A DATABASE PROGRAM FOR ACCIDENT AND NEAR-MISS INVESTIGATION: SYSTEM ANALYSIS FOR CORRECTIVE/PREVENTIVE ACTION

SUCHART CHANWIMALAUNG

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Thesis
Entitled

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Suchart Chanwimalaung

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A DATABASE PROGRAM FOR ACCIDENT AND NEAR-MISS INVESTIGATION: SYSTEM ANALYSIS FOR CORRECTIVE/PREVENTIVE ACTION

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ABSTRACT

This research was carried out to design and develop a database program for accident/near-miss investigation and analysis in order that it could be use as a guideline for corrective/preventive action. The methodology consisted of 4 mains steps: 1) collection of accident/near-miss investigation data, based on the principle of loss control management, 2) development of a database program, 3) verification of a database program and 4) writing a user manual. Data collected during collection and development were gathered to construct a database program. Visual BASIC 7.0 (VB. NET) and Microsoft Access were used in the system database management.

The database program was tested for program usability. A questionnaire was sent to 20 professional safety officers. The return rate was 100%. The result showed that the database program can help investigators who have no experience perform accident investigation effectively. This program is easy to use and is not complicated for most of the professional safety officers to utilize. Therefore, professional safety officers did not have a problem with lack of information or insufficient knowledge to perform accident investigation.

It can be concluded that this database program was appropriate to use as a tool to investigate general job-related accidents and near-misses. The results showed that the program appearance needed modification, such as font enlargement. However, it indicated that this database program is practical for professional safety officers.

KEY WORDS: ACCIDENT INVESTIGATION / DATABASE PROGRAM / ACCIDENT ANALYSIS

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โปรแกรมฐานข้อมูลสำหรับการสอบสวนอุบัติเหตุและเหตุการณ์ผิดปกติและระบบการวิเคราะห์มาตรการแก้ไข/ป้องกัน (A DATABASE PROGRAM FOR ACCIDENT AND NEAR-MISS INVESTIGATION: SYSTEM ANALYSIS FOR CORRECTIVE/ PREVENTIVE ACTION)

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บทคัดย่อ

งานวิจัยนี้มีวัตถุประสงค์เพื่อการพัฒนาและออกแบบโปรแกรมฐานข้อมูลสำหรับการสอบสวนอุบัติเหตุและเหตุการณ์ผิดปกติและระบบการวิเคราะห์มาตรการแก้ไข/ป้องกัน โดยรวบรวมข้อมูลเพื่อการจัดทำฐานข้อมูลจากการศึกษาการบริหารจัดการเพื่อควบคุมความสูญเสีย การสืบค้นข้อมูลจากอินเตอร์เน็ท และการทบทวนรายการการสอบสวนอุบัติเหตุทั่วไปของบริษัทแห่งหนึ่ง การออกแบบและจัดทำระบบฐานข้อมูลโดยใช้ไมโครซอฟต์แอกเสซ และพัฒนาการออกแบบหน้าจอการทำงานด้วยไมโครซอฟต์วิชชั่ลเบสิค เวอร์ชั่น 7 โปรแกรมฐานข้อมูลจะช่วยเพิ่มประสิทธิภาพในการทำงานด้านการสอบสวนและวิเคราะห์ เพื่อเป็นแนวทางให้เจ้าหน้าที่ความปลอดภัยในการทำงานระดับวิชาชีพ มีความสามารถในการสอบสวนและมีแนวทางในการวิเคราะห์อุบัติเหตุและเหตุการณ์ผิดปกติ อีกทั้งยังสามารถเป็นแนวทางในการแก้ไข ป้องกัน และการจัดทำรายงานการเกิดอุบัติเหตุและเหตุการณ์ผิดปกติ

การประเมินผลความคิดเห็นในการใช้งานโปรแกรมฐานข้อมูล แบ่งเป็น 2 ลักษณะคือ การประเมินความคิดเห็นของเจ้าหน้าที่ความปลอดภัยในการทำงานระดับวิชาชีพและผู้เชี่ยวชาญในการพัฒนาฐานข้อมูล การประเมินความคิดเห็นของเจ้าหน้าที่ความปลอดภัยในการทำงานระดับวิชาชีพของบริษัทแห่งหนึ่ง จำนวน 20 คน และการประเมินความคิดเห็นของผู้เชี่ยวชาญในการพัฒนาฐานข้อมูล จำนวน 6 คน ผลการประเมินความคิดเห็นของเจ้าหน้าที่ความปลอดภัยในการทำงานระดับวิชาชีพพบว่า มีความพึงพอใจในระดับดี และผลการประเมินความคิดเห็นของผู้เชี่ยวชาญในการพัฒนาฐานข้อมูล มีความพึงพอใจในระดับดี จุดเด่นของโปรแกรมฐานข้อมูลคือมีความเหมาะสมกับเจ้าหน้าที่ความปลอดภัยในการทำงานระดับวิชาชีพเนื่องจากง่ายต่อการใช้งานไม่จำเป็นต้องมีความรู้ เชี่ยวชาญพิเศษใดๆ ในการสอบสวนอุบัติเหตุและเหตุการณ์ผิดปกติ จุดที่ต้องทำการปรับปรุงแก้ไขได้แก่ ขนาดตัวอักษร จากการศึกษาครั้งนี้สามารถสรุปได้ว่าโปรแกรมฐานข้อมูลสำหรับการสอบสวนอุบัติเหตุและเหตุการณ์ผิดปกติและระบบการวิเคราะห์มาตรการแก้ไข/ป้องกันมีความเหมาะสมกับเจ้าหน้าที่ความปลอดภัยในการทำงานระดับวิชาชีพ

