

**Development of Management Information System on Social Compliance in
RMG Sector Using Open Source System Architecture**

by
Alauddin Ahmed

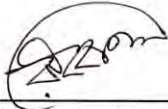
MASTER OF ENGINEERING IN INFORMATION AND COMMUNICATION
TECHNOLOGY



Institute of Information and Communication Technology
BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY
2009

The project titled “Development of Management Information System on Social Compliance in RMG Sector Using Open Source System Architecture”, Submitted by Alauddin Ahmed, Roll No : MF 0331014, Session 2003-2004 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Master of Engineering in Information and Communication Technology held on 29 April 2009.

BOARD OF EXAMINERS

1. 
Dr. Md. Saiful Islam
Assistant Professor
Institute of Information and Communication Technology
BUET, Dhaka – 1000
Chairman
(Supervisor)
2. 
Dr. Md. Liakot Ali
Assistant Professor
Institute of Information and Communication Technology
BUET, Dhaka – 1000
Member
3. 
Md. Rubaiyat Hossain Mondal
Assistant Professor
Institute of Information and Communication Technology
BUET, Dhaka – 1000
Member

CANDIDATE'S DECLARATION

It is hereby declared that this project or any part of it has not been submitted elsewhere for the award of any degree or diploma.



Alauddin Ahmed

Dedicated
to
my parents

TABLE OF CONTENTS

LIST OF TABLES.....	VIII
LIST OF ABBREVIATIONS.....	IX
ACKNOWLEDGEMENTS.....	X
ABSTRACT	XI
CHAPTER 1 INTRODUCTION	1
1.1 Background.....	1
1.2 Objectives of the Study	2
1.3 Significance of the Project.....	3
1.4 Organisation of the Report	3
CHAPTER 2 SOCIAL COMPLIANCE AND OPEN SOURCE SYSTEM....	4
2.1 Social Compliance of Factories.....	4
2.1.1 Introduction	4
2.1.2 Importance of Compliance	5
2.1.3 Particulars of Compliance	6
2.1.4 Present Scenario of Compliance in Bangladesh Garment Sector.....	7
2.2 Open Source Software.....	8
2.3 Java.....	10
2.3.1 Java as a Modern Language	11
2.4 MySQL.....	11
2.5 Conclusions	14
CHAPTER 3 REQUIREMENT COLLECTION AND ANALYSIS	16
3.1 Social Compliance Grading of RMG Factories.....	16
3.1.1 Assess Factory's Present Standard.....	16
3.1.2 Corrective Action Plan	17
3.1.3 Orientation on CAP	18
3.1.4 Management Training on Compliance Issues	18
3.1.5 Continuous Review	18
3.1.6 Data Collection.....	18

3.1.7	Data Analysis and Interpretation	20
3.2	Database for the MIS	21
3.2.1	Entity Relationship Diagram: High Level Model	21
3.2.2	Relational model of the database.....	24
CHAPTER 4	SOFTWARE DEVELOPMENT AND TESTING	25
4.1	Overview	25
4.2	Application Design	25
4.3	Database Design	28
4.4	Testing of the system	34
4.4.1	Execution-based Software Testing Model.....	35
4.5	Using process of the system	37
4.5.1	Creating a New Project/Factory	38
4.5.2	Insertion of Audit Data.....	38
4.5.3	Modification of Data	39
4.5.4	Generating Reports.....	40
CHAPTER 5	CONCLUSION AND RECOMMENDATIONS	44
5.1	Conclusion	44
5.2	Recommendations for Future Improvement.....	45
REFERENCES		46
APPENDIX – I.....		50
Questionnaires for Factory Audit		50
APPENDIX – II		56
Relationship between the Heading and Questions		56
APPENDIX – III.....		59
Sample Code.....		59

LIST OF FIGURES

Figure 3.1: Social compliance achievement procedure.....	16
Figure 3.2: The E-R diagram of the database.....	23
Figure 3.3: The relational model of the database	24
Figure 4.1: The main window of the MIS	26
Figure 4.2: The Audit panel of the data management module used for data entry ...	26
Figure 4.3: The Broad Category panel under the Setup module	27
Figure 4.4: The Create Report section of the MIS	28
Figure 4.5: Hierarchy of software testing techniques.....	35
Figure 4.6: A Model of the Software Testing Process	36
Figure 4.7: Factory's general information input form.....	38
Figure 4.8: Audit data input form.....	39
Figure 4.9: Question modification form.....	40
Figure 4.10: Sub heading wise factory audit grading report	41
Figure 4.11: Sub category wise factory audit grading report	42
Figure 4.12: All audit results summary report of all factories	43

LIST OF TABLES

Table 3.1: Level of importance of different aspects of compliance	17
Table 3.2: Factory Grading.....	17
Table 4.1: The database 'nuk' designed under the project for the MIS	29
Table 4.2: Design details of table 'bcategory'	29
Table 4.3: Design details of table 'sbcategory'	30
Table 4.4: Design details of table 'factory'	30
Table 4.5: Design details of table 'heading'	31
Table 4.6: Design details of table 'sheading'	31
Table 4.7: Design details of table 'question'	31
Table 4.8: Design details of table 'subquestion'	32
Table 4.9: Design details of table 'questionans'	32
Table 4.10: Design details of table 'sheadingquestion'	33
Table 4.11: Design details of table 'subsummarycategory'	33
Table 4.12: Design details of table 'subsummaryheading'	33
Table 4.13: Design details of table 'summaryfactory'	34

LIST OF ABBREVIATIONS

API	Application Programming Interface
BSD	Berkeley Software Distribution
CAP	Corrective Action Plan
CoC	Code of Conduct
CPL	Common Public License
ERD	Entity Relationship Diagram
EU	European Union
FS	Free Software
GNU	GNU's Not Unix
GPL	General Public License
HTML	Hyper Text Markup Language
ILO	International Labour Organization
JDK	Java Development Kit
JIT	Just in Time
JVM	Java Virtual Mac
LGPL	Library General Public License
MFA	Multi Fibre Arrangement
MIS	Management Information System
MIT	Massachusetts Institute of Technology
MPL	Mozilla Public License
OSS	Open Source Software
PC	Personal Computer
RDBMS	Relational Database Management System
RMG	Ready Made Garment
SCSL	Sun Community Source License
SISSL	Sun Industry Standards Source License
SPL	Sun Public License
SQL	Standard Query Language
VM	Virtual Machine
WTO	World Trade Organization
WWC	Workers Welfare Committee

ACKNOWLEDGEMENTS

I would like to express my deep and sincere gratitude to my supervisor Dr. Md. Saiful Islam, Assistant Professor, Institute of Information and Communication Technology (IICT), Bangladesh University of Engineering and Technology (BUET), Dhaka. I owe to him for his supervision, encouragement, personal guidance during the progress of my project. His in-depth knowledge in Software Engineering and his logical way of thinking have been very helpful for the successful completion of this work. I am deeply grateful to him for his co-operation.

I would like to thank the members of my project committee for their patience in understanding my work. I warmly thank Dr. Md. Liakot Ali and Mr. Md. Rubaiyat Hossain Mondal for their valuable suggestions.

A number of people contributed their technical and analytical expertise to this project; they include Professor Dr. Jobair Bin Alam, Md. Delwar Hossain and others. Apart from that Nari Uddog Kendra, a national NGO also provided with support regarding social compliance of RMG factories. However, any error or omissions associated with this project are strictly to the author.

I am thankful to all of my teachers, colleagues, and friends for their support during the completion of my project. Finally, I owe my loving thanks to my parents, brothers, sisters and other relatives. Without their encouragement it would have been impossible for me to finish this work.

Above all, I am grateful to Almighty Allah who gave me the strength to finish this work.

ABSTRACT

In addition to price and quality of the product, and delivery period, all major garment buyers, now a day, have set their business policies focusing on compliance of factories with their corporate code of conduct. Hence, social compliance of Ready Made Garment (RMG) factories is very crucial for ensuring the export of their products in the developed countries. A Management Information System (MIS) can function significantly in doing a social compliance audit of garment factories and can be used for information storage, handling, processing and retrieval of data for improving the services provided by any organization. The MIS will also facilitate quick decision making for overall functional improvement.

To establish a structured system for reporting and monitoring of social compliance status of RMG factories through a standard, logical and comprehensive flow of information a MIS has been developed under this project. The MIS has been assisting different organizations carrying out social compliance audit of RMG factories. The system has been implemented in open source environment using Java and MySQL. The MIS has been designed with a front-end application and backend database system. The design of forms and self descriptive front-end panel with appropriate captioning ensures the user friendliness of the system.

The system has been tested based on the data and information collected from organizations who are involved in assessing the social compliance of RMG factories. First of all some adequacy criteria such as grading of factories on different headings based on available input data have been chosen. The execution-based, more specifically, the specification-based techniques used for testing, focuses on the functional and non-functional requirements of the software. Test cases are black-box tests which have been created without knowledge of the software's source code. Based on the execution result of the test cases the software has been fine tuned for bugs and errors. The MIS provides status of factories on fifteen major areas and the outputs are helpful to the management for quick and scientific decision-making and improving the services to achieve the required standard.

CHAPTER 1

INTRODUCTION



1.1 Background

The export-oriented Ready Made Garments (RMG) sector has made significant contribution to the economy of Bangladesh for the last few years. The contribution of RMGs to Bangladesh economy is well-known, well-appreciated and well-respected. Total export of the RMG sector in the Jul'07-Jun'08 financial year was US \$ 5532.52 million which is 75.83% of the total national export [1]. However, in the process of globalization and increasing free trade there is a growing need to support social and ethical standards in sourcing and purchasing of goods. Labor productivity is considered as the key indicator of workforce performance [2] and hence, the motive behind social standards in global procurement of goods is to improve the social and ethical standards of work force and bring all sourcing areas to a possible equal level of standards. Firm competitiveness can be enhanced by high-performance work systems [3] and buyers, now a day, seek social compliance at the factory level. In Bangladesh, many RMG manufacturers are not maintaining proper social and ethical standards. These manufacturers are under intense pressure from their foreign, specially European and American customers to demonstrate their commitment to satisfy social and ethical purchase policies. A Management Information System (MIS) is essential for monitoring and evaluation of the different factors of the social compliance of a RMG factory and in the context of Bangladesh such an MIS can be developed using open source software.

Open Source Software / Free Software (OSS/FS) has risen greatly in recent times. OSS/FS has significant market share in many countries, is often the most reliable software and in some cases has the best performance. OSS/FS scales, both in problem size and project size. Due to the possibility of worldwide review OSS/FS software sometimes has far better security than proprietary system. The total cost of ownership for OSS/FS is far less than proprietary software, especially as the number of platforms increases [4]. As an open source environment, Java covers security,

distributed transactions, persistence, messaging, web services, interoperability and much more [5]. Currently, open source is not only considered as resource but also as viable business strategy [6]. Data storage and retrieval is essential element of any application. At present developers can choose from many data storage and retrieval products that use SQL. Products such as Oracle, DB2, Informix, and Microsoft SQL Server implement the SQL standard and are widely used in the industry. However, MySQL, an open source product, has surprised many developers with its capability to outperform many of the popular products mentioned above, especially for small and medium range database [7]. Considering these facts, the project intended to design a complex, secured and pragmatic MIS system for RMG factories using the open source architecture that includes Java and MySQL.

1.2 Objectives of the Study

The project primarily focused on developing a stable and flexible information system that can process and analyze data effectively and generate various kinds of report for the management incorporating different social compliance factors of RMG factories, using open source system that includes Java and MySQL. The outcome of the project is a computerized system which can be used by organizations or consulting firms which are responsible for auditing, monitoring and evaluation of social compliance of RMG factories.

More specifically the objectives of this project work were:

- To develop a Management Information System for RMG sector.
- To design a flexible front end system where collected data on social compliance of RMG factories can be easily posted.
- To implement the system in a 2-tier client server environment.
- To generate various reports for the management regarding social compliance status of RMG factories.

1.3 Significance of the Project

Considering the significance of social compliance of the RMG factories of the country, it is essential to ensure an efficient system that can be used in measuring the social compliance grading of different factories. Implementation of an effective system requires sufficient data collection, data management and analysis of those. This project report presents the development process of the MIS system on social compliance of RMG factories and use of the system. It is expected that the system will assist different organizations in carrying out social compliance of RMG factories quickly and efficiently.

1.4 Organisation of the Report

The contents of the remainder of this report are divided into four chapters. The contents of those chapters are described briefly in the following section.

Chapter 2 outlines preliminaries on social compliance of RMG factories and open source software with special focus on Java and MySQL database. Chapter 3 presents the requirements analysis and design details of the MIS and Chapter 4 illustrate the software development process including application and database design, system testing and using process of the MIS. The project output, conclusions and recommendations for future improvement are discussed in this Chapter 5.

CHAPTER 2

SOCIAL COMPLIANCE AND OPEN SOURCE SYSTEM

2.1 Social Compliance of Factories

2.1.1 Introduction

The apparel industry is a multi-billion dollar global industry and is one of the largest industries of Bangladesh. Bangladesh with almost 4200 garment factories is the 6th largest Ready Made Garments (RMG) exporter to USA and EU. The size of the industry was more than 5.5 billion US dollars in 2008. This industry is the largest net foreign exchange earner for Bangladesh, i.e. 76 percent of the total earning. By 2010, the net exports of this industry are expected to grow to almost 10 billion US dollars. This industry is the largest employment provider with almost 25 lacs women employees [8]. The graph of employment opportunities continues to go up every year. But Bangladesh remains in a most vulnerable position following the removal of Multi Fibre Arrangement (MFA) and now it must maintain quality in production to fight the potential competitors.

Today's consumers in western countries are interested in more than just price and product quality. Due to this, corporate reputations are at stake and so the major multinational corporations want to do the right thing and are keen to protect their reputation by ensuring the social responsibility of their supply chain, which is considered as a competitive asset. So, it is now becoming a pre-condition to ensure the social compliances to get business from the overseas buyers. In order to safeguard social standards, buyers and retailers have developed Codes of Conduct (CoC) for the procurement of goods and they insist their garment suppliers worldwide either to comply with the requirements listed in CoC, or to go for implementation, audit and certification according to existing standards/management systems [9].

New plans are being executed in the global market to make social compliance declaration as mandatory for all importing goods and so, it is now becoming a pre-

condition to ensure the social compliances to get business from the overseas buyers. General business concept is to maximize the profit and getting the best product in less price and right on time delivery, but recently a most important social factor also been included in the business policy of the garment retailers in the western countries which is very essential to protect their brand and run business for long time.

Earlier the garment buyers considered the following issues:

- Price
- Quality of the product
- Delivery period

But now most of the reputed buyer has adopted a social policy that is CoC, which has come to the first priority than to the business policy. Most of the reputed garment buyers have their own social policy and those are verified prior to placing any order to the local garment industry and only when the particular garment factory comply with the buyer's social policy, the business orders are placed with them [10].

