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ABSTRACT

The growth of the Internet and other powerful technological infrastructures allowing companies of all shapes and sizes to add value to the traditional business process, both internally and externally. The project, Integrated Business Solution (IBS), is designed to integrate all the main backend and front-end system of a company, as well as with third party such as banking institute and the supplier. This is important in streamlining the business transaction and critical data flow among the trading communities.

E-supplier is one of the modules in this IBS project. It is designed to facilitate the business process between the buyer and the supplier. This system provides three modules to meet different needs from general user, registered customer and the administrator. All users are allowed to view the catalogue and place order online. Personalization page function is deployed in this system for the registered customers to allow them to do order tracking and furthermore, reorder easily. Value added to both parties.

In the administrator module, one of the important features in this system is the ability to create an electronic link and sharing operational information with the customer/ buyer inventory system to improve supply chain, and increase speed and flexibility. Inventory and sales data are retrieved from the customer's backend system for value-added supply chain. Electronic catalogue was implement to aid the business process and eliminate the traditional paper-based catalogue and paper-form; this will make the business transaction more cost-effective.

The system is developed using Web-based approach, which enable the users to reach on the system remotely regardless of the time and location. ASP technology was deployed to enhance the dynamic content and improve interactive functionality. Besides, Windows 2000 Server, IIS, Microsoft SQL Server 7.0, HTML, and VBScript are implemented in this project. Microsoft Visual InterDev is used as Web development tool.

ACKNOWLEGMENT

First of all, I wish to express a special thanks to my supervisor, Pn. Norizan Mohd. Yasin, for her advice and guidance during the preparation of this project. My most important thanks to her, especially for being extremely helpful and caring all the time. Without her support and encouragement, I would never have completed this paper successfully.

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Not forgetting all of my teammates who have been so helpful in giving me some ideas and elaborations. They are Ms. Wee Siew Ying, Ms. Chong Wan Sian, Mr. Kuan Kian Keong, Ms. Lim Mun Ching, Ms. Chin Hui Mei, Ms. Choo Sin Yong and Ms. Yeap Hui Peng. I am so grateful for their time and assistance, and also keeping me accompanies all the time during the discussion.

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INTRODUCTION

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INTRODUCTION

1.1 Project Definition

A silent revolution is occurring subsequent by the discovery of the Internet, the Information Superhighway. It affects the way people shop for product and services, conduct business, gather information for personal and business use, and meet people.

Nowadays, the Internet is changing the way businesses serve their customers and the way they work with suppliers and service providers. With the business environment becoming increasingly complex and competitive, businesses need to examine alternatives to optimise growth prospects and maximise shareholder value [1]. Partnerships and strategic alliances becoming key issues in develop strategic relationships in business.

The **e-supplier** system is one of the modules in the **Integrated Business Solution (IBS)** project. This whole project is designed and developed based on **E**nterprise **R**esource **P**lanning (ERP) concept. IBS is consist of eight different modules (see Figure 1) as listed below:

- *E-office*: The role as the administrator, which responsible in controlling system access from all level of the organization, regardless whether it is internally or externally.
- *E-human resource*: Involve in the organization's personal management such as employment, payroll, employee profile management, etc.
- *E-accounting*: As the financial management department where it responsible in monetary controlling, general ledger, and other account relevant asset in the organization.
- *E-inventory*: Responsible in warehouse management and inventory control. It involves in product purchasing, stock management, and product separation to the salespersons.

- *E-sales*: Conducts sales online to the end users.
- *E-marketing*: Responsible in marketing researches and surveys, promoting, and other issues that concern about marketing area.
- *E-banking*: Act as the third party who responsible in online banking transaction.
- *E-supplier*

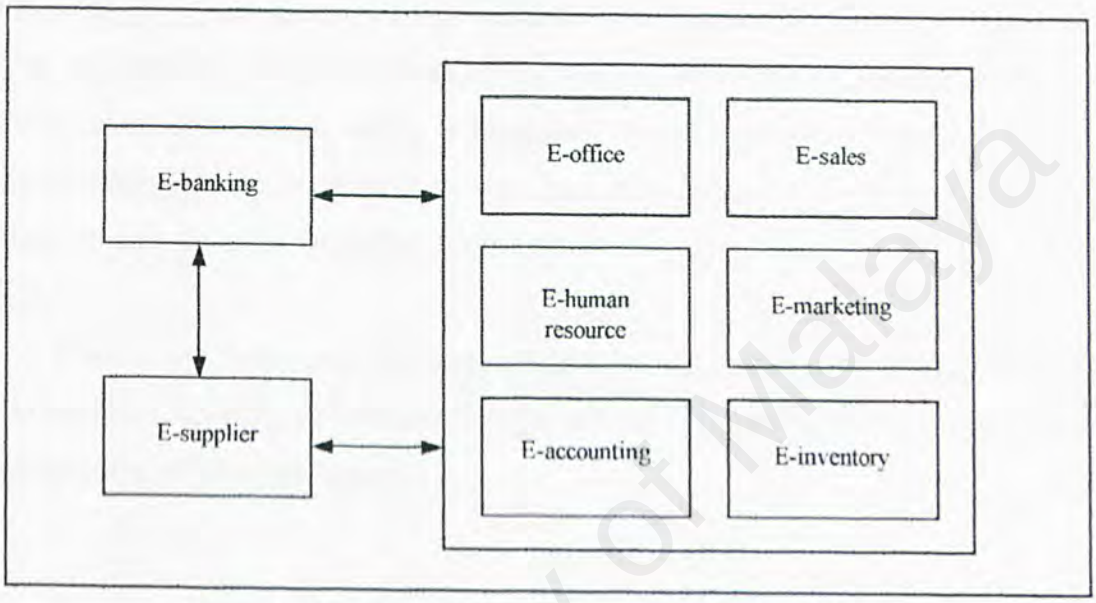

Figure 1: Overview of Integrated Business Solution (IBS)

E-banking and e-supplier are considered as the third party to an enterprise. E-supplier is designed to create a Web-based application that capable in streamlining the business activities between the enterprises and the suppliers.

It today 's business-paced business climate, many organizations still conduct their sales process and doing business manually or by using phone and fax machine. This will bring to inefficient communication mode and cause significant business pain between buyers and vendors. Therefore, today's company of any size should offer electronic data interchange because the World Wide Web (WWW) provides a significant transport medium. E-supplier is able to improve supply chain efficiencies and building stronger customer relationships. It enable suppliers to quickly and efficiently provide a catalogue based online selling facility for their customers with broad functionality supporting, alliances, and backed system integration. As the General Manager e-Business at Optus, Noel Hamill explains, "If you supply your

products online, there is a greater chance of winning orders because your catalogue is easily accessible on any PC within a customer's organization. It's this convenience and ease of use that allows you to lock-in your customers, build loyalty and get an edge over competitors." [2]

E-supplier is designed to provide efficient catalogue management and conducting sales transaction online. Several support features such as order tracking, and FAQ are also included. On the other hand, e-supplier is integrated with trading partner backend system in controlling the partner's inventory level and collect products' sales information which is important for the suppliers to analyse on the products' popularity on the customers site. This is intends in creating trading portals for buyers and sellers. Therefore, information sharing is vital in this integrated system.

Clearly, this business-to-business integration will permanently change the way we do business, opening up new avenues for cutting costs and growing revenue, and also expanding markets strategies.

1.2 Project Motivation

Project motivation serves as a catalyst toward the successful implementation of the project. It is the driving force that invokes the idea of developing this project.

Below shows the motivation concerned:

- Create an efficient communication between buyers and suppliers.
- Cut down the time involved to complete the entire buy/sell process.
- Eliminate processing errors.
- Real-time data and inventory.
- Create better customer relationship.
- Quality of service.

1.3 Project Objectives

This project intended to streamline the business activities of the organization and its trading partners. The objectives of this project are as below:

- To improve industry's value chain of companies those supply and buy from one another by using open standard and nonproprietary Internet protocol.
- To provide electronic catalogue replacing traditional ink-and-paper static medium.
- To provide online ordering by using interactive forms.
- To reduce cost of sale, transaction management and order processing.
- Streamlining the sales order fulfillment process such as in invoicing.
- Strengthened customer relationship through customized communications and services such as allows customers to track previously ordered item and status.
- To maintain customers profile for personalize interactions and build customer loyalty.
- Integrated with customers' backend system for inventory controlling purpose.
- Adopt telegraphic transfer and cheque as the payment option.

1.4 Project Significances

E-supplier is intended to provide process automation between the supplier and customers electronically. Information sharing characteristic eliminated traditional barriers among trading partners, hence, improve business perspective. Here are some project significances:

- To provide a user friendly interface using graphical user interface (GUI), self-explanatory, easy-to-use menus and browsers for the supplier.
- To build an application architecture, which based on publicly defined and open standard that enable quick creation and deployment of robust, dynamic, and platform independent application.

- To ensure integration between the concept network solution and existing network infrastructure and logical isolation administrative domain from unauthorized use of facilities and resources, while maintaining data-availability for authorized users.
- To provide a paperless environment that eliminates all paper statement or documents involves in business transaction such as invoices, order forms, catalogue, etc.

1.5 Project Scope

This project is focused mainly in business (buy/sale) activities that involved large volume. It provides product and services for small- to large-scale organization such as retail shops. Individual or end users are not involved in the product ordering transaction and any business transaction. The scope of this project can be categorized into three main areas as below:

- **General users**

  Everyone on the Internet is able to view the pages under this module. Users are allowed to view company's details, product catalogue, and FAQ. Furthermore, users able to place their order using the preformatted order form and send it online.

- **Registered customers**

  A registered customer has the same viewing priority as the general users. Moreover, the users are allowed to access certain confidential data after mandating the authentication verification. The buyer will be automatically registered to the supplier system as they submit their first order form and customer details form. The login and password are predetermined by the customers themselves during the registration. Register customers are able to view their own profile, order history and order tracking.

- **Administrator**

  Administrator refer to the supplier internal officer that using the system doing backend processes such as catalogue management, sales order

fulfilment management, customers' sales analysis and real time customer inventory control. This module is restricted to the administration staff only, therefore, authentication is being used as security purpose before ones can access this module pages.

1.6 Project Limitation

The limitations of this project are shown as below:

- Supports single communication language, which is English.
- No currency conversion service.
- Project development will be performed in single computer machine.
- Inventory, logistic and delivery functions are not included.

1.7 Project Schedule

Project schedule was premeditated as a guideline to manage the task that need to be accomplished during the system development. It is important to ensure the objectives and goals of the project are successfully achieved. The project schedule is as illustrate below:

Date / Activities	2001							2002
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Literature Review								
System Analysis								
System Design								
Coding								
Testing								
Evaluation								
Documentation								

Table 1: Project Schedule

1.8 Project Layout

The purpose of this layout is to give an overview of the major phases involved during the development of the project. Below is the project layout:

Chapter 1: Introduction

This chapter gives an introduction of the project, the project significance, objectives, project slope and the project schedule.

Chapter 2: Literature Review

This chapter covers all the literature survey done on this project.

Chapter 3: System Design

This chapter discusses the functional and non-functional requirements of this project.

Chapter 4: System Design

This chapter describes the design considerations including processing design, database design and the Web page interface design of this project.

Chapter 5: System Implementation

In this chapter, the system development environment requirements including both hardware and software requirements are discussed. Furthermore, coding approaches, coding style and examples are illustrated. Program documentation and system modules are briefly discussed.

Chapter 6: System Testing

The necessary testing procedures are carried out to evaluate the system's function and non-functional requirements. This is to ensure that the developed system meets the system objectives and specifications that had designed.

Chapter 7: System Evaluation

This chapter discuss on topics relevant to application assessment. Problems encountered during the development phases are elaborated with the solutions applied. Besides, system strength, limitation and future enhancement are mentioned for evaluation purpose. Finally, topic about knowledge and experience gained are discussed here.

1.9 Summary

E-supplier is one of the modules in the Integrated Business Solution (IBS) project. A brief introduction and definition are stated in the first part of this chapter, which is the Project Definition. Apart from that, relevant information and topics are also being discussed consequentially. Topics included are Project Motivation, Project Objectives, Project Significances, Project Scope, Project Limitation, Project Schedule, and Project Layout.

Chapter 2

LITERATURE REVIEW

CHAPTER 2
LITERATURE REVIEW

2.1 Fact Finding Techniques

Several researches were being conducted in the process of collecting requirements and specifications to complete the project. Approaches that being used are as below:

- **Internet research**

  Internet is a very effective and significant medium in conducting research. The World Wide Web (WWW) was used to observe on the examples and theories of the e-supplier system. Relevant information also gained easily through the Internet. Some useful search engines are:

  - http://www.google.com
  - http://www.altavista.com
  - http://www.yahoo.search.com
  - http://www.msn.com

  Keywords such as "ERP", "e-supplier", "electronic supplier", "supply chain management", etc. were used in this searching process. E-supplier examples those being found are not able to access or demonstrate, except for the systems' brief introduction about its features and advantages. However, the ideas and features are used as the guideline in this project analysis phase. Besides, information about development software and technologies are collected for comparing purpose.

- **Group discussion and brainstorming sessions**

  Brainstorming session among group member, course-mates, and supervisor, is a productive way in collecting ideas, suggestions, and solutions of this project.

- **References**

  Materials such as books, magazine, journals, newspapers, and thesis were review through for making comparisons and grasp the ideas. Research is not only concentrate on ERP topics, it also take account of the software and hardware requirements. However, information about e-supplier is not able to find through this method.

2.2 Introduction to Internet, intranet and extranet

2.2.1 Internet

The name "Internet" is derived from the concept of "internetworking", that is, connecting host computers and theirs networks to form an even larger, global network [3]. It is a large worldwide network of networks that use a common protocol to communicate with each other. The networks that make up the Internet are each developed and maintained by different organizations, ranging from government agencies, to educational institutions, to private businesses, and to large commercial services. Therefore, no single person or organization, owns or maintains the Internet.

The Internet was evolved from the ARPANET, which was developed in 1969 by the Advanced Research Project Agency (ARPA) of the U.S. Department of Defence. ARPANET began operations in four locations: University of California at Los Angeles, SRI (Stanford Research Institute) International, the University of California at Santa Barbara, and the University of Utah [4]. ARPANET was created by many of the best communications technology researchers who were hired by the Defence Department agency due to their concern about the possible effects of nuclear attack on its computing facilities. The Defence Department realized that the weapons of the future would require powerful computers for coordination and control. That is why a worldwide network that could operate independently was built to control weapons systems and research files transferring.

In the early 1970s, other uses for this vast network began to appear. In 1972, a researcher wrote a program that could send and receive messages over the network. Consequently, the electronic mail (or e-mail) had been born and became widely used

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In the early 1970s, other uses for this vast network began to appear. In 1972, a researcher wrote a program that could send and receive messages over the network. Consequently, the electronic mail (or e-mail) had been born and became widely used

very quickly. Besides, the network software such as File Transfer Protocol (FTP) and Telnet that were developed for the ARPANET earlier are still widely used on the Internet for file transfers and remote logins. Additionally, more advanced techniques are now available that allow multimedia transmissions such as real-time audio and video clips.

The defence Department's networking software then became more widely used as academic and research institutes realized the benefits of having a common communication network. However, the use of the networks was limited to those members of the research and academic communities who had access to the networks only. In the late 1980s, these independent academic and research networks merged into what we now call the Internet. As the personal computers became more powerful, affordable and available, the Internet has become one of the most amazing technological and social accomplishments of the century. Million of people are using a complex interconnected network of computers to run thousands of different software packages from almost every country of the world.

As the Figure 2 shows, from 1991 through 1999, the number of computers directly connected to the Internet has been growth dramatically. Companies, groups, institutions and individuals are sharing a wide range of data including text, video, audio, graphics, databases and other media types on the Internet. Recently, the largest growth segment of the Internet has been the business sector. Business are using the Internet for commercial purpose such as electronic commerce and marketing, global communications, customer feedback and support, and corporate logistics.

The Internet is more than data and information. It enables you to be in contact with people from all over the globe by using tools such as e-mail and newsgroups. However, there is another development that worked hand-in-hand with the commercialisation of the Internet to spur its growth. That development was the World Wide Web.

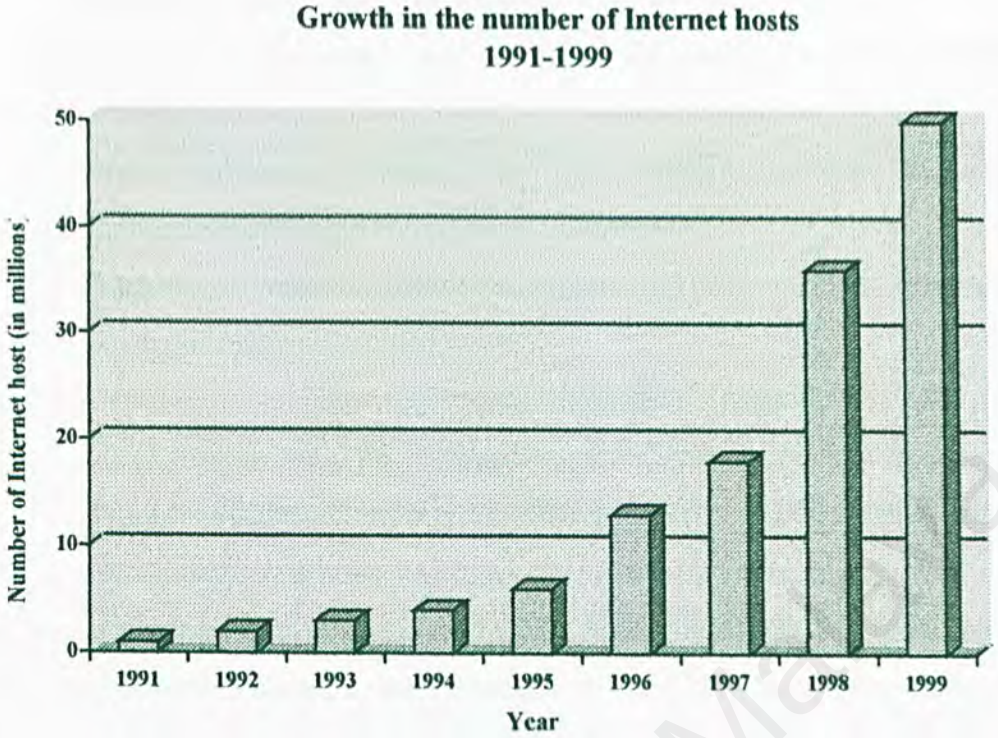

Figure 2: Growth of the Internet

2.2.2 Intranet

Intranet, can be considered as a form of client-server architecture, is a term used to refer to the implementation of Internet technologies within a corporate organization rather than for external connection to the global Internet. Only selected individuals are allowed to access an intranet. Unwanted users on the Internet were blocked out from entering their Web pages and servers by using password protection, firewalls, and other technologies and techniques. Many organizations are figuring out ways to use the Internet for intranet applications.

Key features of an intranet:

- Uses Internet-based standards, such as the hypertext markup language (HTML), FTP, Telnet, HTTP, the simple mail transfer protocol (SMTP) and Web browsers.
- Uses the TCP/IP protocol suite for local- and wide-area networking.
- Comprises wholly owned content not accessible to the general Internet even through the corporation has Internet connections and runs a Web server on the Internet.

- Can be managed, unlike the Internet.
- Can be implemented on virtually all platforms with complete interoperability.
- Open architecture means large and growing number of add-on applications available across many platforms.
- Supports a range of distributed computing architectures (few central servers or many distributed servers).
- Structured to support integration of "legacy" information source (data-bases, existing word processing documents, groupware databases).
- Supports a range of media types (audio, video, interactive applications).

Some common uses of intranet include providing access to online, internal phone books, procedure manuals, and training materials; enabling employees to check inventories and order suppliers; and enabling employees to check and modify their personal benefit plan (see Figure 3) [3]. Literally any internal business process can be supported, particularly those processes that involve the conveyance of information. In large and small organizations, intranets are almost always the best way to distribute a wide variety of internal corporate information because producing and distributing paper is usually slower and more expensive. For instance, nearly every organization publishes a quarterly product-pricing sheet or a policy manual. These documents are often hundreds of pages long, are published several times a year, and are copied and delivered to thousands and thousands of people. This is not only a very expensive process, but in most situations the information change rapidly and consequently the shelf life of the document is not very long. The information is often out-of-date by the time it arrives in the hands of the users. Putting these documents on the Web enables employees throughout the world to quickly, easily, and inexpensively access them there. Moreover, any change in the document is automatically reflected in the views of the document that everyone sees.

- Online company phone directories.
- Online procedure manuals.
- Online training material.
- Online product/price catalogues.
- Inventory management.
- Supply ordering.
- Benefit plan management.
- Electronic mail.

Figure 3: Common Intranet Applications

Intranets expedite application distribution and updating. It can lower the total cost of ownership (TCO) by reducing software maintenance and update cost. Computing staff can place software updates and patches on the intranet and then provide a script to update employee workstations automatically the next time they log on.

Intranets are popular for several reasons. The intranet benefits are listed as below [5]:

- Increased, less-expensive, environmentally friendly internal communication.
- Low acquisition and deployment costs.
- Low maintenance costs.
- Increased information accessibility.
- Timely, current information availability.
- Easy information publication, distribution and training.

2.2.3 Extranet

Extranets are used to connect companies with suppliers or other business partners. An extranet can be any of the following types: a public network, a secure (private) network, or a virtual private network (VPN) [5].

i. **Public network**

A public network extranet exists when an organization allows the public to access its intranet from any public network, such as the Internet, or when two or more companies agree to link their intranets using a public network [5]. Security is an issue in this configuration even some firewall checking are provided. To secure transaction between cooperating companies, each of them must provide protection for outgoing information before that information passes from each intranet onto the public network.

ii. **Private network**

A private network is a private, leased-line connection between two companies that physically connects their intranets to one another [5]. A leased line is a permanent, dedicated telephone connection between two points and is always active. The private networks provide a high security protection against the messages flowing on it. However, this configuration is very costly and time-consuming.

iii. **Virtual Private Network (VPN)**

A Virtual Private Network (VPN) extranet is a network that uses public networks and their protocols to send data to partners, customers, suppliers, and employees by using a system called "tunnelling" or "encapsulation". A VPN provides security shells, with the most sensitive data under the tightest control. Most extranets are implemented either as LAN-to-LAN extranets or client/server extranets [5]. VPNs are designed to save money, so it does not require a leased line during connection. Each cooperating company's intranet is connected using the Internet. Unlike private networks, VPNs establish short-term logical connections in real time that are broken once the communication session ends.

Information on extranets is secure to prevent security breaches from unauthorized users. Authorized users connect transparently to another company's network via the extranet.

Many firms are using the extranets to support their business-to-business commerce with other forms such as:

- Manufacturer order materials from a supplier
- Firm makes travel arrangements with travel agency.
- Advertising firm and customer's marketing department collaborate on ad copy.
- Could be person connected to another firm's computer or could be one form's computer working directly with another firm's computer, with no people involved.
- Could be complete vertical linkage of buyer/supplier/bank.

An extranet may be set up through the Internet, but frequently it is separate network connecting businesses to one another. However, some extranets such as private networks use the Internet protocols and technology to drive communications among them.

2.2.4 The Important of Internet for Business

i. **Rapid information access**

Accessing information over the Internet is much faster (on most occasions) than other transmission methods such as transfer via fax or postal courier services. The information is easy to gain from countries around the world.

ii. **Creating a client base**

Wide used of Internet create a huge market place. As the result, new clients or customers are easy to find.

iii. **Product analysis**

Product analysis and comparisons is able to conduct as a lots of product reports are available on the Internet.

iv. **Market analysis**

Internet is useful is survey distributions for analysis of the market of a new product or service idea. These surveys can reach a great number of people with little effort.

v. **Expert advice and help**

Beyond product analysis, there also exist a lot of experts on the Internet who make their presence widely known and easily accessible. This enable ones to get advice and help for free compare to some consulting services provided by some company that very costly.

vi. **Recruitments**

Internet is currently being widely used in recruitment area. This shorten the formal processing period that using postal mail or fax and more significant. Applicants are able to find job lists easily and submit their resume via the Internet.

2.3 The World Wide Web

The World Wide Web (WWW) or the Web, is a subset of the computers on the Internet that are connected to each other in a specific way that makes those computers and their contents easily accessible to each other. The Web is a system consisting of an internationally distributed collection of multimedia files supported by clients (users) and servers (information providers). Each file is addressed in a consistent manner using its universal resource locator (URL). The files from the providers are viewed by the clients using browsers such as Mosaic, Netscape Navigator, or Microsoft's Internet Explorer. Browsers are fast becoming a standard Internet tool. The WWW links the various tools used on the Internet by providing users with a simple, consistent interface to a wide variety of information. The WWW supports text documents, Telnet sessions, sounds, graphics, file transfers and more by using hypertext. A hypertext text document not only contains information, but also links to other documents that contain related information. The standard method of formatting Web pages is to use hypertext markup language (HTML). HTML is a language that includes a set of codes attached to text. These codes are translated by the Web browser and result in a formatted Web page.

The number of Web sites has grown even more rapidly than the Internet itself. The number of Web site is currently estimated to be well over eight million and the number of Web documents is likely over a billion. As more people gain access to the Web, commercial interest in using the Web to conduct business will increase and the variety of non-business uses will become even greater.

