

THE DEVELOPMENT OF A DATABASE PROGRAM FOR FATAL ELECTROCUTION AND FATAL FALL ACCIDENTS IN CONSTRUCTION INDUSTRY

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(Received: January 2011 / Revised: November 2011 / Accepted: December 2011)

ABSTRACT

Classifying accident information into a specific categories provides inspectors with data needed for accident analysis and subsequent decision-making. This research proposes development of a database for accident analysis prevention. It will also presents a template and accident database focusing on fatal electrocutions and falls in the construction industry. Data has been stored in MySQL database, and a program editor has been employed to customize the program for accident analysis. An accident analysis form connected to the database has been developed, along with an accident report in qualitative format and meaningful categories to provide analyzable data. The program can be used as soon as an inspector finishes preparing an accident report; accessing the database minimizes the lead time for translating qualitative reports into analyzable data, so that the Council for Labor Affairs, corporate personel, and inspectors can have real time information about accident trends and patterns for the prevention of repetitive accidents.

Keywords: Accident analysis; Database program; Fatal falls and electrocution; Construction industry; Accident database

1. INTRODUCTION

An accident is an unplanned event that may result in death, injury, property damage, or a combination of these. An accident is frequently the result of both physical and mental factors that can be caused by unsafe operating systems at work, home, and other sites (Mosby, 2009). By focusing on accident patterns, an accident prevention outcome can be optimally attained using minimal resources. Knowing where, why, when, how, and to whom accidents typically occur is foundational for teaching employees how to avoid future accidents (Anton, 1989).

The classification of accident information into specific categories facilitates its use for accident analysis and referral to an inspector for a decision on future action. A consistent database will help the inspector prepare a report and translate qualitative data into analyzable data. Complete reports are necessary to identify accident patterns. Therefore, an objective of the current research was to develop a consistent template (coding system and database) for accident analysis in the construction industry.

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The database for the construction industry was developed because accidents are not uncommon for building projects in both developing and developed countries. Each component of the database contains specific information. For instance, specific components of the cause of fatal falls and electrocutions are failure to de-energize electrical systems, failure to test electrical parts, failure to follow log out/tag out procedures, and failure to check the status of the electrical systems.

2. METHODOLOGY

The software designer's essential product is not only the software itself, but also the behaviors that it evokes in the 'problem world' outside the computer and the benefits it provides to users. The functional structures created and understood by the designer must be intelligibly related to parallel structures perceived by the users of the system (Jackson, 2010). This research was designed to develop a database for the collection and analysis of occupational fatalities. An accident database and template were generated for accident analysis and investigations of fatal electrical shocks and falls.

The three methods for developing an accident report are a narrative text, coded data, and a combination of a narrative text and a coded data (Lincoln & Soroach, 2004). In this research, the third method was employed for creating an electrical and fatal fall accident database; the narrative text is used as additional information to describe the coded data. The current study of accident information includes electrical shock and fatal fall accidents; the source of this information is the Taiwan Council of Labor Affairs.

2.1. Designing the database

The database will be designed structurally and classified in details. Afterwards, it will be connected to the program editor. Every accident report describes persons involved, source of accident, cause of accident, source of injury, and injury event. Accident information is classified as shown in Table 1.

Table 1 Data base template for accident report

Information	Detail Information	Appearance In Program
Time of event	Month, date, year	Selective item
	Days (workdays and weekend)	Selective item
Employee Information	Name	Free format
	Identification number	Free format
	Gender	Selective item
	Age	Selective item
	Home address	Free format
	Phone number	Free format
	Work Experience	Selective item
Company profile	Occupation	Selective item
	Company name	Free format
	Company address	Free format
	Type of industry	Code format
Accident Information	Company size (workers)	Selective item
	Place of accident	Free format
	Task when accident occurred	Selective item
	Cause of accident	Selective item
	Source of injury	Selective item
	Cause of injury	Selective item

Table 1 Data base template for accident report (cont.)

