A WEB-BASED SKILL ASSESSMENT TOOL FOR THE LIBYAN SOFTWARE INDUSTRY

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Abstract

An explosive growth in the software industry had been seen in the last twenty five years. Now the software market in the world exceeds 370 billion U$ leaded by USA in which software industry sector accounts half of the world software sales followed by Western Europe which accounts the third. Beside developed countries, there are some development countries that develop and expand their software industry and now they accounts for nearly 5 percent of world software sales.

Libyan software industry is still in its primary stages and it is not in the position to give Libya the opportunity to compete and cope especially with newly emerged countries. The main objective of this research is to study the current state of the Libyan software industry and to understand its characteristics, current problems and the challenges it has to meet.

In order to investigate the status of the Libyan Software Industry, two types of data sources were used, primary and secondary data sources. As a primary source of data, two surveys were conducted to collect the required data for this research. The first survey was the companies' survey that targeting companies engaged in software development. The second survey directed to the workforce people participating in software development. Both surveys were conducted in Libya. They were submitted and collected by hand. Secondary sources of data were reviewing software related to archival data sources, such as existing organizational documents, researches and reports on other countries' software industry, software market reports, statistical reports on Libya and other countries and software development related websites.

In addition, an Online Skill Assessment Tool (OSAT) was developed as part of this research. It aims to help software companies evaluate their workforce, and to provide statistical information about their skills and recommendations for suggested training plans. OSAT can also be used as a benchmarking tool for the recruitment of software workforce. This is in line with the initiative of software process improvement.

The conclusion of this research is that, ad hoc software development is a common practice in local companies. This has contributed to producing low-quality local software. The economic hardship that the country went through has badly affected all aspects of life in Libya including the local software industry. However, there are great opportunities for Libyan software companies to compete especially in Arabic software. The recent national policies are promising factors for local software improvement and competitiveness. The significance of this research is that it can be considered as a pioneer study to investigate the state-of-the-art of local software industry. We expect that it will open up doors for more similar studies. Findings of the study shall be of a greater help to IT policy makers in Libya. In addition OSAT, which in a software competencies management tool shall be greater help for local companies.

Acknowledgement

I am very grateful for my supervisor Assoc. Prof. Dr Zaitun Abu Bakar for her guidance, support and efforts making this study possible. I am deeply indebted to her patience. Her insightful observation and meticulous accuracy were instrumentals in shaping this research into its final form. As a foreign student, I faced a lot of difficulties and discouragement while doing this research, but my supervisor gave me great encouragement to finish this research.

I owe special thanks to my friend Ahmed Alharrush for his help while developing OSAT software.

I feel a deep sense of gratitude for my father and mother who formed part of my vision and taught me the good things that really matter in life. The happy memory of them still provides a persistent inspiration for my journey in this life. I am grateful for my brothers Haj Sedeeq, Salah, Abdul Elfatah, Omer and sisters Um-Ahmed and Um-Mohammed for rendering me the sense and the value of brotherhood. I am glad to be one of them. Thanks also go to my nephews, nieces, brothers-in-law and sisters-in-law for their encouragement.

Last but not least is the debt of thankfulness and gratitude to my beloved wife Um-Omran, for being, for many years, incredibly understanding, supportive and most of all her unceasing patience. Special thanks to my children, who though still young, understand and appreciate the nature of my work, and sacrificed many things they expect from me as a father.

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1 Introduction

1.1 Introduction

The research about evaluating the Libyan software industry is still lacking. After the extensive literature review we conducted, we found no previous studies that investigated the status of the Libyan software industry. In specific terms, what is the current status of Libyan software industry in terms of its national turnover, human resource qualities available, the level of formality of the software being developed, and lastly the potentialities of software development as a strategic national industry? Therefore, Details of this research focus on who develops the software (i.e. people), how the software is developed (process models), what types of software being developed (i.e. application diversity) and for whom it is developed (targeted market).

1.2 Research Background

Software is defined as a collection of programs, data and documentations needed for development, operating and maintenance. In the early 60's software was either provided as free with computers by the computer vendors or it is developed by customers themselves. In the middle 60's few companies were established to provide software packages for their customers. At January 1970, IBM as a prominent vendor started to ask for extra charges for the software provided with their computers; it is then followed by other companies (Steinmueller 1995).

An explosive growth in the software industry had been seen in the last twenty five years. Now the software market in the world exceeds 370 billions $ leaded by USA in which software industry sector accounts half of the world software sales followed by Western Europe which accounts the third. Beside developed countries, there are some

developing countries that develop and expand their software industry and now they accounts nearly 5 % of world software sales.

According to Richard Hecks (1999), developing countries can be categorized into five software strategic positions as shown in Figure 1-1.

Strategic Position A: - Export of software services, this model is followed by India. Software services include technical assistance, software enhancement, maintenance, application development, Internet application support and also exportation of skilled programmers and consultants to do work at the client side. Exporting services strategy is beset by various constraints, but does offer opportunities for a few countries.

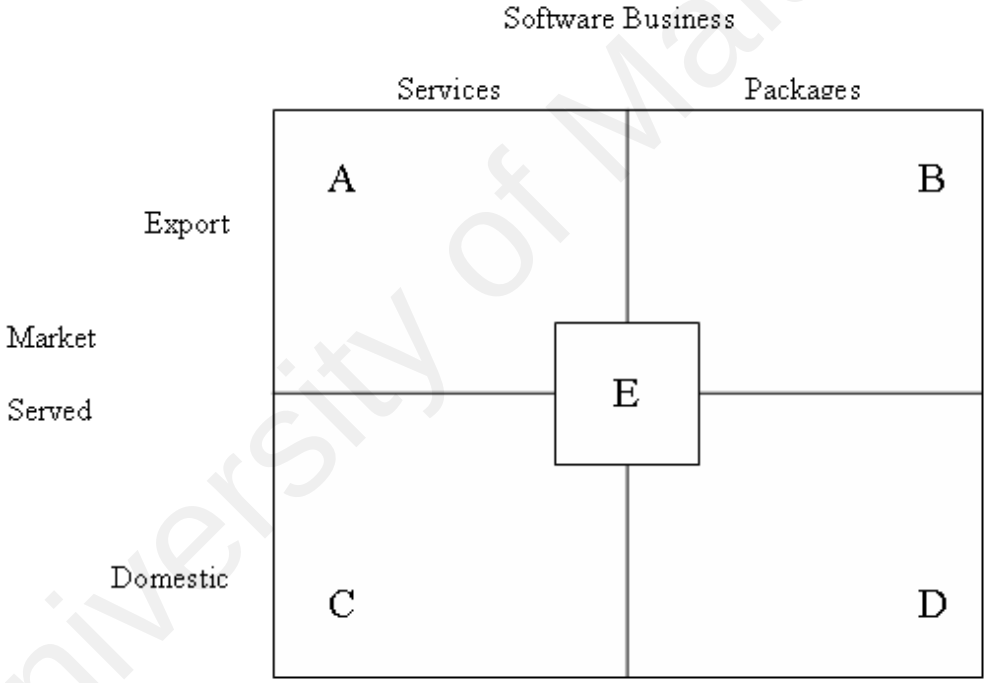

Figure 1-1: Software strategic positioning (Heeks 1999)

Strategic Positions B & D: - The software businesses targeted by countries in this position are software packages including word processing software, spreadsheets, databases, operating systems and the like. Both export and domestic markets are occupied by international players particularly USA. Developing countries do not have necessary competitive edges to compete with those powerful players even local market.

Strategic Position C: - most of developing countries software industries are in this position. It is the easiest point for them to start from. Then they can progress into other positions. Providing sizable demanding domestic market with software services will lead to exports by providing a base of relevant skills, experience, user's needs understanding and cooperative relationships with international partners. But the domestic software market in many developing countries cannot yet be described as either sizeable or demanding, Because of this domestic market roadblock, most position D software industries therefore remain in position D: small fish in a small pool that do not grow and which get very limited (Heeks, 1999).

Strategic Position E: - Under this position, software firms focus on customizing packages for sectors like banking, insurance, health administration, hotel management, mining and forestry; software enhancement like web browsers or providing windows interfaces to meet their local needs. After they gained experience and opportunities they start to export their semi-packages to other markets that share the same needs.

Libya is one of the developing countries and its software industry can be categorized in position D with the restrictions that the local market is small and software demand is low. Though Libya is recognized as an oil-producer rich country but the international sanctions imposed on the country in mid 80s and tightened in early 90's had it is severe impact on all national industries among which is the software industry. Being emerged from the ash of international sanctions in 2002, the country is aggressively exploring its potential driving forces for development. Software is expected to play a major role in improving national growth, and it also might open up doors for international expansion. This is what our research is trying to investigate.

1.3 Problem Statement

Although developing of software in Libya had started in the late 80's, the Libyan software industry still in it's primary stages, and it is not in the position to give Libya the opportunity to compete and cope especially with certain developing countries who are in more advanced stages in this field. However, as a country, which just had its long imposed sanctions released, and seeking to fulfil adequate national growth - The diversity of its revenues and improving quality of administrative services can be regarded as key factors in the Libyan recovery plan. Software can be regarded both as an alternative source of national revenue and as a tool to provide quality services in all administrative levels. However, to what extent the Libyan software industry is in the right position to meet the growing local demand for software products and to what extent Libya has the right edges to cope with other countries in the future. To meet the local demand and to cope with others, Libya has to look deeply at its software industry (strengths, weaknesses, problems and challenges).

Strong companies, skilful human resource, national vision supported by government, close cooperation between software producers, educational centres and the government, infrastructure are the main ingredients needed to establish strategic software industry or to strengthen a weak existing one. In Libya's case, to what extent it has the right ingredients for a prosperous software industry? This is the task that this research is trying to investigate.

1.4 Research Objectives and Questions

The main objective of this research is to study the current state of the Libyan software industry and to understand its characteristics, current problems and the challenges it has to meet. Specific objectives that will be met through this research are:

1- Conduct a survey based study in order to:

- Assess the current state of software development companies
- Assess the software development process and developing activities in the software developing companies.
- Assess the existing skills engaged in software development and determine skills shortage in the Libyan software industry.
- Assess how far the output of software-related educational institutes (i.e. Polytechnics, universities, colleges) met the professional requirements needed improving software development.
- Investigate the role currently played by the government to support software industry in Libya and to explore the role it could play to solve current issues and to meet future challenges.

2- To develop a skill assessment tool for software organisations to evaluate their human resources in the form of programmers, system analysts, testers, etc. Evaluating software development staff is very essential to recruit the ones who have the appropriate level of competency in software development skills. The tool is flexible enough to allow software organisations to tailor the tests to their application domain and/or areas of expertise they focus on.

In order to meet the main objective and the specific objectives this research will answer the following companies-oriented and software-oriented questions:

- **Regarding Companies**
  - When did Libyan software companies emerge? What is the number of software professionals they employ? What software development roles they are engaged at, and what academic or vocational degrees they hold.
  - Do the companies follow standard software development models? What is the percentage of software revenues compared to revenues earned from

other services provided by these companies? Who are their software clients?

- What are the problems that are faced by software companies and how serious are those problems from the companies' point of view?

- **Regarding Software**
  - What types of software are being produced? Does it include innovative software applications or just produce ordered software. Do they produce packaged, semi-packaged or customized software? Do they provide after-sale services? And what are these services?
  - What is the percentage of the software developed in-house comparing with software outsourced to other partners to be developed?
  - Regarding software process models, is there any specific software development life cycle (SDLC) followed? If not, what are the ad hoc steps followed and in which order?
- **Regarding the Workforce**
  - What is the distribution of the workforce samples according to gender, age and educational background? Is there any relation between these factors and the job position?
  - Do Software developers need to improve their skills or to gain new skills? How are they improving their skills? Does the company they work for sponsor their carrier enhancement or they depend on themselves to improve their skills?
  - Do Libyan software developers have exposure to new techniques in programming and software development? Which current currency techniques they use?

- In software industry, universities and institutions are the main source of the work force. Are the surveyed people satisfied with the skills gained during their education? What is their opinion about the quality of software-related education (teaching, courses, classes and other facilities) they had.

1.5 Research Scope

Firstly, due to time limitation and huge geographical map of Libya, the research study did not cover companies which reside in cities other than Tripoli which is the state capital. This is also justified by the fact that the majority of Libyan organizations are located in Tripoli. Another reason is because Libyan society is largely Bedouin, and there is a tendency that all governmental and major private sector companies reside in the capital. For these reasons, the scope for our investigation is limited to software companies positioned in Tripoli.

Secondly, as mentioned in Section 1.4, one of our research objectives is to develop a skill assessment tool for software companies to evaluate their staff competency. However, the tool is not customized to test any specific skill. In other words, software companies can design their own skill assessment test. This would give companies the flexibility to tailor the tool to their needs in regard to what areas of expertise they want to focus on. They would also be able to determine the level of assessment required based on the questions they chose to add to the tool's tests repository.

1.6 Methodology

1.6.1 Survey Research Methodology

The survey based research is a research study in which a survey is used to be as the main or the primary source of data. The data collected using the survey will be analyzed to obtain knowledge, which will be described and discussed through this research.

Surveys conducted for research purpose have three characteristics, which will distinguish them from other kinds of surveys, these characteristics are:

- The goal of conducting a survey is to produce quantitative descriptions of the study population. Collection of the required information is done through asking people well-structured and predefined questions, responses and answers to those questions constitute the data to be analyzed.
- Although the information is collected about a sample (portion of the study population), the findings have the ability to be generalized to the studied population.
- The main objective of a survey research is to answer the questions such as what is happening, how much is it happening and how many it is happening. By further research, analyzing, discussion, and understanding to the previous questions, the research will provide a conclusion that include answers to the questions about how is it happening, why it happening and what is the action to be taken as a response to the finding results (Pinsonneault and Kraemer 1993).

In order to investigate the status of Libyan Software Industry, we used a conclusive descriptive survey research approach. Two surveys are used to collect information. They targeted at Libyan companies and workforce driving the Libyan software industry. This research is aimed to be descriptive because it will describe the nature of the situation of the Libyan software industry as it is found at the time of the study. It describes the distributions of some phenomena in the study population and the relation between distributions. In addition, it is conclusive because after analyzing the collected data statistically, the research will deeply discuss the results of the analysis and suggest recommendations and actions that could be followed to leverage the Libyan software industry. To collect the required data for this research, two types of data sources were used, primary and secondary data sources.

1.6.2 Prototyping

There are many methodologies that are useful for a web-based application development but one that is clearly obvious in this kind of applications is the Prototyping model. This is because the web-based application client will usually present very general objectives and not detailed requirements. This suits the prototyping model key characteristic which is an immediate product followed by a revision of that product and then the changes are made to the product and the cycle continues.

1.6.3 Data Sources

1.6.3.1 Primary Sources of Data

As a primary source of data, two surveys were conducted to collect the required data for this research. The first survey was the companies' survey targeting companies engaged in software development, the second survey which is directed to the workforce is targeting people participated in software development. Both surveys were conducted in Libya. They were submitted and collected by hand. Detailed description of the surveys instruments, how data was analyzed and analyzed data results is elaborated in chapter three.

1.6.3.2 Secondary Sources of Data

Here data is obtained through reviewing software related to archival data sources, such as existing organizational documents, researches and reports on other countries' software industry, software market reports, statistical reports on Libya and other countries and software development related websites.

1.7 Expected Research Outcomes

By discussing the results of both surveys and reviewing previous studies about software industries on other selected countries, this research will provide:

1. A detailed assessment of the status of the Libyan software industry including its characteristics, strengths, weaknesses, problems and challenges for developing software in Libya.
2. Documentation of the lessons learned from other countries experiences and how to use them to implement a national strategy to make the Libyan software industry successful sector. Concluded lessons learned can be regarded as recommendations and suggestions to the Libyan policy makers to reengineer the software industry to meet the future local market demands and make local companies compete with offshore companies in new Libyan free open market
3. A skill assessment tool to help software companies evaluate their workforce, and to provide recommendations for competency development.

1.8 Significance of Research

The research about evaluating the Libyan software industry is lacking. The significance of this research is that it is as a pioneer study that investigated the state-of-the-art of local software industry. This research is expected to open doors for similar studies where certain factors can be explored thoroughly. The state of Libya is striving to compensate the years of political and economic hardship that badly affected IT industry. We believe findings of this study shall be of a greater help to IT policy makers in Libya. As for OSAT, its contribution as a software competencies management tool for local companies is immense. It aims is to help software companies evaluate their workforce, and to provide statistical information about their skills and recommendations for suggested training plan. OSAT can also be used as a benchmarking tool for the recruitment of software workforce.

1.9 Research Limitations

Some research limitations were identified on the way to conduct this research, which are:

There is no enough statistical information available on companies and the workforce engaged in software development in Libya.

It was decided to conduct the surveys in Tripoli area because most of the economic activities and software development companies are situated in Tripoli. For this reason, the results of the surveys can not claim to represent very accurate assessment to the Libyan situation in general.

The populations of both surveys are unknown because the number of software development companies and also the number of computer professionals engaged in software industry within the area of Tripoli are not available.

1.10 Organization of Thesis

The layout of the research structure is shown in figure 1-2 and the thesis has been organized into five chapters as following:

Chapter 1: Introduction.

This chapter outlines the research background, target study population, problem statement, research objectives and questions, research scope, methodology, expected research outcomes, and research limitations.

Chapter 2: Software Industry: Literature Review.

This chapter outlines in details the concept of software, software generations, software segmentation, software industry spectrum, strategies for building software industries in developing countries, and a brief information about Libya and strategy for Libyan software industry.

Chapter 3: Survey Methodology and Results Analysis.

This chapter outlines in detail the survey that was conducted to gather required data about software industry in Libya. The survey is used as a primary source of data to investigate Libyan software industry. Two surveys have been used to collect information about both companies and workforce as well. The goal is to investigate both formal software development practiced and the competency of the software human resources. In this chapter, the researcher has also explained the survey design, data analysis, and survey results that were illustrated in detail using charts and analyzing those chats.

Chapter 4: OSAT Tool Development.

This chapter describes the development and testing stages of OSAT (Online Skill Assessment Tool) system. It firstly briefly explains the tools that have been used to develop OSAT system. It also outlines system overview, system objectives, system scope, system users, software and hardware considerations, system design, system development, system interfaces, system testing, and limitation of the system, future works, and the conclusion. Examples of OSAT interaction scenarios are also presented using related screenshots.

Chapter 5: Conclusion.

This chapter presents summary of the research, research result conclusions, claimed contribution and the future work that can be carried out from this research. This chapter conclude the lessons learned from the experience of newly emerged software developing countries.

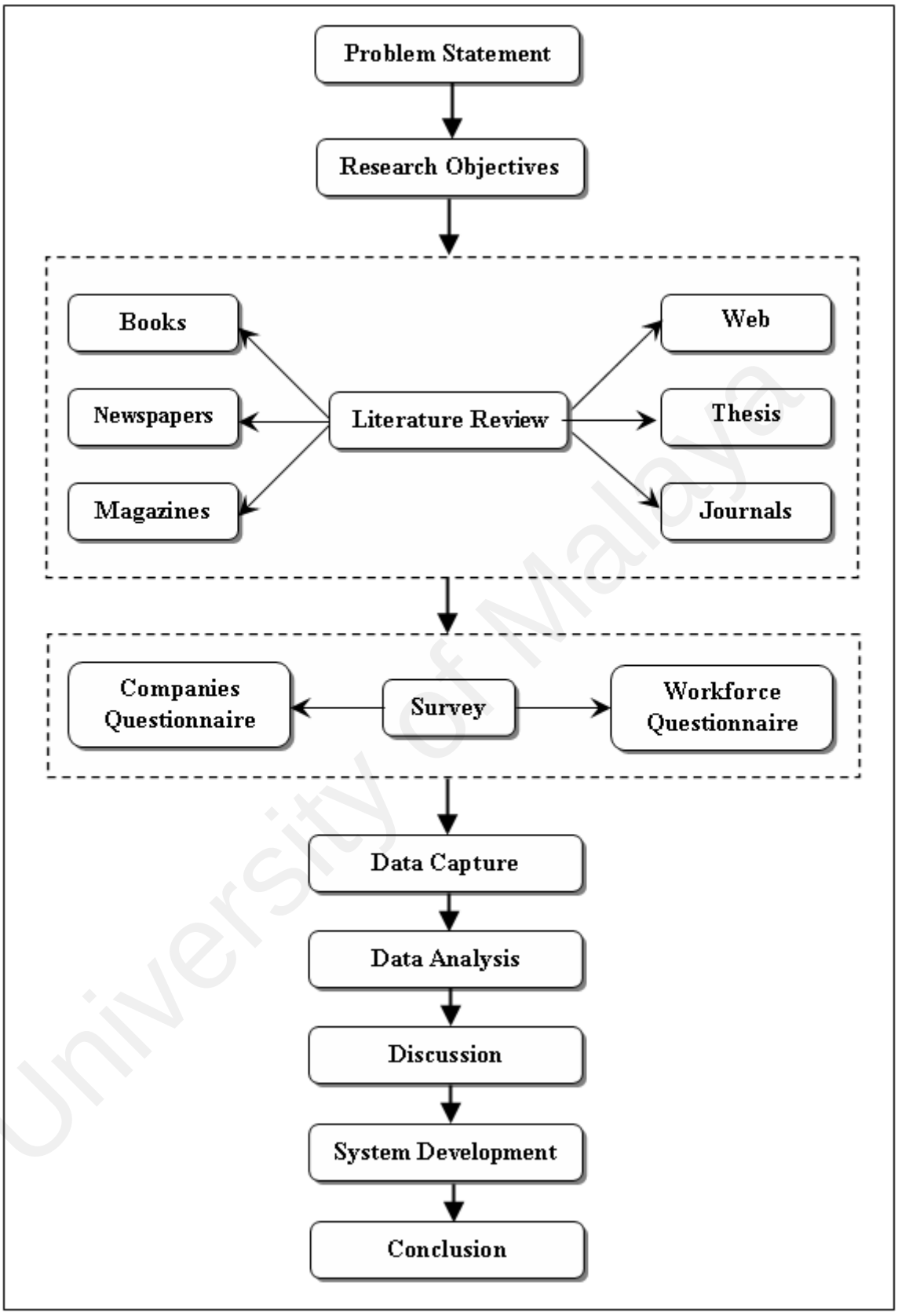

Figure 1-2: Research Structure

2 Software Industry: Literature Review

2.1 Introduction

The software industry is viewed by many as highly revenue industry that can be regarded as key to future competitiveness especially for developing countries. In addition to its potential revenues, software has a major affect in creating related business opportunities. For this reason many developing countries paving its way to secure a share in this industry. Many success stories have been witnessed in countries such as India, China, Brazil, Thailand, Philippines and Malaysia. Libya now ranked top African nation for investment (LiquidAfrica –January, 2005), and investing in software industry can be considered as one of major resources of the diversified economy that it seeks to achieve.

2.2 Software Overview

Software can be defined as, "the programs, routines, and symbolic languages that control the functioning of the hardware and direct its operation" (American Heritage Dictionary, 2000). From the applications viewpoint, software can be regarded as a set of computer readable commands that instruct computers how to perform different tasks. Various types of software are existed to cater for executing different functionalities such as controlling machines, information record keeping, financial management and electronic commerce. Through the history of computing, software technology passed several paradigms called generations.

2.3 Software Generations

Since its first inception software technology and tools advanced significantly. Each time software technology passed a paradigm shift where newer techniques and principles are emerged. Tracing back the software history, software industry can be classified into four generations.

2.3.1 First Generation

The first generation emerged in the 1950's where first computer emerged. Computer of this generation were based on the use of punched tapes and punched cards to store and manipulate data. In order to write programs for 1st generation computer, programmers needed to have a very detailed knowledge of the computer hardware.

2.3.2 Second Generation

Second generation computers emerged in the mid of the 1950's. This generation made use of symbols and are called assemblers which epresented the birth of the second generation languages (2GL). After the introduction of 2ed generation languages, programmers no longer have to work with one's and zero's when using an assembly language - They can use symbols instead. 2ed generation computers also become faster and easier to interact with compared to 1st generation computers.

2.3.3 Third Generation

Third generation computers emerged at the end of the e1950's. What features 3ed generation computers was the introduction of interpreters and compilers. The oldest 3ed generation language is FORTRAN (Formula Translation) that is oriented to for technical and scientific purposes. It was followed by COBOL (Common Business Oriented Language) which a 3GL language intended for business applications.

2.3.4 Fourth Generation

Fourth generation software aims to enable end users or programmers to build an application without using a third generation programming language. 4GL programmers do not need to indicate HOW a computer must perform a task but WHAT it must do. Few instructions in a 4GL will do the same as hundreds of instructions in a lower generation language like FORTRAN and Basic. Therefore, 4GL enable trained users to create an application in a much shorter time for development and debugging than would be possible with 2GL and 3GL

2.3.5 Fifth Generation

Fifth generation software can be regarded as a vision more than a reality. However, one of the major features of 4GL software is the form of interaction scenarios between humans and computers. The target is to enable computers understand and generate natural languages dialogs. However, according to Clark (2000) the outcomes of the various Japanese, U.S. and European Fifth Generation initiatives have generally fallen well short of expectations.