Upon study on the sourcing policy for the garment buyers in USA, Canada, Europe, it seems that the contents of the social policy for all of the countries are almost same. Among the buying countries, USA has a strict state policy on garment buying and all other country has taken their initiative based on the special policy of trade body, pressure from civil society and various NGOs and social organization and thus there is now a great change in sourcing policy as follows:

- Social Compliance Audit
- Price
- Quality of the product
- Delivery period

2.1.2 Importance of Compliance

The environment of world trade has undergone a rapid change due to globalization and trade liberalization under the World Trade Organization (WTO) regime.

Countries, which had so long been protected by the MFA, now face the challenges of free market competition with the MFA phase-out in December 2004 [11]. With the quotas having come to an end, the importing countries are no longer able to discriminate between the exporting countries. While the WTO regime has removed the tariff barriers, the non-tariff barriers have been given immense importance. These non-tariff barriers include maintaining standards of quality and ensuring commitment towards social compliance.

In the process of globalization and increasing free trade, there is a growing need to support social and ethical standards in sourcing and purchasing of goods. The motive behind social standards in global procurement of goods is to improve the social and ethical standards of the workforce and bring all sourcing areas to a possible equal level of standard. Human rights, working conditions and environmental concerns are global and to ensure them is one of the most important aspects in the process of globalization.

2.1.3 Particulars of Compliance

In current trade, global sourcing has become an integral part of international business. Due to global sourcing, the demand for adhering to strict social and environmental needs, besides quality in production, is now a more stringent requirement particularly in the apparel and textile industries of the world. That is to say, today consumers in the western countries are interested in more than mere price and product quality in the production of garments worldwide. They are concerned about the manner of the total process in which the product is made. Consumers want to know whether the production process involved child and/or forced labor, whether the working conditions met the health and safety standards and whether the factories followed all the norms and rules of standard specifications [12].

In other words, upon removal of tariff barriers with the exit of the MFA, concern and importance has been shifted towards the non-tariff barriers, which include maintaining standards of quality and ensuring commitment towards social compliance. These non-tariff barriers are becoming major factors for doing business.

Many garment manufacturers are already under considerable pressure from their American and European customers to demonstrate their commitment to ethical purchase policies. Both the American and European buyers are insisting on strict compliance with the Corporate CoC as a pre-condition for importing garments from Bangladesh.

A Corporate CoC is a document outlining the basic rights and minimum standards a corporation pledges to respect in its relation with workers, communities and the environment. Thus, the challenges ahead for the RMG factories now include strict adherence to the local laws, ILO conventions and the best practices to meet the challenges of globalization and competition.

2.1.4 Present Scenario of Compliance in Bangladesh Garment Sector

Corporate culture in the garment sector in Bangladesh is in the preliminary stage and this is a great challenge for the country. The customers, social organizations, NGOs and particularly the media in the western countries have become conscious about the corporate practices of the multinational apparel retailers. The reputed retailers are therefore, very keen to protect their brand name by ensuring that all of their supply chain follow a good corporate culture. For the sake of brand protection, most of the apparel buyers have adopted the CoC that the apparel and other exporters must comply with. The fact is that most of the garment industries in Bangladesh were established without taking into cognizance the social issues, which actually is a new concept in this sector.

With the help of respective buyers some of the garment industries in Bangladesh are trying to comply with the CoC of the buyers but due to dearth of proper knowledge on good corporate culture and compliance requirements, the garment exporters are very much afraid of losing their business. The buyers are very much interested to work with only some of the large industries, which are complying with their (buyers) CoC. However, majority of the factories fail in the compliance rating and therefore do not get direct business from the buyers. Although the situation varies greatly from one factory to the other, most of the factories violate numerous laws,

such as having longer working hours than authorized and often more than 12 or 14 working hours with less overtime pay rate, not paying the minimum legal wages, having no legal day off (weekly holiday), locking workers in disregard of safety code, etc.

2.2 Open Source Software

Concept of free software is quite old. When computers first reached universities, they were research tools. Software was freely passed around, and programmers were paid for the act of programming, not for the programs themselves. Only later on, when computers reached the business world, did programmers begin to support themselves by restricting the rights to their software and charging fees for each copy. Free Software as a political idea has been popularized by Richard Stallman since 1984, when he formed the Free Software Foundation [13] and its GNU Project [14]. Stallman's premise is that people should have more freedom, and should appreciate their freedom. He designed a set of rights that he felt all users should have, and codified them in the GNU General Public License or GPL [15]. Stallman punningly christened his license the copyleft because it leaves the right to copy in place. Stallman himself developed seminal works of free software such as the GNU C Compiler, and GNU Emacs, an editor so alluring to some that it is spoken of as it were a religion. His work inspired many others to contribute free software under the GPL. Although it is not promoted with the same libertarian fervor, the Open Source Definition includes many of Stallman's ideas, and can be considered a derivative of his work.

The Open Source Definition started life as a policy document of the Debian GNU/Linux Distribution. Debian, an early Linux system and one still popular today, was built entirely of free software. However, since there were other licenses than the copyleft that purported to be free, Debian had some problem defining what was free, and they had never made their free software policy clear to the rest of the world. Bruce Perens was the leader of the Debian project, at that time, and he addressed these problems by proposing a Debian Social Contract and the Debian Free Software

Guidelines in July 1997 [16]. Many Debian developers had criticisms and improvements that Perens incorporated into the documents. The Social Contract documented Debian's intent to compose their system entirely of free software, and the Free Software Guidelines made it possible to classify software into free and nonfree easily, by comparing the software license to the guidelines.

Debian's guidelines were lauded in the free software community, especially among Linux developers, who were working their own free software revolution at the time in developing the first practical free operating system. When Netscape decided to make their web browser free software, they contacted Eric Raymond who insisted that Netscape's license comply with Debian's guidelines [17] for it to be taken seriously as free software. Raymond felt that the Debian Free Software Guidelines were the right document to define Open Source, but that they needed a more general name and the removal of Debian-specific references. Bruce Perens edited the Guidelines to form the Open Source Definition and formed a corporation for Debian called Software in the Public Interest, and offered to register a trademark for Open Source.

There are many business reasons to embrace open source, all the way from just using open-source software such as Linux or Apache to starting and running open-source projects. The reasons to engage with open source include the following:

- Getting high-quality, free software and software design and development help
- Making software ubiquitous through participation and low cost
- Engaging end-users in design and testing
- Reducing time to market
- Doing marketing and marketing research
- Working with partners who prefer a loose relationship
- Positioning a company
- Harvesting innovation
- Making standards

- Building a brand through ubiquity and positioning vis-à-vis the open source community
- Adopting transparent development processes
- Changing customer and market perceptions
- Making a vision pervasive
- Changing the rules
- Reducing support costs
- Injecting discipline into the development process
- Improving integration
- Satisfying more customers
- Porting to otherwise unimportant platforms
- Avoiding lock-in
- Changing pricing practices
- Signing up partners and creating consortia
- Creating markets
- Making ethical, moral, and political statements

2.3 Java

Platform Independent Java was developed at the beginning of the 1990s by James Gosling et al. at Sun Microsystems. Initially, the language (then called Oak) was to be used for the development of consumer electronics, especially set-top boxes for interactive television. Such systems are usually what are called embedded systems, in which the software is just one part of a larger system. Commonly, as market conditions change, these systems require a change of processor. Since each different processor has its own machine language, an early design criterion for Java was platform independence [19]. That is, the code generated by the Java compiler would be able to run on any processor. This feature is now called “write-once-run-anywhere” and allows us to write our Java code on a Macintosh or PC (or other machine) and then run it on whatever machine we desire.

Java happened to come along at about the same time as a new use of the Internet: the World Wide Web. A web browser, such as Netscape Navigator, might run on any machine and download a web page from a server (another, possibly different, kind of machine). The browser would then display the page. A platform-independent language called HTML describes the web page. Originally, web pages were static and simply showed text and graphics like a page in a printed book. However, it was soon realized that dynamic content pages with which the viewer could interact would be much more interesting. What was needed was a programming language whose code could run on any machine. Java was an obvious answer. A special kind of Java program (called an applet) runs within a browser and provides the executable content. This has led to a great deal of interest and a lot of hype about Java as the programming language for the Web.

2.3.1 Java as a Modern Language

Interest in Java as a general application programming language other than as a web programming language or as a language for embedded consumer electronics was mounting up rapidly. Hence, Java was designed to be a modern language. As such, it embodies the object-oriented paradigm of programming. It was also designed to be simple and safe. Like C++, it borrows from the programming language C much of its structure, but it has also improved many of the features that make C++ difficult to use. This makes it a good language for learning computer programming as well as a reasonable language for application development. In object-oriented programming, a program is designed to be a model of the real-world system it is replacing. The program contains objects that represent real-world entities (such as customers, students, reports, and financial transactions) that interact with each other. Many useful objects are provided in libraries to reduce the code that a programmer has to write.

2.4 MySQL

As was the case with many other open source projects, MySQL was first created by someone who needed a better tool to get a specific job done. Monty Widenius and

David Axmark started out with the open source project (MSQL), but found that it lacked some features that they needed [21]. They decided to develop their own database system that met their specific requirements. They started building MySQL by using some low-level database storage code they had already developed for other projects and layered a multithreaded server, SQL parser, and client-server protocol on top. They also structured the API for MySQL to appear very similar to MSQL in order to make it easier for developers to port their MSQL-based software to MySQL.

MySQL was eventually released in source-code form, under a proprietary license. Eventually, this license was changed to the GNU General Public License (GPL), which in most cases allows the software to be used without license cost. However, in certain situations you must purchase a commercial license. The exact terms of the license are available in the documentation that ships with MySQL or on the Web at www.mysql.com. Commercial support is also available for those who need it from MySQL-AB, the company that was created by Monty and David to support the continued development of the MySQL software.

The requirements that Monty and David originally had for MySQL were that it be as fast as possible, while still being stable, simple to use, and able to meet the needs of the majority of database developers. Even today, feature requests for future MySQL development are weighed carefully against these original requirements, and are implemented only when and if the original requirements can be met as much as possible. Over the years, MySQL has evolved into an RDBMS that has the following core features:

Portability: MySQL runs on almost every flavor of Unix, as well as Windows and MacOS X. You can obtain binaries or source code for the MySQL server as well as the tools that access it. More ports of the software become available every day. It is almost a given that MySQL will run on whatever operating system you have available.

Speed: Using techniques such as efficient indexing mechanisms, in-memory temporary tables, and highly optimized join algorithms, MySQL executes most queries much faster than most other database systems.

Scalability: Because of its modularity and its flexibility in configuration, MySQL can run in systems varying in size from embedded systems to large multiprocessor Unix servers hosting databases with tens of millions of records. This scalability also allows you to run a copy of MySQL on a developer-class machine, and later use the same database system on a larger machine in production. Because it is multithreaded, MySQL efficiently utilizes resources for multiple users, compared to other database servers that start full-fledged processes for each user. It is not uncommon to hear of MySQL installations supporting thousands of concurrent users.

Flexibility: MySQL lets us choose the table types we need to meet our software's requirements, ranging from in-memory heap tables, fast on-disk MyISAM tables, merge tables that group together other sets of tables to form larger "virtual" tables, and transaction-safe tables such as InnoDB. MySQL is also very tunable and includes many parameters that can be changed to increase performance for a given solution. However, MySQL comes with sensible defaults for these parameters, and many users never have to tune MySQL to reach a performance they are happy with.

Ease of use: MySQL is easy to install and administer. While other database systems require special knowledge and training, not to mention special operating system configurations, MySQL can be installed in less than 10 minutes if you've done it before. Even if you are a newcomer, you should be able to install MySQL in under an hour. Once it's installed, MySQL requires little maintenance and administration other than adding or changing user permissions and creating or removing databases.

Fine-grained security model: It is possible to restrict users' rights from an entire database down to the column level based on login name, password, and the hostname that users are connecting from. This allows to create secure systems by

partitioning responsibilities and capabilities of different users and applications to prevent unauthorized modification or retrieval of data.

Access from other languages/systems: There are libraries and APIs for connecting to MySQL from Java (the focus of this book), C/C++, Perl, PHP, ODBC (Microsoft Windows applications), TCL, Eiffel, and Lisp. Because of this, a whole set of tools has appeared surrounding the use of MySQL from these languages and systems. MySQL is a flexible and capable RDBMS that has a rich feature set, performs well on the majority of queries, and has a large support base for access from many different languages.

2.5 Conclusions

Open source is a way of building closer relationships with customers and better relationships with developers. People who are encouraged to build projects on top of OSS bases are likely to build more interesting and exiting systems than they might have developed from scratch [23]. An open-source project breaks down organizational boundaries both within the company and between the company and the outside world. Open source results in software that better meets the needs of its users, both in terms of better fit and higher reliability. In an article taking a broad look at open source, Brian Behlendorf wrote:

What the open-source community has proven is that individuals and, by extension, companies can work together on a much more discrete, iterative level. People are starting to understand that having interaction between developers on a daily basis during development is far more valuable than waiting through the typical product revision cycles. It may seem chaotic at times; for programmers, balancing the requirements of their employers with that of the other participants may be a constant challenge. But it can work.

Open source can be a major success factor for any project because of the fact that the control and decision making can be shared with the community. Working together is likely to create something much better than by working alone.

CHAPTER 3

REQUIREMENT COLLECTION AND ANALYSIS

3.1 Social Compliance Grading of RMG Factories

Social compliance means to address the social, legal, ethical and environmental standards of workforce and the community, and bring all sourcing areas to a possible equitable level of standards. To fulfill the requirements of social compliance by any RMG factory, a benchmark has been developed based on the local labor law, ILO convention and CoC of different individual buyers. As shown in Figure 3.1, five processes namely, assess factory's present standard, Corrective Action Plan (CAP), orientation on CAP, management training on compliance issues and continuous review are followed to achieve the social compliance of factories.

