REVIEW THE ASSESSMENT OF EFFECTS OF LOST TIME INJURIES IN AN INDUSTRIAL SYSTEM BY USING AN EXPLANATORY PROGRAM

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ABSTRACT

Health and safety problem can be described by statistics it can only be understood by knowing and feeling the pain, suffering, and depression. Health and safety has a legal responsibility to protect it for everyone who can affect in the workplace. This includes manufacturers, suppliers, designers and controllers of work places and employees. Work injury is one of the major problems in manufacturing and production systems industries; it is reduced production efficiency and affects the cost. To gain flexibility from a traditional manufacturing system and production efficiency, this paper is about the application of estimating technology to preview and synthesis of *Lost Time of Work Injuries* in industry systems aims to provide a safe working environment for all employees to achieve safe workplaces, safe systems of work, and safety understanding within our workforce. Our industry often has a poor record in dealing with modern and development techniques. Thus, as one of the targets, this leads to perform a helpful program plane to provide guidelines of management, employees to eliminate hazards, given the enormous cost of occupational personal damage in industry and to develop safe work methods work site. This work proposed a general methodology for constructing an explanatory software system to review and analysis workers injuries in a work site. The program language used is Axes, which suitable to shows categories of incidences and estimates costs to workers, employers and society of workplace injuries and work-related ill health. Data of the system was collected in the State Company for Woolen Industries in Al-Kadhumiaa in Iraq. The resulting is to provide a simple obvious outline system to evaluate lost time injury and the net-costs on safety interfering at the company level to reduce occupational morbidity and generating a helpful system to estimate of the total costs to employers and workers of workplace accidents and work-related ill health.

الخلاصة

توصف الية الصحة والسلامة بالإحصائيات التي لا يمكن فهمها إلا من خلال المعرفة والشعور بالألم، والمعاناة والاكتئاب. تعد الصحة والسلامة المسؤولية القانونية لحماية كل شخص ومن هو مؤثر في موقع العمل، يتضمن ذلك كل من المصنعين، المجهزين، المصممين والمراقبين للعمل والموظفين. تعتبر اصابة العمل من المشاكل الرئيسية التي تقلل من كفاءة الانتاج وتؤثر في الكلف لعمليات التصنيع والانتاج في الانظمة الصناعية. يهدف البحث الى تطبيق تقنية للتقييم والعرض للوقت الضائع في اصابات العمل لنظام صناعي بغية الوصول الى توفير بيئة صحية سليمة لجميع المستخدمين ولتحقيق مواقع وانظمة عمل آمنة قادرة على التجديد والمرونة في الكفاءة الانتاجية لنظام تصنيع تقليدي. تعاني صناعاتنا في الغالب من مؤشرات ضعيفة في التعامل مع التقنيات الحديثة والمتطورة. لذلك، وكاحد اهداف هذا البحث هو ايجاد، خطة برنامج مساعد لتوفير تعليمات للادارة وللعاملين لإزالة المخاطر التي تؤدي الى الكلف الهائلة للضرر المهني في الصناعة. ولاجل تطوير والوصول الى طرق عمل آمنة لموقع العمل. مقترح البحث هو ايجاد الية عامة لبناء نظام برمجي توضيحي لاستعراض وتحليل إصابات العمل. لغة البرنامج المستخدمة (الكسس)، وهي ملائمة في العرض والتحليل لانواع الاصابات والكلف التخمينية للعاملين من عمال، وموظفين، وكذلك لمجتمع او بيئة الإصابات. بيانات النظام تم جمعها وتطبيقها في الشركة العامة للصناعات النسيجية- الكاظمية – العراق. النتائج المتحققة هو توفير مخطط واضح وبسيط لتقييم الوقت المفقود في الاصابة والكلف الكلية المؤثرة في السلامة لمستوى الشركة لتقليل الاصابات والامراض المهنية وتكوين نظام مساعد في تخمين التكاليف الكلية للحوادث والامراض المرتبطة بموقع العمل للعمال والعاملين.

Key words: Lost Time Injury, **Incidence Cost**, **Work Injury**, **(Key Performance Indicators) KPIs**

1. INTRODUCTION

1.1 Work Injury

Work injuries have been viewed as a major problem to affect the efficiency and cost of production. The work injuries are caused by the repetitive work operations during the production with a high frequency of the repetitive workload [li lin, 2008].

Every employer shall provide employment which shall be safe for the employee therein and shall furnish and use safety devices and safeguards, and shall adopt and use methods and processes reasonably adequate to render such an employment and place of employment safe, and shall do every other thing reasonably necessary to protect the life, health, safety and welfare of such employees; provided that, as used, the term "safe" or "safety" as applied to any employment or a place of employment shall include conditions and methods of sanitation and hygiene reasonably necessary for the protection of the life, health, safety and welfare of employees[Rock, L., 1997].

1.2 Industrial System and Work Injury

Work injury problem persist due to the tough competition in manufacturing industries today in terms of a desire to have a production system with low cost, quick lead-time and high quality of products, making the human in an ever-increasing stress situation. That state has both the right and the duty to make sure that those who are employed within its industries are provided with reasonably safe work places is well established [li lin, 2008].

The great majority of injuries, which, workers suffer in industrial employment, do not result from hazards. Instead, the great annual total of such injuries is, for the most part, built up injury-by-injury and day by day throughout the year from the almost endless variety of relative hazards that are involved in industrial operations [Rock, L., 1997].

1.3 Injuries Cost: Overview

Cost of work injuries includes the direct cost and indirect cost. The direct cost contains the expense on the resources of preventing, detecting and treatment. The indirect cost relates to the loss of production output in economics. The measurement of work injuries, which may occur in production, is the obstacle of cost analysis. The cost estimation of work injuries is limited by the uncertain measurement of them [Leigh, P., 2000].

