SOFTWARE DEVELOPMENT OF THE PHYSICAL CHECK-UP RECORD SYSTEM IN THE HOSPITAL

by

Mr. Bunyarit Wangpaiboon

A Final Report of the Six-Credit Course
CE 6998 - CE 6999 Project

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
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Project Title	Software Development of the Physical Check-up Record System in the Hospital
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Academic Year	November 2002

The Graduate School of Assumption University has approved this final report of the six-credit course, CE 6998 — CE 6999 PROJECT, submitted in partial fulfillment of the requirements for the degree of Master of Science in Computer and Engineering Management.

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ABSTRACT

This project examines and analyses the existing system and development of the data base system to assisting Physical check-up record system for external services to improve the quality/accuracy of data and tractability system of Physical check-up record system for external services.

A survey of location studies was conducted to identify the major considerations of location analysis and to develop a hierarchy of factors in locating of Physical check-up for external services at Navanakorn Hospital. The computer data collection based integrates an object-oriented expert system with other modeling tools, such as a database system and system development life cycle (SDLC). The system incorporates subjective evaluations for development the data record of Physical check-up system for external services with objective, reducing the working processes time and more accurate data record and linkage with the internal data-base of Physical check-up record system. The system also makes transparent the justification for doctors to recommendations in the Physical check-up report.

System evaluation was accomplished to test the accuracy of record and working processes time. The results of the system evaluation suggest that the system performs accurately and satisfactorily according to the design specifications and objectives.

ACKNOWLEDGEMENTS

I wish to express sincere gratitude to my advisor and chairman of the Navanakorn Hospital, Mr. Pracha Sarikid (Marketing Department) and for all staff in marketing department. His patient assistance, guidance, and constant encouragement has led me from the project inception to the project completion. I would like to express appreciation to my Advisor Rear Admiral. Prasart S. for constructive comments and advice throughout the project.

I would like to thanks all of staff at the Department of Computer and Engineering Management, Navanakorn Hospital for their help in securing location to analyzes Physical check-up system for external services.

Special appreciation is due to my family for their fervent and continuous encouragement. Above all, I am forever grateful to my parents whose willingness to invest in my future has enabled me to achieve my educational goal.

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1.1 Significance of Physical check-up system

Quality care most importantly helps patients, and it also plays a critical role in organizational efficiency and effectiveness. In Hospital's need Performance Improvement / Utilization Management participates in physical check-up system.

Quality Improvement Strategic Planning

(a) Identify opportunities for performance improvement.

(b) Formulate quantified goals with data-driven measures.

(c) Create continuous quality improvement initiatives.

(d) Develop performance measurement standards and tools.

Critical Path And Continuum Of Care Guidelines Development

(e) Establish strategy for targeting disease-specific populations.

(f) Formulate goals for product lines such as market positioning, cost reduction, and documentation.

(g) Define outcome measures and continuum of care guidelines.

(h) Design tools for documentation, tracking effectiveness and variances, and physician profiling.

Joint Commission Compliance for Performance Improvement

(i) Assess compliance with standards.

(j) Identify weaknesses in systems, processes, and barriers.

(k) Formulate action plans to ensure compliance.

(1) Design tools for measurement, feedback analysis, and improvement.

Utilization Management

(m) Establish systems and processes to review utilization of resources through pre-admission, admission, continued stay, and discharge planning reviews.

(n) Apply evidence-based criteria and length of stay norms for planning care.

(o) Limit financial loss and revenue at risk by establishing clinical parameters and critical paths.

1.2 The Location Problem

Most hospitals have the external services of Physical check-up because this is one of the marketing strategies now which has a lot of competition. The manufacturing has the benefit for employees for Physical check-up, all of the electronic manufacturing uses the lead and zinc components in process which the operators has been working to concern to lead and zinc components. Electronic manufacturing company should have yearly physical check-up for employee.

This project has to study the external services of the physical check-up system. For the external services has been used the manual system, so that in this project has study and development from manual system to the management information system (MIS) for external physical check-up service. Use the steps of system development life cycle (SDLC) methodology to development the external physical check-up service.

1.3 Project Objective

Verify the Physical Health Check-Up Record System to development software. Use the management information system (MIS) for develop the Physical Health Check-Up Record System as well.

(a) To study the existing system which is based on manual procedure and identify problems and weakness of the manual system.

(b) To replace the existing Check-Up record for external system based manual procedure by use Data Base Management System to development.

(c) To purpose the Data Base Management System of Physical Health Check up Record System by using system analysis and design technique

1.4 Project Scope

For the area that we focus to study and develop is external services area. Now, Hospital has the external services for the Physical Check-Up. Some companies have the benefit for employees to check the health and contact hospital for external service.

(a) Verifies existing system of the Physical Health Check-Up Record System.

(b) Development software of the Physical Health Check-Up Record System.

(c) Recommendation the hardware and software.

(d) Limited to design of Physical Health Check-Up Record software, which does not include phase of implementation of system.

II. LITERATURE REVIEW

2.1 Overview

The scope of information systems today is the whole enterprise. Managers, knowledge workers, and all other organizational members expect to easily access and retrieve information, regardless of its location. Nonintegrated systems used in the past-often referred to as "islands of information" are being replaced with cooperative, integrated enterprise systems that can easily support information sharing. While the goal of building bridges between these "islands" will take some time to achieve, it represents a clear direction for information systems development. The uses of enterprise resource planning (ERP) systems like SAP R/3 (www.sap.com), PeopleSoft (www.peoplesoft.com), Oracle (www.oracle.com), and Baan (www.baan.com) have enabled the linking of these "islands" in many organizations. Additionally, as the use of the Internet continues to evolve to support business activities, system integration has become a paramount concern of organizations (Hasselbring 2000).

Obtaining integrated enterprise-wide computing presents significant challenges for both corporate and information systems management. For example, given the proliferation of personal and departmental computing wherein disparate systems and databases have been created, how can the organization possibly control and maintain all of these systems and data? In many cases they simply cannot because it is nearly impossible to track who has which systems and what data, where there are overlaps or inconsistencies, and how accurate the information. The reason that personal and departmental systems and databases abound is that users are either unaware of the information that exists in corporate databases or they cannot easily get at it, so they create and maintain their own information and systems. Intelligent identification and selection of system projects, for both new and replacement systems, are critical steps in gaining control of system and data. It is the hope of many chief information officers (CIOs) that with the advent of ERP systems, improved system integration, and the rapid deployment of corporate Internet solutions, these islands will be reduced or eliminated (Ross and Feeny 200).

2.2 Knowledge Base System

Businesses today are in a constant struggle to stay one step ahead of their competition. But in the current climate of cost cutting and downsizing, this quest often translates into doing more with less - a goal that, if not well-planned for, can exact a significant emotional toll on employees. There are two sides to every business, the technical and the behavioral. The ongoing whirlwind of change and adjustment that is taking place on the technical side of many organizations cannot help but impact the behavioral component. Unfortunately for employees, this fact is frequently ignored until it results in absenteeism, ineffectiveness, stress and discord among workers.

2.2.1 Physical Health Check-up

If you are overweight, you are more likely to develop health problems, such as heart disease, stroke, diabetes, certain types of cancer, gout (joint pain caused by excess uric acid), and gallbladder disease. Being overweight can also cause problems such as sleep apnea (interrupted breathing during sleep) and osteoarthritis (wearing away of the joints). The more overweight you are, the more likely you are to have health problems. Weight loss can help improve the harmful effects of being overweight. However, many overweight people have difficulty reaching their healthy body weight. Studies show that you can improve your health by losing as little as 10 to 20 pounds.

If you are a woman and your waist measures more than 35 inches, or if you are a man and your waist measures more than 40 inches, you are more likely to develop heart disease, high blood pressure, diabetes, and certain cancers. You may want to talk to your doctor or other health professional about the health risks of your weight.

Heart disease and stroke are the leading causes of death and disability for both men and women in the United States. Overweight people are more likely to have high blood pressure, a major risk factor for heart disease and stroke, than people who are not overweight. Very high blood levels of cholesterol and triglycerides (blood fats) can also lead to heart disease and often are linked to being overweight. Being overweight also contributes to angina (chest pain caused by decreased oxygen to the heart) and sudden death from heart disease or stroke without any signs or symptoms.

The good news is that losing a small amount of weight can reduce your chances of developing heart disease or a stroke. Reducing your weight by 10 percent can decrease your chance of developing heart disease by improving how your heart works, blood pressure, and levels of blood cholesterol and triglycerides.

Non-insulin-dependent diabetes mellitus (type 2 diabetes) is the most common type of diabetes in the United States. Type 2 diabetes reduces your body's ability to control your blood sugar. It is a major cause of early death, heart disease, kidney disease, stroke, and blindness. Overweight people are twice as likely to develop type two diabetes as people who are not overweight. You can reduce your risk of developing this type of diabetes by losing weight and by increasing your physical activity.

If you have type 2 diabetes, losing weight and becoming more physically active can help control your blood sugar levels. If you use medicine to control your blood sugar, weight loss and physical activity may make it possible for your doctor to decrease the amount of medication you need.

Cancer, Several types of cancer are associated with being overweight. In women, these include cancer of the uterus, gallbladder, cervix, ovary, breast, and colon.

Overweight men are at greater risk for developing cancer of the colon, rectum, and prostate. For some types of cancer, such as colon or breast, it is not clear whether the increased risk is due to the extra weight or to a high-fat and high-calorie diet.

Sleep Apnea, Sleep apnea is a serious condition that is closely associated with being overweight. Sleep apnea can cause a person to stop breathing for short periods during sleep and to snore heavily. Sleep apnea may cause daytime sleepiness and even heart failure. The risk for sleep apnea increases with higher body weights. Weight loss usually improves sleep apnea.

Osteoarthritis, Osteoarthritis is a common joint disorder that most often affects the joints in your knees, hips, and lowers back. Extra weight appears to increase the risk of osteoarthritis by placing extra pressure on these joints and wearing away the cartilage (tissue that cushions the joints) that normally protects them. Weight loss can decrease stress on the knees, hips, and lower back and may improve the symptoms of osteoarthritis.

Gout, Gout is a joint disease caused by high levels of uric acid in the blood. Uric acid sometimes forms into solid stone or crystal masses that become deposited in the joints. Gout is more common in overweight people and the risk of developing the disorder increases with higher body weights.

Note: Over the short term, some diets may lead to an attack of gout in people who have high levels of uric acid or who have had gout before. If you have a history of gout, check with your doctor or other health professional before trying to lose weight.

Gallbladder disease and gallstones are more common if you are overweight. Your risk of disease increases as your weight increases. It is not clear how being overweight may cause gallbladder disease. Weight loss itself, particularly rapid weight loss or loss of a large amount of weight, can actually increase your chances of developing gallstones. Modest, slow weight loss of about 1 pound a week is less likely to cause gallstones.

2.2.2 How Can Lower Your Health Risks

If you are overweight, losing as little as 5 to 10 percent of your body weight may improve many of the problems linked to being overweight, such as high blood pressure and diabetes. For example, if you weigh 200 pounds and are considered overweight on the weight-for-height chart, you would need to lose 10 to 20 pounds. Even a small weight loss can improve your health.

Slow and steady weight loss of no more than 1 pound per week is the safest way to lose weight. Very rapid weight loss can cause you to lose muscle rather than fat. It also increases your chances of developing other problems, such as gallstones, gout, and nutrient deficiencies. Making long-term changes in your eating and physical activity habits is the best way to lose weight and keep it off over time.

Eat Better: Whether you are trying to lose weight or maintain your weight, you should take a look at your eating habits and try to improve them. Try to eat a variety of foods, especially pasta, rice, bread, and other whole-grain foods. You should also eat plenty of fruits and vegetables. These foods will fill you up and are lower in calories than foods full of oils or fats. For more information on healthy eating, see the Nutrition and Your Health: Dietary Guidelines for Americans booklet that is available from the Weight-control Information Network (WIN).

Increase Physical Activity:

Making physical activity a part of your daily life is an important way to help control your weight and lower your risk for health problems. Spend less time in activities that use little energy like watching television and playing video games and more time in physical activities. Try to do at least 30 minutes of physical activity a day on most days of the week. The activity does not have to be done all at once. It can be done in short spurts--10 minutes here, 20 minutes there--as long as it adds up to 30 minutes a day. Simple ways to become more physically active include walking to the store or taking the stairs instead of the elevator. See Win's fact sheet Physical Activity and Weight Control for more information. If you are not overweight but health problems related to being overweight run in your family, it is important that you try to keep your weight steady. If you have family members with weight-related health problems, you are more likely to develop them yourself. If you are not sure of your risk of developing a weight-related health problem, you should talk to your health care provider.

2.3 A Database Management System (DBMS)

A computer system organizes data in a hierarchy that starts with bits and bytes and progresses to fields, records, files, and databases. A bit represents the smallest unit of data a computer can handle. A group of bits, called a byte represents a single character, which can be a letter, a number, or another symbol. A grouping of characters into a word, a group of words or a complete number (such as a person's name or age) is called a field. A group of related fields such as the student's name, the course taken, the date, and the grade comprise a record; a groups of records of the same type is called a file. A record describes an entity. An entity is a person, place, thing, or event on which we maintain information. Each characteristic or quality describing a particular entity is called an attribute. Every record in a file should contain at least one field that uniquely identifier field is called a key field. Most organizations began information processing on a small scale, automating one application at a time. As this process goes on for five or ten years, the firm becomes tied up in knots of its own creation. The organization is saddled with hundreds of programs and applications, with no one who knows what they do, what data they use, and who is using the data. There is no central listing of data files, data elements, or definitions of data. The organization is collecting the same information in far too many files. The resulting problems are data redundancy, program-data dependence, inflexibility, poor data security, and inability to share data among applications.

The database management system (DBMS) is simply the software that permits an organization to centralize: data manage them efficiently and provide access to the stored data by application programs. The DBMS acts as an interface between application programs and the physical data files. When the application program calls for a data item the DBMS finds this item in the database and presents it to the application program. Using traditional data files the programmer would have to define the data and then tell the computer where they are. A DBMS eliminates most of the data definition statements found in traditional programs.

The elements of a database management system has three components:

(1) A data definition language is the component of a database management system that defines each data element as it appears in the database.

(2) A data manipulation language is a language associated with a database management system that is employed by end users and programmers to manipulate data in the database.

(3) A data dictionary, This is an automated or manual file that stores definitions of data elements and data characteristics such as usage, physical representation, ownership, authorization, and security in a database.

In an ideal database environment, application programs work through a database management system to obtain data from the database. The above diagram illustrates a database management system with an active data dictionary that not only records definitions of the contents of the database but also allows changes in data size and format to be automatically utilized by the application programs.

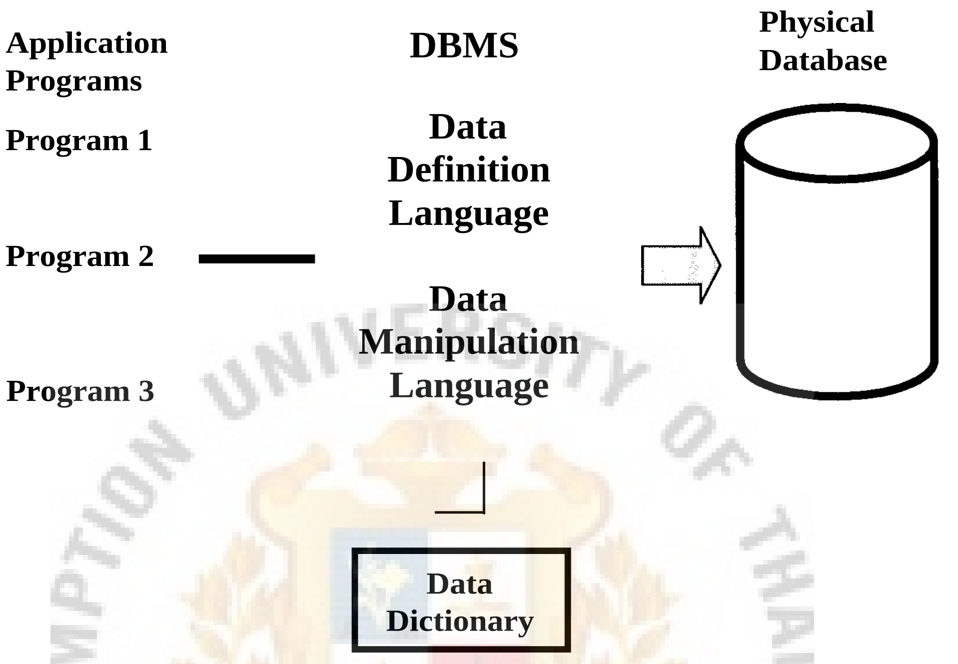

Figure 2.1. The Elements of Database Management System.

Advantages of database management systems.

(a) Central management of data, access, utilization, and security can reduce complexity of the organization's information system environment.

(b) Eliminating all isolated files in which the same data elements are repeated can reduce data redundancy and inconsistency.

(c) Providing central control of data creation and definitions can eliminate data confusion.

(d) Separating the logical view of data from its physical arrangement can reduce program data dependence.

(e) Program development and maintenance costs can be radically reduced.

(f) Flexibility of inforniation systems can be greatly enhanced by permitting rapid and inexpensive ad hoc queries of very large pools of information.

(g) Access and availability of information can be increased.

Given these benefits of DBMS, one might expect all organizations to change immediately to a database form of information management. But it is not that easy.

The three principal logical database models, there are alternative ways of organizing data and representing relationships among data in a database by using a principal logical database models for keeping track of entities, attributes, and relationships. There are three principal logical database models. There are hierarchical, network, and relational. Each has unique advantages and disadvantages. Hierarchical systems, which support one-to-many relationships, are low in flexibility but high in processing speed and efficiency. Network systems support many-to-many relationships. Relational systems are relatively slow but are very flexible for supporting ad hoc requests for information and for combining information from different sources. The choice depends on the business requirements.

Database trends, It is no longer necessary for data to be centralized in a single, massive database. A complete database or portions of the database can be distributed to more than one location to increase responsiveness and reduce vulnerability and costs. There are two major types of distributed databases duplicated databases and partitioned databases. Object-oriented, hypermedia, and multidimensional databases may be alternatives to traditional database structures for certain types of applications. Object-oriented and hypermedia databases can store graphics and other types of data in addition to conventional text data to support multimedia applications. Hypermedia databases allow data to be stored in nodes linked together in any pattern established by the user. A multidimensional view of data represents relationships among data as a multidimensional structure, which can be visualized as cubse of data and cubes within cubes of data, allowing for more sophisticated data analysis. Data can be more conveniently analyzed across the enterprise by using a data warehouse, in which current and historical data are extracted from many different operational systems and consolidated for management decision-making.

A data warehousing is a database with tools that stores current and historical data of potential to manage throughout the company. The data originate in many core operational systems and are copied into the data warehouse database as often as needed-hourly, daily, weekly, monthly. The data are standardized and consolidated so that they can be used across the enterprise for management analysis and decision making. The data are available for anyone to access as needed but cannot be altered. A data warehouse system includes a range of ad hoc and standardized query tools, analytical tools, and graphical reporting facilities. These systems can perform high-level analysis of patterns or trends, but they can also drill into more detail where needed.

The principal elements in a database environment, without management support and understanding, database efforts fail. The critical elements in a database environment are data administration, data planning and modeling methodology, database technology and management, and users.

(1) Data administration that is a special organizational function for managing the organization's data resource concerned with information policy, data planning, maintenance of data dictionaries, and data quality standards.

(2) Data planning and modeling methodology because the organizational interests served by the DBMS are much broader than those in the traditional file environment. The organization requires enterprise wide planning for data. Enterprise analysis, which addresses the information requirements of

the entire organization (as opposed to the requirements of individual applications), is needed to develop databases.

(3) Database Technology and management Databases require new software and a new staff specially trained in DBMS techniques as well as new management structures. Most corporations develop a database design and management group within the corporate information system division that is responsible for the more technical and operational aspects of managing data. The functions it performs are called database administration.

(4) Users A database serves a wider community of users than traditional systems. Relational systems with fourth generation query languages permit employees who are not computer specialists to access large databases.

Database administration is a special organizational function for managing the organization's data resources concerned with information policy, data planning, maintenance of data dictionaries, and data quality standards. Data administration is responsible for the specific policies and procedures through with data can be managed as an organizational resource. These responsibilities include developing information policy planning for data overseeing logical database design and data dictionary development and monitoring the usage of data by information system specialists and end-user groups. The fundamental principle of data administration is that all data are the property of the organization as a whole. Data cannot belong exclusively to any one business area or organizational unit.

2.4 System Development Life Cycle

The scope of information systems today is the whole enterprise. Managers, knowledge workers, and all other organizational members expect to easily access and retrieve information, regardless of its location. Nonintegrated systems used in the past- often referred to as "islands of information" are being replaced with cooperative, integrated enterprise systems that can easily support information sharing. While the goal of building bridges between these "islands" will take some time to achieve, it represents a clear direction for information systems development. The use of enterprise resource planning (ERP) systems like SAP R/3, People Soft, and Oracle have enabled the linking of these "islands" in many organizations. Additionally, as the use of the Internet continues to evolve to support business activities, system integration has become a paramount concern of organizations (Hasselbring 2000).

