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Occupational health and safety management tool

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Labour protection, that is prevention of occupational disease and reduction in the frequency of accident, has always been a matter of major concern of mining industry. Management and the government should promote and maintain high safety standards through some measures to reduce accident frequency and occupational disease. This can be achieved by using the science and technology for improving the working conditions, educating workers and managers about accidents and prevention techniques. The detailed analysis of an accident requires knowledge of many factors such as location, time, type, cost of accident, victim, nature of the injury, personal and environmental factors etc. that can be obtained from the standard coded accident report form. There is a need to prepare safety data in a common format to produce a common safety reporting system and 'Occupational Health and Safety Management Tool' is being designed to manage this by using database and Internet technology. Precautions should be taken according to results from database queries by providing comprehensive and accurate national data. To have an accident is unfortunate, however, to have an accident and learn nothing from it is unforgivable.

Keywords: Occupational health and safety, Accident report form, Accident database, Occupational diseases and accidents, Safety reporting system.

Introduction

Historically, mining has been the industry sector with the highest fatal and non-fatal injury rates. Mining still has the highest fatal injury rate. Underground work locations exhibited both the highest numbers and rates of fatalities, and preparation plants and mills exhibited the lowest fatality rates. Because of the accompanying social toll and public pressures for action, data on fatalities and injuries became available far earlier in the mining industry than in many others.

Unfortunately, in undeveloped countries the problems related with health and safety are still unsolved causing high number of serious accidents and occupational diseases. When mine accidents and the occupational diseases are concerned Turkey is still one of the leading countries. The related statistics for 1999 is given in Table I. Also, Figure 1 and Figure 2 shows the injury and fatality rates relatively for Turkey Lignite Coal Foundation (TTK).

Preventing occupational injuries and illnesses depends on our ability to quantify and track them. Through occupational safety and health surveillance, we can provide ongoing and systematic collection, analysis, interpretation, and dissemination of data for the purposes of prevention. Surveillance increases the effectiveness of prevention activities by targeting them to industries, workplaces, and occupations that have the greatest needs. Surveillance expands knowledge about which prevention programs are effective. Moreover, it may be possible to make informed decisions about specific issues in the workplace. The information, for example, can enable people to identify hazards, take action to prevent injuries, or to control conditions that may affect the health of themselves and other workers.

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This may be achieved by using the science and technology to improve the working condition, educating workers and managers about accidents and prevention technique[1]. Using computer technology it is possible to build a management tool composed of Database, Multimedia and Internet Technology satisfying these needs to prevent accidents. So, it may be possible to make existing data more accessible to provide a variety of occupational safety and health surveillance and educational information on Internet.

'Accident is an undesired event that result in a certain length of disability or stoppage of work or time loss due to the effect of a production related dangerous factor or a combination of such factors.'[1] Accidents may cause death, injury and loss of material. Occupational injuries are defined as all employment-related injuries, which are the result of a single traumatic event occurring while a person is on duty or during a recess period and where there was a short or non-existent latency period. So, the injury is an external damage to the human body resulted from an accident. Occupational diseases are defined as all employment-related diseases which result from repeated or long-term exposure to agents or events or which are the result of a single traumatic event where there was a long latency period. Briefly, occupational disease is an unhealthy condition caused to a person by exposure to unsafe working conditions[2].

The term 'reportable injury' as defined by Mine Safety

Table I
Accident and occupational disease statistics of Turkey (SSK, 1999)

Branch of activity	Employment accident	Occupational diseases	Permanent incapacity for work	Death
Coal mining	5428	629	985	49
Other mining activities	423	4	19	15
Total	5851	633	1004	64