Information	Detail Information	Appearance In Program
Accident Information	Object or substance that directly injured the employee	Free format and Selective item
	How accident occurred	Free format
Injury event	No injury	Selective item
	Un-recordable injury	Selective item
	Recordable injury	Selective item
	Fatality	Selective item
Other information	Hours worked since last day off	Free format
	Overtime worked since last day off	Free format
Prevention measure	Description	Free format
Inspector information	Name, official position	Free format

2.2. Collecting Data

Accident data was collected by researchers from safety journals and books, the OSHA website, and real cases in Taiwan. This research focused on two categories of industrial accidents, namely fatal electrical shocks and fatal falls. Each category includes the cause of accident, cause of injury, object or substance that directly injured the employee, task, source of injury, accident, injury event, and how accident occurred (Chi & Ting, 2005). Each category has a specific code and each element has a consistent description, i.e., company and employee data, such as type of industry, company size, age of injured employee and work experience. Examples are shown in Tables 2 and 3.

Table 2 Company database information

COMPANY				
Case number	Company name	Type of industry	Company size	Address
	Free format	Code Number	< 5 workers 5-9 workers 10-29 workers 30-49 workers 50-99 workers 100-499 workers >500workers Unknown	Free format

Table 3 Employee database

EMPLOYEE								
Case Number	ID Number	Employee Name	Gender	Age	Home Address	Phone	Occupation	Working Exp.
1	Number format	Free format	Male Female	< 24 years 24-34 years 34-44 years 45-54 years >55 years Unknown	Free format	Free format	Free format	< 1 year 1-5 years 5 - 10 years 10-15 years > 15 years Unknown

Other elements that have consistent descriptions include industrial tasks associated with electrical accidents, such as installing, moving, or repairing utility poles and power lines. Examples are shown in Table 4 and 5.

Table 4 Electrical task related to fatal electrocution

ELECTRICAL TASK	
Code	Information
99	Unknown
101	Installing, moving, or repairing utility pole and power lines
102	Installing cable TV wires or telecommunications lines
103	Working on electrical equipment
104	Stripping hot wires
199	Other electrical work
201	Routine machine operation*
202	Operating vehicles
203	Operating hand tool
204	Welding
205	Cleaning
206	Material handling
207	Servicing/ repairing
208	Guiding the load / directing the crane operator
209	Resting
299	Other non-elctrical task
999	Unknown

*Chi et al. (2009)

Table 5 Non-electrical tasks related to fatal fall

NON-ELECTRICAL TASK	
Code	Information
1	Removal of members and reinforcing
2	Hoisting and transport of members and materials
3	Site clean-up and work preparations
4	Structural unit element tasks
5	Unspecified task
6	Others

Accident cause and source of injury also have consistent descriptions, as shown in Tables 6 and 7 below.

Table 6 Accident cause for fatal electrocution and fatal fall database

ACCIDENT FOR CAUSE ELECTRICAL SHOCK AND FATAL FALL			
Code	Information	Detail Code	Detail Information
1	Failed to de-energize electrical system	111	Failed to test the circuit element and electrical parts
		112	Did not follow lock out/tag out
		113	Failed to check status of the electrical systems

Table 6 Accident cause for fatal electrocution and fatal fall database (cont.)