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ABBREVIATIONS

ISO	=	International Organization for Standardization
TISI	=	Thai Industrial Standard Institute
TIS	=	Thai Industrial Standard
ILCI	=	International Loss Control Institute
NSC	=	National Safety Council
CCPS	=	Center for Chemical Process Safety
DOE	=	Department of Energy
ILO	=	International Labour Organization
OSHA	=	Occupational Safety and Health Administration
ISRS	=	Inernational Safety Rating System
RAM	=	Random Access Memory
ALU	=	Arithmetic and Logic Unit
CPU	=	Central Processing Unit
LAN	=	Local Area Network
GUI	=	Graphic User Interface
API	=	Application Programming Interface
Win32 API	=	Windows 32-bit Application Programming Interface
IDE	=	Integrated Development Environment
RAD	=	Rapid Application Development
SQL	=	Structured Query Language

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CHAPTER I
INTRODUCTION

1.1 Background and rationale

Accident and near-miss is an undesired or unexpected event which causes of loss and potential of harm to people, property damage and loss to process. Accident and near-miss investigation is important for organization. Safety officers and related persons have to perform accident investigation in order to find out the etiological (root) causes and to find out the corrective and preventive measures to prevent reputation of this event.

Either the safety officers at professional level or other employee at management level or layman level are directly respond to present the accident and near-miss investigation occurred among their staff. Many investigators are lack of knowledge and skills on appropriate procedures and methods for investigation. Some of them ignored to perform these procedures due to lack of concerning on its' advantages. In general, the investigators attempted to identify some mistakes rather than to concentrate on problems of a management system. All reasons mentioned above let most employees ignore to focus on how to investigate on the accident occurred within their organization, pay less attention on their jobs and increase more technical errors. The etiological causes stilled unclear to verify, especially among those recurring events.

From a summary report of accident/near-miss investigation, major problems found among the factories were composed of 1) Investigator cannot investigate accident and near-miss 2) Group relation problems, as bias causes the investigator cannot find the root causes 3) Investigators have no guideline to specify the corrective and preventive action and 4) Analysis and summary of accident and near-miss use much time.

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This study intend to identify the cause of accident and near-miss in order to use the fruitful information obtained from this study as a guideline to investigate, analysis and suggestion of corrective and preventive measures.

1.2 Objectives

1. To obtain the system analysis of accident and near-miss investigation process among the factories in order to use as a guideline for effective prevention and control.

2. To design a database program to help users to investigate and analyze accident and near-miss for corrective and preventive action based on Loss causation model.

3. To set up a standard manual for accident and near-miss investigation based on Loss causation model.

1.3 Scope of study

This study was carried out at one company located at Rayong province.

1.4 Expected outcome

1. Helps those investigators who still lack of information or insufficient knowledge to perform appropriate accident investigation

2. A Standard strategy for corrective and preventive action in order to use for prevention of recurrence of accident and near-miss

3. A guideline to standardize investigation procedure of an organization

1.5 Limitation of the study

A database program was created by collecting and reviewing the theoretical background from textbooks, secondary data of accident investigation records and websites. Reports of major accidents, traffic accidents were not included in the database. Period of secondary data reviewing was performed during 2003-2004.

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1.6 Operational definition

Incident means an undesired event, which under slightly different circumstances, could have resulted in harm to people, damage to property or loss to process.

Near-miss means an undesired event, which could result potential to have an accident.

Accident means an undesired event or unexpected or lack of control which could or does result in injury, illness or fatal and/or property damage and/or damage to the environmental or public.

Investigation means the determination of the facts of an accident by inquiry, observation, and examination and analysis of these facts to establish the causes of the accident and the measures that must be adopted to prevent its recurrence.

Investigation procedure means the actual procedures used in a particular investigation, which depend on the nature and results of the accident.

Corrective Action means action taken to prevent recurrence of a known accident and near-miss.

Preventive Action means action to prevent the occurrence of a potential accident and near-miss.

Database means a collection of information that has been systematically organized for easy access and analysis. Databases typically are computerized.

VB.net means Microsoft Visual Basic 7.0

Tools means a set of specific steps that must be completed in order to perform an operation.