2.4 E-business/ E-commerce

E-business (or electronic business) is the complex fusion of business processes, enterprise applications and organisational structure necessary to create a high performance business model. It refers to the use of digital technologies to transform both the internal processes as well as an organisation's interactions with external parties.

E-business combine the resources of traditional information systems with the vast reach of the Web and connect critical business systems such as customer relationship management (CRM), supply chain management and enterprise resource planning (ERP) directly to critical business constituencies – customers, employees, partners and suppliers using intranets, extranets and the World Wide Web.

E-commerce (or electronic commerce) by contrast refers only to the external interactions and selling processes of an organization that result in a payment of some kind. The selling processes may include cataloguing of goods, order taking and bill payment. Although the e-business is more than e-commerce, most people often use these terms interchangeably. In this project, I will use the term e-business in its broadest definition.

E-business may take place in a number of different ways and on a number of different technology platforms. For example, Electronic Data Interchange (EDI), the online sale of goods and services between firms, has been happening for over a decade on proprietary networks that these firms have developed and paid for entirely themselves. However, the current trend in business today is to use the public Internet as the vehicle for e-business. Estimate of the volume of the Internet-based transactions for 1995 range from several hundred million dollars to $15 billion, and this proportion is expected to grow exponentially and may dominate very soon.

The market for Internet commerce procurement applications, a subset of the overall market, is expected to reach $9 billion in 2004, up from $770 million in 1999. Besides, according to Forrester Research, B2B e-business will grow to $6.3 trillion worldwide by 2004.

2.4.1 A Model of Electronic Commerce

A company Web sites may range from passive to active. For instance, passive Web sites provide only product information and the company address and phone number. At the other extreme are the relatively sophisticated, active Web sites that enable customers to see products, services and related real-time information; and actually conduct purchase transactions online. A model of e-commerce consists of five phases: information gathering, ordering, payment, fulfilment, and service and support (see Figure 4) [3].

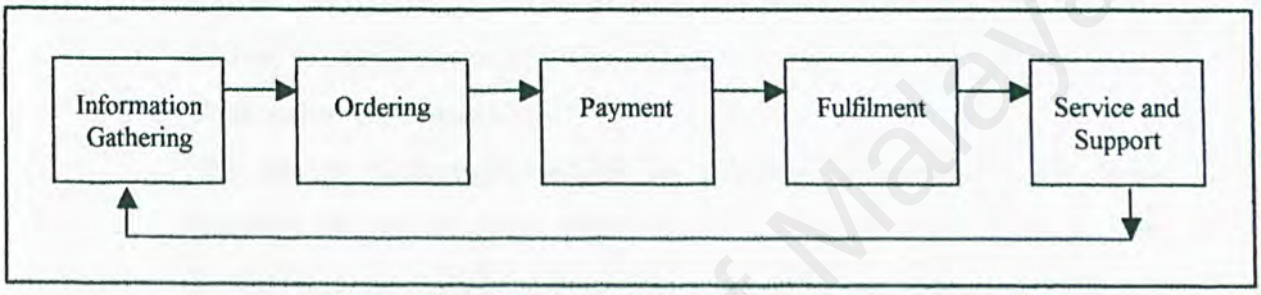

Figure 4: A Model of Electronic Commerce

Customer can place their order and pay for products and service online. If the product or service can be digitised such as videos and software, it can be delivered online as well. Besides, some firms are finding ways to provide online service and support after the sale. This can be done with online support documentation; email hi lines for customers; videoconferencing with a helpful product support technician; or as in the case of some computer hardware vendors, the vendor can go through the Internet and diagnose and repair your computer online in real time.

2.4.2 E-business Areas

E-business can be divided into three main areas (see Figure 5):

i. **Intranet**

The intranet was Internet standards for electronic communication. There Web sites are separated from the rest of the world by firewalls and other

security measures. The authorize users like employee of the organization are able to view organization-specific Web sites.

ii. **Business-to-business (B2B)**

It is characterized by high volume and low price margin. This is done over extranet. It refers to the buying and selling of goods, services and content among enterprises. Two organizations are allowed to see confidential data of the other to enable the business. Business-to-business networks have existed long before the Internet using private networks. However, due to the high maintaining costs, the Internet is being used, and in most cases, in order to keep the business transactions private, Virtual Private Networks (VPNs) are used.

iii. **Business-to-customer (B2C)**

This model is characterized by its volatility. In such a model, both volume and price margins vary on an almost daily basis. Traditionally this is refers as e-commerce, selling products or services on the Web to individuals.

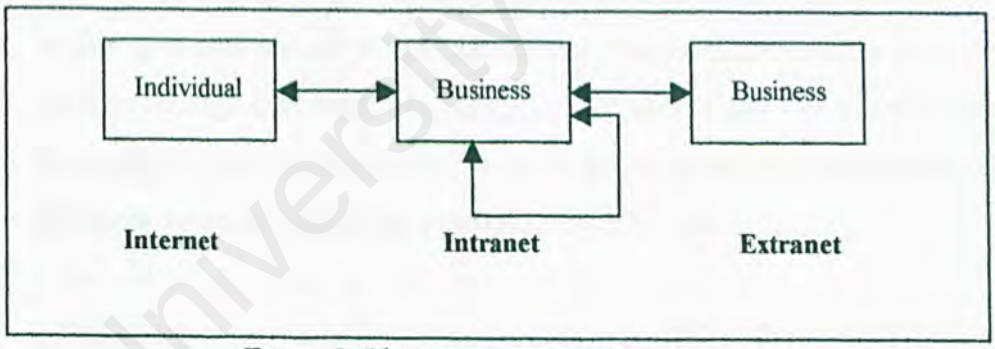

Figure 5: Three e-commerce areas

2.4.3 E-business solution models

Implementing an e-business solution is necessary to maintain a competition advantage. As the result, there are many models for e-business solution available. Here are some key models [6]:

- **Buy-side systems** are those that address the issue of control. In this model, an organization might negotiate with a vender for fixed prices on

some portion of their catalogue. This portion of the catalogue could then be brought to the buyer's site for direct ordering by stuff. One fourth of all buyers plan on using buy-side systems.

- **Sell-side systems** are administered by the selling organization. 64% of all buyers use or plan to use this model. There is low risk and little or no investment by the buyer. Two examples would be Dell and the SU Bookstore.
- **Electronic market places** are aggregated supply sites. Generally they include catalogues of suppliers in a vertical industry and are offered as a one-stop sourcing solution. This is a subscription-based model without transaction costs for buyers and no participation fees for the suppliers. This model improves on the individual sell-side model by providing a more visible site for buyers in particular market place.
- **Internet auctions** are used to sell off excess and obsolete inventory. E Bay is an example of this model; they control 80% of the market today.
- **Online trading communities** This model gives the most flexibility to buyers and sellers and does not require a huge initial investment. This model also uses subscriptions that give an immediate benefit to the buyer without a large investment or long commitment to the e-business vender at a time when the industry is in state of continuous technological changes. Amazon shop is an example of this model.

2.4.4 Success Factors in Implementing E-business

There are several critical success factors in implementing an e-business solution. Below are some relevant points [6]:

- **Ease of use.** Whatever is put in place needs to be usable with little or no instructions; it needs to be intuitive. There also needs to be consistency and standards in the process and look and feel so that the client knows what to expect.

- **Enterprise integration.** The Gartner Group recommends that an e-business roadmap for enterprise be developed early, but implemented in stages. Greater success will be achieved by choosing tactical projects and implementing them successfully rather than tackling large re-engineering projects first.
- **Hybrid or open catalogue architecture.** There are some standards for catalogues to be shared across the Internet. We need to understand these and use the most common. One example is XML, a language used in web applications.
- **Content management.** We need to provide ways to track data, provide ways to search that are consistent and identify the owners of catalogues and other web content involved in e-business.
- **Good project management.** E-business projects fail for the same reasons projects have always failed: poor planning, insufficient staff, staff with the wrong skills, lack of support and lack of buy-in. Insure that all e-business initiatives have a sound business goal. Select technologies based on their fitness for the purpose intended, and be prepared to swap them out as the e-business product market matures. Technology is meant to serve business needs.
- **Adequate security for the web site.** We need to understand and communicate the liabilities and risks to the organization with whatever framework is put into place. Clients should be assured that personal authentication and credit card information remains confidential throughout the payment process.

2.4.5 Advantages of E-business

The advantages of e-business include:

- Instant worldwide availability and easier entry into new market.
- Streamlined buyer-to-seller relationship.
- Reduces paperwork, errors, time, and overhead costs.
- Improved market and product analysis.

- Increased sales by creating virtual communities and reach narrow market segments that are widely scattered geographically.
- Reduced cost of handling sales inquiries, providing price quotes and determining product availability.
- Increased the sales opportunities for the sellers, as well as the purchasing chances for the buyers.
- Make products and services available in remote areas.

2.5 Enterprise Resource Planning (ERP)

Enterprise Resource Planning (ERP) could be described as the spinal cord of the digital nervous system, facilitating exchange of data through the unification of key processes. It is an advanced core business IT system that integrates data across major functions and activities as well as across organizational, and geographical boundaries, providing a platform for increased business performance and competitive advantage. [7]

ERP is the latest in a number of manufacturing and financial information systems that have been devised to streamline the information flow that parallels the physical flow of goods, from raw materials to finished product [8]. The actions in systematizing information flow around the manufacturing process were taken as early as the 1960s when materials requirement planning (MRP) software became available. In the 1980s, these information systems matured into manufacturing resource planning (MRP II) software, which embraced functions such as processing, manufacturing and distribution. This application is more robust and better. Finally, in the 1990s, ERP software, which acts as an engine in linking all internal transactions, was created.

2.5.1 ERP Definitions

ERP is a structured approach to optimising a company's internal value chain. The software, if fully installed across an entire enterprise, connects the components of the enterprise through a logical transmission and sharing of common data with an integrated ERP [8]. As the result, when data such as a sale becomes available at one point in the business, it automatically courses its way through the ERP and the effects of the transaction will be obtained on other areas, such as inventory, procurement, invoicing and so on. Conclusively, ERP is used to organize, codify, and standardize an organization's business processes and data.

Today's ERP systems can be thought of as central repositories of internal corporate information derived from five major processes: finance, logistics, manufacturing, human resources, and sales and marketing [8]. As illustrated in Figure

6, ERP software helps organizations effectively and efficiently manages all their internal information resources to meet overall goals [8].

Figure 6: ERP Focuses on Internal Enterprise Data, Information, and Knowledge

An integrated ERP system is the hub of an enterprise. It provides a company the flexibility required to improve customer responsiveness (the demand side) and to better manage production needs and inventory (the supply side) [8]. ERP also provides a consistency of information across a global enterprise and integrates the following [8]:

- **Resource planning**, which includes forecasting and planning, purchasing and material management, warehouse and distribution management, product distribution, and accounting and finance. By providing timely, accurate, and complete data about these areas, ERP software helps a company to assess, report on, and deploy its resources quickly and to focus on organizational priorities.

- **Supply-chain management**, which includes understanding demand and capacity, and scheduling capacity to meet demand. By linking disparate parts of an enterprise with ERP, more efficient schedules can be established that satisfy, in an optimal way, the enterprise's needs. This reduces cycle time and inventory levels, and improves a company's cash position.
- **Demand chain management**, which includes handling product configuration; quotes, pricing, and contracts; promotions, and commissions. By consolidating information with ERP, contracts can be better negotiated; pricing can be established to consider the total enterprise-wide position; and sales offices can be better assessed, rewarded, and managed.
- **Knowledge management**, which includes creating a data warehouse, a central repository for the enterprise's data; performing business analysis on this data; providing decision support for enterprise leadership; and creating future customer-based strategies.

2.5.2 Extended Value Chain

Web-based technology move information through value chains and provides information instantaneously at a low cost. A company that combines ERP technology with Web-based technology looks something like Figure 7 [8]. With the e-buy/ERP/e-sell enterprises extended across the value chain, companies can create tightly linked extended enterprises [8].

In the effort to create interactive relationships with Value-Chain Partner, there are three alternative models of fully formed ERP technology [8].

- Figure 8 is a model of an extended enterprise in which parties connect with each other through third parties – aggregators of buyers and/or sellers – who create and manage market places. These marketplaces may be collected catalogues, such as those provided for maintenance, repair, and operations (MRO) materials by such companies as Ariba. They may also be industry marketplaces that can be set up as an auction, a bid-and-

ask market, or a third-party matchmaker. Alternatively, they could be portals or even "workplaces", like being created by SAP under the name mySAP.com.

- In Figure 9, the value chain is connected company to company, with each company's e-sell channel connecting directly to the e-buy channel of the next company upstream in the production process. Common part numbers are necessary not only from each company's e-buy and e-sell to its internal ERP system, but also from each company's e-buy to other companies' e-sells and vice verse. However, the industry standards are important to achieve this kind of integration increases.
- In Figure 10, each company's ERP system connects directly to the ERP systems of suppliers and customers. It using an open standards Internet-based protocol in connection to increase flexibility, while in contrast, electronic data exchange (EDI) model using unique protocols for each supplier and customer.

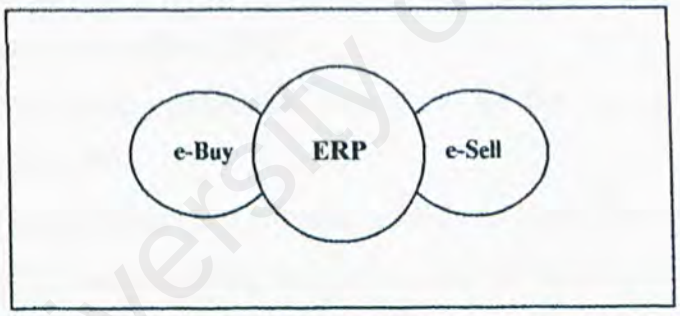

Figure 7: ERP and Web-based Technology Together Extend the Enterprise

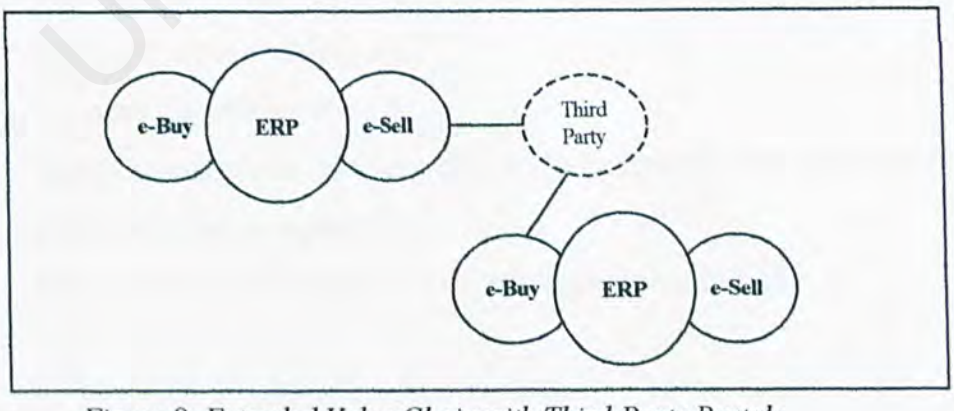

Figure 8: Extended Value Chain with Third-Party Portals

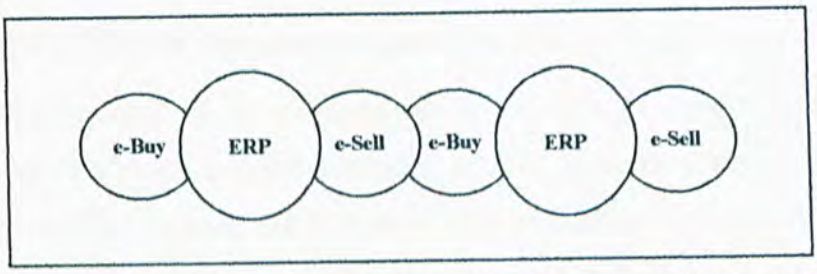

Figure 9: Extended Value Chain: Buy-Side Front End Connects to Sell-Side Front End

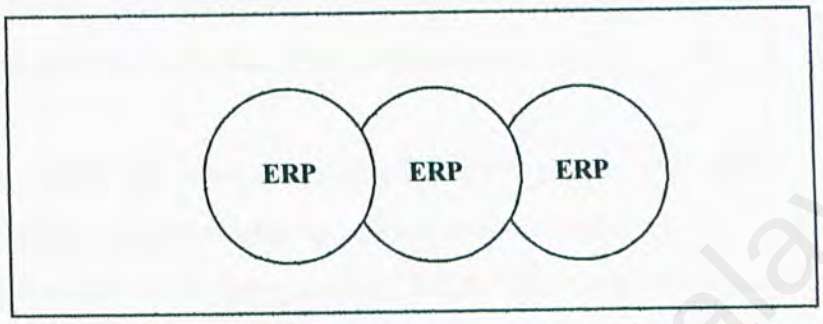

Figure 10: Extended Value Chain: ERP to ERP connections

2.5.3 ERP Benefits

There are several benefits of ERP:

- Online/real time information throughout all the functional areas of an organization [9].
- Data standardization and accuracy across the enterprise [9].
- The analysis and reporting that can be used for long term planning [9].
- Facilitates data sharing and eliminates redundancy [9].
- Provides functionality to interact with other modules [9].
- Increased process efficiency.
- Reduced transaction costs.
- Senior management can use ERP to gain control over information and improve decision support [8].
- More flexible governance and organizational structure [8].

2.6 Supply Chain Management (SCM)

In any industrialized or non-industrialized society, goods must be physically moved between the place they are produced and the place they are consumed. The exchange process has become the cornerstone of economic activity and takes place when there is a discrepancy between the amount, type, and timing of goods available and the goods needs [18]. Channels develop when many exchanges take place between producers and consumers. The alignment of firms that bring products or services to market has been called the supply chain, the demand chain or the value chain.

Supply chain management (SCM) is the integration of business process from end user through organizational suppliers that provides products, services, and information that add value for customer. It has become tremendously important to companies in an increasingly competitive global marketplace. In the past, companies focused primarily on manufacturing and quality improvements within four walls; now their efforts extend beyond those walls to encompass the entire supply chain [19] (see Figure 11).

Figure 11:Evolutionalary SCM

Companies today can no longer rely solely on improved internal efficiencies to be competitive. They must also monitor thousands of external data points and be prepared to react quickly and automatically across their entire supply chain and ecosystem. Nowadays, e-business is able to transform the supply chain into a network that allows companies to work together almost as though they belonged to the same

group. Specifically, they can move from a serial arrangement, where an order is fed in one end and makes its way along the chain, to a collaborative arrangement in which everyone gets a view of the best forecasts and tries to be as ready as possible for the outcome. Figure 12 shows an example of inter-company supply chain optimization.

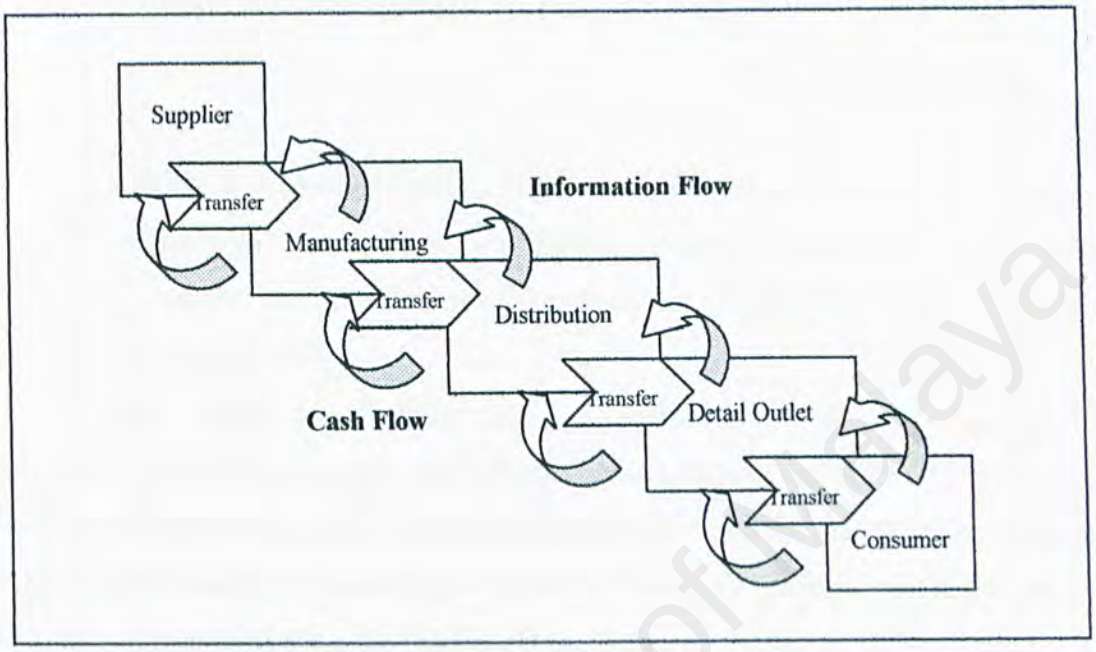

Figure 12: Inter-company Supply Chain

2.6.1 Evolution of Supply Chain Management

SCM generally evolved through three main phases:

i. The first phase is characterized as an inventory 'push' area that focused primarily on physical distribution of finished goods. During this period, which stretched roughly from 1960 to 1975, companies manufacturing work in process and raw materials as separate parts of the business. Production output was pushed down to finished-goods locations.

ii. In phase II of this evolutionary process business leaders begin to recognize the importance of integrating operations within the enterprise. During this period, roughly from 1975 to 1990, the more progressive companies began migrating from an inventory push to a customer pull channel as power began to move downstream to the customer.

iii. The final phase began in the late 1980s, evolving into the supply Chain management concept. Companies realized that significant productivity increases could only come from managing relationships, information and material flow across enterprise borders. This resulted in the concept of supply chain management.

2.6.2 e-SCM

e-SCM is a Web-based supply chain management application that using e-business approach to support tight coordination between business partners. All the information, transactions, and decisions are synchronized along the supply chain and will flow through the Web.

Supply chains in all industries are encountering new requirements for competition in the e-business environment, characterized by mass customisation, massive scalability, faster and more flexible fulfilment and the ability to develop new channels that attract and serve larger customer bases. In contrast, traditional supply chain does not provide these abilities for organizations.

As the e-business concepts being deployed, many crucial management decisions and processes will take place on the common ground of the Internet rather than within the physical and technical boundaries of a single company. A new electronic supply chain information exchange will encompass hubs, auctions and exchanges containing a wealth of not only information but also value to customers and suppliers alike.

Several strategic advantages provide by e-SCM are:

- Rapid Deployment & Scalability: The e-SCM is based on an "open" Internet Application Architecture that provides for enterprise-wide scalability and rapid deployment to numerous end users. Moreover, the use Internet technology and other tools allow an integrated use of e-SCM combining internal and external users in a "real-time", dynamic environment. This architecture allows businesses to manage their changing environment easily by adds processing capability quickly,

brings new users online, and facilitates the transfer and dissemination of information and data.

- Real-Time Processing: e-SCM creates an open, integrated system that addresses the complex e-Business and supply chain management needs and requirements by allowing the exchange of "real-time" information to take place with employees, and their trading partners (customers, suppliers, distributors, manufacturers) regarding product configuration, order status, pricing, and inventory availability. This "real-time" data enables users to make informed ordering, purchasing and inventory decisions and thereby enhances the quality and scope of customer service.
- Return On Investment: In addition to increasing productivity and reducing overall operating expenses, e-SCM maximizes selling opportunities by capturing valuable customer information, buying patterns, frequency, preferences, order history and then uses this information to suggest up-selling, cross selling and promotional opportunities. e-SCM provides the tools sets to achieve new business by reaching out to customers that you never could before.
- Platform Independence: e-SCM open architecture facilitates continuity with legacy products and third party files and data sets. In addition, e-SCM is not restricted to any server technology, operating system or database. Renaissance believes that this architecture enables superior flexibility, interoperability and addresses the desire of customers to migrate business processes to an e-Business paradigm.
- Easily Expandable Functionality: Renaissance can easily expand or modify the product functionality to meet the diverse and rapidly changing customer processes to ensure maximum customer satisfaction.

2.7 Case Study

2.7.1 Existing E-supplier System Review

In order to have better understanding of the e-supplier system, the Internet was used as the tools to seek for example and relevant information. The information gained was being a valuable and useful guideline during the development of this project.

2.7.1.1 HubStorm eSupplier™ (http://www.hubstorm.com)

HubStorm Corporation is a provider of Supplier Enablement solutions to mid-sized enterprises. They offer the HubStorm eSupplier solution that is designed to be both rapidly deployable and a complete end-to-end solution. HubStorm eSupplier offers catalogue and transaction connectivity with a wide number of e-procurement and e-marketplace systems provided by Commerce One, Ariba, and others. Beside, it provides the user with a single control panel to manage the distribution of product catalogues to different customer systems.

HubStorm eSupplier offers the following features [10]:

- **Rich Catalogue Content Management**
  Creation of multiple catalogues with buyer specific content, pricing, and images-upload from most native formats through a simple point-and-click interface.
- **Catalogue Content Syndication**
  Supplier can selectively 'push' catalogues to multiple selling venues including buyer-centric private exchanges, point-to-point e-procurement software, consortia e-marketplaces, etc.
- **Consolidated Order Management**
  Consolidated view for all incoming purchase orderings, RFx management, and order inquiry.
- **EAI and Legacy Integration**
  Support of major document sharing protocols and EDI legacy system interfaces.