The most observable form of ‘‘undesirable cost’’ is time away from work (recorded as a lost time injury). However, productive time will also be lost where workers are not able to equipment or work procedures causing (sore or tired muscles). Poor working conditions may contribute to people staying away from work or avoiding time in certain work areas. Poor quality job design and working conditions may also increase staff turnover and items that constitute the greatest proportion of additional costs are: overtime, over-employment, training, supervision, employee turnover, waste and rework, lost production time, and reduced productivity [Oxenburgh, M., and Marlow, P., 2005].

1.4 Industrial Costs of Injuries and Illnesses

“Safety Pays" helps estimate cost gains realized through the prevention of work injuries and illness claims. Industries can use this information to predict the direct and indirect costs of injuries and the sales needed to compensate for these losses [OSHA Home, 2010].

The Firms can provide information and assistance on developing and implementing an effective safety and health management systems that can help prevent injuries and / or illnesses to provide a safe working environment for the employees.

Compensation and medical costs (as direct costs) are obvious. It has however, taken careful studies by experienced cost accountants and industrial executives to show how large the other costs (as indirect costs) are. It is now clear that on the average the indirect costs of accidents in industry are not less than four times the direct costs. Figure (1-1) describes the different categories that make up the total costs for each of these items [Economic Advisers Unit June, 2004].

1.5 Objectives

a. Provide guidelines to promote among worker, making an increased under-standing of safety

through the efficient and accurate reporting and recording of accidents.

b. Design an illustrative program system for organized analysis of work injuries and for estimation the cost of work injuries in industry system.
c. Describes the concepts behind cost benefit analysis related safety and introduces a method by which an analysis may be performed relatively easily in a service or manufacturing workplace.

2. THE SAFETY STATE IN TEXTILE AND FABRIC INDUSTRIES

The injuries and illnesses among textile workers in a workplace as follow [Mahone, D, & NIOSH, 1997 & State Company for Woolen Industries 2010]:

- 70% of machine operators using foot controls report back pain.
- 35 % report persistent low back pain.
- 25 % have suffered a compensable Cumulative Trauma Disorder (CTD) where: 81 % of CTDs were to the wrist, 14% of CTDs to the elbow, and 5% of CTDs to the shoulder.
- 49% of workers experience pain in the neck.
- Absenteeism increases as working conditions worsen.
- Loss of workers due to Injuries or turnover is associated with working conditions.

2.1 Work Organization [Mahone, D, & NIOSH, 1997]

- As many as 100% of piecework operators in high manipulation jobs have symptoms of CTDs.
- Workers in piecework are 4 times as likely to develop severe disabilities as hourly workers.
- Workers in piecework are 9 times as likely to develop arthritic disorders as hourly workers.
- As duration of employment in piecework increases, so do severe disabilities.

2.2 Duration of Exposure [Mahone, D, & NIOSH, 1997]

- Machine operators experience cumulative damage to the neck and shoulders over time.
- Risk for persistent neck and shoulder pain increases with years of employment as a machine operator.
- Work for more than 8 years as machine operator increases risks for neck and shoulder pain.

2.3 State Company for Woolen Industries

State Company for Woolen Industries is the only publicly owned group of factories for woolen textile industries in Iraq. The company consists of seven production factories. The Headquarter of the company is the ninth location in Kadhumiaa**.**

The Company had suffered as many of the Iraqi industries, during the sanction time in the nineties and early years of this century. Only in year 2009, it started to recover from the consequences of the neglect and lack of resources during the last 2 decades. It has been working hard over the past years to promote health safety best practices to report that 2010 was another record-setting year in most of health safety aspects. This safety reports reflects the performance and demonstrates to the health and safety of the employees. Currently, a huge effort is taking place to make use of the available limited funds to bring the items of production lines into live again. The effect of such machines (old and not properly maintained) still running had affected the quality of the products and the safe of employee, so the requirement is to provide much better results in terms of quality, quantity, and safety can be achieved once some or part of the production lines can be replaced.

The financial results and costs are in no way a true reflection of the actual costs. At the moment, the salaries represent a huge junk of the cost (71%), this high cost is due to the production lines either not working or running at a very low efficiency and have poor workplace safety. The workforces are for 3- shift work while only one shift (hour shift of 8 hours per day).

The total hours worked by all employees in Al- Kadhumiaa plant during the period covered were (566 employees * 8 hours per day * 250 days) in one year.

Tables (2-1) and (2-2) shows the data and information that based on collection and the inquiring of employees from different members of the plant and the comments from the workshop participants.

3. METHODOLOGY \ STATISTICS OUTCOMES (KPIs)

The outcomes, such as work-related fatalities, injuries and illnesses, are a necessary component of reporting on an industrial system because they reflect the extent to which an organization system has been successful in preventing working injury and disease. Outcomes can be identified, as the most important (Key Performance Indicators) KPIs**.** The various categories of work injury and illness results are severity-based measures of work outcomes (O'Neill, S., 2009). KPIs can be detail as in Table (3-1), where:

- Number of work-related fatalities
- Number of permanent disabilities (medical discharge)
- Number and rate of permanent disability (return to work)
- Number and rate of long-term (more than 6 months) temporary disability
- Rate of the medium term temporary disability, (2 weeks to 6 months).

Rate of short-term temporary disability (up to 2 weeks).

System Outline: Most companies have some, if not all, of their data in creat or design programs, but most people don't know how to use these programs assessment, estimate to make graphs, charts, or diagrams of their improvement efforts. The program consists of *two subsystems*.These systems have the capability, flexibility,and easey in employment for changing, adding, and eliminating information. Figure (3-1) shows the daigram of the system,where:

Second: Entering through The *1st subsystem* (Rates calculation work incidents), another window will be activated with three enabled selections as clearly in figure (3-3), and each selection was described in (**Part A**) below.

Items: (Back) in each window will reverse to the previous window to do another option and (Quit) to be exit.

First: Main window which includes the two subsystems as shown in figure (3-2)

Third: Figure (3-4) represent the first selection of previous screen that lead to (KPI flow diagrams) mentioned in (**Part A\A1**) where the second selection to get the state in (**Part A\A2**).