Obtaining integrated enterprise-wide computing presents significant challenges for both corporate and info illation systems management. For example, given the proliferation of personal and departmental computing wherein disparate systems and databases have been created, how can the organization possibly control and maintain all of these systems and data? In many cases they simply cannot because it is nearly impossible to track who has which systems and what data, where there are overlaps or inconsistencies, and how accurate the information is. The reason that personal and departmental systems and databases abound is that users are either unaware of the information that exists in corporate databases or they cannot easily get at it, so they create and maintain their own information and systems Intelligent identification and selection of system projects, for both new and replacement systems, are critical steps in gaining control of systems and data. It is the hope of many chief information officers (CIOs) that with the advent of ERP systems, improved system integration, and the rapid deployment of corporate Internet solutions, these islands will be reduced or eliminated (Ross and Feeny 2000).

2.4.1 Identifying and Selecting Systems Development Projects

The first phase of the SDLC is project identification and selection. During this activity, a senior manager, a business group, an IS manager, or a steering committee identify and assess all possible systems development projects that an organization unit could undertake. Next, those projects deemed most likely to yield significant organizational benefits, given available resources, are selected for subsequent development activities. Organizations vary in their approach to identifying and selecting projects. In some organizations, project identification and selection is a very formal process in which projects are outcomes of a larger overall planning process. For example, a large organization may follow a formal project identification process whereby a proposed project is rigorously compared to all competing projects. Alternatively, a small organization may use informal project selection processes that allow the highest-ranking IS manager to independently select project or allow individual business units to decide on projects after agreeing to provide project funding.

There is variety of sources for information systems development requests. One source is requests by managers and business units for replacing or extending an existing system to gain needed information or to provide a new service to customers. Another source for requests is IS managers who want to make a system more efficient, less costly to operate, or want to move it to a new operating environment. A final source of projects is a formal planning group that identifies projects for improvement to help the organization meet its corporate objectives (for example, a new system to provide better customer service). Regardless of how a given organization actually executes the project identification and selection process, there is a common sequence of activities that occurs. In the following sections, we describe a general process for identifying and selecting projects and producing the deliverables and outcomes of this process.

The Process of Identifying and Selecting IS Development Projects

As shown in Figure 2.2, project identification and selection consists of three primary activities:

(1) Identifying Potential Development Projects.

Organizations vary as to how they identify projects. This process can be performed by:

(a) A key member of top management, either the CEO of a small-or medium sized organization or a senior executive in a larger organization.

(b) A steering committee composed of a cross section of managers with an interest in systems.

(c) User departments, in which either the head of the requesting unit of a committee from the requesting department decides which projects to submit (often you, as a systems analyst, will help users prepare such requests).

(d) The development group or a senior IS manager.

All methods of identification have been found to have strengths and weaknesses. Research has found, for example, that projects identified by top management more often have a strategic organizational focus. Alternatively, projects identified by steering committees more often reflect the diversity of the committee and therefore have a cross-functional focus. Projects identified by individual departments or business units most often have a narrow, tactical focus. Finally, a dominant characteristic of projects identified by the development group is the ease with which existing hardware and systems will integrate with the proposed project. Other factors, such as project cost, duration, complexity, and risk, are also influenced by the source of a given project. In addition to who makes the decision, characteristics specific to the organization such as the level of firm diversification, level of vertical integration, or extent of growth opportunities can also influence any investment or project selection decision (Dewan, Michael, and Min 1998).

Of all the possible project sources, those identified by top management and steering committees most often reflect the broader needs of the organization.

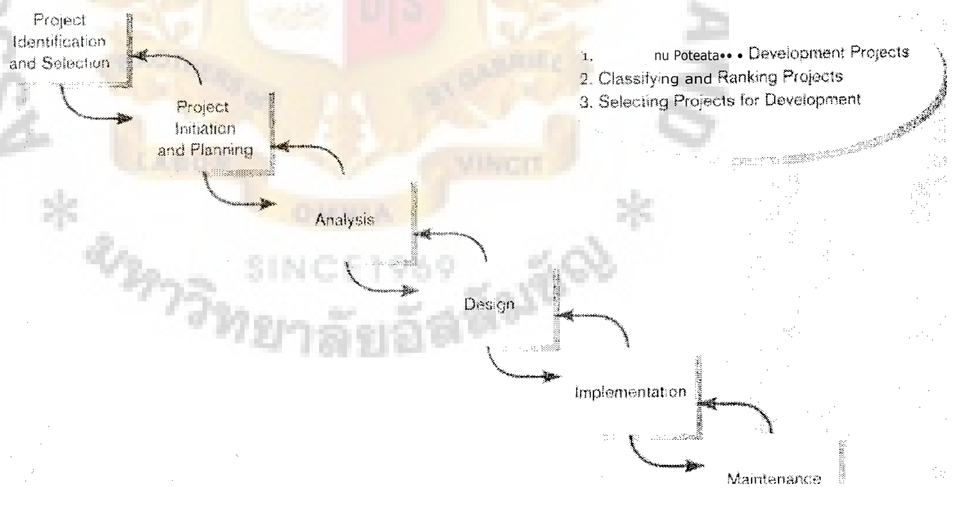

Figure 2.2. SDLC with Project Identification and Selection Highlighted.

This occurs because top management and steering committees are likely to have a broader understanding of overall business objectives and constraints. Projects identified by top management or by a diverse steering committee are therefore referred to as coming from a top-down source.

Projects identified by functional manager, business unit, or by the information system development group are often designed for a particular business need within a given business unit. In other words, these projects may not reflect the overall objectives of the organization. This does not mean that projects identified by individual managers, business units, or the IS development group are deficient, only that they may not consider broader organizational issues. Project initiatives stemming from managers, business units, or the development group are generally referred to as coming from a bottom-up source. These are the types of projects in which you, as a systems analyst, will have the earliest role in the life cycle as part of your ongoing support of users. You will help user managers provide the description of information needs and the reasons for doing the project that will be evaluated in selecting, among all submitted projects, which ones will be approved to move into the project initiation and planning phase of the SDLC.

In sum, projects are identified by both top-down and bottom-up initiatives. The formality of the process of identifying and selecting projects can vary substantially across organizations. Also, since limited resources preclude the development of all proposed systems, most organization has some process of classifying and ranking the merit of each project. Those projects deemed to be inconsistent with overall organizational objectives, redundant in functionality to some existing system or unnecessary would thus be removed from consideration. This topic is discussed next.

(2) Classifying and Ranking IS Development Projects.

The second major activity in the project identification and selection process focuses on assessing the relative merit of potential projects. As with the project identification process, classifying and ranking projects can be performed by top managers, a steering committee, business units, or the IS development group. Additionally, the criteria used when assigning the relative merit of a given project can vary. In any given organization, one or several criteria might be used during the classifying and ranking process.

As with the project identification and selection process, the actual criteria used to assess projects will vary by organization. If, for example, an organization uses a steering committee, it may choose to meet monthly or quarterly to review projects and use a wide variety of evaluation criteria. At these meetings, new project requests will be reviewed relative to projects already identified, and ongoing projects are monitored. The relative ratings of projects are used to guide the final activity of this identification process project selection.

An important project evaluation method that is widely used for assessing information systems development projects is called value chain analysis (Porter, 1985; Shank and Govindarajan, 1993). Value chain analysis is the process of analyzing an organization's activities for making products and / or services to determine where value is added and costs are incurred. Once an organization gains a clear understanding of its value chain, improvements in the organization's operations and performance can be achieved. Information systems projects providing the greatest benefit to the value chain will be given priority over those with fewer benefits. As you might have guessed, information systems have become one of the primary ways for organizations to make changes and improvements in their value chains. Many organizations, for example, are using the Internet to exchange important business information with suppliers and customers such as orders, invoices, and receipts. To conduct a value chain analysis for an organization, think about an organization as a big input/ output process (see Figure 2.3). At one end are the inputs to the organization. For example, supplies that are purchased supplies that are purchased. Within the organizations, those supplies and resources are integrated in some way to produce products and services.

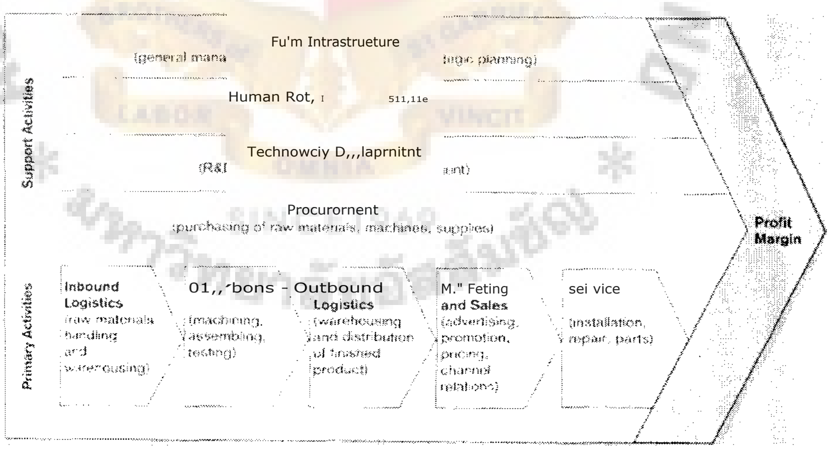

Figure 2.3. Organization Value Chain.

At the other end are the outputs, which represent the products and services that are marketed, sold and then distributed to customers. In value chain analysis, you must first understand each activity, function, and process where value is or should be added. Next, determine the costs (and the factors that drive costs or cause them to fluctuate) within each of the areas. After understanding your value chain and costs, you can benchmark (compare) your value chain and associated costs with those of other organizations, preferably your competitors. By making these comparisons, you can identify priorities for applying information systems projects.

Selecting IS Development Projects.

The final activity in the project identification and selection process is the actual selection of projects for further development. Project selection is a process of considering both short-and long-term projects and selecting those most likely to achieve business objectives. Additionally, as business conditions change over time, the relative importance of any single project may substantially change. Thus, the identification and selection of projects is a very important and ongoing activity.

Numerous factors must be considered when making project selection decisions. Figure 2.4 shows that a selection decision requires that the perceived needs of the organization, existing systems and ongoing projects, resource availability, evaluation criteria, current business conditions, and the perspectives of the decision makers will all play a role in project selection decisions. Numerous outcomes can occur from this decision process. Of course, projects can be accepted or rejected. Acceptance of a project usually means that funding to conduct the next phase of the SDLC has been approved. Rejection means that the project will no longer be considered for development. However, projects may also be conditionally accepted;

projects may be accepted pending the approval or availability of needed resources or the demonstration that a particularly difficult aspect of the system can be developed. Projects may also be returned to the original requesters who are told to develop or purchase the requested system themselves. Finally, the requesters of a project may be asked to modify and resubmit their request after making suggested changes or clarifications.

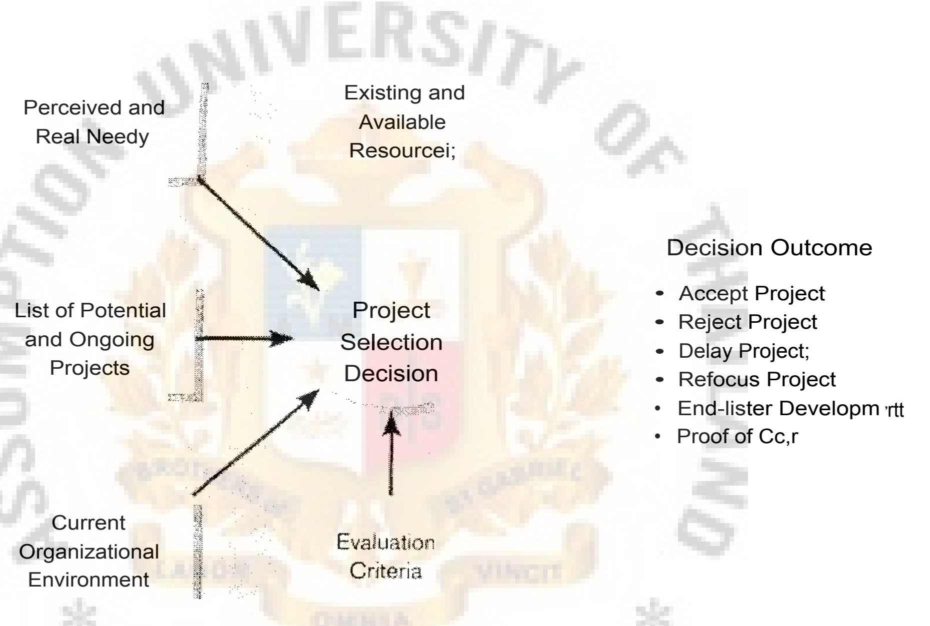

Figure 2.4. Project Selection Decisions Must Consider Numerous Factors and Can Have Numerous Outcomes.

Deliverables and Outcomes, The primary deliverable from the first SDLC phase is a schedule of specific IS development projects, coming from both top-down and bottom-up sources, to move into the next SDLC phase-project initiation and planning (see Figure 2.6). An outcome of this phase is the assurance that careful consideration was given to project selection, with a clear understanding of how each project can help the organization reach its objectives. Due to the principle of *incremental commitment,* a selected project does not necessarily result in a working system. After each subsequent SDLC phase, you, other members of the project team, and organizational officials will reassess your project to determine whether the business conditions have changed or whether a more detailed understanding of a system's costs, benefits, and risks would suggest that the project is not as worthy as previously thought.

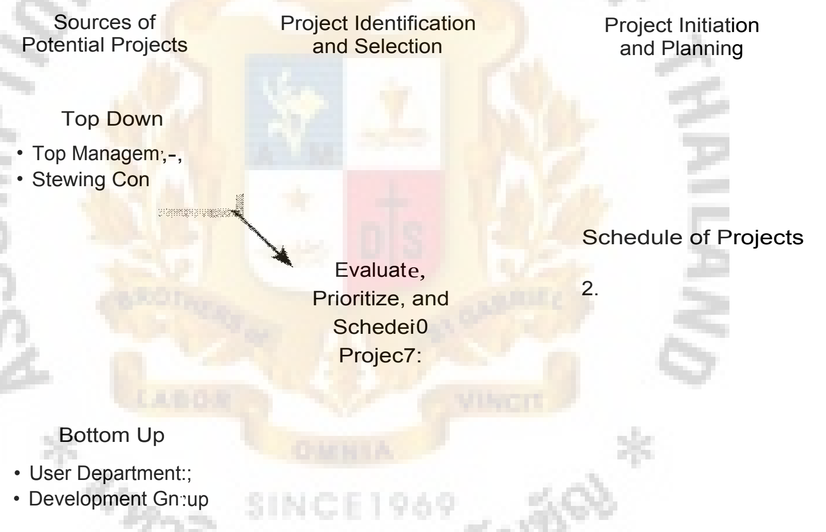

Figure 2.5. Information System Development Project Come from Both Top-Down and Bottom-Up Initiatives.

Many organizations have found that in order to make good project selection decisions and to provide sound guidance as issues arise in your work as a systems analyst on a project, a clear understanding of overall organizational business strategy and objectives is required. This means that a clear understanding of the business and the desired role of information systems in achieving organizational goals are precondition to improving the identification and selection process. In the next section we provide a brief overview of the process many organizations follow, involving corporate strategic planning and information systems planning, when setting their business strategy and objectives and when defining the role of information systems in their plans.

2.4.2 Initiating and Planning Systems

The first phase of the systems development life cycle is project identification and selection, during which the need for a new or enhanced system is recognized. This first life cycle phase does not deal with a specific project but rather identifies the portfolio of projects to be undertaken by the organization. Thus, project identification and selection is a pre-project may come as part of a larger planning process, information systems planning, or from requests from managers and business units. Regardless of how a project is identified and selected, the next step is to conduct a more detailed assessment of one particular project selected during the first phase. This assessment does not focus on how the proposed system will operate but rather on understanding the scope of a proposed project and its feasibility of completion given the available resources. It is crucial that organizations understand whether resources should be devoted to a project, otherwise very expensive mistakes can be made. The focus of this chapter is on this process. In other words, project initiation and planning is where projects are accepted for development, rejected, or redirected. This is also where you, as systems analyst, begin to play a major role in the systems development process.

In the next section, the project initiation and planning process is briefly reviewed. Next, numerous techniques for assessing project feasibility are described. The information uncovered during feasibility analysis is organized into a document called a

Baseline Project Plan. Once this plan is developed, a formal review of the project can be conducted. The process of building this plan is discussed next. Yet, before the project can evolve to the next phase of the systems development life cycle-analysis the project plan must be reviewed and accepted. In the final major section of the chapter, we provide an overview of the project review process.

(1) Initiating and Planning Systems

A key consideration when conducting project initiation and planning (PIP) is deciding when PIP ends and when analysis, the next phase of the SDLC, begins. This is a concern since many activities performed during PIP could also be completed during analysis. Pressman (2001) speaks of three important questions that must be considered when making this decision on the division between PIP and analysis.

(a) How much effort should be expended on the project initiation and planning process?

(b) Who is responsible for performing the project initiation and planning process?

(c) Why is project initiation and planning such a challenging activity?

Finding and answer to the first question, how much effort should be expended on the PIP process, is often difficult. Practical experience has found, however, that the time and effort spent on initiation and planning activities easily pay for them selves later in the project. Proper and insightful project planning, including determining project scope as well as identifying project activities, can easily reduce time in later project phases. For example, a careful feasibility analysis that leads to deciding that a project is not worth pursuing can save a considerable expenditure of resources. The actual amount of time expended will be affected by the size and complexity of the project as well as by the experience of your organization in building similar systems. A rule of thumb is that between 10 and 20 percent of the entire development effort should be expended on the PIP study. Thus, you should not be reluctant to spend considerable time in PIP in order to fully understand the motivation for the requested system.

For the second question, who is responsible for performing the PIP, most organizations assign an experienced systems analyst, or team of analysts for large projects, to perform PIP. The analyst will work with the proposed customers (managers and users) of the system and other technical development staff in preparing the final plan. Experienced analysts working with customers who well understand their information services needs should be able to perform PIP without the detailed analysis typical of the analysis phase of the life cycle. Less experienced analysts with customers who only vaguely understand their needs will likely expend more effort during PIP in order to be certain that the project scope and work plan are feasible.

Third, the project initiation and planning process is viewed as a challenging activity because the objective of the PIP study is to transform a vague system request document into a tangible project description. This is an open-ended process. The analysis must clearly understand the motivation for and objectives of the proposed system. Therefore, effective communication among the systems analyst, users, and management is crucial to the creation of a meaningful project plan. Getting all parties to agree on the direction of a project may be difficult for cross-department projects when different parties have different business objectives. Thus, more complex organizational settings for projects will result in more time required for analysis of the current and proposed systems during PIP.

(2) The Process of Initiating and Planning IS Development Projects

As its name implies, two major activities occur during the second phase of the SDLC, project initiation and planning (Figure 2.6). Project initiation focuses on activities designed to assist in organizing a team to conduct project planning. During initiation, one or more analysis are assigned to work with a customer that is, a member of the business group that requested or will be impacted by the project to establish work standards and communication procedures. Depending upon the size, scope, and complexity of the project, some project initiation activities may be unnecessary or may be very involved. Also many organizations have established procedures for assisting with common initiation activities. Project planning, the second activity within PIP, is distinct from general information systems planning, which focuses on assessing the information system needs of the entire organization. Project planning is the process of defining clear, discrete activities and the work needed to complete each activity with a single project. The objective of the project planning process is the development of a Baseline Project Plan (BPP) and the Statement of Work (SOW). The BPP becomes the foundation for the remainder of the development project. The SOW produced by the team clearly outlines the objectives and constraints of the project for the customer. As with the project initiation process, the size, scope, and complexity of a project will dictate the comprehensiveness of the project planning process and result documents. Further, numerous assumptions about resource availability and potential problems will have to be made. Analysis of these assumptions and system costs and benefits forms business case.

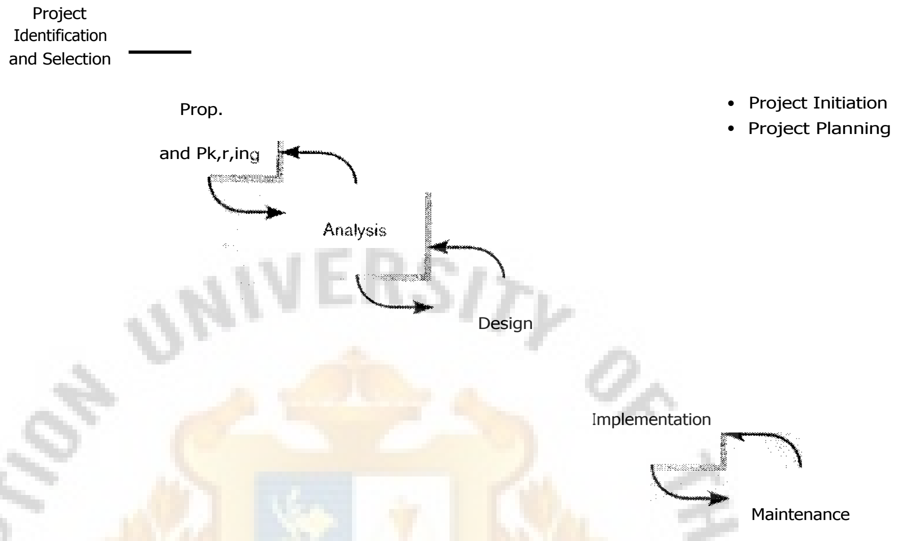

Figure 2.6. SDLC with Project Initiation and Planning Highlighted.