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1.7 Conceptual framework

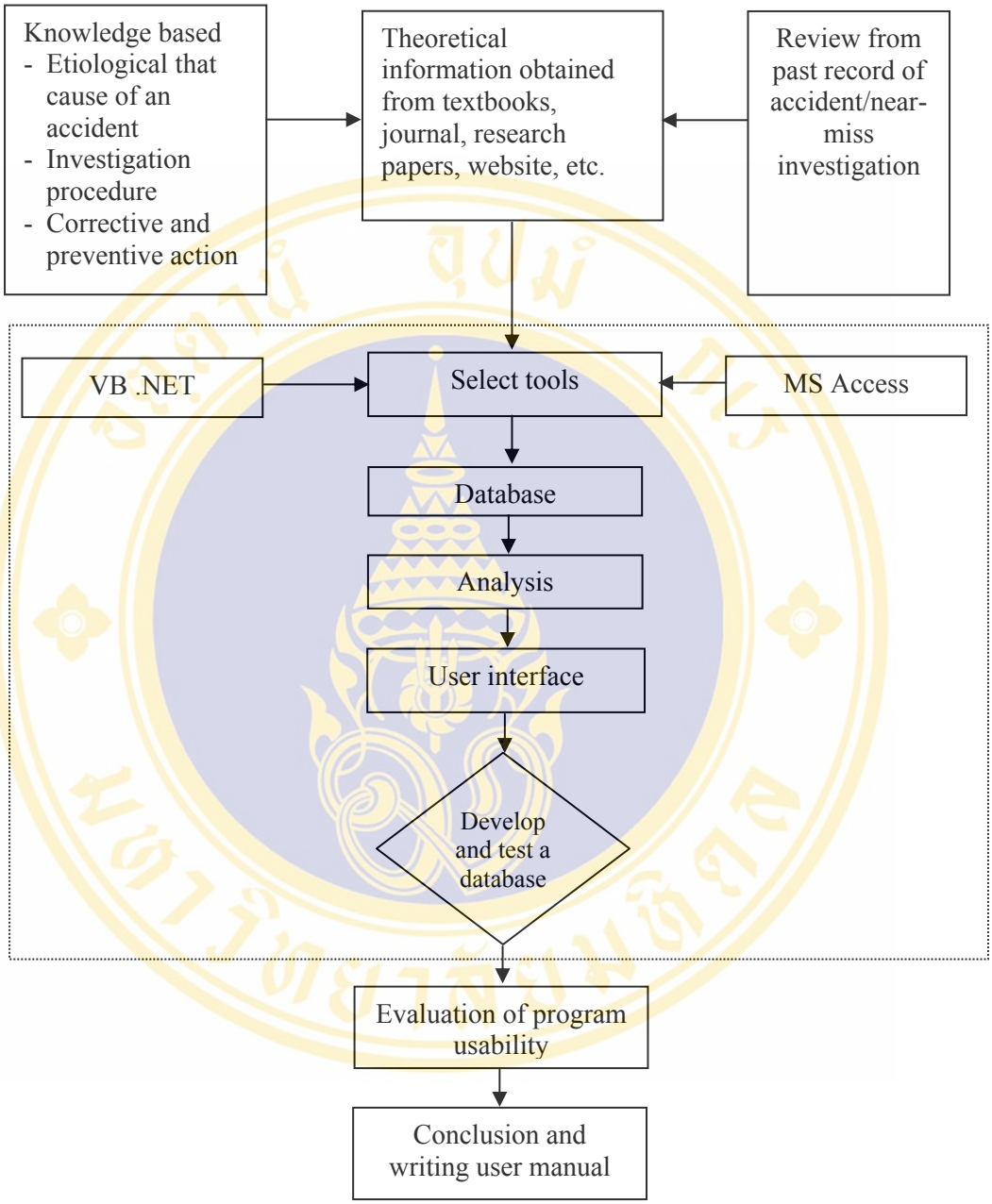

Figure 1 Conceptual framework of a database program for accident and near-miss investigation: system analysis and corrective/preventive action

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CHAPTER II
LITERATURE REVIEW

2.1 Introduction

The statistics of National Institute for the Improvement of Working Condition and Environment (1) illustrated the rate of the injured and death worker is still high. The accident investigation has aimed to find the etiological (root) causes and to find out the corrective and preventive measures.

Thailand has been suggested from International Organization for Standardization (ISO) to establish the Occupational Health and Safety Management System. Thai Industrial Standards Institute (TISI) has been announced TIS-18001 (2) in 1999. The goals of TIS 18001 focuses on reducing and control the risk of workers and stakeholders, increasing the performance of management system and demonstrating the responsibility of organization to social. The clause 4.6.3 specified the accident, near-miss and incident are nonconformity (non-fulfillment of a requirement) (3).

TIS 18001 defined the incidents as an undesired event that could or does result in an accident or near-miss. International Loss Control Institute (ILCI) (4) described incident as an undesired event, which under slightly different circumstances, could have resulted in harm to people, damage to property or loss to process.

The accident investigation is an important for every organization to perform to find the root causes for prevention of reoccurring of the event. National Safety Council (NSC) (5) defined accident investigation and analysis as a means used to prevent accidents. As such, the investigation or analysis must produce information leading to corrective actions that prevent or reduce the number of accidents. The more complete the information the easier it will be for the professional safety officers to take effective corrective actions. CCPS (6) describes three purposes of techniques for accident investigation. The first purpose is to organize information about the accident once evidence has been collected. The second is to help describes accident causation and developing hypothesis for further examination by experts, and the last is to help

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with the assessment proposed of corrective action. In addition, the analytical techniques may also ensure that the results are transparent and verifiable.

The accident investigation process is describes somewhat different by different authors. DOE (7) divides the process in three (partially overlapping) main phases: (i) collection of evidence and facts; (ii) analysis of evidence and facts and development of conclusions; and (iii) development of judgments and need and writing the report. Kjellen (8) describes the implementation and follow-up of recommendations as part of the investigation.

2.2 Type of Accident

International Labor Organization (ILO) (9) identifies the classification the type of event, which directly resulted in the injury, i.e. the manner in which the object or substance causing the injury enters into contact with the injured person.

2.2.1 Falls of persons

- Falls of persons from heights (trees, buildings, scaffolds, ladders, machines, vehicles) and into depths (wells, ditches, excavations, holes in the ground)
- Falls of persons on the same level

2.2.2 Struck by falling objects

- Slides and cave-ins (earth, rocks, stones)
- Collapse (buildings, walls, scaffolds, ladders, piles of goods)
- Struck by falling objects during handling
- Struck by falling objects, not elsewhere classified

2.2.3 Stepping on, striking against or struck by objects excluding falling objects

- Stepping on objects

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- Striking against stationary objects (except impacts due to a previous fall)
- Striking against moving objects
- Struck by moving objects (including flying fragments and particles)
- Excluding falling objects

2.2.4 Caught in or between objects

- Caught in an object
- Caught between a stationary object and a moving object
- Caught between moving objects (except flying or falling objects)

2.2.5 Overexertion or strenuous movements

- Overexertion in lifting objects
- Overexertion in pushing or pulling objects
- Overexertion in handling or throwing objects
- Strenuous movements