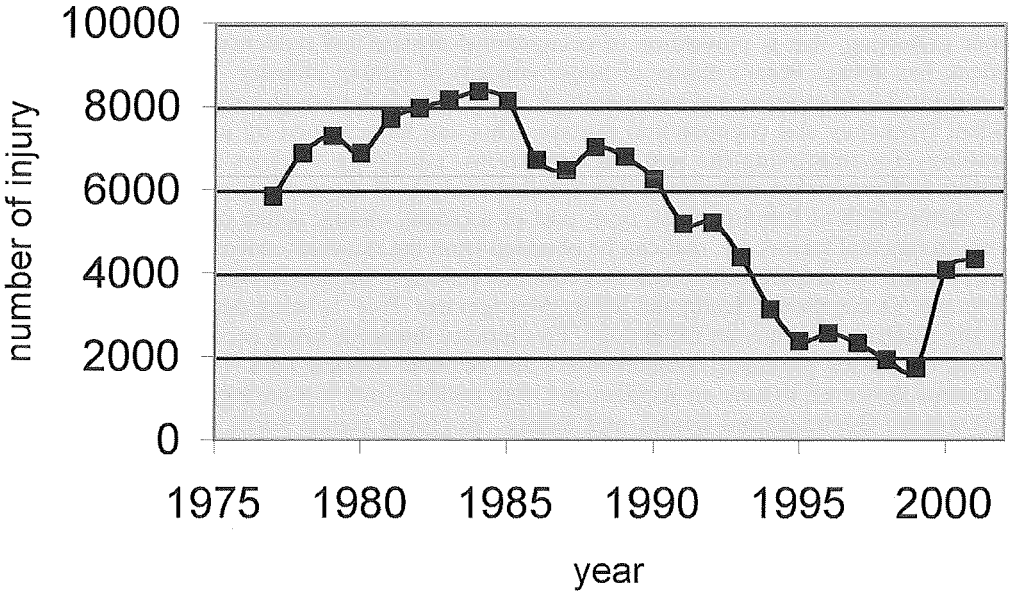


Figure 1. TTK injury statistics (1977–2001)

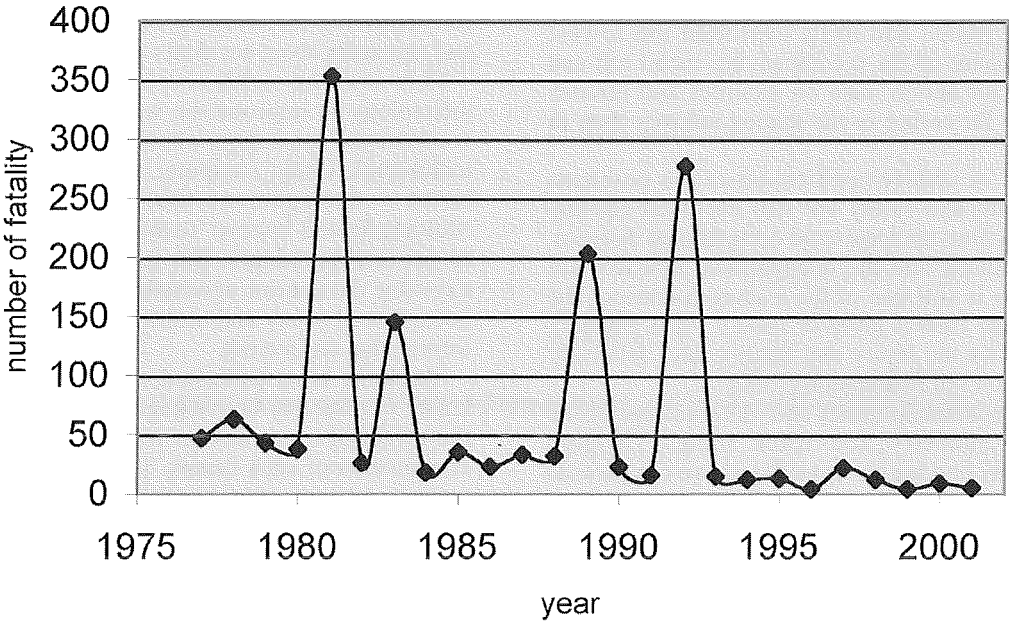


Figure 2. TTK fatality statistics (1977–2001)

and Health Administration Department of Labor (MSHA) includes all incidents that require medical treatment or result in death, loss of consciousness, inability to perform all job duties, or temporary assignment or transfer to another job[3].

Information reported mainly includes titles like; demographics of the injured or ill worker such as age, sex, years of total mining experience, years of experience at current mine, where the incident occurred (i.e., underground, surface, plant/mill), days away from work,

days of restricted work activity, source of the injury, body part(s) injured, and a narrative description of the incident. Here, it is important to prepare a comprehensive coding guidelines and rules; otherwise it is impossible to provide comprehensive and accurate accident data. The data should include all details of the circumstances surrounding the accident or injury so that all information necessary to make conclusions and find out statistical data is available. So, all reported cases involve straightforward coding.