2.4.3 Determining System Requirements

System analysis is the part of the systems development life cycle (SDLC) in which you deteimine how the current information system functions and assess what users would like to see in a new system. There are three sub-phases in analysis: requirement determination, requirements structuring, and alternative generation and choice.

Techniques used in requirements determination have evolved over time to become more structured and, as we will see in this chapter, current methods increasingly rely on the computer for support. We will first study the more traditional requirement determination methods including interviewing, using questionnaires, observing users in their work environment, and collecting procedures and other written documents. We will then discuss modern methods for collecting system requirements.

(1) Determining System Requirements.

As stated earlier and shown in Figure 2.7, there are three sub-phases to systems analysis: requirement determination, requirements structuring, and generating alternative system design strategies and selecting the best one. We will address these as three separate steps, but you should consider these steps as somewhat parallel and iterative

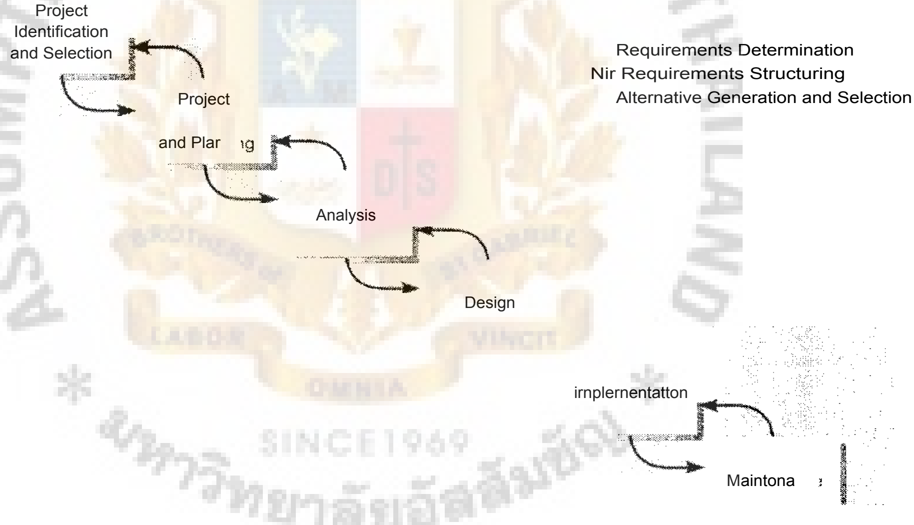

Figure 2.7. SDLC with Analysis Phase Highlighted.

For example, as you determine some aspects of the current and desired system(s), you begin to structure these requirements or to build prototypes to show users how a system might behave. Inconsistencies and deficiencies discovered through structuring and prototyping lead you to explore further the operation of current system(s) and the future needs of the organization.

Eventually your ideas and discoveries converge on a thorough and accurate depiction of current operations and what the requirements are for the new system. As you think about beginning the analysis phase, you probably wonder what exactly is involved in requirement determination. We discuss this process in the next section.

(2) The Process of Determining Requirements

Once management has granted permission to pursue development of a new system (this was done at the end of the project identification and selection phase of the SDLC) and a project is initiated and planned, you begin determining what the new system should do. During requirements determination, you and other analysis gather information on what the system should do from as many sources as possible: from users of the current system, from observing users, and from reports, forms, and procedures. All of the system requirements are carefully documented and made ready for structuring.

In many ways gathering system requirements is like conducting any investigation. Have you read any of the Sherlock Holmes or similar mystery stories? Do you enjoy solving puzzles? From these experiences, we can detect some similar characteristics for a good systems analyst during the requirement determination supplies. These characteristics include

(a) Impertinence. You should question everything. You need to ask such questions as: are all transactions processed the same way? Could anyone be charged something other than the standard price? Might we someday want to allow and encourage employees to work for more than one department?

(b) Impartiality: Your role is to find the best solution to a business problem or opportunity. It is not, for example, to find a way to justify the purchase of new hardware or to insist on incorporation what users think they want into the new system requirements. You must consider issues raised by all parties and try to find the best organizational solution.

(c) Relax constraints: Assume anything is possible and eliminate the infeasible. For example, do not accept this statement: "We've always done it that way, so we have to continue the practice." Traditions are different from rules and policies. Traditions probably started for a good reason but, as the organization and its environment change, traditions may turn into habits rather than sensible procedures.

(d) Attention to details: Every fact must fit with every other fact. One element out of place means that the ultimate system will fail at some time. For example, an imprecise definition of who a customer is may mean that you purge customer data when a customer has no active orders; yet these past customers may be vital contacts for future sales.

(e) Reforming: Analysis is, in part, a creative process. You must challenge yourself to look at the organization in new ways. You must consider how each user views his or her requirements. You must be careful not to jump to this conclusion: "I worked on a system like that once this new system must work the same way as the one I built before.

2.4.4 Structuring System Requirements

In this part, our focus will be on one tool used to coherently represent the information gathered as part of requirement determination the data flow diagrams. Data flow diagrams allow you to model how data flow through an information system, the relationships among the data flows, and how come to be stored at specific locations. Data flow diagrams also show the processes that change or transform data. Because data flow diagrams concentrate on the movement of data between processes, these diagrams are called process models.

As the name indicates, a data flow diagram is a graphical tool that allows analysis (and users, for that matter) to depict the flow of data in an information system. The system can be physical or logical, manual or computer-based. In this chapter, you will learn the basic mechanics of drawing and revising data flow diagrams and you will learn the basic symbols and a set of rules for drawing them. You will learn about what to do and what not to do when drawing data flow diagrams. You will learn two important concepts related to data flow diagrams: balancing and decomposition. You will also learn the differences between four different types of data flow diagrams: current physical, current logical, new logical and new physical. Toward the end of the part, you will learn how to use data flow diagrams as part of the analysis of an information system and as a tool for supporting business process reengineering. You will learn about two other tools available for process modeling: Oracle's process modeling tool, and functional hierarchy diagrams. Finally, you will learn how process modeling is also important for the analysis of Internet-based systems.

(1) Process Modeling

Process modeling involves graphically representing the functions, or processes, which capture, manipulate, store, and distribute data between a system and its environment and between components within a system. A common form of a process model is a data flow diagram. Over the years, several different tools have been developed for process modeling. In this part, we focus on data flow diagrams, the traditional process modeling technique of structured analysis and design and the technique most often used today for process modeling.

Data flow diagramming is one of several notations that are called structured analysis techniques. Although not all organizations use each structured analysis technique, collectively techniques like data flow diagrams have had a significant impact on the quality of the systems development process. For example, Raytheon (Gibbs, 1994) has reported a saving s from 1988 through 1994 of $17.2 million in software costs by applying structured analysis techniques, due mainly to avoiding rework to fix requirements flaws, This represents a doubling of systems developers' productivity and helped them avoid costly system mistakes.

(2) Modeling a System's Process

As Figure 2.8 shows, there are three sub-phases of the analysis phase of the systems development life cycle: requirement detennination, requirements structuring, and generating alternative systems and selecting the best one. The analysis team enters requirements structuring with and abundance of information gathered during requirement determination. During requirements structuring, you and the other team members must organize the information into a meaningful representation of the information system that exists and of the requirements desired in a replacement system.

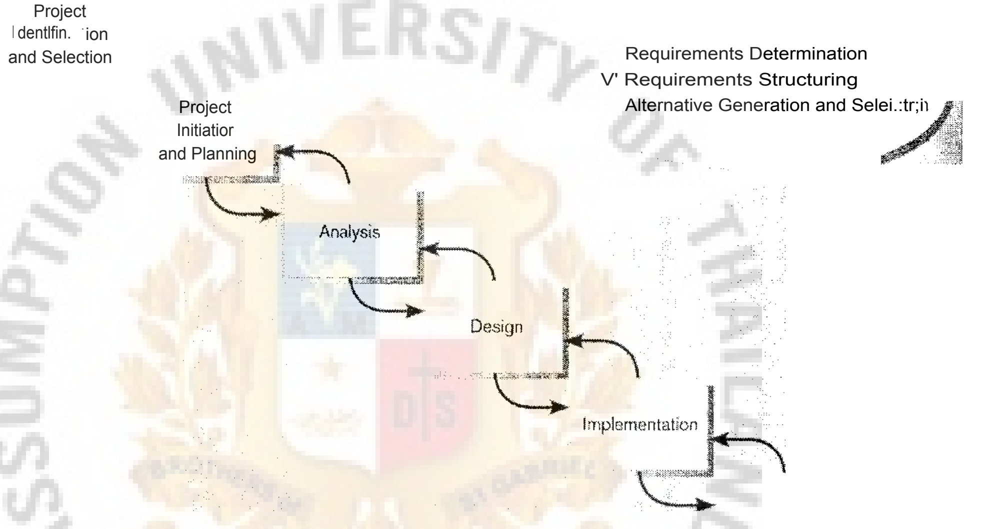

Figure 2.8. SDLC with Analysis Phase Highlighted (Requirements Structuring).

In addition to modeling the processing elements of an information system and how data are transformed in the system, you must also model the processing logic and the timing of events in the system and the structure of data with in the system.

Thus, a process model is only one of three major complementary views of an information system. Together, process, logic and timing, and data models provide a thorough specification of an information system and, with the proper supporting tools, also provide the basis for the automatic generation of many working information system components.

Data Flow Diagramming Mechanics

Data flow diagrams are versatile diagramming tools. With only four symbols, you can use data flow diagrams to represent both physical and logical information systems. Data flow diagrams (DI›lls) are not as good as flowcharts for depicting the details of physical systems; on the other hand, flowcharts are not very useful for depicting purely logical information flows. In fact, flowchart has been criticize by proponents of structured analysis and structured design because it is too physically oriented. Flowcharting symbols primarily represent physical computing equipment, such as punch cards, terminals and tape reels. One continual criticism of system flowcharts has been that reliance on them tends to result in premature physical system design. Consistent with the incremental commitment philosophy of the SDLC, you should wait to make technology choices and to decide on physical characteristics of an information system until you are sure all functional requirements are right and accepted by users and other stakeholders.

DFDs do not share this problem of premature physical design because they do not rely on any symbols to represent specific physical computing equipment. They are also easier to use than flow charts as they involve only four different symbols.

(4) Definitions and Symbols

There are two different standard sets of data flow diagram symbols, but each set consists of four symbols that represent the same things: data flows, data stores, processes, and sources/sinks (or external entities). Gane and Sarson (1979) devised the set of symbols we will use in this book. DeMarco and Yourdon developed the other standard set.

A data flow can be best understood as data in motion, moving from one place in a system to another. A data flow could represent data on a customer order form or a payroll check. A data flow could represent the results of a query to a database, the contents of a printed report, or data entry computer display form. A data flow is data that move together. Thus, a data flow can be composed of many individual pieces of data that are generated at the same time and flow together to common destinations. A data store is data at rest. A data store may represent one of many different physical locations for data, for example, a file folder, one or more computer-based file (s), or a notebook. To understand data movement and handling in a system, the physical configuration is not really important. A data store might contain data about customers, students, customer orders, or supplier invoices. A process is the work or actions performed on data so that they are transformed, stored, or distributed. When modeling the data processing of a system, it doesn't matter whether a process is performed manually or by a computer. Finally, a source/sink is the origin and/or destination of the data. Source/sinks are sometimes referred to as external entities because they are outside the system. Once processed, data or information leave the system and go to some other place. Since sources and sinks are outside the system we are studying, there are many characteristics of sources and sinks that are of no interest to us. In particular, we do not consider the following:

(a) Interactions that occur between sources and sinks.

(b) What a source or sink does with information or how it operates (that is, a source or sink is a "black box").

(c) How to control or redesign a source or sink since, from the perspective of the system we are studying, the data a sink receives and often what data a source provides are fixed.

(d) How to provide sources and sinks direct access to stored data since, as external agents, they cannot directly access or manipulate data stored within the system; that is, processes within the system must receive or distribute data between the system and its environment.

The symbols for each set of DFD conventions are presented in Figure 2.9. For both conventions, a data flow is depicted as an arrow. The arrow is labeled with a meaningful name for the data in motion; for example, customer order, sales receipt, or paycheck. The name represents the aggregation of all the individual elements of data moving as part of one packet, that is, all the data moving together at the same time. A square is used in both conventions for sources/sinks and has a name that states what the external agent is, such as customer, teller, EPA office, or inventory control system. The Gane& Sarson symbols for process are rectangle with tounded corner; it is a circle for Demarco & Yourdon. The Gane & Sarson rounded rectangle has a line drawn through the top. The upper portion is used to indicate the number of the process. Inside the lower portion is a name for the processes, such as generate paycheck, calculate overtime pay, or compute grade point average. The Gane & S arson symbol for a data store is a rectangle that is missing its right vertical side. At the left end is a small box used to number the data store and inside the main part of the rectangle is a meaningful label for the data store, such as student file, transcripts, or roster of classes.

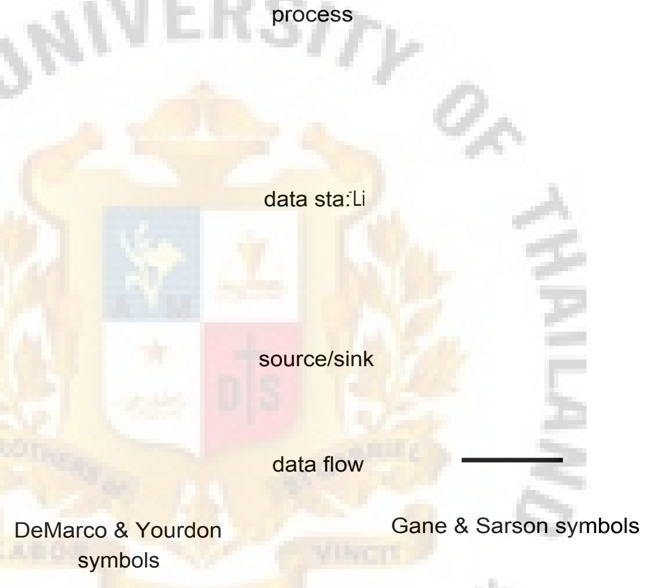

Figure 2.9. Comparison of DeMarco & Yourdon and Gane & Saron Data Flow Diagram (DFD) Symbol Set.

The DeMarco data store symbol consists of two parallel lines, which may be depicted horizontally or vertically.

As stated earlier, sources/sinks are always outside the information system and define the boundaries of the system. Data must originate outside a system from one or more sources and the system must produce information to one or more sinks (these are principles of open systems, and almost every information system is and example of an open system). If any data processing takes place outside of the system we are diagramming. A source/sink might consist of the following:

(a) Another organization or organization unit that sends data to or receives information from the system you are analyzing (for example, a supplier or an academic department in either case, this organization is external to the system you are studying).

(b) A person inside or outside the business unit supported by the system you are analyzing and who interacts with the system (for example, a customer or loan officer).

(c) Another information system with which the system you are analyzing exchanges infotIlation.

2.4.5 Structuring System Requirements

In this part, you learned how the processes that convert data to information are key parts of information systems. As good as data flow diagrams are for identifying processes, they are not very good at showing the logic inside the processes. Even the processes on the primitive-level data flow diagrams do not show the most fundamental processing steps. Just what occurs within a process? How are the input data converted to the output information? Since data flow diagrams are not really designed to show the detailed logic of processes, you must model process logic using other techniques. This chapter is about the techniques you use for modeling process decision logic.

First you will be introduced to Structured English, a modified version of the English language that is useful for representing the logic in information system processes. You can use Structured English to represent all three of the fundamental statements necessary for structured programming: choice, repetition, and sequence.

Second, you will learn about decision tables. Decision tables allow you to represent a set of conditions and the actions that follow from them in a tabular format. When there are several conditions and several possible actions that can occur, decision tables can help you keep track of the possibilities in a clear and concise manner.

Third, you will also learn how to model the logic of choice statements using decision tree. Decision trees model the same elements as a decision table but in a more graphical manner.

Fourth, you will have to decide when to use Structured English, decision tables, and decision trees. In the chapter, you will learn about the criteria that you can use to make a choice among these three logic-modeling techniques.

Fifth, you will see how logic modeling techniques can also be used for Internet applications.

(1) Logic Modeling

In this part, you learned how the requirements for an information system are collected. Analysis structures the requirement information into data flow diagrams that model the flow of data into and through the information system. Data flow diagrams, though versatile and powerful techniques are not adequate for modeling all of the complexity of an information system. Although decomposition allows you to represent a data flow diagram's processes at finer and finer levels of detail, the process names themselves cannot adequately represent what a process does and how it does it. For that reason, you must represent the logic contained in the process symbols on D1-Ds with other modeling techniques.

Logic modeling involves representing the internal structure and functionality of the processes represented on data flow diagrams.

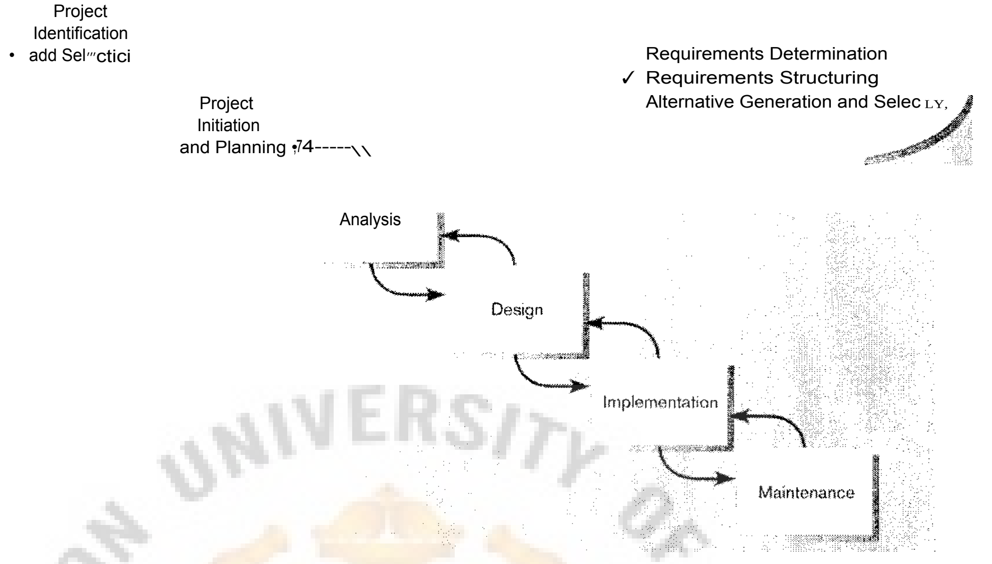

Figure 2.10. SDLC with the Analysis Phase Highlighted (Requirements structuring).

These processes appear on DFDs as little more than black boxes, in that we cannot tell from only their names or CASE repository descriptions precisely what they do and how they do it.

Yet the structure and functionality of a system's processes are a key element of any information system Processes must be clearly described before they can be translated into a programming language. In this chapter, we will focus on techniques you can use during the analysis phase to model the logic within processes; that is, data-to-information transformations and decisions. In the analysis phase, logic modeling will be complete and reasonably detailed, but it will also be generic in that it will not reflect the structure or syntax of a particular programming language. You will focus on more precise, language-based logic modeling in the design phase of the life cycle.

(2) Modeling a System's Logic

The three sub-phases to systems analysis are requirements determination, requirements structuring, and generating alternative systems and selecting the best one (Figure 2.10). Modeling a system's logic is part of requirements structuring, just as was representing the system with data flow diagrams. Here our focus is on the processes pictured on the data flow diagrams and the logic contained within each. You can also use logic modeling to indicate when processes on a D1-4D occur (for example, when a process extracts a certain data flow from a given data store). Just as we use logic modeling to represent the logic contained in a data flow diagram's processes, we will use data modeling to represent the contents and structure of a data flow diagram's data flows and data stores.

2.4.6 Designing Data-Bases

In this part, learned how to represent an organization's data graphically using an entity-relationship (E-R) diagram. Learn guidelines for well-structured and efficient database files and about logical and physical database design. It is likely that the human interface and database design steps will happen in parallel, as illustrated in the SDLC in Figure 2.11.

Database design has five purposes:

(a) Structure the data in stable structures, called normalized tables, that are not likely to change over time and that have minimal redundancy.

(b) Develop a logical database design that reflects the actual data requirements that exist in the forms (hard copy and computer displays) and reports of and information system. This is why database design is often done in parallel with the design of the human interface of an information system.

(c) Develop a logical database design from which we can do physical database design. Because most infoiniation systems today use relational database management systems, logical database design usually uses a relational database model, which represents data in simple tables with common columns to link related tables.

(d) Translate a relational database model into a technical file and database design that balances several performance factors.

(e) Choose data storage technologies (such as floppy disk, CD-ROM, or optical disk) that will efficiently, accurately, and securely process database activities.

The implementation of a database (i.e., creating and loading data into files and databases) is done during the next phase of the systems development life cycle.

(1) Data Base Design

File and database design occurs in two steps. You begin by developing a logical database model, which describes data using a notation that corresponds to a data organization used by a database management system. This is the system software responsible for storing, retrieving, and protecting data (such as Microsoft Access, Oracle, or SQL Server). The most common style for a logical database model is the relational database model. Once you develop a clear and precise logical database model, you are ready to prescribe the technical specifications for computer files and databases in which to store the data ultimately. A physical database design provides these specifications.