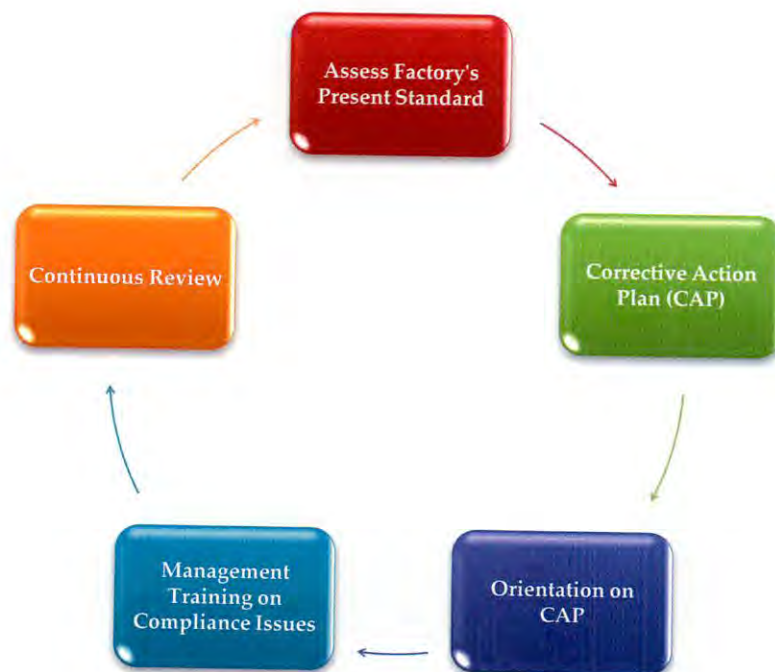


Figure 3.1: Social compliance achievement procedure

3.1.1 Assess Factory's Present Standard

The present status of a factory on various aspects of compliance is being assessed first. For this data is collected on predefined aspects through a set of structured

questionnaires. The collected data are then analyzed considering the level of importance (presented in Table 3.1) of different aspects. Based on the score found by analysis the factory is graded according to the criteria mentioned in Table 3.2.

Table 3.1: Level of importance of different aspects of compliance

Level	Description
High	Most urgent issue that should rectified with 1st priority
Medium	Very urgent issue that should rectified with as early as possible
Low	Urgent issue that should be rectified by priority basis

Table 3.2: Factory Grading

Grade Range	Grade	Description
0%-29%	E	No precaution is taken. Only a few documents are maintained such as operational license, attendance and salary record. All other compliance issues are found not to be maintained.
30%-49%	D	Some actions are taken in issues like fire safety, health facility by providing necessary equipments in the work floor but they are not being maintained regularly, properly and no documentations are being maintained.
50%-69%	C	Most of the physical facilities are provided, all precaution is taken and being implemented, but improvement is still required.
70%-84%	B	Almost all physical facilities are provided, document is also maintained but lack of awareness among worker is found.
85% +	A	All physical facilities are provided, with proper documentation and other issues. Both workers and management is found to be aware on the compliance issues. Current standard needs to be maintained and cope with all new issues.

3.1.2 Corrective Action Plan

The next stage is to develop a Corrective Action Plan (CAP) for the factory assessed or audited. The plan is prepared to take care of high and medium priority issues first and eventually the low priority issues. A target is also set in the CAP to be attained by the factory within a fixed time frame.

3.1.3 Orientation on CAP

As soon as the CAP is prepared the factory workers are oriented on CAP. It is expected that the ideas on different compliance issue will be cleared to the workers and they will take proper interest and assist the management in achieving the compliance target.

3.1.4 Management Training on Compliance Issues

After the orientation on CAP the factory owners and management are trained on compliance issues based on the findings of the factory's present standard and CAP prepared. The capacity of the management is strengthened through the management training for attaining the compliance target set in the CAP.

3.1.5 Continuous Review

Finally when the time frame, set earlier during the CAP, the factory is again audited to figure out the present status. Based on the assessment the whole process continues if that factory has not been able to achieve the grading required. If the factory grading is satisfactory, still then the factory's status is being assessed after a set interval of time to verify that the social compliance of the factory met the required standard.

The MIS system developed under the project will assist in carrying out the first and last process that is, assess factory's present standard and continuous review of the social compliance of RMG factories.

3.1.6 Data Collection

For assessing factory's present standard data are collected using three different questionnaires through review of various papers, registers and documents, inspection of different items and materials and testing of workers' knowledge and understanding about different issues. The questionnaires presented in Appendix-I are titled as-

- Document Review
- Visual Inspection
- Verification of Workers Awareness

The questionnaires cover information on five major categories and various sub-categories which are listed below.

- A. Documentation
 - A.1 Legal and Other Requirements
 - A.2 Employment Documents
- B. Management Practice
 - B.1 Policy and Other Practice
 - B.2 Discrimination
 - B.3 Posting of the Code & Policies
 - B.4 Fire Safety/Evacuation Procedures
 - B.5 Child Labor
 - B.6 Employment Condition
 - B.7 Forced Labor
 - B.8 Freedom of Association
 - B.9 Non-Discrimination
 - B.10 Maternity Protection
 - B.11 Grievance Procedure
 - B.12 Harassment or Abuse
- C. Working Hour, Wages and Benefits
 - C.1 Daily Attendance
 - C.2 Working Hour
 - C.3 Wages
 - C.4 Leave
 - C.5 Working Hour, Wages and Leave
 - C.6 Benefits/Facilities
- D. Occupational Health and Safety
 - D.1 Health & Hygiene
 - D.2 Safety & Fire Safety
 - D.3 Fire Equipment
 - D.4 Electrical Wiring
 - D.5 Medical Facilities and First Aid
 - D.6 Machine Guarding
 - D.7 Personal Protective Equipments
 - D.8 Hazardous and Combustible/Flammable Materials
 - D.9 Health and Safety

- E. Workplace Environment
 - E.1 Workplace Comfort and Cleanliness
 - E.2 Toilet Facilities
 - E.3 Dining Facilities
 - E.4 Stores and Bonded Warehouse

3.1.7 Data Analysis and Interpretation

The collected data are being analyzed to get the status of a factory under 15 headings and various sub headings which are as below.

1. **Code posting and awareness**
Code posting/information, Worker's and management's awareness on Code of compliance
2. **Management Practice**
Compliance/Welfare Officer, License & certificate, Policy, Register, Attendance Card, Pay statement
3. **Recruitment procedure**
Recruitment Procedure, Employment Records
4. **Forced Labor**
Excessive and forced overtime called Forced Labor
5. **Child Labor**
Employment of Child labor, Working hour & other benefit for adolescent workers
6. **Hours of Work**
Working hour, Overtime Limitations
7. **Leave**
Casual, Medical, Annual, Festival, Maternity
8. **Wages and Benefits**
Minimum Wage, Benefits, Basic calculation, Proper deduction & Awareness on these issues
9. **Overtime Compensation**
Overtime rate, workers awareness on these issues
10. **Harassment or Abuse**
Physical, Mental, Oral Harassment/Abuse, Disciplinary Practices
13. **Workplace environment/condition and facilities for workers**
Workplace comfort and cleanliness, Drinking Water Facility, Dining Facility, Child Care Center, Machinery Maintenance, Notice board, Complain/suggestion Box

14. Freedom of Association and Collective Bargaining

Formation and Function of Workers Welfare Committee (WWC)

15. Miscellaneous

Store management, Warehouse

Questions under different categories and sub- categories may belong to several sub-headings; however, any question belongs to only one sub- heading. The list of questions under different sub- headings is presented in Appendix-II. The questions are weighted as such summation of all the questions of the three questionnaires mentioned in the previous section is equal to hundred. The response of the question contributes to the grading of any sub- heading equal to its weight if the answer is 'YES' and zero otherwise. The weighted average of all the sub- headings under any category provide the grading of that heading and similarly the weighted average of all headings gives the factory grading. The grading status of factory is then presented in tabular form.

3.2 Database for the MIS

3.2.1 Entity Relationship Diagram: High Level Model

Data modeling schema is a method that allows us to model or illustrate a database. The Entity Relationship diagram (ERD) is a graphic tool that facilitates data modeling. The ERD is a subset of "semantic models" in a database. The ER diagram of the project database is presented in Figure 3.2.

Entity-Sets designation of the database

The specification of data requirements for the MIS results the conceptual schema for the database. The entity sets and their attributes are listed as below.

- The *Factory* entity set, with attributes *factory-name*, *date-of-establishment*, *registration-no*, *contact-person*, *type-of-product*, and *factory-ID*.
 - Additional descriptive features are the multi-valued attribute *address* with component attributes *location*, *phone-number*, and *email-address*; multi-valued attribute *building* with component attributes *total-floor*, and *total-floor-space*; and multi-valued attribute

workforce with component attributes *female-workforce*, and *male-workforce*.

- The *Category* entity set, with attributes *category-name*, and *category-ID*.
- The *Sub category* entity set, with attributes *sub-category-name*, and *sub-category-ID*.
- The *Heading* entity set, with attributes *heading-name*, and *heading-ID*.
- The *Sub heading* entity set, with attributes *sub-heading-name*, and *sub-heading-ID*.
- The *Question* entity set, with attributes *question-description*, *question-weight*, *sub-question-status*, and *question-ID*.
- The *Sub question* entity set, with attributes *sub-question-description*, *sub-question-weight*, and *question-ID*.
- The *Question answer* entity set, with attributes *audit-number*, *yes-status*, *no-status*, and *n/a-status*.

Relationship Sets designation of MIS with mapping

Following the rudimentary design scheme of ERD the following relationship sets and mapping cardinalities have been made.

- *catg-contain* is a one-to-many relationship set between *Category* and *Sub category* that indicates which sub category belongs under which category.
- *hed-contain* is a one-to-many relationship set between *Heading* and *Sub heading* that indicates which sub heading belongs under which heading.
- *scat-ques* is a one-to-many relationship set between *Sub category* and *Question* that indicates different questions belong to different sub categories.
- *shed-ques* is a one-to-many relationship set between *Sub heading* and *Question* that indicates different questions belong to different sub heading.
- *Subq-belong* is a one-to-many relationship set between *Question* and *Sub question* that specifies which question contains different sub questions.
- *audit-result* is a many-to-many relationship set between *Question* and *Question answer*

- *audit-of-fact* is a many-to-many relationship set between *Question answer* and *factory*

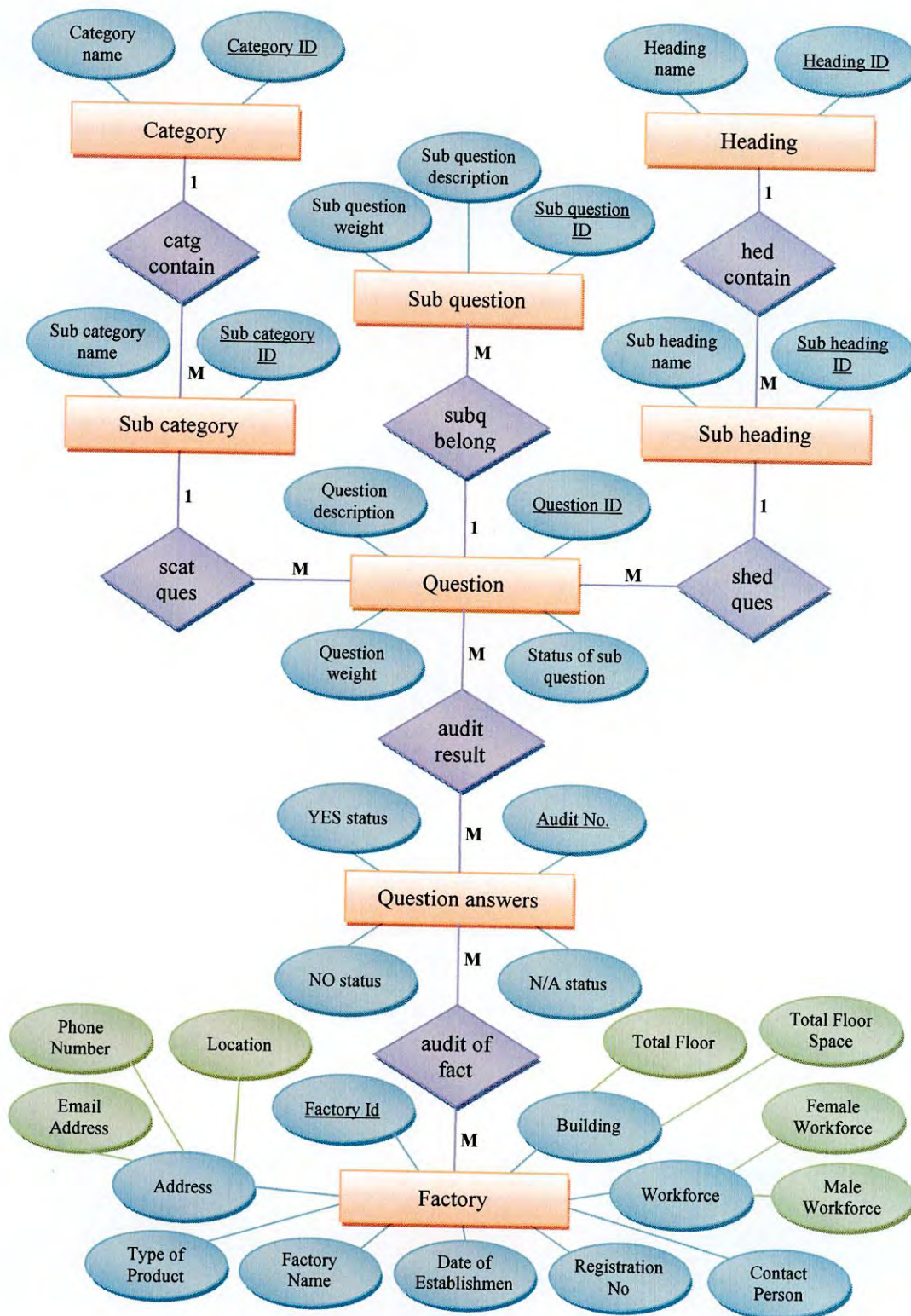


Figure 3.2: The E-R diagram of the database

3.2.2 Relational model of the database

The relational model describes a database as a collection of predicates over a finite set of predicate variables, describing constraints on the possible values and combinations of values. The content of the database at any given time is a finite (logical) model of the database. In the relational model, related records are linked together with a "key". The purpose of the relational model is to provide a declarative method for specifying data and queries; we directly state what information the database contains and what information we want from it, and let the database management system software take care of describing data structures for storing the data and retrieval procedures for getting queries answered. The relational model of the project database is presented in Figure 3.3.

