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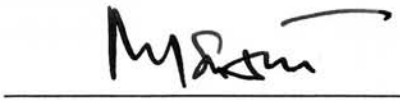

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DEVELOPMENT OF WEB BASED SAFETY AUDIT OCCUPATIONAL SAFETY AND HEALTH ON CONSTRUCTION SITES IN MALAYSIA

TAN WEI KEAT

A project report submitted in partial fulfillment of the
requirement for the award of the degree of
Master of Science (Construction Management)

Faculty of Civil Engineering
Universiti Teknologi Malaysia

MAY, 2008

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To my lovely Wife, my beloved mother, my lecturers and all my friends……

Thanks for all the love, support and encouragement……

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ABSTRACT

Safety audit on construction sites in Malaysia is conduct quarterly by experienced and trained DOSH officer manually. The safety audit consists of 20 elements and 94 sub-elements based on Guideline for Public Safety and Health at construction sites by OSHA 94. Manual safety audit is time consuming and required many man power. Therefore this study has been conducted with aim to develop a web based safety audit. Before the website being develop, a through investigation has been conducted to determine current approach safety audit and their limitation and then develop a data flow model for existing safety audit. Based on the information gathered, a web based safety audit for Windows® XP has been developed using JavaScript with VBScript written in ASP pages. Developed web based safety audit is then validated by DOSH officer and tested on sample data from DOSH. Questionnaire has been used to validate web based safety audit in term of its usability and effectiveness. Output generated by web based safety audit is more accurate compared to result calculated manually by DOSH officer. This web based safety audit can help to perform safety audit on construction sites faster, more efficiently and accurately.

ABSTRAK

Audit keselamatan di tapak pembinaan dalam Malaysia dijalankan dalam sukuan tahuanan oleh pegawai JKKP yang berpengalaman dan terlatih secara manual. Audit keselamatan ini mengandungi 20 element dan 94 sub-element berpandukan Panduan untuk Keselamatan dan Kesihatan Awan di Tapak Pembinaan oleh AKKP 94 (*Guideline for Public Safety & Health at Construction Sites by OSHA 94*). Audit keselamatan manual adalah makan masa dan memerlukan tenaga kerja yang banyak. Oleh itu kajian ini dilaksanakan dengan tujuan untuk membangunkan satu audit keselamatan laman layaran. Sebelum laman layaran dibina, kajian terpenci dilaksanakan untuk menentukan audit keselamatan sediada and batasannya dan kemudian membuatkan model carta jalan bagi sediada audit keselamatan. Berdasarkan maklumat-maklumat yang dikumpul, satu audit keselamatan laman layaran yang operasi dalam *Windows® XP* dibina dengan menggunakan *JavaScript* dan juga *VBScript* yang ditulis dalam *ASP pages*. Audit keselamatan laman layaran yang sempurna akan diuji oleh pegawai JKKP dengan menggunakan data daripada simpanan maklumat JKKP. Kajian soal didik digunakan untuk mengkaji audit keselamatan laman layaran dalam kegunaan dan kesesuaiannya. Keluaran yang dijana oleh audit keselamatan laman layaran akan dibanding dengan keputusan yang dikira secara manual oleh pegawai JKKP. Dengan bantuan audit keselamatan laman layaran ini, audit keselamatan boleh dilakukan dengan lebih cepat, kerap dan tepat.