You typically do logical and physical database design in parallel with other systems design steps. Thus, you collect the detailed specifications of data necessary for logical database design as you design system inputs and outputs. Logical database design is driven not only from the previously developed E-R data model for the application but also from form and report layouts. You study data elements on these system inputs and outputs and identify interrelationships among the data. As with conceptual data modeling, the work of all systems development team members is coordinated and shared through the project dictionary or repository. The designs for logical databases and system inputs and outputs are then used in physical design activities to specify to the computer programmers, database administrations, network managers, and others how to implement the new information system. We assume for this text that the design of computer programs and distributed information processing and data networks are topics of other courses, so we concentrate on the aspect of physical design most often undertaken by a systems analyst physical file and data base design.

(2) The Process of Database Design

Figure 2.12 shown that database modeling and design activities occur in all phases of the systems development process. In this chapter we discuss methods that help you finalize logical and physical database designs during the design phase. In logical database design you use a process called normalization, which is a way to build a data model that has the properties of simplicity, non-redundancy, and minimal maintenance.

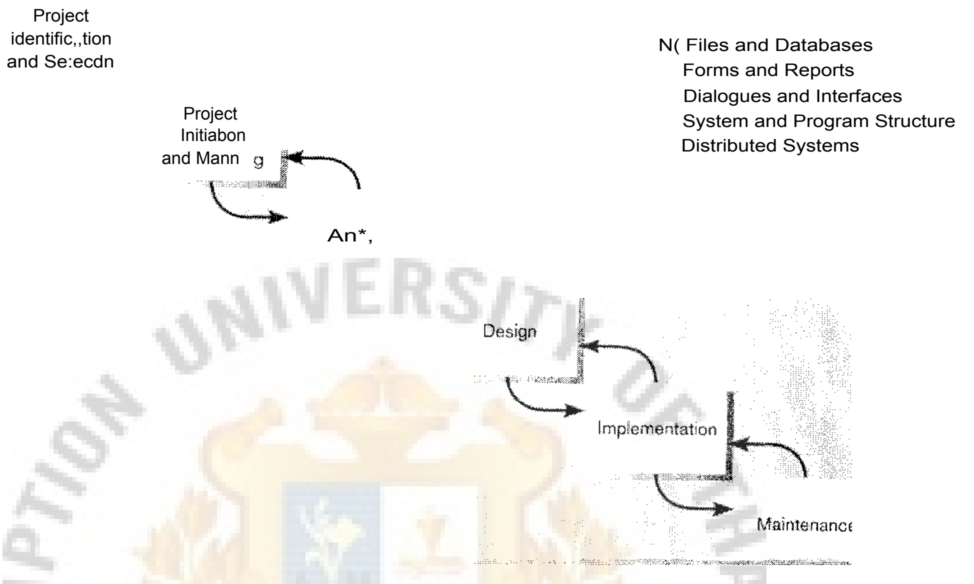

Figure 2.11. SDLC with the Design Phase Highlighted (Files and Databases).

In most situations, many physical database design decisions are implicit or eliminated when you choose the data management technologies to use with the application. We concentrate on those decisions you will make most frequently and use Oracle to illustrate the range of physical database design parameters you must manage. The interested reader is referred to Hoffer, Prescott, and McFadden (2002) for a more thorough treatment of techniques for logical and physical data base design.

There are four key steps in logical database modeling and design:

(a) Develop a logical data model for each known user interfaces (form and report) for the application using normalization principles.

(b) Combine normalized data requirements from all user interfaces into one consolidated logical database model; this step is called view integration.

(c) Translate the conceptual E-R data model for the application, developed with out explicit consideration of specific user interfaces, into normalized data requirements.

(d) Compare the consolidated logical database design with the translated E-R model and produce, through view integration, one final logical database model for the application.

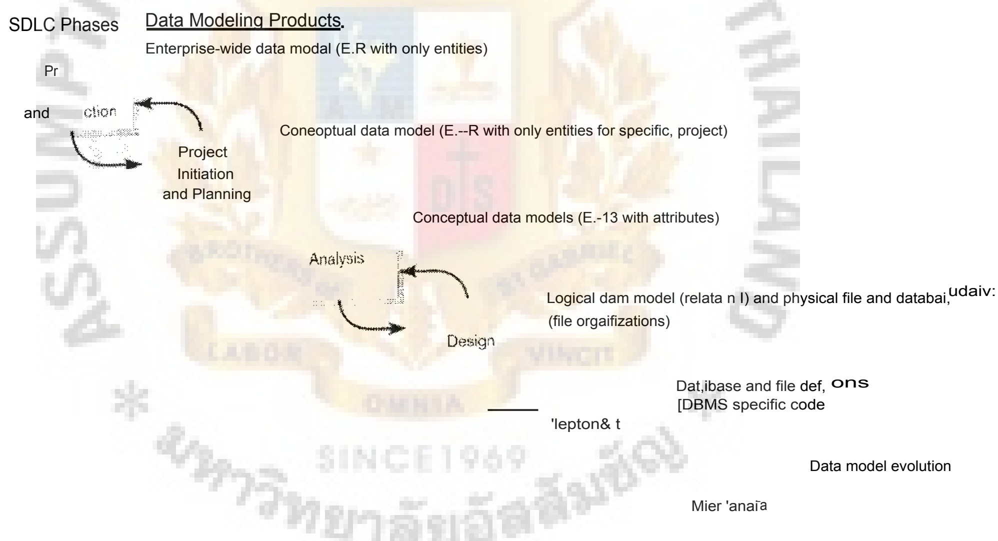

Figure 2.12. Relationship between data modeling and SDLC.

During physical database design, you use the results of these four key logical database design steps. You also consider definitions. Of each attribute; descriptions of where and when data are entered, retrieved, deleted, and updated; expectations for response time and data integrity; and descriptions of the file and database technologies to be used. These inputs allow you to make key physical database design decisions, including the following:

(a) Choosing the storage format (called data type) for each attribute from the logical database model; the format is chosen to minimize storage space and to maximize data quality. Data type involves choosing length, coding scheme, number of decimal places, minimum and maximum values, and potentially many other parameters for each attribute.

(b) Grouping attributes from the logical database model into physical records (in general, this is called selecting a stored record, or data, structure).

(c) Arranging related records in secondary memory (hard disks and magnetic- tapes) so that individual and groups of records can be stored, retrieved, and updated rapidly (called file organizations). You should also consider protecting data and recovering data after error are found.

(d) Selecting media and structures for storing data to make access more efficient. The choice of media affects the utility of different file organizations. The primary structure used today to make access to data more rapids is key indexes, on unique and non-unique keys.

2.4.7 Designing Forms and Reports

In general, forms are used to present or collect information on a single item such as a customer, product, or event. Forms can be used for both input and output. Reports, on the other hand, are used to convey information on a collection of items. Form and report design is a key ingredient for successful systems. As users often equate the quality of a system to the quality of its input and output methods, you can see that the design process for forms and reports is an especially important activity. And since information can be collected and formatted in many ways, gaining an understanding of the dos and don'ts and the trade-off between various formatting options is a useful skill for all systems analysis.

In the next section, the process of designing forms and reports is briefly described and we also provide guidance on the deliverables produced during this process. Guidelines for formatting information are then provided that serve as the building blocks for designing all foil is and reports. The next section describes methods for assessing the usability of form and report design. The chapter concludes by examining how to design forms and reports for Internet-based electronic commerce applications.

(1) Designing Forms and Reports

This is focusing on system design within the systems development life cycle (see Figure 2.13). We describe issues related to the design of system inputs and outputs forms and reports. System inputs and outputs forms and reports were identified during requirements structuring. The kinds of forms and reports the system will handle were established as part of the design strategy formed at the end of the analysis phase of the systems development process. During analysis, however, you may not have been concerned with the precise appearance of forms and reports, only with which ones needed to exist and what their contents were. You may have distributed prototypes of forms and reports that emerged during analysis as a way to confirm requirements with users. Forms and reports are integrally related to various diagrams developed during requirements structuring. For example, every input form will be associated with a data flow entering a process on a DFD, and every output form or report will be a data flow produced by a process on a DID. This means that the contents of a form or report correspond to the data elements contained in the associated data flow. Further, the data on all forms and reports must consist of data elements in data stores and on the E-R data model for the application, or must be computed from these data elements. (In rare instances, data simply go from system input to system output with out being stored within the system). It is common that, as you design forms and reports, you will discover flaws in DI-ills and E-R diagrams; the project dictionary or CASE tool repository, therefore, continues to be the central and constantly updated source of all project information.

If you are unfamiliar with computer-based information systems, it will be helpful to clarify exactly what we mean by a form or report. A form is a business document containing some predefined data and often includes some areas where additional data are to be filled in. Most forms have a stylized format and are usually not in a simple row and column format. Examples of business forms are product order forms, employment applications, and class registration sheets. Traditionally, forms have been displayed on a paper medium, but today video display technology allows us to duplicate the layout of almost any printed form, including an organizational logo or any graphic, on a video display terminal. Forms displayed on a video display may be used for data display or data entry.

Additional examples of forms are an electronic spreadsheet, computer sign-on or menu, and an ATM transaction layout.

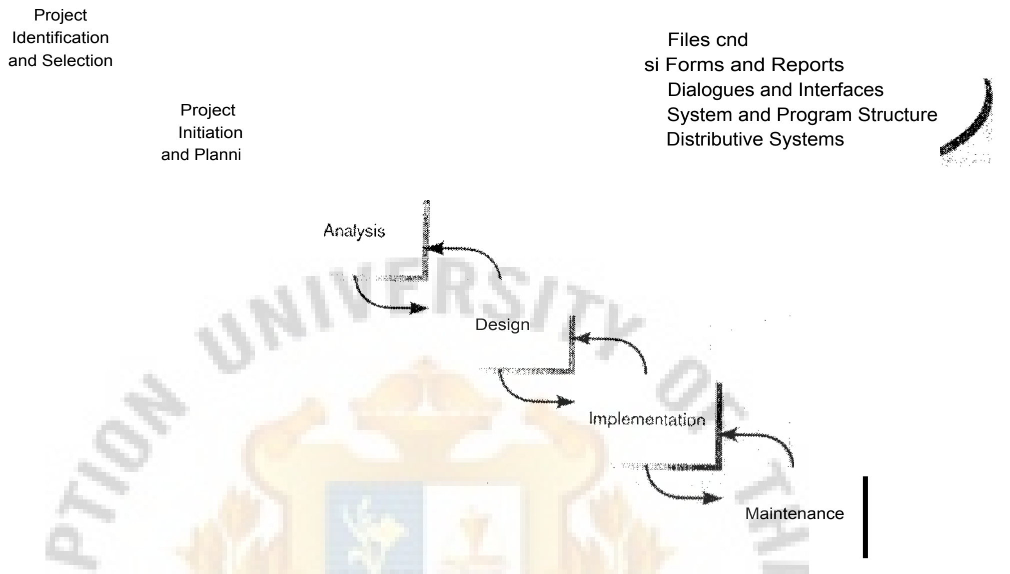

Figure 2.13. SDLC with the Design Phase Highlighted (Forms and Reports).

On the Internet, form interaction is the standard method of gathering and displaying information when consumers order products, request product information, or query account status.

A report is a business document containing only predefined data; it is a passive document used solely for reading or viewing. Examples of reports are invoices, weekly sales summaries by region and salesperson, and a pie chart of population by age categories. We usually think of a report as printed on paper, but in may be printed to a computer file, a visual display screen, or some other medium such as microfilm. Often a report has rows and columns of data, but a report may consist of any format for example, mailing labels, Frequently, the differences between a form and a report are subtle. A report is only for reading and often contains data about multiple unrelated records in a computer file. On the other hand, a form typically contains data from only one record or is, at least, based on one record, such as data about one customer, one order or one student. The guidelines for the design of forms and reports are very similar.

(2) The Process of Designing Forms and Reports

Designing forms and reports is a user-focused activity that typically follows a prototyping approach. First, you must gain an understanding of the intended user and task objectives by collecting initial requirements during requirement determination. During this process, several questions must be answered. These questions attempt to answer to "who, what, when, where, and how" related to the creation of all forms or reports. Gaining an understanding of these questions is a required first step in the creation of any form or report.

For example, understanding whom the users are their skills and abilities will greatly enhance your ability to create an effective design. In other words, are your users experienced computer users or novices? What are their educational level, business background, and task-relevant knowledge? Answers to these questions will provide guidance for both the format and content of your designs. Also, what is the purpose of the form or report? What task sill users are performing and what information is needed to complete this task? Other questions are also important to consider. Where will the users be when performing this task? Will users have access to on-line systems or will they be in the field? Also, how many people will need to use this form or report? If, for example, a report is being produced for a single user, the design requirements and usability assessment will be relatively simple. A design for a larger audience, however, may need to go through more extensive requirement collection usability in assessment process.

After collecting the initial requirements, you structure and refine this information into an initial prototype. Structuring and refining the requirements are completed independently of the users, although you may need to occasionally contact users in order to clarify some issue overlooked during analysis. Finally, you ask users to review and evaluate the prototype. After reviewing the prototype, users may accept the design or request that changes are made. If changes are needed, you will repeat the construction-evaluate-refinement cycle until the design is accepted. Usually, several iterations of this cycle occur during the design of a single faun or report. As with any prototyping process, you should make sure that these iterations occur rapidly in order to gain the greatest benefits from this design approach. The initial prototype may be constructed in numerous environments, including DOS, Unix, Windows, Linux, or Apple. The obvious choice is to use a CASE tool or the standard development tools used within your organization. Often, initial prototypes are simply mock screens that are not working modules or systems. Mock screens can be produced from a word processor, computer graphics design package, or electronic spreadsheet. It is important to remember that the focus of this phase within the SDLC is on the design content and layout. How specific forms or reports are implemented (for example, the programming language or screen painter code) is left to later phases.

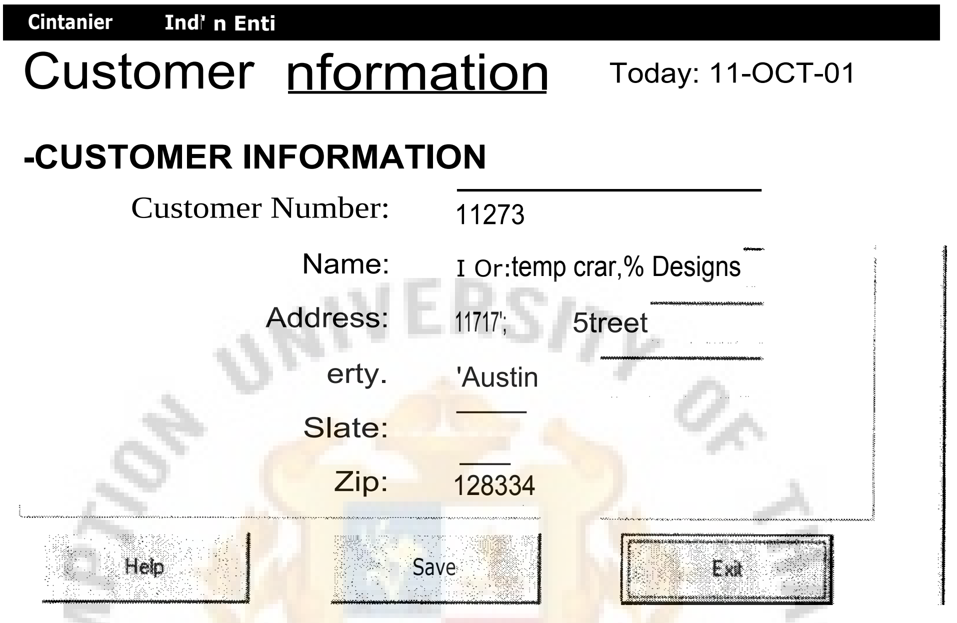

Figure 2.14. A Data Input report screen design in Microsoft' s Visual Basic
Irnrmc and Rennrtel

Nonetheless, tools for designing forms and reports are rapidly evolving. In the past, inputs and outputs of all types were typically designed by hand on a coding or layout sheet. For example, Figure 2.14 shows the layout of a data input form using a coding sheet.

Although coding sheets are still used, their importance has diminished due to significant changes in system operation environments and the evolution of automated design tools. Prior to the creation of graphical operating environments, for example, analysis designed many inputs and outputs that were 80 columns (characters) by 25 rows, the standard dimensions for most video displays. These limits in screen dimensions are radically different in graphical operation environments such as

Microsoft's Windows where font sizes and screen dimensions can often be changed from user to user. Consequently, the creation of new tools and development environments was needed to help analysis and programmers develop these graphical and flexible designs.

2.5 Computer Networking

2.5.1 Local Area Network

Local Area Network, commonly known as LAN, is a high-speed communications system designed to link computers and other data processing devices together within a small geographic area such as a workgroup, department, or a single floor of a multi-story building. Several LANs can be interconnected within a building or campus of buildings, as well, to extend connectivity.

Prior to the development of LAN technology, individual computers were isolated from each other and limited in their range of applications. By linking these individual computers over local area networks their usefulness and productivity have been increased enormously. But a LAN by its very nature is a local network, confined to a fairly small area such as a building or even a single floor of a building. To realize the full benefit of computer networking, it is critical to link the individual LANs into an enterprise-wide backbone network that connects all of the company employees and computing resources no matter how geographically dispersed they may be.

Today, LANs and LAN inter-networks are powerful, flexible, and easy to use, but they incorporate many sophisticated technologies that must work together flawlessly. For a LAN to really benefit an organization it must be designed to meet the organizations changing communications requirements. Building a LAN is a process of choosing different pieces and matching them together. Today local area networking is a shared access technology. This means that all of the devices to the LAN share a single communications medium, usually a coaxial, twisted pair, or fiber optic cable.

Figure 2.15 illustrates this concept: several computers are connected to a single cable, which serves as the communications medium for all of them. Putting a network interface card (NIC) inside the computer and connecting it to the network cable marks the physical connection to the network. Once the physical connection is in place it is up to the network software to manage communications between stations on the network.

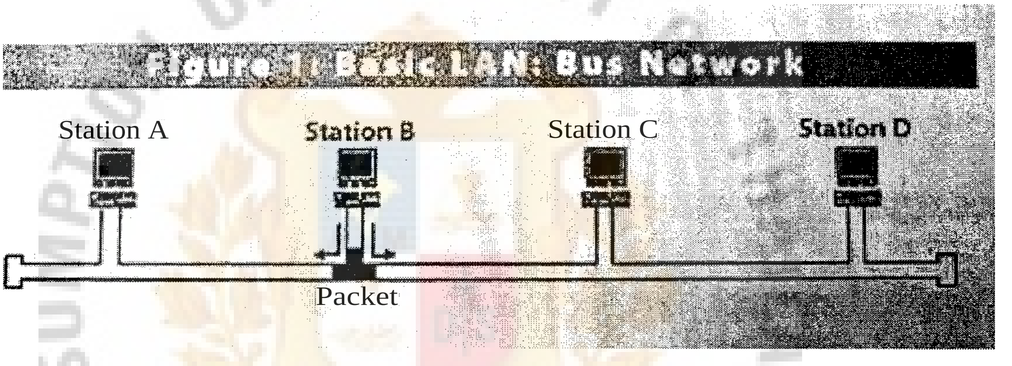

Figure 2.15. Bus Network.

In a shared media network, when one station wishes to send a message to another station it uses the software in the workstation to put the message in a packet. It consists of message data surrounded by a header and trailer that carry special information used by the network software to the destination station. One of the pieces of information placed in the packet header is the address of the destination station. Then, the NIC transmits the packet onto the LAN. The packet is transmitted as a stream of data bits represented by changes in electrical signals. As it travels along the shared cable all of the stations attached to it see the packet. As it goes by the NIC in' each station, the NIC checks the destination address in the packet header to determine if the packet is addressed to it. When the packet passes the station to which it is addressed, the NIC at that station copies the packet and then takes the data out of the envelope and gives it to the computer.

Figure 2.15 shows one source station sending a single message packet to one destination station. If the message the source station wants to is too big to fit into one packet it will send the message in a series of packets.

(1) Ethernet

The most widely used LAN technology in use today is Ethernet. It strikes a good balance between speed and ease of installation, and supportability. The Institute of Electrical and Electronic Engineer (IEEE) define the Ethernet standard in a specification commonly known as IEEE 802.3. The 802.3 specification covers rules for configuring Ethernet LANs, the types of media that can be used, and how the elements of the network should interact. The Ethernet protocol provides the service called for in the Physical and Data Link Layers of the OSI reference model

The important element, which defined by the 802.3 specification, is the access method to be used by stations connected to an Ethernet LAN. It is called Carrier Sense Multiple Access with Collision Detection (CSMA/CD). In this method each station contends for access to the shared medium. It is possible for two stations to try sending packets at the same time, which results in a collision on the LAN. In Ethernet networks collisions are considered noinial events and the CSMA/CD access method is designed to quickly restore the network to normal activity after a collision occurs.

Ethernet networks can be configured in either a star or bus topology and installed using any of three different media. Coaxial cable was the original LAN medium and it is used in what is called a bus topology (Figure 2.15 depicts a typical bus topology). This topology is rarely used in new LAN installations today because it is relatively difficult to accommodate adding new users or moving existing users from one location to another. It is also difficult to troubleshoot problems on a bus LAN.

Figure 2.16 illustrates a star topology, which is a more robust topology. In a star topology each station is connected to a central wiring concentrator, or hub, by an individual length of twisted pair cable. The cable is connected to the stations NIC at one end and to a port on the hub at the other. The hubs are placed in wiring closets centrally located in a building.