2.4 Software Segmentation

The term "software" did not come into use until 1958 (Philipson, 2004). Software can be defined as a set of instructions that tells the computer how to perform any task. According to Xu and Brinkkemper (2005), software products can be classified as shrink-wrapped software, commercial off-the-shelf (COTS) software, packaged software, commercial software, open source software and application service providers (ASP) (see Figure 2-1).

Another classification of software can be made according application types. For example there is application software, System software and Application development software. Applications software helps computer users to do all basic software

applications such as word processors, spreadsheets and financial management. Systems software work as a middleware between users and technical hardware complexities of computers. They include operating systems and utilities. Applications development software is meant to help computer programmers to develop different software applications. They include programming languages, database management systems (DBMS) and query tools.

2.5 Software Industry Spectrum

According to Johnson (1998) software industry began when IBM announced, on 23 June 1969, that it would begin pricing software separately from hardware beginning on 1 January 1970. It gradually become high revenue industry and it should come of now surprise that the richest man in the world is an owner of a software company.

Currently, the software industry is a key factor in realising knowledge based economy. It represents the enabling technology driving every electronically realised service in our life. Together with communication technology, software products and services become the information super highways that deliver the right piece of information to the right person at the right time. This high level of penetration of software service in people' life has made software industry as one of the major source of revenues to many countries especially the first world countries.

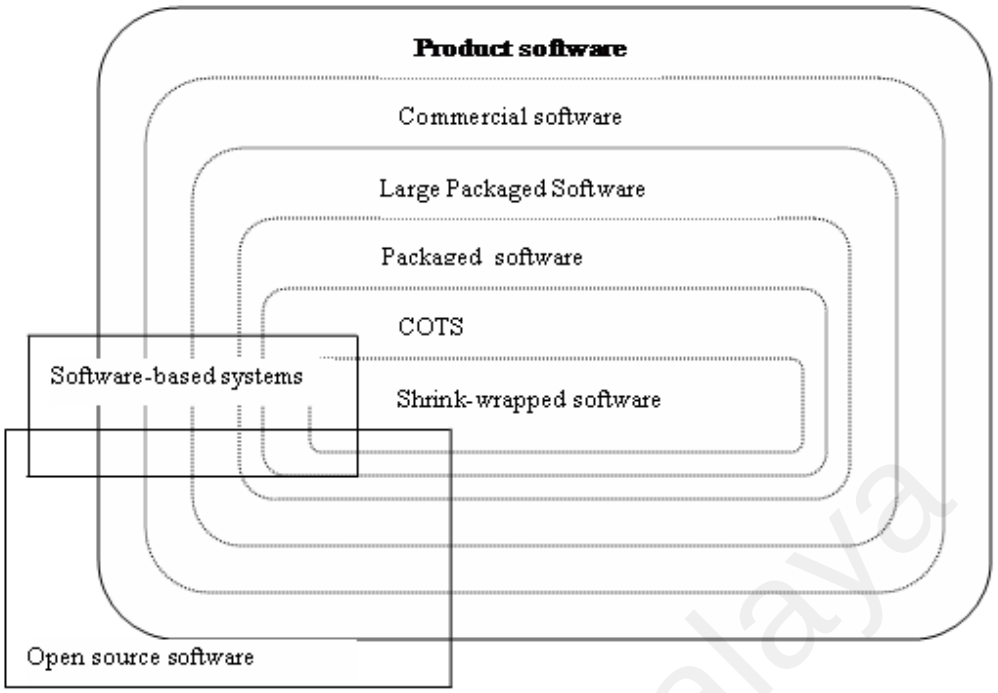

Figure 2-1: Categories of Product software [adapted from Xu and Birkkemper (2005)]

The United States and Western Europe are the pioneers in software industry. However, due to global economic changes and other management practices such as outsourcing and cost reduction initiatives, even few developing countries benefited from such changes. Countries such as India and China become the most successful stories in this regard. But, when software industry really began? Carmel (2003) classified software exporting nations based on 4-Tier taxonomy (see Table 2-1). He defined three types of thresholds for the transition from one tier to another. These thresholds are: maturity, clustering, and export revenues. Clustering refers to the number of local software-export enterprises. Maturity refers to the number of years that the nation's firms are exporting, while revenue represents those revenues from products and services. For example, based on the criterion of export revenue as a threshold, as cited by [(Ju, 2001), (American Chamber of Commerce report, 2001), (Terekhov, 2001)] in Carmel (2003) China and Russia are likely to export $1 billion in software by 2010 and move into Tier 1.

Table 2-1: The 4-tier taxonomy of the world's software exporting nations.

[Adopted from Carmel (2003)]

	Label	**Nations**
Tier 1	Major software exporting nations	Mostly OECD nations such as: USA, Canada, UK, Germany, France, Belgium, Netherlands, Sweden, Finland, Japan. Switzerland, Australia.
Tier 2	Transition software	Only Russia and China
Tier 3	Emerging software	Brazil, Costa Rica, Mexico, Philippines, Malaysia, Sri Lanka, Korea, Pakistan,
Tier 4	Infant stage software	Cuba, El Salvador, Jordan, Egypt, Bangladesh, Vietnam, Indonesia, Bangladesh,
Non-	Non-	Most of the (smaller, least developed)

In relation to the scope of our thesis, Libya can be categorized as Non-Competing nations. According to Carmel's taxonomy, these nations have *few to no* software exporting firms to speak of.

2.5.1 Big Players of the Software Industry

Big players of software industry are nations that have a tradition of exporting high tech and software products and services. They usually represented by advanced industrialized economies. According to Carmel (2003) until quite recently close to 100% of tradable software products and services came from G-7 nations. But still USA represents the dominate software producer compared to other G-7 nations such as Japan, Great Britain, Germany, France, and Canada. In addition to the G-7 nations, there are several other European countries that have successful software industry such as Sweden, Netherlands, and Finland.

2.5.2 Emerging Software Marketing Countries

Hardware industry can said be a monopolized industry. Not all countries can involve into this type of industry because of its high cost of entry. It is unlike software industry that can be initiated as results of individual effort. The low cost of entry of the software industry has led to many less developed countries set plans for software marketing.

In recent years dozens of many lower-wage countries have emerged as new software marketing countries. Countries such as India, China, Brazil, and Ireland exemplify the new software tigers among developing countries. However, according to Arora (2005), though the success shared by these countries, but they have pursued a very different model for development. Studying the varieties in the models followed by these countries could lead us to conclude factors that would help Libyan software industry to emerge.

2.5.2.1 China's Position

China emerged as a software industrial giant during the 1990s. It is now regarded as the second largest software producer among the newly emerged software producers after India. As shown in Figure 2-2, software applications still constitute that highest percentage of software produced in China. However, China's growth in hardware industry still vastly supersedes the growth in its software industry. The rise of China' software industry can be attributed to the Chinese government's promotional policies. According to Hu et al (2002), China will inevitably become the main provider of software outsourcing services as well as the main software consuming market in the world. Nonetheless, China's software industry could grow up even faster if the government succeeds to crack down piracy. Among the factors that help the speedy growth in Chinese software industry are:

a) Less trade protection

b) Strong government support to domestic firms

c) Improved protection for intellectual rights

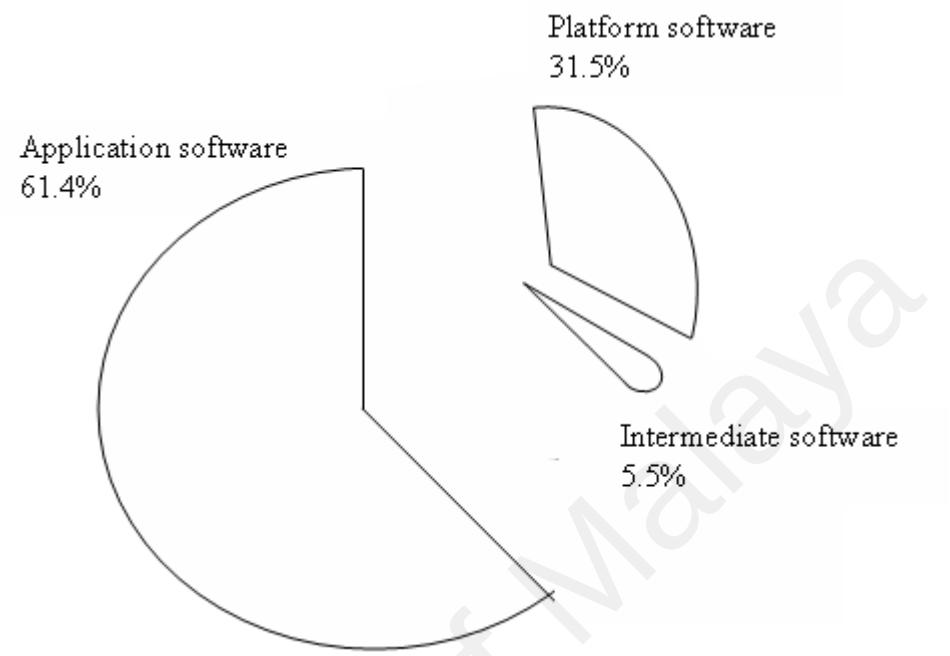

Figure 2-2: China's software market 2001
[Source (Kharbanda and Suman, 2002)]

2.5.2.2 India's Position

India can be regarded as the most remarkable case of emerging software industries among developing countries. The Indian success story can be attributed to many socio-technical factors, in addition to stronger government commitment to support software industry as a strategic plan for development. It is not only the low cost of production that attracted huge investment in the Indian software market. But in addition, the removal of import restrictions, improved infrastructure of communication, and greater population of well educated IT professionals. According to (Bharati, 2005), The Indian government has played a central role in establishing and promoting the IT services industry. It created software technology parks to provide the necessary office space, data and satellite communication links, and hardware and prioritized funding of the country's telecommunications infrastructure. Another factor that gives India an edge

over its competing developing counties is that English being a common language for Indians.

The Indian software industry started with less complex software development practices such as coding and maintenance. This initiated by multinational software vendors outsourcing parts of their software production. But recently, few Indian firms are also involved in producing their own IT products. According to Heeks (1996), software exports from India in 1994/95 were a staggering US$480m - up from less than US$4m in 1980 and growing at 40% or more per year.

2.5.2.3 Brazil's Position

Roots of the Brazilian software industry can be traced back to 1970s. But according to Duarte (2002), in the beginning of 1992, the Brazilian IT industry recorded positive growth, even receiving external recognition. A distinctive feature of the Brazilian case is that, its focus was more towards domestic market. The high rate of diffusion of ICT in Brazilian economy can be described as one of the main factors for Brazilian success. Current quality enforcement policies are expected to boost the Brazilian software industry. The Brazilian software plan is to enhance the quality of local software is summarised by Weber and Nascimento (2002) as:

- Increasing the number of master and doctor degrees of software degrees in Brazil.
- Increasing the cooperation among Brazilian universities-companies-government in the software quality area.
- Increasing the percent of Brazilian software companies which have experimented with ISO/IEC 9126.
- Increasing the percent of Brazilian software companies which have experimented with CMM

2.5.3 Outsourcing and Off-shoring Software

Basically, outsourcing means contracting out all or part of a service provided or a manufactured component. In regard to software industry outsourcing means contracting out all or part of a software product. In other words it represents a paradigm shift from in-house development to outsourced one. According to Philipson (2004), software outsourcing gained much attention in the 1990s.

Within the outsourcing paradigm, there has been a major shift which is described as "off-shoring". Off-shoring means outsourcing of software development to other countries. Certainly the new shores belong to more competitive markets in relation to lower cost production and low-wage quality professionals. Of course this formula is only applicable to developing countries such as India and China.

2.6 Strategies for Building Software Industries in Developing Countries

Setting up ground for prosperous software industry can't be fulfilled by plain intentions. There must be a strategic plan working for it. In the case of emerged players of software industry, one can find each country made its won strategy that suited its circumstances. For example, India's initial plan focused on offshore programming. On the other hand, the regime in the occupied Palestine focused on Palestine as an incubator of software products; while Ireland software industry plan focused on programming services & localization services. We believe Ireland's model can be customized to suit Libya case because the local demand for IT is immense due to years of hardship that the country went through. In addition, Heeks (1996) suggested four strategic positions that can be

taken within the software industry, as shown in Figure 2-2. He proposed that for many African countries and software firms, the export- oriented strategy seems highly attractive, and strategies C or D to be recommended at present. Nonetheless, Heeks (1996) predicted many barriers facing African nation to contribute to software export-oriented industry. They are:

- Lack of skilful workers
- Lack of electricity supply and telecommunication infrastructure.
- Lack of market information

Though these limitations are applicable to the majority of African countries, but Libya's capabilities especially in regard to electricity supply and telecommunication infrastructure is not lacking. While the lack of skilful workers is expected to be eased by recent practices in the form of government incentives to private educational institutes and the privatization of major public companies including IT –based public organizations.

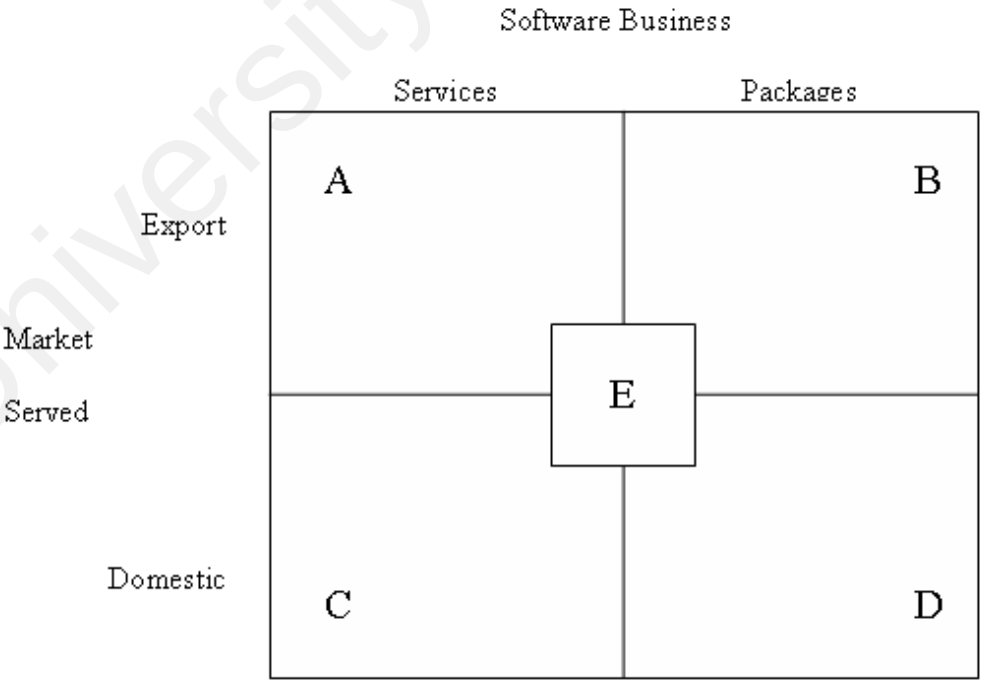

Figure 2-3: Strategic Positioning for Software Firms

2.6.1 The Future of Software Industry

Technology change is beyond recognition and it is unpredictable how the software industry will look like in regard to newer software technology, newer software applications, and in what way it would influence people's life style. According to Dolbeck (2004), as more technological devices are developed and more services are provided online or through data networks, demand is generated for soft-ware products to operate the new products and systems.

The open source paradigm, which is increasingly capturing new grounds in software industry, is another force of the future. In fact it is one of the most influencing factors for the growth in less developed countries.

2.7 Libya: Target Study Population

Libya is a large country situated on the north of Africa. It covers an area of 1757000 square kilometres, but most of this area is either desert or semi-desert. The population of Libya is about 5.5 million; half of them are females. The average age in Libya is very young with half of the population being under the age of 15. Tripoli is the Libyan capital; it is the largest metropolitan centre with population of about 1.5 million. Other major cities include Benghazi, Sebha, Sirte and Misurata (Libyan national information and documentation authority, 2003). In Libya the state official language is Arabic. However English is commonly spoken and understood.

2.7.1 Political System

The official name of Libya is The Great Socialist People's Libyan Arab Jamahiriya. The word Jamahiriya means a state, which includes all its peoples and run by all its peoples regardless of race, language, or beliefs. The political system of government in Libya is run by the basic people's congress, which includes all Libyans of 18-year olds and above. The basic congresses act as legislative bodies that issue decisions to be

formulated in general people's congress "GPC", which is highest political body in the country. The popular committees on different levels are intended to execute and follow-up the decisions of the GPC. This system was introduced in Libya in 1977 (Jana, 2004).

2.7.2 Education System

According to the Libyan Law, education is a right and duty of all Libyans. It is compulsory from the age of six years until the age of fifteen, which is equivalent to primary and secondary school. The State guarantees this right through the establishment of schools, institutes, universities, and pedagogical and cultural institutions in which education is free. The private education sector is only permitted few years ago. Now there are a lot of private schools, institutes, and universities, all are regulated by national authorities. The State is particularly concerned to enhance the physical, intellectual, and moral development of the youth (Gathour 2001).

2.7.3 Economy

The Libyan economy depends primarily upon oil sector revenues, which account for practically all export earnings and approximately one-third of the GDP. Oil revenues together with a small population give Libya one of the highest per capita GDPs in Africa (Ghattour, 2001). Libya's economic performance in recent years has been regarded as very poor. This can be attributed to, low oil prices, economic inefficiencies, and unnecessary state involvement in the economy. The major hit to Libyan growth is made by the long period of sanctions imposed on it. Libya has been the target of US trade sanctions since 1982 when the United States banned imports of Libyan oil and some exports to Libya. In 1986, the United States expanded the sanctions to include total ban on direct import and export trade including state-of-the-art software and hardware technology. This trade ban has had a stifling effect on the Libyan economy.

The situation worse by the sanctions imposed by the UN in 1992 which include freezing of assets abroad as well as certain oil assets and air and arms embargo.

Now, after lifting the sanctions, Libyan government is planning to privatize most of its state-owned companies, including government owned software companies. This is a strategic move to enter into the free market economy and reduce the government control over economy by allowing private businesses operate in the country and encouraging local and foreign investors to invest in Libya safely (MBendi 2003, Global Policy).

2.7.4 Strategy for Libyan Software Industry

In relation to Heeks' inquiry: "*Does it make sense for African nations to set up their own software industries*?" Heeks (1996); Heeks' answer is an unequivocal "Yes". But does the "YES" is inclusive of Libya. We believe Heeks' answer is also applicable to Libya, and there are many facts that support this claim. Libya now top African nation for investment (LiquidAfrica –January 2005), and inline with the fact that companies in US more openly admit the growth of offshore outsourcing (The global software industry: McNamus and Fayed). This gives Libya historic moment to engage more with the international software industry. The huge local demand for software products can also contribute to the viability of setting up the ground for dynamic and self-sustaining software market. According to Porther (2006), the competitiveness of Libya depends heavily on such things as

- Improving education and skill levels
- A trusted rule of law
- Safe working conditions
- A healthy population
- A sense of equal opportunity
- Protecting the natural environment

- Libya is in a geographically attractive location linking Europe and Northern Africa

We believe these factors would help realign Libyan software industry to better exploit global opportunities and realize the full local potentialities. In spite of all obstacles and barriers that we would highlight in Chapter 3, we believe that the majority of these barriers are caused by the hardship that the country went through as a result of political confrontations with the west. As all confrontations are resolved and all sanctions on importing technology is already lifted. Libyan ambitions to gear up with software industry are strongly valid and prosperous.

Education and Human Resources issues can be regarded as major attributes for any software industry strategic plan. Previous education policy decisions have negatively affected education in important areas for business such as IT and foreign languages Potler (2006). Therefore current education sector does not provide a job-ready work force. However, the wave of new private and governmental IT oriented educational institutes is likely to contribute to the availability of competent IT experts. In fact the influx Libyan IT experts to Gulf region are very noticeable. They are specifically attracted by higher wages compared to local market.

2.7.5 Competitiveness of Libyan Software Initiative

The potential of software industry is very high, and any country can invest in software industry because of it is low entry cost. Nonetheless, competition becomes stiff especially among third world countries. But what is the core competitiveness of Libyan software industry.

Basically, investing in software industry is one of the alternatives of the Libyan government intentions to diversifying the economy beyond the oil and gas cluster. Competitive strengths including:

- Availability of educated labour force

- Lower cost of living and cost of doing business
- intellectual property rights and protection have been established (Managing Intellectual Property 2005)
- Stronger government commitment to ICT diffusion (UNESCO, 2005)
- Libya's strategic geographic position allows it to become an IT hub in the middle of the world.

2.8 Assessment Tools

2.8.1 Background

In order to estimate the skill of Libyan programmers and other computer people ware that are already involve in software industry in Libya we develop an assessment tool that can be used online to assess the skills of any organization members. So organization administration can take decisions regarding improving the members skills in a particular field.

Assessment refers to gathering data and/or information that measure the impact of a certain activity relative to its objectives (Scriven, 1991). The purposes of assessment are varied and depend on one's perspective (Dietel, Herman and Knuth, 1991) ; (Scriven, 1991). Assessment takes many forms depending on the outcomes that one wishes to assess.

For instance educational policymakers use assessment to set standards, monitor the quality of education, or formulate policies, while teachers may use assessment to perform individual diagnosis of performance problems, monitor overall student progress and to plan and improve curriculum and teaching.

Although the assessment process has many components (e.g. defining the objectives of the activity / intervention to be assessed, developing assessment instrumentation in alignment with those objectives), developing, distributing and collecting those data are a

significant portion of the process. The expense can be prohibitive for small programs or activities.

Use of assessment can provide a competitive edge in addition to measuring effectiveness, improving programming and informing future activities. Many programs are competing for limited resources and frequently this translates into a need to provide data that a program or activity is meeting its stated objectives. Although there are many ways of gathering the needed data, online assessment tools have the potential to aid in some aspects of the assessment process with the following benefits (Yun and Trumbo, 2000).

- Lower cost relative to other data collection methods
- A supportive environment for actual development of an instrument
- An online data collection product that for some populations may facilitate a better response rates
- Support for the data collection process; responses are automatically stored in the provider's database with the ability for you to download the results when you wish. This eliminates the need for manual data entry.

Most tools require minimal technical ability to use them. One sets up an account with the tool provider and then proceeds to use the main tool functions – which are often accompanied with online help and other support systems.

2.8.2 Sample Assessment Tools Review

We conducted a review of online assessment tools for use in developing online skills assessments. During the initial review we:

- Read the documentation on the tool website to begin to understand basic.
- Examined product demonstrations available through the tool web site.
- Created sets of items using the demonstration or trial functions that are generally available for no charge via the product web site.

- Tested assessments with both users who had never set up an online assessment before and with experienced users.

We have chosen three different tools for discussion and comparison. See Table 2-2 .

Table 2-2: Sample Skills Assessment Tools

Assessment Tool	URL
eskill	http://www.eskill.com/
E-validator	http://www.e-validator.com/
scalebrain	http://www.scalebrain.com

1 – sSkill

eSkill is a Web-based skill testing services for Human Resources. eSkill generate tests to accurately fit job descriptions. Efficient tests are provided to measure a person's skill for a particular job more effectively than any off-the-shelf test.

eSkill's online skills assessments streamline the employee screening procedures, provide quantitative data for proving bias-neutral hiring decisions, and serve as an in-house training tool. It is used to test candidates in Typing, 10-key data entry, Office, English, Math, and many high-end technical and IT subjects.

Basically, none of the respondents of the survey we conducted has ever used assessment tools. As for the recruitment of IT staff in Libyan software organizations, all companies investigated relies on traditional (verbal and written) methods for the IT competencies' assessment. They neither use of-the-shelf assessment tools nor do they rely in using in-house developed ones.

These reviewed tools have many strengths and weakness as well. However, as for the context of our study, we do believe that customized assessment tools shall be more practical for the category of companies targeted by our research. The scope of the reviewed tools spans all basic competencies including secretarial skills such as typing and office applications. Domain-specific assessment tools such as the proposed one (i.e. OSAT) is tailored to the needs of software companies needs. Hence is would be easier to use and less complicated. Another added-value missing in the reviewed tools is that assessment tools should not cater for the assessment only. It has to offer advices for training courses and other materials that help to master the competences being assessed. None of the assessment tools we reviews considered this issue.

2 – E-Validator

Ev-Screen is supplying online skills tests and services such as Multiple-choice mixed skills tests, software simulation, on-line screening, typing speed and accuracy tests, data entry speed and accuracy tests, as well as all type of customer-defined tests. Ev-Screen also links a set of screening questions and a set of skills questions to a particular job vacancy.

Ev-Audio, listening and keying tests are designed to measure a candidate's ability to transcribe data quickly and accurately from a simulated contact centre caller. You are presented with a series of screens into which you are required to enter data based on the audio clips. Certain scenarios require simple processing also. This test is designed to measure the ability of the candidate to listen to a simulated support or service call and enter the information presented into a database system. Some rudimentary decision making is required from the candidate as the call progresses. The speed and accuracy of the data entered and decisions made are then assessed and scored.