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LIST OF SYMBOLS AND ABBREVIATIONS

OSHA	-	Occupational Safety and Health Act, 1994
DOSH	-	Department of Occupational Safety and Health
FMA	-	Factories and Machinery Act, 1967
VBScript	-	Visio Basic Script
ASP	-	Active Server Pages
JKKP	-	*Jabatan Keselamatan dan Kesihatan Pekerjaan*
AKKP	-	*Akta Keselamatan dan Kesihatan Pekerjaan*
PDA	-	Personal Digital Assistant
SMBF	-	*System Maklumat Bersepadu Fasa*
RAP	-	Rapid Application Prototyping
EMS	-	Enforcement Management System
ICT	-	Information Communication Technology
NOP	-	Notice of Prohibition (OSHA)
NOI	-	Notice of Improvement (OSHA)
PLS	-	Notice of Immediate Prohibition (*Pemberitahuan Larangan Serta Merta*) (FMA)
PL	-	Notice of Prohibition (*Pemberitahuan Larangan*) (FMA)
OS	-	Operating System
®	-	Registered Trademark
UTM	-	*Universiti Teknologi Malaysia*
Bhd	-	*Berhad*
MPSES	-	Machinery Plant Safety Evaluation Standard
SPE	-	Safety Pre-Evaluation
SEPS	-	Safety Evaluation on Project Completion
OSECS	-	Overall Safety Evaluation of Current Status

SSE	-	Special Safety Evaluation
SMS	-	Safety Management System
CP	-	Code of Practice
EMR	-	Experience Modification Rating
ISRS	-	International Safety Rating System
PRIMA	-	Process Safety Management
REALM	-	Resource Efficient Auditing for Life Management
HSE	-	health, safety and environment
CHASE	-	Complete Health and Safety Evaluation
AHP	-	Analytic Hierarchy Process
3P+1	-	Policy Factor, Process Factor, Personnel Factor and Incentive Factor
BOWEC	-	Building Operations & Work of Engineering Construction
P.E.	-	Professional Engineer
SHW	-	Safety, Health and Welfare
FMS	-	Fencing of Machinery and Safety
PPE	-	Personal Protective Equipment
HTML	-	Hyper Text Markup Language
www	-	Worldwide Web
SGML	-	Standard Generalized Markup Language
ISO	-	International Standard
W3C	-	World Wide Web Consortium
IE	-	Internet Explorer
CSS	-	Cascading Style Sheets
IIS	-	Internet Information Services
PWS	-	Personal Web Server
SQL	-	Structured Query Language
MB	-	Mega Bytes
RAM	-	Random access memory
SHC	-	Safety and Health Committee

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CHAPTER ONE

INTRODUCTION

1.1 Background

Construction industry is known as one of the most hazardous activities. Thousands of people are killed and disabling injury annually in industrial accident. In profit driven business, it is common for construction stakeholder; owner, contractor, subcontractor or even supplier to concentrate exclusively on completing projects to meet the requirement of quality standard with focus more on completing the projects on time and allocated cost. Safety is usually treated as a secondary matter. The lack of motivation in fostering a safety culture has resulted in a poor safety record particularly in construction industries

Department of Occupational Safety and Health, DOSH (*Jabatan Keselamatan dan Kesihatan Pekerjaan, JKKP*) is the premier government authority responsible for occupational safety, health and welfare are related to the safety, health and welfare of persons at work and also other persons that affected by the activities of the persons at work.

DOSH carries out three major activities. These are standard setting, enforcement and promotion. First, DOSH continually active in generating the relevant legislation, codes of practice, guidelines, documents and brochures to guide employers and workers onwards along the path to acceptable standards of OSH in construction site. Second, DOSH conduct strategic and effective enforcement to ensure that all national OSH standards carrying legal weight, for example acts and regulations are complied with. For this purpose, DOSH maintains regional branch offices in virtually every state as well as

the Federal Territory of Kuala Lumpur. Third, DOSH keep up a leading role in promotional activities, which will definitely be continued and further strengthened, by giving OSH talks, briefings and lectures, by organizing OSH exhibitions and campaigns, etc. These has enhance OSH consciousness among employers, workers and the general public as well as to sow and nurture a "safe and healthy work" culture among employers and workers in particular and all citizens in general.