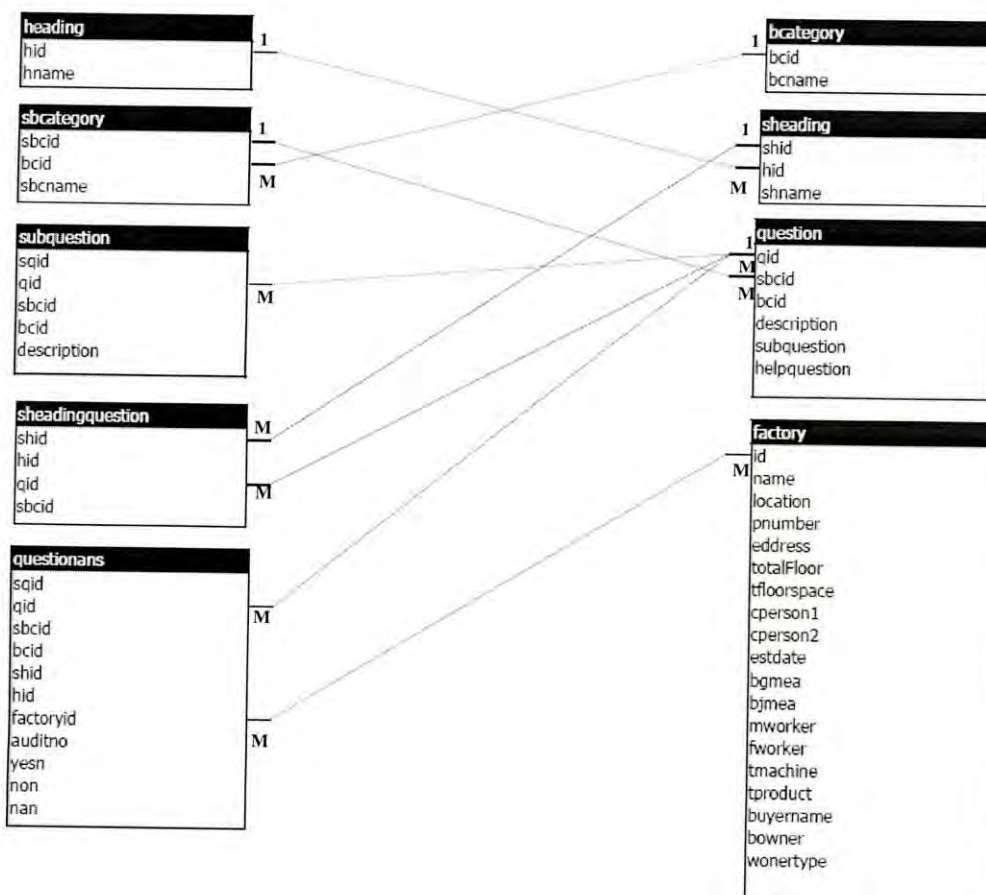


Figure 3.3: The relational model of the database

CHAPTER 4

SOFTWARE DEVELOPMENT AND TESTING

4.1 Overview

The development process of the MIS on social compliance in RMG sector included the followings.

- Properly identifying the requirements;
- Design the system for meeting the requirement;
- Modularize the design;
- Building the system, testing it and then implementing/delivering the system

The software engineering approach followed in developing the MIS is likely to ensure a high quality system, which is not amenable to the one smart programmer approach common to open source projects.

4.2 Application Design

The application has been designed under the J2SDK version 1.5 environment. The application is consisting of three main modules which are

- Data Management;
- Setup; and
- Create Report.

The main window of the MIS system includes all these three modules (Figure 4.1). The data management module is used to input the findings of the questionnaires 'Document Review', 'Visual Inspection' and 'Verification of Workers Awareness'. Apart from that the input data can be exported for checking of error (Figure 4.2).

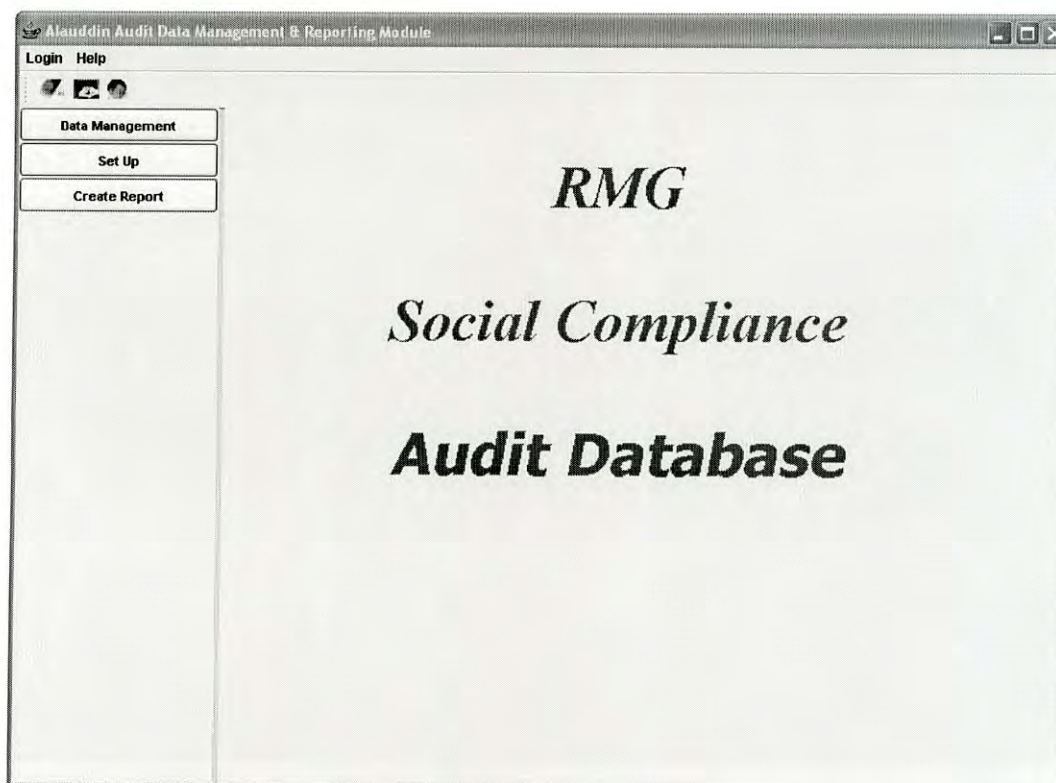


Figure 4.1: The main window of the MIS

AC No	Tariff
B 3	Posting of the code & policies
B 4	Fire safety/Evacuation plan
D 3	Fire equipment
D 4	Electrical wiring
D 5	Medical Facility and first aid
D 6	Machine guarding
D 7	Personal protective equipments
D 8	Hazardous & combustible/Flammable materials
E 1	Workplace comfort and cleanliness
E 2	Toilet facilities

Question ID	Question Description	Value	Weight
1	Is the company's code of conduct posted in prominent places throughout the fac...	Yes	0.11
2	Has the factory posted national and local labor laws in prominent places in the l...	Yes	0.11
3	Recruitment Policy	Yes	0.11
4	Leave policy	Yes	0.11
5	Policy regarding forced labor & discrimination	Yes	0.11
6	Policy regarding disciplinary practice	Yes	0.11
7	Policy regarding abuse & harassment	N/A	0.11
8	Safety Health & hygiene policy	N/A	0.11
9	Environment policy	N/A	0.11
10	Deduction policy	Yes	0.11
11	Maternity benefit	Yes	0.11

Audit Information Add/Edit Form

Reset Close Save

Figure 4.2: The Audit panel of the data management module used for data entry

The setup module has been designed as the administration panel of the application. It is consisting of six sub-modules. The 'Broad Category' module is used to setup the categories based on which data are collected. At present data are collected on five broad categories as mentioned in section 3.1.6. However, to make the application robust and flexible the module is designed with the provision of accommodating and future changes and any category can be added, edited or deleted through the 'Broad Category' panel (Figure 4.3). Similarly the 'Sub Broad Category', 'Question', 'Sub Question' and 'Factory' modules are also designed to add, edit or delete any sub category, question, sub question and factory information respectively. As mentioned in section 3.1.7, the grading status of factories is reported on 15 major headings and sub-headings under the headings. The 'Sub-Heading Question' module is used to store the relationship with the questions and the sub headings; that is which question belongs to which sub-heading.

Alauddin Audit Data Management & Reporting Module

Login Help

Data Management

Set Up

Broad Category

Sub Broad Category

Question

Sub Question

Sub-Heading Question...

Factory

Create Report

☐ New

Broad Category: A

Address:

Documentation:

Update Delete

Broad Category ID	Broad Category Name
A	Documentation
B	Management Practice
C	Working hour, wages and benefits
D	Occupational Health & safety
E	Workplace environment

Save To Database Close

Broad Category Add/Edit/Delete Form

Figure 4.3: The Broad Category panel under the Setup module

The outputs of the application are generated under the 'Create Report' module (Figure 4.4). The module consists of four sub modules for generating different kinds of report. 'SubCategory', module is designed to generate sub category wise grading of any particular audit of a factory. Similarly 'SubHeading' module generates sub category wise grading of any particular audit of a factory. The 'Factory Grading' module provides the status of all the factories only for the last audit and 'Full Summary Report' generates grading status of all the factories for all audits accomplished. Sample code for creating the full summary report is presented in Appendix-III.

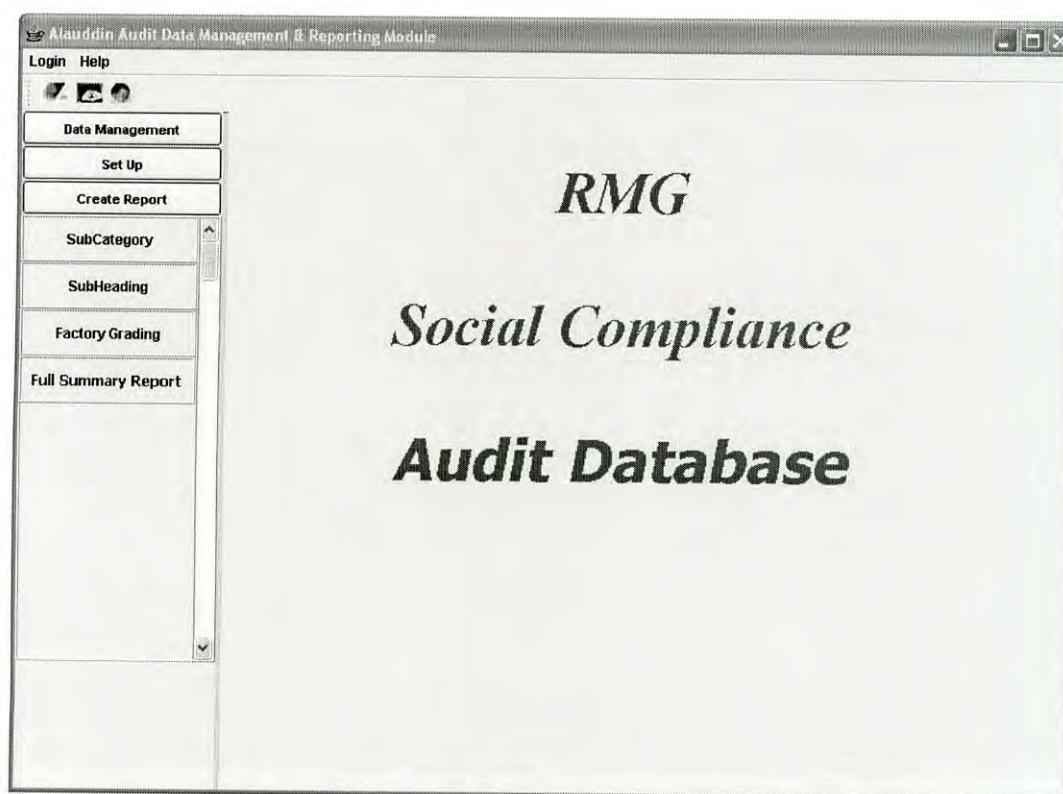


Figure 4.4: The Create Report section of the MIS

4.3 Database Design

To maintain the flexibility and incorporation provision of any future changes, major part of the MIS has been designed as variable and stored in a database. MySQL version 5.0.5.1b has been used to create the database 'nuk' for this project. The database is consisting of twelve tables. The list of tables in the database and main

function of the tables are presented in Table 4.1. Table 4.2 to Table 4.13 present the design details of different tables of the database.

Table 4.1: The database 'nuk' designed under the project for the MIS

Name of the tables	purpose
bcategory	Store the broad categories of questionnaires
factory	Store the general information of factories
heading	Store the heading on which factory grading are generated
question	Store the questions belongs under different sub categories of the questionnaires
subquestion	Store the sub questions belongs under different questions
questionans	Store the answers of the questionnaires that is the input of the system
sbcategory	Stores the list of sub categories under different categories
sheading	Stores the list of sub headings under different headings
sheadingquestion	Store the list of questions belongs under different sub headings
subsummarycategory	The table is used to store sub category wise grading result of factories while generating sub category wise report
subsummaryheading	The table is used to store sub heading wise grading result of factories while generating sub heading wise report
summaryfactory	The table is used to store factory grading result as a whole while generating factory wise report and full summary report

Table 4.2: Design details of table 'bcategory'

Field	Data type	Length	Description
bcid	varchar	5	Contains the identity field of category
bcname	varchar	150	Contains the name of category

primary key of the table is **bcid**

Table 4.3: Design details of table 'sbcategory'

Field	Data type	Length	Description
sbcid	varchar	5	Contains the identity field of sub category
bcid	varchar	5	Contains the identity field of category under which the sub category belongs to.
sbcname	varchar	150	Contains the name of sub category
auditlevel	varchar	50	Contains the audit number

primary key of the table is **sbcid, bcid**; foreign key of the table is **bcid**

Table 4.4: Design details of table 'factory'

Field	Data type	Length	Description
id	varchar	5	Contains the identity field of factory
name	varchar	200	Contains the name of factory
address	varchar	200	Contains the address of factory
location	varchar	100	Contains the location of factory
pnumber	varchar	15	Contains the phone number of factory
eaddress	varchar	25	Contains the email address of factory
tfloor	int	10	Contains total floor number
tfloorspace	float	5,2	Contains total floor space
cperson1	varchar	15	Contains name of 1st contact person
cperson2	varchar	15	Contains name of 2nd contact person
estdate	timestamp		Contains the date of establishment
Bgmea	varchar	10	Contains BGMEA registration no
bkmea	varchar	10	Contains BKMEA registration no
Mworker	int	11	Contains number of male workforce
fworker	int	10	Contains number of female workforce
tmachine	varchar	25	Contains type of machine
typeproduct	varchar	25	Contains type of product produced

primary key of the table is **id**

Table 4.5: Design details of table 'heading'

Field	Data type	Length	Description
hid	varchar	5	Contains the identity field of heading
hname	varchar	150	Contains the name of heading

primary key of the table is **hid**

Table 4.6: Design details of table 'sheading'

Field	Data type	Length	Description
shid	varchar	5	Contains the identity field of sub heading
hid	varchar	5	Contains the identity field of heading under which the sub heading belongs to.
shname	varchar	150	Contains the name of sub heading

primary key of the table is **shid, hid**; foreign key of the table is **hid**

Table 4.7: Design details of table 'question'

Field	Data type	Length	Description
qid	varchar	5	Contains the identity field of question
sbcid	varchar	5	Contains the identity field of sub category under which the question belongs to.
bcid	varchar	5	Contains the identity field of category under which the sub category belongs to.
description	varchar	500	Contains the question
subquestion	char	1	This field is used to record whether there is any sub question under the question
weight	float	5,2	Contains weight of the question

primary key of the table is **qid, sbcid, bcid**; foreign key of the table is **sbcid, bcid**

Table 4.8: Design details of table 'subquestion'