Forth; With this window in figure (3-5), the selection between the two (Run Rate) will be demonstrate as stated in (**Part A\A3**).

Fifth: Recurring into the main window in figure

(3-2), *2nd subsystem* of (Cost estimation of work incidents) window will selected, these cost estimation activities will be implemented as described in (**Part B\B1**).

3.2 Process Performance Indicators (PPIs)

Occupational processes are those programs and activities used to identify and eliminate (or at least control) hazards. Process Performance Indicators PPIs are a number of safety performance indicators have become "standard" in many industry sectors. They are mostly expressed in terms of event frequency.

The number of hours worked being the common denominator representing the level of activity. Such parameters have the advantage of relying on a small number of simple inputs, which allows meaningful statistical analysis even when the data sets are incomplete. The performance indicators are: identified as most important to stakeholders related to: work injury audit non-conformances; monitoring of health exposures to risks; safety risk assessment and training; incident analysis and employee discussion (A. Burton, and, K.H. den Haan, 2008). Only when a company compares its injury experience with that of its entire industry, or with its own previous experience, can it obtain a meaningful evaluation of its safety accomplishments. To make such comparisons, a method of measurement is needed that will adjust for the effects of certain variables contributing to

differences in injury experience. Injury totals alone cannot be used for two reasons: **First**, a company with many employees may be expected to have more injuries than a company with few employees. **Second,** if the records of one company include all the injuries treated in the first aid room, while the records of a similar company include only injuries serious enough to cause lost time, obviously the first company's total will be larger than the second company's figure.

4. THE PRACTICAL IMPLEMENTING OF THE SYSTEM WORK

Part A: Incidences Rates

Return to Table (3-1) the system was applied with Information that was collected injuries or illness suffered by employees and workers with 11 or more employees (at any one time in the previous calendar year) must keep OSHA standards records when they are) [OSHA Home, 2010]:

- Engaged in activities involving the design, project engineering, production, handling, filling, sales, distribution and production units which, including associated administration and supporting services. The statistics include:
- Number of Recordable Injuries (RI) and Recordable Injuries Rate (RIR) per 200,000 employee-hours, as equivalent (100 employees working 40 hours per week for 50 weeks per year).

- Number of Lost Time Injuries (LTI) and Lost Time Injuries Rate (LTIR) per 200,000 employee-hours, as equivalent (100 employees working 40 hours per week for 50 weeks per year).
- Caused annual work injury costs (direct and indirect) which, impact of work injury on profit and sales. The calculations include:
- Work injury costs (estimated or actual).
- Work injury costs as a percent of profits.

$$\text{Incidence Rate of Recordable Cases} = \frac{\text{No. of injuries and illnesses} * 200{,}000}{\text{Total hours worked by all Employees during period covered}}$$

or

$$= \frac{\text{No. of lost work days} * 200{,}000}{\text{Total hours worked by all employees during period covered}}$$

Two other formulas can be used to measure the average severity of the recorded cases:

During that period, several safety reports were accomplished, to complete the requirements of the program as below, these tasks are:

A1: Designing flow diagrams to explain the current KPI, Figure (4-1).

A2: Evaluation data annually as worksheets that are classified according to each KPI and show their behavior diagrams, figure (4-2) explains data input to this window of the system. The data was collected in Al-Kadhumiaa plant which some of these information as mentioned in Table (2-2). The capability for changing, innovating, and coming first or next or last was clear in this window.

The information will be appearing as a worksheet window by (press to show data) with the behavior histogram that run out by using each key individually down the worksheet window as presented in figure (4-3) where the concepts of (LTIs, TRC & LWC) are denoted in Table (3-1) above.

A3: Reviewing the evaluation and diagrams behavior of the annual Incidence Rate IR and Lost Work Day Rate LWDR, for example, the related information for years 2009 & 2010 in figures (4-4) & (4-5) were linked with the above worksheet in figure (4-3), and then they run out to calculate and demonstrate histograms in figure (4-6) related information .

4.1 Procedure

Work injury rates are based on the exposure of 100 full-time workers using 200000 employee-hours as the equivalent (100 employees working 40 hours per week for 50 weeks per year).

- An injury rate can be computed for each category of cases or days lost depending on what number is put in the numerator of the formula.
- The denominator of the formula should be the total number of hours worked by all employees during the same time- period as that covered by the number of cases in the numerator.

I. Injury and /or Illness Incidence Rates: [OSHA Home, 2010]

$$\text{Average Lost Workdays} = \frac{\text{Total lost workdays}}{\text{Total lost workday cases}}$$

$$\text{Average day's away from work} = \frac{\text{Total days away from work}}{\text{Total days-away-from-work cases}}$$

- If these numbers are small, then it is known that the cases are relatively minor. If, however, the numbers are large, then the cases are of greater average severity and should receive serious attention.
- For example, to calculate the incidence rate for total recordable cases at the end of the year, one would simply multiply the number of recordable

cases by 200,000 and divide that by the number of hours worked by all employees for the whole year**.**

- The incidence rates may also be interpreted as the percentage of employees who will suffer the degree of injury for which the rate was calculated.
- That is, if the incidence rate of lost workday cases is 5.1 per 100 full-time workers, then about 5% of the establishment's employees incurred a lost-workday injury.