3 – ScaleBrain

ScaleBrain Skills Testing systems and Assessments provide confidence to the employees and focus areas on which to build greater competency, productivity and skill development for the individual.

Since 2002 these skills testing systems have provided the Staffing Industry, Corporate Human Resource Departments, Training Services and Educational Institutions with software skills evaluation and training systems for popular business applications on the Windows platform. These tests have helped thousands of organizations understand more about the real abilities of their job applicants and prospective trainees. Scalebrain has a different, job-related, valid test for just about every position, and can design, customize and validate any test for any purpose.

2.8.3 Online Assessment Tool Requirements

As we review and test out different tools, we recommend considering the following:

- □ How easy is it to use? Have several potential users in your organization "test drive" the tool. Most sites offer a free download for a trial period, a demonstration, or some combination.
- □ Verify that the tool provides a secure server where responses are stored. The writers assume that users will want their data to be both confidentially and privately stored to protect their respondents, but also will want their data to be rigorously protected from technical errors that could result in data loss. If this level of information is not readily available on the tool website, contact the technical support or sales consultant.
- □ Does it offer the types of items that you need? (e.g. Does it provide the possibility of open-ended questions, forced-answer questions, etc.)
- □ Does it offer other special features you may require?
    - Graphics?
    - Ability to insert HTML coding?
    - Ability to skip pages or items?
    - Item numbering?

Lastly, it is important to note that commercial delivery of online assessments is dynamic and highly competitive, so check for changes in basic services, format, etc., before a final decision.

2.9 Conclusion

There is no doubt about the major impact of software industries on national economies. As an industry of very low entry cost and it largely depends on intellectual capabilities, these requirements make software industry a very attractive choice especially for third

world countries. As a result, there are many newly emerged software development players such as India, China, Brazil, etc. Libya is also a third world country and recently strives to diversify its national income by seeking alternative national resources in addition to the oil industry. Based on the basic requirements mentioned above, Libya's circumstances in regard to political well, geographical, social and technical capabilities indicates a potential success in building national software industry. This study is meant to cater for exploring these capabilities and to suggest recommendations as is applicable. These findings are explained in the next chapter.

3 Survey Methodology and Results Analysis

3.1 Introduction

The survey based research is a research in which a survey is used as the main or the primary source of data. The data collected using the survey is then analyzed to derive conclusions related to the problem domain. Basically, surveys conducted for research purpose have three characteristics, which distinguishes them from other kinds of surveys, these characteristics are:

The goal of conducting a survey is to produce quantitative descriptions of the study population.

Collecting the required information through asking people well-structured and predefined questions, responses and answers to those questions constitute the data to be analyzed.

Although the information is collected about a sample (portion of the studied population), the findings have the ability to be generalized to the studied population.

The main objective of a survey research is to answer the questions such as what is happening, how much is it happening and how many it is happening. By further research, analyzing, discussion, and understanding to the previous questions, the research will provide a conclusion that include answers to the questions about how is it happening, why it happening and what is the actions to be taken as a response to the finding results (Pinsonneault and Kraemer 1992) .

In the Investigation on Libyan Software Industry research, a conclusive descriptive survey research approach is used. It is descriptive because it describes the nature of the

situation of the Libyan software industry, as it is found at the time of the study by describing the distributions of some phenomena in the study population and the relation between distributions. In addition, it is conclusive because after analyzing the collected data statistically, the research will discuss in deep the results of the analysis and suggest recommendations and actions that could be followed to leverage the Libyan software industry. Two surveys used to collect information about companies and workforce in the Libya. The aim is to investigate both formal software development practiced and the competency of the software human resources.

3.2 Survey Objectives

Survey is the main or the primary source of data in this research. The data collected using the survey will be analyzed to obtain knowledge, which will be described and discussed through this research. The objectives of the survey are as follows:

- Assess the current state of software development companies
- Assess the software development process and developing activities in the software developing companies.
- Assess the existing skills engaged in software development and determine skills shortage in the Libyan software industry.
- Assess how far the output of software-related educational institutes (i.e. Polytechnics, universities, colleges) met the professional requirements needed improving software development.

3.3 Survey Design

Two surveys were conducted. Each survey has a questionnaire with a cover letter, which includes the following:

- The title of the research
- The title of the survey's questionnaire

- Who is conducting the survey and why
- The main objective of the research
- A guarantee to the participant that he/she will need few minutes to complete the questionnaire where most of the questions are multiple-choice
- A declaration to the participant that all responses are completely confidential and will remain totally anonymous and
- A phone number to be contacted for any questions or concerns

Both questionnaires can be found in appendix I.

3.3.1 Companies Survey

The aim of this survey is to provide the basic information about software developing companies and software development in Libya.

3.3.1.1 The Questionnaire

The companies' survey used a well-structured questionnaire with 26 predefined questions; some of the questions are open-ended where the others are multiple-choice. The answers to open-ended questions are quite short such as numbers or percentages. Questionnaires from other countries' similar studies were reviewed and some questions were taken and modified to be used in this questionnaire. Questions can be classified into four groups: First Group, Q1-Q3, is about general information about the company (name. type, establishing date). Second Group, Q4-Q8 and Q11, are about the employees within the company (their number, their education level, their position and how many of them are related to software development). Third Group, Q9, Q10 and Q12, are about the time spent for software development, revenue from and the problems that face the companies in their field and how serious are these problems. Fourth Group, Q13-Q26, is about the software development within the company.

The questionnaire was printed on five pages including the cover letter in English language.

3.3.1.2 Population and Sampling

As a population, the companies' survey targeted companies engaged in software industry within the area of Tripoli with the following conditions:

a) The company must be local Libyan company
b) Either the company at the time of conducting the survey was developing software or it has developed software and providing after-sale services.

The target sample was determined to be between twenty-five and thirty companies and to reach the target number; thirty-five questionnaires were delivered randomly to thirty-five companies, which had to meet the conditions above.

3.3.1.3 Data Collection

The questionnaire was given by hand to the responsible person in each company within the sample to ensure that the right person fills the questionnaire and to answer any question regarding the questionnaire or the research in general. A second visit was scheduled to collect questionnaires from those decided to complete the questionnaire later. At the end of the survey, there were thirty-two questionnaires collected.

3.3.2 Workforce Survey

Data collected through this survey is about computer science educated people engaged in software development.

The Questionnaire

Compared with companies' survey questionnaire, the workforce questionnaire is short and consisting of 14 questions, three of the questions are open-ended. The others are multiple-choice. Questions were grouped into three groups: First Group, Q1and Q2, is about gender and age of the participant. Second Group, Q3-Q8, is about educational

experience, assessment of the participant's skills. Third Group, Q9-Q14, is about participant's work experience, his/her current job and tools that he/she used in software development.

The workforce questionnaire was printed on three pages including the cover letter in English language. In addition, an Arabic translation was available on request by the participant who could not understand the questions in English.

3.3.2.1 Population and Sampling

As a population, the workforce' survey targeted all computer science educated people within the area of Tripoli with the following conditions:

a) He/she must be Libya resident and with Libyan nationality.
b) Has a degree on computer science or IT
c) He/she currently is working in developing software or has participated in software development at the past and still working in the same field.

The target sample was determined to be between eighty and one-hundred companies. To reach the target number; one hundred and ten questionnaires were distributed randomly taking into account that every participant has to meet the three conditions above.

3.3.2.2 Data Collection

Questionnaires were distributed by-hand to the randomly selected sample. The completed questionnaires were collected on the next day or later according to the participant's request. At the end of data collection, there were ninety five questionnaires collected and ready to be analyzed.

3.4 Data Analysis

All collected questionnaires from both surveys were manually reviewed and edited for completeness, accuracy and reasonableness prior to computer analysis. Two

questionnaires from companies' survey questionnaires were rejected, one because it was incomplete the other one because the values provided by the participant were unrealistic (extreme values) and cannot be accepted. After the manual revision, thirty questionnaires were complete, accurate and passed to the next the analysis step.

As the questionnaires of the companies' survey, the workforce's survey questionnaires were verified, five questionnaires were rejected because they were incomplete the remaining ninety questionnaires were complete, accurate and passed to the next computer analysis step. See Table 3-1

Table 3-1: Survey Questionnaires

	Questions	Distributed	Collected	Rejected	Accepted
Companies Questionnaire	26	35	32	2	30
Workforce Questionnaire	14	110	95	5	90

Statistical Package for the Social Sciences (SPSS) was used to process all data because of its comprehensive and integrated capabilities in managing, analyzing and displaying data. Using the SPSS data editor, all data were entered into two different SPSS data files, one for companies' survey the other one for workforce's survey. A case id (case is a row in a data file, a case includes data entered from one specific questionnaire) was copied into the front page of the corresponding questionnaire therefore when we analyze the data we could find incorrect values, using the case id, we can refer to the corresponding questionnaire to correct.

3.5 Survey Result

The following sections briefly describe the questions of the survey. Statistics of the survey results are presented in tabular form. Comments about the results derived from the received answers are also presented briefly.

3.5.1 Workforce Part

The competency of the workforce has a major influence on progress of any software development initiative. The following questions represent the areas of focus of our investigation study. Based on respondents' replies, all question answers are analyzed and graphically illustrated as shown in the following sections.

3.5.1.1 Gender Distribution

In many third world and specifically Middle Eastern countries, sex based segregation is very common in workplaces; however, the involvement of female citizens in the workforce is rare. However, in Libya there is no such segregation policy as it is practiced in many Middle Eastern countries. In fact, the government fully supports female workforce to participate in all aspects society affairs. However, certain cultural barriers still contribute to marginalize especially female workforce in rural areas. Based on the findings of our research, 94.4% of the software development workforce is male IT professionals. The female sector only caters for 5.6% of software development workforce in Libya (See Figure 3-1). This conclusion can be largely attributed to social barriers, the less matured software industry and also the fact that most females are working in educational institutions and non software organization.

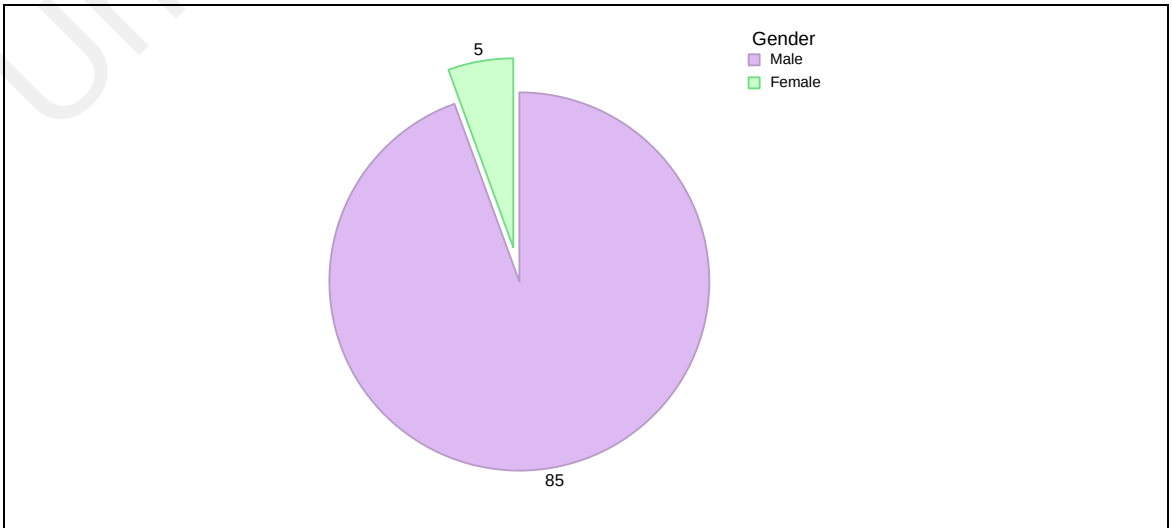

Figure 3-1: Respondents Gender

3.5.1.2 Software Professionals Age

Basically, the average age of software development professional in general is not as high as the age of other engineering disciplines such as electrical or electronic or mechanical engineering professionals. That is due to younger age of software development in general. In regard to the Libyan case, the survey showed that the highest percentage of software professional's age lies in the range of 26-30 years (see Figure 3-2). This can be justified by the introduction of software related educational institutes in the 1970's. However, these figures are expected to boost as a result of recent release of banning importing software and hardware technologies to Libya.

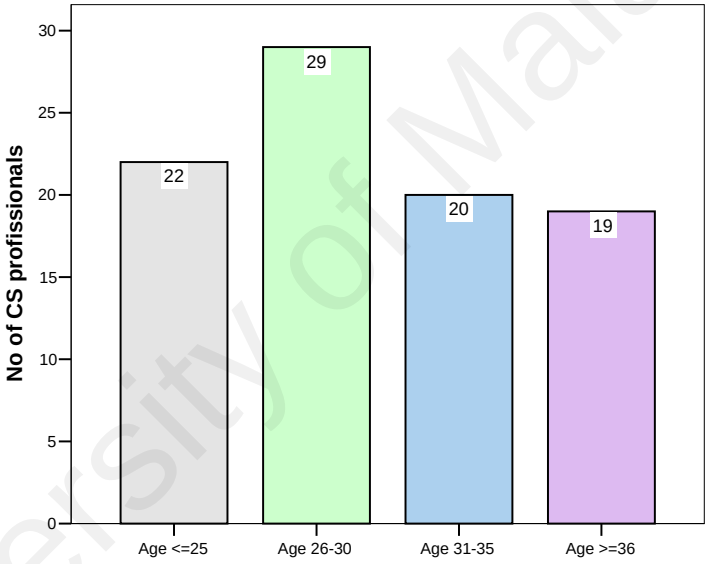

Figure 3-2: Respondents age

3.5.1.3 Educational Qualifications

There are many software related educational institutes that contribute to the supply of Libyan software professionals. They vary from universities, colleges, and higher institutes. Based on the survey results, 63.33% of the Libyan IT workforce is university graduates. The higher institutes contribute to 24.44% of the IT workforce while only 12.22% IT professionals hold postgraduates qualifications (see Figure 3-3).

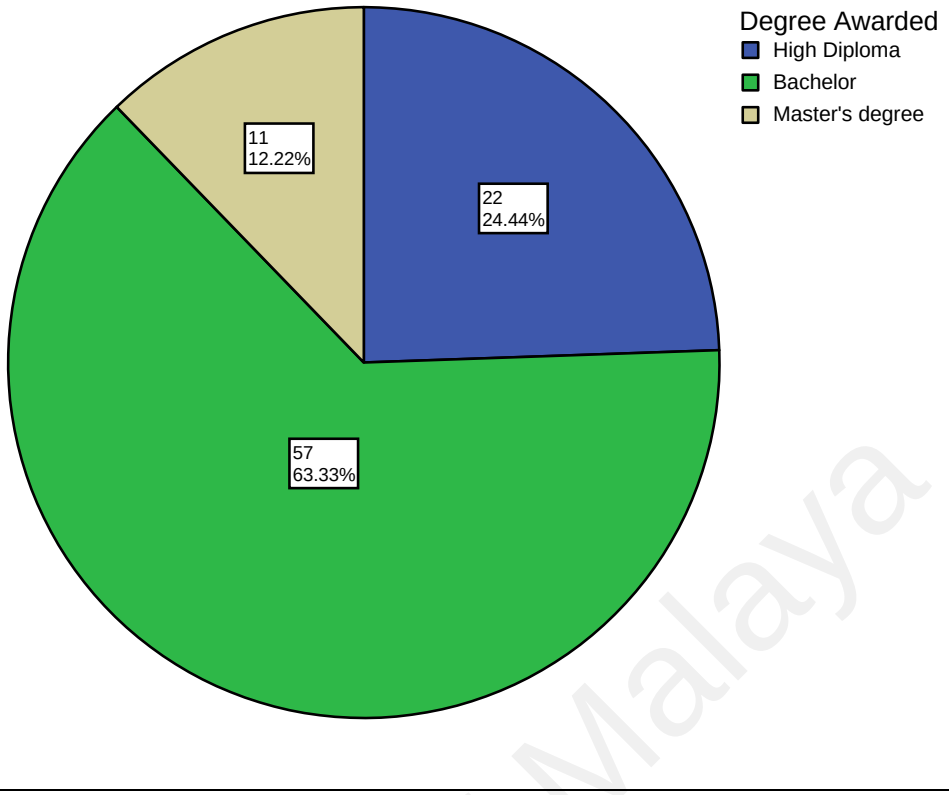

Figure 3-3: |Respondents' Education Levels

3.5.1.4 Software Professionals' Overall Satisfaction with Software Skills They Were Taught in Colleges

Competency of software workforce is largely influenced by the quality of teaching in IT oriented educational institutes. The rationale of this question is to investigate whether the quality of these IT educational agencies is appropriate or not from the graduates' viewpoint. The survey results shows that the majority of respondents are not satisfied with quality of that they have been taught. This is a very serious issue as it could affect the confidence of Libyan software professionals. As shown in Figure 3-4, 77.78% of the respondents are not satisfied with the quality of software skills they acquired or lacked during their educational studies. Only 22.22% who assumes that the software knowledge the acquired in IT colleges is very helpful in the task that do in as they were employed.

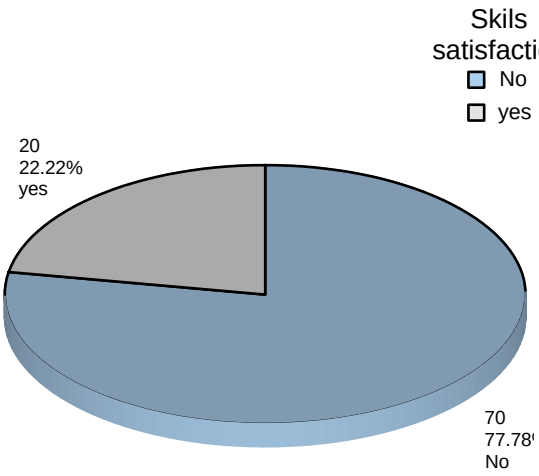

Figure 3-4: Respondents' college educated Skills satisfaction

3.5.1.5 Software Professionals' Satisfaction with Certain Educational Aspects

The quality of education has a major influence of the quality of IT professionals. This question is to gauge the quality of education received by Libyan IT graduates. Many educational aspects were highlighted as quality indicators. This includes the quality of the teaching environment, the educational materials, facilities and the quality of teaching. The overall conclusion of the answers received show high percentage of dissatisfaction in all educational aspects investigated (see Figures 3-5 and 3-6).

I. Adequacy of Library Materials

Under this category of problems, the study shown that 54.0% of correspondents expressed their severe dissatisfaction with quality and volume of library materials available in the educational institutes they enrolled at. 12.0% of correspondents were moderately dissatisfied with this option while 20% were neutral in their assessment. Only 3.0% of the correspondents expressed their very satisfaction, and 9.0% of the respondents were moderately satisfied. However, 1.0% declined to express their views in regard to this matter (see Figure 3-5).

II. Adequacy of Library Facilities

This issue recorded very negative figures of dissatisfaction. Under this category, the study shown that 57.0% of correspondents expressed their severe dissatisfaction with quality of library facilities provided in the educational institutes they enrolled at. 13.0% of correspondents were moderately dissatisfied with this option while 16.0% were neutral in their assessment. Only 4.0% of the correspondents expressed their very satisfaction, while 10.0% of the respondents were moderately satisfied (see Figure 3-5).

III. Adequacy of Computer Facilities

This figure is very disappointing as the computing facilities should be essential requirements for qualifying IT professionals. This issue recorded very negative figures of dissatisfaction as well. Under this category, the study showed that 60.0% of correspondents expressed their severe dissatisfaction with computer facilities provided in the educational institutes they enrolled at. 8.0% of correspondents were moderately dissatisfied with this option while 13.0% were neutral in their assessment. Only 10.0% of the correspondents expressed their very satisfaction, while 9.0% of the respondents were moderately satisfied (see Figure 3-5).

IV. Quality of Classroom Facilities

Under this category of problems, the study shown that 56.0% of correspondents expressed their severe dissatisfaction with classroom facilities available in the educational institutes they enrolled at. 16.0% of correspondents were moderately dissatisfied with this option while 11.0% were neutral in their assessment. Only 1.0% of the correspondents expressed their very satisfaction, and 14.0% of the respondents were moderately satisfied. However, 2.0% declined to express their views in regard to this matter (see Figure 3-5).

V. Practical Session

Under this category, the study shown that 34.0% of correspondents expressed their severe dissatisfaction with practical sessions provided in the educational institutes they enrolled at. 19.0% of correspondents were moderately dissatisfied with this option while 20.0% were neutral in their assessment. Only 6.0% of the correspondents expressed their very satisfaction, while 12.0% of the respondents were moderately satisfied (see Figure 3-5).

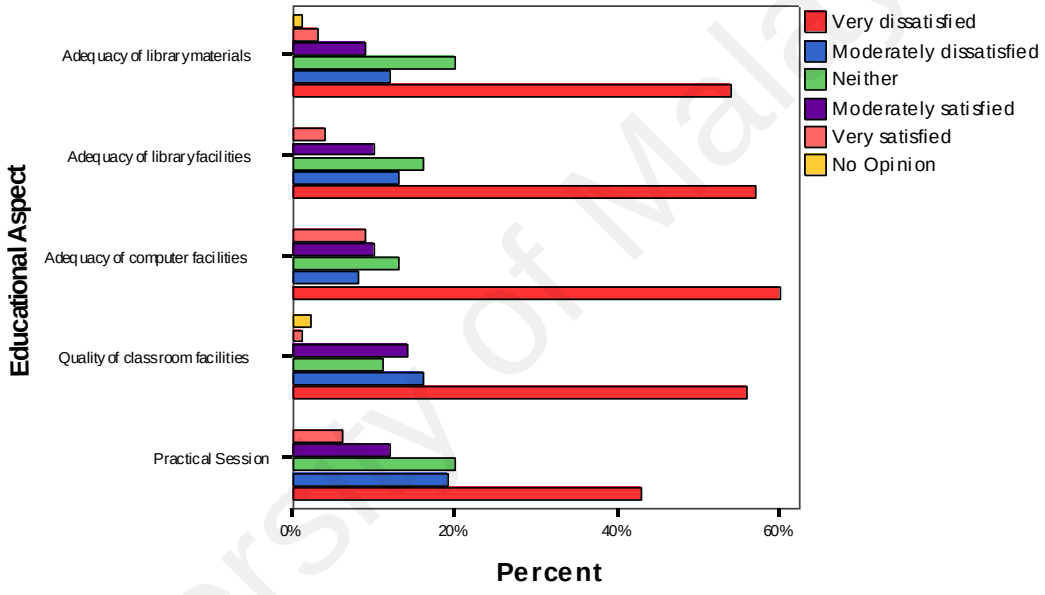

Figure 3-5: Educational Aspects Satisfaction (a)

VI. Quality and Availability of Advising

Under this category of problems, the study showed that 54.0% of correspondents expressed their severe dissatisfaction with advising services provided in the educational institutes they enrolled at. 12.0% of correspondents were moderately dissatisfied with this option while 20.0% were neutral in their assessment. Only 3.0% of the correspondents expressed their very satisfaction, and 9.0% of the respondents were moderately satisfied. However, 1.0% declined to express their views in regard to this matter (see Figure 3-6).

VII. Availability of Related Courses

Under this category of problems, the study showed that only 27.0% of correspondents expressed their severe dissatisfaction with software related courses that are provided in the educational institutes they enrolled at. 33.0% of correspondents were moderately dissatisfied with this option while 22.0% were neutral in their assessment. Only 2.0% of the correspondents expressed their very satisfaction, and 14.0% of the respondents were moderately satisfied. However, 1.0% declined to express their views in regard to this matter (see Figure 3-6).

VIII. Diversity of Courses

Under this category of problems, the study showed that only 27.0% of correspondents expressed their severe dissatisfaction with the diversity of courses that are provided in the educational institutes they enrolled at. 33.0% of correspondents were moderately dissatisfied with this option while 22.0% were neutral in their assessment. Only 2.0% of the correspondents expressed their very satisfaction, and 14.0% of the respondents were moderately satisfied. However, 1.0% declined to express their views in regard to this matter (see Figure 3-6).

IX. Quality of Texts and Reading

Under this category of problems, the study showed that only 28.0% of correspondents expressed their severe dissatisfaction with the quality of text books and other reading materials provided in the educational institutes they enrolled at. 24.0% of correspondents were moderately dissatisfied with this option while 23.0% were neutral in their assessment. Only 2.0% of the correspondents expressed their very satisfaction, and 20.0% of the respondents were moderately satisfied. However, 2.0% declined to express their views in regard to this matter (see Figure 3-6).

X. Quality of Teaching

Under this category of problems, the study showed that only 43.0% of correspondents expressed their severe dissatisfaction with the quality teaching provided in the educational institutes they enrolled at. 19.0% of correspondents were moderately dissatisfied with this option while 20.0% were neutral in their assessment. 12.0% of the correspondents expressed their very satisfaction, while 12.0% of the respondents were moderately satisfied (see Figure 3-6).