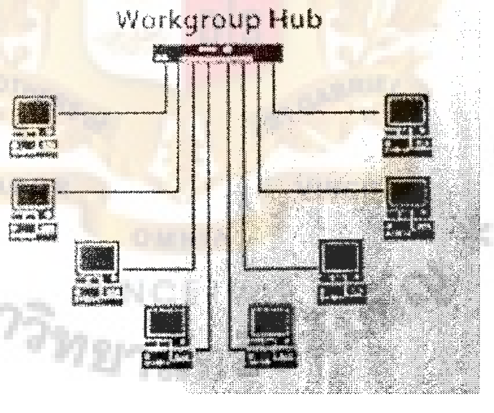

Figure 2.16. Star Topology.

The most common is twisted pair because it is associated with the more popular star topology. It is inexpensive, and very easy to install, troubleshoot, and repair. Twisted pair cable comes both unshielded and shielded. Unshielded twisted pair (UTP) cable used for LANs is similar to telephone cable, but has somewhat more stringent specifications regarding its susceptibility to outside electromagnetic interference (EMI) than common telephone wire. Shielded twisted pair (STP), as its name implies, comes with a shielding around the cable to provide more protection against EMI.

Of the two types of twisted pair cable, UTP is by far the most commonly used. The specification for running Ethernet on UTP is called 10BASE-T.

(2) Token Ring

Another major LAN technology in use today is Token Ring. Token Ring rules are defined in the IEEE 802.5 specification. Like Ethernet, the Token Ring protocol provides services at the Physical and Data Link Layers of the OSI model.

The access method used on Token Ring networks is called token passing. Token is a deterministic access method in which collisions are prevented by assuring that only one station can transmit at any given time. This is accomplished by passing a special packet called a token from one station to another around a ring. A station can only send a packet when it gets the free token. When a station gets a free token and transmits a packet it travels in one direction around the ring, passing all of the other stations along the way. Token Ring networks use what is called a ring topology. However, it is actually implemented in what can best be described as a collapsed ring that looks like a physical star topology (see Figure 2.16). In Token Ring LANs each station is connected to a Token Ring wiring concentrator, called a multi-station access unit (MAU), using an individual run of twisted pair cable. Like Ethernet hubs MAUs are located in wiring closets.

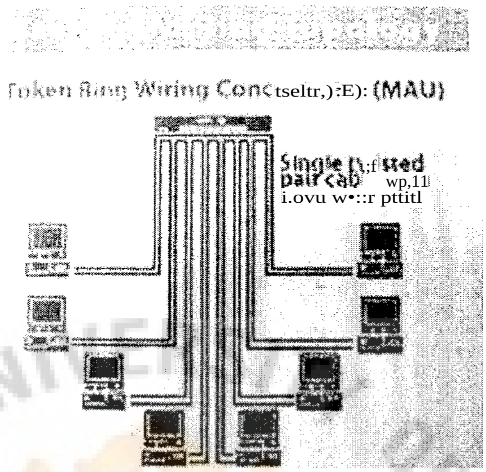

Figure 2.17. Ring Topology.

2.5.2 Hub

The hub is one of the most important elements of a LAN. It is a central connection point for wiring the network (refer to Figure 2.18), and all stations on the LAN are linked to each other through the hub. The term hub is generally associated with 10 BASE-T Ethernet networks while the term multi-station access unit (MAU), is used to refer to the Token Ring wiring concentrator. These two LAN technologies use different media access methods hubs and MAUs perform different media access functions internally, but at one level they perform the same function, they are both network-wiring concentrators.

A typical hub multiple ports user to which computers and peripheral devices such as servers are attached. Each port supports a single 10BASE-T twisted pair connection from a network station. When an Ethernet packet is transmitted to the hub by one station it is repeated, or copied, over onto all of the other ports of the hub.

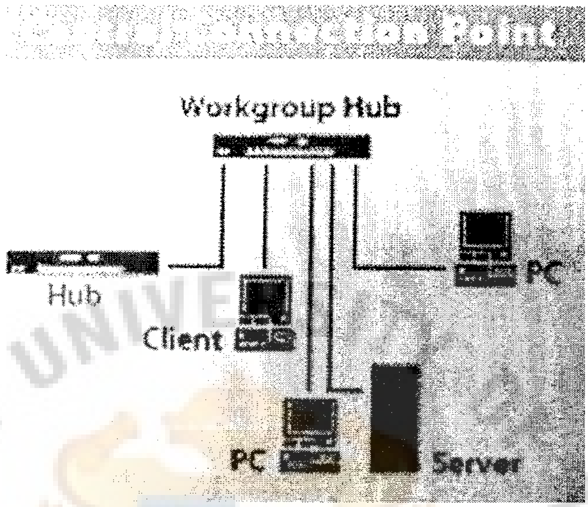

Figure 2.18. Central Connection Point.

In this way all of the stations see every packet just as they do on a bus network. So that, even though each station is connected to the hub with its own dedicated twisted pair cable a hub-based network is still a shared media LAN picture it as a LAN in a box.

(1) Manageable hub

Intelligent hubs have been defined as manageable hubs, meaning that each of the ports on the hub can be configured, monitored, and enabled or disabled by a network operator from a hub management console. Hub management can also include gathering infoimation on a variety of network parameters, such as the numbers of packets that pass through the hub and each of its ports, what types of packets they are, whether the packets contain errors, and how many collisions have occurred. Each hub vendor has some type of management package they sell with their product. These applications vary in how much information they can gather, what commands can be issued, and how the information is presented to the network operator.

(2) Stand-alone Hub

Both hubs and MAUs come in three configurations: stand-alone hubs, stackable hubs, and modular hubs. Some products are combinations of the best configurations. Stand-alone hubs are as the term implies single box-level products with a number of ports.

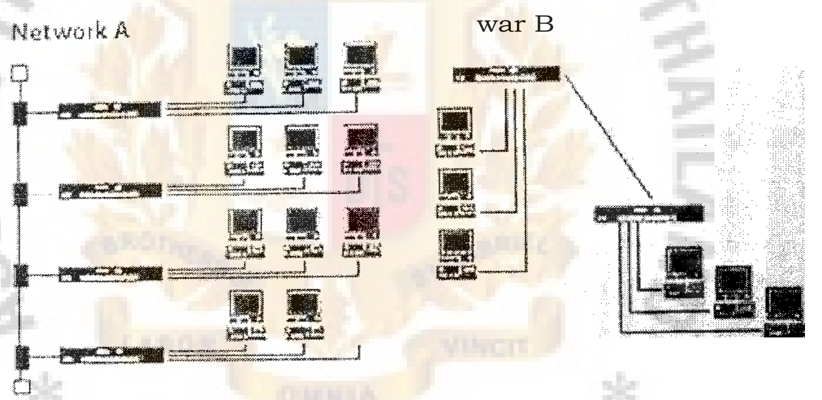

Figure 2.19. Summary of Architectures.

Stand-alone hubs usually include some method of linking them to other stand-alone hubs either by connecting them together with a length of 10BASE-5 coaxial cable or cascading them using twisted pair between individual ports on each hub (see Figure 2.20). They are best suited for small, independent workgroups department.

(3) Stackable Hub

A third type of hub is the stackable hub. Stackable hubs look and act like stand-alone hubs except that several of them can be stacked or connected together, usually by short lengths of cable. When they are linked together they act like a modular hub in that they can be managed as a single unit. One manageable hub, used within a stack, can typically provide the management for all other hubs in the stack. These hubs are ideal when an organization wants to start with a minimal investment but knows that its LAN will grow.

(4) Modular Hub

Modular hubs are popular in networks because they are easily expanded and always have a management option.

Figure 2.20. Modular Hub.

A modular hub starts with a chassis, or card cage, with multiple card slots, each of which accepts a communications card, or module.

Each module acts like a stand-alone hub, when the communications modules are placed in the card slots in the chassis. They connect to ac communication back plane that links them together so that a station connected to a port on one module can easily communicate with a station on another module. Figure 2.20 illustrates a modular hub.

2.5.3 Wide Area Network

The term Wide Area Network, common known as WAN refers to linking individual local area networks together to from a single inter-network. This inter-network is sometimes called an enterprise network because it interconnects all of the computer networks throughout the entire enterprise. Workgroup LANs on different floors of a building or in separate buildings on a business campus can be linked together so that all of the computing systems at that site are interconnected. Geographically distant company sites can also be tied together in the enterprise-wide inter-network.

An individual LAN is subject to limits on such things as how far it can extend, how many stations can be connected to it, how fast data can be transmitted between stations, and how much traffic it can support. If a company wants to go beyond those limits link more stations than that LAN can support, for example it must install another LAN and connect the two together in an inter-network.

There are two main reasons for implementing multiple LANs and internetworking them. One is to extend the geographic coverage of the network beyond what a single LAN can support to multiple floors in a building, to nearby buildings, and to remote sites. The other key reason for creating inter-networks is to share traffic loads between more than one LAN. A single LAN can only support so much traffic. If the load increases beyond its carrying capacity users will suffer reduced throughput and much of the productivity achieved by installing the LAN in the first place will be lost. One way to handle heavy network traffic is to divide it between multiple internetworked LANs.

There are many essential elements of computer networking and three major types of device used for internetworking: bridges, routers, and switches. Today the most commonly used internetworking devices are high-speed routers, especially in wide-area internet works linking geographically remote sites. But routers are also heavily used in building and campus internet works, as well. Bridges have also been popular even though the offer less functionality than routers because they are less expensive to purchase, implement and maintain.

(1) Bride and Router

Bridges and routers are both special kinds of devices used for internetworking LANs that is, linking different LANs or LAN segments together. Many organizations have LANs located at sites that are geographically distant from each other. Routers were originally designed to allow users to connect these remote LANs across a wide-area network, but bridges can be used for this purpose, as well. By placing routers or bridges on LANs at two distant sits and connecting them with a telecommunications link, a user on one of the LANs can access resources on the other LAN as if those resources were local.

Bridges and routers link adjacent LANs. Local bridges and routers were first used to extend the area a network could cover by all owing users to connect two adjacent LANs to maintain performance by reducing the number of users per segment. Both Ethernet and Token Ring specify limits on maximum distances between workstations and hubs, hubs and hubs, and a maximum number of stations that can be connected to a single LAN. To provide network connectivity for more people, or extend it to cover a larger area, it is sometimes necessary to link two different LANs or LAN segments. Bridges and routers can both provide this function.

(a) Bridge

Bridges are the simpler, and often less expensive, type of device. Bridges filter packets between LANs by making a simple forward/don't forward decision on each packet that they receive from any of the networks to which they are connected. Filtering is done based on the destination address of the packet. If a packet destination is a station on the same segment where it originated, it is not forwarded. If it is destined for a station on another LAN, it is connected to a different bridge port and forwarded to that port. Many bridges today filter and forward packets with very little delay, making them good for large traffic volumes.

(b) Router

Routers are more complex internetworking devices and are also typically more expensive than bridges. They use Network Layer Protocol Information within each packet to route it from one LAN to another. This means that a router must be able to recognize all of the different Network Layer Protocols that may be used on the networks it is linking together. This is where the term multi-protocol router comes from a device that can route using many different protocols. Routers communicate with each other and share information that allows them to determine the best route through a complex inter-network that links many LANs.

(2) Switch

Switches are another type of device used to link several separate LANs and provide packet filtering between them. A LAN switch is a device with multiple ports, each of which can support a single end station or an entire Ethernet or Token Ring LAN. With a different LAN connected to each of the switch's ports, it can switch packets between LANs as needed. In effect, it acts link the switch based on the destination address filters a very fast multiport bridge packet.

Switches are used to increase performance on an organization network by segmenting large networks into many smaller, less congested LANs, while still providing necessary interconnectivity between them. Switches increase network performance by providing each port with dedicated bandwidth, without requiring users to change any existing equipment, such as NICs, hubs, wiring, or any routers or bridges that are currently in place. Switches can also support numerous transmissions simultaneously. Deploying technology called dedicated LANs is another advantage of using switches.

(3) Radius server or authentication server

An authentication server is a server, which determines whether someone or something is, in fact, who or what it is declared to be. In private and public computer networks, authentication is commonly done through the use of logon passwords. Knowledge of the password is assumed to guarantee that the user is authentic. Each user registers initially, using an assigned or self-declared password, On each subsequence use, the users know and use the previously declared password.

(4) File Server

A file server acts as a librarian, storing various programs and dateless for network users. The server deteimines who gets access to what and in what sequence. Servers may be powerful microcomputers with larger hard disk capacity, workstation, minicomputer, or mainframes, although specialized computers are now available for this purpose. The server typically contains the LAN's network operating system, which manages the server and routes and manages communications on the network.

(5) Gateway

A gateway is a network point that acts as an entrance to another network. On the Internet, in terms of routing, the network consists of gateway nodes and host nodes. The computers of network users and the computers that serve content are host nodes. The computers that control traffic within your company's network or at your Local Internet service provider (ISP) are gateway nodes.

In the network for Virtual Private Network (VPN), a computer server acting as a gateway node is often also acting as a proxy server and a firewall server. Gateways also involve the use of router and switches.

(6) Application Server

An application server is a server program in a computer in a distributed network that provides the business logic for an application program. The application consisting of a graphical user interface (GUI) server, and application (business logic) server, and a database and transaction server.

(7) Mail Server

Mail Server is a high-end computer with Mail server, Software installed, Mail Server serve as an electronic post office for both internal and external communications. Users can send and receive electronic mails (e-mail) to and from other users inside company, and other organizations on the Internet; both domestically and in overseas.

(8) Leased Line

A leased line is a telephone ling that has been leased for private use. In some context, it's called a dedicated line. A leased line is usually contrasted with a switched line or deal-up line.

Typically, large computers rent leased lines from the media provide to interconnect different geographic location in their company. The alternative is to buy and maintain their own private lines, or, increasingly perhaps, to use the public switched lines with secure message protocols. (This is called tunneling)

2.5.4 Virtual private Network

Virtual Private Networks, commonly known as VPNs supply network connectivity over a possibly long physical distance. In this respect, VPNs are a form of Wide Area Network (WAN). The key feature of a VPN, however, is its ability to use public networks like the Internet rather than rely on private leased lines. VPN technologies implement restricted-access networks that use the same cabling and routers as does a public network, and they do so without sacrificing features or basic security. VPNs support at least three different modes of use:

(1) Remote access client connections

Low-cost, ubiquitous, and secure Remote Access can be offered by using the public Internet to connect teleworkers and mobile users to the corporate .

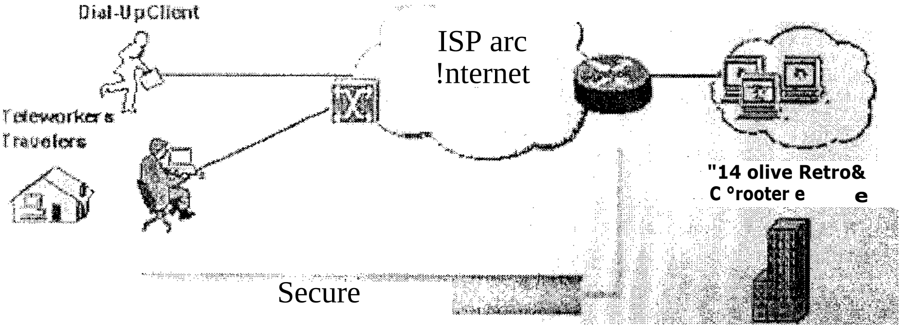

Figure 2.21. Remote Access VPN.

Internet, Thus forming a Virtual Private Dial Network (VPDN). In Remote Access VPNs, privately operated dial access servers are again replaced by shared infrastructure-the dial access servers at any convenient ISP POP

(2) Site-to-Site VPN

Private workgroups can be provided with secure Site-to-Site connectivity, even when LANs that comprise a workgroup are physically distributed throughout a corporate network or campus. Intranet services can be offered to entire LANs or to a select set of authorized hosts on several LANs-for example, allowing accounting users to securely access a payroll server over a network segments that are not secured. In Site-to-Site VPNs, shared network infrastructure a service provider network or the public Internet replaces dedicated site-to-site WAN links.

(3) Controlled access within an Intranet

Intranets can also utilize VPN technology to implement controlled access to individual sub-nets on the private network. In this mode, VPN clients connect to a VPN server that acts as a gateway to computers behind it on the subnet. Note that this type of VPN use does not involve ISPs or public network cabling. However, it does take advantage of the security features and convenience of VPN technology.

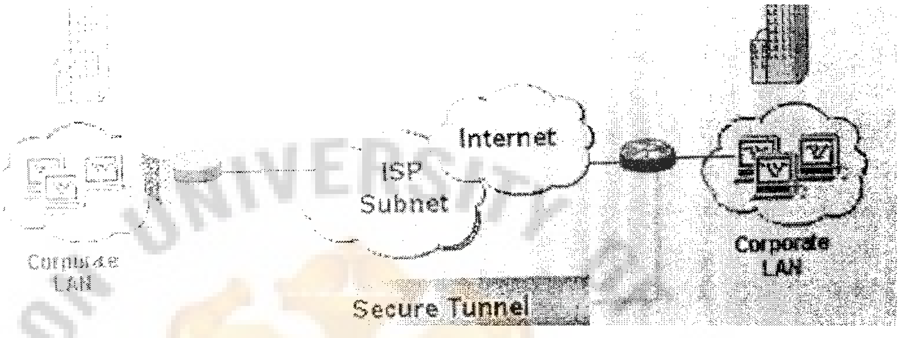

Figure 2.22. Site to Site VPN.

2.5.5 Advantage and Disadvantage of Virtual Private Network

(1) Advantage of Virtual Private Network

VANs promise two main advantages over competing approaches cost savings, and scalability (that is really just a different form of cost savings).

(a) The low cost of VPN

One way a VPN lowers costs is by eliminating the need for expensive long-distance leased lines. With VPNs, an organization needs only a relatively short dedicated connection to the service provider. This connection could be a local leased line (much less expensive than a long-distance one), or it could be a local broadband connection such as DSL service.

Another way VPNs reduce costs is by lessening the need for long-distance telephone charges for remote access. Recall that to provide remote access service, VPN clients needs only call into the nearest service provider's access point. In some cases this may require a long distance call, but in many cases a local call will suffice.

A third, subthle way that VPNs may lower costs is through offloading of the support burden. With VPNs, the service provider tather than the organization must support dial-up access for example. Service providers can in theory charge much less for for their support than it costs a company internally because the public provider's cost is shared amongst potentially thousands of customers.

(b) Scalability and VPNs

The cost to an organization of traditional leased lines may be reasonable at first but can increase exponentially as the organization grows. A company with two branch offices, for example, can deploy just one dedicated line to connect the two locations. If a third branch office needs to come online, just two additional lines will be required to directly connect that location to the other two.

However, as an organization grows and more companies must be added to the network, the number of leased lines required increases dramatically. Four branch offices require six lines for full connectivity, five offices require ten lines, and so on. Mathematicians call this phenomenon a combinatorial explosion, and in a traditional WAN this explosion limits the flexibility for growth, VPNs that utilize the Internet avoid this problem by simply tapping into the geographically distributed access already available.

(2) Disadvantages of VPNs

With the hype that has surrounded VPNs historically, the potential pitfalls or "weak spots" in the VPN model can be easy to forget. These four concerns with VPN solutions are often raised.

(a) VPNs require an in-depth understanding of public network security issues and proper deployment of precautions.

(b) The availability and performance of an organization's wide-area VPN (over the Internet in particular) depends on factors largely outside of their control.

(c) VPN technology from different vendors may not work well together due to immature standards.

(d) VPNs need to accommodate protocols other than IP and existing ("legacy") internal network technology.

Generally speaking, these four factors comprise the "hidden costs" of a VPN solution. Whereas VPN advocates tout cost savings as the primary advantage of this technology, detractors cite hidden costs as the primary disadvantage of VPNs.

2.5.6 Technology Behind VPNs

VPN technology is based on a *tunneling* strategy. Tunneling involves encapsulating packets constructed in a base protocol format within some other protocol. In the case of VPNs run over the Internet, packets in one of several VPN protocol formats are encapsulated within IP packets.

(1) VPN Security

VPNs work hard to ensure their data remains secure, but even its security mechanisms can be breached. Particularly on the Internet, sophisticated hackers with ample amounts of free time will work equally hard to "steal" VPN data if they believe it contains valuable information like credit card numbers.

Most VPN technologies implement strong encryption so that data cannot be directly viewed using network sniffers. VPNs may be more susceptible to "man in the middle" attackes, however, that intercept the session and impersonate either the client or server. In addition, some private data may not be encrypted by the VPN before it is transmitted on the public wire. IP headers, for example, will contain the IP address of both the client and the server. Hackers may capture these addresses and choose to target these devices for future attacks.

(2) VPN Protocols

Several interesting network protocols have been implemented for use with VPNs. These protocols attempt to close some of the security holes inherent in VPNs. These protocols continue to compete with each other for acceptance in the industry.

(a) Point-to-Point Tunneling Protocol (PPTP)

PPTP is a protocol specification developed by several companies. People generally associate PPTP with Microsoft because nearly all flavors of Windows include built-in support for the protocol. The initial releases of PPTP for Windows by Microsoft contained security features that some experts claimed were too weak for serious use. Microsoft continues to improve its PPTP support, though.

PPTP's primary strength is its ability to support non-IP protocols. The primary drawback of PPTP is its failure to choose a single standard for encryption and authentication. Two products that both fully comply with the PPTP specification may by totally incompatible with each other if they encrypt data differently, for example.