2.7.1.2 Izodia InTrade 5 (http://www.izodia.com)

Izodia InTrade 5 is the next-generation B2B global e-business software trading platform. It supports multiple trading models, complex transactions and sophisticated e-Services in a single integrated platform.

Izodia InTrade 5 offers the following features:

- InTrade 5 has open architecture, which allows it to easily integrate with back-office business software products.
- InTrade 5 allows users at any participating organization to be profiled as a supplier, a buyer, or both ultimately supporting trades between departments within a single organization or within multiple marketplaces.
- On the sell side model, e-Supply provide suppliers with a suite of powerful catalogue management tools, easy navigation, sophisticated catalogue support, sales order and price management, logistics and fulfilment, reporting, invoicing, taxation and payment, as well as market intelligence, and easy integration.

2.7.1.3 TASKCo's e-Supplier (http://www.taskco.com.tw)

TASKCo's e-Supplier is a collaborative system that helps companies build and conduct activities such as procurement and collaborative business as an integrated community. E-Supplier helps suppliers automate the entire ordering process online, respond to changing markets in real-time, instantly update product mix, change pricing or develop product discounts while eliminating the costs surrounding paper catalogs. TASKCo's e-Supplier redefines the buying process, reduces costs, eliminates inefficiencies, and speeds up transactions.

2.7.2 Organizations Review

The maturity of the Internet with the powerful technological infrastructure is now allowing companies to add tremendous value to the traditional business process between different organization entity and the customers. Some companies have already deployed the advanced of IT (Information Technology) system in order to build an electronic supply chain which is faster, and more efficient than the old paper chain. This is able to streamline their internal operations and made further savings by improving the exchange of information with trading partners through e-business. This section includes a brief review on the business relationship between the supplier/ seller and the customer/ buyer. Hence, it will view either from the seller perspective or from the buyer perspective.

2.7.2.1 Safeway Stores plc

Safeway Stores plc of United Kingdom implements Supplier Information Service system to reduce stockholding, give better availability and reduce wastage. Supplier Information Service is an Internet based collaborative system that enables effective and structured two-way communication between Safeway and its trading partners [20]. It allows both parties to concentrate on getting the product to the consumer as effectively as possible. Therefore information on products is more valuable than the product. Safeway treats suppliers as part of the organization and provides information sharing by allowing suppliers to view on how their products are doing on Safeway's shelves. However, each supplier is limited to accessing information pertaining solely to products that they supplied to Safeway. This will build a more responsive supply chain [20].

Safeway's information systems constantly record how much the customers are buying, predict how much they are likely to buy and then calculate how much stock must be sent to the stores and how much must be ordered. The resulting information will be placed upon it is all stored securely in Safeway's data warehouse on its Enterprise Servers. The Supplier Information Service allows this information to be available within seconds of its creation, using an Internet browser, to the desktops of both the suppliers' and Safeway's own personnel. This information becomes the basis

for collaborative management of the supply chain. This collaboration is extended further into the fields of effective business-to-business communication with the ability to manage new product introductions and joint forecasting and planning of product promotions [20].

The system facilitates integration of the supply chain and hence helps increased sales through better product availability. By using prediction of customer demand the suppliers will be able to better plan their production and distribution activities which should also enable a reduction in inventory levels and therefore working capital. The suppliers will be able to see an up-to-the-minute account of how their product is selling across the country [20].

2.7.2.2 Dell™

Dell Computer Corporation is the world's leading direct computer systems company. Dell has created "Virtual Integration" with both their upstream partners and their downstream partners/customers so that the entire supply chain acts like a single integrated company [19]. They combine organization strategy – customer focus, supplier partnerships, mass customization, and just-in-time manufacturing to enable co-ordination across boundaries [20].

Dell focuses on how to co-ordinate the company's activities to create the most value for customers. That means identifying and partnering with the most responsive suppliers in the computer hardware industry. They suppliers or partners are treated as if they are inside the company and sharing information in a real-time fashion. As Michael Dell says 'we tell our suppliers exactly what our daily production requirements are. So it's not, "Well, every two weeks deliver 5,000 to this warehouse, and we will put them on our shelf, and then we will gradually take them off the shelf." It's, "Tomorrow morning we need 8,562, and deliver them to door number seven by 7am"' [20]. Dell shares design databases and methodologies with supplier-partners. This speeds up the time to market – often dramatically –and creates a lot of value that can be shared between buyer and supplier.

Besides, Dell has developed customized intranet sites called Premier Pages for well over 200 of its largest global customers. These exist securely within the

customer's firewalls, and they give them direct access to purchasing and technical information about the specific configurations they buy from Dell. One of their customers, for example, allows its 50,000 employees to view and select products online [20].

2.7.2.3 Staples Inc

Staples is a retailer of office suppliers, business services, furniture and technology to consumers and businesses from home-based businesses to Fortune 500 companies in the United States, Canada, the United Kingdom, Germany, the Netherlands and Portugal [21]. They are using personalization to reduce the cost large companies incur when ordering its office supplies electronically. The Staples system can maintain lists of previously ordered item, saving customers time when reordering [22]. By searching and ordering electronically, Staples' customers can reduce their purchase order processing costs, which are costly at sometime. Apart from that, Staples also provides customized supply catalogue that can run on its customers' intranet [22]. These catalogues contain those items and prices negotiated in contracts with each company.

2.7.2.4 Bentalls

Bentalls, an independent department store based in Kingston-on-Thames, England, is using the Internet to place orders with its huge range of suppliers. Bentalls uses the Xtranet system developed by Kewill Systems to link all of its stores electronically to its suppliers [20]. This has allows the company to build an electronic trading community and make significant savings and cut paperwork.

Bentalls persuading each of its suppliers to place an electronic version of its catalogue online. This will allow suppliers to change their prices, and add or remove lines automatically [20]. Xtranet allows Bentalls exchange invoices, shipping and sales information with their suppliers electronically. Bentalls can achieve suppliers' catalogue and stock levels, on the other hand, the orders will send direct to the suppliers' mailbox.

Apart from that, Bentalls has now forged an alliance with Allders and Selfridges (other UK-based department stores) so that they can share the advantages of the Internet-based system and co-operate in the operation manner [20]. For the moment the company is content to leave its suppliers to manage their own supply chain in any way they see fit. This will allows the company to gain maximum efficiency, with the shortest cycle time and at the same time improves satisfaction rating with customers [20].

2.7.3 Analysis of Previous Review

Review in the Section 2.7.1 take three examples of the e-supplier system, which develop by different vendor. All of them have provide almost similar features such as a set of significant catalogue management tools that enable supplier configures the product catalogue easily and time saving.

However, some of those systems like Izodia InTrade 5 do not offer customer inventory management feature that used for customers' inventory monitoring and products sales analysis generator. As propose in this project, e-customer inventory management module responsible in monitoring customers' inventory status, it is done through the alliance and integration with customers inventory backend system. Notification for reorder point will be sent to those customers if their inventory level reaches critical status. Besides, products' sales information on each collaborative customer is collect and used for analysis purpose.

2.8 The Supplier

2.8.1 Supplier Definition

Suppliers are considered as the external stakeholder of an organization. Suppliers provide energy, equipment, finance, labour, raw materials and services to the organization which then uses them to produce products and services. Their position in the organization is definable and significantly important (see Figure 13 [11]). Organizations are therefore dependent on their suppliers in order to survive. Figure 14 illustrates an example of the flow of information to and from customers and suppliers, with then enterprise as the hub [12].

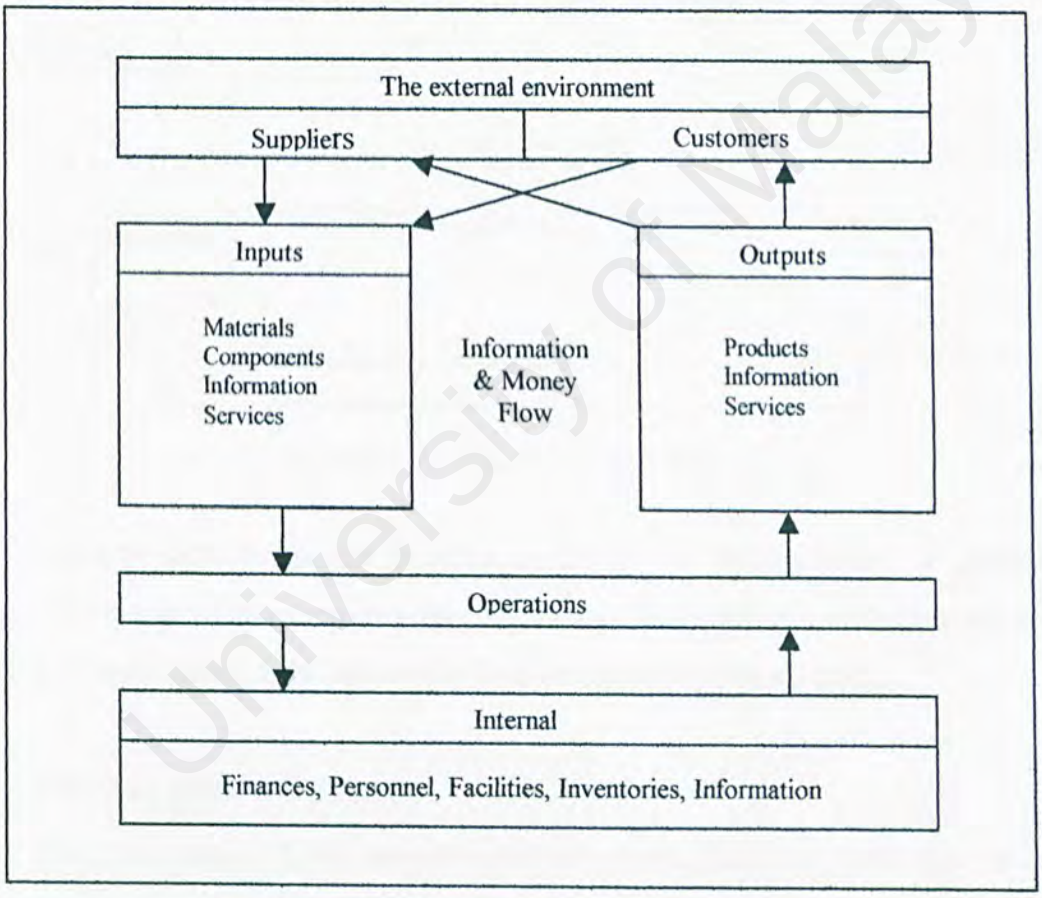

Figure 13: A Model of A Business System

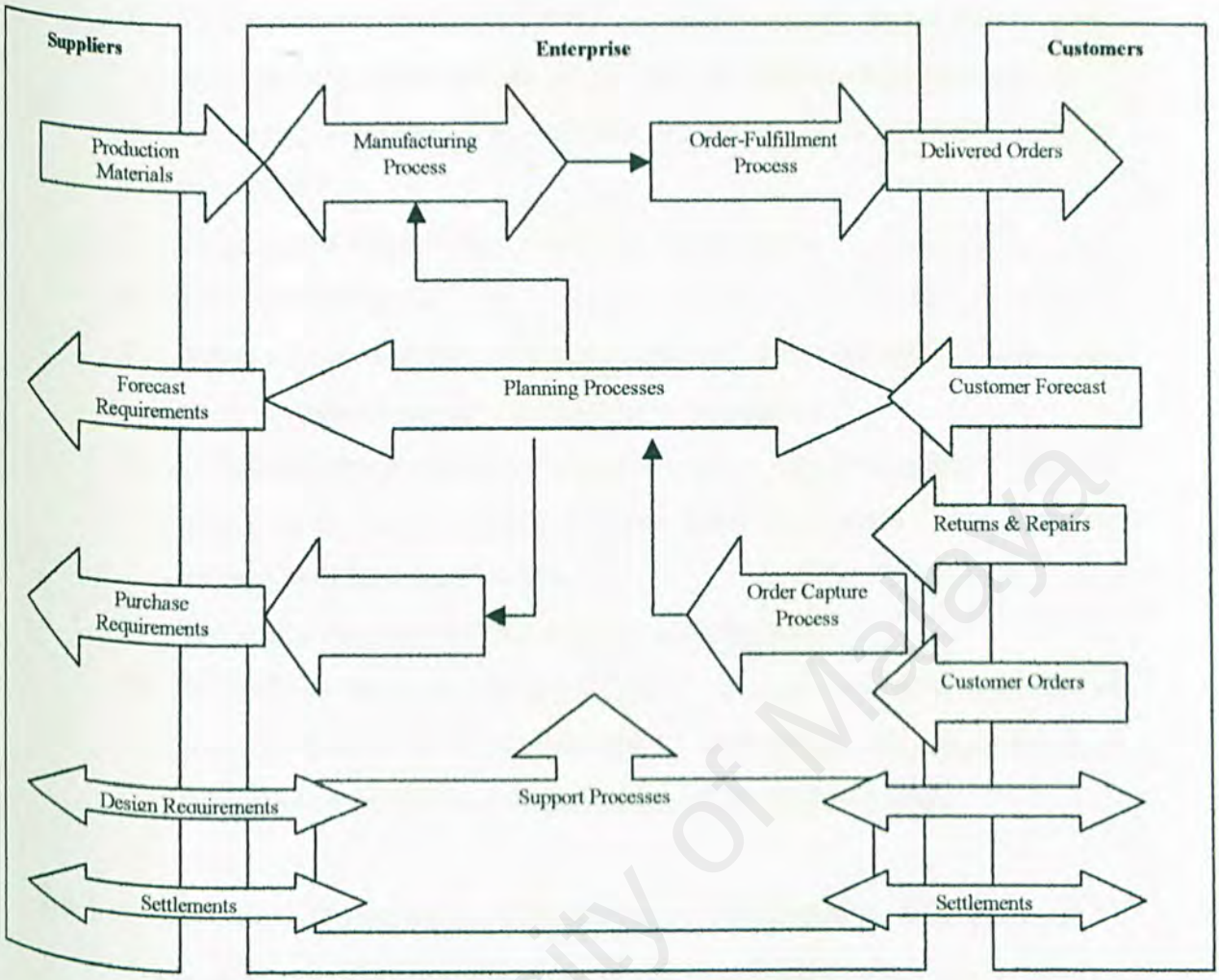

Figure 14: Enterprise Process Flow

Suppliers have the power to affect an industry by raising prices or reducing quality. The power of the suppliers depends on the characteristics of the market and the relative importance of its sales to the firm compared to its total sales.

2.8.2 The Supplier's Strategy

The typical supplier who makes and sells a product has the prime objective of making profit. Therefore several strategic approach are defined as following [12]:

1. To be able to compete successfully against the competition.
2. To stay competitive they must specialize in certain product ranges where they can concentrate on tooling, capital equipment, design and quality.

3. To consider the possibility of taking work on at cost to pay the overhead while seeking other work on which they can make a considerable profit.
4. To target companies who will buy their product at a suitable price to them.
5. To go out for big volumes. (Benefits of repetition.)
6. To go out for big accounts.
7. Not to reveal more than is strictly necessary about company details – this gives the buyer a possible advantage in negotiation.
8. To balance the big account with the need to diversify across a range of industries so that if defence is going down, their sales in the chemical industry will keep them solvent.
9. To maintain a good reputation in the market place.
10. To find customer who are good payers – but not very good organizer or co-ordinators. It gives the suppliers' salespeople the opportunity to manipulate a poorly co-ordinated company to their own ends.

2.8.3 E-supplier: Business and Web-based Technology Integration

Traditionally, buyers and sellers conducted trade through mail, phone and also face-to-face. This three alternatives involved in the process of making a product or service available for use or consumption by the customer, whether a consumer or a business. Nowadays, new technologies and the Internet are changing the way businesses serve their customer, and the way they work with suppliers and partners. The emergence of e-business especially in segment B2B (business-to-business) is able to integrate information sharing between disparate corporate applications. This leads to a consistent way in network communication among suppliers, and partners, in addition to integrating the knowledge gained.

E-supplier is the collaborative use of technology to enhance business processes between an enterprise and the suppliers. At the same time, it improves speed, agility, real-time control, and customer satisfaction. E-supplier shortens the traditional time-consuming business transaction, and replace the paper form

transaction documents such as purchase order with electronic forms. Data are sending and receiving electronically via Internet and other network medium.

Transformation from traditional business process to this new e-business approach involves not only the change in technology, it also change the organization culture, management policies, performance metrics, business processes, and organizational structures. In order to optimise the business process, all companies in this relationship must view partner collaboration as a strategic asset and a "must do" in terms of operational priorities. Information visibility across the supply chain can become a substitute for inventory [8].

2.8.4 Factors in Driven The Concept of Business Integration

The need for increase business integration between suppliers and the enterprise (the customer) concerned as follow [13]:

- **Globalisation**

  In order to compete in global markets, companies are entering into international partnerships. A high degree of integration is crucial to ensure smooth operations across international borders.

- **Supply chain complexity**

  A high degree of automation and integration are required due to the increasing complex network of partners and suppliers. This able the key requirement being visible along the supply chain for all partners.

- **Time to market**

  To get products to market swiftly, businesses are being driven to collaborate with their suppliers in joint design and engineering, collaborative demand planning, and coordinated supply chain management.

- **Reducing inventory levels**

  To reduce costly inventory whilst at the same time improving service levels, trading partners must collaborate, integrate, and share a range of information that has traditionally been considered proprietary, such as forecasts, demand data, and production data.

2.8.5 Types of Integration (B2B Integration)

There are a wide variety of areas across a value chain's operations where e-business integration can have a dramatic impact. Each of these areas of partner interaction delivers its own set of benefits [13].

- **Product development**

  This can include joint design, synchronized document management, and test and quality feedback.

- **Planning, forecasting and replenishment**

  Partners can share forecast information, exception notification and capacity planning.

- **Quality**

  In becomes possible to chare information about product or service failures, customer complaints, and their impact on both product and service reliability. As the result, partners can coordinate action planning to compensate for deficiencies in product, process, or service quality.

- **Order management**

  Multiple organizations in the supply chain are able to indicate their ability to fulfil orders in real time. Customer orders can be taken automatically, with automated replenishment orders going to suppliers.

- **Operations/Logistics**

  Full synchronisation of supply chin leading to real time inventory status and shipment updates, both up and down the supply chain.

- **Customer service/support**

  Integration of trading partners support processes, call centres, and knowledge bases. It pilots to real time transfer of customer and problem information. This can lead to initiatives such as inter-company support training programs.

2.8.6 Advantages of E-supplier

E-supplier, which is an e-business integration, provides a number of benefits and advantages:

- Improved customer satisfaction, better customer support and increase customer benefits.
- Tighter links with logistics providers in improving manufacturer/ distributor coordination with better inventory management at all point. This will reduce inventories with fewer stockouts and improved on-time delivery.
- Reduced processing costs, purchase price leverage, contract compliance, and improves delivery and quality.
- Better delivery of information required for planning and forecasting, with lower cost of supply and reduced obsolescence/ product returns.
- Synchronize production plans and product flows, optimise resource utilization over an expended capacity base and increase customer responsiveness.
- Faster time-to-market.
- Reduced R&D (Research and Development) expense.
- Better operational decisions and leading to improve manufacturing utilisation through lower cycle times, and better asset utilisation.
- Strengthen business relationships where real time capabilities provide a sense of teamwork and shared goals.
- Reduced time involved and the number of error.
- Reduce inventory costs by shortening the sales and supply cycles.
- Provides competitive advantages in business world.

2.8.7 Keys requirements for E-supplier

In order to integrate organizations effectively using Internet, a software infrastructure must be deployed that meets the following requirements [13]:

- **Security, scalability and robustness**

  Due to many inter-enterprise process are confidential and critical, any system that involve must be highly robust and reliable. Besides, it must be able to scale to support many processes, many trading partners, and high volumes of interaction. To reinforcing the integrated security, all data or information that deliver to and fro must be across firewalls.

- **Manageability**

  It must be easy to implement, update and manage by present IT resources, and easy to operate by line stuff. It must be able to interface easily with legacy systems.

- **Heterogeneous environments**

  A system must support a wide variety of data formats, systems, protocols, databases, operating systems, and messaging systems.

- **Extensibility**

  The solution should provide an easy way for multiple companies to participate in shared process design, review, and testing.

2.9 System Architecture and Development Tools

2.9.1 Web Client and Server Architecture

Client/ server network is one of the distributed systems. It is a network environment where the control of data is established at a server and is available for access at other nodes (or the clients). Web server is usually a high-powered computer or a mainframe, tat connected to the Internet and houses information or files that their owners have made publicly available through their Internet connection. On the other hand, a Web client is usually a PC or workstation, which connected to the Internet and processes send requests to a Web server. The Web browser software such as Microsoft Internet Explorer or Netscape Navigator is the software that makes your computer work as a Web client. Since these software are platform-neutral, it enables your computer communicate with many different types of computer which running different operating system easily and effectively, through the Internet.

Over the past few decades, the architecture of the applications have evolved from single-tier to n-tier designs. The driving force for this change has been cause by the following general goals: scalability, separation and encapsulation of functionality, maintainability, multi-user support, and the ability to be distributed. The three categories of tiers are generally described as user (first), business (second or middle), and data (third) service tiers.

2.9.1.1 Two-Tier Client/ Server

A two-tier model involved only a client and server. All communication takes place between the client on the Internet and the target server at the other end. In this type of application, the database (and perhaps a portion of the data services) is separated from the user interface and business logic. Typically, the database is placed on a dedicated server (see Figure 15).

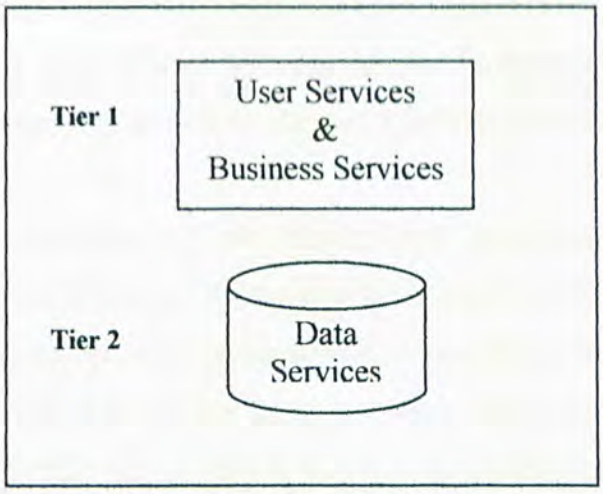

Figure 15: Two-Tier Client/ Server

Two-tier client/ server applications are the most common type of client/ server model built today. They offer significant benefits as below:

- Distribute the workload to a large number of relatively cheap clients.
- For the purpose of increasing higher performance of the system, purchasing a client computer is less costly compare to a larger expensive host system.

However, two-tier model also cause some difficulties, foe instance, installation are becoming time-consuming and hard to coordinate, as the installation process have to be done on multiple machines.

2.9.1.2 Three-Tier Client/ Server

As the application becoming larger, the two-tier client/ server model is simply not flexible or powerful enough to handle processes. Maintaining a dialog between each client workstation and the central database server can result in high network traffic and poor performance. Three-tier client/ server architecture was used to help address these issues by putting another layer between the users and the database server. The first tier is the client, the second tier is the Web server, and the third tier consists of applications and their associated databases that supply non-HTML information to the Web server on request [5]. The Web or business services layer (tier 2) is logically separated from the data services (tier 3) (see Figure 16). Interactions between client and server operate the same way as they do in a two-tier architecture.

However, third tier provides more comprehensive data services, including database operations supported by database software, enterprise resource planning software services, and other services needed to support a robust electronic commerce server [5].

Since the workload is split into two distinctly hardware, it tends to be more stable and scalable. And change or enhancement of is only altering the affected small pieces of components compare to the huge built of everything. One of the advantages of three-tier architecture is the ability to extract the business logic from the user and data tiers into the middle tier, where it is easier to maintain. In addition, several benefits offers by three-tier model are as follow:

- Some upgrades can be done entirely at the server level.
- Allows for component-based development that can increase reusability.
- The separation of the business and data services in two different servers offers more option and cheaper in upgrading.
- Lower network bandwidth is sufficient due to only the needed information are send through network to be displayed.

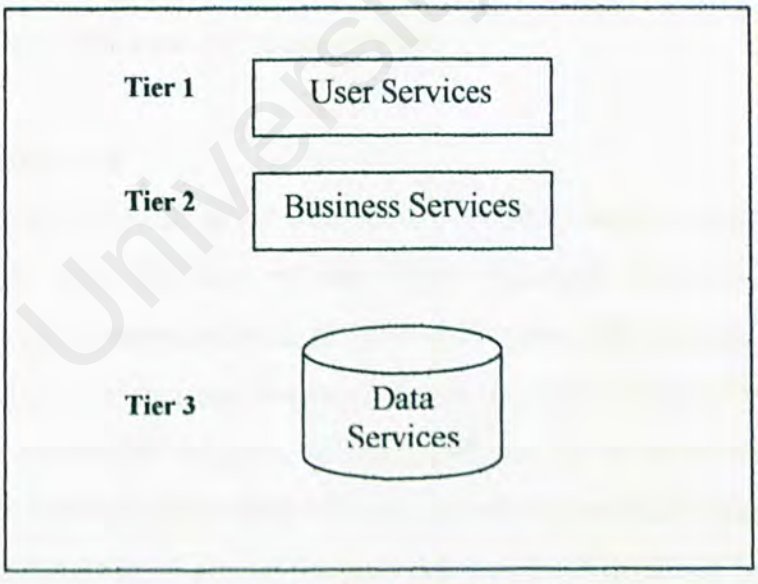

Figure 16: Three-Tier Client/ Server

2.9.2 Platform

An operating system is the collection of programs that forms the foundation for the basic operations of the computer hardware. It performs and coordinates the interaction between hardware devices (e.g. the CPU and the monitor), peripherals (e.g. printer), and application software (e.g. a word processing program) [3].