ACCIDENT FOR CAUSE ELECTRICAL SHOCK AND FATAL FALL			
Code	Information	Detail Code	Detail Information
2	Used improper Personal Protective Equipment	221	Defective Personal Protective Equipment
		222	Personal Protective Equipment was not used
		223	Protective device and shield were not used
3	Failed to maintain safe distances	331	Movement and loss of balance
		332	Failed to maintain distance when driving vehicle
		333	Exposed electrical parts
4	Poor work practices	441	Tasks error
		442	Improper driving maneuver or hosting
		443	Improper outfit
		444	Inadequate wiring
		445	Operated electrical object with wet hands
		446	Accidentally broke the power line when working
		449	Other unsafe work practice
5	Defective insulation	551	Damaged insulation
		552	Missing insulation
		553	Insulated tool handles with damaged or missing insulation
6	Improper grounding	661	Improperly protected by a GFCI
		662	Back feed voltage
		663	Induced current
		664	Improper grounding of associated fence, housing, enclosure, and supporting structure
7	Environment	771	Wet condition/ Rain
		772	Cramped condition
		773	Low lighting
		774	Strong wind
		775	Struck by foreign object
		776	Thunder
		777	Earthquake
8	General lack of physical strength		Loss of body balance
9	Unsafe bodily action		
10	Insufficient mental capacities		Distraction
11	Insufficient physical capacities		
12	Mechanical failure		
13	Unsafe working environment	1301	Unsafe ladder
		1302	Unguarded openings
		1303	Lack of complying scaffolds
		1304	Unauthorized access to hazard area
		1305	Contact with flying object
		1306	Harmful substance
		1307	Unfixed floor covering
		1308	Bumpy & restricted walkways
		1309	Poor lighting and ventilation
14	Lack of complying scaffolds	1401	Lack of platform
		1402	Lack of scaffold
		1403	Lack of fixed barrier

Table 6 Accident cause for fatal electrocution and fatal fall database (cont.)

ACCIDENT FOR CAUSE ELECTRICAL SHOCK AND FATAL FALL			
Code	Information	Detail Code	Detail Information
15	Being pulled down	1501	Being pulled down by collapsing
		1502	Being pulled down by hoist
		1503	Being pulled down by trolley
		1504	Being pulled down by ladders
16	Remove protection measures	1601	Removal of barriers to facilitate material handling
		1602	The release of anchors after finishing a task
17	Inappropriate protection	1701	Unfixed floor cover
		1702	Insecure warning barrier
		1703	Broke Personal Protective Equipment
		1704	Ineffective safety net
		1705	Lack of secure anchor
18	Unknown		

Table 7 Source of injury for electrical shock and fatal fall

SOURCE OF INJURY			
Code	Information	Detail Code	Detail Information
1	High voltage wire	11	Overhead power line
		12	Underground power line
		13	Railway power line
		19	Other
2	Electrical equipment	21	Switchboards, switches, fuses
		22	Transformers
		23	Electricity rail connector
		24	Powered machinery
		29	Other
3	Electrical wires	31	Missing Insulation
		32	Damaged or aging insulation
		33	Insulated tools handles with missing or damaged insulation
		39	Others
4	Lighting equipment	41	Lighting fixture
		42	Light wires
		49	Others
5	Vehicle and mechanical equipment	51	Heating, cooling, and cleaning machinery
		52	Metal, wood working, special material machinery
		53	Paper production and printing machinery
		54	Textile, apparel leather production machinery
		55	Pumps
		56	Mixer and blender
		57	Heavy vehicles
58	Loading and unloading machinery		
59	Other construction equipment		
6	Power hand tools	61	Welder

Table 7 Source of injury for electrical shock and fatal fall (cont.)

SOURCE OF INJURY			
Code	Information	Detail Code	Detail Information
6	Power hand tools	62	Electric drill
		63	Electric sander
		64	Chipping hammer/crusher/jackhammer
		65	Electric saw
		66	Bold threaded
		69	Others
7	Energized object	71	Ladder
		72	Metal material
		73	Scaffold
		74	Signboard
		79	Other conductive objects
8	Material and tools	81	Flammable, combustible, and explosive material
		82	Construction material and supplies
		83	Hand tools
9	Non-classified media	91	Structure and construction facilities
10	Unknown		

2.3. Developing database in chosen program

The database was built in php MyAdmin database engine. Since the researcher used PHP-based website programming, X-Apache-My SQL-php-Perl (XAMPP) was used for the web server and library provider to php based sites with MYSQL database. Program editor software was installed as the secondary program for creating accident database information system, which includes an online program.