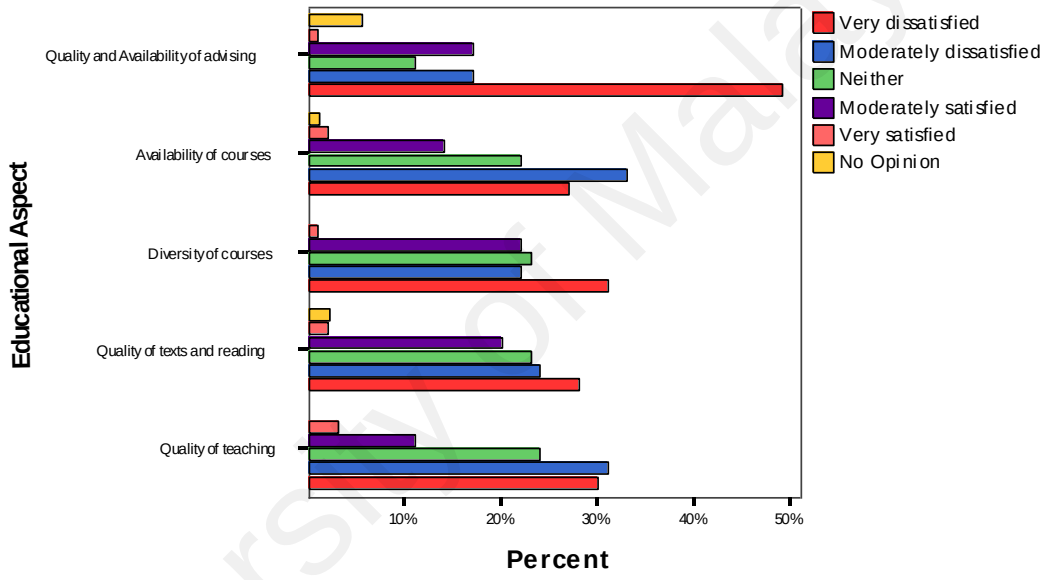

Figure 3-6: : Educational Aspects Satisfaction (b)

3.5.1.6 How software professionals improve their software development skills

As a result of the high rate of professionals' dissatisfaction with the quality of software development skills they taught in educational institutes, these professional rely on their own way for training. Based of respondent's replies, the result of this question shows that 72% percent of respondents rely on self efforts (see Figure 3-7). Such a high rate of improper training strategies has to be rectified I order to improve the quality of Libyan software industry. Planned training as well as revising software related curricula have to be of a high priority in shaping up successful local software industry.

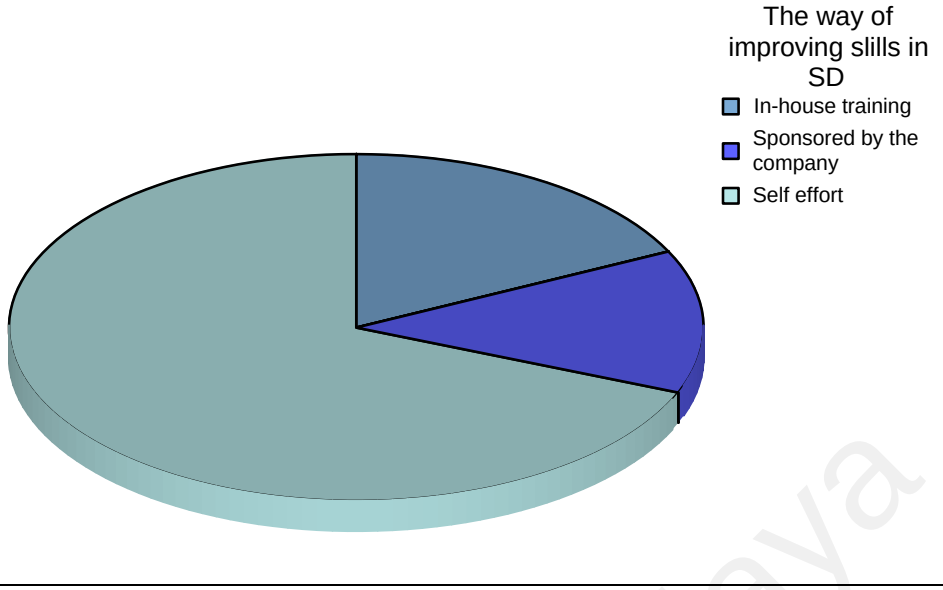

Figure 3-7:The way of improving Skills in SD

3.5.1.7 Professional's Preference of Individual or Team Based Working

Software development process is largely team-based process. However, personal attitude of certain IT professionals sometimes lead to the tendency that, the individual working become the preference. The individuality of the software development process has to be overcome because it contributes to less learning cycles among software development teams. Current software development models such as Extreme Programming promotes team working because the quality of software products can be enhanced through team based software development process. Unfortunately, as shown in Figure 3-8, the survey result showed that 87.78% of respondents prefer individual software development. Only 12.22% who prefer team based working.

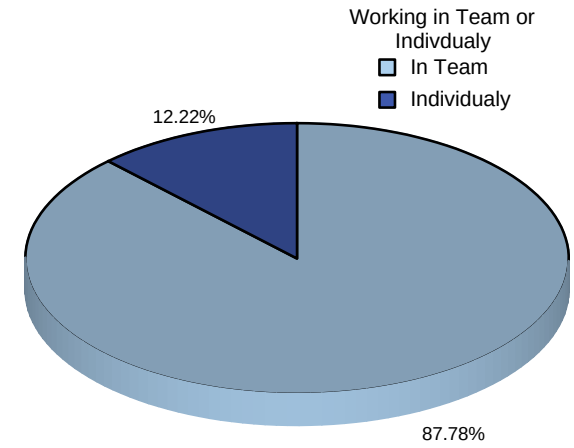

Figure 3-8: Working in team or individually preferring

3.5.1.8 English Proficiency

English has become the world lingua franca and English language proficiency is regarded as one of the winning factors of emerging software developing countries. As mentioned in chapter 2, in this regard India has an edge over other software developing counties such as China and Brazil. Unlike India, Libya has a very short and limited British colonial heritage. This is one of the reasons that English is not widely spoken in Libya. Nonetheless, until the late 1980's, English was the language of instruction in the university level.

As shown in Figure 3-9, the survey results indicated that all respondents having average score in all English language skills (i.e. listening, reading, writing, and speaking). Percentages of those who have mastery level skills (very good) are very few. This group must have self improved their English skills. These negative indications can be attributed to historical and national circumstances. Nationalization of the education system in the late 1980's has contributed largely to the low level of Libyan graduates in general. The government has recently introduced English courses as early as grade 3, and university lecturers have given the choice to use English. These new legislations are likely to raise the level of English proficiency to adequate level.

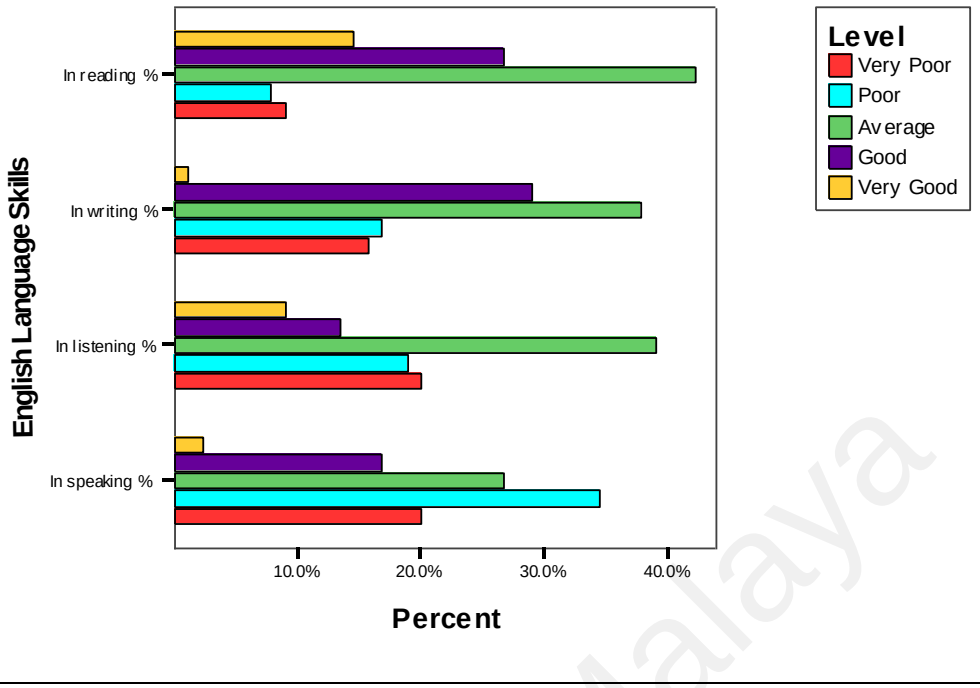

Figure 3-9: English skills level

3.5.1.9 Software Professionals' Job Category

The software development process involves different tasks that span all phases of the software development life cycle. Unlike the old days of software development where one person does all these tasks, the complexity of recent software applications and utilities necessities team based software development where different tasks are accomplished by different professionals of different competencies. Based on the survey result shown in Figure 3-10, the majority of respondents regarded themselves as programmers, while the percentage of other software roles (systems analyst, database administrator, IT manager, consultant, and network administrator) scored very low. The justification for these figures can be attributed to the current lack of teamwork in the target companies. In fact, the size of these companies is not as big as they would be involved in big IT projects where teamwork is a must.

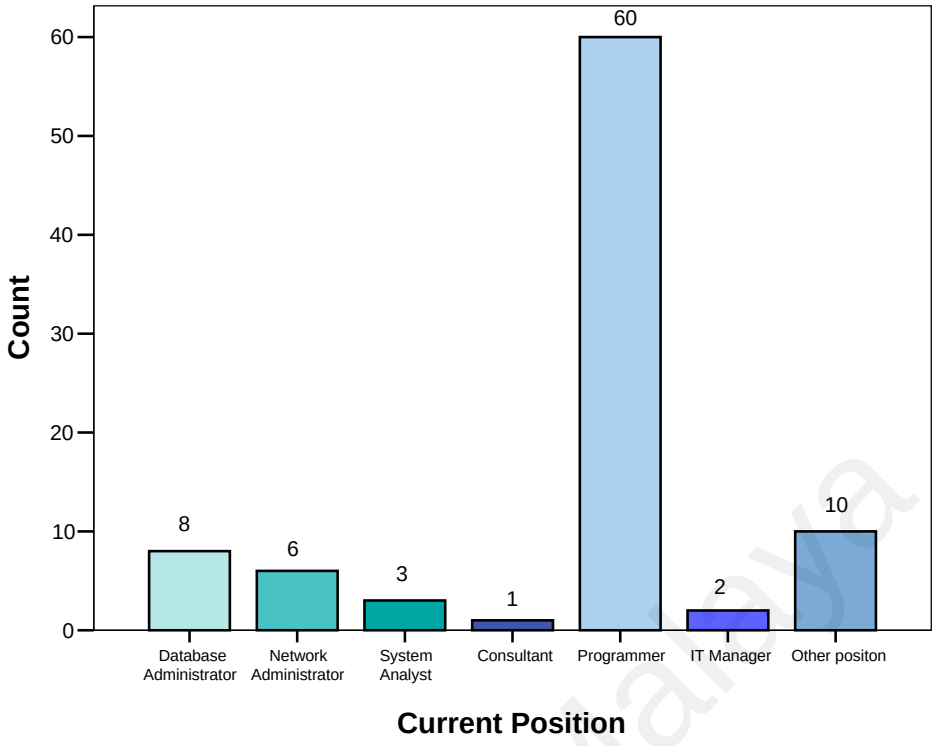

Figure 3-10: Respondents' distribution among work position

3.5.1.10 Professionals' Income Rate

Software development is generally highly paid profession, but generally speaking the income of Libyan workforce especially governmental post, is relatively low. Though this is a negative indicator for software professionals but in the same time it can be regarded as a positive feature for investors. As shown in the Figure 3-11, 73.33% of the Libyan software workforce earns less than LD6000 (US$1≈LD1.30). Based on the average income (LD2000-3000) of the wages in Libya, the majority of software professionals earn reasonably well. 25.56% of the correspondents earn an income of the range 6000-12000, while 1.11% of the correspondents earn an income of the range 12000-15000.

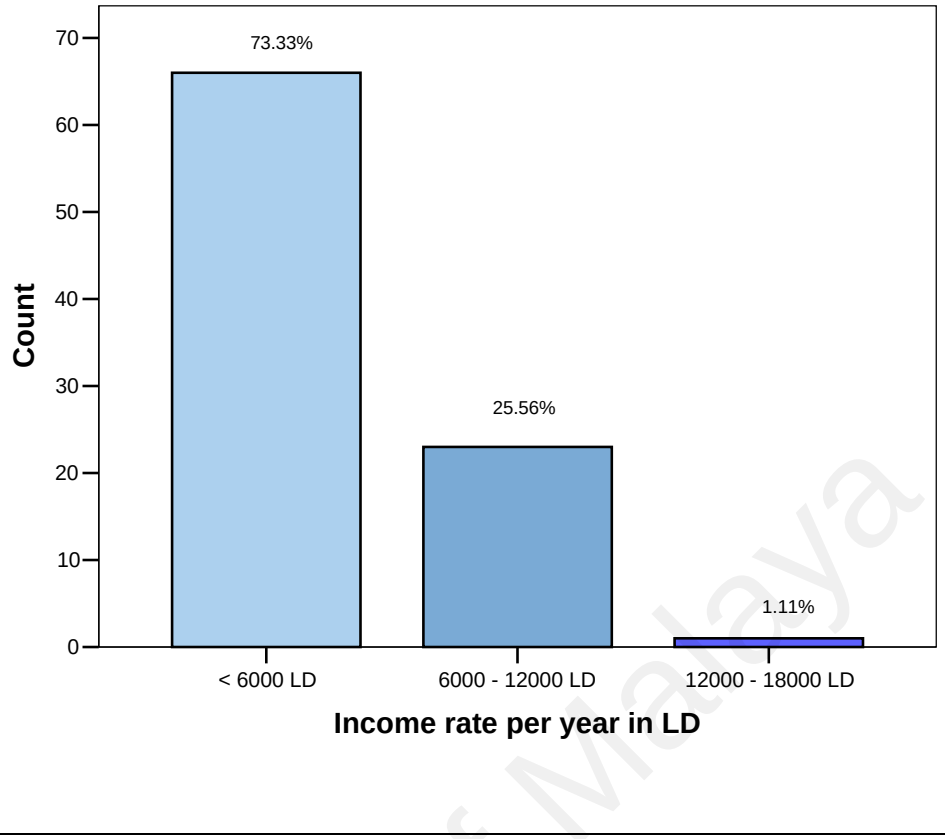

Figure 3-11: Income rate per year in LD

3.5.1.11 Correspondents' Used Programming Languages

This question was proposed to investigate to what extent Libyan software workforce is equipped with software competencies. As shown in Figure 3-12, the study showed that 53% of respondents use Delphi. Visual Basic ranked the second widely practiced programming tool, 51% of the respondents claim to use VB. 45% of correspondents rely on using C programming as their preferred programming language. 37% of correspondents rely on using C++ while, 20% of correspondents rely on using Visual C. 16.0% of correspondents rely on using Java while, 7% of correspondents rely on using COBOL. 19.0% of correspondents rely on using other programming languages not mentioned in the questionnaire.

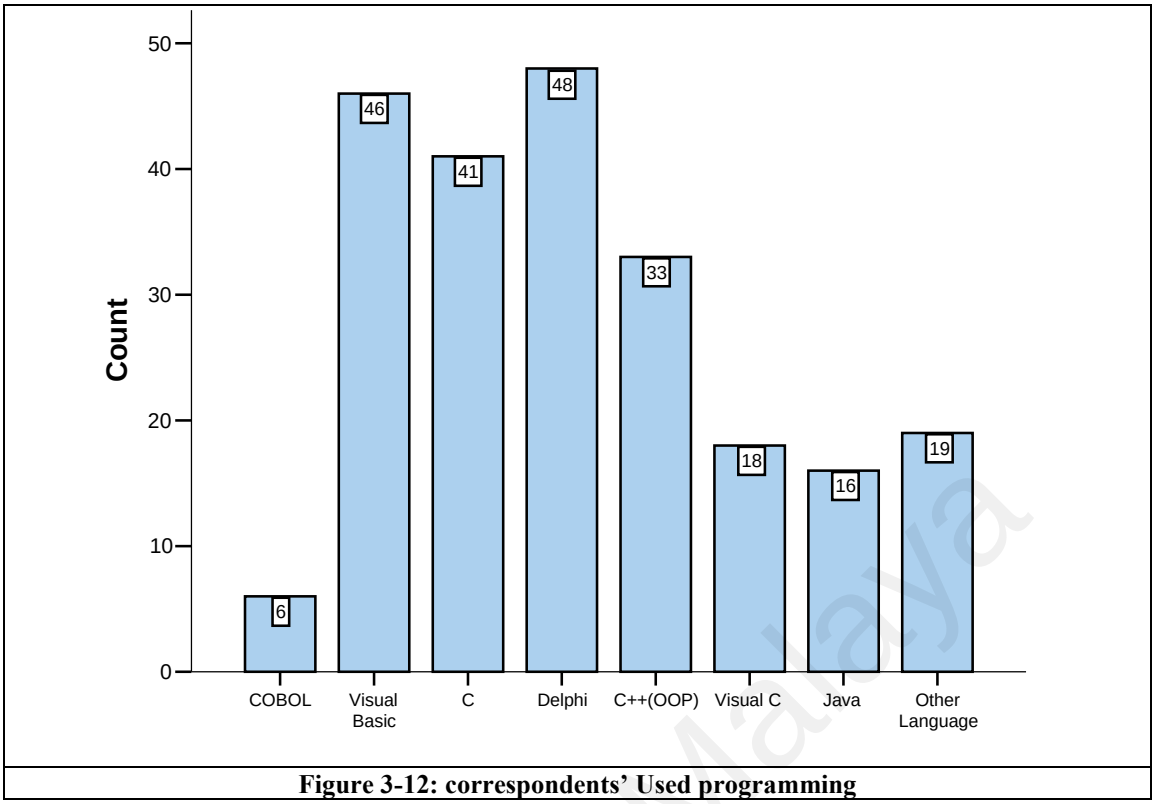

Figure 3-12: correspondents' Used programming

3.5.2 Companies Part

Managing the production of software development should not be carried out in ad hoc bases. The aim of this questionnaire is investigating the current situation of Libyan software companies and the quality of current software development practices in those companies.

3.5.2.1 Type of Company

In Libya, all business organizations use to be state owned. Private business has only been permitted since the late 1980's. Since then, the state gave it is full support to partnership companies as part of the philosophy of Libyan version of democracy. As a result the survey showed greater percentage of partnership organizations compared to single-owner IT organizations.

As shown in Figure 3-13, 76.67% of Libyan IT organizations are partnership owned compared to 23.33% single owned ones.

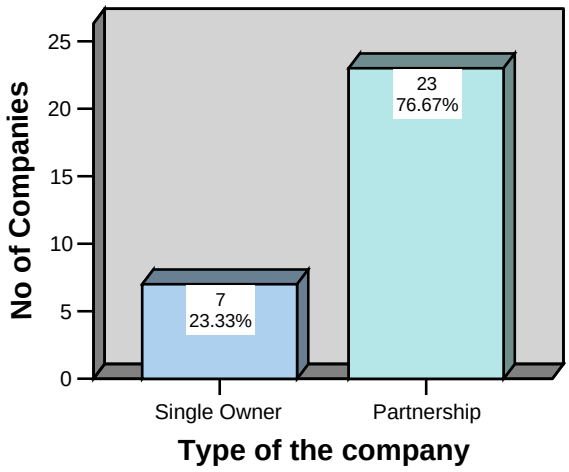

Figure 3-13: Income rate per year in LD

3.5.2.2 Establishing Date

As mentioned in the above question, in Libya, private business has only been permitted since the late 1980's. As a result, the survey showed that only 13.33% of IT organizations were established before 1990 (see figure 3-14). The years 1990-1994 represented the peak of newly established IT organizations. This can be justified by the fact that the market demand for IT products were very huge as a result of the rising of private sector business that need IT products to manage their business. Since the year 1995, the rate of establishing more IT organizations dropped sharply. 26.67% of the existing IT organizations were established in the period 1995-1999, while 20% of the surveyed organizations were established after 2000.

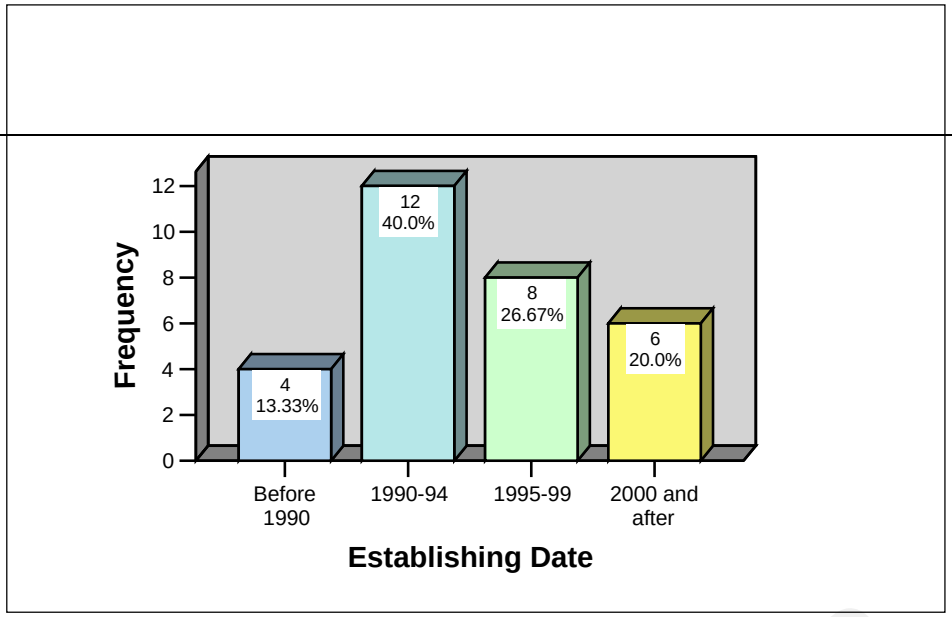

Figure 3-14: Companies Establishing Date

3.5.2.3 Size of Companies

Though the size of companies is not necessarily a good indicator for prosperous national software industry, but it does marginally indicate how far national IT companies are capable of involving in huge investment in software industry. In the Libyan case, as shown in Figure 3-15, the study showed that the size of Libyan IT companies is considered small, and no change in the size of the workforce since these IT companies first [illegible] in softw

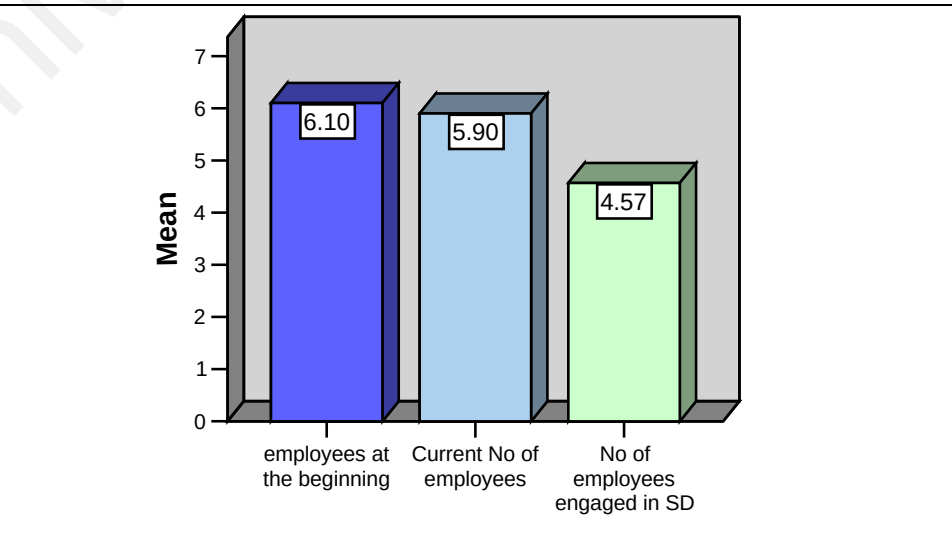

Figure 3-15: Companies size (Employment)

3.5.2.4 Taskforce Qualifications

As part of the formula of success for software industry, IT professionals must have the proper training to the mission. The national education system is expected to provide the qualified outputs in all disciplines including IT. The education system in Libya caters for qualifying IT professionals in all levels of education such as diploma, Bachelor, higher diploma and to less extent Master's degree. The ministry of higher education is also contributing to qualify IT professionals abroad especially on the postgraduate level. In regard to the range of qualifications of the existing IT professionals, the survey in Figure 3-16 showed that the 50.36% of Libyan IT professional posses Bachelor degree in IT related subjects, while 33.58% of them possess high diploma in computer science. 7.3% of the respondents possess diploma in computer related subjects while, in the postgraduate level, only 8.78% are holding Master's degree or higher in computer science.