Field	Data type	Length	Description
sqid	varchar	5	Contains the identity field of sub question
qid	varchar	5	Contains the identity field of question under which the sub question belongs to
sbcid	varchar	5	Contains the identity field of sub category under which the question belongs to.
bcid	varchar	5	Contains the identity field of category under which the sub category belongs to.
description	varchar	500	Contains the sub question
weight	float	5,2	Contains weight of the sub question

primary key of the table is **bcid,sbcid,qid,sqid**; foreign key of the table is **qid,sbcid,bcid**

Table 4.9: Design details of table 'questionans'

Field	Data type	Length	Description
sqid	varchar	5	Contains the identity field of sub question
qid	varchar	5	Contains the identity field of question
sbcid	varchar	5	Contains the identity field of sub category under which the question belongs to.
bcid	varchar	5	Contains the identity field of category under which the sub category belongs to.
shid	varchar	5	Contains the identity field of sub heading under which the question belongs to.
hid	varchar	5	Contains the identity field of heading under which the sub heading belongs to.
factoryid	varchar	5	Contains the identity field of factory
auditno	int	11	Contains the audit number of the factory
yesn	float	5,2	This field is used to record whether the answer of the question is yes
nonn	float	5,2	This field is used to record whether the answer of the question is no
nan	float	5,2	This field is used to record whether the answer of the question is N/A

primary key of the table is **sqid,qid,sbcid,bcid,factoryid,auditno**

Table 4.10: Design details of table 'sheadingquestion'

Field	Data type	Length	Description
shid	varchar	5	Contains the identity field of sub heading under which the question belongs to.
hid	varchar	5	Contains the identity field of heading under which the sub heading belongs to.
qid	varchar	5	Contains the identity field of question
sbcid	varchar	5	Contains the identity field of sub category under which the question belongs to.
bcid	varchar	5	Contains the identity field of category under which the sub category belongs to.

primary key of the table is **shid, hid, qid, sbcid, bcid**; foreign key of the table is **qid, sbqid, bcid**

Table 4.11: Design details of table 'subsummarycategory'

Field	Data type	Length	Description
sbcid	varchar	5	Contains the identity field of sub category
bcid	varchar	5	Contains the identity field of category under which the sub category belongs to.
factoryid	varchar	5	Contains the identity field of factory
auditno	int	11	Contains the audit number of the factory
yesn	float	5,2	This field is used to record the count of yes
nonn	float	5,2	This field is used to record the count of no
nan	float	5,2	This field is used to record the count of N/A

primary key of the table is **sbcid, bcid, factoryid, auditno**

Table 4.12: Design details of table 'subsummaryheading'

Field	Data type	Length	Description
shid	varchar	5	Contains the identity field of sub heading
hid	varchar	5	Contains the identity field of heading under which the sub heading belongs to.
factoryid	varchar	5	Contains the identity field of factory
auditno	int	11	Contains the audit number of the factory

Field	Data type	Length	Description
yesn	float	5,2	This field is used to record the count of yes
nonn	float	5,2	This field is used to record the count of no
nan	float	5,2	This field is used to record the count of N/A

primary key of the table is **shid,hid,factoryid,auditno**

Table 4.13: Design details of table 'summaryfactory'

Field	Data type	Length	Description
factoryid	varchar	5	Contains the identity field of factory
auditno	int	11	Contains the audit number of the factory
yesn	float	5,2	This field is used to record the count of yes
nonn	float	5,2	This field is used to record the count of no
nan	float	5,2	This field is used to record the count of N/A
sdate	timestamp		Stores the date of reporting

primary key of the table is **factoryid,auditno**

4.4 Testing of the system

Software testing is essential for ensuring the system to be achieved an appropriate level of quality. Software verification is the process of ensuring that a program meets its intended specification [25]. One technique that can assist during the specification, design, and implementation of a software system is software verification through correctness proof. Software testing, or the process of assessing the functionality and correctness of a program through execution or analysis, is another alternative for verifying a software system. Figure 4.5 shows the hierarchy of software testing techniques. The model of the execution based software testing followed for the project is described below.

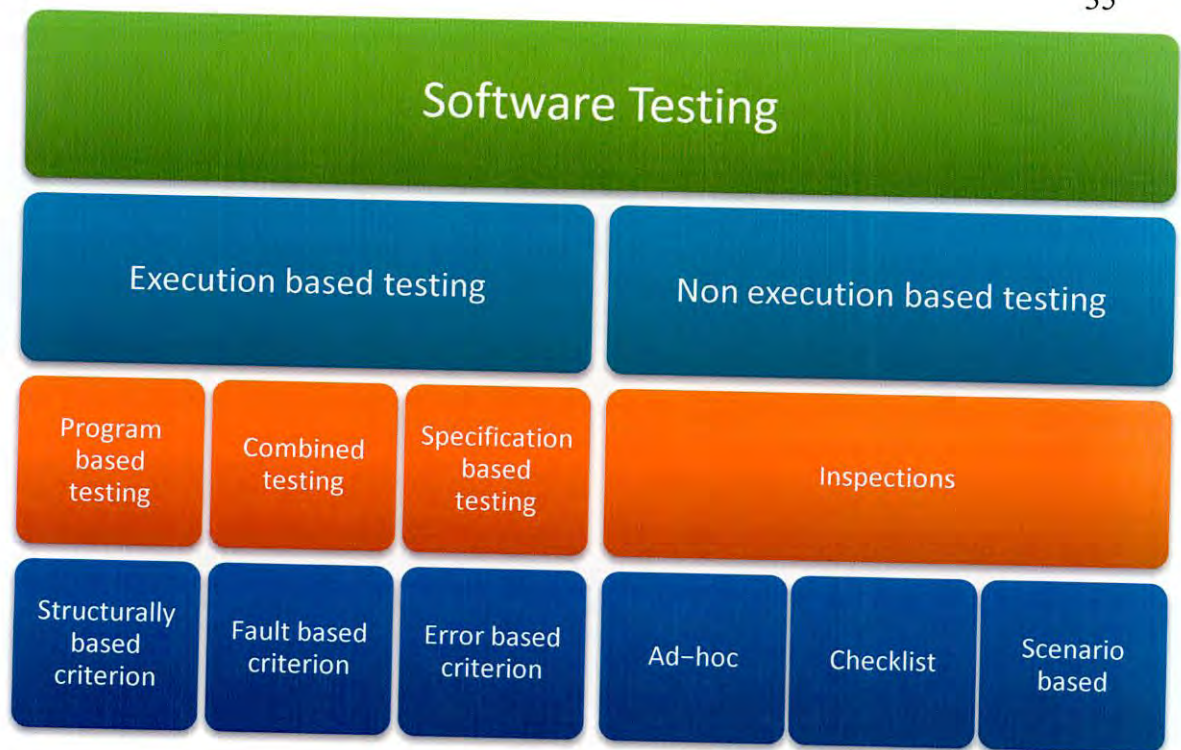


Figure 4.5: Hierarchy of software testing techniques.

4.4.1 Execution-based Software Testing Model

A model of execution-based software testing is illustrated by Figure 4.6. Since there are different understandings of the process of testing software, it is important to note that our model is only one valid and useful view of software testing. This model of software testing takes a system under test, P , and a test adequacy criterion, C , as input. This view of the software testing process is iterative in nature. That is, the initial creation and execution of T against P can be followed by multiple refinements of T and subsequent re-testing of P . The testing process is stopped iterating when the tests within test suite T have met the adequacy criterion C and the testing effort has established the desired level of confidence in the quality of P [26]. In addition testing often stopped when a release deadline is reached, monetary resources are exhausted, or it was sensed that P has reached an acceptable level of quality. It should be noted, however, that even if the testing effort was stopped when T meets C , there is no guarantee that T has isolated all of the defects within P . Since C traditionally represents a single view of test case quality, it is often important to use

multiple adequacy criteria and resist the temptation to allow the selected $C(s)$ to exclusively guide the testing effort [27].

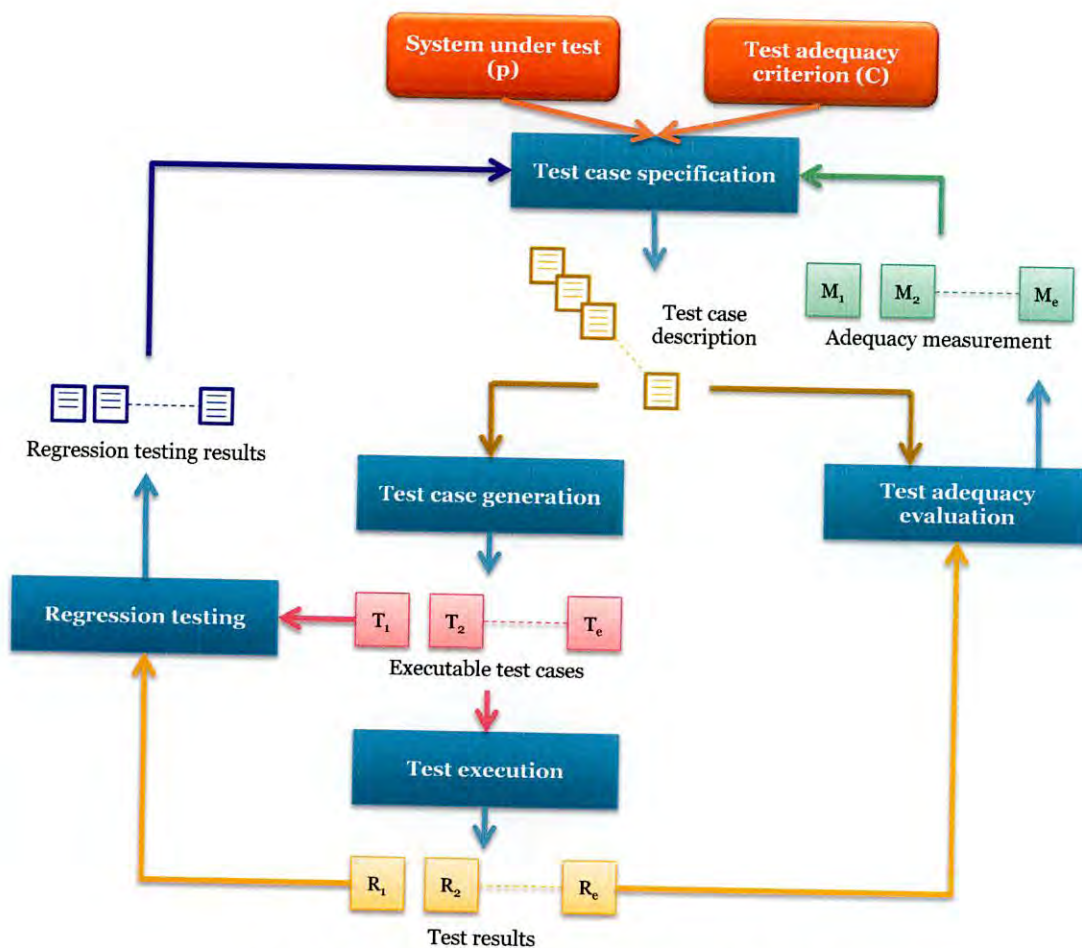


Figure 4.6: A Model of the Software Testing Process

The formulation of a test adequacy criterion is a function of a chosen representation of P and a specific understanding of the “good” qualities that T should represent. The test specification stage analyzes a specific P in light of a chosen C in order to construct a listing of the tests that must be provided to create a completely adequate test suite. That is, the test case specification stage shown in Figure 4.6 is responsible for making C directly apply to the system under test. Once a test case specification tool has created test case descriptions for P , the test case generation phase could begin.

After the test cases have been generated, it was possible to perform test execution. Then the results from the execution of the tests were analyzed to determine if each individual test case passed or failed. The executable test cases that were constructed during the generation phase have been analyzed by a test adequacy evaluator that measures the quality of T with respect to the test case descriptions produced by the test specifier. The test results from the execution phase and the adequacy measurements produced by the evaluator were used, if necessary, to change the chosen adequacy criteria and/or augment the listing of test case descriptions and used during subsequent testing.

The iterative process of testing used may be sufficient throughout the initial development of P. However, it is also important to continue the testing of P after the software application has been released and it enters the maintenance phase of the software lifecycle [28]. Regression testing is an important software maintenance activity that attempts to ensure that the addition of new functionality and/or the removal of program faults do not negatively impact the correctness of P. The regression testing process can rely upon the existing test cases and the adequacy measurements for these tests to iteratively continue all of the previously mentioned stages [29].

4.5 Using process of the system

The software consists of following three major sections.

- Data Management
- Setup
- Create Report

The Data Management section is the major input section of the software. All the data collected by questionnaire survey will be entered through the Data Management section of the software. The Setup section is used to create new projects and components of a project. Any modification or alteration of questions of the questionnaires is also made through the Setup section of the software. The Create

Report section of the software provides outputs and is used to generate the reports or to display results.

4.5.1 Creating a New Project/Factory

At the very outset of using the software, detail information of a factory is inserted through the *Setup* → *Factory* section of the program that automatically creates a new project/job. The form looks like as Figure 4.7. The user will have to fill up the form providing detail information of a factory and then click Update to save the result.

The screenshot shows a software window titled "Alauddin Audit Data Management & Reporting Module". Inside, there's a sidebar on the left with a tree view containing: "Data Management", "Set Up", "Broad Category", "Sub Broad Category", "Question", "Sub Question", "Sub-Heading Questio...", "Factory", and "Create Report". The "Factory" item is selected. The main area displays the "Factory Information Insert Form". At the top of the form is a checkbox labeled "New". Below it are several input fields: "Factory Id (*)" with a dropdown showing "1", "Factory Name (*)" with a text box containing "abc Fashion", "Address" (empty), "Location(*)" with a dropdown showing "Dhanmondi", "Phone Number" (empty), "Email Address" (empty), "Total Floor" (empty), "Total Floor Space" (empty), "Contact Person1" (empty), "Contact Person2" (empty), "Date of Establishment" (empty) with a date format hint "dd/mm/yyyy", "BGMEA No" (empty), "BKMEA No" (empty), "Male Workforce" (empty), "Female Workforce" (empty), "Type of Product" with a "Type Here" button, "Total Machine" (empty), "Building Ownership" with a dropdown showing "Rented", "Name of Buyers" with a "Type Here" button, and "Owner's Type" with a dropdown showing "Foreign". At the bottom right of the form are "Close" and "Update" buttons. The text "Factory Insert Form" is visible at the bottom left of the main area.

Figure 4.7: Factory's general information input form

4.5.2 Insertion of Audit Data

The data collected by questionnaire under an audit are inserted through *Data Management* → *Audit* section of the software. The user will have to choose a factory and select an audit number for which the data has been collected. Afterward

the user will have to choose a subsection (A1, A2, B1...etc.). The questions under the chosen subsection will appear automatically. The user can then choose the answer of the questions individually between the options – 'YES', 'NO' and 'N/A'. The weights of individual questions can also be adjusted here. After providing the answer press *Reset* to reset all the answers to default value or *Close* to close the window without saving the answers provided or *Save* to save the inputs. A warning window will appear as Figure 4.8. Press *Yes* to confirm or *No* to abort. Finally press *Close* to close the window.