(b) Layer Two Tunneling Protocol (L2TP)

The original competitor to PPTP in VPN solutions was L2F a protocol implemented primarily in Cisco products. In an attempt to improve on L2F, the best features of it and PPTP were combined to create new standard called L2TP. L2TP exists at the data link layer (layer two) in the OSI Model-thus the origin of its name.

Like PPTP, L2TP supports non-IP clients. It also fails to define an encryption standard. However, L2TP support non-Internet based VPNs including frame relay, ATM, and SONET.

(c) Internet Protocol Security (IPsec)

IPsec is actually a collection of multiple related protocols. It can be used as a complete VPN protocol solution, or it can used simply as the encryption scheme within L2TP or PPTP. IPsec exists at the network layer (layer three) in OSI.

IPsec extends standard IP for the purpose of supporting more secure Internet-based service (including, but not limited to, VPNs).

IPsec specifically protects against "man in the middle attacks" by hiding IP addresses that would otherwise appear on the wire.

(d) SOCKS Network Security Protocol

The SOCKS system provides a unique alternative to other protocols for VPNs. SOCKS functions at the session layer (Layer five) in OSI, compared to all of the other VPN protocols that work at layer two or three. This implementation offers advantages and disadvantages over the other protocol choices. Functioning at this higher level, SOCKS allows administrators to limit VPN traffic to certain applications. To use SOCKS, however, administrators must configure SOCKS proxy servers within the client environments as well as SOCKS software on the clients themselves

(3) VPN Hardware and Software

Literally dozens of vendors offer VPN-related products. These products sometimes do not work with each other because of the choice of incompatible protocols (as described above) or simply because of lack of standardized testing.

Some VPN products are hardware devices. Most VPN devices are effectively routers that integrate encryption functionality. Other types of VPN products are software packages. VPN software installs on top of a host operating system and can require significant customization for the local environment. Many vendor solutions comprise both server-side hardware and client-side software designed for use with the hardware.

2.5.7 Why use a VPN.

More recently, using the Internet as a means of providing more cost-effective access to business critical information such as order status, inventory levels, or even financial inforniation has gained wider acceptance through Virtual Private Networks or VPNs. A Virtual Private Network is a business solution that provides secure, private connections to network applications using a public or "unsecured" medium such as the Internet. With a VPN deployed across the Internet, virtual private connections can be established from almost anywhere in the world. In order to protect the system from unauthorized users. It must have a VPN security in the system.

The Internet as it stands is a fairly hostile place. In order to keep your information safe, your VPN must be able to insure the following:

(1) Confidentiality

Make sure it is hard for anyone but the receiver to understand what data has been communicated. You do not want anyone to see your passwords when logging into a remote machine over the Internet.

(2) Integrity

Guaranty that the data does not get changed on the way. If you are on a line carrying invoicing data you probably want to know that the amounts and account numbers are correct and not altered while in-transit.

(3) Authenticity

Sign your data so that others can see that it is really you that sent it. It is clearly nice to know that documents are not forged. Up to this point, the discussion has revolved around the security components of data privacy, data authentication and data integrity. Of equal importance is the process of ensuring the user is who they say they are (user authentication) and controlling the network resources that they can access (access control). The encrypted data transmission is only part of the overall data communication stream; the user must be authenticated so that specific access to particular services, applications and resources are permitted.

(4) Replay protection

You need a way to ensure a transaction can only be carried out once their authorization to repeat it. These are all provided by modern VPN technologies today. A popular method of fulfilling the above requirements is to create a VPN with IPSec tunnels.

III. METHODOLOGY OF DEVELOPMENT

3.1 Feasibility Analysis

During this phase, need to create a preliminary budget that outlines the planned expenses and revenues associated with the propose project. The project justification will demonstrate that the benefits are worth these costs. Table 1.1 shows a cost-benefit analysis for a new development project. This analysis shows net present value calculations of the project's benefits and costs as well as a return on investment (ROI) and cash flow analysis.

Given that we now know the relationship between time and money, the next step in perfoiining the financial/economic analysis is to create a summary worksheet reflecting the present values of all benefits and costs as well as all pertinent analyses. Due to the fast pace of the business world, PVF's System Priority Board feels that the useful life of many information systems may not exceed five years. Therefore, all cost-benefit analysis calculations will be made using a five-year time horizon as the upper boundary on all time-related analyses. In addition, the management of PVF has set their cost of capital to be 12 percent (that is, PVF's discount rate).

On the worksheet displayed in Table 1.1 summarize the NPV of the total tangible benefits from the project and summarize the NPV of the total costs from the project. The overall NPV for the project (492,460B), overall NPV benefits is 901,200B, overall NPV costs is 408,740B.

The overall return on investment (ROI) for the project is also shown on the worksheet (83%). Since alternative projects will likely have different benefit and cost values and, possibly, different life expectancies, the overall ROI value is very useful for making project comparisons on an economic basis.

The last analysis shown in Figure 3.1 is a break-even analysis. The objective of the break-even analysis is to discover at what point (if ever) benefits equal costs (that is, when break-even occurs). To conduct this analysis, the NPV of the yearly cash flows are determined. Here, The yearly cash flows are calculated by subtracting both the one-time cost and the present values of the recurring costs from the present value of the yearly benefits. The overall NPV of the cash flow reflects the total cash flows for all preceding years. On line# 21 of the worksheet shows that break-even occurs between years 1 and 2. Since year 2 is the first in which the overall NPV cash flows figure is nonnegative, the identification of what point during the year breakeven occurs can be derived as follows:

$$\text{Break-Even Ratio} = \frac{\text{Yearly NPV Cash Flow-Overall NPV Cash Flow}}{\text{Yearly NPV Cash Flow}}$$

Using data from Figure 3.1,

Break-Even Ratio = (119,580 — 25,215) / 119,580 = 0.789

Therefore, project break-even occurs at approximately 1.8 years. A graphical representation of this analysis is shown in Figure 3.1.

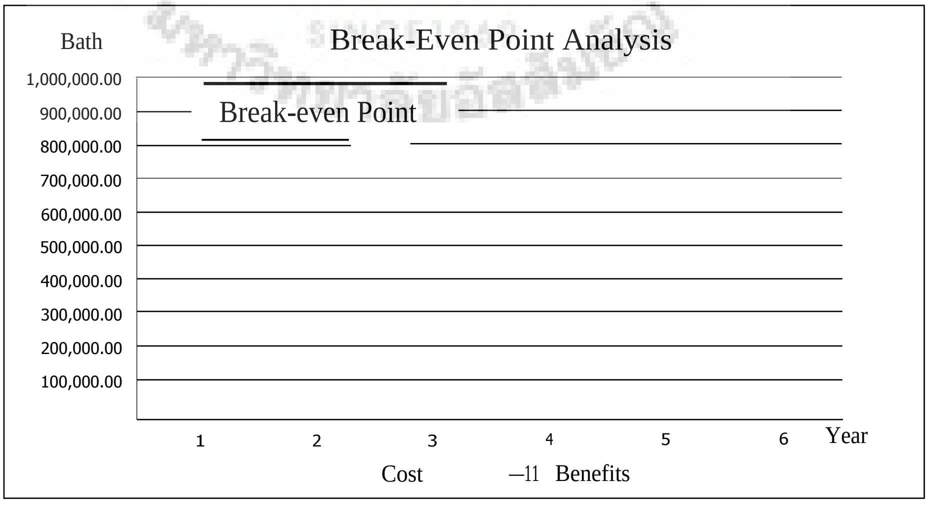

Figure 3.1. Break-Even Point Analysis.

Financial Analysis

economic bene	[illegible]	250,000.00	250,000.00	[illegible]	250,000.00
	[illegible]	0.797	0.712		0.567
PV of benefit	[illegible]	199,300.00	177,950.00		141,850.00

Recurring Costs	[illegible]	[illegible]	[illegible]	[illegible]
Discount rate 12%	[illegible]			
PV of Recurring Costs	44,645.00	[illegible]	[illegible]	
	73,145.00			

[illegible]	134,135.00	[illegible]	106,770.00	[illegible]
[illegible]	94,365.00	[illegible]	131,985.00	[illegible]

Project break-even occurs b [illegible]

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3.2 Analyzing System's Requirements.

(1) Tractability System Requirement:

Need the tractability system to check and find the record. Because of for the existing system has keep record by hard copy which some of customers need to compare the result of physical check-up on last year and current year it has do manually.

(2) Simple of Working Process Requirement:

Need simple process to work and reduce working time for each process.

(3) Centralization of Information System:

Need the centralization information to reduce working duplicates in the system. Need to reduce paper work and area to keep the record by hard copy (Around 20 - 25 boxes per company, for one time in External services)

3.3 Existing System's Conceptual Architecture

For the existing system they used the manual record by using the traveler card to record the result of the Physical Check-Up that you check. For the blood and urine will be submitted to Lab for analysis then put the test lab result on traveler card. After that submitted the traveler card to doctor to verify the reading from lab and data measured such as Cholesterol, Triglycerdide ete... then report the Physical Check-Up result, conclusion and recommendation to customer.

The hospital has a copy then keeps hard copy and pack in the boxes to keep record. After that send the original one of traveler card report to the customer.

(1) Registration:

The customer has registration company name and employee number and name on the check-up traveler card.

(2) Measurement the basis check-up:

Officer has measuring the basis check-up such as age, height and weight ete... then record onto check-up traveler card.

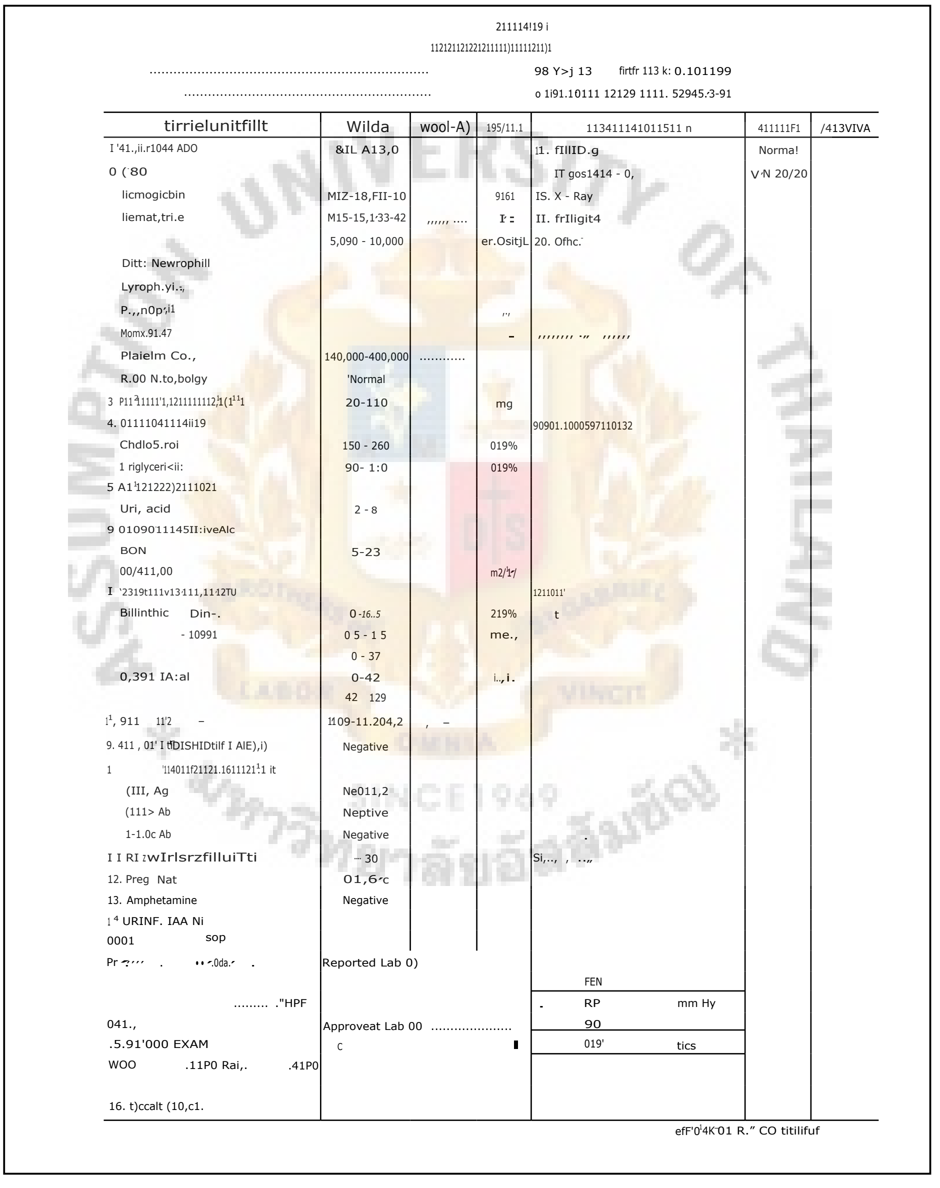

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Figure 3.2. Physical Check-up Record for External Services.

(3) Bloodless:

Officer has attached the name, employee no. on the tube then customer has bloodless into tube for lab analysis.

(4) Lab Analysis:

Lab officer has been the blood from customer to analysis and reports the result onto traveler card.

(5) Doctor recommendation:

Doctor has been analysis the reading from lab report, then reports the result of physical check-up and recommendation on the traveler card.

(6) Keep Record:

Physical Check-Up department has copies the traveler card and keeps the record by hard copy.

(7) Customer Report:

Marketing department has collect the original traveler card to report the Physical Check-Up result.

3.4 Current Problem of the Existing System

(1) Tractability problem:

In terms of the tractability, the system has a lot of problems to check and find the records. Because of the existing system has to keep records in hard copy, so some customers need to compare the results of physical check-up of last year and current year it has do manually.

(2) More process and working time:

Take more process time to working for each process

(3) More paper work and area to keep the record by hard copy:

Around 20 - 25 boxes per company, for one time in External services.

3.5 A System Development Lift Cycle (SDLC)

3.5.1 Identification and Selection System Development Project

The first phase of the SDLC is project identification and selection. During this activity, a senior manager, a business group, an IS manager, or a steering committee identify and assess all possible systems development projects that an organization unit could undertake. Next, those projects deemed most likely to yield significant organizational benefits, given available resources, are selected for subsequent development activities. Organizations vary in their approach to identifying and selecting projects. In some organizations, project identification and selection is a very formal process in which projects are outcomes of a larger overall planning process. For example, a large organization may follow a formal project identification process whereby a proposed project is rigorously compared to all competing projects. Alternatively, a small organization may use informal project selection processes that allow the highest-ranking IS manager to independently select project or allow individual business units to decide on projects after agreeing to provide project funding.

There is a variety of sources for information systems development requests. One source is requests by managers and business units for replacing or extending an existing system to gain needed information or to provide a new service to customers. Another source for requests is IS managers who want to make a system more efficient, less costly to operate, or want to move it to a new operating environment. A final source of projects is a formal planning group that identifies projects for improvement to help the organization meet its corporate objectives (for example, a new system to provide better customer service). Regardless of how a given organization actually executes the project identification and selection process, there is a common sequence of activities that occurs. In the following sections, we describe a general process for identifying and selecting projects and producing the deliverables and outcomes of this process.

3.5.2 Initiation and Planning System Development Project

A key consideration when conducting project initiation and planning (PIP) is deciding when PIP ends and when analysis, the next phase of the SDLC, begins. This is a concern since many activities performed during PIP could also be completed during analysis. Pressman (2001) speaks of three important questions that must be considered when making this decision on the division between PIP and analysis.

(1) How much effort should be expended on the project initiation and planning process?

(2) Who is responsible for performing the project initiation and planning process?

(3) Why is project initiation and planning such a challenging activity?

Finding and answer to the first question, how much effort should be expended on the PIP process, is often difficult. Practical experience has found, however, that the time and effort spent on initiation and planning activities easily pay for them selves later in the project. Proper and insightful project planning, including determining project scope as well as identifying project activities, can easily reduce time in later project phases. For example, a careful feasibility analysis that leads to deciding that a project is not worth pursuing can save a considerable expenditure of resources. The actual amount of time expended will be affected by the size and complexity of the project as well as by the experience of your organization in building similar systems. A rule of thumb is that between 10 and 20 percent of the entire development effort should be expended on the

PIP study. Thus, you should not be reluctant to spend considerable time in PIP in order to fully understand the motivation for the requested system.

For the second question, who is responsible for performing the PIP, most organizations assign an experienced systems analyst, or team of analysts for large projects, to perform PIP. The analyst will work with the proposed customers (managers and users) of the system and other technical development staff in preparing the final plan. Experienced analysts working with customers who well understand their information services needs should be able to perform PIP without the detailed analysis typical of the analysis phase of the life cycle. Less experienced analysts with customers who only vaguely understand their needs will likely expend more effort during PIP in order to be certain that the project scope and work plan are feasible.

Third, the project initiation and planning process is viewed as a challenging activity because the objective of the PIP study is to transform a vague system request document into a tangible project description. This is an open-ended process. The analysis must clearly understand the motivation for and objectives of the proposed system. Therefore, effective communication among the systems analyst, users, and management is crucial to the creation of a meaningful project plan. Getting all parties to agree on the direction of a project may be difficult for cross-department projects when different parties have different business objectives. Thus, more complex organizational settings for projects will result in more time required for analysis of the current and proposed systems during PIP.

Performing Requirement Determination.

There are three sub-phases to systems analysis: requirement determination, requirements structuring, and generating alternative system design strategies and selecting the best one. We will address these as three separate steps, but you should consider these steps as somewhat parallel and iterative. For example, as you determine some aspects of the current and desired system(s), you begin to structure these requirements or to build prototypes to show users how a system might behave. Inconsistencies and deficiencies discovered through structuring and prototyping lead you to explore further the operation of current system(s) and the future needs of the organization. Eventually your ideas and discoveries converge on a thorough and accurate depiction of current operations and what the requirements are for the new system. As you think about beginning the analysis phase, you probably wonder what exactly is involved in requirement determination. We discuss this process in the next section.

3.5.3 Logic Modeling

Analysis structures the requirement information into data flow diagrams that model the flow of data into and through the information system. Data flow diagrams, though versatile and powerful techniques are not adequate for modeling all of the complexity of an information system. Although decomposition allows you to represent a data flow diagram's processes at finer and finer levels of detail, the process names themselves cannot adequately represent what a process does and how it does it. For that reason, you must represent the logic contained in the process symbols on DFDs with other modeling techniques.

Logic modeling involves representing the internal structure and functionality of the processes represented on data flow diagrams. These processes appear on DFDs as little more than black boxes, in that we cannot tell from only their names or CASE repository descriptions precisely what they do and how they do it. Yet the structure and functionality of a system's processes are a key element of any information system Processes must be clearly described before they can be translated into a programming language. In this chapter, we will focus on techniques you can use during the analysis phase to model the logic within processes; that is, data-to-information transformations and decisions. In the analysis phase, logic modeling will be complete and reasonably detailed, but it will also be generic in that it will not reflect the structure or syntax of a particular programming language. You will focus on more precise, language-based logic modeling in the design phase of the life cycle.

3.5.4 Process Modeling

Process modeling involves graphically representing the functions, or processes, which capture, manipulate, store, and distribute data between a system and its environment and between components within a system. A common form of a process model is a data flow diagram. Over the years, several different tools have been developed for process modeling. In this chapter, we focus on data flow diagrams, the traditional process modeling technique of structured analysis and design and the technique most often used today for process modeling.

Data flow diagramming is one of several notations that are called structured analysis techniques. Although not all organizations use each structured analysis technique, collectively techniques like data flow diagrams have had a significant impact on the quality of the systems development process. For example, Raytheon (Gibbs, 1994) has reported a saving s from 1988 through 1994 of $17.2 million in software costs by applying structured analysis techniques, due mainly to avoiding rework to fix requirements flaws, This represents a doubling of systems developers' productivity and helped them avoid costly system mistakes.

IV. SYSTEM DEVELOPMENT

4.1 The System Operational Diagram

For the area that we focus to study and development is external services area. Now, Hospital has the external services for the Physical Check-Up. In some company has the benefit for the employee to check the health and contact to hospital to for external service. The operational diagram shown in Figure 4.1.

Data Flow Diagram Designing of the Propose System.

The data flow diagram is a process modeling that involves graphically representing the function of the system. It can be used a tool for representing the process of the propose system. The context diagram is shown in Figure 4.1.

4.2 Context Diagram

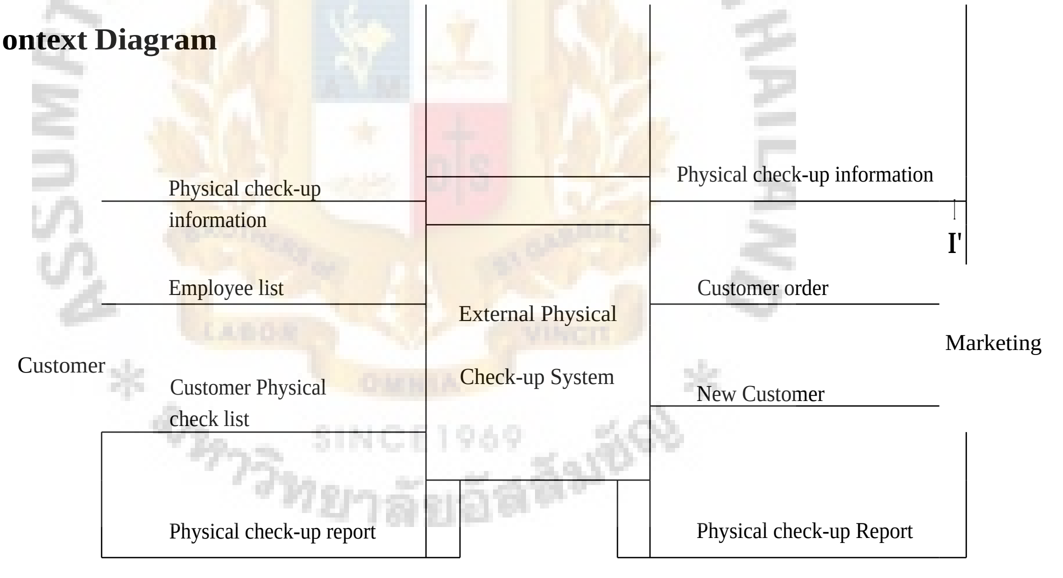

Figure 4.1. Context Diagram.