The operating system is typically stored on disk, and a portion of it is transferred into temporary memory when the computer starts up. After it is in memory, it can go about its task of managing the computer and providing an interface for users to interact with the computer. Operating system perform many services such as determines the sequence of the applications in multitasking environment. Many different tasks including the following [3]:

- Booting (or starting) the computer.
- Reading programs into memory.
- Managing memory allocation to those programs.
- Maintaining the structure of directories and subdirectories.
- Sending objects to the printer.
- Formatting disks.
- Controlling the computer monitor.

2.9.2.1 Windows 98

Windows 98 is one of the Microsoft Windows operating system evolutions. It is more stable than Windows 95 and faster. Windows 98 provides a variety of powerful Net-based programs such as Internet Explorer that you use to surf the Web, and Outlook Express, that you use to send and receive electronic mail. Windows 98 also provides a new chat program, software that you use to create and then host your own Web site, and the Netmeeting software that can use to hold virtual-office meeting or to talk with other users (around the globe) across the Internet for free [14].

The biggest visual change will find within Windows 98 is related to its Active Desktop (which you can turn on and off as your needs require) that user can use to display and update specific Web sites on the Desktop as you work [14]. Within the

Active Desktop, for example, you might display real-time information about stock price or the weather.

Windows 98 also provides a 32-bit file allocation table (FAT32) that allowing a single-partition disk drive larger than 2Gbytes. The other features in Windows 98 includes supports for Universal Serial Bus (USB), which make it easy to plug in new devices support for Digital Versatile Disc (DVD), support for a new industry standard form of power management called Advanced Configuration and Power Interface (ACPI).

2.9.2.2 Windows NT

Windows NT is the operating system created for personal computer users and for business purpose that require advanced capability. It comprise of two products: Microsoft NT Workstation and Microsoft NT Server. The workstation is a safer than Windows 98 and Windows 95. It is designed especially for business users, who need faster performance. The server is designed for business machines that need to provide services for LAN-attached computers.

Windows NT provides Microsoft's Internet Information Server (IIS), which is Web server software that use to serve Web pages. In term of networking, Microsoft Windows NT Server 4.0 works with Microsoft LAN Manager, Microsoft Windows for Workgroups operating system, AppleTalk, DECPATH WORKS, IBMLAN Server, IBMSNA networks, the Internet, NFSnetworks, Novell NetWare, Remote Access Services by way of ISDN, X.25, and standard phone lines and TCL/IP networks.

2.9.2.3 Windows 2000

The latest version of Microsoft's evolving Windows operating system is Windows 2000. Before that, it is called Windows NT 5.0. It is a built on NT technology. It is designed especially for small business and professional users as well as to more technical and larger business market.

It was reported in earlier reviews that Windows 2000 is more stable that Windows 98/NT systems. A significant new feature in Windows 2000 is Microsoft's

Active Directory, that enables virtual private networks to be set up by a company, give users access to shared files in a consistent way any network computer.

Another features such as fully customisable administrative console that can be based on tasks rather than files, applications, or users. Also Dynamic Domain Name Server (DNS), which replicates changes in the network using the Active Directory Services, the Dynamic Host Configuration Protocol (DHCP), and the Windows Internet Naming Service (WINS) whenever a client is reconfigured.

Besides that, it also has the ability to create, extend, or mirror a disk volume without having to shut down the system and to back up data to a variety of magnetic and optical storage media. In addition, it also has close integration with and supports for Microsoft's Message Queue Server, Transaction Server, and Internet Information Server (IIS).

2.9.3 Database Server

2.9.3.1 MySQL

MySQL consists of a server daemon "mysqld" and many different client programs/libraries, which is an implementation for the client/server. It is a true multi-user, multi-threaded SQL (Structured Query Language – the most popular database language in the world) database server.

MySQL is high in speed, robust and ease to use. Database servers typically use some type of a monitor application to do system administration. This application can be character based, or graphical and the administrator will most likely use both since each has its strengths in different areas of system administration.

2.9.3.2 Microsoft SQL Server Version 7.0

Microsoft SQL Server Version 7.0 is the most robust database for the Windows family. It is a Relational Database Management System (RDBMS) of choice for a broad spectrum of corporate customers and Independent Software Vendors (ISVs) building business application. SQL Server 7.0 runs on Windows NT 4.0 or Windows 2000.

SQL Server is a client/server relational database management system (RDBMS) that is highly integrated with the Windows NT operating system. Microsoft SQL Server supports a set of features that result in the following benefits:

- **Ease of installation, deployment and use**

  SQL Server includes a set of administrative and development tools that improve your ability to install, deploy, manage and use SQL Server across several sites.

- **Scalability**

  The same database engine can be used across platforms ranging from laptop computers running Microsoft Windows 95/98 to large, multiprocessor server running Microsoft Windows NT, Enterprise Editor.

- **Data warehousing**

  SQL Server includes tools foe extracting and analysing summary data for Online Analytical Processing (OLAP). SQL Server also includes tools for visually designing database and analysing data using English-based questions.

- **System integration with other server software**

  SQL Server integrates with e-mail, the Internet and Windows.

SQL Server includes OLAP Services, Data Transformation Services and English Query, and works with over 45 ISVs that form Data Warehousing Alliance. It is the first database that scale from the laptop to the enterprise using the same code base, offering 100% code compatibility.

2.9.3.3 Microsoft Access

Access offers an easy-to-use database for managing and sharing data. Moreover, Access 2000 brings not only the traditional broad range of easy data management tools but also adds increased integration with the Web for easier sharing of data across a variety of platforms and user levels.

It is powerful new tools for managing data. It enables sharing of database among the co-workers over the Internet, searching and retrieving the information quickly, and taking advantage of automated, pre-packaged solutions to quickly create databases. Data in Microsoft Access can be migrated to the Microsoft SQL Server.

Benefits of Microsoft Access:

- **Making information easy to find and use**

  Access 2000 continues to offer an easy-to-use tool for easily finding information that provides consistency and integration with the other applications in the office suite.

- **Web-enabled information sharing**

  Access 2000 allows easily sharing information via the corporate Intranet and the ability to easily host a database within the browser. This combines the power of a desktop database with the power of the Web.

- **Powerful solutions tools for managing information**
  Power users and developers may now create solutions that combine the easy-to-use of the Access interface (client) with the scalability and reliability of SQL server.

2.9.3.4 Oracle 8i

Oracle server is a multi-user database that provides unprecedented ease-of-use and is pre-tuned and pre-configured for dynamic workgroup and line-of-business environments. It provides a fully integrated set of easy to use management tools, full distribution, and replication and Web features. Therefore, it allows users to share relational data across applications and servers. Concurrently, Oracle is able to be supported at different hardware platforms.

Advantages of Oracle 8i:

- Oracle supports SQL commands such as add new tables to a database, add new columns, etc. SQL (Structured Query Language, pronounced "sequel") is an English-like language consisting several "layer" of increasing complexity and capability. It is easy to learn and use.
- Oracle allows old and new "views" of the same data to exist simultaneously. Multiple views of the same data enable the existing programs continue to run without modification by using the old views of your data, while your new applications takes advantage of the new view of the data. This feature is known as data independence.

2.9.4 Web Server Software

There are over 30 Web server software packages in the market. According to Netcraft, a networking consulting company, recent report indicates that four of the most popular Web server programs are Apache HTTP Server, Microsoft Internet Information Server, Netscape Enterprise Server, and O'Reilly's WebSite Professional [5]. This section follows with descriptions of Apache HTTP Server, and Microsoft Internet Information Server.

2.9.4.1 Apache HTTP Server

Apache HTTP Server is free Web server software that provides powerful and efficient performance. Apache is able to runs on many platforms such as Microsoft NT, OS/2, AIX, BSD/OS, FreeBSD, HP-UX, Iris, Linux, Solaris and several other operating systems.

Apache has a built-in search engine and HTML authoring tools and also supports FTP. Apache's application development tools support CGI (Common Gateway Interface), SSI (Server Side Includes), and several proprietary APIs (Application Program Interfaces). SSI is a type of HTML comment that directs the Web server to dynamically generate data for Web page when it is requested.

On the security matter, Apache supports password authentication and digital certificate authentication. It allows administrators to easily set up password-protected pages with enormous numbers of authorized users, without slowing down the server. Server access can be restricted by domain name, by IP address, or by user and group. Besides, Apache can prohibit access by directory or file, and supports SSL (Secure Sockets Layer).

Apache is also flexible enough to perform multiple Directory Index directives, where administrators can instruct the server to either send back index .html or run index .cgi when a directory URL is requested, which ever it finds in the directory. Apache server uses Open Database Connectivity (ODBC) standard and can access Oracle, Sybase, Microsoft SQL Server, and IBM's DB2 database. Apache also supports Active Server Pages (ASPs) and Java servlets.

Today the Apache server is the most widely implemented Wed server on the Internet area. It offers a powerful and customisable approach. It has been shown to be substantially faster, more stable and more feature-full than many other Web servers. Apache is the ideal choice for the sites that received high capacity of hits per day.

2.9.4.2 Microsoft Internet Information Server

Microsoft Internet Information Server (IIS) comes bundled (free) with Microsoft's Windows NT operating system [5]. It is a robust and capable Web server program that is suitable for small right up to enterprise-class sites doing high transaction volumes.

IIS includes an integrated search engine that allows users to create custom search forms with a variety of tools, including ASP, ActiveX Data Objects, and scripts to produce dynamic pages. ActiveX Data Objects, an ASP component, allows developers to access and control data in any ODBC or OLEDB compliant database using any ActiveX scripting language. The IIS Web server software also includes Microsoft's FrontPage HTML development tool and reporting tools from Crystal reports. IIS supports FTP that allow users download files and data from the server site.

The Microsoft Management Console (MMC), which is including in IIS, provides central server management from any server on the network [5]. IIS also supports multiple virtual hosts. Microsoft also includes its own Internet Services API (ISAPI), which is an application programming interface for creating programs that run as processes. Database support includes ODBC and Microsoft SQL.

Security in IIS is tightly integrated with Windows NT's operating system security. Thus, NT basic access control mechanisms (username/password) and SSL software encryption are also providing in IIS [5]. Additionally, IIS have built-in certificate server that allows organizations to issue and manage digital certificates verifying identities. With IIS, Web developers can restrict access to a directory or URL by user, group, or IP address, or by using Windows NT's Challenge/Response authentication.

2.9.5 Web Development Tools

2.9.5.1 Microsoft Visual InterDev

The Microsoft Visual InterDev is an integrated development environment (IDE) that integrates Web application and development system in order to build dynamic, data-driven Web applications for corporate intranets and the Internet. The Visual InterDev development environment integrates all the tools needed to create, publish, and manage Web applications that are portable and platform independent. This full-featured authoring environment enable users easily create Web sites that incorporate advanced client- and server-side programming, powerful database connectivity options, and rich ActiveX content.

Visual InterDev provides an easy-to-use and rapid development environment for building Active Server Pages (ASP). It also offers advanced publishing and site management features, as well as support for team-based projects through interoperability with the Microsoft FrontPage Web authoring tool.

Besides, with Visual InterDev, a developer can assemble pages that use ActiveX technologies and other similar COM technologies. Value added for data driven web applications that are developed using Microsoft's Universal Data Access, which includes ADO (ActiveX Data Objects), ODBC (Open Database Connectivity), and OLEDB.

2.9.5.2 Microsoft FrontPage

Microsoft FrontPage is focused on making basic Web document publishing and site management easy for business professionals and end users who are not full-time Web publishing professionals. Microsoft FrontPage is like Internet Assistants, it allows users to create multimedia Web sites with just a few mouse clicks. Even a non-expert user is able to use FrontPage in creating and maintaining sophisticated, and interactive Web site. From the aspect of integration with Microsoft Office, there is add-in for Office and it is easy to update Office documents.

2.9.5.3 ColdFusion

ColdFusion is a popular set of product for building Web sites and serving pages to users. It enables a content database to be built by using input templates and combine these with application programs to create a dynamic Web site. It consists of ColdFusion Studio, which is used to build a site, and ColdFusion Server, which serves the pages to users. ColdFusion Studio is described as "a complete integrated development environment (IDE)" and also ColdFusion Server as "a deployment platform".

ColdFusion has the ability to build Web sites as "piece parts" that can be stored in a database and reassembled then for Web pages, e-mail, newsletters and other users. Besides, ColdFusion provides a visual interface for building Web page directly or for building the "piece parts". It is also a popular tools for building e-commerce sites.

ColdFusion has its own page markup language called ColdFusion Markup Language (CFML). CFML encompasses the Web's Hypertext Markup Language HTML and Extensible Markup Language (XML). A just-in-time (JIT) compiler turns the CFML into the pages that get served. ColdFusion can be coordinated with distributed applications that use CORBA or Microsoft's DCOM to interact with other network applications.

ColdFusion is scalable. It allows both the size of a database and the number of users that can be served to grow accordingly. For large Web sites, multiple ColdFusion Servers can be run together as a cluster.

2.9.5.4 Notepad

Notepad is still a popular text editor tool. No matter how many development tools are available now, there always be people who will use Notepad as their editor of choice. This may due to its simplicity and does not generate any extra code. However, people normally use Notepad as a third party tool for developed their Web pages.

2.9.6 Web Development Technology

2.9.6.1 Active Server Page (ASP)

Microsoft Active Server Page is a file which containing HTML with embedded one or more executable code written in a language such as JavaScript or VBScript is processed on a Microsoft Web server before the requested page is sent to the users or clients. With ASPs, the executable code contained in the file is executed on the server rather than on the client machine. The result of that execution, together with any HTML or other information contained in the file, is sent to the client and displayed by the browser [15]. (See Figure 17)

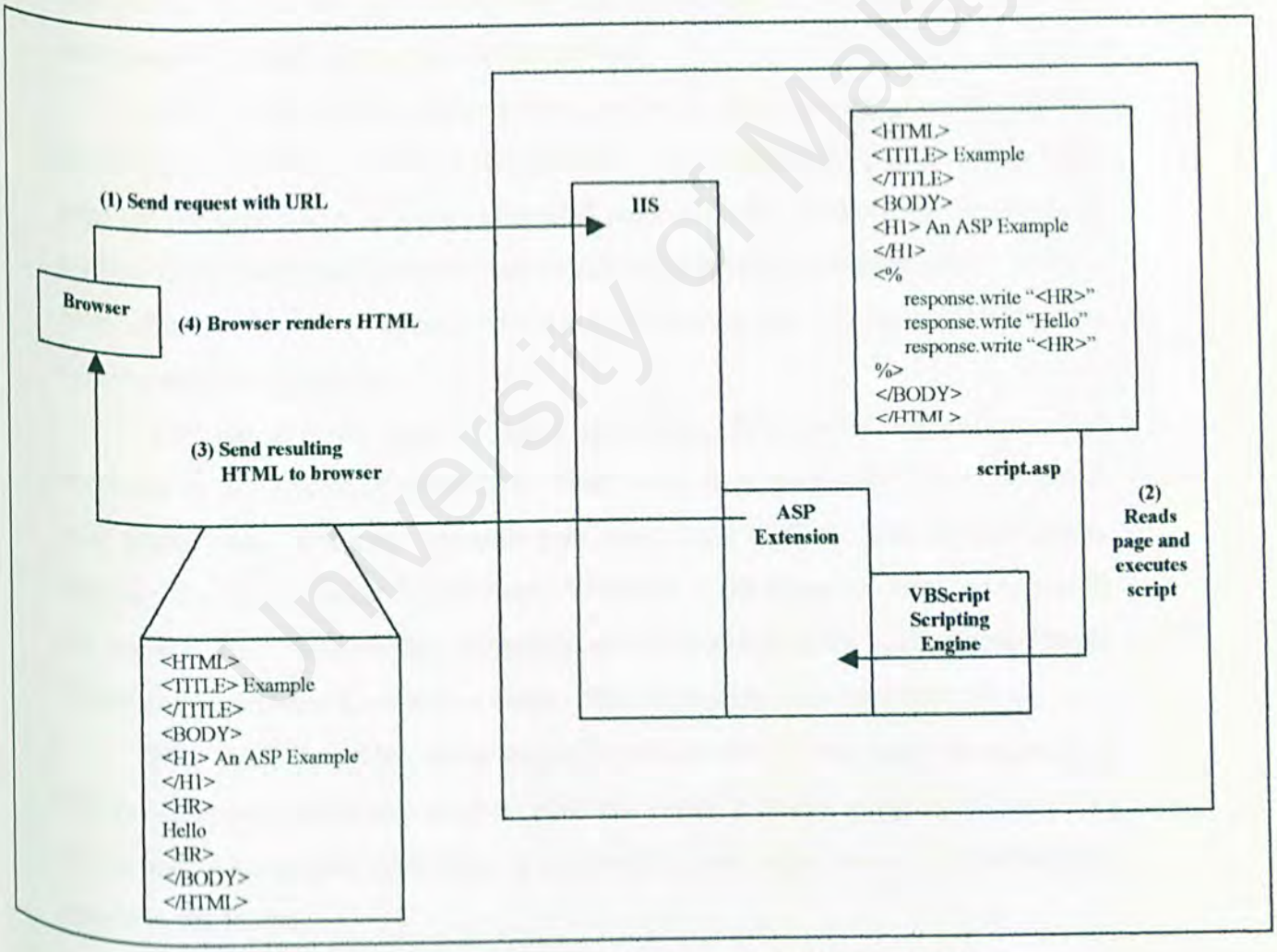

Figure 17: A request referencing an ASP page causes IIS to execute the script in the named file, and then send the result to the client

The ASP functionality can be thought of as two separate parts. One is a scripting engine that actually reads and interprets the script code on the page, and the other is a standard ISAPI extension named asp.dll that actually implements the core ASP functions. Which scripting engine is loaded depends on what language the page contain [15].

An ASP file (ASP script must end in .asp) can contain HTML tags, ordinary text, or script statements in some language. A scripting engine must be available on the server machine for the language the script statements are written in. Windows 2000 includes engines for VBScript and Microsoft Jscript (Microsoft's implementation of JavaScript), and engines for other languages are available from the third parties. While the ASP machinery is language-neutral, VBScript is by far the most commonly used choice for ASP developers.

ASP is a server side scripting. It is similar to the common gateway interface (CGI) application that all involve programs that run on the server, usually tailoring a page for the users. ASP is server-generated page that can invoke other programs to perform tasks like access database, serve different pages to different browser, etc. It is more efficient than CGI because it runs as a service and can take advantage of multithreaded architectures.

ASP has evolved into an "open technology framework", means it is not necessary to use Microsoft product to create code in it. Nowadays, you can create ASP pages using whatever language you want such as C++, Java or JavaScript. Anyway, the most popular is VBScript. VBScript is the simplest language to use in the website. ASP can also take advantage of COM and DCOM (Component Object Model and Distributed Component Object Model) objects with minimum effort.

With ASP, the code can be simply written in the HTML page. No compiling and no complex interfacing needed. ASP has made it much quicker and easier to create highly interactive Web sites. It also makes your pages easier to maintain and update in the future.

2.9.6.2 Common Gateway Interface (CGI)

Common Gateway Interface is a common way for Web servers to interact dynamically with clients (users). It is a standard way of interfacing backend applications with Web servers. It is uses to pass a browser's request to an application program; the application then processes the data and formulated into HTML documents, and then returned to the Web server. These documents are then send back to the browser (the client). The application program (or CGI application) can be written in a number of languages such as Perl, C, C++ and Java. However, the most popular language used in a CGI application is Perl, which the file has a ".pl" suffix.

2.9.7 Markup and Scripting Language

2.9.7.1 Markup Language

2.9.7.1.1 Hypertext Markup Language

Hypertext Markup Language (HTML) is a language of the World Wide Web that can create Web pages with colours, test formatting, hypertext links and image. It is a simple and powerful markup language that able to generate platform-independent hypertext documents and viewable by any Web browser.

An HTML document contains both document content and tags. The document content consists of all the information actually appearing on the computer screen. The tags are the HTML codes inserted in a document that specify how a complete document or portion of it should be formatted and arranged onscreen. Since the HTML code defines the structure and formatting of a Web page, but a page may look different in two different browsers. There are a fairly large number of tags defined for HTML. Here is a basic structure of HTML document:

```
<HTML>
  <HEAD>
    <TITLE>
      Example Title
    </TITLE>
  </HEAD>
  <BODY>
    Your main document information and HTML goes here.
  </BODY>
</HTML>
```

Due to the fact that HTML could not provide the real programming power for Web programmers, many alternatives such as JavaScript and VBScript are used for builds dynamic interaction and content. They are used to complement HTML.

2.9.7.2 Scripting Language

2.9.7.2.1 JavaScript

JavaScript is a scripting language developed by Netscape Communications Corporation that allows users to create dynamic Web pages. JavaScript is based on the Java programming language, but it differs from the programming language in several ways. First, JavaScript is much simpler than a genuine programming language, so it is relatively easy to learn. JavaScript is more on the scale of HTML than a true programming language. It embedded within the HTML of a Web page and executed by the browser in order that no additional files are required to perform its function. JavaScript is merely a scripting language that is parsed and executed by the parser. It needs no compiling process.

JavaScript is an object-based scripting language that is designed for developing Internet applications. As a scripting language, JavaScript is used as a means to tell an application what to do, compare to the languages that are used to create applications, it cannot do anything without the application. Java Script offers much more expressive power that HTML such as create multipart documents, build dynamic documents that take users through a Web site from one document to another, and generate documents that interact with the user.

JavaScript runs on Netscape Navigator 2.01 and its later releases. There are several version of JavaScript supported by certain browsers and browser version. JavaScript is also supported by Internet Explorer 3.x (in most cases) and Internet Explorer 4.x.

Using JavaScript, even less-experienced developers will be able to direct response from a variety of events, objects and actions. It provides anyone who can compose HTML with the ability to change image and play different sounds in response to specified events, such as a users' mouse click or screen exit and entry.

2.9.7.2.2 VBScript

VBScript is developed by Microsoft, which is a subset of its Visual Basic programming language and is a lightweight interpreter language. It is embedded in the HTML page to build the Web applications.

It is natively executed on the Internet Explorer browser and other browsers through plug-in technologies. It is the default scripting language of the Internet Information Server 3.0 and later. Although Microsoft does support Netscape's JavaScript (it converts it into its own JScript), Netscape does not support VBScript. For this reason, VBScript best used for Intranet Web sites that use the Internet Explorer browser only. VBScript is the newest member of the Visual Basic family of programming languages that brings active scripting to wide variety of environments, including Web client scripting in Microsoft Internet Explorer version 3.0 and Web server scripting in Microsoft Internet Information Server version 3.0.

For people who are already know Visual Basic or Visual Basic For Applications, VBScript will be very familiar. Even if they don't know Visual Basic, once they learn VBScript, they are on their way to programming with the whole family of Visual Basic language. VBScript is extremely easy to learn and use compare to Java and JavaScript.

VBScript talks to host applications using ActiveX Scripting. With ActiveX Scripting, browsers and other host applications do not require special integration code for each scripting component. ActiveX Scripting enables a host to compile scripts, obtain and call entry points and manage the namespace available to the developer.

2.10 Summary

Literature review is an important approach to search and gather system requirements and relevant information. Initially, the Fact Finding Techniques topic elaborates the methods being used during conducting the researches. Then, the concepts and theory of the relevant topics were being studied and optimised the understanding. The topics are includes Intranet, intranet, extranet, electronic commerce, electronic business, and etc. Several case studies were being done to achieve some guidelines in developing the business models and requirements of the system. Some functions were deployed in this system such as electronic catalogue, electronic ordering, invoicing, and inventory integration. Finally, information of the development tools and languages were collected and compared.

Chapter 3

SYSTEM ANALISYS

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SYSTEM ANALYSIS

3.1 Methodology

A system development methodology or also known as process model is an essential element that must include in software engineering. It shows the way in applying the set of software process activities and associated results towards produce a software product. It defines the stages of a system development project, specifies the task to be carried in and out, and the output is expected from each stage. Methodology provides guidelines for project management and control, and backed by a philosophy on its approach towards system development. There are four fundamental process activities, which are common to all software processes [16]:

i. **Software specification:** The functionality of the software and constraints on its operation must be defined.
ii. **Software development:** The software to meet the specification must be produced.
iii. **Software validation:** The software must be validated to ensure that it does what the customer wants.
iv. **Software evolution:** The software must evolve to meet changing customer needs.

A good methodology that able to provide the effective ways of system development is best defined before the project starts and then becomes the framework to development staff. Below are some benefits offers by a good methodology:

- Provides a standard framework that the developer does not have to reinvent the wheel for each project.
- Each method or tool in the methodology results in successful completion of each development task.

- Reviews procedures are available to identify any errors, inconsistencies and discrepancies during development.
- Increase the system quality by forcing the developer to produce flexible systems and adequate documentation.
- Provides better understanding of user needs and validation of user needs.
- Provides the management with tools to review project progress and checklist to access tasks and deliverables.
- Improves communication among management, analyst, programmers, users and other stakeholders by providing a communication base.
- Facilitates planning and controlling the project.