DOSH has their vision to be the ultimate champion of Occupational Safety and Health with the mission to ensure that employee safety and health is guaranteed. DOSH has quarterly performance safety audit on the safety performance on construction site in Malaysia. The objective of the safety audit at construction sites is to eliminate the non-satisfactory categories, which was a continuation objective of DOSH. Continuous efforts will ensure the achievement on the objective and a satisfactory level of safety and health at construction sites.

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Safety audit at construction sites were conducted with the aim of exacting maximum compliance with OSHA, 1994 and FMA, 1967. Feedbacks from previous operations indicate that there are still several elements causing the less than satisfactory performance. DOSH has categorized the construction sites safety compliance level into five (5) categories, namely:-

a) A – 90% to 100% - Excellence
b) B – 75% to 89% - Good
c) C – 50% to 74% - Satisfactory
d) D – 35% to 49% - Less Than Satisfactory
e) E – 0% to 34% - Poor

Actions were taken by the DOSH on those audited companies which were found to flout either FMA, 1967 or OSHA,1994 in Category D & E as below:-

NOP - Notice of Prohibition (OSHA)
Notis Larangan (AKKP)

NOI - Notice of Improvement (OSHA)
Notis Perbaikan (AKKP)

PLS - Notice of Immediate Prohibiton (FMA)
Pemberitahuan Larangan Serta Merta (AKJ)

PL - Notice of Prohibiton (FMA)
Pemberitahuan Larangan (AKJ)

DOSH had upgraded information system on department since 2004 called Integrated Information System (SMBF 1). The second phase of the Integrated Information System (SMBF 2) project is the continuation of SMBF 1 that has been completed. SMBF 2 is expected to further consolidate the Department's operations and increase productivity through several module upgrades and additions. The SMBF 2 project was started on 19 August, 2005 and expected to be complete on August 2007.

With the SMBF 2 project, DOSH gave emphasis to upgrading the SMBF 1 function, adding new modules and the improvement of workflow. Workflow is important since the system developed needed to be efficient and fast. The portal system would afford the customer the opportunity to enjoy online service such as registrations, status inquiries and updates of customer profiles. This will indirectly allow customers to manage their own data.

Apart from these, the availability of forums, surveys and questionnaires give customers the opportunity to offer their views and make themselves heard. This could potentially be a catalyst for the further development of the Department thereby helping to improve the services offered.