There are two external entities communicate to the External Physical Check-up System, as shown in Figure 4.1

(a) Marketing:

Marketing section has to provide the customer order into the system. The proposed system will be check whether new customer. If so, the purpose is to request to register the new customer into our record. Current customer, the proposed system has to prepare and check the historical and information. Then the proposed system will provide the infoiniation of Physical check up system to marketing section for communicating to customers for review and add up some physical checklist. Finally, the proposed system will prepare the Physical check-up report to marketing section to contact with financial section in terms of the money and also to provide the Physical check-up reports to customer.

(b) Customer:

The proposed system has to provide the Physical check-up information to customers for reviewing and add up some list of physical check-up. After that, customer will provide the Employee's name list to the proposed system with Physical check-up list for preparing the physical check list report (traveler card) when out-site services.

4.3 LEVEL 0: External Physical Check-Up System

This level shown the main processes of the External Physical Check-up System that shown in Figure 4.2

Process 1: Registration New Customer.

Process 2: Generate Physical check-up information.

Process 3: Create Employee list with Physical information.

Process 4: General Physical check-up.

Process 5: Lab Analysis

General Physical check-up

Create Employee list with Physical information

Compare physical result with last year (If Need)

Generate Physical check-up information

r Physical the

Physical check-up result

sical check-up recor

Physical check-up report

External Physical Check-Up System.

Process 6: Doctor review and comment.

Process 7: Compare physical result with last year (If Need).

Process 8: Generate Report.

4.3.1 Process 1: Registration New Customer.

This process for new customers to registration the information into the proposed system. Marketing section will provide the customer information into proposed system for registration in customer file to keep records.

4.3.2 Process 2: Generate Physical Check-up Information.

Generate Physical check-up information process will review the customer physical checklist against with physical check-up file. Then generate the information for all of customer physical checklist for provides to customer.

4.3.3 Process 3: Create Employee list with Physical infoimation.

Regarding to Generate Physical check-up information process has to provide the physical check-up information and also employee name list from customer to this process. After that, this process has matching & linking the employee name list with physical check-up list. Out site services will print out the report (Physical Checklist: Traveler card) for customer at out site.

4.3.5 Process 4: General Physical Check-up.

This process received input from process#3 for general physical check-up such as weight, height, plus and blood pressure. To key-in those information into proposed system. After that pass all information to process#5 (Lab Analysis).

4.3.6 Process 5: Lab Analysis

Lab analysis is the one of process that received the input from process#3 with included the general physical check-up information from process#4.After that, for all information in process #4 and process # 5 will shown on screen of process # 6.

4.3.7 Process 6: Doctor review and comment.

This process has received all information from general physical check-up process, X-Ray result and Lab analysis result. On screen of this process will shown above information for doctor review and comment.

4.3.7 Process 7: Compare physical result with last year (If Need).

Some customers need to compare the physical check-up result with last year. This process will prepare the report for compare the physical result on the previous with new one. Then pass to process of generates reports.

4.3.8 Process 8: Generate Report.

This process is the summary of information from general physical check-up, Lab analysis and comment from doctors. Thus, prepare the final physical check-up report to marketing section and customer.

4.4 LEVEL 1: External Physical Check-Up System

4.4.1 Level 1: Register New Customer

Figure 4.3. Process **1:** Register New Customer.

(1) Check Customer Eligibility.

This process has received the new customer information from marketing section. Then the proposed system will check customer eligibility, if so, pass all information to covert into proposed system format.

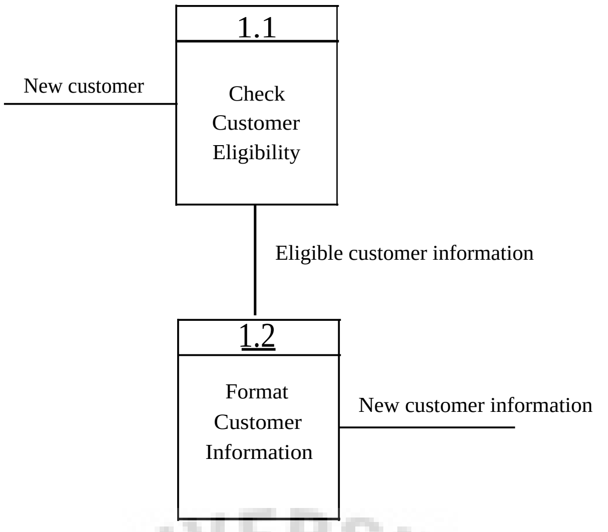

Figure 4.4. Level 1: Processl.1 & Processl.2.

(2) Format Customer information.

This process will be receiving customer information from Check customer eligible process to covert into proposed system format. Then register and keep records into customer file.

4.4.2 Level 1: Generate Physical Check-up Information.

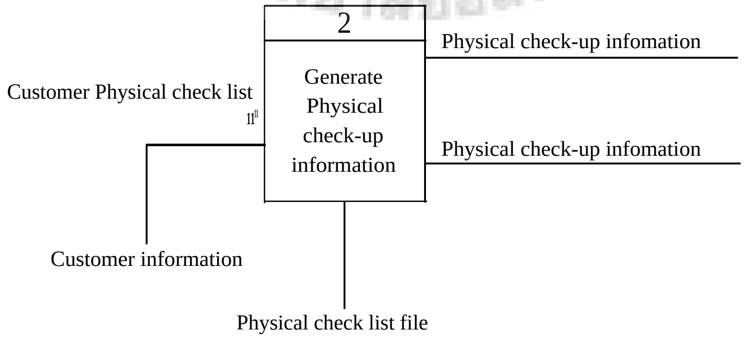

Figure 4.5. Process 2: Generate Physical Check-Up Information.

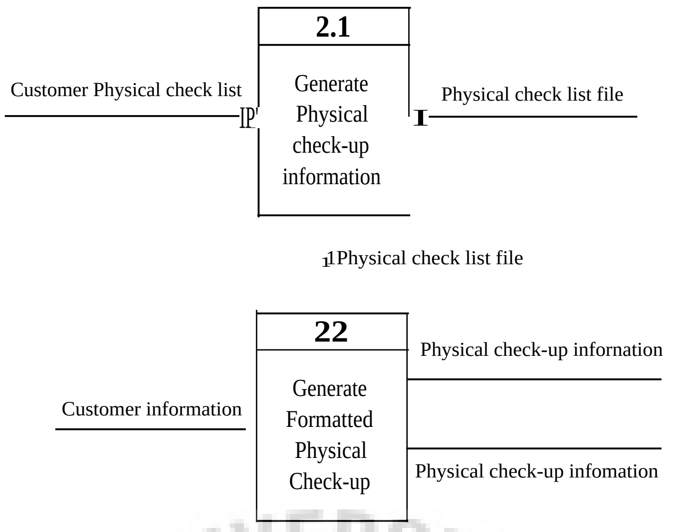

Figure 4.6. Level 1: Process2.1 & Process2.2.

(1) Generate Physical check-up information.

Receive customer physical checklist to review against physical checklist files. Then pass some physical checklist files to next process.

(2) Generate Format Physical Check-up

This process has to prepare physical check-up information with include customer information such as company name, address and telephone number.

4.4.3 Level 1: Create Employee List with Physical Information

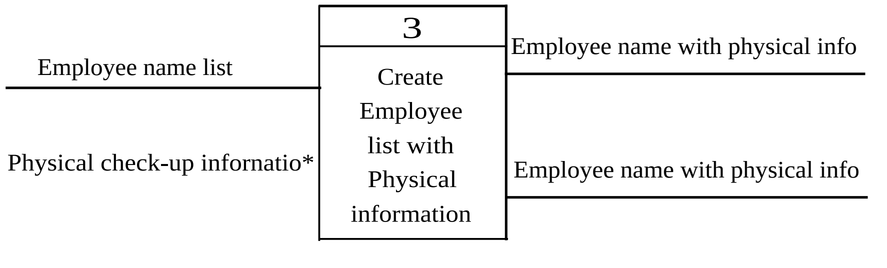

Figure 4.7. Process 3: Create Employee List with Physical Information.

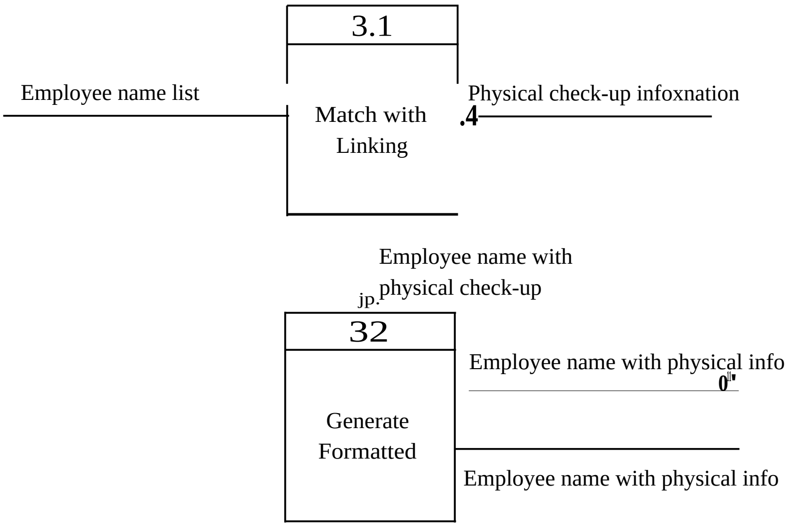

Figure 4.8. Level 1: Process3.1 & Process3.2.

(1) Match with Linking

This process will be matched and linked between customers and employees name lists with physical check-up information. After that, pass information of employee's name with physical check-up to generate of proposed system format.

(2) Generate Formatted

This process has generated employee name with physical check-up information in proposed system format.

4.4.4 Level 1: Doctor Review and Comment

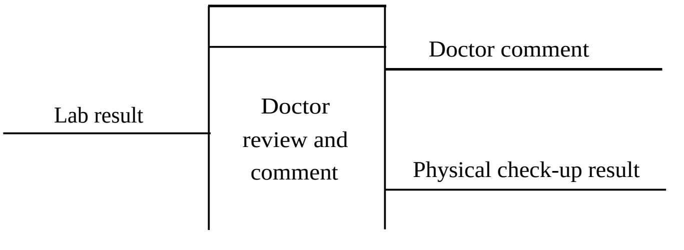

Figure 4.9. Process 6: Doctor review and Comment.

(1) Check & Review Lab Result

Doctor will review and check reading from the lab results after lab had key-in lab result. After check lab reading, doctors will key-in the comment of lab result. In case of abnormal reading from lab result, Lab officer will check back and retest again for confirm the lab result.

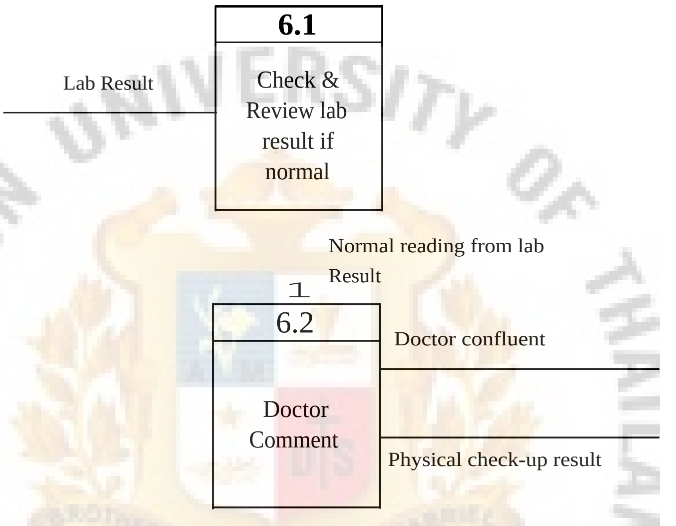

Figure 4.10. Level 1: Process6.1 & Process6.2.

(2) Doctor Comment

This process doctor will comment are X-Ray result, Lab result and general comment include with recommendation.

4.4.5 Level 1: Compare Physical Check Result with Last Year (If Need)

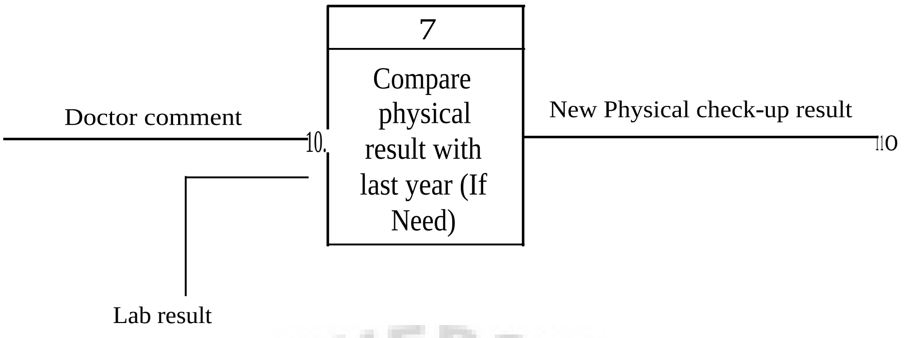

Figure 4.11. Process 7: Compare physical result with last year (If Need).

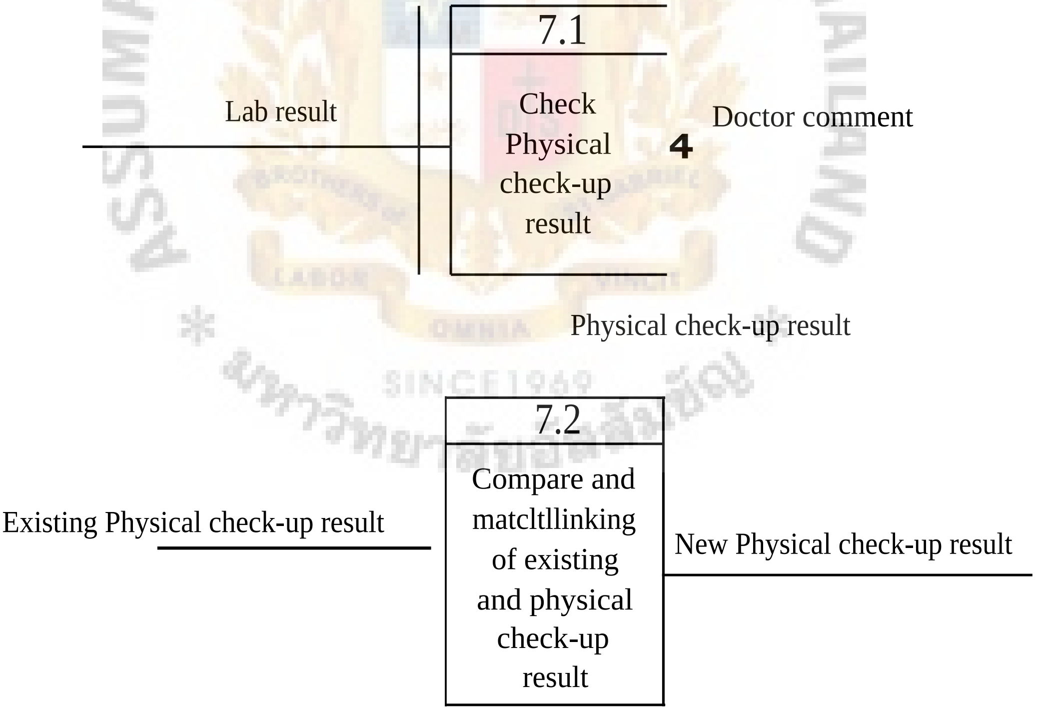

Figure 4.12. Level 1: Process7.1 & Process7.2.

(1) Check Physical check-up result

Doctor will review and check reading from lab result after lab had key-in lab result. After check lab reading, doctors will key-in the comment of lab result. In case of abnormal reading from lab result, Lab officer will check back and retest again for confirm the lab result. .

(2) Compare and match/linking of existing physical check-up result

This process will compare and match the existing physical check-up result with new physical check-up result (if need).

4.5 Entity Relationship Diagram (ERD)

The Entity Relationship Diagram (ERD) is a tool that used show data modeling of proposed system, as show in Figure 4.13. There are 4 entities.

Each entity has its own attributes that related to others.

(1) Check-up Information.

(2) Complete Blood Count.

(3) Urine Analysis.

(4) Liver Function

(5) Blood Chemistry and Serology.

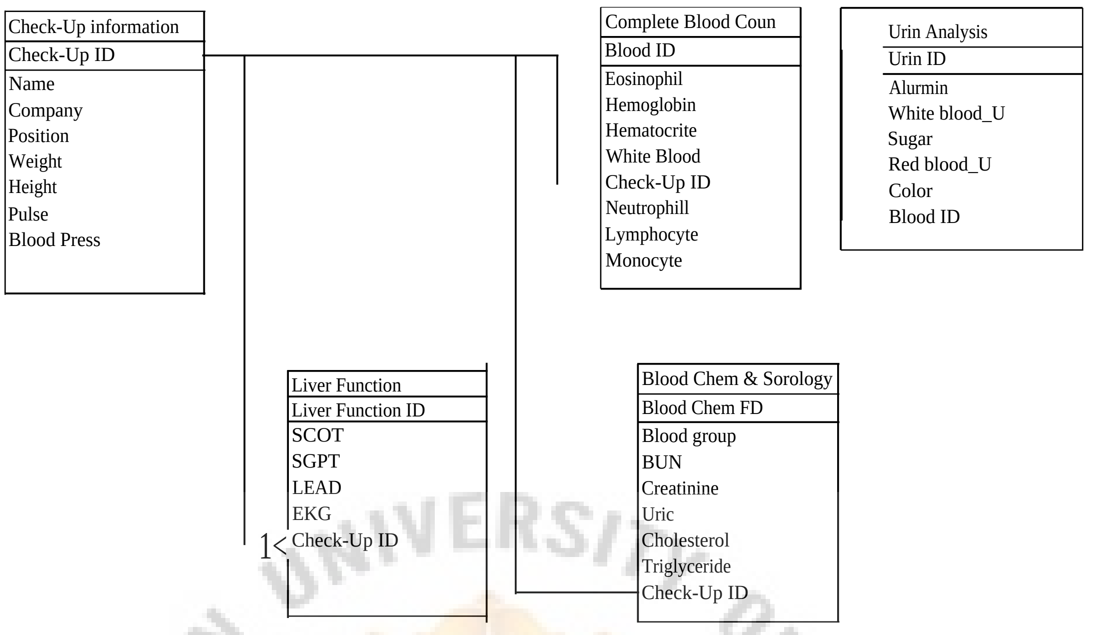

Figure 4.13. Entity Relationship Diagram (ERD).

4.6 Computer Networking Structure

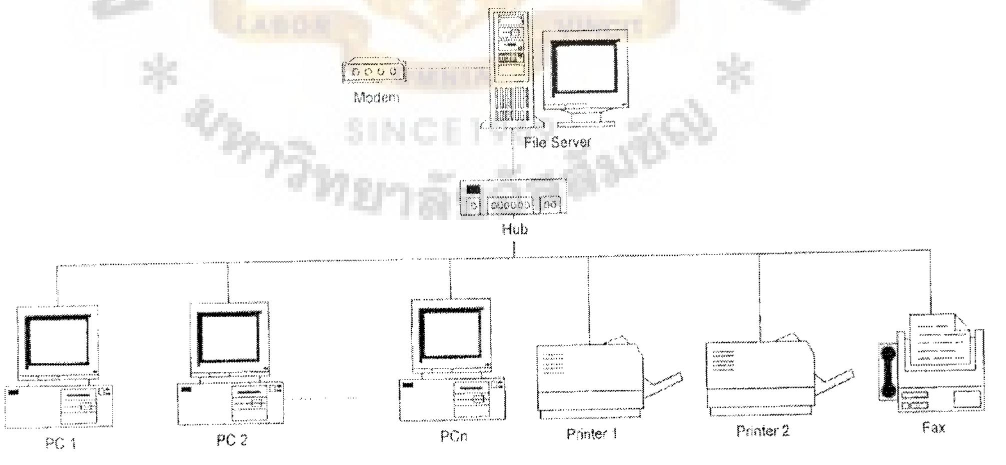

Figure 4.14. The Local Area Network Structure.

The purpose of the Computer Networking Structure is supported by Local Area Network (LAN) technology. The detail of this technology and essential component of computer networking are explained in chapter 2. The computer networking is shown in Figure 4.14.

4.7 Hardware and Software Requirements

The purpose of this project is to eliminate the problems of the existing system and improve productivity with not to take more times in Physical Check-Up processes. After complete the purposed system by applying an existing operation to a Data Base Management System, the working time and paper work will be reduce then make the customer satisfaction for more effective than the exiting one. The hardware and software requirements are.