There are a number of different methodologies that exist and being used, however, the waterfall model has been chosen as the system process approach. Waterfall model is sometimes called the software life cycle. It offered a means of making the development process more visible. Each level or phase is performs systematically and sequentially (Figure 18). The cascade from one phase to another makes possible it known as the "waterfall" model.

This model is the oldest and being the most widely used procedural model for software development. It provides a template into which methods for analysis, design, coding, testing, and maintenance can be positioned. This is very helpful in providing the developer a guideline that is easy to manage and control. Moreover, waterfall model is designed towards cost-effective development.

Requirements analysis is the first phase of this methodology. During this phase, information relevant with the project is collected through available medium such as books, magazines, Internet, etc. The requirements gathering process is intensified and focused especially on software, as well as the gathering of required function, performance, and interfacing. All the hardware and software requirements, constraints, functionality and system's goals are established at this stage.

Process continues to the next phase, which is the system and software design phase. The system design process partitions and translates the established requirements following from the first stage into either hardware or software systems.

The software requirements are translated in such a way that they can be readily transformed into computer system. This stage establishes an overall system architecture. It is also involves drafting out the data flow diagrams that resembles the functionality of the systems and its subsystems. The software design involves representing the software system functions in a form that may be transformed into one or more executable programs [16].

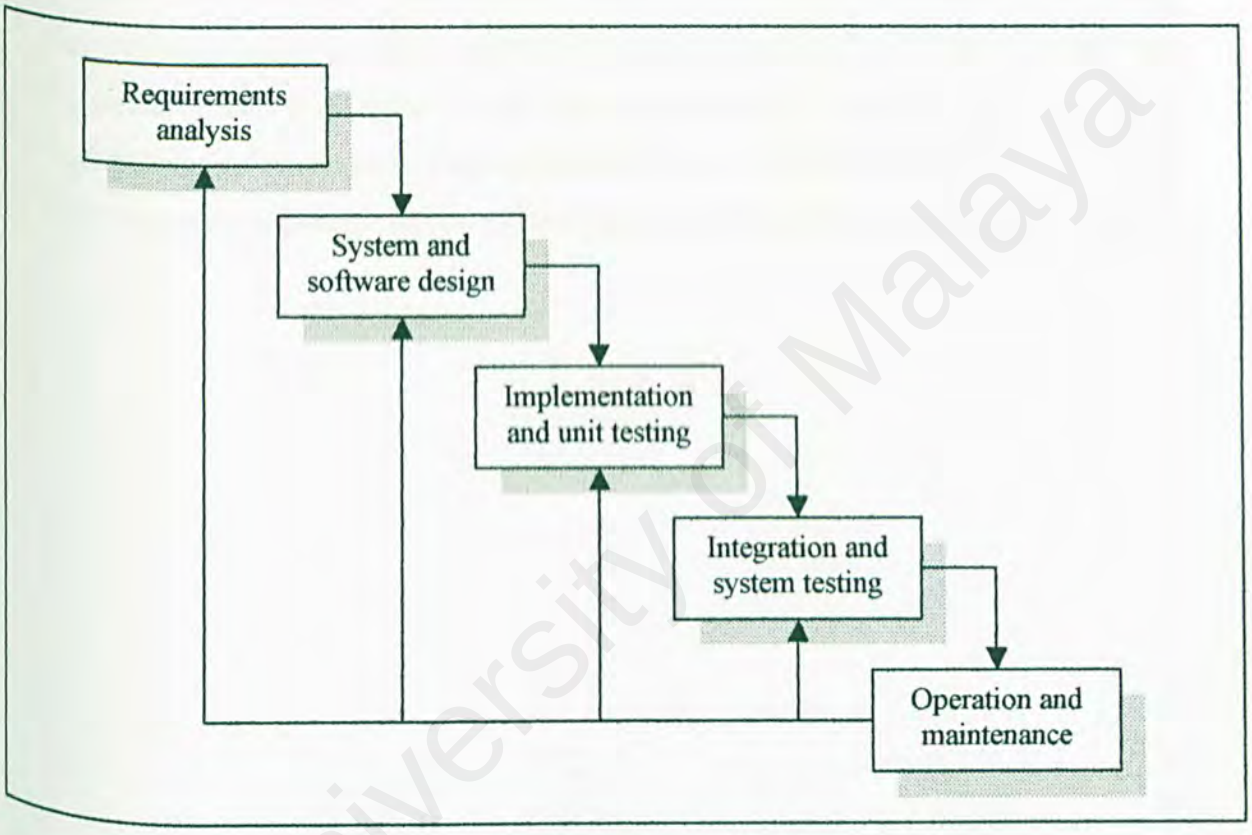

Figure 18: The Waterfall Model

The following phase of this methodology is the implementation and the unit testing. The design must be translated into a machine-readable form. In this level, all programs will be coded using selected programming language together with the application development tools based on the design determined in the previous section. Each program is called a unit and unit testing involves verifying that each unit meets its specification.

Integrating and system testing is the next phase. During this stage, all the individual program units or programs are integrated and tested as a complete system to ensure that the software requirements have been met [17]. The testing process

focuses on the logical internals of the software, ensuring that all statements have been tested, and on the functional externals that is, conducting tests to uncover errors. The system must be tested to ensure that defied input will produce actual results that agree with required results. When the combined programs are successfully tested, the software product is completed.

The last phase is the operation and maintenance. The system is installed and put into practical use. Maintenance involves correcting the errors that being encountered, which were not discovered in earlier stages of the life cycle, improving the implementation of system units and enhancing the system's services as new requirements are discovered. Making these changes may involve fed back to some or all of the previous process stages and the development is set back to that stage again.

3.2 Programming Technologies and Languages Consideration

Analysis has been done in order to select the most appropriate programming technologies and languages that suit the requirements of this system. Below are the choices that have been decided and chosen:

Description	Technologies/Software
Operating system/ Platform	Windows 2000 Server
Database server	Microsoft SQL Server 7.0
Web server software	Internet Information Server (IIS)
Web development tool	Microsoft Visual InterDev
Web development technology	Active Server Pages (ASP)
Markup and scripting language	HTML, VBScript

Table 2: Selected Programming Technologies and Language

3.2.1 Why Windows 2000 Server?

Windows 2000 Server has being selected as the e-supplier system platform since it is the upgrading version of Windows 98 and enhancement of Windows NT 4.0. Besides, the Microsoft Internet Information Server 4.0 (IIS) and Internet Explorer 5.0 browser are built-in application in Windows 2000 package.

Windows 2000 Server is a robust and secure operating system to manage mission-critical information of the system. It is suitable for enterprise or organizational level. Windows 2000 Sever showing high performance, reliable, secure and easy-to-manage characteristics for information sharing and running applications in the most demanding business environment.

3.2.2 Why Microsoft SQL Server 7.0?

The reasons that I choose Microsoft SQL Server 7.0 as the database server is as follow:

- It is able to handle more concurrent users as compared to Microsoft Access.
- Most viable solution to accommodate the vast storage requirements.
- Through tight integration with IIS, SQL Server can be queried and updated via Web browsers.

3.2.3 Why IIS?

Microsoft Internet Information Server (IIS) has been selected as the Web server software of this project because it is a high-end enterprise-level server. It has been proved as powerful and easier to set up and maintain than many of its UNIX-based server.

IIS offers a superb platform for building sophisticated Internet applications. Its tight integration with Windows 2000 Server provides powerful security, administration and development functionality.

IIS provides some beneficial features as below:

- Easy installation and uninstall on the existing hardware with graphical setup.
- Flexible since Windows NT server runs on thousands od standard hardware platforms.
- Accessible since all kinds of browsers can work with it.
- Virtual server support optimises hardware and allows for hosting multiple sites.
- Integration with Windows NT built-in security provides capabilities for secure transactions with the SSL (Secure Sockets Layer) support and for authentication.
- Windows-based Web authoring and development tools are supported.

- Integration with existing industry-standard database such as Microsoft SQL Server, Microsoft Access, Oracle, Infomix, Sybase and other ODBC-compliant databases.
- Indexing of HTML pages and Microsoft Office documents with Index Server facility in IIS.

3.2.4 Why Microsoft Visual InterDev?

Microsoft Visual InterDev provides an ideal environment for developers to visually construct sophisticated HTML and ASP pages. It is able to assist in coding and supporting figures like statement and recognition of key words. Visual InterDev enables developers to build applications accessible from any platform that running a standard Web browser such as Microsoft Internet Explorer or Netscape Navigator. It also provides the page and site design, and management tools.

3.2.5 Why ASP?

Active Server Pages (ASP) is selected as the development tool for this project due to its simplicity and ease of implementation. Executable scripts can be included directly into HTML files by using ASP. Therefore, HTML development and scripting development become the same process, enabling developer to focus directly on the look and feel of the Web page. Advantages of ASP are:

- Completely integrated with HTML files.
- Easy to create
- Require no manual compiling or linking processes of programs.
- Object-oriented and extensible with ActiveX server component.

The ASP files are written in VBScript or Jscript that enables the ASP to receive high-level commands as input. Sophisticated functionality using ActiveX sever components to process data and generate useful information can be incorporated in ASP. This allows the server to deal with large number of queries at the same time. Another advantage of using ASP is it connects to the database using standard ODBC protocols. This allows a high degree of database portability. ASP also offers the same

functionality as a CGI programs and much more efficient because of higher speed and native ODBC functionality.

ASP has the following features:

- Compile free.
- Faster than CGI.
- Use any scripting language with ActiveX scripting.
- Database connectivity.
- Connectivity to legacy information or applications.
- Open development environment.
- Use favourite Web tools.
- Foundation for the Active Server.

3.2.6 Why HTML?

HTML is simple yet powerful markup language used to generate independent hypertext documents that are viewable by a Web browser. It is very popular because of its simple syntax. HTML makes Web programming work easy and simple but to certain extent. There is no prior programming knowledge needed to learn HTML. Therefore, simple HTML pages can be developed almost immediate with access to word processing applications.

3.2.7 Why VBScript?

After considering several languages that are available in the market, VBScript seems to be the most desirable scripting language. This is because VBScript is the default scripting language for ASP. Moreover, it is much easier to learn. VBScript is easy to implement as well as it does not require any additional software besides Windows 2000 Server (or Windows NT server) and Internet Information Server.

3.3 Requirement Analysis

A requirement can be categorized as functional requirements and non-functional requirements.

3.3.1 Functional Requirements

Functional requirements describe the system's services and functions that provide for the users.

(i) **General users module**

- *Home*: users are able to view supplier's company details and profile. Information is about the organization, people and objectives.
- *Product catalogue*: users are able to browse the product catalogue.
- *Placing order*: users are able to place their order online by using the preformatted order form.
- *FAQ*: users are able to browse through the FAQ's pages to fulfil their doubts or questions.
- *Registered customer login*: the registered customers have to go through the authentication verification before enter their customised page and viewing on the confidential information.
- *Administrator login:* administrator login through this page in order to enter the supplier's backend system. Authentication is emphasizing here. Therefore, each administrator must have their own login ID and password.

(ii) **Registered customer module**

- *Logout*: logout from the registered customer module.
- *Profile*: viewing the customer's own information.
- *Order tracking*: customer is able to view their order history and status that being made previously until the most recently for tracking purpose. At this point, customers are able to do reorder as in previous order form, this will save customers time in editing a new order form.

(iii) **Administration module**

- *Logout*: logout from the registered customer module.
- *Product catalogue management*: administrator can edit the items in catalogue such as add, delete, and modify.
- *Order fulfilment management*: administrator can process the sales order being received, and online invoicing.
- *E-customer inventory management*: link to the customer's intranet and view the customer's inventory and sales status. This is important for real-time inventory control. Alert the customer if the inventory is in critical level.
- *Customer information management*: customize the customer profile.

3.3.2 Non-functional Requirements

Non-functional requirements are those constraints placed on the services or functions offered by the system (for instance, the required response time), or on the development process (such as the use of a specific language standard). These are important to ensure the quality of the system.

(i) **Flexibility**

The system should have the capability to take advantage of the new technologies and resources. The system should be able to adapt and implement in the changing environment.

(ii) **Reliability**

A system is said to have reliability if it does not produce dangerous or costly failures when it is used in a reasonable manner. The system should be reliable in perform its intended functions and operations accurately. For example, whenever a button is clicked, the system should able to respond and execute particular function accordingly such as generate some messages to inform the user what is happening.

(iii) **Usability**

The system should be developed in such a way that it is easy to use. It should be able to enhance and support rather than restrict the processes. Besides, the interface should be self-explanatory and consistent with other application in the system environment.

(iv) **User friendliness**

A good flow of navigation is important to help and guide users on navigating with little effort through hyperlinks and procedure steps. Good interface is able to improve interaction between the users and the system.

(v) **Efficiency**

The system should be called or accessed in an unlimited number time to produce expected outcome or output at a creditable pace or speed.

(vi) **Manageability**

The system should be easy to manage and handle to ensure that maintenance can be done regularly. Besides, it should enable the evolutionary of the system easy to be done and making the enhancement works simpler.

(vii) **Robustness**

Robustness refers to the quality that a system to handle or avoid disaster. The system should be able to continue implementing in spite of unexpected problems.

(viii) **Correctness**

The system should be built according to the user requirements and specifications. It must meet its objectives and mission.

(ix) **Modularity**

Modularity is a key factor in good programming design. Program is broken into several sections that isolated from one another that each performs distinct functions. This characteristic will make testing and maintenance much more easier.

(x) **Maintainability**

The system where the software should be able to be understood, corrected, adapted and allow enhanced in the future.

(xi) **Expandability**

The degree to where the architectural, data, or procedural design can be extended.

(xii) **Security**

The system should involve the capability in performing authentication and authorisation of valid users. The system should mandate a user to input a username and password before being allowed access into the system. This is important to provide security characteristic to privacy and confidential data, in order to avoid improper admission of eavesdroppers or hackers to the system.

3.3.3 Run-Time Requirements

3.3.3.1 Hardware Requirements

The hardware requirements prior to implementation of the system are show as the table below:

Hardware components	Requirements
Computer	Pentium 133 MHz processor and above
Memory	At least 32 MB RAM
Hard disk space	At least 4 GB
Others	Network connection

Table 3:Hardware Requirements

3.3.3.2 Software Requirements

The software requirements prior to implementation of the system are show as the table below:

Software components	Requirements
Operating system	Windows 2000 Server
Web server software	Internet Information Server (IIS)
Database server and application	Microsoft SQL Server 7.0
Web Browser	Microsoft Internet Explorer 4.0 and above

Table 4:Software Requirements

3.4 Summary

During the system analysis stage, the Waterfall model was being chosen as the system development process model. This is due to its simplicity and efficiency in providing the guideline to accomplish the development successfully. The development technologies and languages that being chosen after a quantity of consideration are Windows 2000 Server as the server platform, which running IIS and ASP technologies, and integrate with Microsoft SQL Server 7.0 database server. For the developing languages, the system uses Microsoft Visual InterDev to write the HTML and VBScript programs. The system includes three different functions that suite the administrators, registered customer, and also general module that design for everyone. Apart from the functional requirements, the non-functional and run-time requirements are being recognized and established at this stage to achieve expected and significant results.

Chapter 4

SYSTEM DESIGN

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SYSTEM DESIGN

4.1 Introduction

System design is the specification or construction of a technical, computer-based solution for the business requirements that being identified and established during the stage of system analysis. In other words, the design phase addresses *how* technology will be used in the system [23]. It focuses on the technical or implementation concerns of the system. Therefore, design phase is concerned with technology-based views of the system's DATA, PROCESSES, and INTERFACES.

System design is important in serving the purposes as stated below:

- To transform requirement into a working system.
- To determine a set of components and intercomponent interfaces that satisfies a specified set of requirements.
- To change the abstract logical model to the concrete physical implementation.

4.2 System Architecture Design

A three-tier web client/ server architecture was being deployed in this project to achieve the requirements specification. Generally, it can be divided into three distinctive tiers. The first tier is known as the application layer. It consists of all the necessary applications. Web browser such as the Internet Explorer is the main component that appears to the users. Besides, the HTML and VBScript components are also included in this tier to provide interactive and dynamic pages or interfaces to the users.

The second or middle tier is the service tier. It is also known as web server that responsible to link the first and third tier. The components reside in this tier are include Internet Information Server (IIS) and Microsoft SQL Server.

Finally, the third tier is the data repository. It acts as the main storage of the system's data. This layer included all the Microsoft SQL databases.

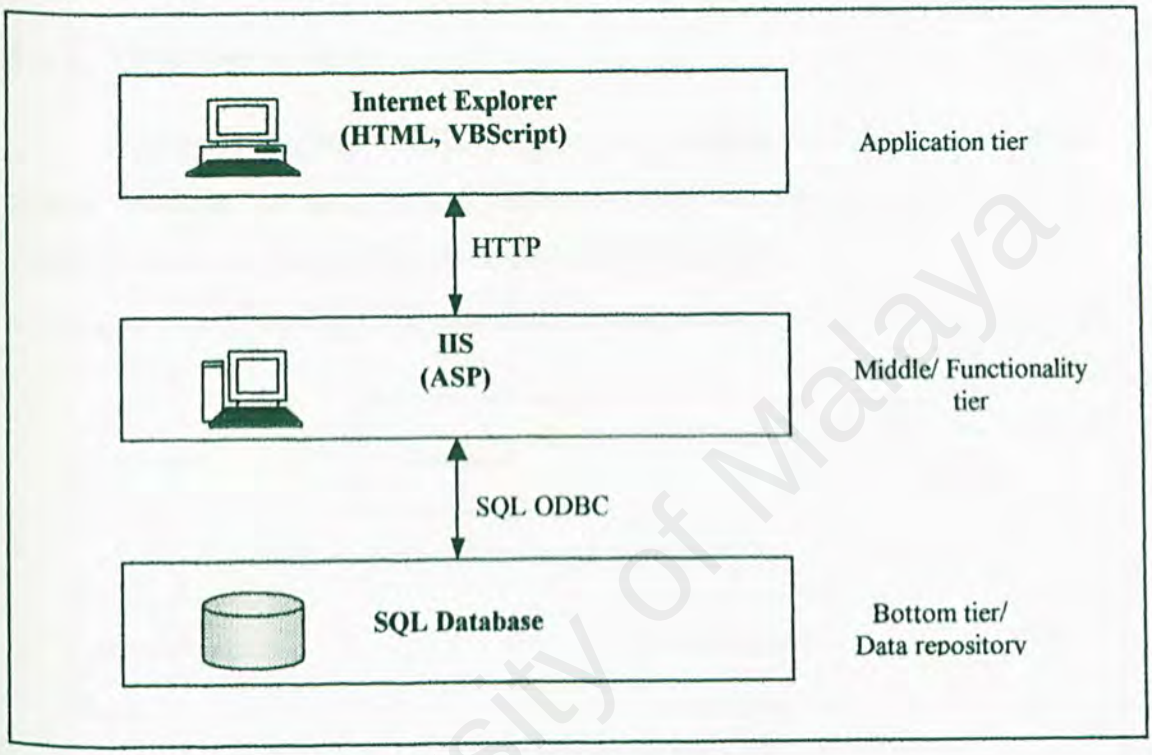

Figure 19: Three-tier Architecture

As shown in Figure 19, the first layer and the second layer are communicating using Hypertext Transfer Protocol (HTTP) through the network or the Internet. As the server receives the HTTP requests from the users, it will then retrieve the require information from the database server in the third tier through ODBC connection. The requested information is then being constructed into a HTTP message containing the Web page and send back to the client. When the server's message arrives back at the requesting client, the browser recognizes the HTML file and displays the page on the screen.

4.3 Process Design

Process design is depicted and mentioned in two approaches:

- Structure chart
- Data Flow Diagram

4.3.1 Structure Chart

Structure chart is a treelike diagram that depicted modules contain in the system. Modules are decomposed, from top-down into sub-modules. Figure 20 shows the overview flow of the main module of the system.

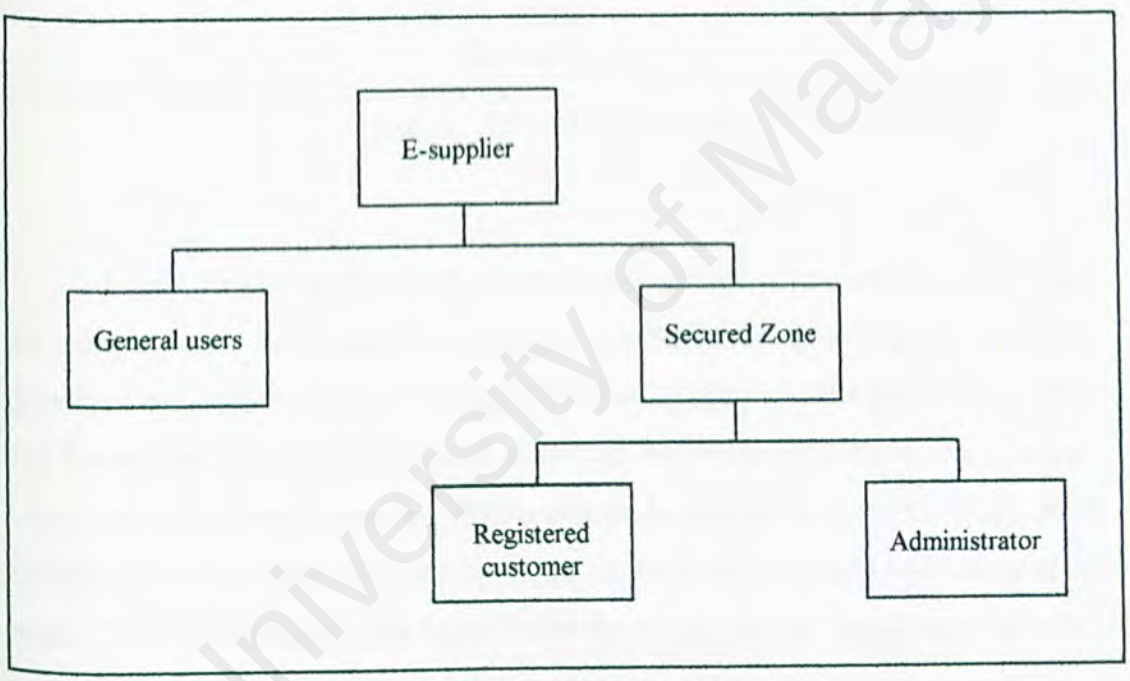

Figure 20: E-supplier Overview

Every user that enters the e-supplier system is considering a general user. Furthermore, if the user also has the role as either the registered customer or the administrator, he/ she is allows in reaching to the secure zone after go through the authentication control. The user will then be assigned to the appropriate module according to the user's identity and role.

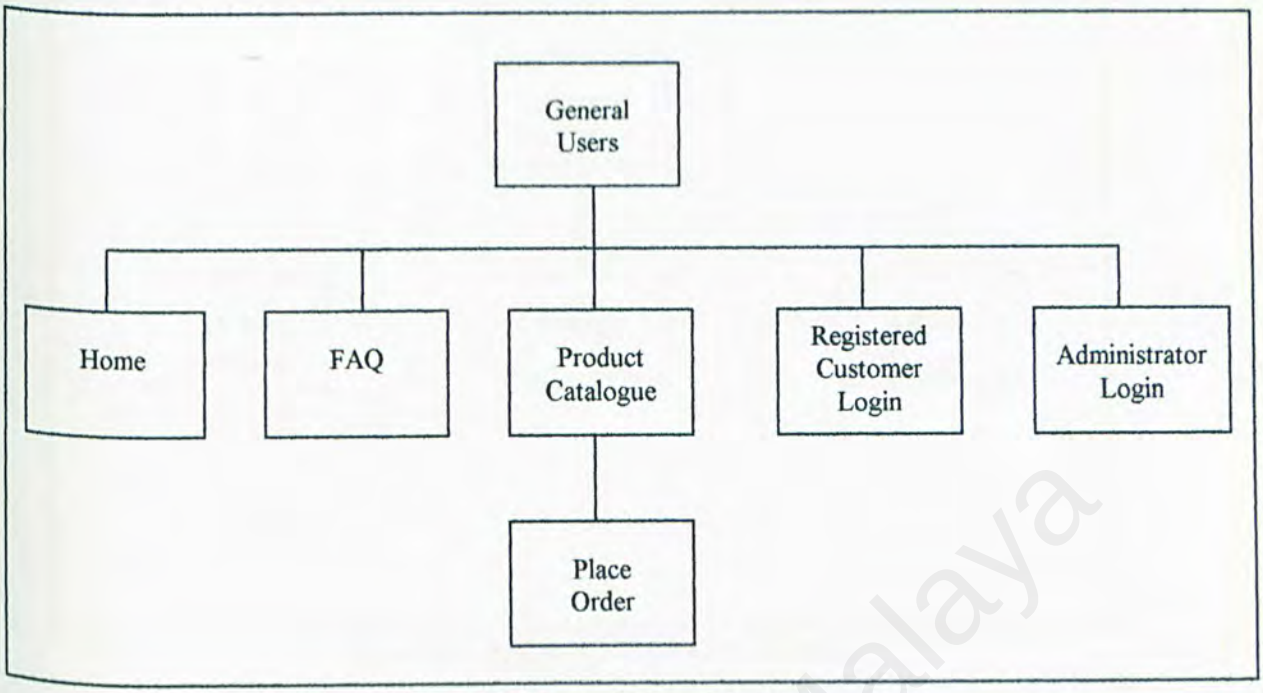

Figure 21: General Users Module

Figure 21 shows the sub-modules of the general user functionality. Users are able to view on supplier's company details at the Home page, and also questions and answers at the FAQ page. Product catalogue is the page where users can browse the products that available on sell and then place their order online. Users that have being registered before can go to registered customer login page to enter their login name and password, as the first steps to login into personalize pages. The administrator can login from the administrator login page to enter backend system.