2.2.6 Exposure to or contact with extreme temperatures

- Exposure to heat (atmosphere or environment)
- Exposure to cold (atmosphere or environment)
- Contact with hot substances or objects
- Contact with very cold substances or objects

2.2.7 Exposure to or contact with electric current

2.2.8 Exposure to or contact with harmful substances or radiations

- Contact by inhalation, ingestion or absorption of harmful substances

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- Exposure to ionizing radiations
- Exposure to radiations other than ionizing radiations

2.2.9 Other types of accident, not elsewhere classified, including accidents not classified for lack of sufficient data

- Other types of accident, not elsewhere classified
- Accidents not classified for lack of sufficient data

2.3 Step of accident and near-miss investigation and data collection

Accident and near-miss needs to be investigated. It's an important in occupational health and safety management system. Management and all employees have responsibility to report and perform accident and near-miss investigation.

Accident and near-miss occur from work shows that safety management is inadequate. The purpose of investigation aim to find out etiological (root) causes of accident and near-miss occurred during work, and also to check whether corrective and preventive action is adequate.

2.3.1 Key questions in the accident investigation and data collection (10)

When accident and near-miss occurred, needed data must be collected for investigation process. The related person such as professional safety officers, supervisors was responded to investigate. Six basic questions provide for opening the investigation and lay the foundation upon which it can be developed. These key questions composed of:

- WHO was injured? Who saw the accident or near-miss?
- WHAT happened? What was the cause of the accident? What did the injured person do substandard practices or fail to do? What equipment or facilities were involved?
- WHERE did the accident happen? Where was the injured person's supervisor at the time of the accident? Where? Questions help to determine that caused the accident and the events leading up to it.

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- WHEN did the accident occur? Though the time for the accident occurrence is important to know, relationships are often more important. “When” questions ask such questions as: When was the injured person last given safety instructions? “When” questions also elicit information or relationships between activities or events.
- How? Questions beginning with the work “how” also provide information on the interaction and relationship between activities and events. How did the accident happen? How well was the worker instructed to perform the task? How did the guard fall off the machine?
- WHY didn’t the worker perform the job as instructed? Why supervisor allowed worker perform the job under substandard practices or in substandard conditions? Answers to “why” questions should give some indication so as to the corrective and preventive measures that should be taken, since the answers here will generally focus on substandard conditions and substandard practices.

2.3.2 Investigation procedure

Occupational Health and Safety Administration (OSHA) (11) defined the actual procedures used in a particular investigation depend on the nature and results of the accident. The organization having jurisdiction over the location determines the investigative procedures. In general, responsible officials will specific in job description or appoint an individual to be in charged of the investigation. Professional safety officers and safety officers at supervisory level are responsible for investigation by the law. The investigation procedure is shown as the following:

- Define the scope of the investigation.
- Select the investigators. Assign specific tasks to each investigator.
- Present a preliminary briefing to the investigating team, which are included:
  a. Description of the accident, with damage estimates.
  b. Normal operating procedures.
  c. Maps (local and general).
  d. Location of the accident site.

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e. List of witnesses.

f. Events that preceded the accident.

- Visit the accident site to get updated information.
- Inspect the accident site.

a. Secure the area. Do not disturb the scene unless a hazard exists.

b. Prepare the necessary sketches and photographs. Label each carefully and keep accurate records.

- Interview each victim and witness. Also interview those who were present before the accident and those who arrived at the site shortly after the accident happen. Keep accurate records of each interview. Use a recorder if desired and if approved.
- Determine

a. What was not normal before the accident.

b. Where the abnormality occurred.

c. When was first noted.

d. How it occurred.

- Analyze the data obtained in determining the accident. Repeat any of the prior steps, if necessary.
- Find out

a. Why the accident occurred.

b. A likely sequence of events, immediate causes and basic causes.

c. Alternative sequences.

- Check each sequence against the data from determining the accident and near-miss.
- Determine the most likely sequence of events and the most probable causes.
- Conduct a post-investigation briefing.

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- Prepare a summary report, including the recommended actions to prevent a recurrence. Distribute the report according to related person.

2.4 Loss causation model

International safety rating system (ISRS) has been established by Frank E. Bird (4) in 1969. The safety management was emphasized on preventing injuries without having considered a loss control and the basic causes of the event. Describe the cause and effect of loss, which from accident. It resulted from contact with substance or source of energy. The cause of accident came from immediate causes such as substandard practices. The substandard practices such as an operating without any authority; use improper equipment. The substandard conditions such as hazardous environment condition, inadequate warning system. Basic causes or etiological (root) cause composed of personal factors and job factors. The personal factor such as lack of knowledge, inadequate maintenance. The job factors such as lack of operating standard, lack of maintenance. Basic causes derived from lack of control. These are inadequate program, inadequate standard and inadequate compliance with standard. The inadequate such as no training course for operator to do the hazard job. Training course was done but do not meet standard. Training evaluation is inadequate also affected to accident and near-miss.