4.6.1 In Site Requirement

(1) Hardware Requirement

(a) HUB or Switching (Number channel is depend on stations as required).

(b) LAN Card (More than 10/100 Mbps).

(c) Personal Computer Work stations.

(1) Pentium IV.

(2) 128 MB RAM.

(3) 4 GB HD.

(2) Software Requirement

(a) 0/S Program

(1) Window NT.

(2) Novell (Net-Ware).

(b) MS Visual Fox-Pro.

4.6.2 Out Site Requirement

(1) Hardware Requirement

(a) PC with Pentium IV (RAM: 128 MB and Hard Disk: 4 GB HD).

(b) LAN Card (More than 10/100 Mbps).

(2) Software Requirement

(a) 0/S Program: Windows 98 or Window 2000 dealing with networking.

(b) Visual Fox-Pro.

V. SYSTEM EVAUATION

5.1 Verification

Verification of the new of Physical Health Check-Up Record System that I have developed the software. I simulated to use the Physical Health Check-Up Record System at Navanakorn hospital for one company.

(1) Working process time:

(a) Registration:

Existing System: Patient has to register by hand writing to fill-in the information such as First Name, Last Name, Employee Number and Company Name etc... into Physical check-up form (traveler form).

Proposed System: Request the employee list then transfer into database. External working, Key in the employee number into program, it will show the employee information then print it out.

Existing System: Hour Per Unit (HPU) = 8-10 minutes.

Proposed System: Hour Per Unit (HPU) = 1-2 minutes.

(b) Measurement of basis check-up:

Measuring the basis check-up such as age, height and weight then record onto Physical check-up form.

(c) Bloodless:

Attach the Name and Employee number on the blood tube then patient has bloodless into tube for lab analysis.

(d) Laboratory Analysis:

Existing System: Lab officer has analyze/test the blood then fill-in the result onto Physical check-up form (traveler card).

Proposed System: Lab officer has analyze/test the blood then fill-in the result into Physical check-up database.

Existing System: Hour Per Unit (HPU) = 7-8 minutes.

Proposed System: Hour Per Unit (HPU) = 4-5 minutes.

(e) Doctor recommendation:

Existing System: Doctor has been analyzing the reading from lab report and then reports the result of physical check-up and recommendation onto Physical check-up form (traveler card).

Proposed System: Doctor will analyses the reading from lab report in Physical check-up data-base then fill-in recommendation.

Existing System: Hour Per Unit (HPU) = 7-8 minutes.

Proposed System: Hour Per Unit (HPU) = 4-5 minutes.

(f) Keep Record:

Existing System: Physical Check-Up department has copies the completed fill-in of Physical check-up form (traveler card) and keep it by hard copy. After that pack in box and identify on the box.

Proposed System: Automatically keep record in the Physical check-up database.

Existing System: Hour Per Unit (HPU) = 1-2 minutes.

Proposed System: Hour Per Unit (HPU) = Zero.

(g) Customer Report:

Existing System: Marketing department has collect the original completed fill-in of Physical check-up form then report the Physical Check-Up result to customer.

Proposed System: Print the Physical Check-Up result from Physical check-up database. Marketing department has made a book report of Physical Check-Up result. Thus, report to customer.

(2) Tractability:

Firstly, in business world has very high competitive, so that "Quality" is importance. ISO 9000 is the quality standard to show and make the customer to know "Quality" of your product and service. Tractability is one of requirement in ISO 9000.

Secondly, Some of the customers would like to comparison of Physical Check-Up result between last year and current year.

Verification in Tractability:

Existing System: Manual finding from hard copy that keep in the box.

Proposed System: Automatic search in Physical check-up database.

(3) Reduce paper work:

For the existing system uses the base on paper to keep record but the proposed system will keep records in the computer database. Proposed system can be reducing the cost of paper because of the proposed system use the computer database. It can be reduce paper from around 20 boxes to 5 boxes per company that has services

5.2 Validation

The proposed system has met the objective of this project are:

(1) It can be reduce the working process time.

Existing System: HPU around lhour (60 minutes).

Proposed System: HPU around 30 minutes.

(2) Reduce the paper work for manual record and hand carry the information to pass for all concern departments.

(3) Accurate information and easier to tract back for historical of patient.

5.3 Evaluation Summary

After the proposed system is completed, the problem of the existing is replaced and it also provides the effective communication to the entire concerned department in Physical Check-Up process.

The proposed system has provides the reduces cost of paper work and improves the working processes time of customer report from a few week to one week after collected information and finish processes.

(1) Verifies existing system of the Physical Health Check-Up Record System.

(2) Development software of the Physical Health Check-Up Record System.

(3) Recommendation the hardware and software.

(4) Limited to design of Physical Health Check-Up Record software which not include phase of implementation of system.

VI. CONCLUSIONS

6.1 Project Summary

The study of the project started from studying and analyzing the existing system of Physical Check-Up processes that use manual for all operations/processes. It is found there are many problems that have been in existing system (manual record) such as the accuracy of information has not enough, difficult to retrieve/revise information, having duplicated work and time consuming. Thus, researcher has to plan the proposed systems that replace the existing system (manually) with new system design (computer database) to meet the user requirements.

The objective of the project is propose the computers database based Management Information System (MIS) with Fox-Pro data base program. MIS supplies database to collect and record the data replaced with manual data collection. It will support the communication and data from only one source of infoiiiiation to concern departments that need the information to used and process to next operations. Reduce the duplicated information and working process in Physical Check-Up System. In order to secure the information of the purposed system. The user authentication and access control and the encryption method will be applied to the purposed system. It will provide high security in communication and information.

6.2 Achievements

Study the existing system, which base on manual procedure and identify problems and weakness of the manual system. Replace the existing Check-Up record for external system based manual procedure with the Data Base Management System (DBMS).

After the proposed system is complete, the problem of the existing system is replaced and it also provides the effective communication to the entire concern department in Physical Check-Up process.

The proposed system provides reduced cost of paper work and improves the working processes time of customer report from a few weeks to one week after collecting information and finishing the processes.

APPENDIX A

OTHER RELATED TERM

OTHER RELATED TERM

(1) **Asynchronous Transfer Mode (ATM):** A type of switching technology in which the switches are small, fixed-length cells containing data.

(2) **Backbone:** A segment of network that links several individual workgroup or department LANs together in a single building. It is also used to link several building LANs together in a campus environment.

(3) **Bridges:** Bridges filter packets between LANs by making a simple forward/don't forward decision on each packet they receive from any of the networks to which they are connected.

(4) **Carrier Sense Multiple Access with Collision Detection (CSMA/CD):** An element defined by the 802.3 specifications. It is an access method that used by stations connected to an Ethernet LAN. In this method each station contends for access to the shared medium.

(5) **Collision:** When two stations try to send packets at the same time. In Ethernet networks collisions are considered normal events and the CSMA/CD access method is designed to quickly restore the network to normal activity after a collision occurs.

(6) **EMI:** Electromagnetic interference.

(7) **Ethernet:** The most popular LAN technology in use today.

(8) **Inter-Repeater Links:** One method of linking hubs. This type of connection simply repeats all of the packets from one hub to the other hub it is linked to, so that in effect the two hubs are part of the same LAN.

(9) **LAN Inter-Network:** Connecting disparate and geographically dispersed local area networks together to form an enterprise system.

(10) Local Area Network (LAN): A LAN is a high-speed communications System designed to link computers and other data processing devices together within a small geographic area such as a workgroup, department, or a single floor of a multi-story building.

(11) Manageable Hubs: Another definition for intelligent hubs. Each of the ports on the managed hub can be configured, monitored, and enabled or disabled by a network operator from a hub management console.

(12) Modular Hubs: A modular hub starts with a chassis, or card cage, with multiple card slots, each of which can accept a communications card, or module. Each module act like a stand-alone hub when the communication module are placed into the card slots of the chassis, they connected to a high-speed communication back plane that link them together. So that a station connected to a port on one module can easily communicate with a station on another module.

(13) Network Interface Card (NIC): The physical connection from the computer to the network is made by putting a network interface card (NIC) inside the computer and connecting it to the shared cable.

(14) Multi-station Access Unit (MAU): A Token Ring wiring concentrator that connects each station in a Token Ring LAN.

(15) Open Systems Interconnect Reference Model (OSI): A communications model developed by the International Standards Organization (ISO) to define all of the services a LAN should provide. This model defines seven layers, each of which provides a subset of all of the LAN services. This layered approach allows small groups of related services to be implemented

in a modular fashion that makes designing network software much more flexible.

(16) **Packet:** In a shared media network, when one stations wishes to send a message to another station, it uses the network software to put the message in an envelope. This envelope is called a packet.

(17) **Routers:** Routers are more complex in internetworking devices and are also typically more expensive than bridges. They use Network Layer Protocol Information within each packet to route it from one LAN to another.

(18) **Shared Access:** Shared media technology means that all of the devices attached to the LAN share a single communications medium, usually a coaxial, twisted pair, or fiber optic cable.

(19) **Structured Wiring Architecture:** A structured wiring architecture, which physically star-wires all network stations to intelligent hubs.

(20) **Switches:** Links several separate LANs and provide packet filtering between them. A LAN switch is a device with multiple ports, each of which can support an entire Ethernet or Token Ring LAN.

(21) **10BA SE-T:** The specification for running Ethernet on UTP. This stand for 10 Mbps, baseboard signaling (the signaling method used by Ethernet networks), over twisted pair cable.

(22) **Token Passing:** The access method used on Token Ring networks.

(23) **Token Ring:** A major LAN technology in use today. Token Ring rules are defined in the IEEE 802.5 specification. Like Ethernet, the Token Ring protocol provides services at the Physical and Data Link Layers of the OSI model. Token Ring networks can be run at two different data rates, 4 Mbps or 16 Mbps.

(24) Stands and Protocols: LANs are complex systems that implement many different services in order to provide communication between all of the types of devices that can be connected to them. A communications model called the Open Systems Interconnect (OSI) Reference Model was developed by the International Standards Organization (ISO) to define all of the services a LAN should provide (see Figure Al). This model defines seven layers, each of which provides a subset of all of the LAN services. This layered approach allows small groups of related services to be implemented in a modular fashion that makes designing network software much more flexible. A network software module that implements services at the Network and Transport Layers of the model can be paired up with different Physical and Data Link Layer module depending on the requirements of the users application.

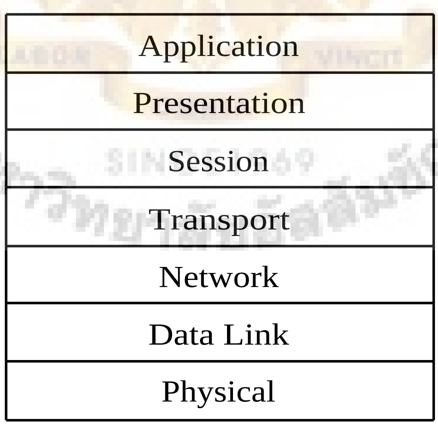

Figure A.1. OSI Seven Layers Model.

But the OSI model doesn't say how these services should actually by implemented in LAN equipment. The how to part has been defined in a number of different protocols that have been developed by international standards bodies, individual LAN equipment vendors, and ad hoc groups of interested parties. These protocols typically define how to implement a group of services in one or two layers of the OSI model. For example, Ethernet and Token Ring are both protocols that define different ways to provide the services called for in the Physical and Data Link Layers of the OSI model. The Institute of Electrical and Electronic Engineers (IEEE), an international communications standards body has approved them both. Because they are approved and published by the IEEE, both the Ethernet and Token Ring protocols are said to be industry standards. Any company can acquire the specifications and design Ethernet or Token ring NICs. Users can purchase an Ethernet NIC, for example, from any vendor and be assured that it will operate in a network with Ethernet NICs from other vendors. This degree of interoperability is highly desirable.

However, they are many more protocols for providing services at the higher layers of the OSI model and very an international standard body has approved few of them. In fact, most upper layer LAN protocols are incorporated into proprietary network operating systems, such as Novells NetWare, IBMs LAN Server, and Microsoft LAN Manager. A user has to buy only those vendor products in order to be assured that they will interoperate on a LAN.

(25) Network Operating Systems: Ethernet and Token Ring technologies are just one part of a complete LAN. They provide the services specified in the Physical and Data Link Layers of the OSI model, but several other services must be added on top of the connectivity of Ethernet or Token Ring.

Network operating systems (NOSs) are most often used to provide the additional communications services. A NOS defines client and server systems. Clients are individual user workstations attached to the network where application programs are run and data is generated. Servers are shared network resources that provide hard disk space for users to store files, printer services, and a number of other network services. The network operating system provides a set of protocols in software that run on both servers and client systems and allows them to communicate with each other, share files, printers and other network resources.

APPENDIX B

GRAPHIC INTERFACE LAYOUT

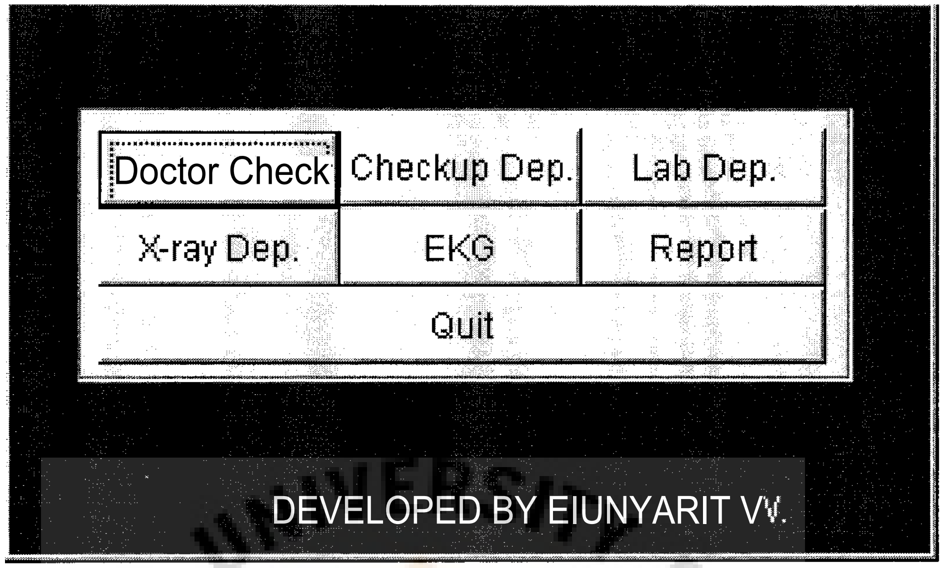

Figure B.1. Main Menu.

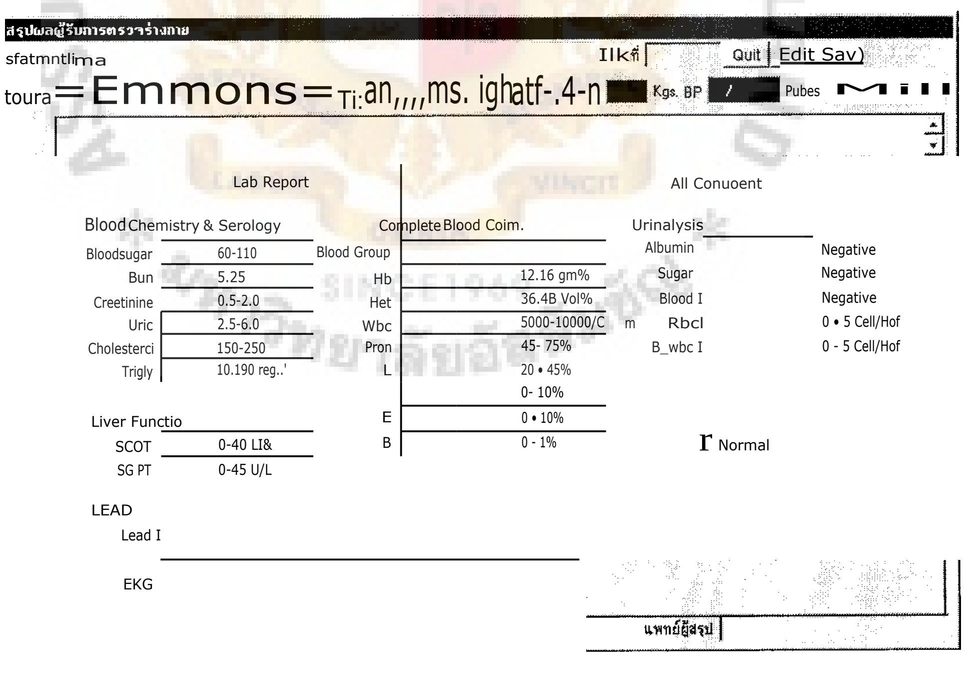

Figure B.2. Doctor Reading and Comment.

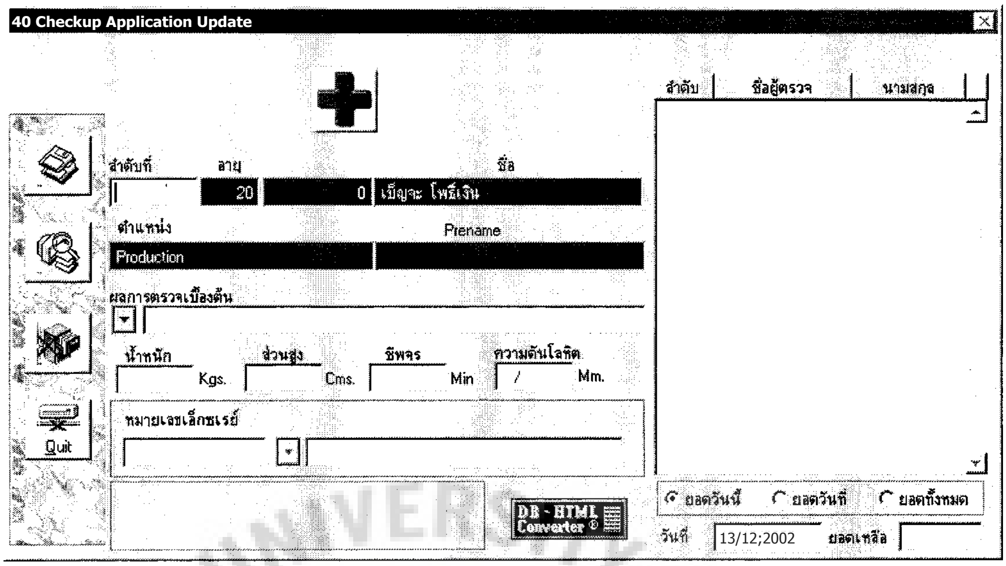

Figure B.3. General Information of Physical Check-Up.

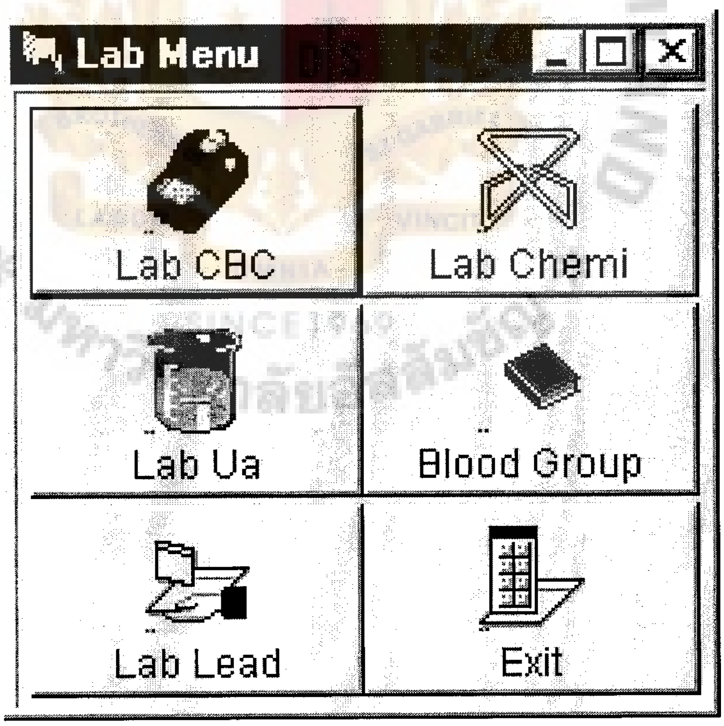

Figure B.4. LAB Main Menu.

APPENDIX C

REPORT DESIGN

Name **n141 ip** CHK No. 22 Date : *231012002*

Company em Wsn460 **Position** Pmclimthn

Weight(Kg) **Height(mm)**

Pulse **Blood Pre**

Complete Blood Coun :			**Urinanlysis :**	
Hemoglobin	0	g/dl	Alurmin	Negative
Hematocrite	0	%	Yhite Blood	Negative
Yhite Blood	0	Cells/UL	Sugar	*Negative*
Neutrophill	0	%	Red Blood	Negative
Lymphocyte	0		Color	Yam
Monocyte	0			
Eosinophil	0			

Blood Chemistry & Serology :			**Liver Function :**		
Blood Group			SGOT	0	U/L
BUN	0	mg/dl	SGPT	0	U/L
Creatinine	0.00	mg/dl			
Uric	0	mg/di			
Cholesterol	0	mg/dl	LEAD		ug/dl
Triglyceride	0	mg/dl	EKG		

CaNNENT

Figure C.1. Physical Check-up Report.