There are many items for an accident to be coded. One of the aims of coding is to clarify the situation. Besides, on database point of view, coding system has got many advantages. First of all, when coding system is used on database, users do not have to know the code given for each case. He will be choosing the appropriate condition that will be converted to codes by the program. This makes database much more user friendly. The other benefit is the ease of making statistical conclusions using already coded data. For example, when the user input sex of the person subjected to the accident, he will just make his choice between the 'male' and 'female' buttons. He does not have to know the code that will be used for sex in database. If he choose male as an accident person's gender, this datum will be input as '1' in gender field. Then it will be very easy to count how many '1' exists in gender field to make comparisons between the genders accident ratio for a given period. Another benefit of the coding will be the speed of the database. It is much more speedy to count '1' instead of "male" in database. Also, the database will be smaller which also affects the speed of it in case of coding.

Data analysis

There are some items in database, which are not going to be analysed. These are the data to be used to clarify the situation. For example, it may be meaningless to make any analysis over 'witness name'. This is just complementary information for the accident. So the data that are not going to be analysed will be recorded on a different database part to make sure that the analysing process will be fast.

Data could be analysed in a variety of ways by a number of different users. Some of the more important types of analysis are

- causal factors, to analyse the cause of the accident
- occurrence time, to take some extra precautions in dangerous shifts
- company name, to enable investigation for distribution of occupational injury/disease for each company
- number of employees working, to enable investigation of size of business factors on occupational injury/disease experience, etc.

Analysis of the type of occurrence data items, that is, nature of injury/disease, bodily location of injury/disease, mechanism of injury/disease, and agency helps in the identification of the nature and causes of the problem, enabling research, resources and risk reduction strategies to be better targeted.

Measurement rates

Various accident statistics are used to determine trends when evaluating an accident prevention program. Trends are usually evaluated in terms of accidents and injuries per man-shift, per million man-hours, per million tons of material moved, etc. One of them is the Disabling Injury Frequency Rate (DIFR) that is given by the equation;

$$\text{DIRF} = (\text{Number of disabling injuries} \times 1.000.000)/ \text{Hours of exposure (or tonnage)} \quad [1]$$

Another trend tool is the Fatality Injury Frequency Rate (FIFR), which is given by the equation;

$$\text{FIFR} = (\text{Number of fatalities} \times 1.000.000)/ \text{Hours of exposure (or tonnage)} \quad [2]$$

To have better idea of the situation the Severity Rate (SR) may also be calculated. SR is the total number of days lost per thousand man-hours of exposure. For each fatality case (death) 7500 days is considered as days lost.

Accident frequency rates, together with SR can be used in the mining industry as comparative standards for safety measurements either between the years in the same mine or between the mines in the same company in the same period and between the company and the industry average in the same period.

A complete study of accident trends also includes a study of causes, activity at the time of the accident, location, job experience, occupation of injured, years at the mine, and time of day. These data can be used to evaluate hazards, prepare job safety guides, formulate new policies, redesign equipment modify operating procedures and develop training programs[1]. These measurement rates can be easily calculated from the database.

Coding

The detailed analysis of an accident requires knowledge of many factors such as location, time, type, cost of accident, victim, nature of the injury, personal and environmental factors, etc., that can be obtained from the standard coded accident report form.

The system is designed to code both injuries and diseases. An injury is the result of a single traumatic event where the harm or hurt is immediately apparent, for example, a broken leg resulting from an accident of a hit by a truck. A disease, on the other hand, results from repeated or long-term exposure to an agent or event, for example, loss of hearing as a result of long-term exposure to noise. Figure 3 shows the accident database tables prepared in SQL server. Each table has its own fields as given in Figure 4. Field details for an accident is shown in Figure 5.

These subtitles should include as many items as possible. Detailed coding system is used for on-line interface. But, it is not possible to give a code to each parameter at the beginning. So, accident report interface includes an administration part to add new codes. As shown Figure 6, web browser is connected to the database and administrator is capable of registering new mechanism field through web interface.