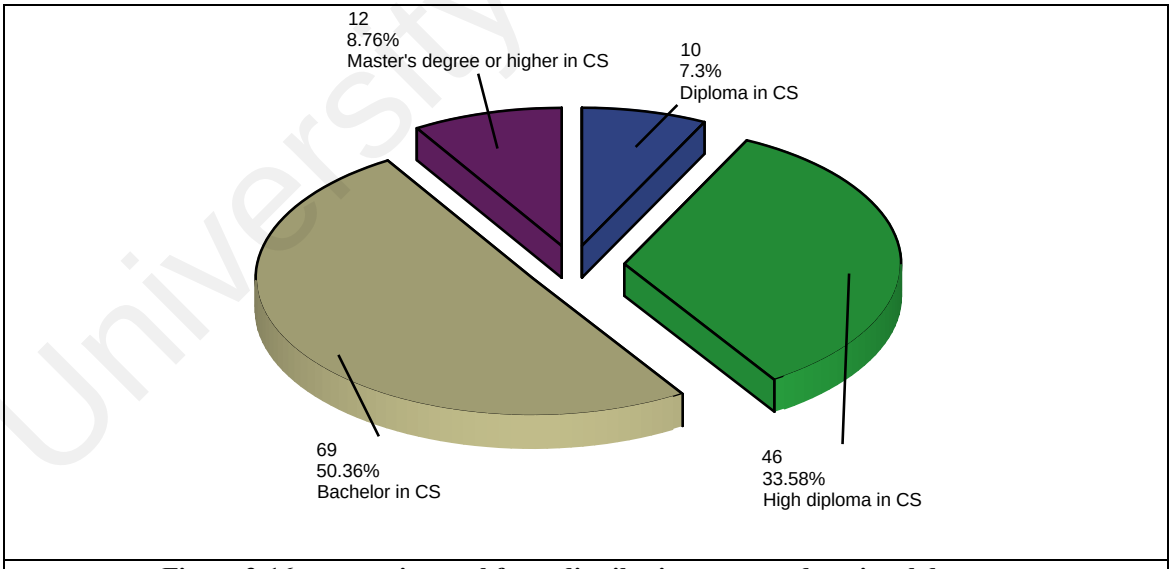

Figure 3-16: companies workforce distribution among educational degrees

3.5.2.5 Statistics of Overseas Personnel

The study was also aimed at investigating the statistics of overseas personnel among the workforce of Libyan software companies. The rationale behind this question is that staff

outsourcing has been regarded as one of strategies to promote local software industry. Low- wage countries where the population of skilful software experts is beyond national demand, this could be a target for prosperous software countries. Unfortunately, none of the corresponded companies has recruited overseas staff. The most relevant justification for this result is that Libya is not very attractive yet in regard to staff income. Perhaps the strict immigration rules and regulations also contribute to this result as well.

3.5.2.6 Software Development Revenue and Time Spent' Percentage

Staff of software development companies does not spend their working hours solely in developing software. There are many other activities that the staff found themselves doing such as hardware sales, consultations, and services and training. Companies need to coordinate the allocation of time spent doing any of these tasks because the revenue received out of carrying each task vary a lot. From the time allocations viewpoint and as shown in Figure 3-17 the study showed that 47.08% of daily working hours is spent in software development. On the other hand, 25.04% of the time is allocated for hardware sales, while 27.88% of staff time is spent on services and training. It is very understandable, that the higher percentage of staff daily working hours is spent in software development. This is justified by the fact that the Libyan IT market is still of a high demand because the adoption of IT products begin late.

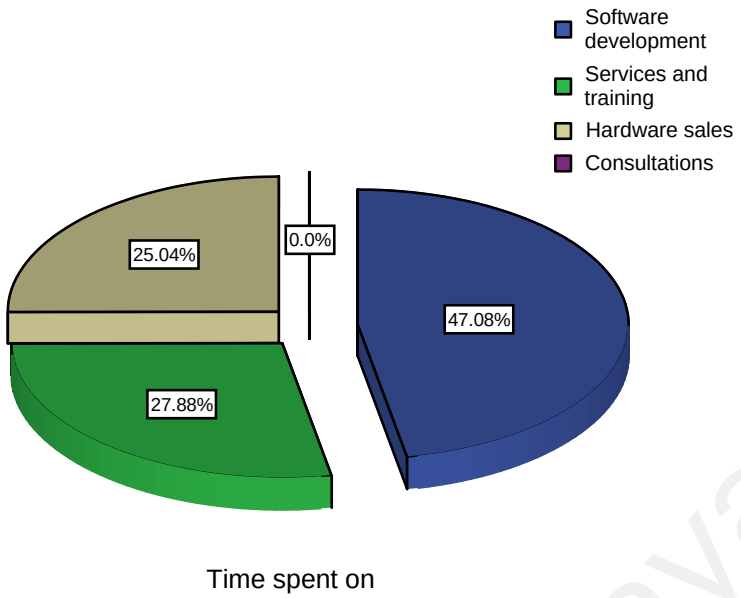

Figure 3-17 companies Time spent on comparison

From the viewpoint of the sources of revenue, the study showed that the bigger source of revenue is hardware sales which mounted for 41.17% of the total revenue (see Figure3-18). Surprisingly enough that the revenue out of the software development does not reflect the longer time the staff spent in software development. It only caters for 25.33% of the total revenue. Meanwhile, 27.88% of total revenue is generated from the product services and training.

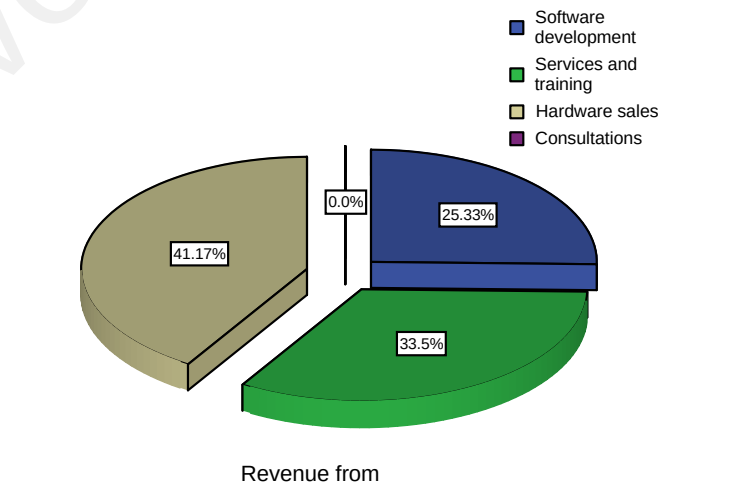

Figure 3-18: Companies Revenue from comparison

3.5.2.7 Distribution of Companies' Workforce among Positions

This question was asked to investigate the types of managerial and technical posts as described in respective companies. As shown in Figure 3-19, the study showed that 70.07% of workforce is categorized as programmers which were the highest job category. The position of database administrator ranked the second of 9.49% of the companies workforce. 6.57% of the respondents were categorized as network administrators, while 4.38% of workforce was categorized as data entry operators. Among the job positions investigated are systems analysts which cater for 3.65% of the workforce posts. Only 1.46% of the workforce categorized as IT managers, while surprisingly, none of the correspondents have the position of consultant as part of their workforce. In the meantime, 3.38% of the investigated workforce defines other positions that were not mentioned in the questionnaire.

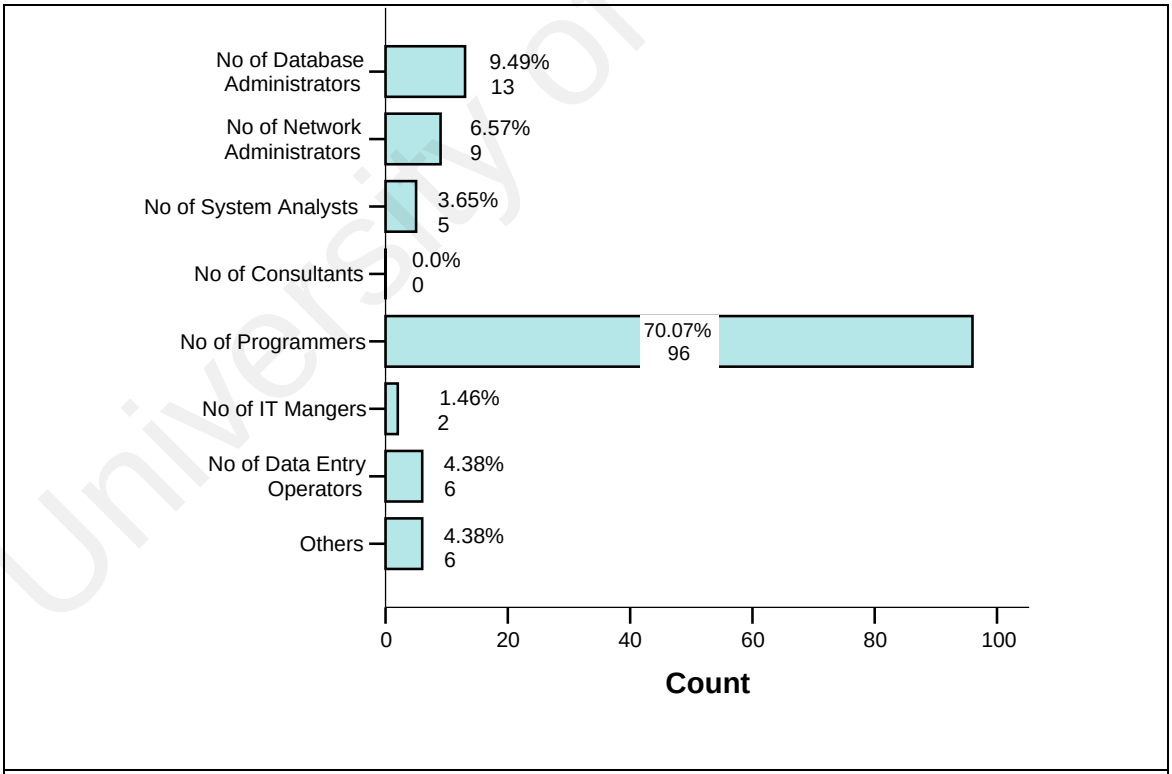

Figure 3-19: distribution of companies' workforce among Position

3.5.2.8 Software Market Sectors

Local market is still very small and because Libyan private sector is still forming, the study showed in figure 3-20 that public sector constitutes a great market share for software developed in Libya. 83% of the software developed for public sector clients, while 30% of clients were small & medium enterprises. The study also showed that the large local corporate clients contributed to 93% of the software marketed.

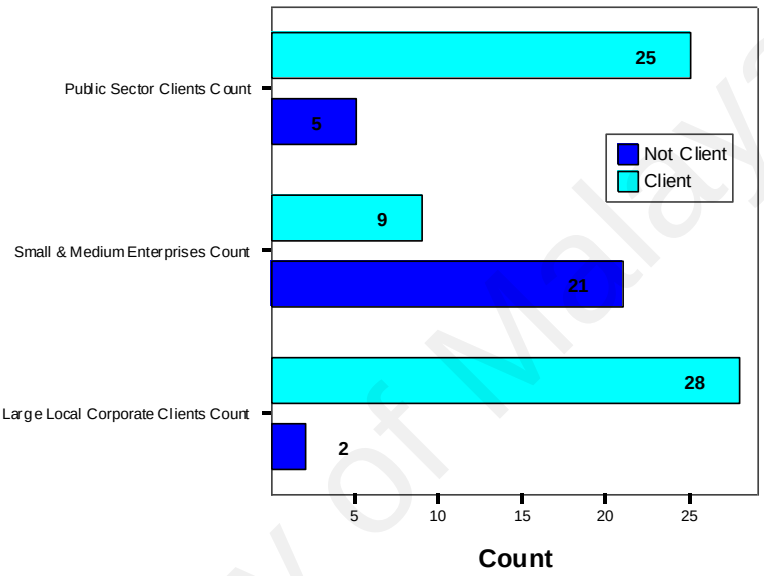

Figure 3-20:Software market sectors

3.5.2.9 Problems Faced by Software Companies

This question was proposed to identify any potential problems faced by local software companies. Nine areas of problems were identified and the correspondents were asked to identify applicable problems. Correspondents can give how sever is the problem by ranking them in a scale of 1 to 5 (5 is the highest). As shown in Figures 3-21, 3-22,

I. Manpower Shortage/Skills

Under this category of problems, the study shown that 3.3% of correspondents regard themselves as having little shortage (i.e. degree 2 in 1-5 scale) in manpower. 26.7% of correspondents regard their manpower shortage as remarkable which is equivalent to degree 3 in 1-5 scale. 50.0% of correspondents regard their manpower

shortage as sever which is equivalent to degree 4 in 1-5 scale. 20.0% of correspondents regard their manpower shortage as critical which is equivalent to degree 5 in 1-5 scale.

II. Physical Infrastructure

Under this category of problems, the study shown that 23.3% of correspondents regard themselves as having little problems in their physical infrastructure (i.e. degree 2 in 1-5 scale). 50.0% of correspondents regard problems in their physical infrastructure as remarkable which is equivalent to degree 3 in 1-5 scale. 13.3% of correspondents regard problems in their physical infrastructure as sever which is equivalent to degree 4 in 1-5 scale. 13.3% of correspondents regard problems in their physical infrastructure as critical which is equivalent to degree 5 in 1-5 scale.

III. Communication Infrastructure

Under this category of problems, the study shown that 3.3% of correspondents regard themselves as having little problems in their communication infrastructure (i.e. degree 2 in 1-5 scale). 6.7% of correspondents regard problems in their communication infrastructure as remarkable which is equivalent to degree 3 in 1-5 scale. 60.0% of correspondents regard problems in their communication infrastructure as sever which is equivalent to degree 4 in 1-5 scale. 30.0% of correspondents regard problems in their physical infrastructure as critical which is equivalent to degree 5 in 1-5 scale.

IV. Quality Certification

Under this category of problems, the study shown that 6.7% of correspondents regard themselves as having little problems in their quality certification (i.e. degree 2 in 1-5 scale). 66.7% of correspondents regard problems in their quality certification as remarkable which is equivalent to degree 3 in 1-5 scale. 13.3% of correspondents regard problems in their quality certification as sever which is

equivalent to degree 4 in 1-5 scale. 13.3% of correspondents regard problems in their quality certification as critical which is equivalent to degree 5 in 1-5 scale.

V. Access to Capital

Under this category of problems, the study shown that 6.7% of correspondents regard themselves as having little problems in the access to capital (i.e. degree 2 in 1-5 scale). 43.3% of correspondents regard problems in the access to capital as remarkable which is equivalent to degree 3 in 1-5 scale. 26.7% of correspondents regarded having problems in the access to capital as sever which is equivalent to degree 4 in 1-5 scale. 23.3% of correspondents regarded having problems in the access to capital as critical which is equivalent to degree 5 in 1-5 scale.

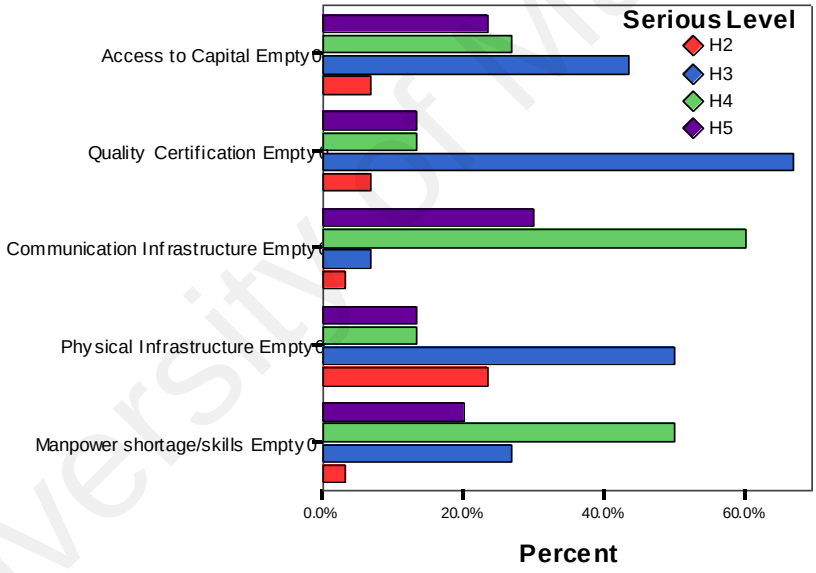

Figure 3-21 : problems faced by software companies (a)

VI. Intellectual Property Rights

Under this category of problems, the study shown that 6.7% of correspondents regard themselves as having little problems in protecting their intellectual rights (i.e. degree 2 in 1-5 scale). 40% of correspondents regard the problems they face in intellectual rights as remarkable which is equivalent to degree 3 in 1-5 scale. 43% of correspondents view the same problem as sever which is equivalent to degree 4 in 1-

5 scale. 10% of correspondents regard this problem as critical which is equivalent to degree 5 in 1-5 scale.

VII. General Public Committee Policies

Under this category of problems, the study shown that 10% of correspondents regard the IT national policies as causing problems to them (i.e. degree 3 in 1-5 scale). 30% of correspondents regard the problems caused by imposed national IT policies as serious which is equivalent to degree 4 in 1-5 scale. In the meantime, 60% of correspondents regard this problem as critical which is equivalent to degree 5 in 1-5 scale.

VIII. Domestic Market Access

Under this category of problems, the study shown that 10% of correspondents regard themselves as having little problems in getting access to domestic market (i.e. degree 2 in 1-5 scale). 40% of correspondents regard the problems they face in getting access to local market as remarkable which is equivalent to degree 3 in 1-5 scale. 33.3% of correspondents view the same problem as sever which is equivalent to degree 4 in 1-5 scale while, 16.7% of correspondents regard this problem as critical which is equivalent to degree 5 in 1-5 scale.

IX. Foreign Market Access

Under this category of problems, the study shown that 13% of correspondents regard themselves as having little problems in getting access to foreign markets (i.e. degree 2 in 1-5 scale). 56% of correspondents regard the problems they face in getting access to foreign markets as remarkable which is equivalent to degree 3 in 1-5 scale. 16% of correspondents view the same problem as sever which is equivalent to degree 4 in 1-5 scale while, 14% of correspondents regard this problem as critical which is equivalent to degree 5 in 1-5 scale.

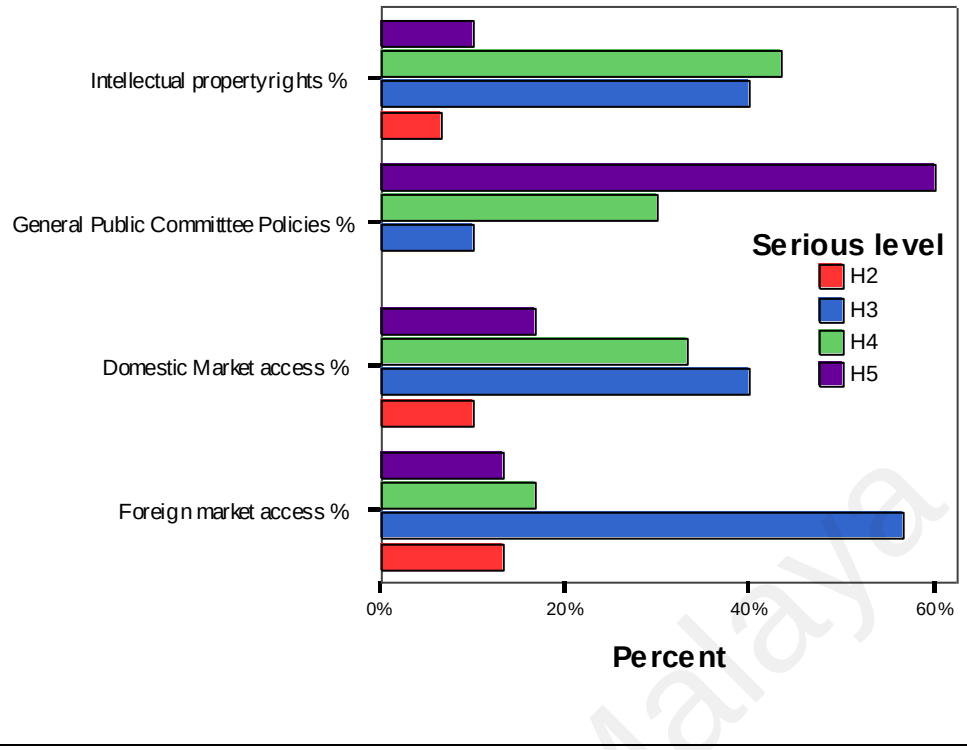

Figure 3-22 : problems faced by software companies (b)

3.5.2.10 Origination of IT Projects

This question was asked to investigate the role of IT companies in the diffusion of IT applications in Libyan market. In other words, the aim was to check whether the IT companies matured enough to open up opportunities for their IT products. As shown in Figure 3-23, the study showed that 94.67% of the IT projects were initiated by client organizations, while only 5.33% of software products were initiated by the software companies as commercial of the shelf products.

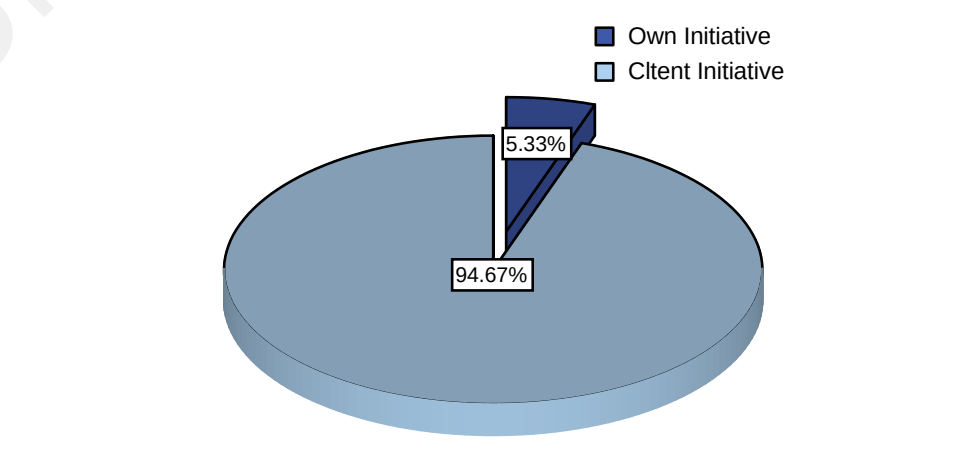

Figure 3-23 : Origination of IT projects

3.5.2.11 In-house vs. Outsourced Software

This question was asked to investigate whether Libyan software organizations are matured enough to rely on outsourced components of IT applications they develop, or they 100% crafted such IT products. As shown in Figure3-24, the study showed that 82.67% of the software products is fully in-house developed, while only 17.33% of these products were either fully or partially outsourced. Even though, the percentage of outsourced software is quite low, but for the case of newly emerged Libyan software experience, this is can be regarded as a positive indicator. This figure does show that some of these organizations are aware of benefits of outsourcing paradigm

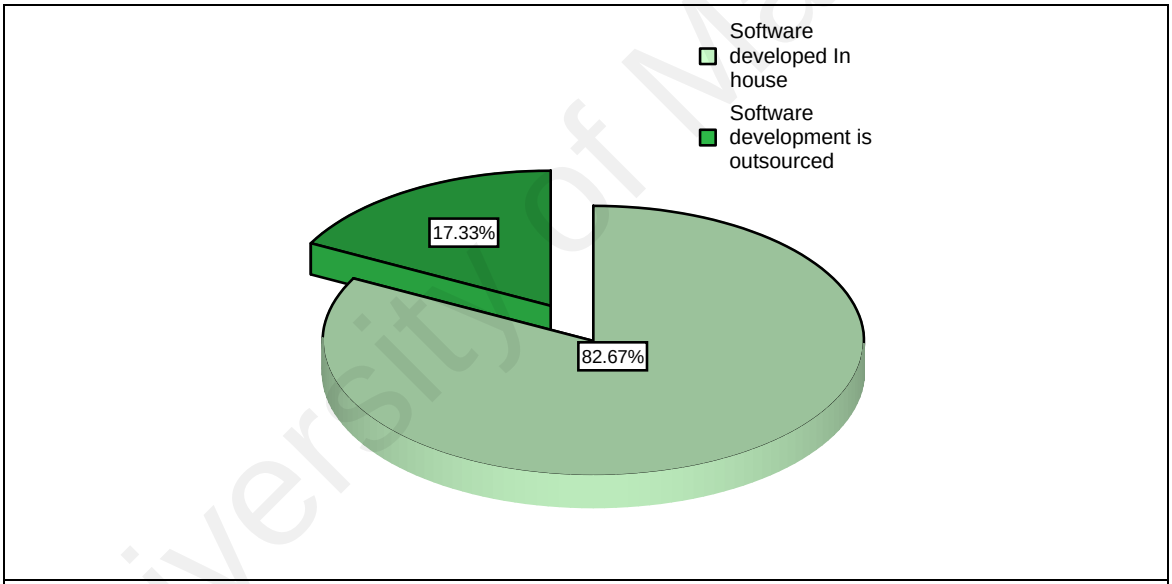

Figure 3-24: In-house, outsourced software comparison

3.5.2.12 Software Typology

This question was asked to investigate what types of software in terms of packaged, semi packaged or customized products. As shown in Figure 3-25, the study showed that all the companies marketed custom developed software based on clients' requirements. Companies marketed semi packaged software number is estimated to 17% of the total companies. Meanwhile, none of the companies had the experience to market packaged

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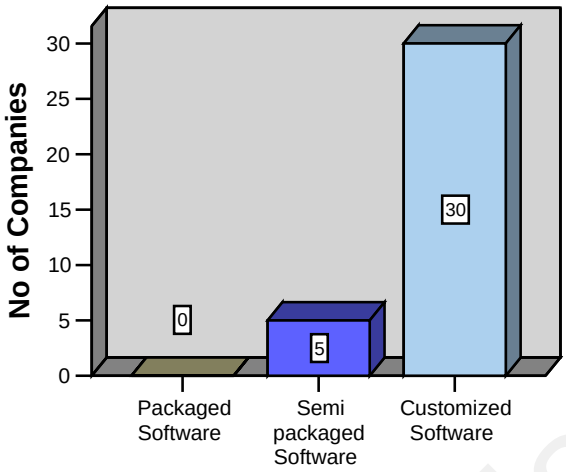

Figure 3-25: Software typology

3.5.2.13 Category of Developed Software

Currently, IT products span large area of applications such as education, management, marketing, ERP, etc. It is no longer restricted to limited application domains. This question was aimed to investigate the application areas of IT projects in Libya. As shown in Figure 3-26, our research showed that the majority of respective companies engaged in developing traditional applications such as payroll, inventory and sales. The payroll system has recorded the highest percentage of software products developed by respective companies. All the corresponding companies engaged in developing this type of software. 96% of the companies are involved in developing personnel and administration. In regard to the inventory software, 93% of respective companies claimed to market this category of software while, 90% of the companies are building software oriented for the sales sector. 47% of Libyan software companies construct software categorized as accounting systems while the same percentage of companies builds financial management software. However, other application areas recorded very low percentages of the software developed by respective companies. For example, 16%

of respective companies builds marketing software while, only 10% of the respondents construct software for manufacturing and engineering sector. This poor figure can be justified by very few customers involved in such a business domain. ERP is also undiscovered application in Libya, and the statistics showed none of the Libyan software companies have ever engaged in developing this type of software.