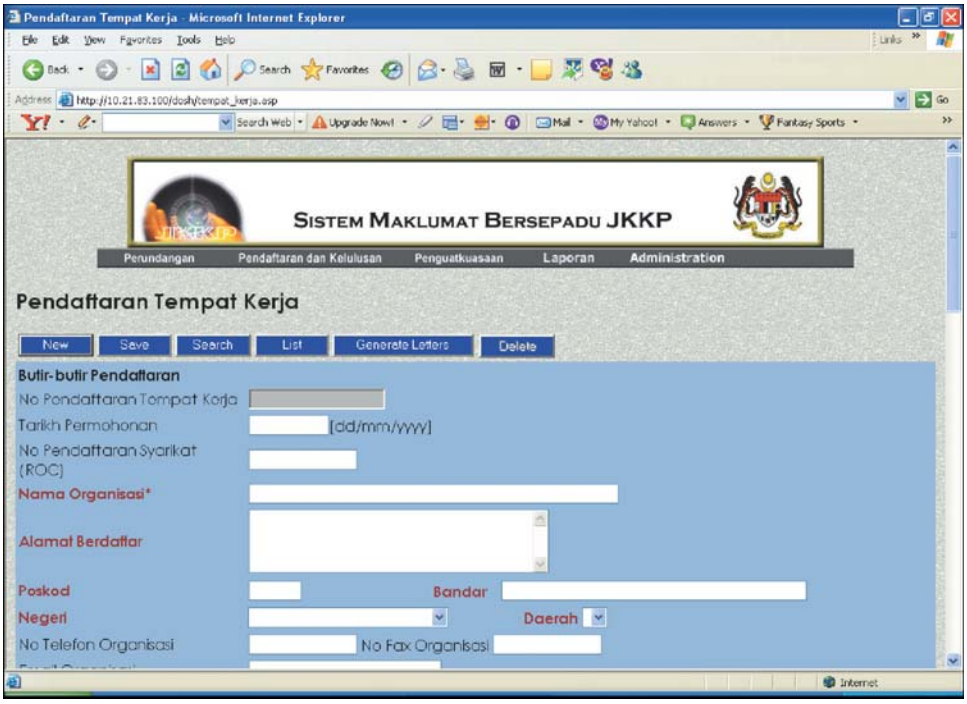

Figure 1.1: Integrated Information System of DOSH.

For 2005, the project contractor had carried out the customer needs survey which would be used to identify the needs before the development of the final system. These needs would form the basis for the system architecture when the new system was constructed.

It is hoped that the development of the system using the Rapid Application Prototyping (RAP) method would have maximum impact on the way work is carried out based on workflow. It is also hoped that this system would provide better output to enable the Department to enjoy a more excellent achievement of its objectives.

Also in 2005, the DOSH website was improved with the availability of more information on the Department's services. Apart from that, all the forms that were use were converted into online forms so that they could be downloaded in order to allow their easier accessibility through the internet. In additional, three DOSH services had been offered online myGovernment Portal; namely DOSH 6 (Notice of Accident/Hazardous Occurrence), DOSH 7 (Notice of Occupational Poisoning/Occupational Disease) and application status checks such as design approvals, or Competent Persons or Firms. These services could be accessed through DOSH official website (http://www.gov.my).

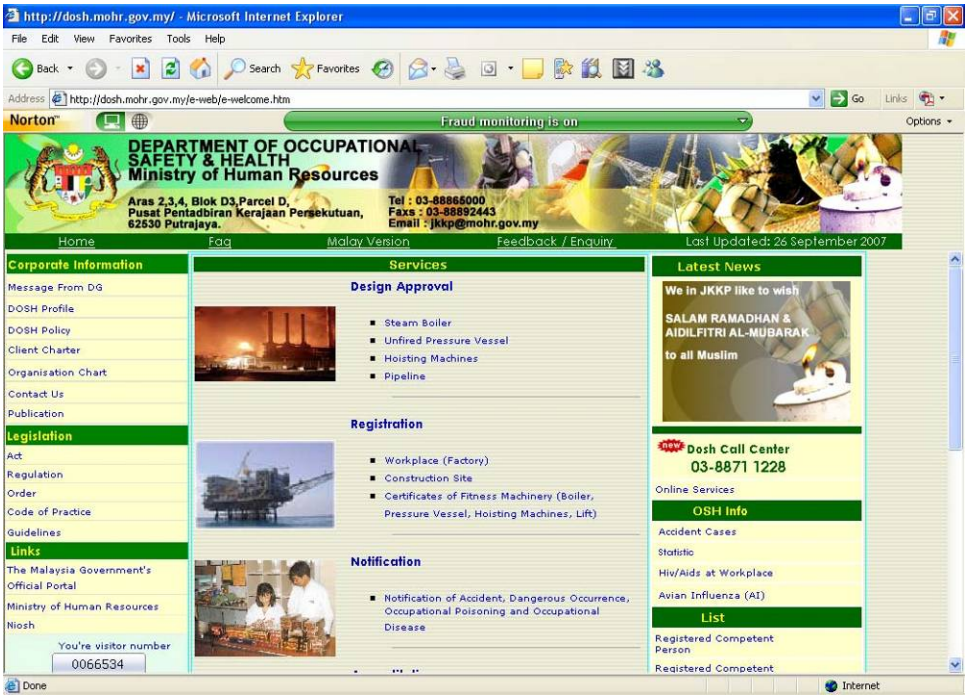

Figure 1.2: DOSH Official Website.