Considering all of the information given, a coding system is developed as given below.

Company information data items

a. Company Name
b. Address of the Company
c. Total employees working in underground
d. Total employees working in open-pit.

Personal information of the employee subjected to an accident

a. Date of birth
b. Gender
c. Occupation
d. Duty status
e. Number of hours usually worked each week

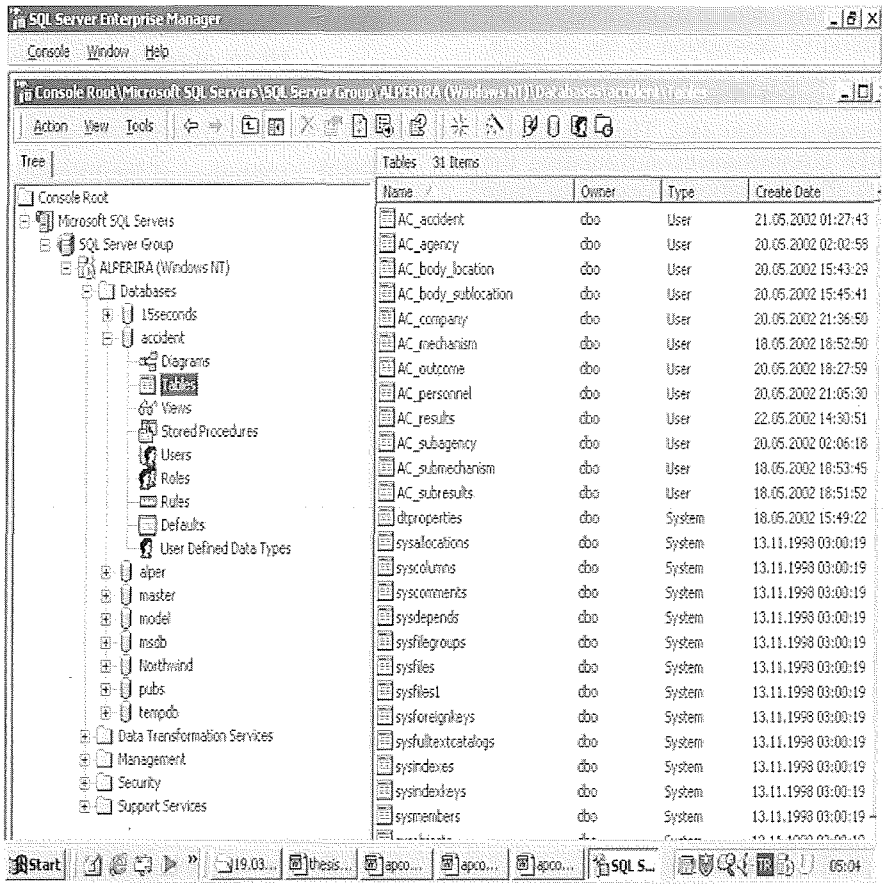


Figure 3. Accident database tables in SQL server

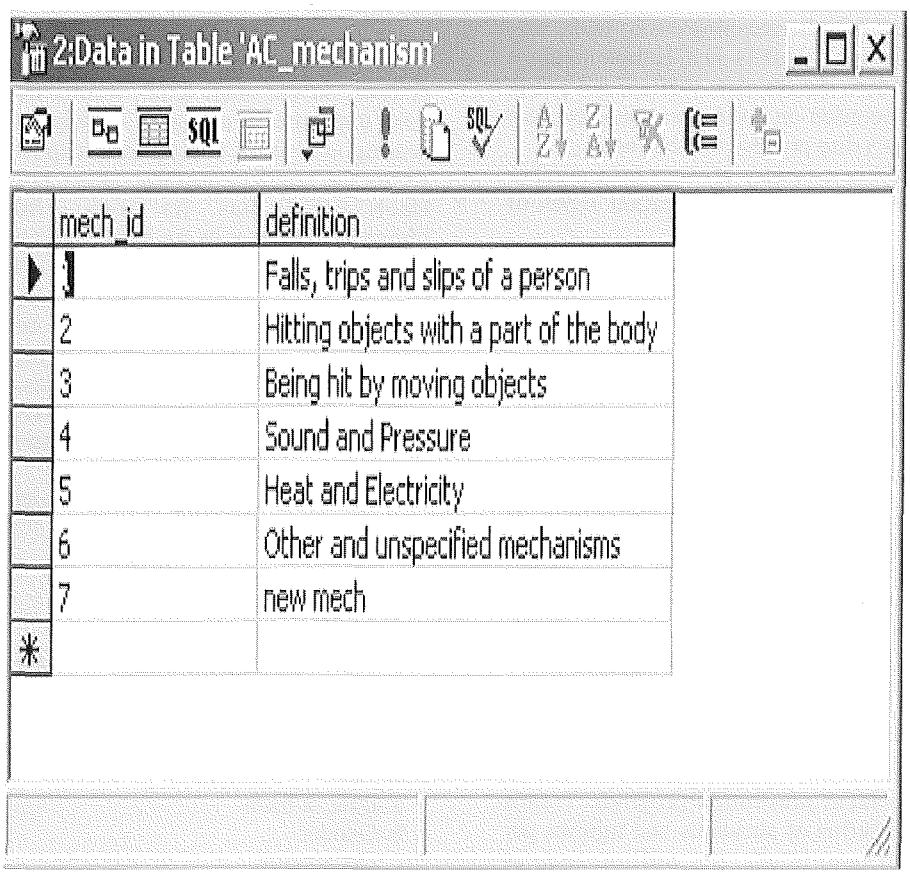
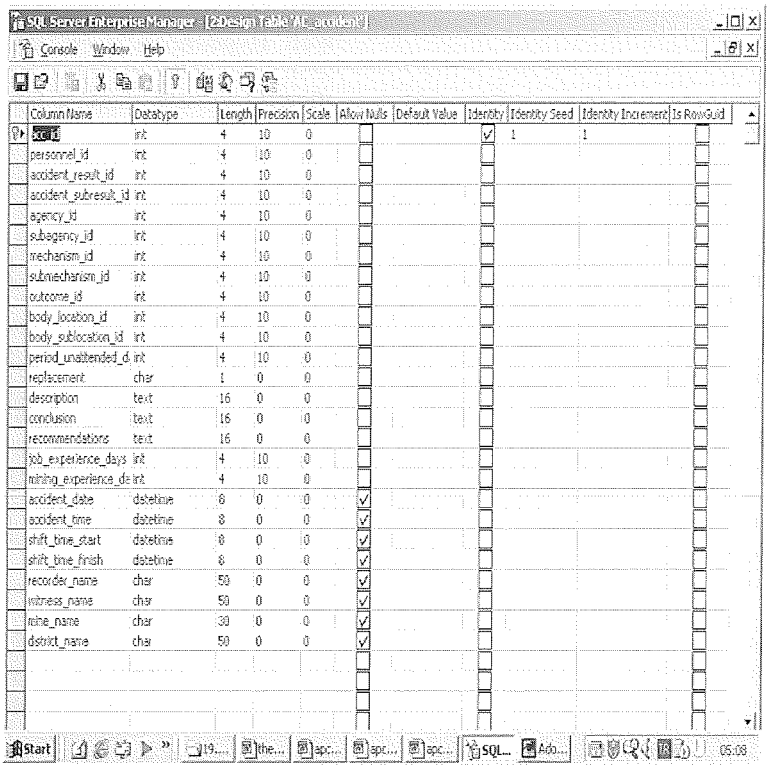


Figure 4. Accident mechanism fields



Column Name	Datatype	Length	Precision	Scale	Allow Nulls	Default Value	Identity	Identity Seed	Identity Increment	Is RowGuid
accid	int	4	10	0			✓	1	1	
personnel_id	int	4	10	0						
accident_result_id	int	4	10	0						
accident_subresult_id	int	4	10	0						
agency_id	int	4	10	0						
subagency_id	int	4	10	0						
mechanism_id	int	4	10	0						
submechanism_id	int	4	10	0						
outcome_id	int	4	10	0						
body_location_id	int	4	10	0						
body_sublocation_id	int	4	10	0						
period_unattended_d	int	4	10	0						
replacement	char	1	0	0						
description	text	16	0	0						
conclusion	text	16	0	0						
recommendations	text	16	0	0						
job_experience_days	int	4	10	0						
mining_experience_de	int	4	10	0						
accident_date	datetime	8	0	0	✓					
accident_time	datetime	8	0	0	✓					
shift_time_start	datetime	8	0	0	✓					
shift_time_finish	datetime	8	0	0	✓					
recorder_name	char	50	0	0	✓					
witness_name	char	50	0	0	✓					
mine_name	char	30	0	0	✓					
district_name	char	50	0	0	✓					