These rates are really a general terms. In addition to the total injury-illness incidence rate: (**1.** Injury rate, **2.** Illness rate, **3.** Fatality rate, **4.** Injury Severity Rate, **5.** Lost-workday-cases injury rate LWDI, **6.** Number-of-lost-workdays rate. The following as shown in the box below:

- Rate 5 counts cases in which one or more workdays were lost or in which the worker was transferred to another job.
- Rate 6 counts the total number of workdays lost or days in which the worker was transferred to another job.
- In counting the number of lost workdays, the date of the injury or start of illness should not be, even though the employee may leave work for most of that day.
- Thus, if the employee returns to his regular job and is able to perform all regular duties full time on the day after the injury or illness, no lost workdays are counted.
- The most widely recognized standard incidence rate is LWD incidence rate, which known as the
- A somewhat surprising characteristic of the LWDI is that it considers injuries only- not illnesses.
- Illnesses are more difficult to track than injuries because there are often time delays in their diagnosis. In addition, it is more difficult to prove work-relatedness for chronic exposures, which may have a variety of simultaneous causes.
- LWDI does not include fatalities, whether they are by illness or injury.
- Fatalities should always be considered a rare occurrence of serious importance and as such should not be averaged among the more common injury statistics on which the LWDI is based.
- Using National Safety Council average costs, 1998, includes both direct & indirect costs, excludes property damage

Part B: Cost Estimation

B1: Insert data from Table (4-1) with the window as illustrated in figure (4-7), noting that the activation of button (Injury Type Index) in this window lead to open a listed window includes data from (National Council on Compensation Insurance), data about average cost per workers compensation insurance claim by nature of injury as well as presented the cost multiplier and indirect cost ratio as shown in figure (4-8) [NCCI, 2010]. The behavior of cost estimation illustrated in figure (4-9).

This information can be obtained from the listed data of (NSCAC standards, 1998) shown in Table (4-2) which appears from the selection of (print preview). The analysis and histograms behavior will be appear in figures below:

II. Cost of Injury and Illness and Their Impact on Industry System

Direct Cost**:** To calculate the direct cost: The total value of compensation claim for an injury or illness (consist of medical costs and assurance payments).

These estimating compensation cost which ranging between (100000 & 150000) ID for (PPD & PTD) respectively per injury or case, paid to employers of damage to materials, machinery and property that caused by the same management failures that lead to injury accidents in the group of factories for woolen textile industries in Al-Kadhimyaa plant as present in Table (4-1), note that (1 $ ≈ 1190 ID) in 2010.

Indirect Cost: To calculate the indirect cost of the injury or illness, multiply by a cost multiplier shown in System Table (4-2), the cost multiplier that used will depend on the size of the direct cost.

Indi ct Cost:

Direct Cost * Cost Multiplier = Indirect Cost

Total Cost:

Direct Cost + Indirect Cost = Total Cost

5. CONCLUSIONS & RECOMMENDATIONS

5-1 Conclusion

During the period of coverage search, it is necessary to ensure that the workplace is safe and

without risk to health, everyone shall at all times undertaking to complete all work in a safe manner where people are not at risk due to an unsafe working environment. To achieve this, it is the responsibility of management, and employees to eliminate hazards and develop safe work methods.

The work provides a simple obvious outline system to estimate lost time injury and the net-costs on safety interfering at the company level to reduce occupational morbidity. It illustrates the structure with two explanatory subsystems. The particular formulation of the model was based on several other existing supports that are existing in the study and was adapted to the data that were readily made available by the company that had introduced such interventions over a number of years, note: the discussion about 2009\2010, during the application of the work and the outcomes in changing towards the best was clear in safety and reduction cost.

These results and conclusions have been drawn as follow:

1- There were 82 major injuries to employees reported in 2009/10, the distribution in figure (4-3) **(Part A\A2)** explain the difference that the reduction in injuries was possible comparing with what came in the recent three years this indicated by charts related to. There were 77 other injuries to employees causing absence from work of over three days were caused by handling, lifting or carrying, and nearly a quarter due to slipping or tripping.
2- This also corresponds with point in (1) that Lost Workday Incidence Rate (LTIR) and Incidence Rate (IR) are the lowest ever achieved and is significantly better than the industry situation.
3- This explanatory system provides estimations of the total costs of employers and workers for workplace accidents and work-related ill health.

The financial results and costs in Al-kadihumiaa plant listed later in table (5-1) with the comparison between figures (5-1) for (*cost analysis in the plant)* and (4-7) for (*cost estimation of work incidence)* in this work, we find that the total estimated cost (7203000) given from the system formed 7% from the working expenses. That facilitates the process of analyzing the cost and how to find appropriate solutions to reduce.

4- It also discusses the efforts to reduce harm, to identify where the greatest burdens of health and safety failures fall. Although the estimates can never show how easy or successful attempts to reduce harm might be, unless provide a good starting point from which to analyze the problems.
5- Systems design features by high accuracy and effective efficiency guide to reduce lost time injury time and effort in cost. In addition, the proposed system has the capability to show information and dynamics in performance as well as proved to be flexible and easy to use

5.2 Suggestions for Future Work

- It is possible expansion the work system to include estimate to calculate the impact of injury or illness on profitability, using the profit margin to determine the sales of the company would need to generate to pay for this injury or illness where:

Total Profits ÷ Total Sales= profit margin

Keep the profit margin in dismal form

Total Cost of Injury or Illness ÷ Profit Margin = Sales Required to Pay for Injury or Illness

- The work could be extended in a variety fields of industry that it can be useful in future research.
- Finding methods to make the system more strong and generalized. This includes investigation of how the system needs to be modified to deal with other subjects in industrial engineering science.
- The system suitable for more functional items, such as time, cost, productivity…etc for example analysis the percentage of (LTI) according to accident activity, injury cause and body location.