2.4. Validating the database

Steps for connecting database accident information to the program editor follow:

1. Install XAMPP into user's computer; click XAMPP control panel; then click start in apache and My SQL.
2. Find host or computer where database is maintained. Complete username and password to access database (see Figure 1). As an example if the database installed on user's computer, then the name of the host is localhost. If the database is installed on a server computer, then the name of the host is server computer's IP Address.
3. Connect information from database by PHP language `mysql_connect($host, $user, $password)`, where "\$host" is the name of the host. "\$user" and "\$password" are user and password for accessing database.
4. Interface of the program appears by opening the web browser (in this case, the researcher used Mozilla Firefox). After opening the browser, then type "http://localhost/main.php."
5. Database can be seen at "http://localhost/phpmyadmin/accident.php."

After constructing the database and creating a program, the researcher validated the research as follows:

Appropriate attributes of accident information systems are:

1. The program can be installed in any computer.
2. The information system can be accessed easily by inspectors.
3. When the inspector clicks Log In and enters their name and password, their

name will automatically appear at the End of report under Inspector Name and ID.

4. Database can be saved on C: Drive.
5. In this research, cross tabulation is only possible for certain data: Gender and Age, Task and Accident Classification, Company Size and Accident Classification.
6. Input cases on a program editor. Read narrative cases carefully and find the key words to complete the accident form. As an example, for task when accident occurred, and select Electrical or Construction task, then select specific task suitable to the case.
7. If there is no information in the program editor database that suitable for the case, inspector inputs new information in the program editor database column and then directly saves it in phpmyadmin- Accident database in the appropriate table.
8. It is important to verify that the case was directly and correctly input to the master database in phpmyadmin- Accident database. Check in “Cases” table, “Employee” table and “Company” table. When an inspector inputs a new case, a new of employees or victim should appear in the “Employee” table and new information should appear about the company in the “Company” table.
9. “Search” function works if the inspector needs to find accident data in specific categories.

3. RESULTS AND DISCUSSION

Results of the research verify that the database can be installed in any computer and work properly as follow.

Operating Program

1. Copy file master database to drive C:
2. Install XAMPP on new computer at drive C:
3. Choose list Control Panel, click start in apache and MYSQL
4. Open web browser Mozilla Firefox or Internet Explorer
5. Type <http://localhost/accident>
6. Accident analysis program opened

Add New Information

1. On the Log In form, fill in User name and Password noted in master database, then click Submit. The example appears in Figure 1.
2. Click “Input New Data”. The example picture is shown in Figure 2.

Edit Information

Editor menu is for adding new information in report fields if the information is not currently available. Fields are “accident classification”, “task”, “company size”, “working experience”, “cause of accident”, and “source of injury”. If the inspector adds new information in the fields, then it will be sent and saved directly to the master database. The three functions of Editor menus are to input new data, input data and modify master data and manage all data.

Search Function

Search function appears in Main Menu. Search function is applied for searching information with a key word. As an example, if an inspector wants to search source of injury-overhead, type “overhead” in the quick search box, then choose “Source of injury” in the next table and then click “Enter/Ok”. Eventually, all accidents caused by overhead will appear.

Analysis Accident Report

Cross tabulation analysis can be used in the accident report. Thereby, the inspector will know how many accident(s) happened because of two elements, i.e. how many accident(s) happened in a company based on gender and age. Age is further categorized as are <24 years, 24-34 years, 34-44 years, 45-54 years, and >55years. Examples of cross tabulation analysis appear in Figure 3.