Figure 5. Field details for an accident

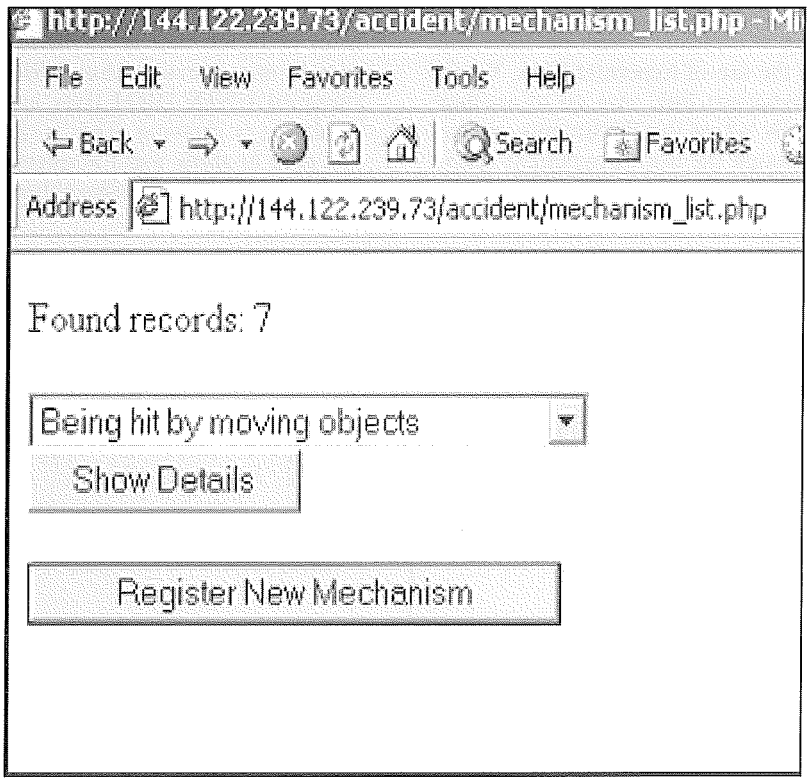


Figure 6. Database administration through a Web interface

f. Insurance number

Accident details

a. Date of occurrence/report
b. Nature of injury/disease
c. Bodily location of injury/disease
d. Mechanism of injury/disease
e. Agency of injury/disease
f. Breakdown agency
g. Location

Outcome of the accident

a. Time lost
b. Severity indicator
c. Payments made
d. Compensation payments
e. Non-compensation payments
f. DIFR
e. FIFR

Programming

World Wide Web

The World Wide Web (www) is a vast collection of information that is spread across hundreds of thousands of computers around the world. When you access a document on the www, there's a lot going on behind the scenes. Very simple and brief description is 'The www is a network of thousands of computers, all of which fall neatly into two categories: *clients* and *servers*. Through the use of special software, they form a kind of network called a *client-server network*'.[4]

Servers store information and process requests from clients. Then they send the requested information to the clients. This information includes all kinds of data, including images, sounds, and text. Servers also send instructions to the client on how to display all this information. These instructions are sent in the form of Hypertext Markup Language (HTML).

Clients make requests for information and then handle the chore of displaying that information to the end user. When you are using a Web browser to navigate the www, your browsing software is acting as a client. Users navigate the World Wide Web through the use of hypertext links. When you select or click on a hypertext link, you go to another area on the Internet. Almost all of the documents on the Web are interconnected through the use of hypertext links. HTML provides instructions for the client software on how the document should be displayed. HTML also contains information about how to link up to other documents on the Web. Hypermedia are hypertext systems which use other formats in addition to text and much more efficient and effective for info sharing: Images- gif, jpeg, Video- mpeg, quicktime, Audio-wav, mp3, etc.