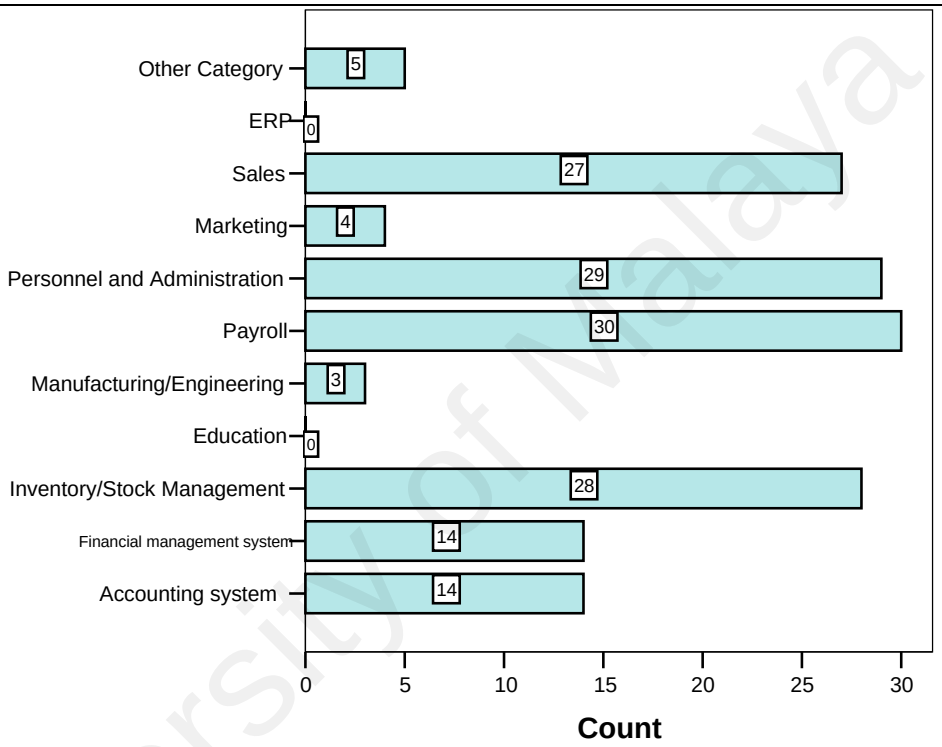

Figure 3-26: Category of developed software

3.5.2.14 Software Development Models Adopted

Following defined software process models is one of parameters that indicate producing good quality software. This question was asked to investigate whether following defined software process models is a common practice among Libyan software companies. However, as shown in Figure 3-27, the study showed that ad hoc development is the common practice in these companies. 80% of correspondents replied as they do not follow any defined process model, which means that build-and- fix methodology is

widespread among correspondent companies. Only 13.33% of the companies follow the water fall model, while 6.67% claim to follow rapid prototype model.

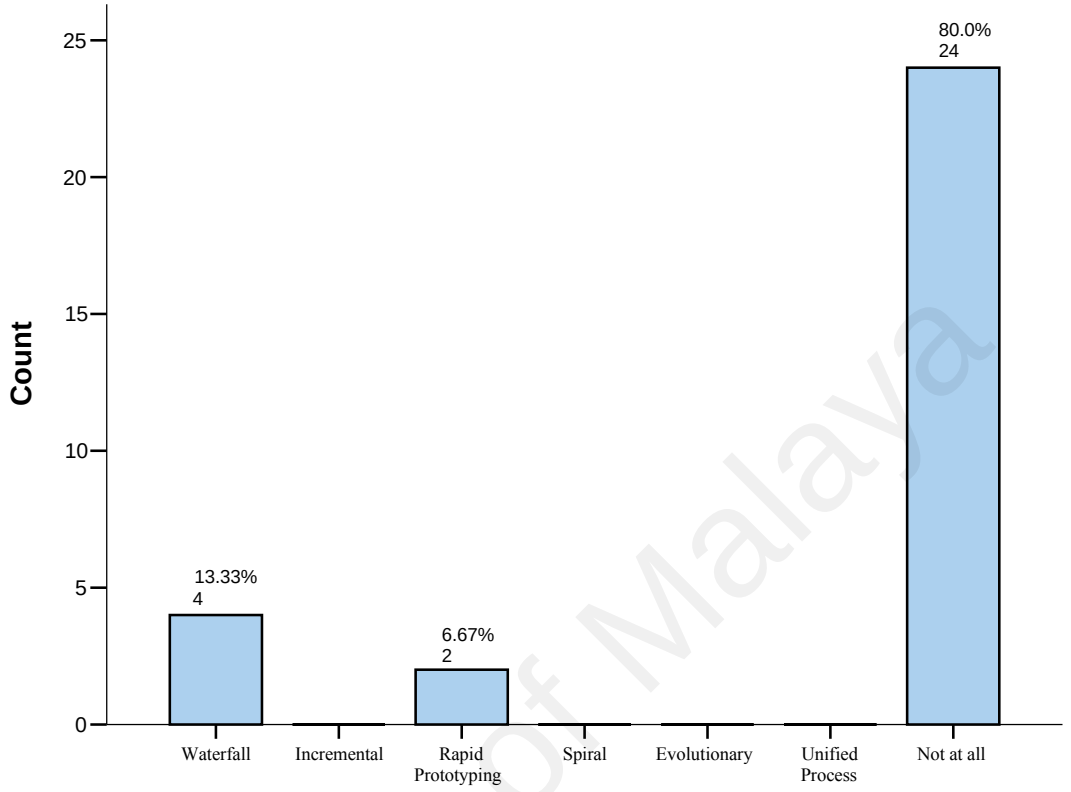

Figure 3-27: Adoption of software process models

3.5.2.15 Software Documentations

One of the major problems of software crisis is the lack of proper software documentations. The success in software maintenance relies heavily on the adequate level of documentation that any software product has. As shown in Figure 3-28, the study showed that no proper attention is paid to software documentation. 63.33% of correspondents replied as they do not have formal documentation procedures, while only 36.67% of respective companies who claim to perform proper documentations for the software they develop.

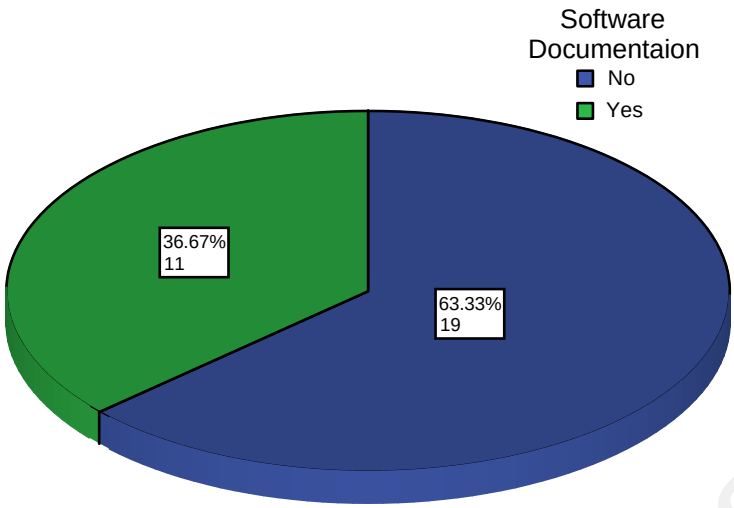

Figure 3-28: Software documentations

Those who answered yes, when they were asked what type of software documentations they provide, 81.82% of the correspondents said they only provide user manuals (see Figure 3-29). In the meantime, only 9.09% of companies make the operational manuals, while 9.09% companies claim to provide the two types of manuals.

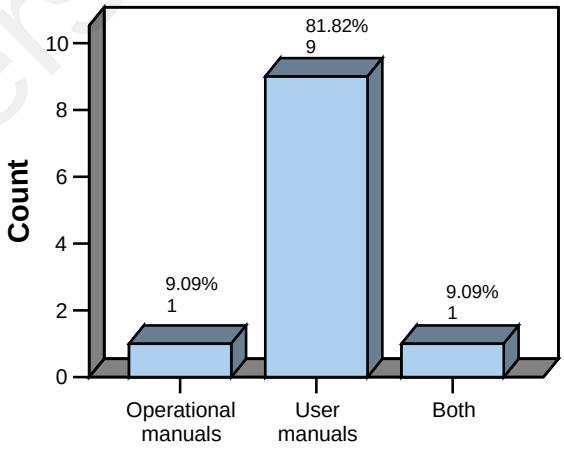

Figure 3-29: Documentation types

3.5.2.16 Participation in Software Reuse Campaign

Software reuse campaign is initiated as a result of the call for increasing software productivity and producing quality assured software. The principle of software reuse is to avoid developing software from scratch each time. Certain software components are reused in subsequent software projects especially in the case of domain oriented software. Similar computational services are likely to be shared by various software products within an application area.

The study showed that software reuse is not a common practice in respective software companies. As shown in Figure 3-30, the study showed that 76.67% of correspondents replied as they do not reuse previously developed software components in subsequent projects. In other words, all the software products they developed scratch. Only, 23.33% of the correspondents claim to rely on reusable software components.

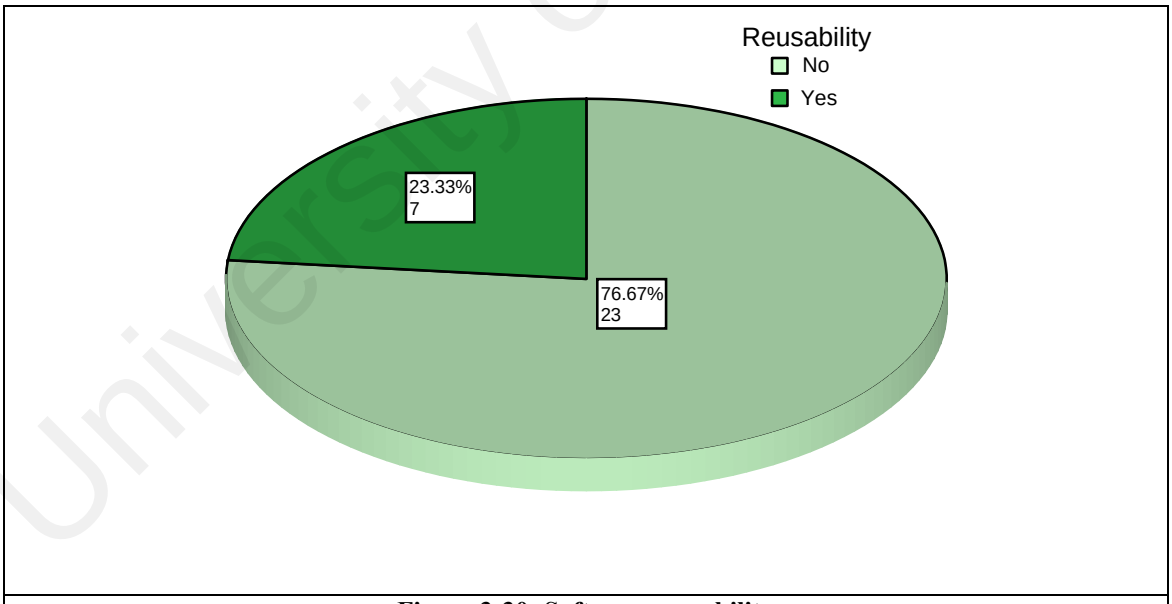

Figure 3-30: Software reusability

3.5.2.17 Services Provided after Implementing Software Products

Post implementation services are very important to promote clients interest and commitment to invest in IT. There are many types of services and technical support

offered to clients. As shown in Figure 3-31, the study showed positive indications to companies' commitment to after sale service. Only 6.6% of the correspondents claimed to provide no after implementation services. However, the type of service provided vary among those who offer it. 93% of the correspondents claimed to provide training services, while 86% stated that they provide maintenance services. 14% of the correspondents asserted to offer upgrade services.

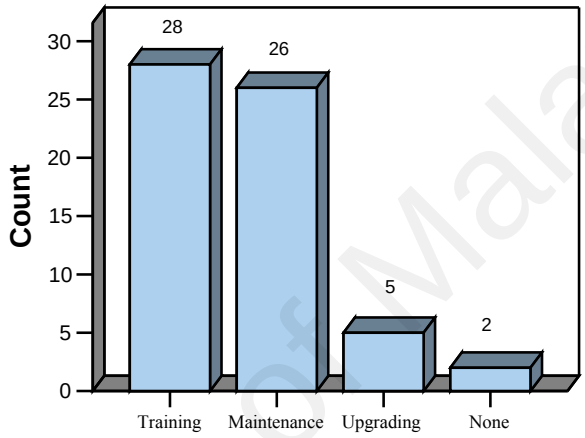

Figure 3-31: Services provided after implementing software products

3.5.2.18 Programming Languages and Software Developing Tools

Software development is skill based profession, and the software development teams must have the workforce that master many software competencies. This question was proposed to investigate to what extent Libyan software workforce is equipped with software competencies. The list of competencies is not exhaustive, but we nominated the most widely practiced software tools in the form of programming languages. As shown in Figure 3-32, the study showed that the most widely practiced programming tool is Delphi. It comprised 80% of the programming tools used in respective companies. C programming ranked the second widely practiced competency among these companies, and it comprised 73.3% of the study sample.60% of correspondents relied as Visual Basic is their preference. C++ programming comprised 46.6% of

languages used by the sample, while Visual C makes up 37% of the practiced programming tools.

Java which being the most widely programming languages has only formed 20% of the competences practiced by respective companies. COBOL programming still have a foot in Libyan software, it comprised 13% of the software competencies practiced by respective companies. Apart from the list programming languages given to correspondents, 60% of correspondents rely on using other programming languages.

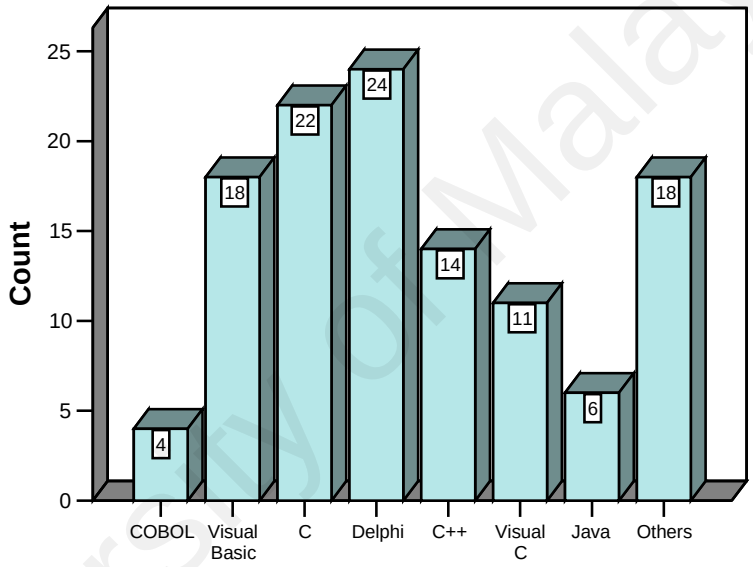

Figure 3-32: Used Programming languages

3.6 Conclusion

The goal of this chapter is to study the current state of the Libyan software industry and to understand its characteristics, current problems and the challenges it has to meet. Issues investigated are related to different factors such as national policies, educational training, and software market trends. Recommendations for overcoming these problems are offered when applicable.

Two surveys were conducted; first survey was targeting companies engaging in software development in Libya, the other survey was targeting software professionals in

Libya too. Based on the analysis of the both surveys data, many concluding remarks can be drawn. We classified these concluding remarks based on surveys into two parts: the companys' part and the workforce part as highlighted in the sections below.

3.6.1 Companies' Part

The study showed that the age of Libyan software companies is considerably young compared to other emerging software countries. It began after the emergence of the national strategy in regard to the transfer from national ownership to private business ownership. This policy introduced in the late 1980's. Due to this short experience, ad hoc process is a common practice and companies do not follow formal managerial or technical models. The study also showed that the all developed software is locally marketed. The survey also showed that no international workforce is recruited in local companies. This can be attributed to less attractive payments expected. The study also showed that national companies face many problems such as the lack of quality certification and communication infrastructure. In addition, the country still lacks a formal national IT policy, the frequent changes in these policies is very common.

In regard to the typology of nationally produced software, traditional applications such payroll and inventory management are dominant. While, high-tech and innovative software applications such ERP are less known in Libyan market. The study has also showed the majority of produced software is ordered one, and these companies offer very little semi packaged products while, no packaged (off the shelf) software is produced locally. Though the recent hype in software outsourcing, but in-house development is the common practice in Libyan companies, they only utilise very few outsourced components. This same thing is applicable to the issue of software reusability where local software is largely built from scratch.

3.6.2 Workforce Part

The quality of workforce available has a major influence on the success of any software development initiative. From the gender viewpoint, it was very noticeable remark that the majority of Libya IT workforce is male. It seems that the strong governmental support in regard to encouraging female to enterprise in all sorts of business is still less functioning. Perhaps social factors still have a big influence in this regard. The study has also showed that the highest percentage of software professional's age lies in the range of 26-30 years. This figure indicates that Libyan IT experts are scarce but the figure is very promising for prosperous industry. From the training viewpoint, the study witnessed adequate level of satisfaction in regard to the quality of courses and training available in universities and other educational institutes. But, the correspondents are less satisfied with many aspects such as financial income, attractiveness of national IT policy, English training, computing facilities provided at educational institutions. Such less practical training made the majority of local workforce depend on self training as the study indicated.

The study figures indicated that training is a major obstacle especially in regard to having quality workforce. To cater for this very important issue, the training has to go beyond what usually provided in educational institutes. In fact, the continuous change in technology available especially software industry, this make software related workforce under continuous pressure to learn newly emerged technologies. For this reason, we believe software assessment tools are needed for both companies as workforce. It is good for companies to gauge the capabilities of their workforce, as well as it is good for the workforce to upgrade their knowledge continuously. For this purpose we proposed a prototypical software called OSAT. Different aspects of OSAT are explained in the following chapter.

4 OSAT Tool Development

4.1 Introduction

In order to help organizations to assess their employees' skills, we decide to develop a web-based competency assessment tool. Online Skills Assessment Tool (OSAT) is a comprehensive tool intended to assist any organization to define domain skills that it needs to examine its employees. OSAT provide the host organization a set of useful reports and statistics that gauge the level of competency of its workforce.

Assessing a skill is not used as a pass/fail exam, but rather as a mean to identify strengths and weaknesses and to put a required plan for improving organization performance.

This chapter describes the development of the assessing skill tool as a website to be used all over the world, so any global organization can use it to assess its employees skills.

The tool is called OSAT (Online Skill Assessment Tool) and it can be accessed using the domain name "http://www.osattool.com".

4.2 System Overview

OSAT is a web based interactive system, which is developed as online system to be used by three types of users namely: guests, employees, or system administrators as shown in figure 4-1. Training centres can also use OSAT to publish useful courses related to the skills defined in the system.

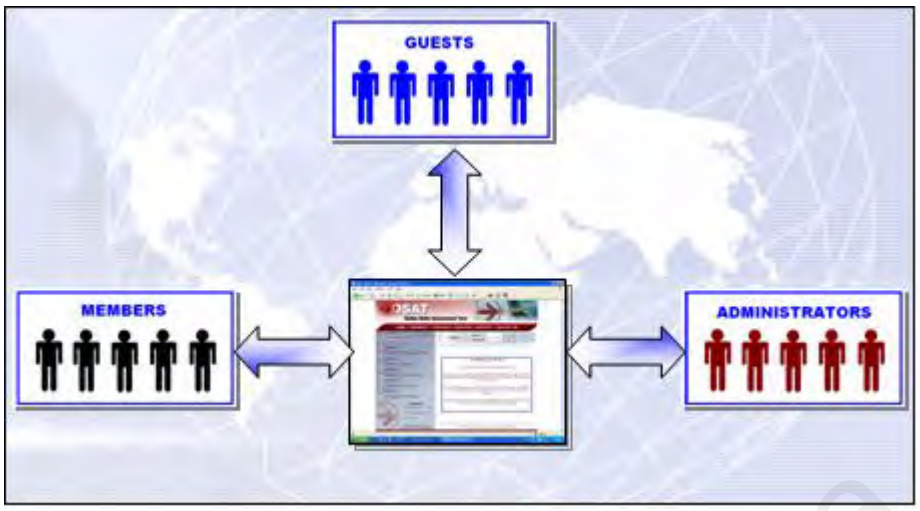

Figure 4-1: OSAT Overview

OSAT has general options that represent some services and information about the system. Guest users can use the system without any previous authentication information. However, guests are not permitted to store or modify any information during their surfing sessions. The system only permits members and system administrators to save or modify OSAT repository.

Members can login into the system using login information provided by a system administrator, so members have get more options such as browsing their results. System Administrators can do anything in the system, such as manage members, skills, questions, news, links, categories, and activate or terminate training centres access.

System administrators also get reports from the system about members and skills as well. These reports can be used by the organization to improve employees' performance by setting up staff training plan.

The system can track all actions taken by any system administrator so it would be easy to know who issue a particular process, as shown in OSAT overview Figure (4-1).

4.3 System Objectives

Assessing skills of an organization's employees is necessary for both the organization and the employees. It helps to clearly identify the efforts needed to enhance the

efficiency and the performance of the employees and to improve the organization's performance as a result.

Using OSAT allows the organization to decide a lot of things to do regarding employees skills, but the main objectives can be defined as following:

- Assessing employees' skills in the organization and get useful results about taskforce competency assessments.
- Allowing employees to evaluate their skills and encourage them to enhance themselves.
- Providing latest news and helpful links to OSAT users. This includes useful links to important announcements about new products and tools related to respective domains.
- Allowing training centres to offer domain related training courses.
- Providing regular courses inside the organization that can refresh the employees' skills and enhance the general knowledge of the employees.
- Enabling performing of assessments online any time from any where to help OSAT users assessing their skills easily and conveniently.
- Allowing system administrator to manage the system online from any place and in any time to enable globe sharing in the system by all organization's branches.
- And finally, OSAT provides some useful services to all users, such as searching the internet and browsing useful links regarding the skills used.

4.4 System Scope and Users:

As mentioned above, OSAT system can be used by three kinds of users, guests, members, and system administrators, so the scope of the system will be described in three areas, which are guest view, member view, and system administrator view.