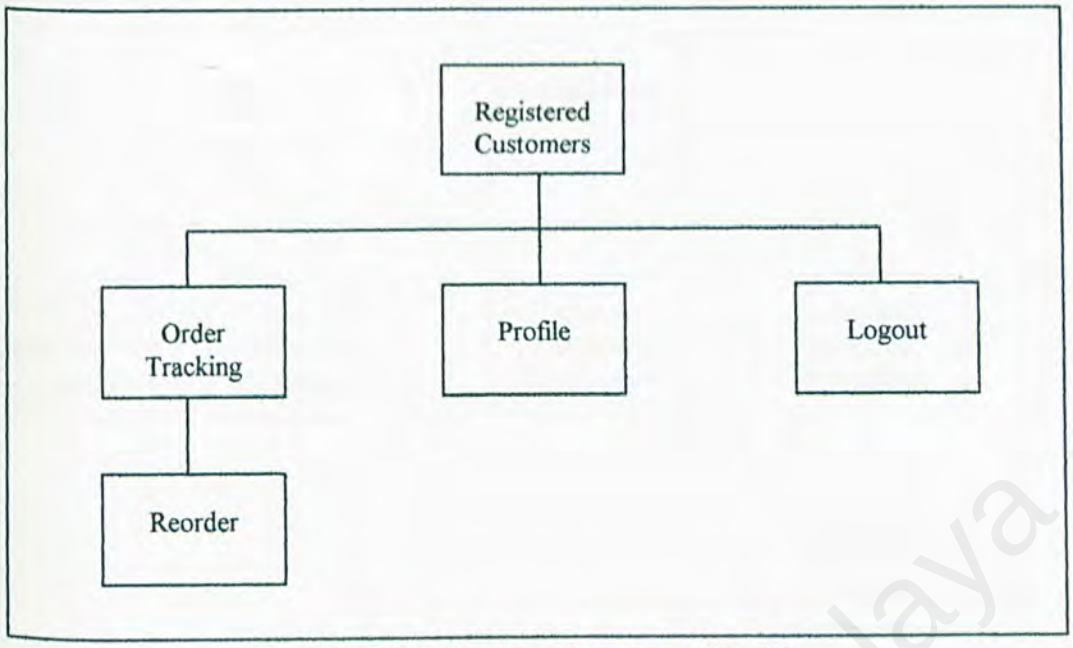

Figure 22: Registered Customers Module

Figure 22 shows the sub-modules of the registered customers module. Apart from the general users accesses, the registered customers have the priority to browse on the personalize pages. The customer can view their profile and do order tracking. At this point, they also can reorder the same items as the previous placed order.

Figure 23 shows the sub-modules for the administrator module. Administrator can edit the product catalogue at the product catalogue management module. Customers' information can be viewed or edited in the customer information management pages. In order to fulfil the new received order, administrator can process sales order in the order fulfilment management module. Here, invoice will be process and send to the customer accordingly. A special characteristic offer in e-supplier system is the capability to integrate with the customers' inventory system in order to collect the products' sales and inventory information on the customer site. This information is important to analyse on the popularity and demand of the products in the market. Inventory control can help the customers to manage their inventory in a more strategic approach. All these features are implement in the e-customer inventory management module.

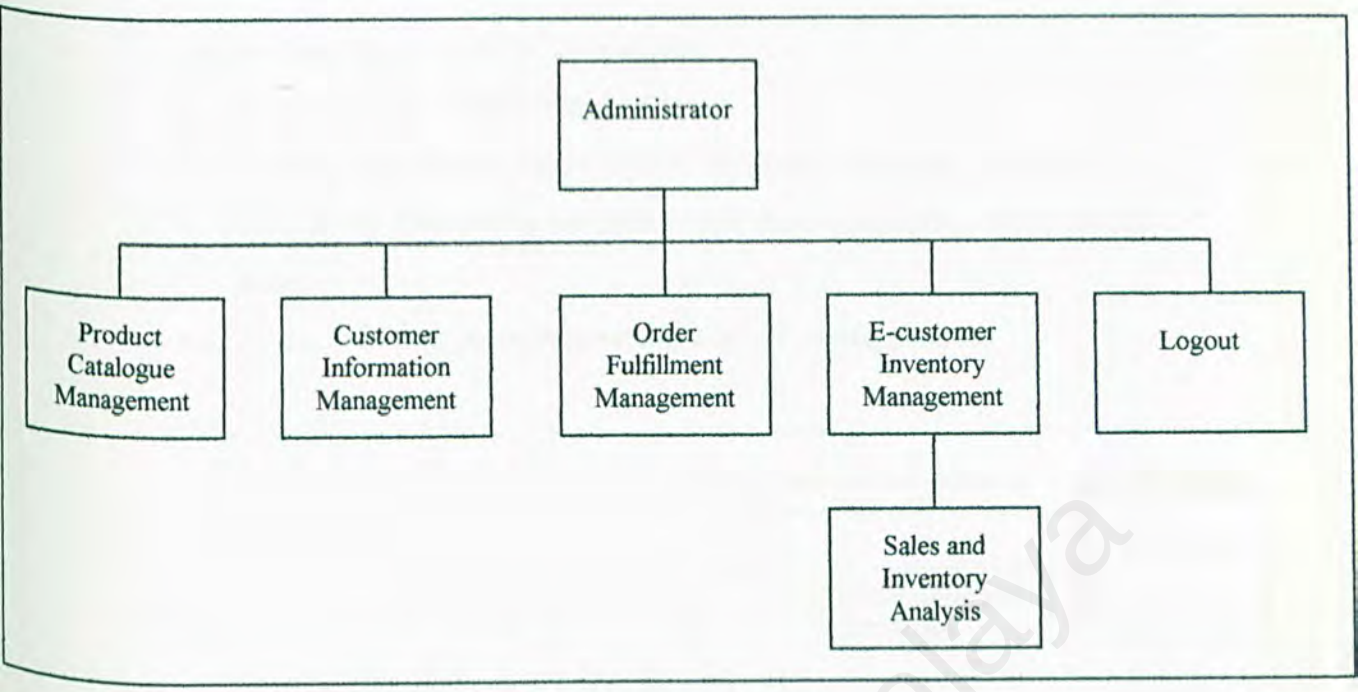

Figure 23: Administrator Module

4.3.2 Data Flow Diagram

Data flow diagram (DFD) is a tool that used to depicts the flow of the data through a system and the work or processing performed by that system [23]. DFDs illustrate the input of data to a process or the output of data from a process. It is broadly being used to depict overview of the system inputs, process and outputs. Components that used in the DFDs have distinct symbolic meaning. Below shows the description of each component.

Component	Description	Component	Description
	Entity		Data store
	Flow of data		Process

Table 5: DFD Components

Further description of DFD Components:

- *Entity*: Source or destination of data.
- *Flow of data*: Shows movement of data from one point to another.
- *Data store*: Depository for data which allows addition and retrieval of data.
- *Process*: Shows the occurrence of a transforming process.

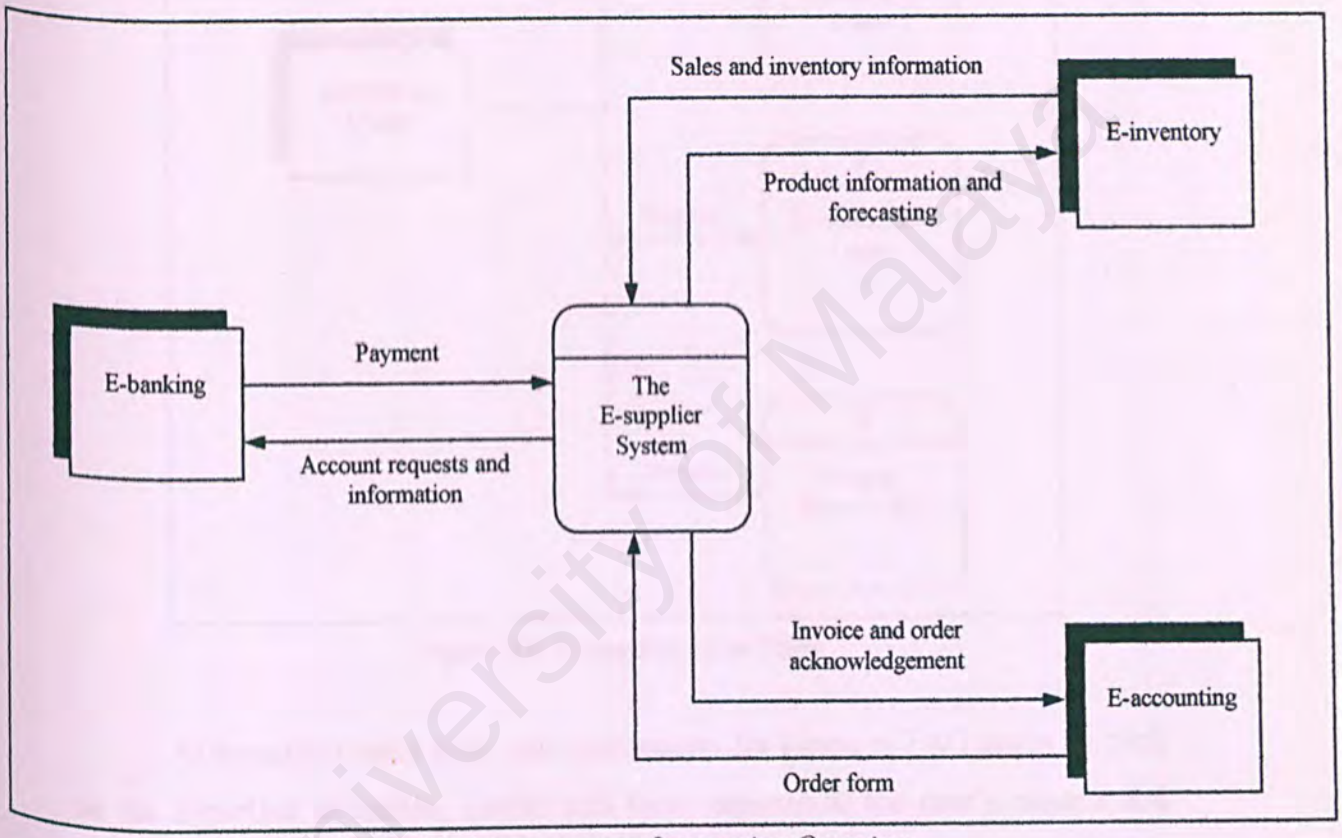

Figure 24: Inter-company Integration Overview

Some DFDs for the modules and sub-modules of the e-supplier system are depicting in this section. Figure 24 illustrates an overview of the modules that have integration with e-supplier system in the IBS (Integrated Business Solution) project. This integration involves three different organization entities, which are the supplier itself, the banking institute and the customer (the retailer). E-supplier is incorporates with the customer e-inventory and e-accounting system in business transaction and other long-term relationship planning like forecasting.

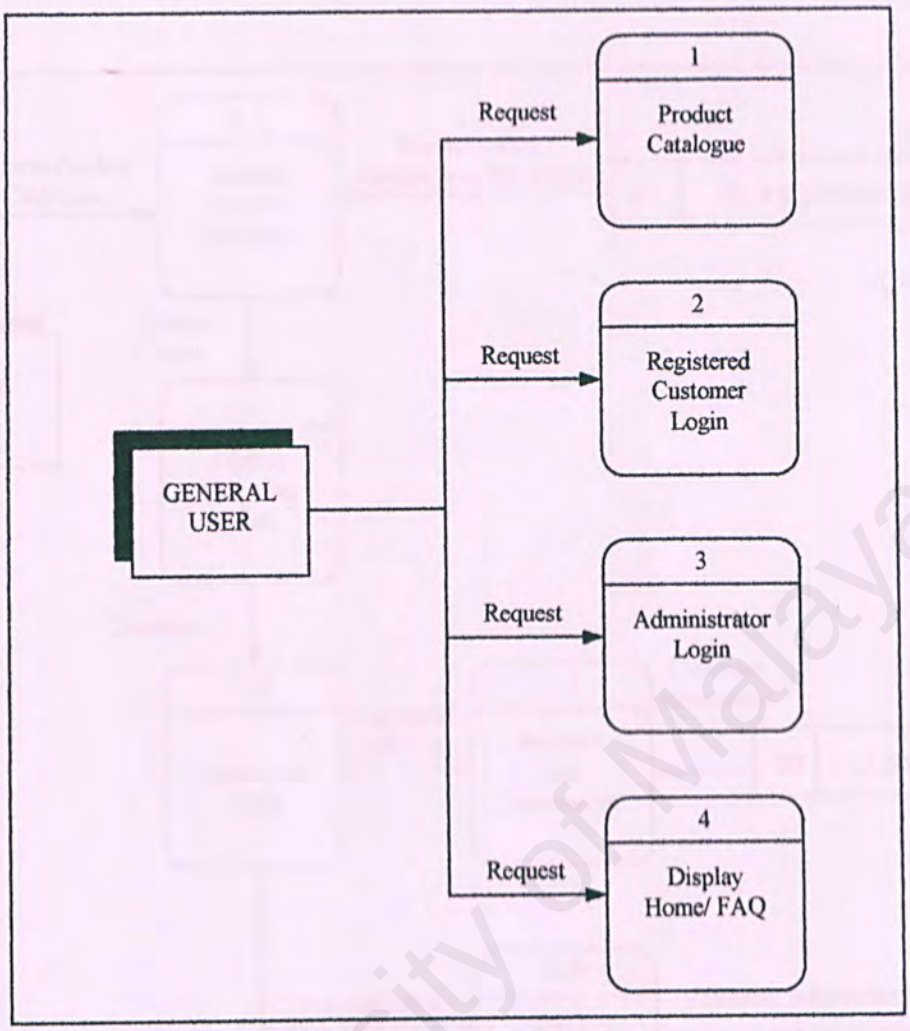

Figure 25: E-supplier Main Page

At e-supplier main page, user can request for Home or FAQ pages by click on the hyperlink or button. Server will then response to the user's request and send back the requested pages information. Otherwise, users also can browse the product catalogue. On the other hand, administrator or registered customer can request login into the e-supplier system.

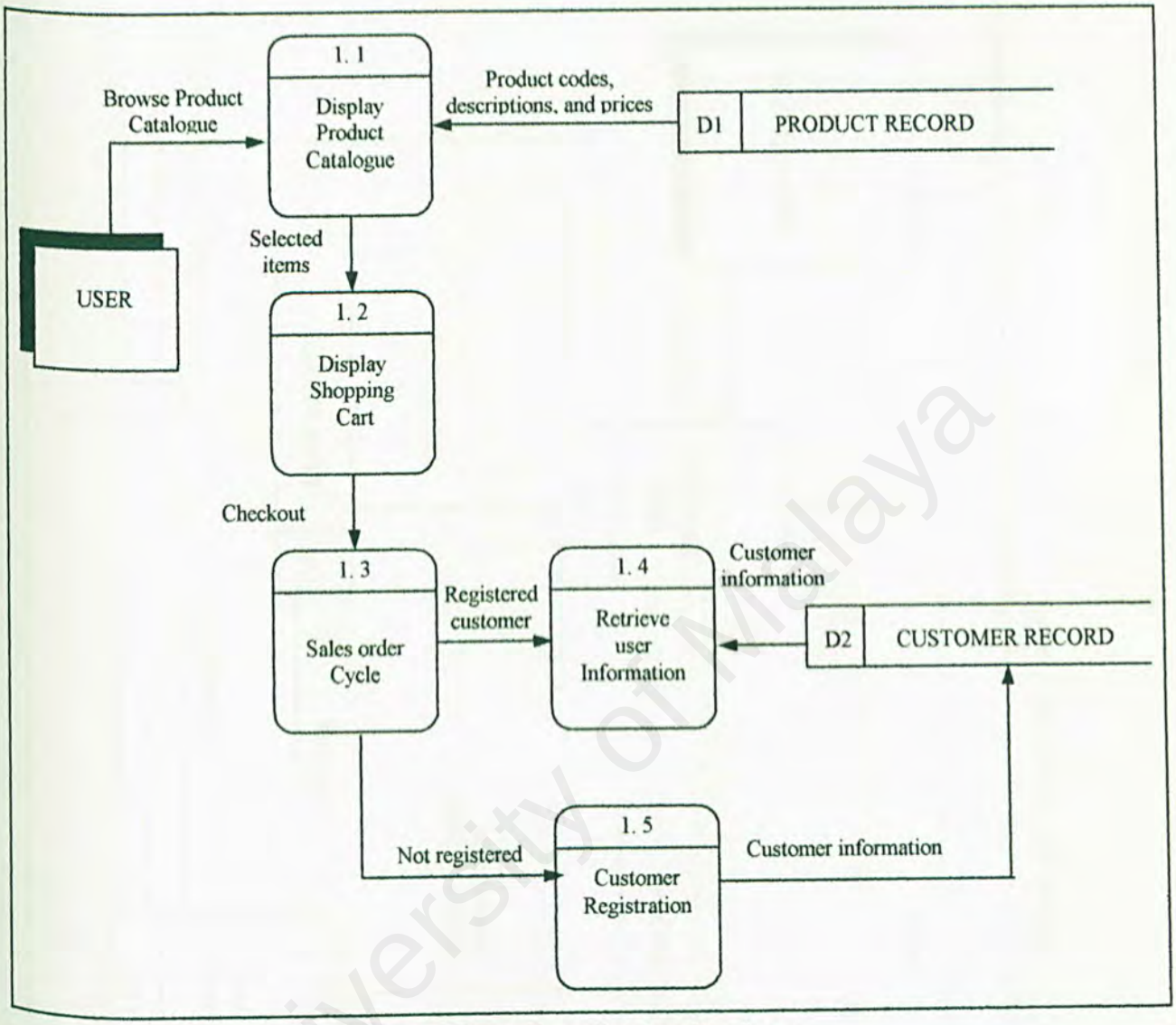

Figure 26: Purchase From Product Catalogue

In Figure 25, as the user request for the product catalogue to do online shopping, the data flow of that module is depicted in the Figure 26. Selected items will display in a shopping cart, at this point, user is allows updating item's quantity as require. At the checkout counter, the submitted order form will be processed and customer's information will be updated in the database.

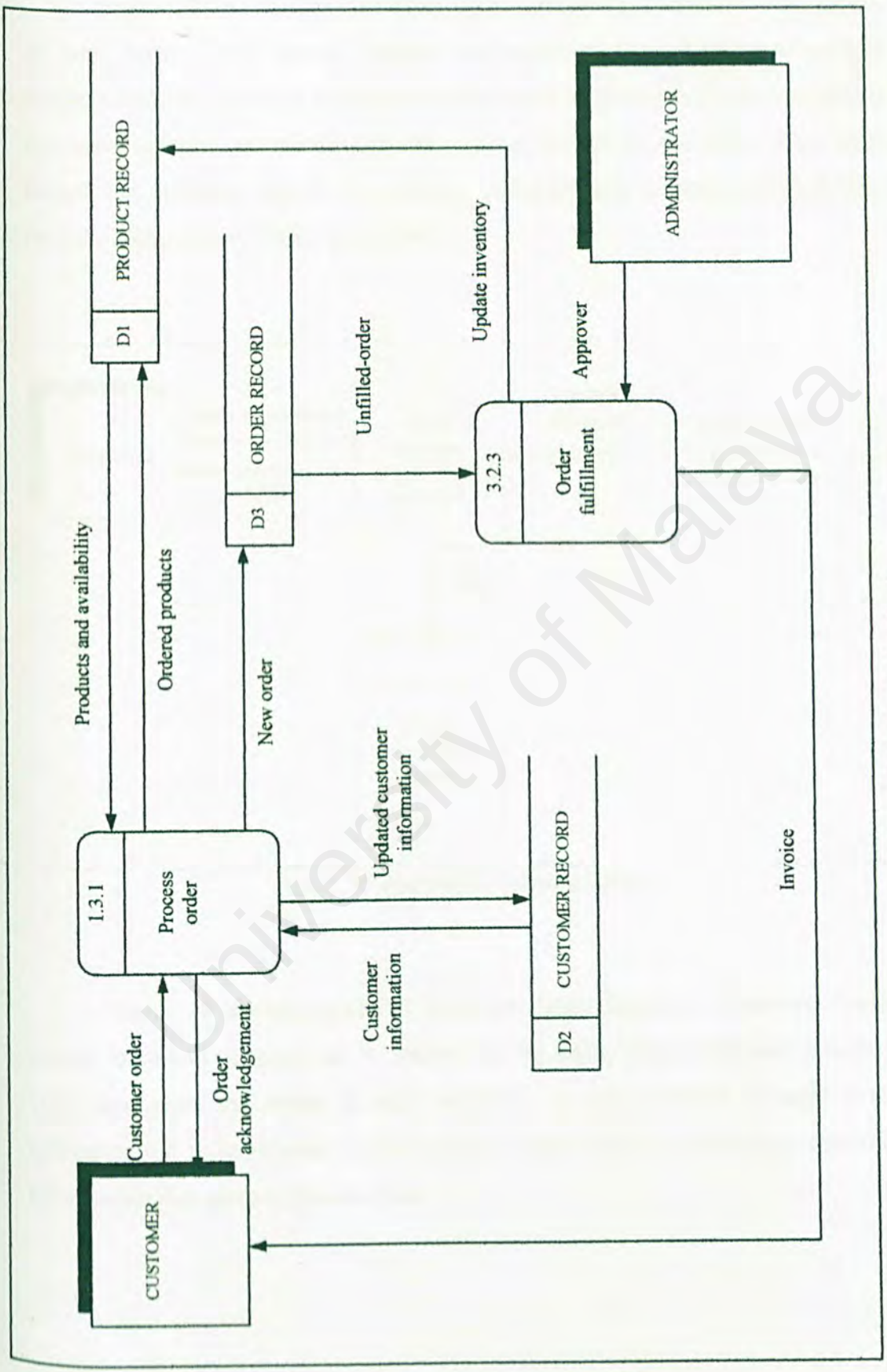

Figure 27: Sales Order Cycle

Figure 27 depicts the sales order cycle. Firstly, the customer/ user submits an order form, it will then be process and an order acknowledgement will be displayed on the customer screen as confirmation. Ordered products availability and sales quantity are updated in the product record. At the same time, order record and customer record are updated. Administrator retrieves unfilled-order records, approves and fulfils the requests.

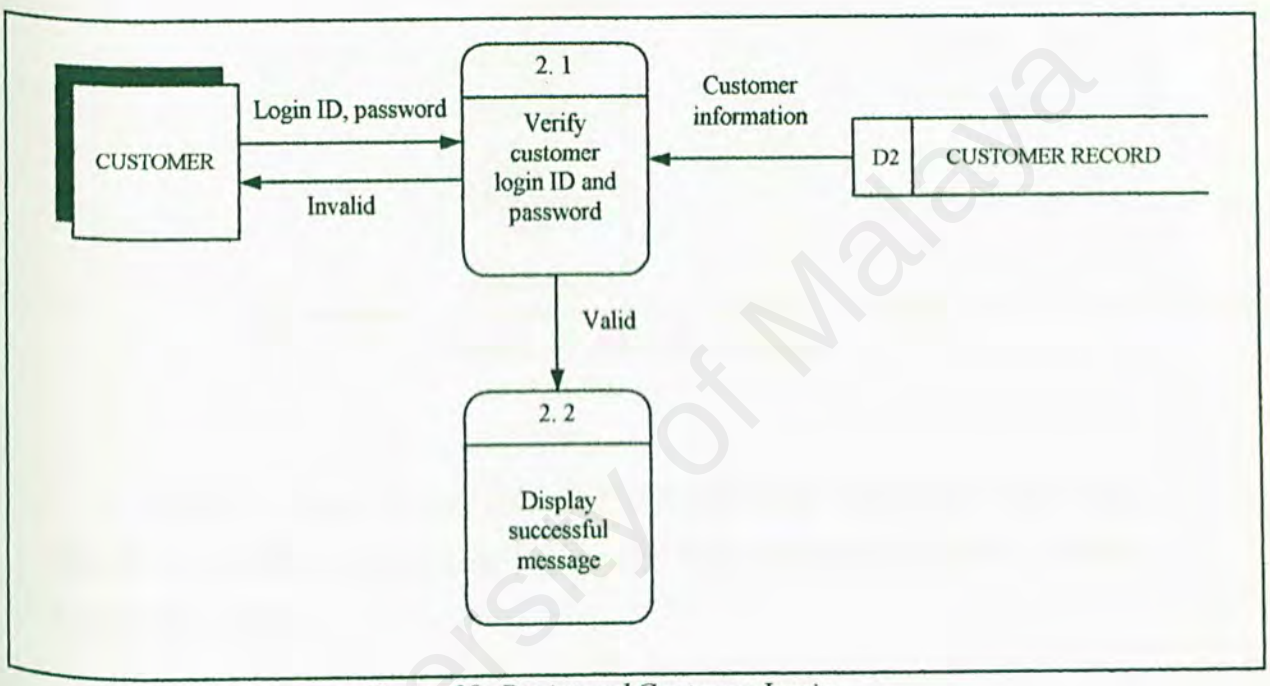

Figure 28: Registered Customer Login

Figure 28 shows registered customer login function. Customer has to submit login and password to the system during login. These information will be verify and grant the access if valid customer, or return invalid message if the authentication unsuccessful. Authentication being done by comparing customer information that store in the database.