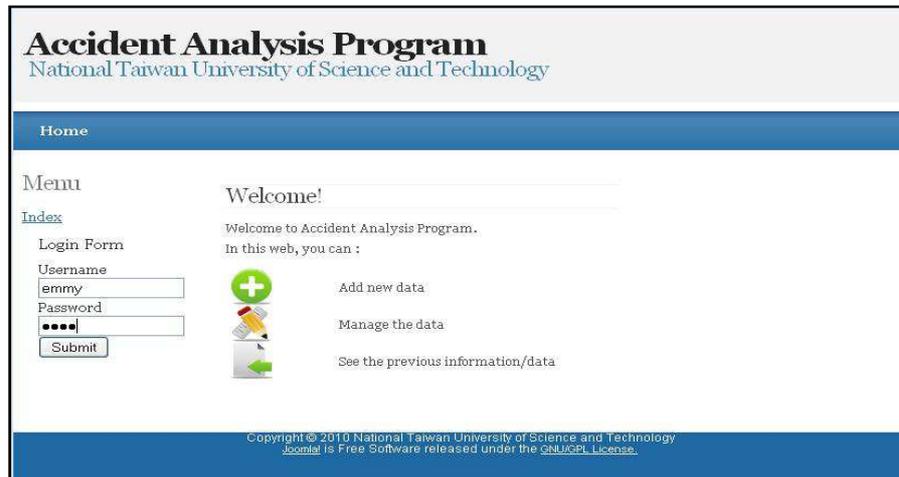


Figure 1 Log in menu



Figure 2 Main menu and editor menu

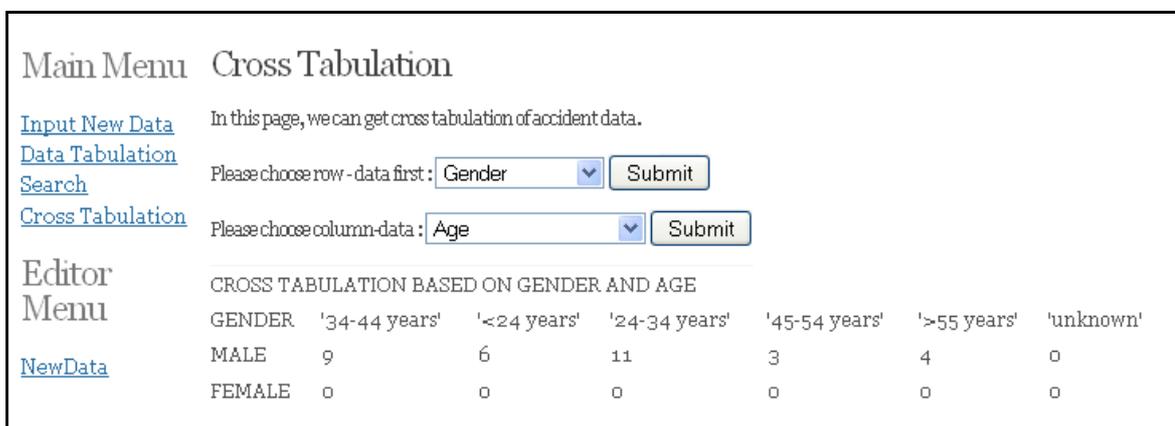


Figure 3 Example of cross tabulation

4. CONCLUSION

For this research, we created an accident database in MYSQL; 30 electrical cases were coded and categorized according to age, company size, work experience, task, source of injury, and secondary source of injury. The program also includes codes for time of event, weather, type of industry, company name, address, employee name, gender, identification number, home address, phone, occupation, place of accident, hours worked since last day off, and overtime hours worked since last day off.

The database allows a user to create an accident report and code the descriptive information into analyzable data. Additionally, the program allows the user to add and edit the database or to search critical information in the database.

Limitations of database and program editor are, it only provide for fatal fall and electrocution cases, Statistical analysis only for cross tabulation analysis on limited factors, and narrative text is needed to describe the complete accident sequence and further prevention measures.

For future research, this database can be converted to Mandarin version with My SQL 5.1.12. Additionally, this model can be used to create a general database that includes all accident types and encompasses a wide variety of industries.

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