Causal analysis of accident and near-miss by using loss causation model is shown in figure 2 as below:

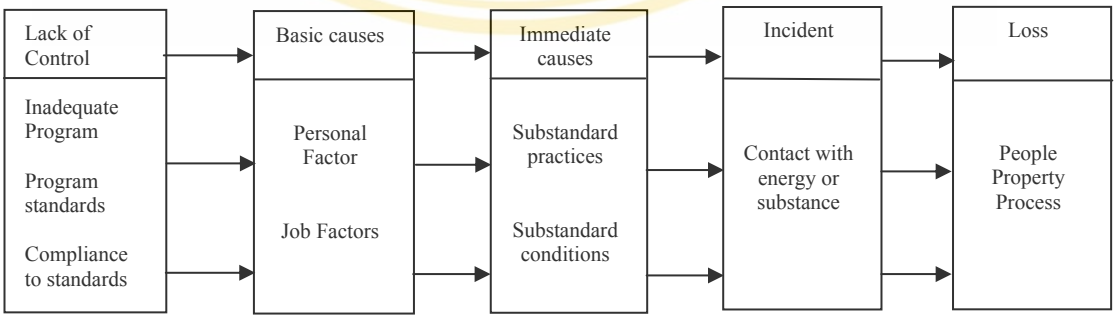

Figure 2 Loss causation model

2.5 Accident and near-miss analysis, corrective and preventive action (12)

Due to this study, an important step of accident and near-miss investigation was collecting all relevant information related to an accident and near-miss. The

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completed data will lead to the proper analysis of causal inference to indicate prompt action. There are two main sources of information to obtain. First is the substandard practices and the second is the substandard conditions. The details are as follows:

- Evidence-based record of all losses.
- Sources of energy or substances used as record that produced the losses.
- Gathering in important information as much as possible. It's important for accident and near-miss investigation and analysis for causal finding during the investigation.

a. Record evidence of all losses. Such as kind of injury, illness, property damage, loss of production.

b. Record of sources of energy or substances that causes of losses.

In the part of analysis, the researcher use types of contact as an initiator of analysis, which are divided into 9 categories as following:

- Struck against
- Struck by
- Fall to lower level
- Fall in the same level
- Caught in
- Caught on
- Caught between
- Contact with (Electricity, Heat, Cold, Radiation, Corrosive, Toxic, Biological hazard, Noise)
- Overstress/overexertion/overload

There are two main factors influenced accidents and near-miss. First is the immediate cause. The investigation process analyzes the immediate cause by using loss causation model as a guideline. These are composed of:

2.5.1 Substandard practices

- Operating without authority
- Failure to warn
- Failure to secure
- Operating at improper speed

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- Making safety devices inoperable
- Remove safety devices
- Using improperly equipment
- Using defective equipment
- Failing to use personal protective equipment properly
- Improper loading
- Improper placement
- Improper lifting
- Improper position for task/job
- Servicing equipment in operation
- Horseplay
- Under influence of alcohol and/or drugs

2.5.2 Substandard conditions

- Inadequate guards or barriers
- Inadequate or improper protective equipment
- Defective tools, equipment or materials
- Congestion or restricted action
- Inadequate warning system
- Fire and explosion hazards
- Poor housekeeping
- Hazardous environmental conditions; gases, dusts, smokes, fumes, vapors,
- Noise exposures
- Radiation exposures, high or low temperature exposures
- Inadequate or excess illumination
- Inadequate ventilation system

2.6 Etiological agents of accident and near-miss

There are two main factors based on loss causation model of basic causes influence accidents and near-miss. These factors composed of personal factors and job factors as follows:

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2.6.1 Personal factors

- Lack or inadequate of knowledge
    a. Lack of experience
    b. Inadequate orientation
    c. Inadequate initial training
    d. Inadequate update training
    e. Misunderstood directions
- Lack or inadequate of skill
    a. Inadequate orientation
    b. Inadequate practice
    c. Infrequent performance
    d. Lack of coaching or instructing
    e. Inadequate refresh training
- Inadequate Physical/Physiological Capability
    a. Unsuitable height, weight, size, strength, reach, etc.
    b. Restricted range of part of body movement
    c. Limited ability to sustain body positions
    d. Substance sensitivities or allergies
- Sensitivities to sensory extremes (temperature, noise, pressure, etc.)
    a. Vision deficiency
    b. Hearing deficiency
    c. Other sensory deficiency (taste, smell, etc.)
    d. Respiratory incapacity
    e. Other temporary/permanent physical disabilities
- Inadequate Mental/Psychological Capability
    a. Fears and phobias
    b. Emotional disturbance
    c. Mental illness
    d. Intelligence level
    e. Inability to comprehend
    f. Improper judgment
    g. Improper coordination

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h. Slow reaction rate
i. Low mechanical aptitude
j. Low learning aptitude
k. Memory failure

- Physical or Physiological Stress
  a. Injury or illness
  b. Fatigue from task overload or long duration of work
  c. Fatigue from lack of rest time
  d. Fatigue from sensory overload
  e. Exposure to health hazards
  f. Exposure to temperature extremes
  g. Oxygen deficiency
  h. Atmospheric pressure variation
  i. Constrained movement
  j. Influence of drugs
- Mental or Psychological Stress
  a. Emotional overload
  b. Fatigue from mental task load or speed
  c. Extreme judgment/decision demands
  d. Routine, monotony work
  e. Extreme concentration/perception demands
  f. Meaningless activities
  g. Confusing directions
  h. Conflicting demands
  i. Preoccupation with problem
  k. Frustration
  l. Mental illness
- Improper motivation
  a. Improper performance is rewarding
  b. Proper performance is punishing
  c. Lack of incentives
  d. Excessive frustration

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e. Inappropriate aggression
f. Improper attempt to save time or effort
g. Improper attempt to avoid discomfort
h. Improper attempt to gain attention
i. Inappropriate per pressure
j. Improper supervisory example
k. Inadequate performance feedback
l. Inadequate reinforcement of proper behavior