Question ID	Question Description	Value	Weight
1	Is the company's co	Yes	0.36
2	Has the factory pos	Yes	0.11
3	Recruitment Policy	Yes	0.11
4	Leave policy	Yes	0.11
5	Policy regarding forced labor & discrimination	Yes	0.11
6	Policy regarding disciplinary practice	Yes	0.11
7	Policy regarding abuse & harassment	Yes	0.11
8	Safety Health & hygiene policy	N/A	0.11
9	Environment policy	N/A	0.11
10	Deduction policy	Yes	0.11
11	Maternity benefit	Yes	0.11

Figure 4.8: Audit data input form

4.5.3 Modification of Data

The software has preset Broad Categories, Sub-broad categories, Questions and Sub-questions as per the questionnaires used during an audit. However, the software is robust and pragmatic in nature. To allow any future change in the categories and questions the *Broad Category*, *Sub Broad Category*, *Question* and *Sub Question*

sections are created under the *Setup* section of the software. The value of categories and questions and sub sections of those can be added or altered through these sections. Use the *Setup → Broad Category* section of the software to add or modify any broad category. Use the *Setup → Sub Broad Category* section of the software to add or modify any sub-category. Use the *Setup → Question* section of the software to add or modify any Question. The form looks like as Figure 4.9. Use the *Setup → Sub Question* section of the software to add or modify any Sub-question under a question.

Alauddin Audit Data Management & Reporting Module

Login Help

Data Management

Set Up

Broad Category

Sub Broad Category

Question

Sub Question

Sub-Heading Question...

Factory

Create Report

☐ New

Broad Sub Category: 3 (Posting of the code & policies)

Broad Category: B (Management Practice)

Question ID:

Question Name:

Weight:

Question ID	SBCategory ID	BCategory ID	Description	Weight
1	3	B	Is the company's ...	0.11
2	3	B	Has the factory po...	0.11
3	3	B	Recruitment Policy	0.11
4	3	B	Leave policy	0.11
5	3	B	Policy regarding f...	0.11
6	3	B	Policy regarding di...	0.11
7	3	B	Policy regarding a...	0.11
8	3	B	Safety Health & hy...	0.11
9	3	B	Environment policy	0.11
10	3	B	Deduction policy	0.11
11	3	B	Maternity benefit	0.11
12	3	B	OT calculation	0.11
13	3	B	Working hour	0.11
14	3	R	Notice about Pav...	0.11

Reset Save Delete Close

Question Add/Edit/Delete Form

Figure 4.9: Question modification form

4.5.4 Generating Reports

The output from the software is generated through the *Create Report* section. Various kind of report will be generated automatically simply by pressing the corresponding tab. Some sample reports are presented in Figure 4.10 to Figure 4.12.

Report - Print Preview

File Navigation Zoom Help

100 %

abc Fashion

Grading Sheet

Audit

Code/Compliance Issue	yes	No	N/A	Grade
Code posting and awareness				
Code posting/information	1.57	0.00	0.33	82.63 %
Management Practice				
Pay statement	0.44	0.66	0.00	40.00 %
Register	0.00	1.76	0.00	0.00 %
License & certificate	0.55	1.46	0.00	27.36 %
Attendance Card	0.11	0.44	0.00	20.00 %
Policy	0.77	1.10	0.00	41.18 %
Compliance / Welfare Officer	0.00	0.22	0.00	0.00 %
Recruitment procedure				
Employment Records	0.33	0.66	0.00	33.33 %
Recruitment Procedure	0.11	0.22	0.00	33.33 %
Forced Labor				
Forced Labor	0.22	0.11	0.00	66.67 %
Child Labor				
Employment of Child labor	0.22	0.00	0.00	100.00 %
Hours of Work				
Working hour	0.11	0.55	0.00	16.67 %
Overtime Limitations	0.00	0.11	0.00	0.00 %
Leave				
Leave	0.22	0.33	0.00	40.00 %
Wages and Benefits				
Minimum Wage, Benefits, Basic calculatio..	0.55	1.10	0.00	33.33 %
Overtime Compensation				
OT Compensation	0.11	0.22	0.00	33.33 %
Harassment or Abuse				
Harassment/Abuse	0.22	0.44	0.00	33.33 %
Disciplinary Practices	0.00	0.22	0.00	0.00 %
Discrimination				
Discrimination on age, sex, race etc.	0.33	0.77	0.00	30.00 %
Safety & Health requirements				
Safety team and fire fighting training	0.33	0.33	0.00	50.00 %

Figure 4.10: Sub heading wise factory audit grading report

Report - Print Preview

File Navigation Zoom Help

100 %

Print

SCategory ID	Sub Category Name	Yes	No	N/A	Grade
A:1	Legal & other Requirement as	0.55	3.22	0.00	E
A:2	Employment Document	0.44	0.77	0.00	D
B:1	Policy & other practices	0.88	1.43	0.00	D
B:10	Maternity Protection	0.22	0.22	0.00	C
B:11	Grivance Procedure	0.22	0.11	0.00	C
B:12	Harassment or Abuse	0.22	0.44	0.00	D
B:2	Discrimination	0.22	0.55	0.00	E
B:3	Posting of the code & policies	1.57	0.00	0.33	B
B:4	Fire safety/Evacuation plan	0.55	0.55	0.00	C
B:5	Child labor	0.22	0.00	0.00	A
B:6	Employment Condition	0.00	0.33	0.00	E
B:7	Forced Labour	0.22	0.11	0.00	C
B:8	Freedom of Associations	0.00	0.55	0.00	E
B:9	Non-Discrimination	0.11	0.22	0.00	D
C:1	Daily attendance	0.11	0.44	0.00	E
C:2	working hour	0.00	0.44	0.00	E
C:3	Wage	0.44	0.44	0.00	C
C:4	Leave	0.22	0.33	0.00	D
C:5	working hour & wage	0.33	0.99	0.00	E
C:6	Benefits/Facilities	0.22	0.55	0.00	E
D:1	Health & Hygiene	0.11	0.22	0.00	D
D:2	Safety & Fire safety	0.11	0.22	0.00	D
D:3	Fire equipment	0.22	2.53	0.00	E
D:4	Electrical wiring	0.00	0.77	0.00	E
D:5	Medical Facility and first aid	0.55	0.66	0.00	D
D:6	Machine guarding	0.44	0.88	0.00	D
D:7	Personal protective equipments	0.55	1.21	0.00	D
D:8	Hazardous & combustible/Flammable materials	0.66	0.33	0.00	C
D:9	Health and Safety	0.22	0.11	0.00	C
E:1	Workplace comfort and cleanliness	1.98	0.00	0.00	A
E:2	Toilet facilities	1.10	0.11	0.00	A

Figure 4.11: Sub category wise factory audit grading report

Report - Print Preview

File Navigation Zoom Help

100 %

Full Summary Report

Factory	1st Audit		1st FL-Up		2nd FL-Up		3rd FL-Up		4th FL-Up		5th FL-Up		6th Audit	
	Date	Grade	Date	Grade	Date	Grade	Date	Grade	Date	Grade	Date	Grade	Date	Grade
abc Fashion	02/4/09	E(16)	27/12/07	A(100)										
abc3	16/1/08	E(13)												
xyz Garments	06/11/07	E(0)	06/12/07	E(0)	06/1/08	E(0)								

Figure 4.12: All audit results summary report of all factories

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In today's intensely competitive world, application of information technology has been ensured through the MIS developed under the project. The 2-tier client server nature of the system is providing a flexible front-end system to the user. The backend database system is ensuring the reliability of stored data. The use of the MIS is providing significant global competitive advantage. Manual information processing that was resulting wastage of valuable and highly skilled manpower has been reversed now through the use of the MIS.

The MIS is assisting different organizations carrying out social compliance of RMG factories and taking decisions based on the reports that are generating from the software. The process of social compliance audit at present is much more rapid, efficient and of higher quality. The 2-tier model of the system is allowing some layers to run in one memory space and other layers in a different memory space. This eliminated unnecessary complexity and expensive boundaries not essential for the system but without sacrificing the scalability of the system.

The user friendliness of using the system has been appreciated and the similarity of the data input section with data collection forms has been appraised. The outputs are simple and efficient for using by the user and the management. The system has been implemented in open source environment using Java and MySQL. The project revealed Java to be an excellent language for MIS development and is greatly facilitated by strong typing, built-in threading, and automatic memory management of JAVA. One of the discoveries of the project is that MySQL database has no negative impact on the performance and scalability of services of the MIS.

5.2 Recommendations for Future Improvement

The future improvement of the system may include inclusion of user level access to ensure more safety and security of the MIS. The graphical interface can also be designed for aesthetical improvement of the system. The report section may also include more types of report with graphical representation based on the requirement of the management. An integrated backup restore system can also be added with the application. If data input load increases than additional tier can be implemented for making the system more robust. Considering benefits such as reduction of redundancy, avoidance of inconsistency, sharing of data, enforcement of standards, application of security restrictions and maintaining of data integrity the system may be implemented in proprietary Oracle RDBMS environment.

REFERENCES

- [1] http://www.bkmea.com/facts_figures.php (last access on March, 2009).
- [2] Delery, J. E. and Shaw, J. D., "The strategic management of people in work organizations: Review, synthesis and extension." In Proceedings *Research in Personnel and Human Resource Management*, 2001, Edited by K. M. Rowland and G. R. Ferris, Greenwich, CT: JAI Press, USA, pp. 165–197, 2001
- [3] Datta, D. K., Guthrie, J. P. and Wright, P. M., "Human Resource Management and Labor Productivity: Does Industry Matter?", *Academy of Management Journal*, vol. 48, no. 1, pp. 135-145, 2005.
- [4] Wheeler, D. A., http://www.dwheeler.com/oss_fs_why.html (last access on March, 2009).
- [5] Sam-Bodden, B. and Judd, C., "Enterprise Java Development on a Budget: Leveraging Java Open Source Technologies", Berkeley, Apress, USA, 2004.
- [6] Ron Goldman, R. P., "Innovation Happens Elsewhere", San Fransisco, USA, Morgan Kaufmann, 2005.
- [7] Sasha P. A., "MySQL Enterprise Solutions", Indianapolis, Indiana, USA, Wiley Publishing, 2003.
- [8] Razzaque, M.A., "Trade Liberalization and Poverty Linkage: RMG and Mobile Phone Sectors in Bangladesh" in Proceedings *TDP National Dialogue 2006*, University of Dhaka, Bangladesh, 2006.
- [9] Urminsky, M., "Self-regulation in the Workplace: Codes of Conduct, Social Labelling and Socially Responsible Investment", Working Paper No.1, International Labour Office, Geneva, Switzerland, 2001.

- [10] Stefanie, B. H., "Does Corporate Social Responsibility Need Social Capital?", *The Journal of Corporate Citizenship*, vol. 23, pp. 81-91, 2006.
- [11] Miller, D., Nuon, V., Aprill, C. and Certeza, R., "Business as usual? governing the supply chain in clothing post MFA phase out : the case of Cambodia", International Labour Office, Geneva, Switzerland, 2007.
- [12] Witte, J. M., "Realizing Core Labor Standards, The potential and limits of voluntary codes and social clauses, A review of the literature", Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Eschborn, Germany, 2008.
- [13] FSF, "Free software is a matter of liberty not price. You should think of free as in free speech", Free Software Foundation, Inc., Boston, U.S.A., 2009.
- [14] FSF, "The GNU Operating System", Free Software Foundation, Inc., Boston, U.S.A., 2009.
- [15] FSF, "GNU General Public License", Free Software Foundation, Inc., Boston, U.S.A., 2009.
- [16] Pawlak, M., Bryce, C. and Lauriere, S., "The Practice of Free and Open Source Software Processes", Centre de recherche INRIA Rennes – Bretagne Atlantique, Rennes Cedex, France, 2008.
- [17] Kelty, C. M., "The Cultural Significance of Free Software, Two Bits", Duke University Press, U.S.A., 2008.
- [18] Perens, B., "Open Sources: Voices of the Open Source Revolution", Edited by DiBona, C., Ockman, S. and Stone, M., O'Reilly Media. Inc, California, U.S.A., 1999.

- [19] Hughes, D., *"Fundamentals of Computer Science Using Java"*, Jones and Bartlett Publishers, Massachusetts, U.S.A., 2002.
- [20] Deitel, P. J. and Deitel H. M., *"Java for Programmers: Deitel Developer Series"*, Pearson Education, Inc., New Jersey, U.S.A., 2009.
- [21] Widenius, M. M., Axmark, D. and MySQL AB, *"MySQL Reference Manual"*, Edited by Oram, A., O'Reilly Media. Inc, California, U.S.A., 2002.
- [22] Matthews, M., Cole, J. and Gradecki, J.D., *"MySQL and Java Developer's Guide: Java Open Source Library"*, John Wiley and Sons, California, U.S.A., 2003.
- [23] O'hara, J; Kay, S. J (2003) *"Open Source Software and Computer Science Education"* Journal of Computing Sciences in Colleges, Volume 18, Issue 3, pp 1-7
- [24] Bagui, S. and Earp, R., *"Database Design Using Entity Relationship Diagrams"*, CRC Press LLC, Florida, U.S.A., 2003.
- [25] Karen, J. R., Curtis, R. C., Margaret, M. B., Justin, S., Green, T. R. G., and Gregg, R., *"WYSIWYT testing in the spreadsheet paradigm: an empirical evaluation"*, In Proceedings of the 22nd International Conference on Software Engineering, pp. 230-239, ACM Press, 2000.
- [26] Zhu, H., Hall, P. A. V., and May, J. H. R., *"Software unit test coverage and adequacy"*, ACM Computing Surveys, vol. 29, no. 4, pp. 366-427, 1997.
- [27] Marick, B., *"When should a test be automated?"*, In Proceedings of the 11th International Quality Week Conference, San Francisco, California, U.S.A., pp. 26-29, 1998.

[28] Sommerville, I., "*Software Engineering*". Addison-Wesley, 6th edition, California, U.S.A, 2000.

[29] Onoma, A. K., Tsai, W. T., Poonawala, M., and Suganuma, H., "*Regression testing in an industrial environment*", Communications of the ACM, vol. 41, no. 5, pp. 81-86, 1998.