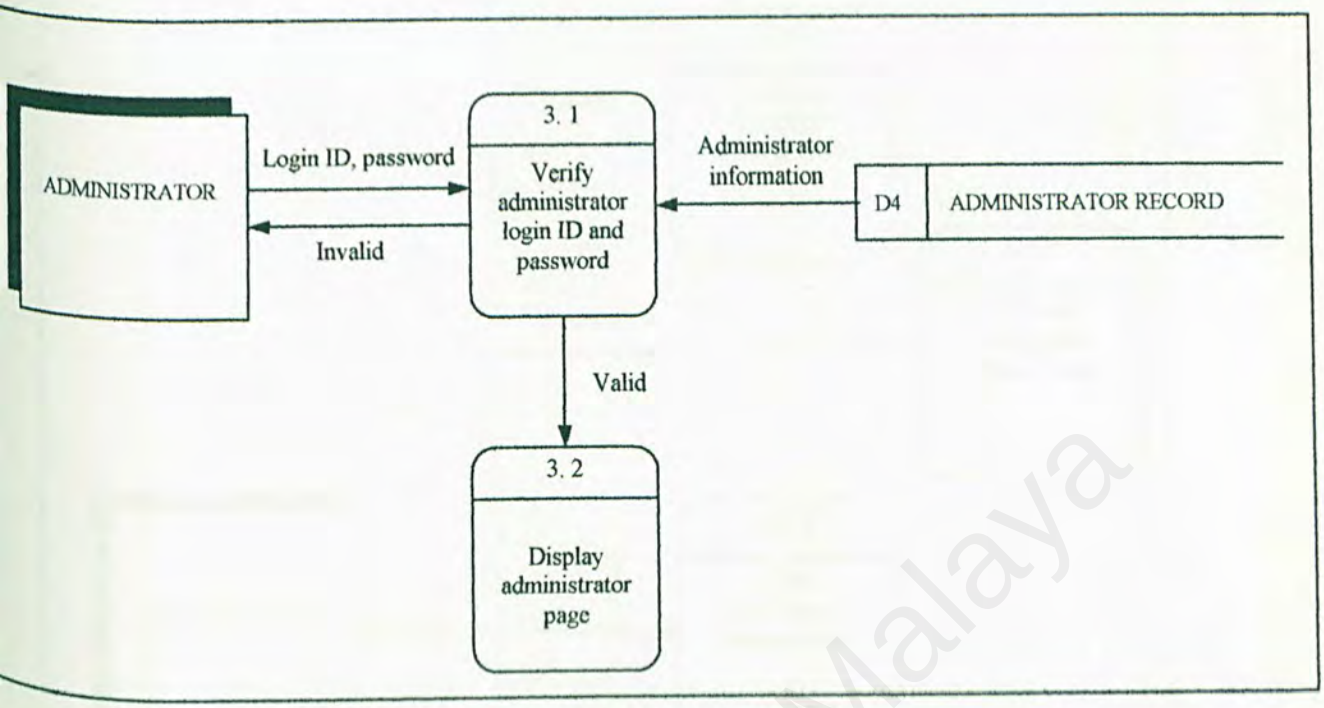

Figure 29: Administrator Login

Figure 29 shows the data flow as the administrator login to the system. The data flow has the same logic in Figure 28. Authentication is emphasis before approve the access.

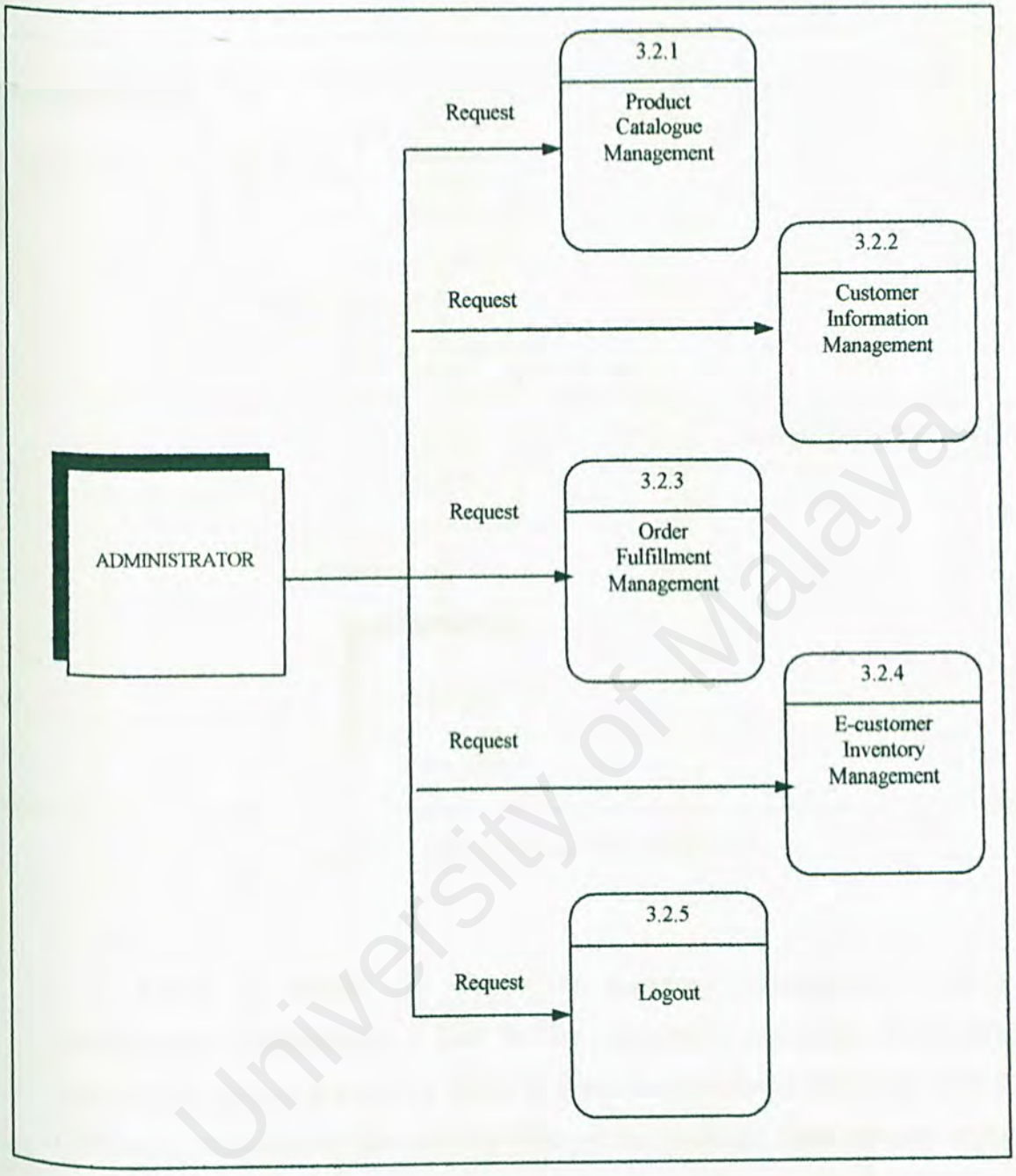

Figure 30: Administrator Module

Figure 30 illustrates the function or process included in the administrator module. Sub-module will be invoked according to the administrator's request.

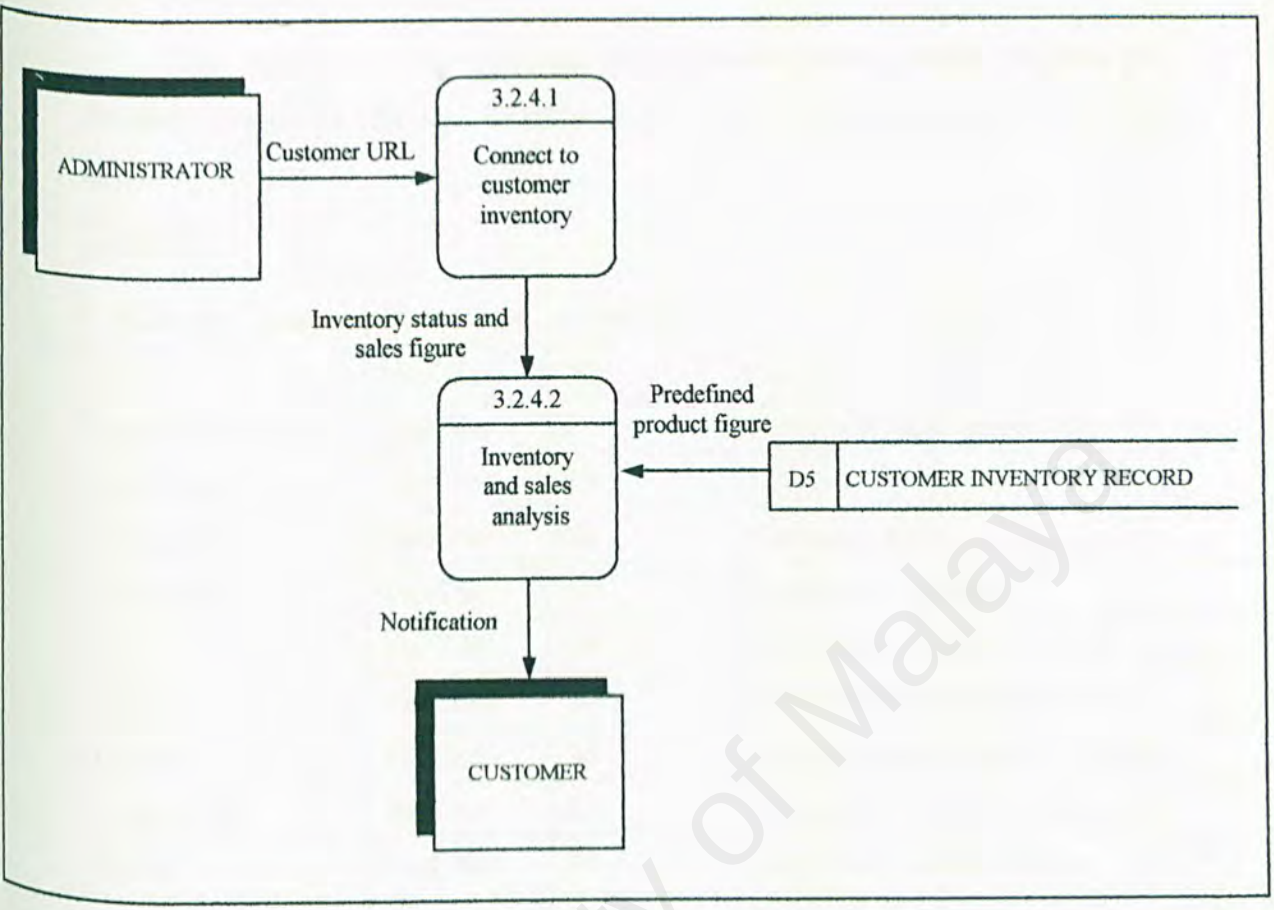

Figure 31: Customer Inventory Integration

Figure 31 depicts the e-customer inventory management function. Administrator accomplishes a link to the customer's inventory system and retrieves the product availability status in stock, and performs inventory control. Otherwise, administrator also able to view on the products' sales statistic in the customer shelves. This information is used for analysis function and estimation. The collected information is important for popularity assessment.

4.4 Database Design

The system's database is consists of several tables, which illustrate the database design physically. Descriptions of each table will discuss in the following section.

CustTbl

Column Name	Data Type	Length	Description
CustId	VarChar	30	Customer's identification
LoginPassword	VarChar	6	Customer login password
CustName	VarChar	50	Customer's name
CompName	VarChar	50	Company name
StreetAddr	VarChar	50	Customer's address
City	VarChar	30	City where customer reside
State	VarChar	30	State where customer reside
Country	VarChar	30	Country where customer reside
PostalCode	VarChar	20	Customer's address postal code
Email	VarChar	30	Customer's email address
PhoneNo	VarChar	20	Customer's phone number
FaxNo	VarChar	20	Customer's fax number
RegisteredDate	Datetime	8	Customer registered date
URLLink	VarChar	50	Customer's URL

Table 6: Registered Customer Table

ProductTbl

Column Name	Data Type	Length	Description
ProductId	VarChar	5	Product code
ProductName	VarChar	30	Product name
ProductManufact	VarChar	20	Product manufacturer
ProductDesc	VarChar	500	Product description
QtyInStock	Int	4	Product quantity in inventory
Category	Char	5	Product category
SellPrice	Money	8	Product selling price

Table 7: Product Table

OrderTbl

Column Name	Data Type	Length	Description
OrderId	Int	4	Identification of the customer order
CustId	VarChar	30	Customer's identification
OrderDate	Datetime	8	Date of the order is placed
OrderStatusId	Char	10	Customer's order status
PONo	VarChar	10	Purchase Order reference number
PODate	Datetime	8	Purchase Order received date
OrderTotal	Money	8	Total amount of the order
ShipStreetAddr	VarChar	50	Recipient's address
ShipCity	VarChar	30	City where recipient reside
ShipState	VarChar	30	State where recipient reside
ShipCountry	VarChar	30	Country where recipient reside
ShipPostalCode	VarChar	20	Recipient's address postal code
ShipMethod	Char	1	Shipment method
ShipStatus	Char	1	Shipment status
PaymentMethodId	Char	1	Customer's order payment option
DiscValue	Float	8	Discount amount upon order total
DiscTerm	VarChar	10	Discount terms if available: on total basis or day term or no discount at all

Table 8: Order Table

CustOrderProductTbl

Column Name	Data Type	Length	Description
OrderId	Int	4	Identification of the customer order
ProductId	VarChar	5	Product code
OrderQty	Int	4	Ordered quantity

Table 9: Customer Ordered Product Table

AdminTbl

Column Name	Data Type	Length	Description
AdminId	VarChar	6	Administrator identification
LoginPassword	VarChar	6	Administrator login password

Table 10: Administrator Table

CustSalesTbl

Column Name	Data Type	Length	Description
CustId	VarChar	30	Customer's identification
ReferDate	Datetime	8	Date of the information collection
ProductId	VarChar	5	Product code
SaleQty	Int	4	Sold quantity in customer shelf
LastPurQty	Int	4	Quantity last purchased by customer
QtyOnHand	Int	4	Quantity on hand in customer's inventory

Table 11: Customer's Product Sales Table

CartTbl

Column Name	Data Type	Length	Description
CartId	Int	4	Cart's identification
ProductId	VarChar	5	Product code
ProductName	VarChar	30	Product name
Qty	Int	4	Ordered quantity
SellPrice	Money	8	Product selling price

Table 12: Shopping Cart Table

CatalogTbl

Column Name	Data Type	Length	Description
ProductId	VarChar	5	Product code
Description	VarChar	500	Product description
ImagePath	VarChar	100	Product image path

Table 13: Product Catalogue Table

InvoiceTbl

Column Name	Data Type	Length	Description
InvoiceId	VarChar	10	Invoice ID
OrderId	Int	4	Identification of the customer order
CustName	VarChar	50	Customer's name
CompName	VarChar	50	Company name
Email	VarChar	50	Customer's email address
CreateDate	Datetime	8	Date of invoice created
SendDate	Datetime	8	Date of invoice sending to the customer
DespDate	Datetime	8	Delivery date
FilePath	VarChar	200	Location path of the invoice

Table 14: Invoice Table

4.5 Interface Design

4.5.1 General Screen

Graphical or form-based user interfaces have now become the norm for interactive system. However, the effort involved in specifying, designing and implementing a user interface represents a significant part in application development.

Figure 32 shows the general design layout of the output page, the upper bar illustrates the company name and title. The left site bar is the navigation bar. It provides the navigation buttons and hyperlinks to another available functions in the system. For example, users are able to link to the company detail's page through the hyperlink.

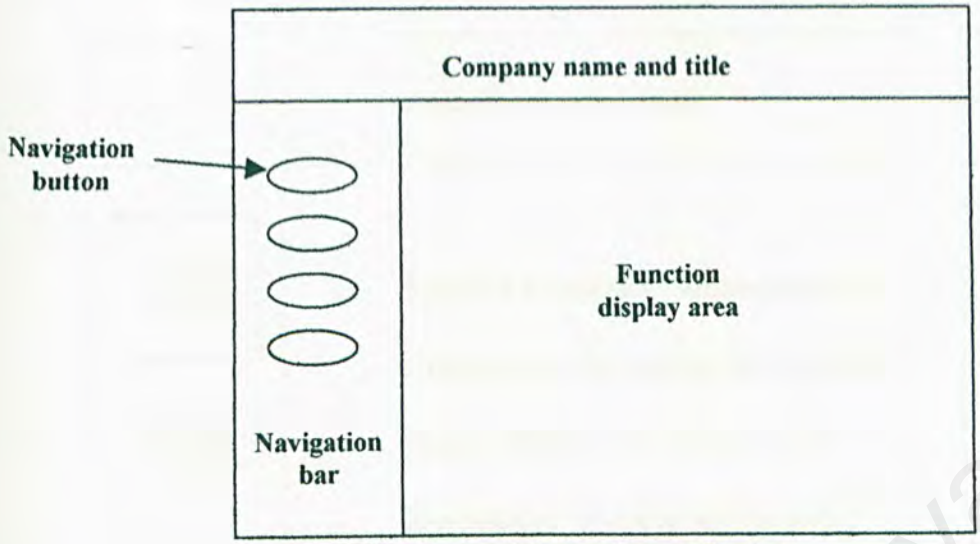

Figure 32: General Output Screen Design

4.5.2 Expected Outcome

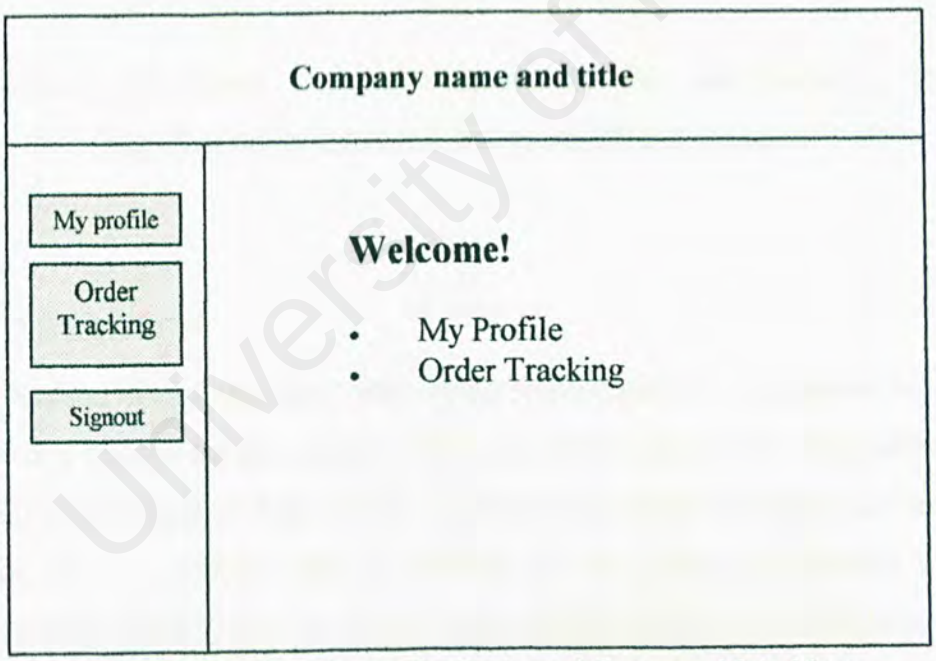

Figure 33: Interface Design for Registered Customer Main Menu

Figure 33 shows the personalize page for the registered customers after they login as the valid users. Users can click on the hyperlink and browse another pages.

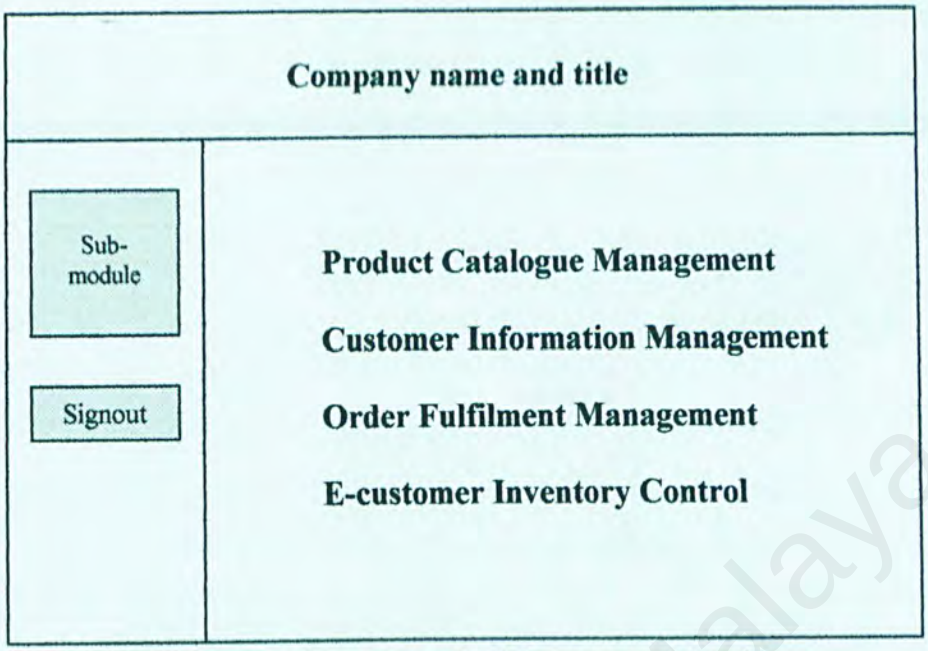

Figure 34: Interface Design for Administrator Main Menu

Figure 34 shows the main menu in the administrator module. Administrator can click on the hyperlink and proceed to the backend system.

4.6 Summary

Several design strategies were being studied in order to achieve the finest and suitable designs for the system. Three-tier client/ server was being adopted as the Web architecture in this project. Furthermore, structure charts are used to illustrate all the modules and sub-module in the system to improve overall understanding of the system. DFDs are being used to depict the logical flow of the data in the system. Database design section provides several tables to show the database design in the system. Finally, the interface design section layout some main pages design that will be include during the system development.

Chapter 5

SYSTEM IMPLEMENTATION

CHAPTER 5
SYSTEM IMPLEMENTATION

5.1 Introduction

System implementation is the process that converts the system requirements and designs into program codes using selected programming language. It focuses on implementing the solution as software. This stage involves both application and database implementation. Nevertheless, the system analysis, system design and implementation phases are usually overlapping with one another, as they do not have a clear boundary. Hence, this phase at times involves some modifications to the previous design.

5.2 Development Environment

Development environment has certain impact on the development of a system. Appropriate hardware and software chosen will not only help to speed up the system development but also determine the success of the project. Below are the lists of hardware and software tools being used to develop the entire system.

5.2.1 Hardware Requirement

Hardware requirement during system development process are as below:

- Pentium 133 MHz processor and above
- 32MB RAM and above
- Hard Disk capacity 4 GB and above
- Other standard desktop PC components
- Network connection

5.2.2 Software Requirement

5.2.2.1 Software Tools for Design and Report Writing

There are a lot of software tools that can be used in designing and writing report. The design process involves drawing of structure chart, data flow diagram and others that form the foundation of the software development. This logical design is able to graphically describe an overall view of whole system and the also interconnection between modules. Microsoft Word is the software that used to design and write report for this system.

5.2.2.2 Software Tools for Development

During the system development process, software tools as determine during system analysis (Chapter 3) are being used. However, there is minor modification at the software version and also few additional tools are selected. Table 15 depict the software tools used to develop the system.

Technologies/Software	Description	Purpose
Windows 2000 Server	Operating System (OS)	System Requirement
Microsoft SQL Server 2000	Database that store and manipulate data	Database
Internet Information Server (IIS) 5.0	Web Server Host	System Requirement
Microsoft Visual InterDev 6.0	Coding the web pages	System Development
Active Server Pages (ASP)	Coding the web pages	System Development
Hyper Text Markup Language (HTML)	Coding the web pages	System Development
Dynamic Hyper Text Markup Language (DHTML)	Coding the web pages	System Development
VBScript	Coding the web pages	System Development

Table 15: Selected Programming Technologies and Language (Part 1 of 2)

JavaScript	Coding the web pages	System Development
Internet Explore 4.0 or above	Viewing the web pages	System Development
Macromedia Fireworks 4.0	User Interface Design	Button and image creation
Adobe Photoshop 5.0	Image design and creation	User Interface Design

Table 15: Selected Programming Technologies and Language (Part 2 of 2)

5.3 Platform Development

Platform Development involves all the development environment set-up processes from the operating system, database to the software development tool. A brief installation steps and requirements are discuss here.

5.3.1 Development Environment Setting

As mention before, Microsoft Windows 2000 Professional was selected as the operating system (OS) whereas Internet Information Server (IIS) 5.0 as the Web server host. Firstly, the OS is install then follow by the IIS. As the IIS installed successfully, it has to be configure to create a virtual directory for this project. This will allows users access the application through HTTP protocol using Web browser.