2.6.2 Job factors

- Inadequate Leadership and Supervision
  a. Unclear or conflicting reporting relationships
  b. Unclear or conflicting assignment
  c. Improper or insufficient delegation
  d. Giving inadequate procedure, work instruction or guidelines
  e. Giving objectives, standards that conflict
  f. Inadequate instructions, orientation and/or training
  g. Providing inadequate reference documents, directives and procedures
  h. Inadequate identification and evaluation of loss exposures
  i. Lack of supervisory/management job knowledge
  j. Inadequate matching of individual qualifications and job/task requirements
  k. Inadequate performance measurement and evaluation
  l. Inadequate or incorrect performance feedback
- Inadequate Engineering
  a. Inadequate assessment of loss exposures
  b. Inadequate consideration of human factors/ergonomics
  c. Inadequate standards, specifications and/or design criteria
  d. Inadequate monitoring of construction
  e. Inadequate assessment of operational readiness
  f. Inadequate monitoring of initial operation

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g. Inadequate risk assessment/evaluation of changes

- Inadequate Purchasing
  a. Inadequate specification on requisitions
  b. Inadequate research on materials/equipment
  c. Inadequate specifications to vendors/suppliers
  d. Inadequate route of transportation
  e. Inadequate receiving inspection and acceptance
  f. Inadequate communication of safety and health data
  g. Improper handling of materials
  h. Improper storage of materials
  i. Improper transporting of materials
  j. Improper identification of hazardous items
  k. Improper salvage and/or waste disposal
- Inadequate Maintenance
  a. Preventive maintenance
  b. Assessment of needs
  c. Lubrication and servicing
  d. Adjustment /assembly
  e. Cleaning
  f. Repairable
  g. Planning of maintenance work
  h. Examination of units
  i. Part substitution
- Inadequate Tools and Equipments
  a. Inadequate assessment of needs and risks
  b. Inadequate human factors/ergonomics considerations
  c. Inadequate standards or specifications
  d. Inadequate availability
  e. Inadequate adjustment/repair/maintenance
  f. Inadequate salvage and reclamation
  g. Inadequate removal and replacement of unsuitable items
- Inadequate Work Standards

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a. Development of standards
b. Communication of standards
c. Maintenance of standards
d. Observation of practice

- Wear and Tear
  a. Inadequate planning of usage
  b. Improper extension of service life
  c. Inadequate inspection and/or monitoring
  d. Improper loading or rate of use
  e. Inadequate maintenance
  f. Use by unskilled or untrained people
  g. Use for wrong purpose
- Abuse and Misuse
  a. Condoned by supervision
  b. Not condoned by supervision

2.7 A control program for accident and near-miss (4)

2.7.1 Management responsibility

- Occupational health and safety policy
- Established occupational health and safety section
- Management level participation
- Establish management performance standards
- Safety agenda in management meeting
- Management audit perform
- Responsibility for occupational health and safety
- Establish objectives/KPIs in occupational health and safety annual plan
- Participate in occupational health and safety committee
- Refusal work on work hazard policy
- Established document control system
- Standard operating procedure implemented
- Established communication system

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2.7.2 Management training

- Management orientation/induction program
- Formal initial training of senior management personnel
- Formal review an update training of senior management personnel
- Formal initial training of supervisory and middle line management person
- Formal review and update training of supervisory and middle line management person

2.7.3 Planned inspection

- Planned inspection procedure
- Planned general inspection
- Inspection report analysis
- Critical parts/items inspection
- Materials-handling, Mobile pre-use equipment inspection

2.7.4 Task analysis and procedure

- Management directive
- Critical job/task inventory
- Task analysis and procedure
- Operating criteria state in safety standard operating procedure (SSOP)
- Review and revise critical job/task, risk assessment as needed

2.7.5 Accident investigation

- Accident/near-miss investigation procedure
- Safety officer at management and supervisory level involvement in investigation
- Near-miss investigation and report
- Corrective and preventive action follow-up
- Record keeping

2.7.6 Job/task observation

- Management directive
- Complete job/task observation program
- Level of complete job/task observations

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- Partial job/task observation
- Job/task observation report analysis
- Regular program monitoring

2.7.7 Emergency preparedness and response

- Management directive
- Emergency/contingency plan
- Source of energy control
- Training in first aid and qualified first aid attendants
- Emergency lighting and power supply in emergency situation
- Organized outside help and mutual aid
- Keeping of important records
- Post-event planning
- Emergency situation communication
- Communications to the public

2.7.8 Organizational rules

- General safety and health rules/regulations
- Specialized work rules/regulations
- Permit to work and specialized procedure systems
- Rule/regulation education and review program
- Rule/regulation compliance effort
- Use of signs and color codes
- Regular program monitoring

2.7.9 Accident analysis

- Statistics computed and used
- Occupational injury analysis
- Property damage identification and analysis
- Problem-solving project teams
- Near-miss analysis

2.7.10 Employee training

- Training procedure
- Training need survey
- Training evaluation

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- Training record

2.7.11 Personal protective equipment

- Personal protective equipment needed survey
- Personal protective equipment standard of use
- Personal protective equipment record keeping
- Personal protective equipment usage training

2.7.12 Health control

- Working environment monitoring/measurement
- Occupational health risk assessment
- Occupational health hazard control
- Health examination
- Health maintenance program
- Professional assistance
- Internal communication
- Records keeping

2.7.13 Program evaluation

- Evaluation of management compliance with program standards
- Evaluation of compliance with standards for general physical conditions
- Evaluation of compliance with fire prevention and control standards
- Evaluation of compliance with occupational health standards
- Program evaluation system record keeping

2.7.14 Engineering control

- Design/modification engineering control
- Process engineering consideration and control
- Regular program monitoring

2.7.15 Personal communication

- Training in personal communication techniques
- Job orientation/induction
- Job/task instruction
- Planned personal contacts
- Regular program monitoring