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NOMENCLATURES

Symbol	Description
CTD	Cumulative Trauma Disorder
KPIs	Key Performance Indicators
LTI	Lost Time Injuries
LTIR	Lost Time Injuries Rate
LWC	Lost Workday Case
MTC	Medical Treatment Case
PPD	Permanent Partial Disability
PTD	Permanent Total Disability
PPIs	Process Performance Indicators
RI	Recordable Injuries
RIR	Recordable Injuries Rate
RWC	Restricted Work Case
TRC	Total Recordable Cases
WI	Work Injury

Table (2-1) Employees & Plants

Plant name	No. of Employees
Mechanical carpet	682
AL- Fateh	674
Al- Kadhumiaa	566
Al-Nassiriaa	1879
Al-Hurriaa	502
Al-Taji	126
Spinning & fitted carpet	384
Manuf. & spare part	65
General administration	341
Total	5219

Table (2-2) Occupational injuries
in Al- Kadhumiaa plant \2010

Types of Occupational injuries\ Illnesses	Lost Time Injuries \ Illness Cases LTI	Permanent Total & Partial Disability PTD & PPD
Back problems / Lower limb disorder	5	15
Neck / Upper limb disorder	5	8
Noise induced hearing	2	7
Respiratory disease (Asthma)	5	10
Skin disease	4	6
Burns-Related injuries	1	1
Cancer and malignant blood disease	0	0
Infections / preventable disease	0	0
Mental ill-health	0	0
Poisoning	0	3
Other Occupational illness	2	3
Total	24	53

Table (3-1) Statistics Definitions and Guiding Records

Name	Explanation	Evaluating the Extent of Recordable Cases
Incident	This is an uncontrolled or unplanned event, or sequence of events, that results in a fatality or injury to a o n company premises	• Criminal or terrorist activity; • A purposeful act on the part of another individual; • Incidents, which occur Off company premises but where the consequences appear onboard later.
Work Injury WI	This is any sign or of physical damage or impairment to any part of the body directly resulting from an incident, regardless of the length of time between the incident and the appearance of the injury	
Hours Worked	Includes hours actually worked by:	1. All permanent/regular employees - full time and part time. 2. All casual employees - full time and part time (include with full time permanents). 3. All engaged staff plus other permanent contractors.
Fatalities	A death directly resulting from a work injury regardless of the length of time between the injury and death.	Fatalities are included in the Lost Time Injury count
Lost Workday Case LWC	Lost workday cases occur when the injured or ill employee experiences days either away from work, or days of restricted work activity, or both.	1. Days must be taken off from the job for medical treatment or recovery, or 2. The employee is unable to perform his normal job duties over a normal work shift (which could be an extended hour shift of 8 to 12 hours)
Permanent Total Disability PTD	PTD is any work injury which harm an employee permanently and results in termination of employment on medical grounds(e.g. loss of limb(s) permanent brain damage, loss of sight) and precludes the individual from working	
Permanent Partial Disability PPD	PPD is any work injury which results in the complete loss, or permanent loss of use, of any member or part of the body, or any impairment of functions of parts of the body, regardless of any pre-existing disability of the injured member or impaired body function, that partially restricts or limits an employee's basis to work on a permanent basis	
Lost Time Injury LTI	The sum of: PTDs, PPDs and LWC.	***LTIs = Fatalities + LWC+ PTD + PPD***
Restricted Work Case RWC	This is an injury, which results in an individual being unable to perform all normally assigned work functions during a scheduled work shift or being assigned to another job on a temporary or permanent basis on the day following the injury.	**4.** The employee was temporarily assigned to another job, **5.** The employee worked at a permanent job less than full time, or **6.** The employee worked at his permanently assigned job but could not perform all the duties normally
Medical Treatment Case MTC	This is any work-related loss of consciousness (unless due to ill health), injury or illness requiring more than first aid treatment by a physician, dentist, surgeon or registered medical personnel, e.g. nurse or paramedic under the standing orders of a physician, or under the specific order of a physician.	MTCs include: injuries which result in loss of consciousness, even if the individual resumes work after regaining consciousness; sutures for non-cosmetic purposes; use of casts, splints or other means of immobilization; any general surgical treatment; removal of embedded objects from eye by surgical means; use of other than non-prescriptive drugs or medications; use of a series of compresses for treatments of bruises, sprains or strains
Total Recordable Cases TRC	The sum of (work-related fatalities), LTIs, RWCs, and MTCs.	***TRCs = LTIs + RWCs + MTCs.***

Table (4-1) Cost of Workers Compensation in Al – Kadhumiaa plant

Year	No. of Permanent Total Disability PTD*150000 ID	No. of Permanent Partial Disability PPD*100000 ID	Total Compen-sation
2006	1650000	3100000	7850000
2007	1650000	2300000	7850000
2008	750000	1700000	2450000
2009	1000000	3800000	4600000
2010	330000	3100000	3430000

Table 4.2 Cost multiplier (National Council on Compensation Insurance, NCCI, 2010)

Injury Type Index		
Injury Type	Average Direct Cost Multiplier	Indirect Cost Ratio
AIDS	$ 4,469	1.6
Amputation	$ 48,318	1.1
Angina Pectoris	$ 28,136	1.1
Asbestosis	$ 23,346	1.1
Asphyxiation	$ 88,126	1.1
Black Lung	$ 34,165	1.1
Burn	$ 27,380	1.1
Byssinosis	$ 13,523	1.1
Cancer	$ 52,785	1.1
Carpal Tunnel Syndrome	$ 24,695	1.1
Concussion	$ 68,456	1.1
Contagious Disease	$ 15,657	1.1
Contusion	$ 23,748	1.1
Crushing	$ 45,272	1.1
Dermatitis	$ 8,295	1.2
Dislocation	$ 59,207	1.1
Dust Disease, NOC (all other pneumoconiosis)	$ 27,682	1.1
Electric Shock	$ 86,448	1.1
Enucleation (to remove ex: tumor, eye, etc.)	$ 62,699	1.1
Foreign Body	$ 17,585	1.1
Fracture	$ 37,911	1.1
Freezing	$ 13,365	1.1
Hearing Loss or Impairment (traumatic only)	$ 15,304	1.1
Laceration	$ 15,398	1.1
Loss of Hearing	$ 13,145	1.1
Mental Disorder	$ 37,420	1.1
Mental Stress	$ 27,004	1.1
Multiple Injuries Including Both Physical and Psychological	$ 115,961	1.1
Multiple Physical Injuries Only	$ 58,607	1.1
Myocardial Infarction (Heart Attack)	$ 85,962	1.1
No Physical Injury	$ 22,093	1.1
Poisoning - Chemical (other than metals)	$ 43,690	1.1
Poisoning - General (not OD or cumulative injury)	$ 44,761	1.1
Poisoning - Metal	$ 25,054	1.1
Puncture	$ 15,381	1.1
Radiation	$ 36,124	1.1
Respiratory Disorders (gases, fumes, chemicals, etc.)	$ 35,266	1.1
Rupture	$ 61,506	1.1
Severance	$ 59,394	1.1
Silicosis	$ 31,393	1.1
Sprain	$ 23,098	1.1
Strain	$ 27,363	1.1
Syncope	$ 31,138	1.1
VDT-Related Diseases	$ 51,404	1.1
Vascular	$ 56,316	1.1
Vision Loss	$ 49,693	1.1
All Other Cumulative Injury, NOC	$ 30,647	1.1
All Other Occupational Disease Injury, NOC	$ 27,820	1.1
All Other Specific Injuries, NOC	$ 35,671	1.1