The first phase of the Integrated Information System (SMBF 1) has now been implemented fully at all the offices of state DOSH as well as the Divisions at the Head Office. The system has two main modules, namely approvals and enforcement. The system has been instrumental in assisting the Department to increase productivity and service delivery level to customers. These modules form a major system of the Department and are very crucial in guaranteeing that occupational safety and health are assured.

In 2005, maintenance work was carried out on SMBF 1 which covered application and database maintenance and database recovery in order to increase the effectiveness of the system. SMBF 1 has provided very useful output to the Department by generating statistics, approval letters, investigation reports, certificates of competency as well as certificates of fitness. The maintenance work was to ensure that the system continue to be in an optimum condition.

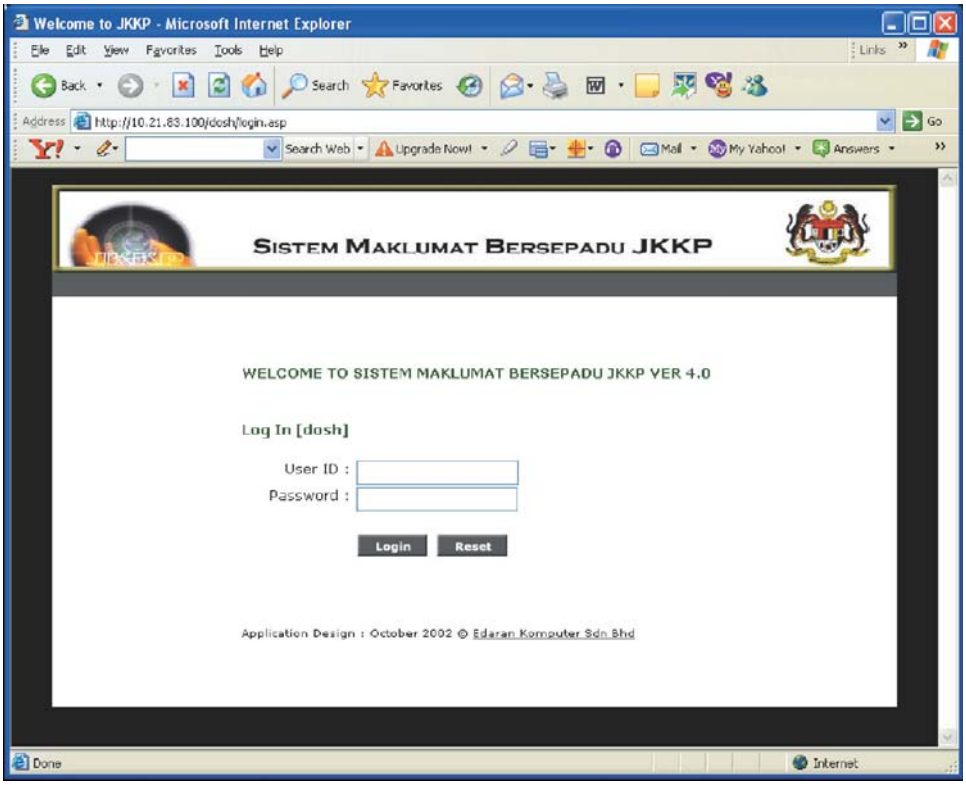

Figure 1.3: Security Login Integrated Information System

The Enforcement Management System (EMS) was developed by the Ministry of Human Resources aimed at increasing the quality of the delivery system to the general public through online services. In essence, the EMS provides the means for the ministry and the public to communicate interactively. The project was started in August, 2004 and is expected to start functioning in August, 2006.

As a department of the ministry, DOSH was also involved in the project through two general modules; namely External Promotion and Educational Activities, and One Stop Centre for Accident Data. Both the modules would be used by all Departments and DOSH is actively involved with these modules.

External Promotion and Educational Activities is a module focusing on the Department's promotional and publicity activities. It would be able to assist the Department in recording and retrieving information as well as in generating reports based on the data input.