After these steps, Microsoft SQL Server 2000 is installed to provide data storage and data management system. A new database named **esupplier** was created which then will holds all the tables as designed during system design phase.

Finally, Microsoft Visual Studio 6.0 (included Visual Basic 6.0 and Visual InterDev 6.0) was installed as the programming tools for this system.

5.3.2 Creating Visual Basic Project

An ActiveX DLL class module named **esupplier** was created in the **IBS** project. The component object model (COM), which is used to connect to database between ASP page and SQL server, was developed.

5.3.3 Creating Visual InterDev Project

A project named **Esupplier** was created and the coding started by adding ASP page into the project. Designs and specifications are coded according to the requirements.

5.4 Development of The System

5.4.1 Coding Approach

There are properly two types of coding approach, namely top-down and bottom-up. The bottom-up coding is based on coding the lower-level modules initially and leaving the high-level modules merely as skeletons that are used to call the lower modules, whereas the top-down approach is the reverse of the bottom-up approach.

The E-supplier system was developed modularly using the bottom-up approach. Each lower-level function and procedure was developed individually which are then integrated into appropriate high-level modules accordingly. Bottom-up approach offers some advantages such as:

- Testing can be conduct on some of the modules while the others are still under construction.
- Critical functions can be coded initially to test their efficiency.
- Increase the development process as the lower-level modules or functions can be built independently and simultaneously without waiting or delaying the others.
- Faults are easier to be detected.

5.4.2 Coding Style

Active Server Pages (ASP) is the main scripting technology in building system's web page. ASP page is likely to be composed of a combination of three types of syntax – some parts ASP, some parts HTML tags, and some parts pure text. Each of them is not hard to distinguish. Each ASP section contained within <% and %> delimiters and statements falls in this block are called ASP script. VBScript is used as the scripting language as the ASP statements.

Apart from the server-side scripting, client-side scripting also being used to enhance the web page performance and interactivity. Both VBScript and JavaScript are being used as the scripting language and delimited by the <SCRIPT>...</SCRIPT> tags. In order to improve the understanding, an example is given as below.

Another useful technique being used is inserting pre-built blocks with "#include" statement in an ASP page. For example, both top banner and left side navigation menu are managed in separate files. Then, pages that required displaying a top banner, for instance, used this include statement to achieve its display function. This approach is able to minimize duplication and simplify the possible maintenance work in the future. If the maintainer wish to modify the top banner, he or she only require to make modification on one file, and without modify all the relevant files.

5.4.2.1 Coding Example

Below is example taken from part of the project file name "custlogin.asp":

i. **ASP Script**

```
<%
  If Request.Querystring("SecondTry") = "True" Then
    ST="True"
    Response.Write "<BR><BR><H2><FONT color=red>"
    If Request.Querystring ("WrongPW") = "True" Then
     Response.Write "Invalid Password. Please try again."
    Else
     Response.Write "Unregistered customer."
    End If
    Response.Write "</FONT></H2>"
  End If
  Response.Write "<H3><BR><BR>Please enter your customer ID and
                  password: </H3>"
%>
```

The above ASP scrip is used to display message according to the condition. One of the condition is when the user entered the wrong password, querystring variables named "SecondTry" and "WrongPW" are returned as "True" from the "checklogin.asp" file, as the result, message "Invalid Password. Please try again." Will be display.

ii. **HTML Coding**

```
<B>Customer ID   :  </B>
<INPUT name="CustId" style="HEIGHT: 22px; WIDTH: 165px"><BR>
```

The above HTML code is used to create label with message "Customer ID" and a text field at its right side for the users to fill in their customer ID.

iii. **JavaScript Coding**

```
<SCRIPT LANGUAGE="Javascript">
  function cmd_Login(st)
 {
   if (document.form1.CustId.value=="") {
    alert("Please enter your customer ID.");
   } else if (document.form1.CustPw.value==""){
    alert("Please enter your password.");
   } else {
    if (st=="True"){
document.form1.action="checkLogin.asp?Person=CustSecondTry=True";
     document.form1.submit();
    } else {
     document.form1.action="checkLogin.asp?Person=Cust";
     document.form1.submit();
    }
  }
  return;
}
</script>
```

JavaScript function "cmd_Login(st)" is used to perform some verification before submit the customer ID and password to the "checklogin.asp" file.

iv. **Include File**

```
<!--#include file="include/top_banner.asp"-->
```

The above command is used to display the top banner, which scripts indeed are written in "top_banner.asp" file.

5.4.3 Database Connection

In this system, Component Object Model (COM) is used as the connection medium between ASP page and the SQL server database. COM contains several functions that use for performed the data maintenance activities, such as add record, update record, delete record, select record and so on.

Below is an example taken from a part of the "checklogin.asp" file. These commands are used to select all available records in the "CustTbl" table.

```
<%
    Set dbObj = server.CreateObject("dbaccess.esupplier")
    Set adors = server.CreateObject("adodb.recordset")
    constr = "provider=sqloledb; data source=hueyping; initial
    catalog=esupplier; user id=sa; password=;"
    rs = dbObj.Sel_Record(constr,"*","CustTbl","","","",adors)
%>
```

Firstly a COM object is being created. Then, a recordset was created to keep the selected records. Follow by initial a connection string, which will link to the SQL server database. After that, the program will select all the records from the table.

5.5 Program Documentation

Program documentation is a set of written descriptions that explain to readers about what the programs do and how they do it. This documentation may categorize as internal documentation whereas the others are known as external documentation. Internal documentation is descriptive material written directly within the code. It contains information directed at someone who will be reading the source code of the program. Comment within the code is the example of

internal documentation. It provides line-by-line explanation of what the program is doing such as the description about data structures, algorithms and so on. Besides, it also breaks the code into phases that represent major activities.

Different programming language uses distinguish comment syntax. For instances, in Visual Basic Scripting Language (VBScript), each comment tag is proceeding with a single code (‘). Any statement at the same line after a single code will be ignored during execution time. This comment line will appear in green colour.

Example:

```
' This is a comment.
```

For Java Scripting Language (JavaScript), the syntax for demarcating text as a comment is different from VBScript. There are two alternatives provided. For single line comments, simply precede the line with two backslashes. For multi-line comment blocks, begin the comment with /* and close with */. All the comments will be ignored during execution time and also in green colour.

Example:

```
// This is a single line comment.

/* This is a multi-line
   comment block. */
```

Apart from the comment usage, meaningful variable names and statement labels also being used to increase code readability.

5.6 Module Implementation

There are three main modules in E-supplier system: General User Module, Registered Customer Module and Administrator Module. Each module is consists of several sub-module or functions.

5.6.1 General User Module

Below are five sub-modules in General User Module.

i. **Home**: As the main page of the E-supplier system.

ii. **Product Catalogue**: Place where users can browse the products that available on sell and then place their order online.

iii. **Administrator Login**: Mandate page for the administrators before they are granted the access to the functions in Administrator Module. Users have to enter their login identification as well as the password.

iv. **Registered Customer Login**: Authentication page for the registered customers before they are allowed to access the Registered Customer Module. Users are required to enter their login identification and password.

v. **FAQ**: Group of questions and answers that are considered frequent required by the users.

5.6.2 Registered Customer Module

As the users login successfully as registered customer, they are allowed to access two sub-modules in Registered Customer Module.

i. **My Profile**: Users can view on their own personal profile and also update the required information.

ii. **Order Tracking**: Users can view on their order history and its order status here. They can make reordering for the same product list in existing order by click on the "Reorder" button.

5.6.3 Administrator Module

When administrators successfully login, they are freely to perform several administrative function provided in this module. This module contains four sub-modules as descript as below:

i. **Product Catalogue Management**: In this sub-module, administrator can perform catalogue maintenance operation such as add, delete or edit products in catalogue.

ii. **Customer Information Management**: Customers' information can be viewed or edited through this sub-module. Besides, administrator also can add new customer information or delete existing customer's records from the database.

iii. **Order Fulfilment Management**: There are three sub-functions in this section. Administrator can create a new sales order as they received customer's purchase order or when required. Administrator may also perform order fulfilment operation in Order Fulfilment function. Invoices can be created or send to the customer in this segment. Additionally, Order Navigation provide the administrator free access to the existing sales order for reviewing purpose.

iv. **E-Customer Inventory Management**: In this sub-module, administrator can link to the customer's web page and view on their product inventory system. Useful value such as the product sales quantity and quantity on hand are acquired which will then be entered in to ready made table in order to keep that record in to administrator own database. This information can be used for later sales analysis. Administrator also can email to the customer if they wish.

5.7 Summary

During system implementation, system requirements and designs were converted into program codes. Besides, it also involves development environment setting such as the operating system and the database server. Several software tools were used to deploy the design into machine-readable language and then in turn to produce the required applications.

Chapter 6

SYSTEM TESTING

CHAPTER 6
SYSTEM TESTING

6.1 Introduction

After coding the program components, we usually examine the code to spot faults and eliminate them right away. Testing is a process that focused on finding faults. Therefore, we consider a test successful only when a fault is discovered or a failure occurs as a result of our testing procedures. Fault identification is the process of determining what fault or faults caused the failure, and fault correction or removal is the process of making changes to the system so that the fault are removed.

Software testing is crucial for software quality assurance and represents the ultimate review of specification, design, and code generation. In this chapter, software testing fundamentals, testing strategies and debugging methods will be presented.

6.2 Type of faults

Faults can be categorized as algorithmic faults, syntax faults and documentation faults. Algorithmic fault occurs when a program algorithm or logic does not produce the proper output for a given input because something is wrong with the processing steps. These faults are sometime easy to spot by reading through the program (call desk checking) or by submitting input data from each of the different classes of data that we expect the program to receive during its regular working.

Syntax fault can be checked while parsing for algorithmic faults. This will ensure that the construct of programming language is used properly. On the other hand, documentation fault occurs if the documentation does not match what the application does, and such faults can lead to other faults later because of the wrong implementation.

6.3 Testing Strategy

Testing is a process of exercising or evaluating a system by manual or automatic means to verify that it has satisfied requirements or to identify differences expected and actual results. Testing can uncover different classes of errors in a minimum amount of time and with a minimum amount of effort. There are three types of testing strategies, namely, unit testing, integration testing and system testing.

6.3.1 Unit Testing

Unit testing is the first approach in system testing. Each program component is tested on its own, isolated from the other components in the system. This process verifies that the component functions properly with the types of input expected from studying the component's design. Testing can start by examining the program code by reading through it, trying to spot algorithm, data and syntax faults. Test also can be performed by comparing the code with the predefine specifications and design to ensure that all relevant cases have been considered. Finally, test cases are developed ensure that the input is properly converted to the desired output.

Following steps are used in carry out the unit testing for E-supplier system:

- The code of the program is examined by reading through it to spot for possible algorithm, data and syntax faults.
- Control objects are tested to ensure its functionality.
- Different data types are used to test the error handling function.
- Test cases are developed to ensure that the input is properly converted into the desired output.

6.3.1.1 Examining the Code

In this stage, a code walk-through is carried out where the program codes are read to identify faults. The code and the accompanying documentation are presented during reviewing. This project review team consist of my group-mate. The team will

comment on their correctness. Walk-through is conducted in an informal manner. This method is useful to identify faults that have been left out by the programmer.

6.3.1.2 Control Objects Testing

Control object such as buttons and text boxes are tested for their functionality. Buttons are clicked to ensure they perform expected response, whereas the text boxes are tested with different data type to perform validation.

6.3.1.3 Different Data Type Testing

Different data types such as numbers, characters or date are used as test to ensure that invalid data for certain function can be traced by the system without causing any error. Apart from the normal and erroneous data, NULL value also being used to detect faults.

6.3.1.4 Choosing Test Cases

To test a component, input data and condition are chosen. Then the component is allowed to manipulate that data, and the output is observed. The input is selected so that the output demonstrates something about the behaviour of the code. A test point or test case is a particular choice of input data to be used in testing a program. A test is a finite collection of test cases.

To perform tests on the components, we must first determine the test objectives. Then, select test cases and define a test designed to meet the specific objective. Some data are purposely chosen to be improper. This is to check that the code handles incorrect data gracefully.

6.3.1.5 Unit Testing Example

Here are few examples among a great number of unit testing cases that have been performed for this system.

Unit Test Case Example 1

Each table in database has at least associated with one trigger program. Unit testing was carried out on each trigger program once it was completed. Table below shows the test case for unit testing on adding new product into catalogue and then delete it from the database. This function is provided in the Product Catalogue Management sub-module.

Step	Test Procedure	Expected Output	Test Result Analyzing
1	Add a new product into the catalogue table named CatalogTbl.	The record is inserted permanently.	Record is inserted successfully.
2	Click on the Delete link to delete the added product.	The record is deleted permanently from CatalogTbl table.	Record is deleted successfully.

Table 16: Unit Test Case Example 1

Unit Test Case Example 2

The Update Record function in this system is used to update the existing record in database. Unit Testing was carried out to ensure that the record was being updated successfully. Table below shows the test case for unit testing on the function of updating customer information in the My profile sub-module.

Step	Test Procedure	Expected Output	Test Result Analyzing
1	Change information in the My Profile page, and then click on update button.	The records are updated permanently.	Records are updated successfully.

Table 17: Unit Test Case Example 2

6.3.2 Module Testing

When the individual components are working correctly and meet the objectives, these components are combined into a module. A module is a collection of dependent components. Module testing enables each module to be tested independently. This testing will ensure that the module calling sequence in this project is systematic.

6.3.2.1 Module Testing Example

After all relevant components for certain module were developed, testing was carried out to ensure the module functioning as expected. Below shows some test case example in module testing.

Module Testing Example 1

Before allowing administrator to access sub-modules in Administrator Module, he or she has to undertake an authentication by entering login identification and password. Testing is carried out to ensure that the system perform verification properly and granted the access only to proper and valid users.

Step	Test Procedure	Expected Output	Test Result Analyzing
1	Click on the Administrator Login link.	Display login page.	Page was link successfully.
2	Enter the invalid user ID and password. Click on Login button.	Access denied and "Unregistered user" message will be displayed.	Verification was successfully performed and expected output was accomplished.
3	Enter the valid user ID and password. Click on Login button.	Access granted and administrator menu will be shown.	Verification was successfully performed and administrator menu page was displayed.

Table 18: Module Test Case Example 1

Module Testing Example 2

Customers' Sales Analysis function in the E-Customer Inventory Management sub-module provides a sales report of selected product among available customers. This sales report is used to review on the product popularity on customers' shelf. Users can select the required reference date period and the product. Below shows the test steps involved.

Step	Test Procedure	Expected Output	Test Result Analyzing
1	Click on the Customer's Sales Analysis link in the E-Customer Inventory Management sub-module.	Display E-Customer Inventory Management page.	Page was linked and displayed successfully.
2	Select required reference date period and product ID.	A search result will be display in a table.	Result shows relevant customer's ID and quantity. Function performs successfully.
3	Click on "Details" button.	A page, which display more details and specific results.	Page was loaded and the results was displayed successfully.

Table 19: Module Test Case Example 2

6.3.3 Integration Testing

As each module was tested successfully, these components are then being combined into a working system. In other words, integration testing is the process of verifying that the system components work together as described in the system and program design specifications. This integration is planned and coordinated so that when a failure occurs, idea of the cause can be gained.

Integration testing is used on this system to uncover errors associated with interfacing. This testing will ensure that the interfaces such as the module calling sequence in E-supplier system are systematized and link to the correct document.

Several integration testing approaches exists. However, Sandwich integration was used for this system. This approach combines top-down integration with bottom-up integration. The system is viewed as three layers: the target layer in the middle, the levels above the target, and the levels below the target. Sandwich testing provides advantages consist of the combination advantages of top-down and bottom-up testing.

Testing started from the main page of the system and down to the lowest level of the functions in the Administrator Module and back to the main page. Then testing continues to access the functions in the customer menu page in Registered Customer Module of the system. This testing was performed several times to ensure the system working properly.

6.3.3.1 Integration Testing Example

Testing was performed several times on the same scenario as well as different situation. Therefore a lot of test case involved.

Integration Test Case Example 1

Product catalogue created and maintained in the Administrator Module is then displayed for user to view and purchase the product. Integration Testing was carried out to ensure that the catalogue was created and displayed successfully. Table below shows the test case for this integration testing

Step	Test Procedure	Expected Output	Test Result Analyzing
1	Click on "Add Item" button in the Product Catalogue sub-module.	A page for adding new product to catalogue will be shown.	Page was linked and displayed successfully.
2	Select required product to add.	Product details will be listed in relevant fields.	Product information was retrieved successfully.
3	Click on "Add" button.	Product will be added into the CatalogTbl table and a preview page will be displayed	Product was added and the page was displayed successfully.
4	Click on "Signout" button.	Main page will be displayed.	Successfully signout and the main page was loaded.
5	Click on "Product Catalogue" link.	Product catalogue contained added product would be displayed.	Catalogue was loaded and added product was displayed in the catalogue. Catalogue was created successfully.

Table 20: Integration Test Case Example 1

6.3.4 System Testing

Final testing procedure done is system testing. However, testing the system at whole is very different from previous unit testing and integration testing. The objective of unit testing and integration testing is to ensure that the code has implemented the design properly. In other words, the code is written to do what the design specifications intended. In system testing, a very different objective is to be achieved, that is to ensure that the system does what the users want it to do.

There are several testing scenario exists. Yet, this system was tested with Performance Testing and Function Testing.

6.3.4.1 Performance Testing

Performance Testing addresses the non-functional requirements of the application. Once the functions are convinced work as specified, the performance test compares the integrated components with the non-functional system requirements. The types of performance tests carried out for this application are:

i. **Compatibility Tests**

This test was performed to find out that the interface functions perform according to the requirements. Results clarify that the accuracy of data retrieval was high in this system.

ii. **Security Tests**

This test ensures that the application fulfils the security requirements. Only the valid users are granted the access to the secure zone.

iii. **Volume Tests**

The fields and records are checked to see if they can accommodate all expected data.

6.3.4.2 Function Testing

Function testing is based on the system functional requirements. In other words, a function test is used to check that whether the integrated system performs its functions as specified in the requirements. Each module involved is tested individually to determine whether the system performs as required.

6.4 Summary

During system testing phase, several testing strategies were being used to unsure the system is integrated and developed successfully. Approaches were employed to recover faults in the system. Unit, module, integration and system testing has been carried out for this system. These testing approaches lead to delivering a quality system to users. The objective of a system will only achieve after all the thorough testing done by different user with different aspects.

Chapter 7

SYSTEM EVALUATION

CHAPTER 7
SYSTEM EVALUATION

7.1 Introduction

At this point, the software development cycle of E-supplier system is considered successfully achieved and implemented. The system is now ready for the evaluation and assessment concern. Several issues and reviews on the final system are explained in this section.

7.2 Problems Encountered and Solutions

The following are the major problems encountered during the beginning of the project through out the end of the system development process.

i. **Difficulties during project study and requirement analysis**

This system involves a lot of business rules and model. Therefore, basic knowledge is needed as a foundation in building an application of this nature.

Solution:

Due to the lack of knowledge in this field, a lot of studies and analysis on system requirements have to be done. Information resources are references books, Internet, as well as advise from supervisor.

ii. **Difficulties during software requirement selection**

Due to the variety of available software tools in the market, choosing a suitable Web-based technology and tool was a critical process as all tools have their strengths and weaknesses. In addition, the availability of the required tools for development is also a major consideration.

Solution:

In order to solve this problem, advises and views were sought from project supervisor, course mates and even seniors engaging in similar project. Furthermore, reading material from the Internet and the library are used to help to clarify some doubts.

iii. **Lack of relevant knowledge in Web-based development tools**

Lack of knowledge in Web-based technology and software tools. Relevant knowledge is such as ASP, HTML, VBScript and JavaScript.

Solution:

Reference books and Internet are the major resource of the knowledge. Apart from that, advice and coaching are obtained from coursemates.

iv. **Determining the scope of the system**

During the development of the system, I have confused and misunderstand of the scope of this system. As a result, my system began irrelevant.

Solution:

With the help of supervisor and moderator, the system requirements are finally designed and accepted. The problems are solved successfully.

v. **No end user evaluation**

The E-supplier system is not test by the end users.

Solution:

Tests were done on other course mates.

vi. **Integration with other module in IBS**

Due to the role of supplier as the third party, constraints exist and integration is difficult to done in information exchange scope. There is not

intermediate medium or standardization that can transform document that received or ready for send. For example, customer purchase order (PO) details are not able to directly transform into sales orders. Problem occurs in the invoice sending as well.

Solution:

Documents are exchanged as attachment in email function. Microsoft Outlook is used as the default email engine. The received PO are manually transform into sales order.

7.3 System Strengths

Below are the strengths of E-supplier system:

i. **Password protected site**

Administrator and Registered Customer Module are protected by authentication feature. Login and password are required before allowing the users access to the protected site. As the result, invalid users can be forbidden from viewing or altering the information in the database.

ii. **Simple and user-friendly interface design**

The Web pages are designed to suit a wide spectrum of user. Forms and other command buttons are readable, simple and easy to use. The learning curve is foreseen to be short and a user should be able to use the system with ease within minutes.

iii. **Web enabled**

The system was designed base on the Web technology. Therefore, the application is easy to access from any point that has Internet connection. The client server approach allowed processing load to be shared between

the client and the server, thus reducing the burden on the server and improve server performance.

iv. **Implements error handling**

To avoid run time error, this system is developed with error handling function. Error message will be displayed when exceptions encounters.

v. **Provide database maintenance**

Users are able to do housekeeping for database maintenance. For example, they can create, add, modify, update, and delete customer records in the database.

vi. **Invoice generator**

Administrator can performs fulfilment on the new received sales order and automatically generate an invoice as text document, which will then be sent to customer through email.

vii. **Report generating**

This system provides customers' sales analysis to generate reports on customers' inventory and sales status. Users are able to view their reports based on the product code and time period chosen. These reports are shown in table as text form.

viii. **Product catalogue management**

This system provides function for administrator to perform maintenance work on the product catalogue. Product can be added, edited or removed from the catalogue easily.

ix. **Personalize registered customer site**

Registered customers are allow to login to the personalize Web page to update their personal information. They also can view on the order history and do reordering.

x. **Reasonable response time**

Each web page is designed to be lightweight. These pages are loaded in a reasonable amount of time to ensure that the users and clients need not wait too long to view the pages. Heavy graphic is avoided.

7.4 System Constraints And Limitations

Below are the constraints and limitations of the E-supplier system:

i. **Browser limitation**

This system can only run in Internet Explorer 4.0 and above. This is due to the deployment of VBScript language, which is the default supporting language for ASP. User uses browsers that do not support these features will not be able to use the functions available in this system

ii. **No link to related website**

There is no link function to the other website that related such as to the product manufacturers.

iii. **Language limitation**

This system only supports single communication language, which is English.

iv. **No inventory control**

Ordered products are considered sold without considering the available quantity in the inventory. This is because no inventory control module included in this system.

v. **No shipping charge consideration**

Shipping change algorithm is not included in the system. Logistic management is not involved as the requirement.

vi. **Limited reporting analysis**

Functions in E-customer Inventory Management sub-module are limited to few report generation. Besides, no graphical illustrations such as chart, bar chart and so on.

7.5 Future Enhancements

Future enhancement can be done to make the system more advances in order to improve the quality of the system. A system development knows no boundaries as new requirements and better implementation methods continue to arise and evolve. There are several enhancements that could extend after developed the system.

i. **Extent the ability of browser**

As mention in previously, this system can only support by Internet Explorer 4.0 or above for execution. In future, it can be turned to fulfil other browser requirements such as Netscape Navigator. This is because Netscape has a sizeable share in the browser market besides Internet Explore and Netscape has a lot of users in the world.

ii. **Linking to related website**

The system should provide some useful links for the users to link to other shopping web site and the site related to the product such as the manufacturer.

iii. **Module enhancement**

Additional module such as inventory and logistic domain can be included to enhance the functionality of system and also fulfil more business model. This also makes the system more sophisticated and practical.

iv. **Include chart illustration**

Graphical charts can be included in the reporting area to enhance analysis effectiveness and improve readability.

7.6 Knowledge and Experience Gained

A number of knowledge and experiences are learned during this system development process. The following are some of the knowledge and experience gained from the project:

i. **The importance of SDLC and software engineering phase**

System Development Life Cycle (SDLC) provides an effective guideline for software development. Each phase is highlighted and crucial to the development process. For example, system analysis is important in capturing user requirements, objective and the goal of the system. Any faulty occurs in this stage may delay or cause the failure to the whole system. The same vital role is applied to other phase as well.

ii. **Development tools knowledge**

During the system coding and implementation, a lot of knowledge and techniques in ASP, HTML, VBScript, JavaScript, and Visual Basic are

gained. By practically apply them in the application, it is able to improve the understanding about the languages themselves as well as their integration.

iii. **Communication skill**

During the group discussion, a lot of communication skills are required to achieve cooperation and comprehension among group members. It provides advantage in exploring circumstance that similar to future working environment.

iv. **Self expression**

Involvement and experiences gained during system development have provided the change for self-improvement and evaluation. System design and coding give a great chance to express my own opinions and ideas.

7.7 Summary

System evaluation is needed to ensure its objectives and intended functions have been achieved. This chapter has covered all the aspect of evaluating application software. At this point, it also implies the conclusion of the project.

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