Table (5-1) Cost analysis in the plant

Expenses(million ID)	Million ID/year
Salary	3800
Working expenses	1385
Other expenses	103
Total Expenses	5288

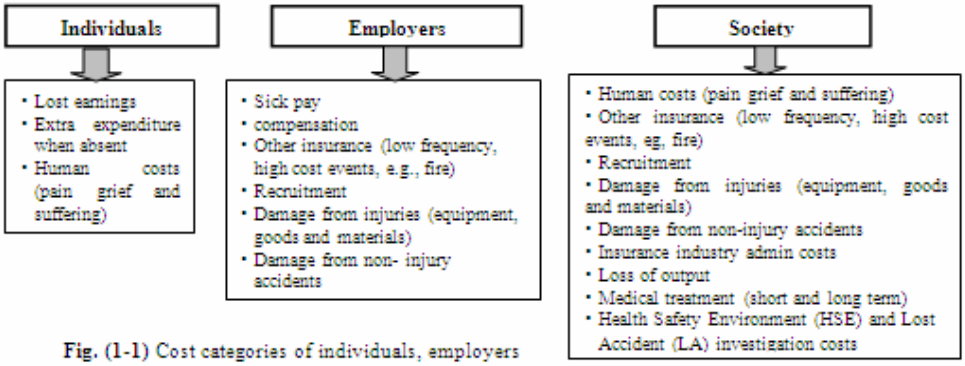


Fig. (1-1) Cost categories of individuals, employers and society of workplace
[Economic Advisers Unit June, 2004]