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- Record keeping

2.7.16 Group meeting

- Group meeting
- Regular promotion monitoring
- Record keeping
- Management involvement

2.7.17 General promotion

- Safety bulletin board program
- Use of program statistics and facts
- Critical topic/task promotion
- Use of rewards and/or recognition
- Program information publication
- Group performance promotion
- Housekeeping promotion
- Records of promotion program's activities

2.7.18 Hiring and placement

- Physical capability requirement
- Physical examination
- General orientation/induction program
- Pre-placement qualification checks

2.7.19 Purchasing control

- Procurement of goods/materials
- Selection of outsource
- Outsource control

2.7.20 Off the job safety

- Problem identification and assessment
- Off-the-job safety education

In this study, International Loss Control Institute (ILCI) involves up to 20 elements with the detailed mentioned above. It is suitable for use as recommended measures for a database program for accident and near-miss investigation: system analysis and corrective/preventive action. However, the researcher used only step 2.5

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and 2.6, the controlling measures as a reference standard to construct a database system.

2.8 Computer application to accident and near-miss investigation (13)

Computer application is widely used in almost every field. Computer costs have decreased because of rapid developments in both hardware and software technology. CPU technology has made computing so economical that hundreds of millions of general-purpose computers are in use worldwide, helping people in business, industry, government and personal lives.

2.8.1 Computer Organization

The computer system compose of:

- Input unit. This "receiving" section of the computer obtains information (data and computer programs) from various input devices. The input unit then places this information at the disposal of the other units to facilitate the processing of the information. Today, most users enter information into computers via keyboards and mouse. Other input devices include scanners (for scanning images) and digital cameras (for taking photographs and making videos).
- Output unit. This "shipping" section of the computer takes information that the computer has processed and places it on various output devices, making the information available for use outside the computer. Computers can output information in various ways, including displaying the output on screens, printing it on paper or using the output to control other devices.
- Memory unit. This is the rapid-access, relatively low-capacity "warehouse" section of the computer, which facilitates the temporary storage of data. The memory unit retains information that has been entered through the input unit, enabling that information to be immediately available for processing. In addition, the unit retains processed information until that information can be transmitted to output devices. The memory unit is called either memory or primary memory-random access memory (RAM) is an example of primary memory.
- Arithmetic and logic unit (ALU). The ALU is the "manufacturing" section of the computer. It is responsible for the performance of calculations such. It

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also contains decision mechanisms, allowing the computer to perform such tasks as determining whether two items stored in memory are equal.

- Central processing unit (CPU). The CPU serves as the "administrative" section of the computer. This is the computer's coordinator, responsible for supervising the operation of the other sections. The CPU alerts the input unit when information should be read into the memory unit, instructs the ALU about when to use information from the memory unit in calculations and tells the output unit when to send information from the memory unit to certain output devices.
- Secondary storage unit. This unit is the long-term, high-capacity "warehousing" section of the computer. Secondary storage device is hard disks. Information in secondary storage takes much longer to access than do information in primary memory.

2.8.2 Personal Computing, Distributed Computing and Server Computing

The computers first pioneered were "stand-alone" units, people did their work on their own machines and transported disks back and forth to share information.

Personal computers were not powerful enough to timeshare several users, the machines could be linked together into computer networks via local area networks (LANs) within an organization. These networks led to the phenomenon of distributed computing, in which an organization's computing is distributed over networks to the sites at which the work of the organization is performed, instead of the computing being performed only at a central computer installation. Personal computers were powerful enough to handle both the computing requirements of individual users, and the basic tasks involved in the electronic transfer of information between computers.

2.8.3 Visual Basic .NET (14) (15)

Visual Basic .NET evolved from BASIC (Beginner's All-Purpose Symbolic Instruction Code), developed in the mid-1960s by Professors John Kemeny and Thomas Kurtz of Dartmouth College as a language for writing simple programs. BASIC's primary purpose was to familiarize novices with programming techniques.

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The widespread use of BASIC on various types of computers had led to many enhancements to the language. The development of the Microsoft Windows graphical user interface (GUI) in the late 1980s and the early 1990s, the natural evolution of BASIC was Visual Basic. Visual Basic appeared in 1991, developing Microsoft Windows-based applications was a difficult and cumbersome process. Although Visual Basic is derived from the BASIC programming language, it is a distinctly different language that offers such powerful features as graphical user interfaces, event handling, access to the Windows 32-bit Application Programming Interface (Win32 API), object-oriented programming and exception handling. Visual Basic .NET is an event-driven, visual programming language in which programs are created using an Integrated Development Environment (IDE). With the IDE, a programmer can write, run, test and debug Visual Basic programs conveniently, thereby reducing the time it takes to produce a working program to a fraction of the time it would have taken without using the IDE. The process of rapidly creating an application is typically referred to as Rapid Application Development (RAD). Visual Basic is the world's most widely used RAD language.

Visual Basic .NET provides the features that are most important to programmers and users, such as object-oriented programming, strings, graphics, graphical-user-interface components, exception handling, multithreading, multimedia (audio, images, animation and video), file processing, prepackaged data structures, database processing, Internet and World-Wide-Web-based server networking and distributed computing. The language is appropriate for implementing Internet-based and World-Wide-Web-based applications that seamlessly integrate with PC-based applications.

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CHAPTER III
MATERIALS AND METHODS

This study aimed to develop a database program for accident and near-miss investigation: system analysis and corrective/preventive action. The evaluation of program usability will be performed among professional safety officers and program experts.

