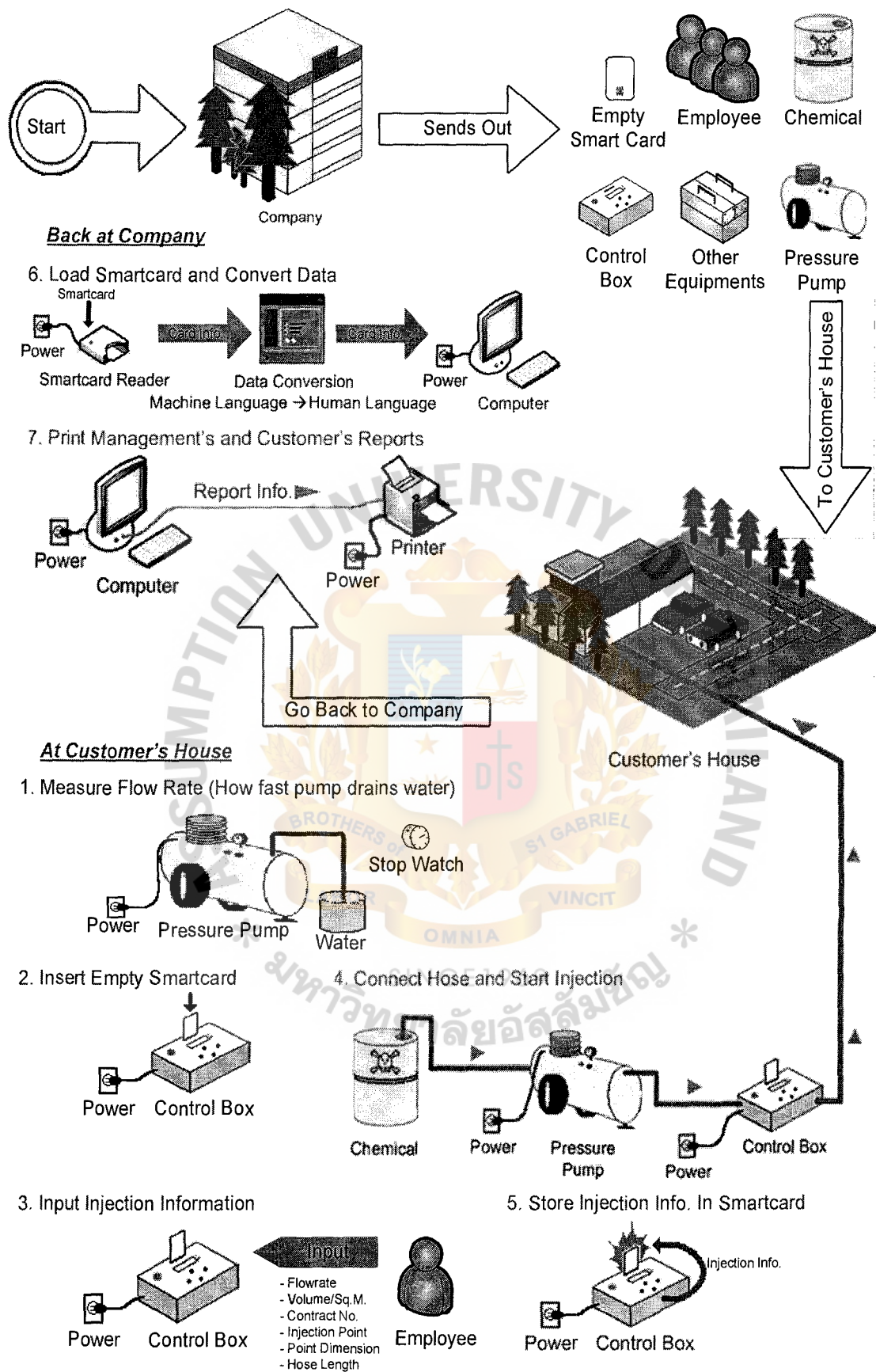


Figure C.1: Work Flow Diagram



**APPENDIX D**  
**COST AND BENEFIT EVALUATION**

## Proposed System's Cost

### Initial Cost

- Smart Card – 2,000 Baht
- Smart Card Reader – 1,500 Baht
- Control Box and Solenoid Valve – 25,000 Baht
- Computer Set – 15,000 Baht
- Microsoft Windows – 14,500 Baht
- Microsoft Visual Basic – 6,000 Baht
- Crystal Report – 10,000 Baht