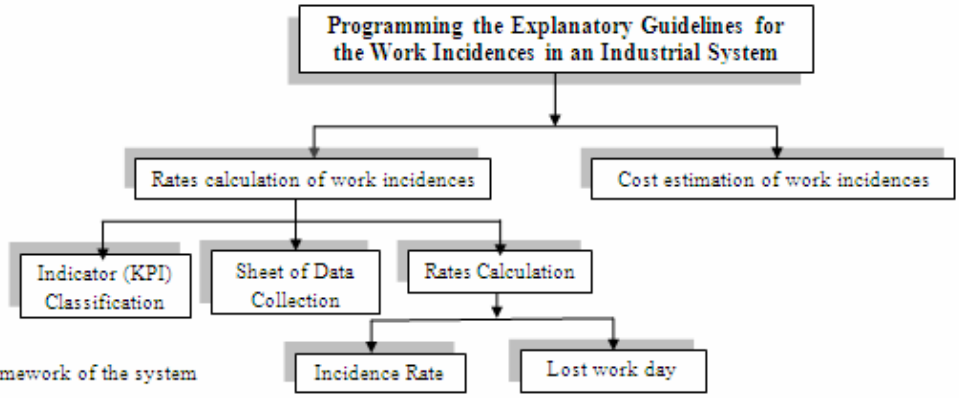


Fig. (3-1) Framework of the system

Fig. (3-2) Main window

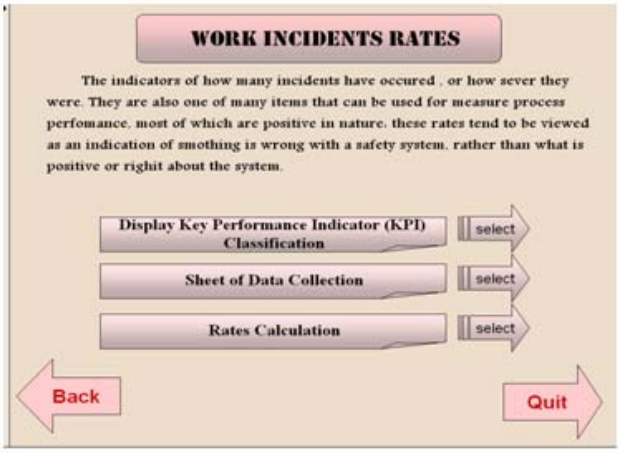


Fig. (3-3) First subsystem

Fig. (3-4) First selection of the subsystem

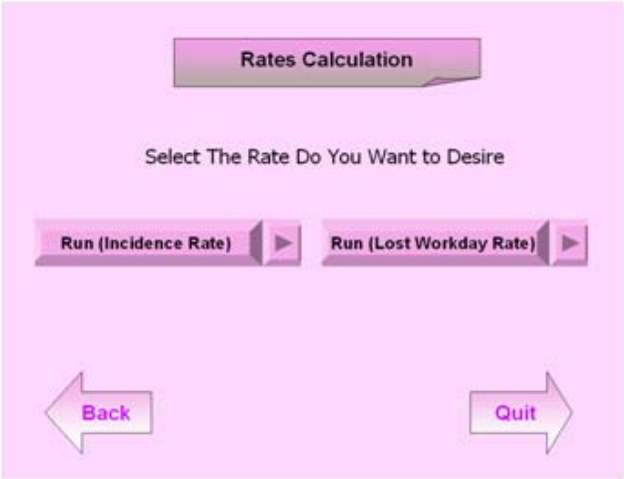


Fig. (3-5) Third selection of the subsystem

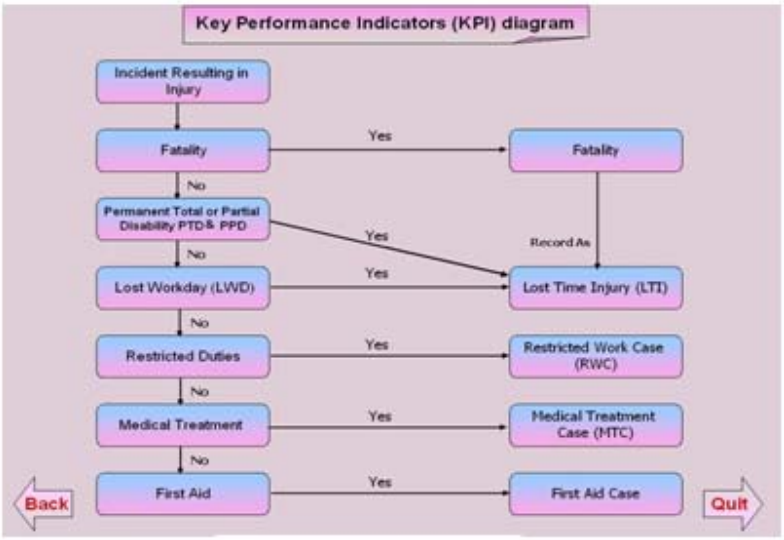


Fig. (4-1) KPI flow diagrams

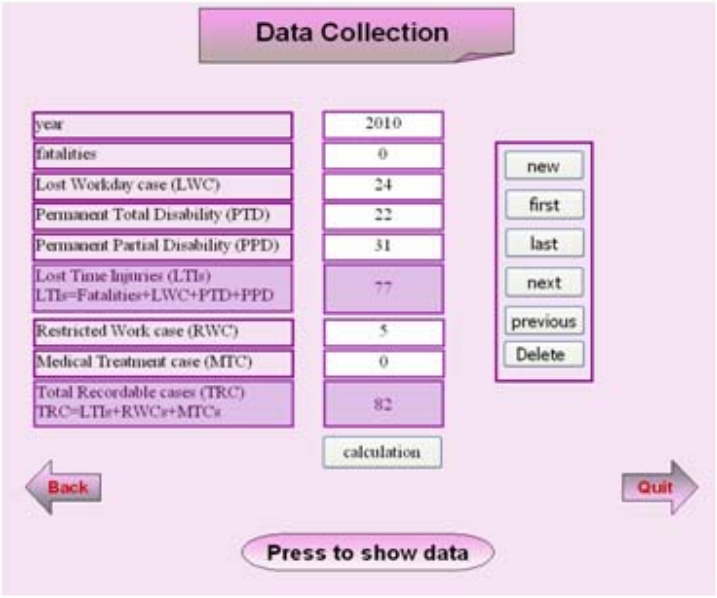
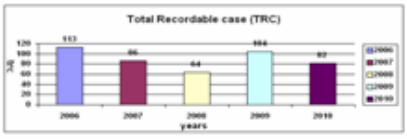