APPENDIX – I

Questionnaires for Factory Audit

DOCUMENT REVIEW

Factory Name:

Address :

Product :

Total Work Force :

Sl. No.	Items	Yes	No	N/A
A DOCUMENTATION :				
A.1 LEGAL AND OTHER REQUIRMENTS				
A.1.1	I. Trade II. Bond III. ERC IV. IRC			
A.1.2	I. Factory License II. EPB Certificate			
A.1.3	I. Environmental Clearance II. Fire License			
A.1.4	I. TIN II. VAT III. Group insurance certificate.			
A.1.5	BGMEA/BKMEA Membership Certificate.			
A.1.6	I. Boiler License II. Boiler operator's operating license.			
A.1.7	Generator installing permission.			
A.1.8	I. Wastage II. Drinking water test report.			
A.1.9	Permission and approval on Factory site plan and Building			
A.1.10	Does factory maintain following registers is maintain : I.Attendance II. Leave III. Maternity IV. Adolescent V. Fire drill VI. Fire Fighting Training VII. Machineries & Fire equipment check VIII. First aider Training IX. First Aid equipments supply X. Cle			
A.2 EMPLOYMENT DOCUMENTS :				
A.2.1	Are there I. Job application (CV) with photo II. Age certificate III. Appointment letter (Received) in each workers personal file?			
A.2.2	Does the Factory maintain I. Service book II. Leave form III. Increment or Promotion letter IV. Performance Appraisal V. Disciplinary action (if any) for each workers.			
A.2.3	Does the management provide I. Appointment letter II. Handbook III. I.D card to the workers?			
B MANAGEMENT PRACTICE :				
B.1 POLICY AND OTHER PRACTICE				
B.1.1	Is there a Human Resource / Compliance Officer?			
B.1.2	Is a Welfare Officer employed in the factory (For factories with more than 500 workers)?			
B.1.3	Is there I. Recruitment II. Leave III. Maternity benefit IV. Working hour V. Overtime VI. Deduction VII. Child labor VIII. Forced Labor IX. Discrimination X. Wages calculation & Payment XI. Abuse & Harassment XII. Health & Hygiene XIII. Gender equality XIV.			
B.1.4	Are there any worker associations in the factory?			
B.1.5	If yes, was the association formed by rules ?			
B.2 DISCRIMINATION :				
B.2.1	Is there No-discrimination in Employment, Promotion and Occupation by Age, Race, Ethnic group, Religion, Political affiliation or National origin?			
B.2.2	Do the management not test pregnancy at the time of recruitment?			
B.2.3	Is there any No-discrimination in the factory regarding Appointment, Salary & OT between Male and Female workers?			
C WORKING HOUR, WAGES AND BENEFITS :				
C.1 DAILY ATTENDANCE :				
C.1.1	Is actual in & out time mentioned in the manual or punching time card?			
C.1.2	Is leave/absent information mentioned in time card?			
C.1.3	Does the time card signed by I. Time keepers II. Workers III. Management?			
C.2 WORKING HOUR :				
C.2.1	Does I. General working hour and II. OT limitation comply with local labor law?			
C.2.2	Are female workers not allowed to work in factory after 8pm?			
C.2.3	Is 7th day rest policy or weekly holiday practiced regularly ?			
C.3 WAGES :				
C.3.1	Are workers wages & OT paid at together time in cash?			
C.3.2	Does the management maintain the salary sheet with I. Salary breakdown II. Revenue stamp III. Workers signature IV. Signature of Designated person V. Proper deduction?			
C.3.3	Is O.T calculation maintained according to local labor law?			
C.3.4	Does the management provide Pay Slip before payment ?			
C.4 LEAVE :				
C.4.1	Does the management grant I. Annual, II. Casual, III. Sick, IV. Festival leave? (If yes, please check some files for evidence)			
C.4.2	Does the management grant maternity leave to the eligible workers with pay? (If yes please check some files for evidence)			
D OCCUPATIONAL HEALTH AND SAFETY :				
D.1 HEALTH & HYGIENE :				
D.1.1	Are regular I. Doctors and II. Nurse appointed in the factory? (If yes, please check their personal File)			
D.1.2	Is there a trained First Aid in-charge for each First-Aid box? (Please check individual's personal file for evidence)			
D.2 SAFETY & FIRE SAFETY :				
D.2.1	Does the factory have Safety & Fire fighting team? (Check for evidence)			
D.2.2	Are adequate nos. of person I. Trained in fire fighting with their II. Names & certificate kept in the personal file? (Please check for evidence)			

Note:

Name of Auditors:

Signature

VISUAL INSPECTION

Factory Name:

Address :

Date:

Sl. No.	Items	Yes	No	N/A
B. MANAGEMENT PRACTICE :				
B.3 Posting of the Code & Policies:				
B.3.1	Is the company's Code of Conduct posted in prominent places throughout the factory in local language?			
B.3.2a	Has the factory posted national and local labor laws in prominent places in local language?			
B.3.2b	Which policies/procedures are posted in prominent places/notice board and in local language? Please mark.			
B.3.3	Recruitment Policy			
B.3.4	Leave Policy			
B.3.5	Policy regarding Forced Labor & discrimination			
B.3.6	Policy regarding Disciplinary Practice			
B.3.7	Policy regarding abuse & harassment			
B.3.8	Safety, Health & Hygiene Policy			
B.3.9	Environment Policy			
B.3.10	Deduction Policy			
B.3.11	Maternity benefit			
B.3.12	OT Calculation			
B.3.13	Working Hour			
B.3.14	Notice about Payment Policy			
B.3.15	Safety signs, posters or notice using text or pictures			
B.4 Fire Safety/Evacuation Procedures:				
B.4.1	Is there 'Fire Evacuation Plan' posted in local language in prominent places throughout the factory?			
B.4.2	Are the photos & identity of Fire/Safety team members posted in the prominent place of the factory?			
B.4.3	Are all Fire Fighters dressed with Yellow Jacket?			
B.4.4	Are Aisles and Gangways 1) Clearly marked 2) Free from obstacles?			
B.4.5	Are all exits 1) Unblocked 2) Unlocked and 3) Open Outward/Sideways (or if exit is a roller door, is it kept fully open during working hours)?			
B.4.6	Does the number of fire exits/escapes meet local law requirements?			
B.4.7	Are Staircases and Exits equipped with handrails?			
D. OCCUPATIONAL HEALTH AND SAFETY:				
D.3 FIRE Equipment:				
D.3.1	Are there adequate Fire Extinguishers (1:1000sq feet) placed in the work floor.			
D.3.2	Are Fire Extinguishers with 1) Fully charged 2) Current inspection date?			
D.3.3	Are the Fire Extinguishers 1) Properly marked 2) Easily accessible for worker?			
D.3.4	Is the Operating procedures posted near each fire extinguisher?			
D.3.5	Does Emergency Light 1) Functioning when electricity is off 2) Installed to ensure illumination of exit paths?			
D.3.6	Is there 1) Fire alarm bell 2) Switch installed with IPS support in the factory?			
D.3.7	Are there enough active Smoke Detectors?			
D.3.8	Are the Fire hose systems covers the total floor factory?			
D.3.9	Is there separate Water Tank to supply Fire hose?			
D.3.10	Are there adequate 1) Sand bucket 2) Fire bucket 3) Water drum 4) Stretcher 5) Lock cutter 6) Fire bitter 7) Fire rope 8) Fire hook 9) Fire blanket 10) Helmet 11) Gas mask installed at prominent place of the factory.			
D.3.11	Are all fire fighting equipments easily accessible to all workers?			
D.4 Electrical Wiring:				
D.4.1	Are electrical cables or wires 1) Properly covered by panel boards 2) Marked with "Danger"?			
D.4.2	Are electrical wires properly taped?			
D.4.3	Is electrical equipment properly grounded?			
D.4.4	No electrical wires found in 1) Damp areas 2) Near fuel source.			
D.4.5	No electrical wires found obstructing aisles or passage.			
D.4.6	No electrical wiring found inside the bonded warehouse.			
D.5 Medical Facilities and First Aid:				
D.5.1	Is the number of First Aid Box in the floor appropriate according to labor law? (1 boxes per 150 workers)			
D.5.2	Are the First Aid Boxes 1) Near the work place 2) Easy accessible?			
D.5.3	Are the First Aid boxes available with adequate equipment?			
D.5.4	Is there 1) First Aid Procedure 2) Equipment list posted near each First Aid Box?			
D.5.5	Are photos & identity of first aid personal posted near first aid box ?			
D.5.6	Does the first Aider use white apron?			
D.5.7	Is there any 1) Doctors Room with 2) Trained medical personnel on site?			
D.5.8	If yes, is the Doctors Room properly well equipped and filled with adequate medicine?			

D.6 Machine Guarding:
D.6.1 Are the 1) Noise control and 2) Ventilation of factory Machinery adequate to protect against fire or health hazards?
D.6.2 Does machinery have 1) Appropriate lockout equipment and 2) Functioning?
D.6.3 Does machinery has proper safety guard, such as upper/Lower pulley cover, Eye guard, needle guard, etc.?
D.6.4 Are machines & machine motors are properly cleaned?
D.6.5 Is oil level of machinery appropriate?
D.6.6 Are switchboards placed near to all machinery?
D.6.7 Is the Generator placed separate from work place?
D.6.8 Is the boiler room separate from work place?
D.7 Personal Protective equipments:
D.7.1 Is Cutter man using 1) Metal Hand gloves & 2) Mask?
D.7.2 Are Masks used for 1) Over-lock and 2) other sections operators where applicable?
D.7.3 Is Boiler operator provided with protective 1) Uniform 2) Boots 3) Gloves 4) Glass etc.?
D.7.4 Is Generator Operator provided with protective 1) Uniform 2) Boots 3) Gloves 4) Glass 5) Air plug/year muff etc.?
D.7.5 Is Spot remover using protective equipments like 1) Goggles 2) Finger guard 3) Mask etc.
D.8 Hazardous and Combustible/flammable Materials:
D.8.1 Is the MSDS posted for the safe handling of hazardous chemicals and materials in local Language?
D.8.2 Are hazardous chemicals and combustible materials segregated from the workplace?
D.8.3 Are hazardous chemicals and combustible 1) Properly contained and 2) Clearly marked?
D.8.4 Is there a source of water and appropriate medical supplies in or near the chemical storage area?
D.8.5 Are workers using hazardous chemicals and materials with all protective items?
D.8.6 Are hazardous materials and chemicals properly disposed off?
D.8.7 Is there Separate 1) Spot Removing Room 2) With all protective items?
E. WORKPLACE ENVIRONMENT:
E.1 WORKPLACE COMFORT AND CLEANLINESS:
E.1.1 Is the Floor/Factory Surroundings Appears clean?
E.1.2 Is the workplace 1) Well ventilated and 2) Well lighted?
E.1.3 Is the factory adequately Heated/Cooled?
E.1.4 Is the Noise limit of work area acceptable?
E.1.5 Is Drinking water supply place 1) Easy accessible & 2) At least 20"(twenty feet) far from toilet or urinals?
E.1.6 Is drinking water place marked with "Drinking Water" in local language?
E.1.7 Are the 1) Width and 2) Angle of factory staircase 45" (inch).
E.1.8 Is there any Child Day Care Center?
E.1.9 Is the Day care center clean & hygienic?
E.1.10 Is Spittoon available in proper place?
E.1.11 Is there sufficient Notice board in the workplace?
E.1.12 Is mandatory notices are posted in the notice board?
E.1.13 Are there grievance boxes in the floor in 1) Secret places 2) Labeled 3) Uses hints?
E.1.14 Are their any 1) Child labors 2) Adolescent workers working in work floor?
E.2 TOILET FACILITIES:
E.2.1a Does the number of toilets comply with local labor law?
E.2.1b Number of toilets
E.2.2 Are the toilets properly 1) Cleaned 2) Dry 3) Well ventilated 4) Odorless?
E.2.3 Are there an adequate number of sinks with proper water supply?
E.2.4 Is toilet decorated with 1) Soaps 2) Towels 3) Slipper 4) Tissue papers etc?
E.2.5 Are Covered basket provided to all ladies toilets?
E.3 DINING FACILITIES:
E.3.1 Are Dining hall provided for worker?
E.3.2 If so, are the dining facilities clean?
E.3.3 Is the 1) Temperatures 2) Ventilation 3) Lightings adequate?
E.3.4 Are there proper seating facilities for eating?
E.4 STORES AND BONDED WEREHOUSE MANAGEMENT:
E.4.1 Is height of stacked empty cartoning not more than 6 feet?
E.4.2 Is there sufficient separate space for 1) Idle machine 2) Accessories 3) Fabric with pallets are provided?
E.4.3 Are rows between lines are clearly marked (in warehouse)?
E.4.4 Are separate sufficient space provided for finished goods and height not more than 5 feet?
E.4.5 Is separate storage area provided for chemicals?
E.4.6 Are chemical containers properly labeled and empty chemical container kept separately?
E.4.7 Are Inflammable & Flammable materials kept in safe place?

Note:

Name of Auditors:

Signature

VERIFICATION OF WORKERS AWARENESS

Factory Name:

Address :

Date:

Sl. No.	Items	Yes	No	N/A
C. WORKING HOURS, WAGES AND BENEFITS:				
C.5 WORKING HOUR, WAGES AND LEAVE:				
C.5.1	Does your general working hours comply with local labor law?			
	What is your general working hour?	8 Hours	10 Hours	
C.5.2	Does your overtime work comply with overtime limitation of law?			
	What is the longest hours that you usually work in a Month?	52 Hours	60 Hours	100 Hours
C.5.3	Does the factory provide any facility when you work overtime?			
	If yes, please mention	Food	Food allowance	Transport
C.5.4	Do you enjoy weekly holiday?			
	If yes/no, please mention	Every week	twice in a Month	Never
C.5.5	Do you receive your salary timely?			
	When do you receive your salary?	By 07th	By 10th	Later than 10th
C.5.6	Do you know what is the government's declaration about minimum wage rate?			
	If yes, please mention how much?			
C.5.7	Do you know government's declaration about overtime wage rate ?			
	If yes, please mention	Double to basic	Based on hours	
C.5.8	Do you know the overtime rate you receive per hour?			
	If yes, please mention	Double to basic	Based on hours	
C.5.9	Do you receive your overtime wages with salary?			
C.5.10	Do you receive pay slip?			
C.5.11	Does management grant leave as per your need?			
C.5.12	Do you know what types of leave you are entitled to enjoy?			
	If yes, please mention	Annual	Casual	Sick Festival
C.6 BENEFITS/FACILITIES:				
C.6.1	Have the factory management			
	If yes, how were you informed?	Orally	Handbook	Policy Training
	Facilities At Factory:			
C.6.2	Insurance for workplace injury			
C.6.3	Dining facility			
C.6.4	Medical care			
C.6.5	Health card			
C.6.6	Handbook on company rules/facility			
C.6.7	Bonus			
B. MANAGEMENT PRACTICE :				
B.5 CHILD LABOR:				
B.5.1	Do you know what is the minimum age for working in factory ?			
	If yes, please mention	14	16	18
B.5.2	When you joined the factory did the factory verify your age?			
	If yes, please describe	Doctor's certificate	Did not check	
B.6 EMPLOYMENT CONDITION:				
B.6.1	Did you receive an appointment letter from the factory?			
B.6.2	Do you know the condition of termination?			
B.6.3	Does the management fulfill the condition during termination of any worker?			
	If no, please mention the practice?	With 15 days notice	Do not give due payment	Terminate right at that moment without any compensation Others
B.7 FORCED LABOR:				
B.7.1	Is there anyone not forced to			
	If yes, please specify			
B.7.2	Do you do overtime in a voluntary basis?			
B.7.3	Do the worker not forced to work overtime during peak season?			
	If yes, please mention	Sometimes	Most of the times	Participate voluntarily
B.8 FREEDOM OF ASSOCIATION:				
B.8.1	Does the management allowed to join any workers association?			
B.8.2	Does the management allowed to establish any workers association?			
B.8.3	Do you know is there any worker association (WRFDC) here?			
B.8.4	Do you know the member's of worker association?			
B.8.5	Do you know the function of the association?			
	If yes, please describe			