On the other hand, One Stop Centre for Accident Data is a one-stop work related accident reporting system in which the stored information could be shared by all departments involved. This would help the Ministry in analyzing and generating the relevant statistics.

When it is fully operational, the EMS will be a very important source of information to consumers. In line with the development of ICT, the system will be able to provide another avenue for effective interaction in the preparation and delivery of services to the public.

1.2 Problem Statement

On current approach of safety audit, after collecting primary data from construction sites, they need to go back to the office and key in the data to their computer to analyze to process secondary data. Safety audit and data collected on construction sites done manually by DOSH offices maybe differ when it send to data entry officer in DOSH.

Therefore, any non-compliance of safety performance on site cannot be identifying on the spot on construction sites unless serious cases. Workplace hazard may happen any time because DOSH officer need to take further action by issuing NOP, NOI, PLS or PL to the construction site management.

1.3 Aim and Objective

The aim of this study is to develop electronic solution (e-solution) system via web base system that helps not only DOSH officers but also contractors, site managers, safety professionals, architects, engineers and clients to evaluate the level of compliances of safety at construction sites. In achieving this aim, three objectives have been outlined:

a. To investigate the current approach in safety audit at site and their limitations.
b. To develop dataflow model for existing DOSH safety audit procedure.

c. To develop “Web Based” safety compliance checklist that will be accessible on site via portable devices.

1.4 Importance of Study

This study attempt to provide real time basis solution, all the safety audit process can be done on the spot on construction sites with hi-tech devices i.e. Laptop computer or PDA devices with wireless internet access. Web base automatic safety audit system will automatically generate report and action to be taken by DOSH officer immediately on construction sites during safety auditing.

This web based safety audit enables site safety audit to be carried out quickly and efficiently in a professional, cost effective and consistent manner. This enables hazards to be identified, control measures to be specified and the safety performance of construction sites to be reviewed.

1.5 Scope of Development

This research is to develop web based safety audit via internet access with the assistance of portable hi-tech devices by trained, experienced and knowledgeable DOSH officers on building construction safety operations which are expected to be carried out four times a year.

This web based safety audit is developed to ease the process of auditing safety performance on construction site in Malaysia and shall fully stimulate as manual safety audit. Web base safety audit is compatible with portable device like Laptop computer or PDA devices with Internet Explorer 6.0 or above. All data input will be directly store into designated database.

Web based safety audit is powered with JavaScript and/or VBScript in Active Server Pages (ASP) to generate grade of safety compliance to ease DOSH officer to take

necessary action to issue Notice of Prohibition (NOP), Notice of Improvement (NOI), *Pemberitahuan Larangan Serta-merta* (PLS) or *Pemberitahuan Larangan* (PL).

1.6 Brief Methodology

Before the website being develop, a through investigation has been conducted to determine current approach safety audit and their limitation. The first step of the study was identifying research problem which covered the significance, objective and scope of study. Research problem was identified through detail study on Guideline for Public Safety & Health at Construction Sites by DOSH 1994. The research areas then focus on safety audit at construction sites that was implemented by DOSH.

This is followed by exploratory research of the literature. Information was gathered mainly through journals, books, working papers, reports and author's working experiences on construction sites.

Based on the information gathered, a data flow model for existing safety audit had been develop for ease of website development. Web based safety audit at construction sites development focus on accessibility via portable devices (Laptop computer or PDA) operate by Windows XP® using Internet Explorer 6.0 and above.

Web based safety audit is developed as similar as possible to existing safety audit perform by DOSH officers. The data collected are then analyze and generate evaluation report according to DOSH grading system.

Questionnaire is then used to validate web based safety audit in term of its usability and effectiveness. Structured questionnaire consist of open ended and closed ended questions.