Fig. (4-2) Data input

Total Recordable case (TRC) Chart

TRC=LTIs+RWCs+MTCs

year	Total Recordable case (TRC)
2006	113
2007	86
2008	64
2009	104
2010	82



Lost Time Injuries (LTIs) Chart

LTIs=fatalities+lwc+ptd+ppd

year	Lost Time Injuries (LTIs)
2006	100
2007	77
2008	58
2009	95
2010	77

Lost Workday case (LWC) Chart

year	Lost Workday case (LWC)
2006	56
2007	43
2008	36
2009	53
2010	24

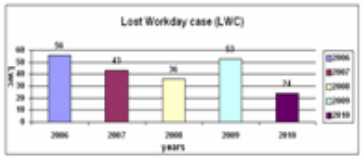


Fig. (4-3) Worksheet & distribution histogram

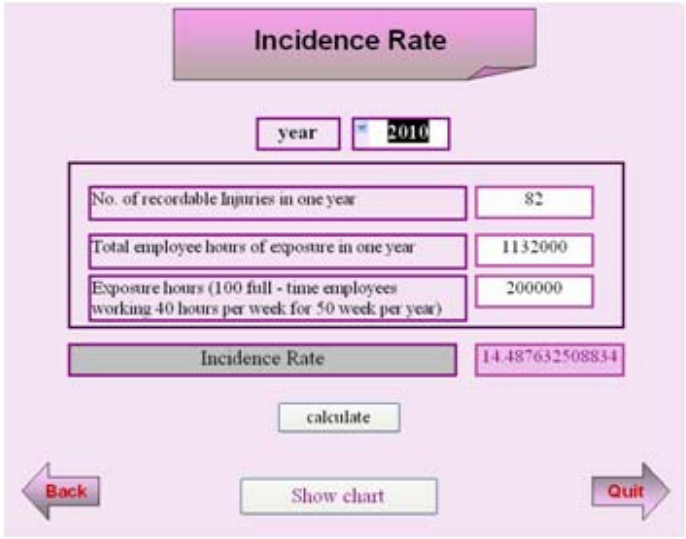


Fig. (4-4) Incidence Rate IR

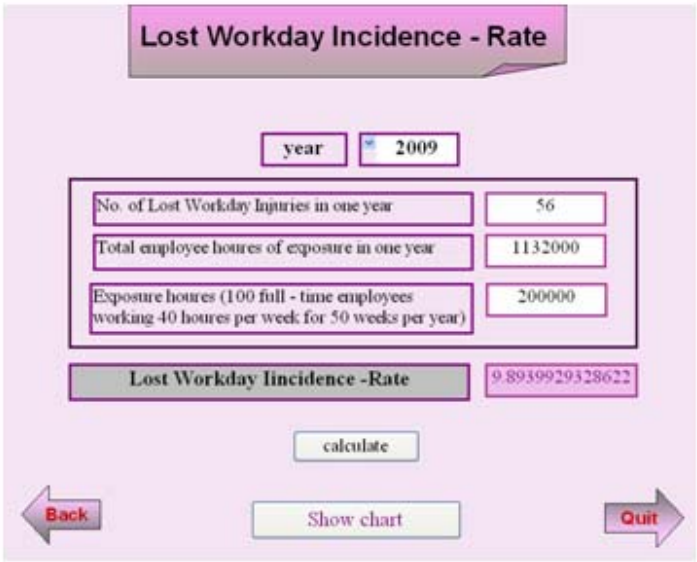


Fig. (4-5) lost Work Day Rate LWDR

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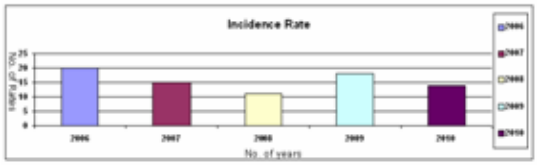
Incidence Rate chart

year	Incidence Rate
2006	20
2007	15
2008	11
2009	18
2010	14

Lost Workday Incidence Rate chart

year	Lost Workday Incidence Rate
2006	10
2007	8
2008	6
2009	9
2010	4



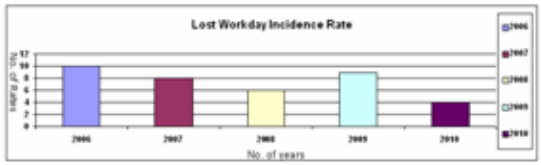


Fig. (4-6) Distribution histograms

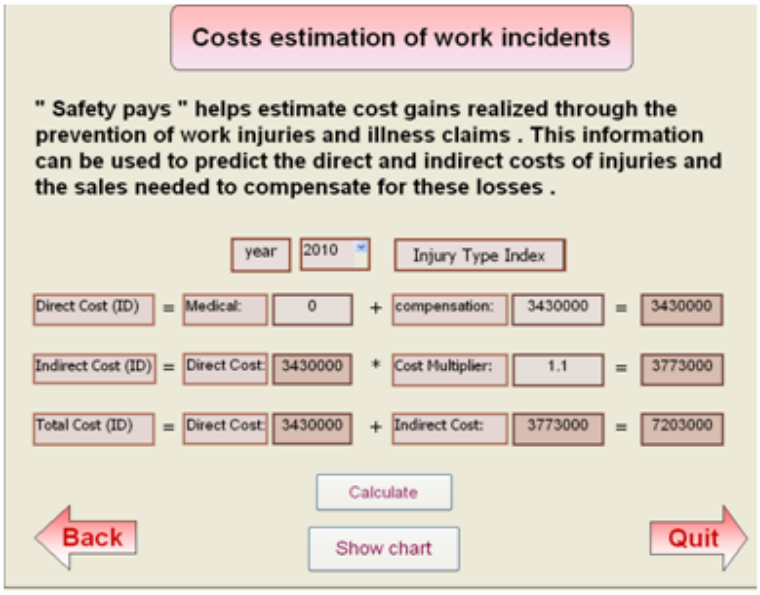


Fig. (4-7) Cost estimation of work incidence

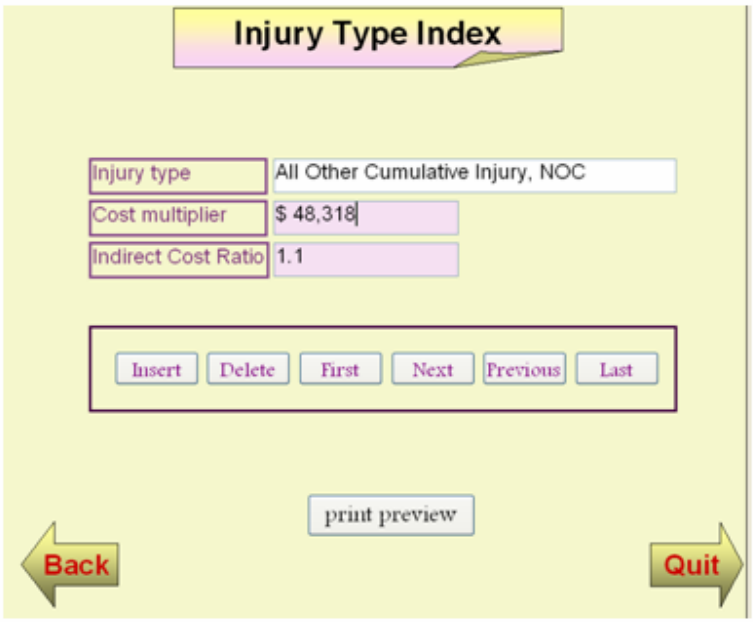


Fig. (4-8) Injury type index

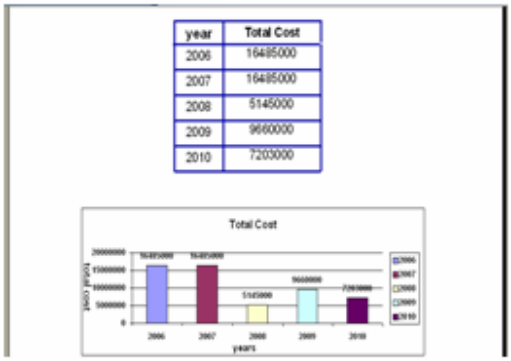


Fig. (4-9) Distribution histogram of cost estimation

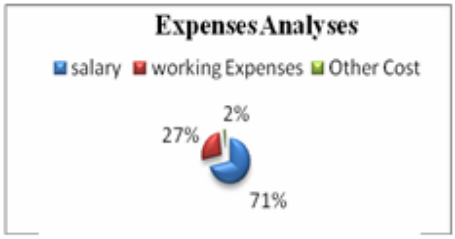


Fig. (5-1) Expenses Analyses in the Al- Kadhumiaa Plant