B.9 NON-DISCRIMINATION:				
B.9.1 Do the workers get promotion as per work performance?				
If no, please mention				
B.9.2 Do the workers get increment as per work performance?				
If no, please mention				
B.9.3 Does the management pay equal				
If no, please mention				
B.10 MATERNITY PROTECTION:				
B.10.1 Do you know the provision of maternity benefit?				
If yes, please mention how long?				
B.10.2 Does the management provide				
B.10.3 Does the factory provide any facility				
If yes, please describe		Regular Medical check up	Medicine supply	A short break in working
		Allow leaving 5		Light/risk free work
B.10.4 Does the factory provide short break for breast-feeding workers?				
B.11 GRIVANCE PROCEDURE:				
B.11.1 Do you make any complain or suggestion to the management?				
If yes, please mention how do you make?		Sup/L.chief/ Apm/Pm	Compliance/HR/ Admin officer	Suggestion box
B.11.2 Is there any suggestion box inside the				
If yes, where is the box?		In bathroom	Dining	Others
B.11.3 Do you know the procedure of handling suggestion box?				
B.12 HARASSMENT OR ABUSE:				
B.12.1 Have never took any steps from				
If yes/no, please describe		Work excessive overtime	No pay work	Fulfill next day
				Any form of harassment or abuse
B.12.2 Have you never experience any harassment or abuse in this factory?				
If no, please mention		Verbal abuse	Physical harassment	Any sort of work related threat
B.12.3 Has there been no incident of				
If no, please mention		Verbal	Physical	By disciplinary practice
B.12.4 Do you know the factory has any rules against harassment or abuse?				
To whom can you post your complain?		Sup/L.chief/ Apm/Pm	Compliance/HR/ Admin officer	Direct to the management
B.12.5 Has the factory never docked your salary as punishment for any reason?				
If no, please mention		Late fine	Mistake in work	Failed to fulfill target
				Misconduct
B.12.6 Does the management follows the rule of docked amount?				
If no, how much was taken away from your salary?		0-50	50-100	100-150
				Half of the salary
D. OCCUPATIONAL HEALTH AND SAFETY:				
D.9 HEALTH AND SAFETY:				
D.9.1 Does the factory provide in house medical facility for workers?				
If yes, please mention		First aid	Taken to Factory doctor	Provide medicine
D.9.2 Does the factory hold regular fire drills?				
If yes/no, please mention		Once in a month	Once in every 3 months	Never
D.9.3 Does the management provide				

Note:

Name of Auditors:

Signature

APPENDIX – II

Relationship between the Heading and Questions

QUESTIONS UNDER HEADINGS

Code/ Compliance issue	Level Of Importance	Question Ratio
1. Code posting and awareness		
Code posting/information	Medium	V- B.3.1 to B.3.15 = 15
2. Management Practice		
Compliance / Welfare Officer	Medium	D-B.1.1 to B.1.2 = 2
License & certificate	High	D-A.1.1 to A.1.9 = 18
Policy	Medium	D-B.1.3 = 17
Register	Medium	D-A.1.10 = 16
Attendance Card	High	D-C.1.1 to C.1.3 = 5
Pay statement	High	D-C.3.1 to C.3.4 = 8 W-C.5.5 & C.5.10=2
3. Recruitment procedure		
Recruitment Procedure	High	D-A.2.3 = 3
Employment Records	High	D-A.2.1 to A.2.2 = 8 W-B.6.1=1
4. Forced Labor		
Forced Labor	High	W-B.7.1 to B.7.3=3
5. Child Labor		
Employment of Child labor	High	W-B.5.1 to B.5.2=2
6. Hours of Work		
Working hour	High	D-C.2.1 to C.2.3 = 4 & W-C.5.1 & C.5.4=2
Overtime Limitations	High	W-C.5.2=1
7. Leave		
Leave	High	D-C.4.1 to C.4.2=5
8. Wages and Benefits		
Minimum Wage, Benefits, Basic calculation, & Awareness on these issues	High	W-C.5.3,(C.5.6 to C.5.7), (C.5.11 to C.5.12) =5 W-C.6.1 to C.6.7 =7 W-B.5.1=1 W-B.10.1 to B.10.4 =4
9. Overtime Compensation		
OT Compensation	High	W-C.5.7 to C.5.9=3
10 Harassment or Abuse		
Harassment/Abuse	High	W-B.12.1 to B.12.6=6
Disciplinary Practices	Medium	W-B.6.2 to B.6.3=2
11. Discrimination		
Discrimination on age, sex, race etc.	High	D-B.2.1 to B.2.3 = 3 W-B.9.1 to B.9.3=3

12. Safety & Health requirements		
Fire Extinguisher & Fire Hose	High	V- D.3.1 to D.3.4 = 6 & V- D.3.8 to D.3.9 = 2
Other Safety & Fire Equipments	High	V- D.3.5 to D.3.7 & D.3.10 to D.3.11 = 17
Electrical Wiring	High	V- D.4.1 to D.4.6 = 8
Aisles, Gangway and Floor Marking	High	V- B.4.4 = 2
Exit & Emergency Exit	High	V- B.4.5 to B.4.7 = 5
Safety team and fire fighting training	High	D -D.2.1 to D.2.2 = 3 V-B.4.2 to B.4.3 = 2 W-D.9.3 = 1
Evacuation Procedure	High	V-B.4.1 = 1 W-D.9.2 = 1
First Aid & Medical facility	High	D-D.1.1 to D.1.2 = 3 V- D.5.1 to D.5.8 = 11 W-D.9.1 = 1
Personal Protective Equipment (PPE)	High	V- D.7.1 to D.7.5 = 16
Chemical Management	Medium	V- D.8.1 to D.8.7 = 9
13. Workplace environment/condition and facilities for workers		
Workplace comfort and cleanliness	High	V- E.1.1 to E.1.7 = 10
Drinking Water Facility	High	V- E.1.9 to E.1.10 = 5
Dining Facility	High	V- E.3.1 to E.3.4 = 6
Toilet and Washing Facility	High	V- E.2.1 to E.2.5 = 11
Notice board	Low	V- E.1.12 to E.1.13 = 2
Machinery Maintenance	High	V- D.6.1 to D.6.8 = 12
Child Care Centre	Medium	V- E.1.11 to E.1.12 = 2
Complain/suggestion Box	Low	V- E.1.14 = 3 W-B.11.1 to B.11.3 = 3
14. Freedom of Association and Collective Bargaining		
Freedom of Association & collective bargaining	Low	D-B.1.4 to B.1.5 = 2 W-B.8.1 to B.8.5 = 5
15. Miscellaneous		
Store management	Medium	V- E.4.1. To E.4.6 = 7
Warehouse	Medium	V- E.4.7 = 4

APPENDIX – III

Sample Code

```

package nuk.data;

import javax.swing.table.AbstractTableModel;
import java.util.Vector;
5 import java.sql.Connection;
import java.sql.SQLException;
import java.sql.Statement;
import java.sql.ResultSet;

10 public class FullSummaryReport extends AbstractTableModel
{
    private final Object [][] data;
    int datacount=0;

15 public FullSummaryReport ()
{
    Vector vccSubcategory = null;
    try {
20         vccSubcategory = getData();
    }
    catch (Exception ex) {
        javax.swing.JOptionPane.showMessageDialog (null, ex.getMessage (), "Error
Message", javax.swing.JOptionPane.ERROR_MESSAGE);
    }
25     data = new Object [vccSubcategory.size()][13];

    int internalCount=0;
    String factoryName="";
    String [] grades=new String [6];
30 String [] gradeDates=new String [6];
    Vector vcSubcategory = new Vector ();
    for (int i = 0; i<vccSubcategory.size();i++)
    {
        vcSubcategory =(Vector) vccSubcategory.get(i);
35         String Grade="";
        String GradePoint=String.valueOf(Math.round(Float.parseFloat(vcSubcategory
y.get(1).toString())));
        if(Double.parseDouble(vcSubcategory.get(1).toString()) < 30.00) Grade="E("
+GradePoint+")";
        if(Double.parseDouble(vcSubcategory.get(1).toString()) >= 30.00 &&
Double.parseDouble(vcSubcategory.get(1).toString()) < 50.00) Grade="D("
+GradePoint
40         +")";
        if(Double.parseDouble(vcSubcategory.get(1).toString()) >= 50.00 &&
Double.parseDouble(vcSubcategory.get(1).toString()) < 70.00) Grade="C("
+GradePoint
+")";
        if(Double.parseDouble(vcSubcategory.get(1).toString()) >= 70.00 &&
Double.parseDouble(vcSubcategory.get(1).toString()) < 85.00) Grade="B("
+GradePoint
+")";
        if(Double.parseDouble(vcSubcategory.get(1).toString()) >= 85.00) Grade
="A("
+GradePoint
+")";

        if(factoryName.equalsIgnoreCase (""))
        {
45             factoryName=vcSubcategory.get(0).toString();
            grades[Integer.parseInt(vcSubcategory.get(3).toString())-1]=Grade;
            gradeDates[Integer.parseInt(vcSubcategory.get(3).toString())-1]
=vcSubcategory.get(2).toString();
            // grades[internalCount]=Grade;
            // gradeDates[internalCount]=vcSubcategory.get(2).toString();
50             internalCount++;
        }
        else if(factoryName.equalsIgnoreCase (vcSubcategory.get(0).toString()))
        {
            grades[Integer.parseInt(vcSubcategory.get(3).toString())-1]=Grade;
55             gradeDates[Integer.parseInt(vcSubcategory.get(3).toString())-1]
=vcSubcategory.get(2).toString();
            internalCount++;
        }
    }
}

```

```

        else if(!factoryName.equalsIgnoreCase(vcSubcategory.get(0).toString()))
        {
60      data[datacount]=new Object[]{ factoryName,grades[0],gradeDates[0]
,grades[1],gradeDates[1],grades[2],gradeDates[2],grades[3],gradeDates[3]
,grades[4],gradeDates[4],grades[5],gradeDates[5]};
        for(int j=0;j<6;j++){grades[j]="";gradeDates[j]="";}
        datacount++;
        internalCount=0;
        factoryName=vcSubcategory.get(0).toString();
65      grades[Integer.parseInt(vcSubcategory.get(3).toString())-1]=Grade;
        gradeDates[Integer.parseInt(vcSubcategory.get(3).toString())-1]
=vcSubcategory.get(2).toString();
        internalCount++;
        }
70      if(internalCount > 0)
        {
            data[datacount]=new Object[]{ factoryName,grades[0],gradeDates[0]
,grades[1],gradeDates[1],grades[2],gradeDates[2],grades[3],gradeDates[3]
,grades[4],gradeDates[4],grades[5],gradeDates[5]};
            datacount++;
        }
75      //      count+=i;
        //      }
    }

    /**
80     * Returns the number of rows in the table model.
     *
     * @return the row count.
     */
    public int getRowCount ()
85    {
        return datacount;
    }

    /**
90     * Returns the number of columns in the table model.
     *
     * @return the column count.
     */
    public int getColumnCount ()
95    {
        return 13;
    }

    /**
100    * Returns the class of the data in the specified column.
     *
     * @param column the column (zero-based index).
     * @return the column class.
     */
105    public Class getColumnClass (final int column)
    {
        return String.class;
    }

    /**
110    * Returns the name of the specified column.
     *
     * @param column the column (zero-based index).
     * @return the column name.
     */
115    public String getColumnName (final int column)
    {
        if (column == 0)
        {
120            return "name";
        }
    }

```

```

        else if (column == 1)
        {
            return "Audit1";
125     }
        else if (column == 2)
        {
            return "Date0";
        }
130     else if (column == 3)
        {
            return "1FU";
        }
135     else if (column == 4)
        {
            return "Date1";
        }
        else if (column == 5)
140     {
            return "2FU";
        }
        else if (column == 6)
145     {
            return "Date2";
        }
        else if (column == 7)
        {
            return "3FU";
        }
150     else if (column == 8)
        {
            return "Date3";
        }
        else if (column == 9)
155     {
            return "4FU";
        }
        else if (column == 10)
160     {
            return "Date4";
        }
        else if (column == 11)
        {
            return "5FU";
165     }
        else if (column == 12)
        {
            return "Date5";
        }
170     else
        {
            return null;
        }
    }
175

/**
 * Returns the data value at the specified row and column.
 *
 * @param row the row index (zero based).
 * @param column the column index (zero based).
 * @return the value.
 */
public Object getValueAt (final int row, final int column)
185 {
    return data[row][column];
}

private Vector getData ()
190 {
    Vector vccCategory=new Vector();

```

```

Vector vcCategory=null;
Connection conn=null;
Statement stmt=null;
ResultSet rs=null;
195 // String query="select name,(sum(yesn)*100)/(sum(yesn)+sum(non)+sum(nan))
from summaryfactory "
//      +" sf,factory f where sf.factoryid=f.id group by name";
String query="      select name,format((sum(yesn)*100)/(sum(yesn)+sum(non)
+sum(nan)),2) per, " +
      "date_format(sdate,'%d/%c/%y') as sdate,auditno from summaryfactory
,factory where " +
      "summaryfactory.factoryid=factory.id " +
200      "group by name,auditno " +
      "order by name,auditno " ;
System.out.println(query);
try {
    conn = createCon();
205    stmt=conn.createStatement();
    rs=stmt.executeQuery(query);
    int j=0;
    while (rs.next()) {
        int i=0;
210        vcCategory=new Vector();
        vcCategory.add(i++,rs.getString(1));
        vcCategory.add(i++,rs.getString(2));
        vcCategory.add(i++,rs.getString(3));
        vcCategory.add(i++,rs.getString(4));
215        vccCategory.add(j++,vcCategory);
    }

}
220 catch (Exception ex) {ex.printStackTrace();
}
return vccCategory;
}
private Connection createCon() throws SQLException
225 {
    Connection conn = null;
    try {
        conn = nuk.util.DBConnectionFactory.getDirectConnection();
    }
    catch (Exception ex) {
230        conn=null;
        throw new SQLException("Cannot create connection to database" );
    }
    if ( conn == null){
235        throw new SQLException("Cannot create connection to database" );
    }
    return conn;
}
240 }

```