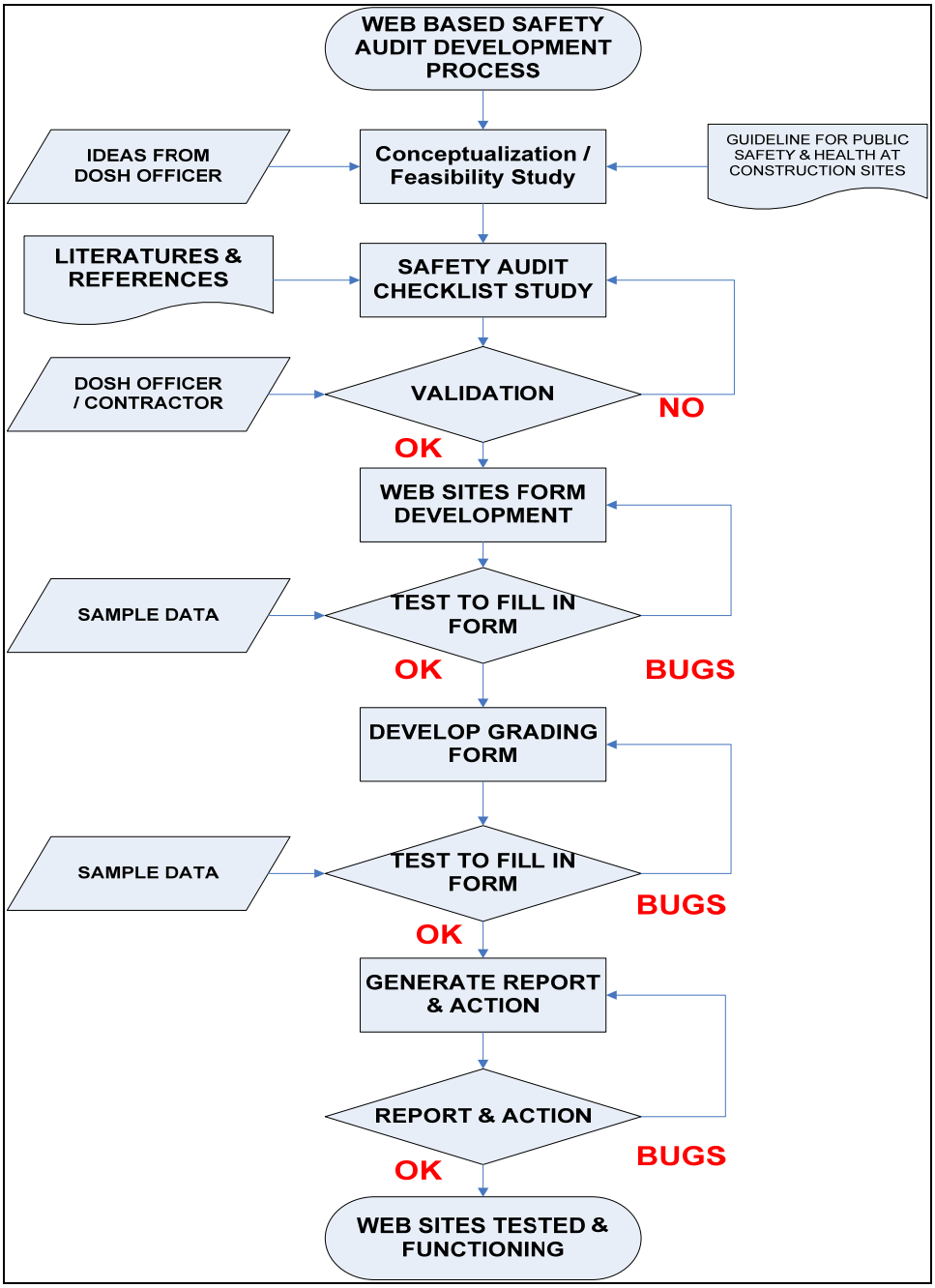

Figure 1.4: Flowchart of Web Sites Development.