4.4.1 Guest View

In guest view there are general options that can be used by all kinds of users includes subscribed members. These general options are:

- Home: used to return to the home page.
- For what: displays information about the aim of OSAT, which means why we should use the system.
- For Who: displays information about who should use the system.
- Service: display services page which contains services for OSAT users:
    1 – Training Centres: allows training centres to register, update, or display information about other training centres.
    2 – Courses: allows users to display a list of available courses categorized by their category to help finding needed course.
    3 – Search: displays a page that contains a means to search the internet using common search engines such as Google.
    4 Useful Link: displays useful links classified by their category.
- Support: displays a page that contains an inquiry form to send any inquiry to OSAT admin.
- Contact us: displays a page that contains contact information of the organization.
- Policy: display a page that contains the organization policy regarding using the system.
- How to use OSAT: displays a page that contains information about how to use the system.
- About: It is providing the user with information about the system such as system version, system owner...etc.

4.4.2 Member View

Members have to login into the system to access member options that can be used in addition to general options (guest area). Member options are:

- Member profile: used to update member profile.
- Assessing a skill: members can assess their skills using this option.
- Member Result: members can get their result using this option.
- Change Password: members can change their password using this option.

4.4.3 Administrator View

System administrators have their own view, which allow them to perform all tool administration tasks, these tasks are represented by the administrator option which includes:

- Members' files: administrators can create new members files, modify them, delete them, or terminate subscription of any member.
- Categories: administrators can add new, modify, delete, and display categories.
- Skill assessments: administrators can add, modify, delete, and display skills.
- Courses: this option allows administrators to add, modify, delete, and display courses.
- Useful links: this option allows administrators to add, modify, delete, and display links to other useful sites.
- Latest news: allows administrators to add, modify, delete, and display links.
- Training centres: administrators can use this option to activate, terminate a subscription, and display training centres.
- Reports: this option displays two other options:

- Member: used to retrieve members' results by defining important criteria.
- Skill: used to retrieve important information regarding skills.

4.5 System Development

As a development methodology, rapid prototyping model has been chosen for developing OSAT. Rapid prototyping has been chosen for the following reasons:

- Obtaining a deeper understanding of system requirements.
- Determining if certain functionality, performance, reliability, or adaptability can be achieved.
- To investigate the risk associated with a specific design.
- To serve as a vehicle for communicating a design within the developer and users.
- To serve as a learning tool for the developer.

4.5.1 Software Process Model

The Prototyping process begins like many lifecycles with requirements gathering. Meetings with the client, discussing and defining the overall objectives of the project, some will be known, others will need further discussion and more time to define. From this discussion a first-design of the project is produced, the first-design matches the requirements of the initial objectives. It focuses on look and feel and functionality of the initial requirements gathering. This quick first-design leads to the construction of a prototype. The prototype is evaluated by the client, and then given back to the developer whom in turn revises the prototype. This cycle continues until all goals and objectives are achieved. The aim of the Prototype model is to use an iterative path to create a system that will finally meet the full objectives of the user. The more iteration the

Prototyping Model has, the finer tuned the system. This initial first-design is usually thrown away and that the second or even third revision is usually more suited.

since our Online Skills Assessment Tool (OSAT) is a web-based application, we choose prototyping model as a development methodology to develop OSAT with one consideration in mind, that is, this tool is our own initiative application, so we have to play both roles; developer and client at the same time.

Rapid Prototyping is the process model we adopted in the development of OSAT. A software rapid prototype is a dynamic visual model providing a communication tool for customer and developer.

The prototype model usually consists of the following:

- Analyze the users' basic requirements.
- Repeat
    - Develop or revise the working prototype to include the requirements that are known at this stage.
    - Allow the user to use the prototype to suggest changes to the requirements. If there are no major changes, exit the loop.
    - Analyze the requested changes with the user.

The outcome is usually one of the following:

- The final prototype is used as part or all of the specifications for the formal development of the system.
- The final prototype is placed into usage.

Figure (4-2) illustrates the sequence and looping steps of prototyping model.

(Chang, 2006)

Because the rapid prototype has been validated through interaction with the client, the resulting specification will be correct. Therefore a major strength of this model is that the development process is essentially linear with little or no feedback loops.

In specification, planning and design, verification is needed. In implementation and integration, testing is needed. An essential aspect of a rapid prototype is in the word rapid.

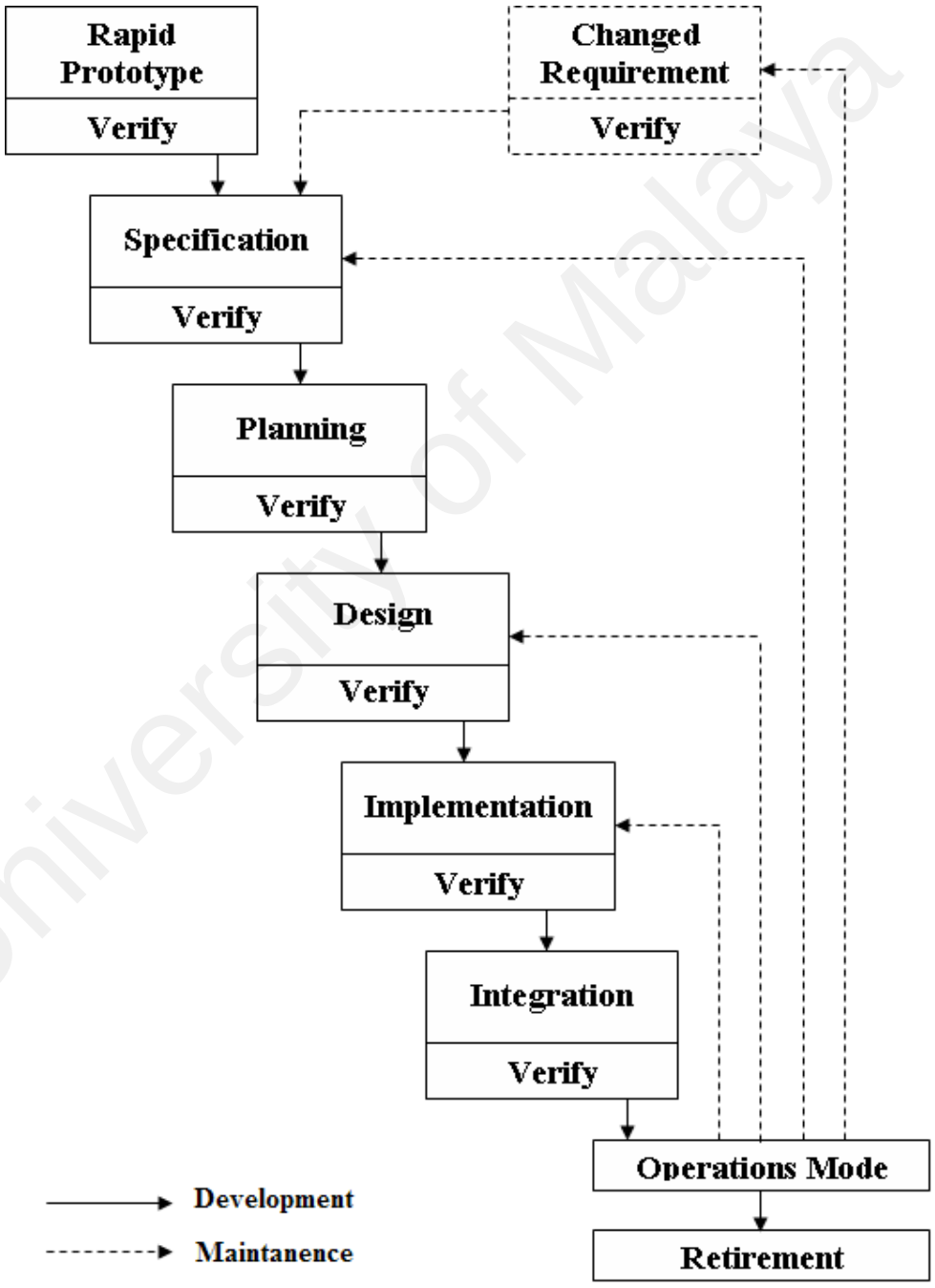

Figure 4-2 Rapid Prototyping Model

4.5.2 Platform and Programming Languages

As a development and programming environment, three types of tools namely Apache, PHP4 and MySQL were used in the development of OSAT. Apache, PHP4 and MySQL are open source technologies that allow you to create powerful and fast database-generated Web based applications. Apache is the most popular Web server. PHP has the unique distinction of being an open-source server-side scripting language that is easy to learn. MySQL is a fast, reliable, open-source database management system. This three open-source software has very respectable position among Web developers who aim to develop robust, database-generated Web applications (Greenspan and Bulger, 2002).

4.5.2.1 Downloading, Installing and Configuring Required Downloads

Since all environment components are open source, they can be freely downloaded from respective sites. Then the installation and configurations of these tools are managed.

Apache Web Server

The Apache server is the world's most popular Web server by a large percentage and is generally considered to be more stable than other servers. It is usually installed on UNIX and Linux systems, but is also available for Microsoft Windows platform. To download the Apache server directly go to download page of www.apache.org. At download section of this page, various packaged downloads are available. Read the instruction presented on this page and download the file suitable for your system setup onto your hard drive in a new directory c:\download\apache\. (When using Windows platform). (Ben Laurie, Peter Laurie, 2002)

PHP4

PHP4 started as a small project to improve a home page and grew into one of the world's most powerful server-side scripts. The PHP community centred on

www.php.net is very active. To download the PHP4, go directly to www.php.net/downloads.php and under "Windows 32 Binaries" click on PHP 4.1.2 zip package [5,824Kb] or whatever the latest version is. When you are asked to save the file, make a new directory called c:\download\php4 and save it there. This windows 32 binary has compiled support for MySQL database. The PHP 4.1.2 download is in a single compressed file of 5.8MB having .Zip extension. You will need the WinZip package or similar tool to uncompress it.

MySQL

MySQL is the database that PHP4 will access to create dynamic Web sites. To download the latest MySQL release, go to http://www.mysql.com/downloads/mysql-3.23.html. At this page links are available to download MySQL in source as well as binary form for various platforms. Search for Windows downloads and under it click on MySQL 3.23.49 Windows 95/98/NT/2000/XP (12M) link to start downloading. Save this file to c:\download\mysql on your hard disk. Also note that this download is also compressed in .Zip format and you will require WinZip to uncompress it.

Installing, Configuring and Testing Tools

After downloading the installation files of Apache, PHP and MySQL, these tools need to be installed and configured to communicate with each other. The following subsections describe the installation and configuration procedure of each on these components.

Installing Apache Web Server

Installing the Apache server takes less than a minute; it is probably the easiest of the three components that need to be installed. In Windows Explorer, go to c:\download\apache and double click on the .exe file that was downloaded, e.g. apache_1.3.23-win32-x86-no_src.exe. Keep clicking on the NEXT and YES buttons.

After you click on the FINISH button, Apache will be installed. Apache gives you a couple of options during the installation; just accept all the defaults for the installation.

Configuring Apache

The Apache server will not work until it is configured well. Configuring Apache is very easy: you simply have to change one line in a text file called httpd.conf. You will find this file under c:/Program Files/Apache Group/Apache/Conf. You can edit it with any text editor, e.g. Notepad. You can also access this file by Start > Programs > Apache HTTP Server > Configure Apache Server > Edit the httpd.conf configuration file.

Open the file httpd.conf in a text editor. Then search for the line:

#ServerName new.host.name

And replace it with proper server name then save the text file. We used localhost as a server name while developing and testing of OSAT.

Testing Apache

To be able to serve pages, a server has to be running, just like any other application before it is used. You will now start the Apache server. Then you will open your browser and see if it displays HTML pages.

To start the Apache server, click on Start > Programs > Apache HTTP Server > Start Apache in Console. You should then see a DOS window that states that Apache is running. This DOS window will always be open for Apache web server. Simply click the minimize icon at the top right corner of this window to minimize it to Windows taskbar.

Now, open up your browser and type in http://localhost. If you should see a screen which reads something like "The Apache server is now installed on this Web site", then you have successfully installed the Apache server!

Installing PHP4

Installing PHP4 consists of simply unzipping it. For uncompressing you will need WinZip or a similar program. There is no install interface as with Apache.

Go to c:\download\php4\ or the directory where you have downloaded the PHP file and double click on the .zip file. Extract the files into a new sub-directory called c:\php4win. After unzipping, to check if you were successful, look in c:\php4win\. There you will find many files & subdirectories containing various files then you have installed PHP4 successfully.

Configuring PHP4

Configuring PHP4 consists of changing a few lines in a text file, renaming it and copying it and another file into the Windows directory. To configure PHP4, create a sub-directory called c:\php. This is where your PHP files will reside. Rename the file c:\php4win\php.ini-dist to php.ini. Open this php.ini file with a text editor and change the doc_root and extension_dir lines so that they read as follows: only lines printed in bold text has to be changed.

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; Paths and Directories Â‘;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
include_path = ; UNIX: "/
doc_root = "c:\php" ; the root Web
user_dir =
;upload_tmp_dir =
upload_max_filesize = 2097152
extension_dir = "c:\php4win"
enable_dll = On
```

Then move the two-file php.ini and php4ts.dll to c:\windows. If you haven't already, make sure you delete the php.ini file from c:\php4win as otherwise it may cause conflicts later. After you have copied these two files, PHP4 is configured.

Configuring Apache for PHP4

Although PHP4 is itself configured, we still will not be able to access it through the Apache server, as Apache has only so far been configured to read static HTML pages.

We still need to tell Apache Server what to do when it encounters embedded PHP script in Web pages. To do this, we need to alter Apache's httpd.conf file again, the same file we changed earlier. Then under the line AddType application/x-tar .tgz add the lines:

```
# For example, the PHP3 module (not part of theÂ…Â…Â…
# will typically use:
#
#AddType application/x-httpd-php3 .phtml
#AddType application/x-httpd-php3-source .phps
AddType application/x-tar .tgz
ScriptAlias /php4/ "C:/php4win/"
AddType application/x-httpd-php .php
AddType application/x-httpd-php .php3
AddType application/x-httpd-php .php4
Action application/x-httpd-php "/php4/php.exe"
```

Check closely for any typing errors, then save your changes. Notice that in the http.conf file when referring to paths, Apache uses forward slashes ("/") instead of the more standard Window's backslashes ("\"). Notice also that a pound sign ("#") in front of a line comments it out so that it is not interpreted. Notice also that the text /php4/ in the above code does not refer to a directory c:\php4 (which should not exist) but is a variable which we define to refer to the PHP directory c:\php4win.

In case you need to know later at some point, there are two ways to configure Apache for PHP4, as a CGI module or an Apache module. Here, we have installed the CGI module. You can also configure PHP4 as an Apache module, look for instructions in the install.txt file in the /php4win directory.

Installing MySQL

The MySQL package you downloaded is a ZIP file that contains setup files. You will first unzip the ZIP file into its own directory then execute the setup file, which has a nice interface similar to Apache. In c:\download\mysql, double-click on mysql-3.23.49-win.zip and uncompress it in a separate directory. After uncompressing run the setup.exe. Keep clicking Next and Yes during the installation process until the MySQL is installed.

In order for PHP to be able to speak to MySQL, it must be started. This means that each time you turn on your machine and want to work with PHP/MySQL, you will have to start MySQL.

To start MySQL, go to c:\mysql\bin\" and double click on mysqld.exe. If a MS-DOS window opens for a second and then closes, you did it correctly! MySQL has been started.

For the Windows XP, You have to use a different command to start MYSQL. Click on mysqld-nt.exe to start MYSQL on Windows XP. This will start standalone MySQL server.

PHP Scripting:

Scripts can run either on the Web server (server-side scripting) or on the user's computer (client-side scripting).

Client-side scripting generally refers to the class of computer programs on the web that are executed client-side, by the user's web browser, instead of server-side (on the web server). This type of computer programming is an important part of the Dynamic HTML (DHTML) concept, enabling web pages to be scripted; that is, to have different and changing content depending on user input, environmental conditions (such as the time of day), or other variables (David Gourley, Brian Totty, Marjorie Sayer, Sailu Reddy, and Anshu Aggarwal, 2002).

Client-side scripts are often embedded within an HTML document, but they may also be contained in a separate file, which is referenced by the document (or documents) that use it. Upon request, the necessary files are sent to the user's computer by the web server (or servers) on which they reside. The user's web browser executes the script, and then displays the document, including any visible output from the script.

In contrast, server-side scripts are executed by the web server when the user requests a document. They produce output in a format understandable by web browsers (usually HTML), which is then sent to the user's computer.

Client-side scripts have greater access to the information and functions available on the user's computer, whereas server-side scripts have greater access to the information and functions available on the server. (Wikipedia, 2006)

Figure 4-3 illustrates the transition of scripts from client side to server side through the Internet.

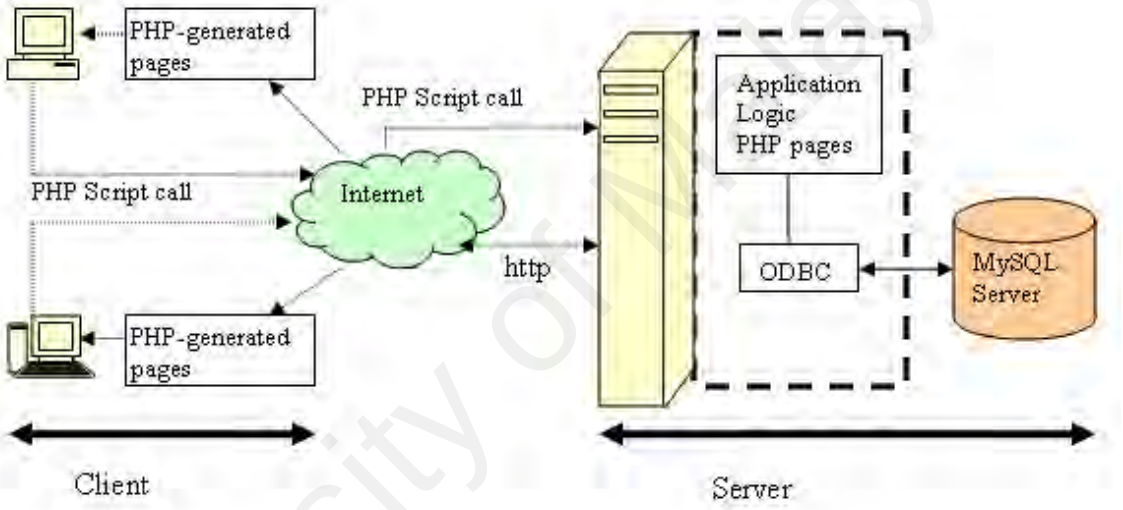

Figure 4-3: OSAT implementation Model

In figure 4-3 we can notice that PHP in server side scripting may connect to the database server (MySQL server) to retrieve requested data by help of ODBC as database connectivity adapter.

4.5.2.2 Web Development Tools

Macromedia Dreamweaver

Macromedia Dreamweaver is a web development tool, created by Macromedia (now Adobe Systems), which is currently in version 8. Initial versions of the application served as simple WYSIWYG HTML editors but more recent versions have incorporated notable support for many other web technologies such as CSS, JavaScript, and various server-side scripting frameworks. Dreamweaver has enjoyed widespread success since

the late 1990s and currently holds approximately 80% of the HTML editor market. The software is available for both the Mac and Windows platforms, but can also be run on Unix-like platforms through the use of emulation software such as Wine (Joseph W. Lowery 2002).

As a WYSIWYG editor, Dreamweaver can hide the details of pages' HTML code from the user, making it possible for non-experts to easily create web pages and sites. Some web developers criticize this approach as producing HTML pages that are much larger than they should be which can make web browsers to perform poorly. This can be particularly true because the application makes it very easy to create table-based layouts. In addition, some web site developers have criticized Dreamweaver in the past for producing code that often does not comply with W3C standards. However, Macromedia has increased the support for CSS and other ways to layout a page without tables in later versions of the application. (Taylor, Dave, 2004)

Adobe Photoshop

Adobe Photoshop is a graphics editor developed and published by Adobe Systems. It is the market leader for commercial bitmap image manipulation, and probably the most well-known piece of software produced by Adobe Systems. It is considered the industry standard in most, if not all, jobs related to the use of visual elements. It is usually referred to simply as "Photoshop". Photoshop is currently available for Mac OS and Microsoft Windows; versions up to Photoshop 8 can also be used with other operating systems such as Linux using software such as CrossOver Office. (Wikipedia, 2006)

4.5.2.3 Hardware Requirements

The hardware requirements for developing, testing, and running OSAT are:

1 – Personal computer with 500 MHz Processor or higher.

2 – 128 MB RAM or higher (256 MB RAM is recommended)

3 – 20 GB of hard disk or higher.

4 – VGA or higher resolution monitor.

4.5.3 System Design

4.5.3.1 System Structure

1 - System Structure for OSAT General Modules

Figure 4-4 shows the system structure for OSAT General Modules.

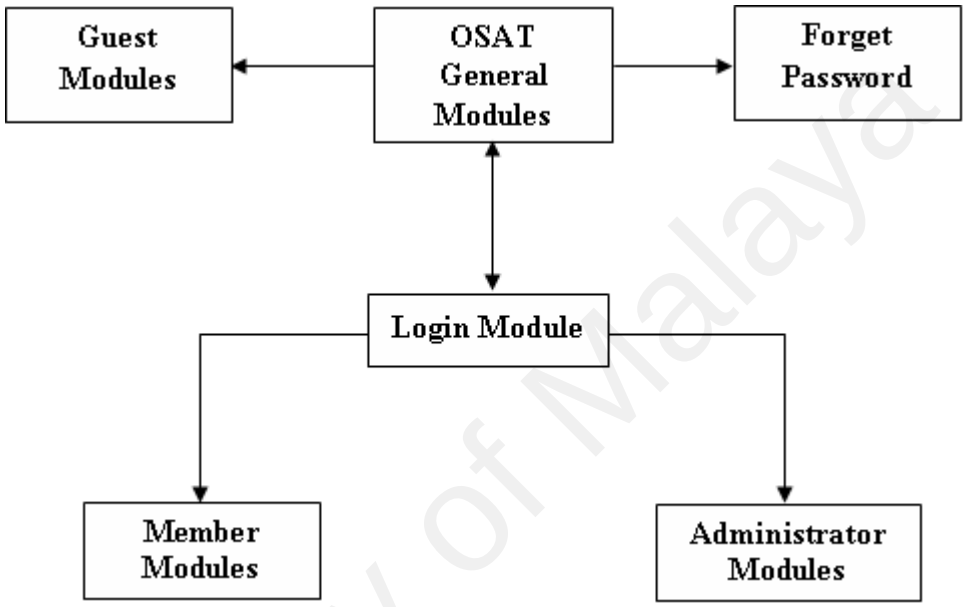

Figure 4-4: OSAT General Module system structure

2-System Structure for Guests

Figure (4-5) shows the system structure for Guest Modules.

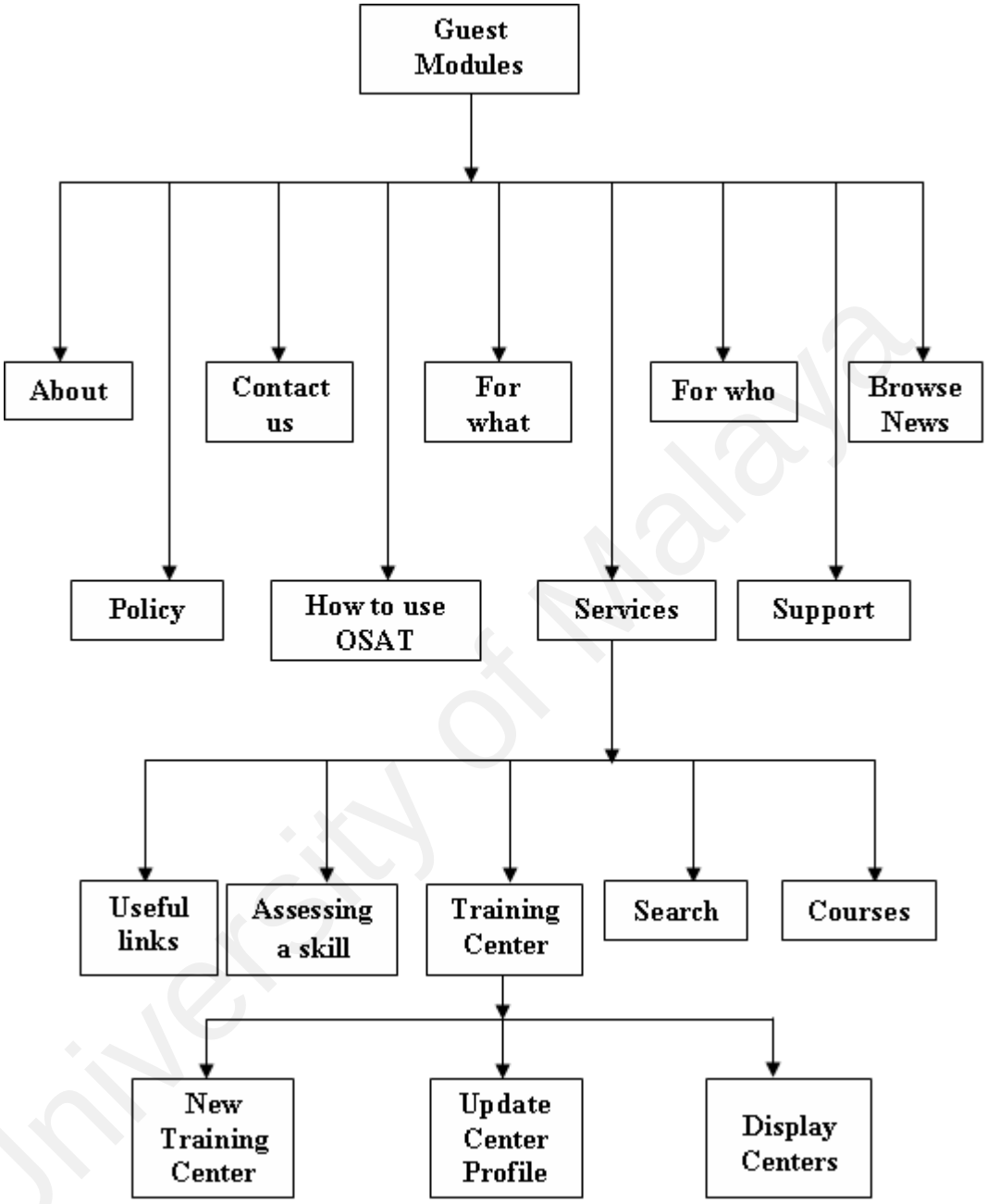

Figure 4-5: Guest Module system structure

From figure 4-5 we can notice that services are available for guests, so any guest can perform a skill assessment to check his/her skill in a particular field in addition to guest users training centre can register to offer courses for members and other guests as well.

3 - System Structure for Members Modules

Figure 4-6 shows the system structure for Members Modules.

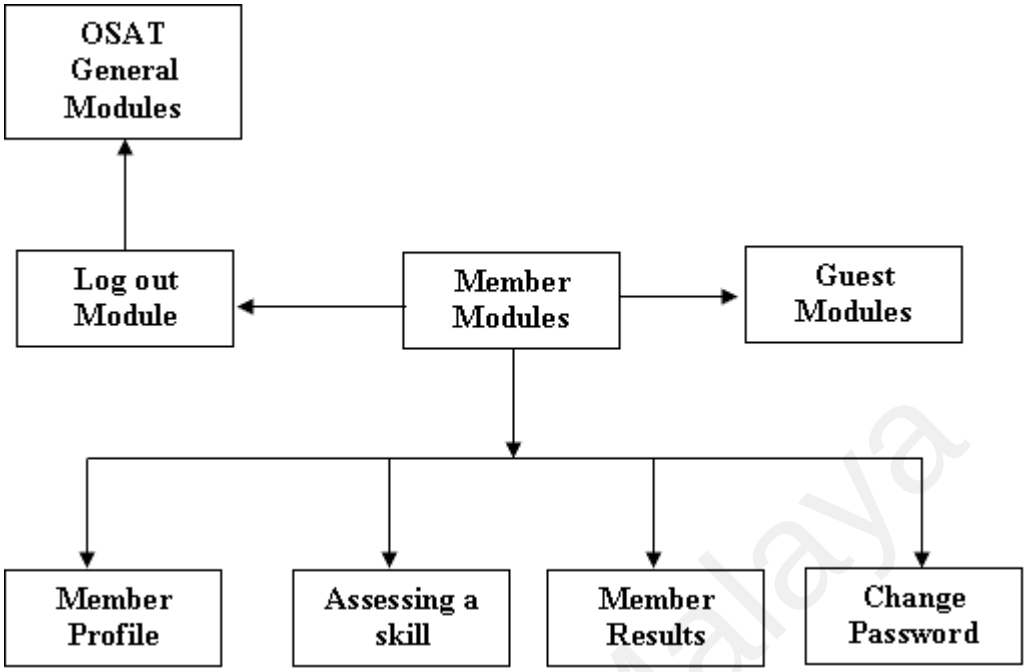

Figure 4-6: Member module system structure

Members can use all guests' modules in addition to their Modules.

4 - System Structure for Administrator's Modules

Figure (4-7) shows the system structure for Administrator's modules.

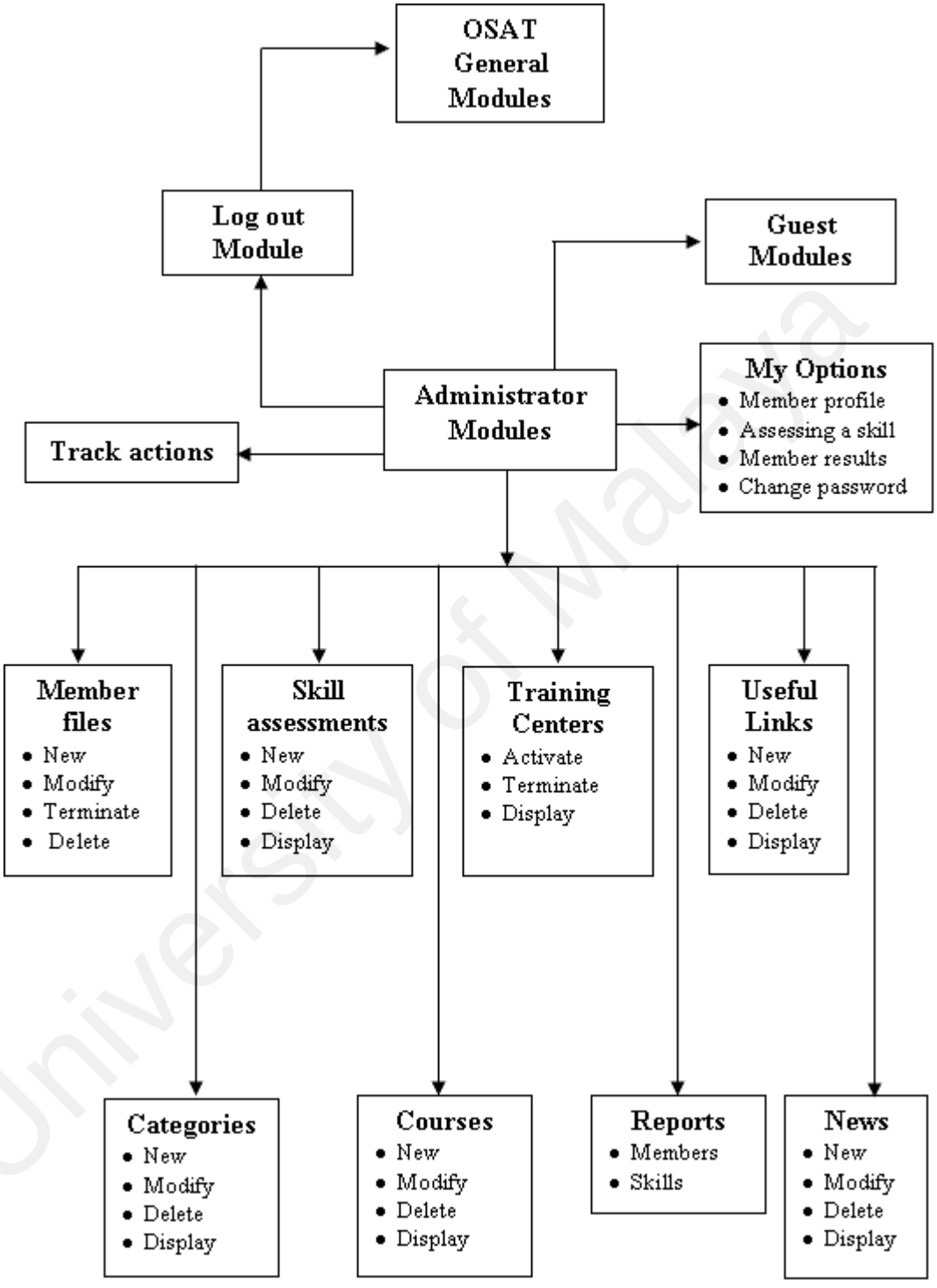

Figure 4-7: Administrator module system structure

Administrators, as well, can use all guests' modules in addition to their modules and member models.

4.5.3.2 Models and Their Functions

OSAT is divided into main modules in three categories: General modules, Member modules and Administrator modules.

4.5.3.2.1 General Modules

Modules are that available to all users (Guests, Members, and Administrators).

The following table (Table 4-1) describes General modules and their functions.

Table 4-1: General Modules Functions

Module	**Function**
About	displays information about OSAT
Policy	displays policy information
Contact us	displays contact information
How to use OSAT	displays brief help information about using OSAT
For what	displays information about why using OSAT
For who	displays information about who should use OSAT
Support	Displays a form in which users can send enquiries and remarks.
Browse news	OSAT displays latest news on the general pages.
Services • Useful links • Assessing a skill • Search • Courses • Training centres o New centre o Update centre profile o Display centres	displays services page which contains: Displays useful links to other websites. Used to start an assessment of a skill. Displays ways to search the web. Displays courses that offered by OSAT. used to display training centres which contains: Used to add new training centre. Used to update training centre profile. Used to display training centres existed in OSAT.
Forget password	Used to get new password automatically from OSAT.

4.5.3.2.2 Member Modules

Modules are that available only to members and administrators.

The following table (Table 4-2) describes Member modules and their functions.

Table 4-2: Member Modules Functions

Module	**Function**
Member profile	Used to update member profile.
Assessing a skill	Used to perform skill assessment.
Member results	Used to get member result.
Change password	Used to change password.

4.5.3.2.3 Administrator Modules:

Modules are that available only to administrators.

The following table (Table 4-3) describes Administrator modules and their functions.

Table 4-3: Administrator Modules Functions

Module	Function
Track actions	Used to track actions taken by administrators.
My Options	Used to display member options to be used by administrator as a member.
Members Files	Used to add, modify, delete, and display member files.
Category	Used to add, modify, delete, and display categories.
Skill assessments	Used to add, modify, delete, and display skill assessments.
Courses	Used to add, modify, delete, and display courses.
Training centres	Used to activate, terminate, and suspend training centres.
Reports	Used to get reports about members and skills.
Useful links	Used to add, modify, delete, and display links.
News	Used to add, modify, delete, and display news.

4.5.3.3 Database Design

OSAT uses a database created by MySQL and contains 10 tables. Tables and their functions are described in table 4-4. See appendix II for detailed database tables design.

Table 4-4: OSAT database tables and their functions

Table	Function
Members	Stores members profiles
Categories	Stores all categories, skill categories and links categories
Skills	Stores all skills information
Questions	Stores questions related to the skills
Results	Stores members assessment results
Centres	Stores training centres information
Links	Stores useful links to be used from guests, members and administrators.
News	Stores latest news about OSAT
Actions	Stores all actions taken by any administrator to be tracked later any time later.
Statistics	Stores important statistics about OSAT

4.5.3.4 Interface Design

The figures 4-8 – 4-13 show the screenshots of some OSAT interfaces as follows:

Figure 4-8: OSAT Homepage

Figure 4-9: About Page

Figure 4-10: Contact us Page

Figure 4-11: "For what?" Page

Figure 4-12: "For Who?" Page

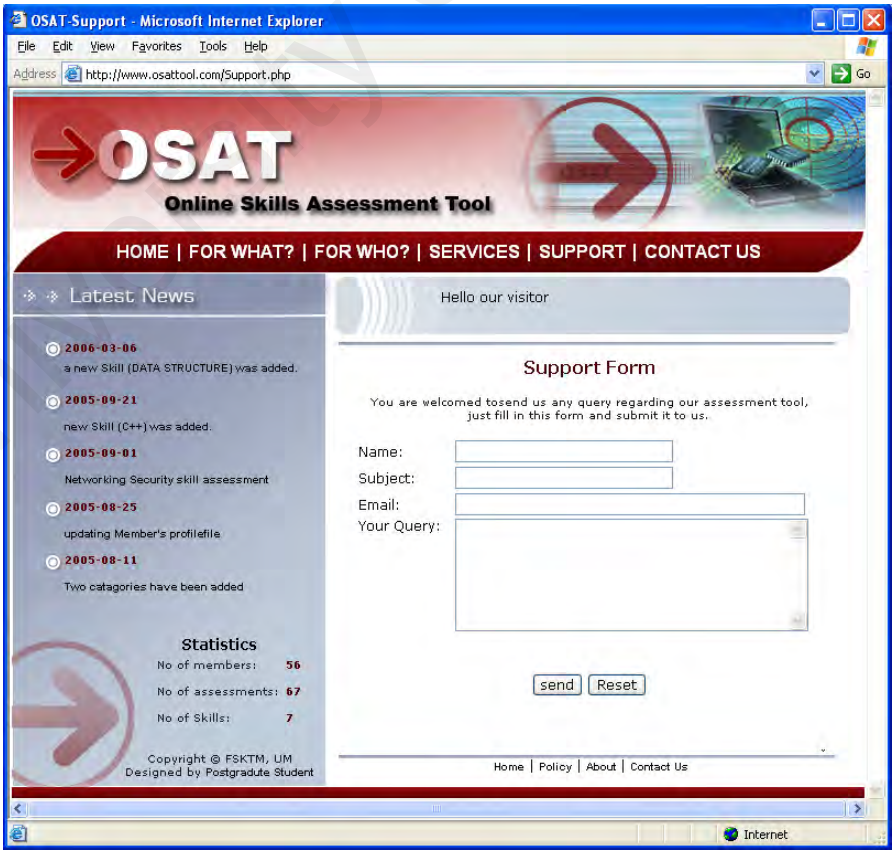

Figure 4-13: Support Page

4.5.4 User Manual

OSAT system is a web-based system and has been designed as a self-explanatory website in which each page has enough information about how to use its links and modules; moreover each page has clearly understandable links that follow the standard web pages specifications. In addition, an explanatory and easy to use manual is provided. See appendix IV

4.5.5 Testing

Testing is a very important process to ensure that OSAT run successfully. Testing was done to validate the requirement as well as the logical accuracy of the flow in the system. Testing process can be divided into three phases inclusive of unit testing, integration testing, and system testing.

4.5.5.1 Unit Testing:

Unit testing is used to test an individual program or module and identify errors. The test data should contain correct and incorrect data. Tests should detect errors in coding, logical mistakes, and flow in the module.

OSAT contains a lot of individual modules to be tested. An example of unit testing, the researcher tested the login module as shown in the following steps:

1 – OSAT home page, shown in figure 4-36, contains login text fields that can be used to enter the username and password.

Figure 4-14: Login Page

2- If the user name is incorrect the system will display the page shown in figure 4-37.

Figure 4-15: User ID validation Page

3 – If the username is correct but the password is incorrect the system will display the page shown in figure 4-38.

Figure 4-16: User Password validation Page

This to help users to identify what data is incorrect and to provide a chance to use forget password link in case of forgotten password.

OSAT can identify the membership type from login information. If login data belongs to a member, he/she will get the member page, and on the other hand if he/she was an administrator, the administrator page will be displayed.

4.5.5.2 Integration Testing:

Integration testing is a logical extension of unit testing, Units that already tested individually, are tested by testing the interfaces between them, that means integration testing is to test the dependency between the modules.

The purpose of integration testing is to ensure that every module in the OSAT is able to correctly interact with related modules when the data flows from one module to another.

Integration testing was done in all the modules as to ensure that functionalities are limited to the type of user login.

For example, when a system administrator login successfully, he/she can perform any task allowed to administrators as shown in administrator page in figure 4-39

Figure 4-17: Administrator Page (Integration Testing)

4.5.5.3 System Testing

The final step in testing process is the system testing to ensure that the system as a whole run correctly. System testing should ensure that each function of the system works as expected and that any errors are noted and analyzed.

Errors may occur if there is problem in the coding which processes data from the database as well as links that are not functioning properly.

4.5.5.4 End User Testing

End user testing was performed to assess the effectiveness, efficiency, user friendliness, functionalities, and specifications and to ensure that the system meets the needs as well as the expectations and objectives.

After the testing was performed the users filled up an evaluation form. A copy of the evaluation form is attached in appendix (III).

The users' feedback is summarized in table (4-5).

Table 4-5: System Evaluation (users' feedback)

Criteria	Feedback
Using OSAT tools features	All users agreed that OSAT system is easy to use.
Interface Design	Most users found the user interface is very good which means that users are quit satisfied with OSAT user interface.
Features of OSAT	Most users found OSAT users very good which means that users have successfully complete all OSAT modules such as adding, updating, displaying and other OSAT modules.
Response and processing time	All users said that the system is fast which indicate that all scripts are performing very well.
OSAT performance	All users agreed that OSAT is performing well.
User-Friendly system	Most users agreed that the system is user-friendly.
Security	Most users agreed that the system is secure enough.
Skill assessment questions	All users strongly agreed that the questions used in skill assessments are completely relevant to the selected skill.
Helpfulness of the system	All users said that the system has much help.
Satisfaction	All users were satisfied with the system.

4.6 Limitations of The System

OSAT has a limitation that it does not provide a real time communication way, such as chat engine, which limits the communication between users who are accessing the system.

4.7 Future Work

OSAT can be upgraded to further enhance communication amongst system administrators whereby it could act as a platform not only to exchange ideas but to work together to manage the system.

OSAT may be upgraded to provide online courses instead of normal courses to help international members to attend useful and important courses.

4.8 Conclusion

OSAT is a web based skill assessment tool. It is aimed to help organizations, members, guests, to assess their domain skills. In addition, training centres can use OSAT to offer courses to members and users as well so members can browse related courses and enrol in useful ones.

5 Conclusions and Future Work

5.1 Summary of the Research

This chapter gives a summary of the research study and highlights the contributions and the expected benefits of our research. The chapter ends with an outline of future research that would extend the benefits of this research.

The eventual goal of this thesis is to study the current state of the Libyan software industry and to understand its characteristics, current problems and the challenges it has to meet. A skill assessment tool for software organisations is also developed to cater for supporting respective companies to improve the competency of its human workforce. The tool is aimed to help software organizations to evaluate their human resources in the form of programmers, system analysts, testers, etc. We believe, evaluating software development staff is very essential to recruit software development staffs that have the appropriate level of competency to produce quality software products. The tool is flexible enough to allow software organisations to tailor the tests to their application domain and/or areas of expertise they focus on.

We think the conclusions of this research can contribute to highlighting obstacles for prosperous Libyan software industry. In this regard, problems related to national policies, educational training, and software market trends are spotted. Recommendations for overcoming these problems are offered when applicable.

5.2 Research Result Conclusions

Based on the analysis of the data we received as a response to the survey we conducted, many concluding remarks can be drawn. The following sections highlight concluding remarks on each of the three main issues we investigated.

5.2.1 Libyan Software Industry: History and Current Practices

The study showed that the age of Libyan software companies is considerably young compared to other emerging software countries. These companies began to emerge in the late 1980's as a result of the paradigm shift from state run economy to the emergence of the private sector. As a result, these companies are still building up their experience. Ad hoc process is a common practice as they do not follow strict managerial and technical models. The study also showed that respective companies do not follow job categorisation plan and there is a tendency that a 'programmer' is the preferred category.

The domestic market is the only consumer of IT products developed in Libya, while all these products are built by local developers. The survey showed no international workforce involved in developing local produced software. The most relevant justification for this result is that Libya is not very attractive yet in regard to staff income. Perhaps the strict immigration rules and regulations also contribute to this result as well. As for the problems faced by correspondent companies, they all face many problems especially in the lack of quality certification and communication infrastructure.

The personal and technical qualities of the workforce have a major influence on progress of any software development initiative. One very noticeable remark is that the majority of Libya IT workforce is male. This is quite surprising because in Libya there is no sex based segregation in the workplaces and, the government fully supports female

workforce to participate in all aspects in society. In regard to the average age IT workforce, highest percentage of software professional's age lies in the range of 26-30 years. This figure indicates that Libyan IT experts are scarce but the figure is very promising for prosperous industry.

In regard to the types of software produced locally, traditional applications such payroll and inventory management are current currency. While, high-tech and innovative software applications such ERP are less known in Libyan market. The study has also showed the majority of produced software is ordered one, and these companies offer very little semi packaged products while, no packaged (off the shelf) software is produced locally.

Though outsourcing is the trend in software development, but in-house development is the common practice in Libyan companies, the only utilise very few outsourced components. This same thing applicable to the issue of software reuse, the majority of software is built from scratch.

5.2.2 The Role of Educational Factors in Shaping Local Software Industry

Training and educational factors are expected to play a major role in shaping quality force. In this regard, the majority of Libyan software workforce is university graduates while professional holding postgraduate degrees are very few. The majority of those graduates are very satisfied with competencies they taught during their university and higher institutes, which means there is mach between educational training and market demand. However, it seems that computing facilities in educational institutes are not very adequate as the majority of respondents expressed their dissatisfaction with these facilities. The same dissatisfaction is expressed in regard to the facilities and material provided by library attached to educational institutes. An adequate level of satisfaction

is expressed in regard to educational courses offered, practical sessions, quality of text books, and quality of teaching.

In regard to training, the majority of workers rely on self training. International standard training course are not established yet in Libya and local courses are very few and limited. A very positive indication is represented by the willingness of the majority of workers to participate in team based projects. The Libyan IT workers do also lack the adequate level of English proficiency. This can be regarded as one of the urgent improvement areas. The nationalisation policy imposed during the 1970's has contributed to this problem, but that policy has been abolished recently and this problem is likely to fade after sometime. Another major problem faced by Libyan IT workers is the low income of these profession especially governmental posts. However, the huge demand for international investors to penetrate to Libyan market would ease this problem.

5.2.3 The Support of National Policies

As discussed in chapter 2, supportive national policies played a big role in the fast grow of emerging software markets. In this regard, this study concluded that less national supported is given to local software companies. This is simply because on the national level, priorities are given to basic industries. IT industry was less favourable due to limited national income and also the technology embargo imposed by US and UN. Only computers with limited capabilities were allowed for export to Libya. Having all these restrictions released, national IT policy is already setup and it is expected to boost the industry in the foreseeable future.

5.3 Claimed Contributions

The work in this research can be divided into three major phases, where we claim to have contribution in each.

- Literature study: We present a literature review on software industry in especially emerging software developing countries. Our aim is to investigate software strategies and policies employed by respective countries, and draw any lessons learned from these cases.
- A survey study is carried out targeting Libyan software companies and software industry workforce. The aim is to investigate the state-of-the-art of Libyan software industry.
- OSAT software which is a tool developed to help software organisations to perform software skills assessment. The tool could support respective organisations to either recruit qualified persons or to evaluate their staff competencies. A plan for training can be proposed as a result.

5.4 Lessons Learned From Newly Emerged Software Markets

Based on the review of newly emerged software markets such as India, China, Brazil and Ireland, many lessons learned can be concluded these initiatives of software industries. Some of these lessons learned are very relevant to forming a national strategy to make the Libyan software industry a very successful sector.

Competition in software industry is very though and it is hard for new nations to won the race with very established software markets. However, Libya can still have a niche in software industry if well planned software strategy is put in place.

First, the major lesson learned from India's experience of exporting services strategy. This strategy does offer opportunities for Libya especially for Arabic software. As

Arabic is the *langua Franca* of a very wide geographical area and, Arabic based IT applications has distinctive features. This could be one of the winning factors for the build up of Libyan software industry. Other lessons, which can be drawn from the Indian experience, are the removal of import restrictions, improved infrastructure of communication, and greater population of well educated IT professionals.

Second, as for the Chinese experience, we cannot find very tempting lessons learned. This is because China's growth in hardware industry still vastly supersedes the growth in its software industry. However, the Chinese government's promotional policies can be regarded as is one of the features that Libya can imitate.

Third, Libya can also learn from Ireland's software industry plan that focused on localization services. We believe Ireland's model can be customized to suit Libyan IT agenda because the local demand for IT is immense due to years of hardship that the country went through. Moreover, localization can be extended to other Arab countries that share the same language. This strategy is also very similar to the Brazilian case which also focuses more towards domestic market. Another positive feature in the Brazilian case lies in increasing the cooperation among Brazilian universities-companies-government in the software quality area.

We can now claim that the research objectives mentioned in Section 1.4 have been achieved.

5.5 Future Work

We now present possible further work that could contribute to further extend the benefits of this research. During our literature review that we carried out as part of this research, we found no published studies related to software development in Libya. We emphasise on intensifying the research on similar studies that would enhance Libya's position in software industry. Future studies should cover all Libya instead of just Tripoli and its surroundings.

Our research only investigated general requirements for software industry regarding companies, workforce and software process. We did not investigate the maturity of software quality models such as CMM (Capability Maturity Model). The models proposed by CMM identify many sub-practices. These sub-practices generate many work-products. Small software organizations, in Libya, simply do not have the resources to satisfy all these requirements. Further studies are suggested to identify the best practices for Libyan local software industry while at the same time aligning these practices with those of CMM. This would enable organizations to smoothly transition to the CMM when desired.

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