### Ongoing Cost

- Annual maintenance cost 15,000 Baht

### Proposed System's Tangible Benefit

- Complaint reduction – 90,000 Baht each month but the company expects only 70 percent of the figure. ( $90,000 * 0.7 = 63,000$ )

### Cash Flow of the Project

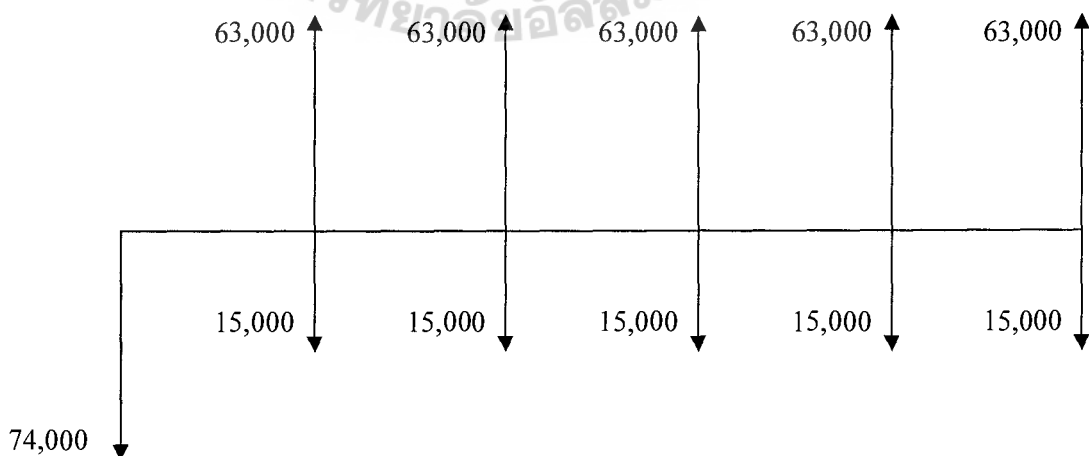


Figure D.1: Cash Flow of the Project



### Simplified Cash Flow of the Project

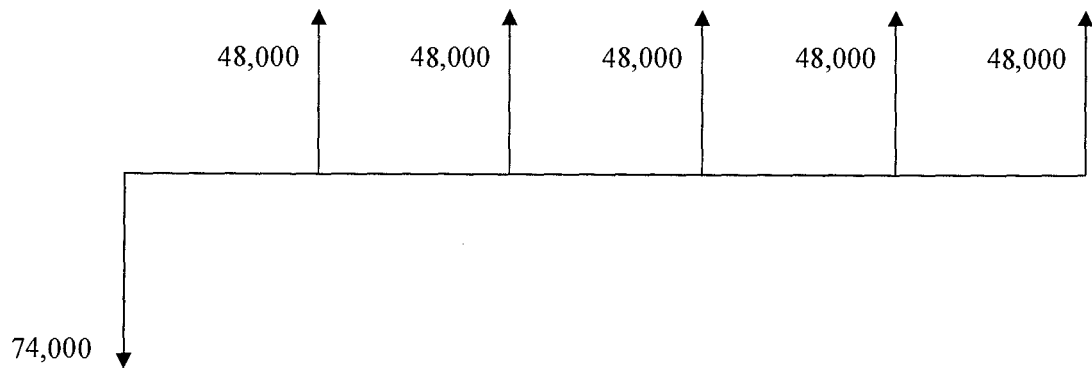


Figure D.2: Simplified Cash Flow of the Project

### Break Even Analysis

End of Year	Cash Flow	Accumulate Cash Flow
0	-74,000	-74,000
1	48,000	-26,000
<b>2 *Break Even*</b>	<b>48,000</b>	<b>22,000</b>
3	48,000	70,000
4	48,000	118,000
5	48,000	166,000

Table D.1: Break Even Analysis

### Present and Annual Worth of the Project

The company's MARR is equal to 20%

$$PW(20\%) = -74,000 + 48,000 (P/A, 20\%, 5)$$

$$= -74,000 + 48,000 (2.9906)$$

$$= -74,000 + 143,549$$

$$= 69,549$$

$$AW(20\%) = 69,549 (A/P, 20\%, 5)$$

$$= 69,549 (0.3344)$$

$$= 23,257$$

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