Database

Database systems store information in every conceivable business environment. From large tracking databases such as airline reservation systems to a child's baseball card collection, database systems store and distribute the data that we depend on. Until the last few years, large database systems could be run only on large mainframe computers. These machines have traditionally been expensive to design, purchase, and maintain. However, today's generation of powerful, inexpensive computers enables programmers to design software that maintains and distributes data quickly and inexpensively[5].

PERL

As a programming language, PERL (Practical Extraction and Report Language) was chosen. Because PERL is efficient, flexible, extensible, and easy to maintain when programming a wide range of tasks, in particular those involving the manipulation of text files. Another advantage is its security. Security is a major issue when writing system administrative programs and on the Internet in general. Using PERL for scripting on your Web server, you can easily guard against users trying to sneak commands through for the server to execute on their behalf. Another facet of PERL that is of particular interest to many Web server managers is that PERL works very well with standard UNIX DBM files and support for proprietary databases is growing. This is a significant consideration if you plan to allow users to query database material over the Web[5]. Accessing a database through a web browser is given in Figure 7.

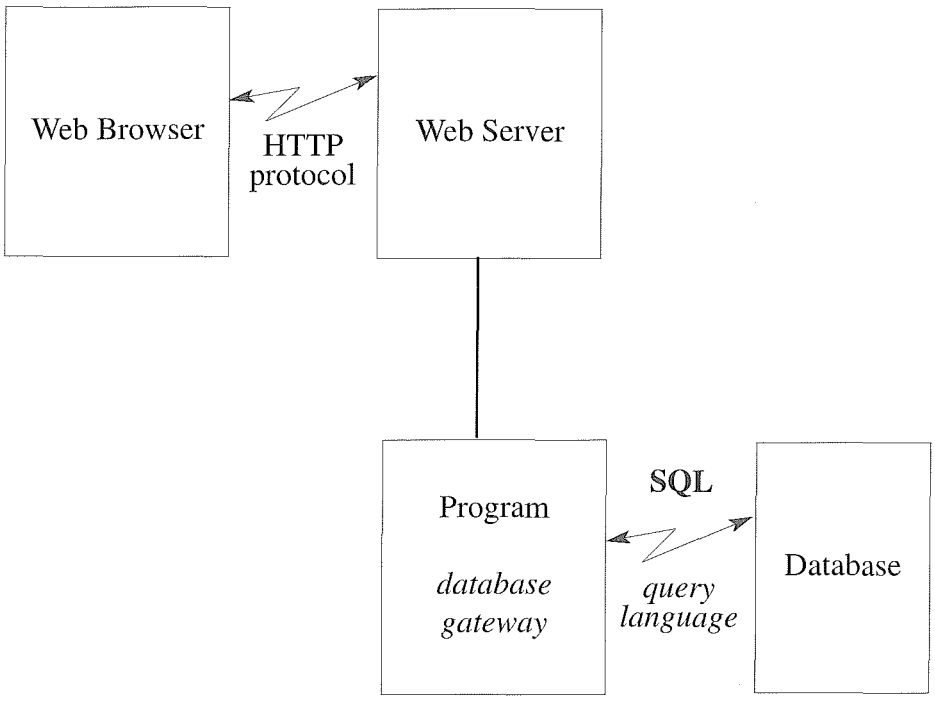


Figure 7. Accessing a database using a Web browser

Conclusions

Having standard report forms filled in a database, they can be analysed considering the distribution of accidents according to the following information:

- Distribution of the accidents according to their types
- Distribution according to job titles
- Distribution according to part of body injured
- Distribution according to the procedure in which it happened
- Distribution according to the age groups
- Distribution according to the days of week
- Distribution according to the type of shift
- Distribution according to the working hours, etc.

Using this type of management tool that is composed of Database and Internet Technology, it will be useful to anyone interested in workplace safety and health, including researchers, legislators and policy makers, health care professionals, educators, and occupational safety and health practitioners in labour, management, and consulting environments.

It may be possible to prevent accidents by education coordinating and disseminating information including mining industry specific practical guidance material. Also, some precautions can be taken according to results taken from database queries by providing comprehensive and accurate national data.

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