3.1 Methods of study

Methods of study are divided into 4 steps as follows:

1. Collecting data of accident/near-miss investigation
2. Development of database program
3. Verification of a database program
4. Writing user manual

3.1.1 Collecting data of accident/near-miss investigation (3) (7)

The researcher reviewed the theoretical background from textbook, accident investigation records and websites such as www.osha.gov; www.ilo.org; www.csb.gov; www.diwsafety.org, principle of investigation, investigation procedure, causal analysis of accident and near-miss from an accident investigation manual of The National Safety Council (NSC), Loss Control Management (Modern Safety Management) and reviewed corrective and preventive measures from accident and near-miss investigation record.

3.1.2 Development of a database program

Steps of development a database program for accident and near-miss investigation: system analysis and corrective/preventive action are compose of:

3.1.2.1 Reviewed and selected a suitable software for the database development. The characteristic of the appropriate software should be applicable and

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have an effective structure for accident/near-miss investigation, users can use the program easily. In addition, the program should be easy to understand and do not complicated.

As reasons mentioned above, the researcher selected The Visual Basic 7.0 (VB .NET) and Microsoft Access to develop the database program.

3.1.2.2 Defined the detail of software development, data input, user communicative screen feature, analyzing part and how to summarize the report.

3.1.2.3 Designed the content. The database program contained 6 tabs. There are general information of accident and near-miss, data of accident and near-miss, accident and near-miss analysis, picture attachment, accident/near-miss analysis and corrective/preventive action and comments of management person.

3.1.3 Verify the program

As the database program of accident and near-miss investigation: system analysis and corrective/preventive action is created and added to the developing system. The program verification was performed among the programmers. The aim was to ensure that the database program were reliable, unbiased, users could work with the different data set without changing any structural condition in any input data. It can work correctly and efficiently. Also, it is convenient, easy to access and user friendliness.

The program should be compromised with the user satisfactory. It should also be simply to use, offered obvious menu, clear meaning and shown attractive appearances.

Evaluation of the program usability, the program will be improved to comply with the requirement of the users.

3.1.4 Writing a user manual

The researcher prepared a user manual of the database program for “Accident and Near-miss Investigation: System analysis and corrective/preventive action”. It included the user instruction, command menu, how to entry data, the result of the software and how to print the report.

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3.2 Evaluation of the program usability

3.2.1 Program usability evaluation

3.2.1.1 Questionnaires for professional safety officers

Program usability questionnaire was introduced in this study. The questionnaire was composed of four parts. The first part was related to general information of the respondents. The second part was the respondents' opinions on program usability. The third part was satisfaction of the users towards the program's usability and the fourth part was the overall comments and suggestions.

3.2.1.1 Questionnaires for program experts

Program performance evaluation forms were introduced to the program experts. The questionnaire was composed of three parts. The first part was related to general information of the program experts. The second part was the experts' opinions on the program development. The third part was comments and suggestions from the experts on program development in future.

3.2.2 Data collection

Data collection procedures composed of:

3.2.2.1 The researcher demonstrated how to use the database program to the subjects.

3.2.2.2 The researcher explained the meaning of each item of the questionnaire and how to fill them. The researcher would collected the questionnaire back for data entry.

3.2.2.3 The researcher analyzed all of collected questionnaires.

3.2.3 The index score

The level of attitude towards the program usability among the professional safety officers and experts were shown in the table below.

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Table 1 The level of program usability

Score	Level
1	Poor
2	Fair
3	Good

The mean score was calculated and classified into three groups as shown in table 2

Table 2 The index score of program usability

Mean score (Percentage)	Level of satisfaction
< 2.2 (<60%)	Poor
2.2-2.4 (60-74%)	Fair
≥ 2.5 (≥75%)	Good

3.2.4 Statistical analysis

The descriptive statistics to describe data from the questionnaires are used. Frequency distributions and percentage were created. Means and standard deviations were also calculated.

Chi-square test was performed to determine the association between the database program satisfaction with sex, professional safety officer, Microsoft Access and Visual Basic .NET experience, use of others accident investigation program, the knowledge of accident investigation

Pearson's correlation was performed to determine the correlation between database program satisfaction with age, years of working experience and years of experience to investigate.

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3.3 Research instruments

A database program of accident and near-miss investigation: system analysis and corrective/preventive action is needed. In addition, the hardware and operating system also included. The details are summarized as follows:

1. Hardware : To set up a database program, several hardware to use are summarized as follows :

CPU	:	At least Intel Pentium II 500 MHz or Compatible
RAM	:	At least 128 MB
Hard disk	:	At least 20 Gigabyte

2. Software : The software used to develop a database program are summarized as follows :

Operating System	:	Microsoft windows XP
Object-Oriented Application	:	Microsoft Visual Basic 7.0 (VB.net)
Database Program	:	Microsoft Access
Document tools	:	Microsoft Word

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CHAPTER IV
RESULTS

The result of this research is a database program of accident and near-miss investigation: system analysis and corrective/preventive action that developed by using Microsoft Visual Basic 7.0 (Visual Basic .NET and Microsoft Access. To develop a database program, there are 3 mains steps to perform as summarized as follows:

Step I : System design
Step II : System analysis
Step III : Evaluation of opinion in database program usability

4.1 System Design

In an initial step of system flow chart, accident and near-miss are obtained from reported by those who are directly respond to report or those who face with the event. All initial information required must enter into the database program. When accident and near-miss investigation took place, the investigators selected type of contact with energy or substance. A database program was analyzed in order to identify substandard actions and substandard conditions, investigators selected related-items. The program analyzed basic causes. The job factors and personal factors displayed on screen investigators selected related-items. Database program may conduct more details of an investigation process to guidance for corrective and preventive action. The effective prevention and control strategies also be recommended, investigators selected at the end of the process. Finally, the report was created to conclude the result. The flow chart of a system design was shown as figure 3:

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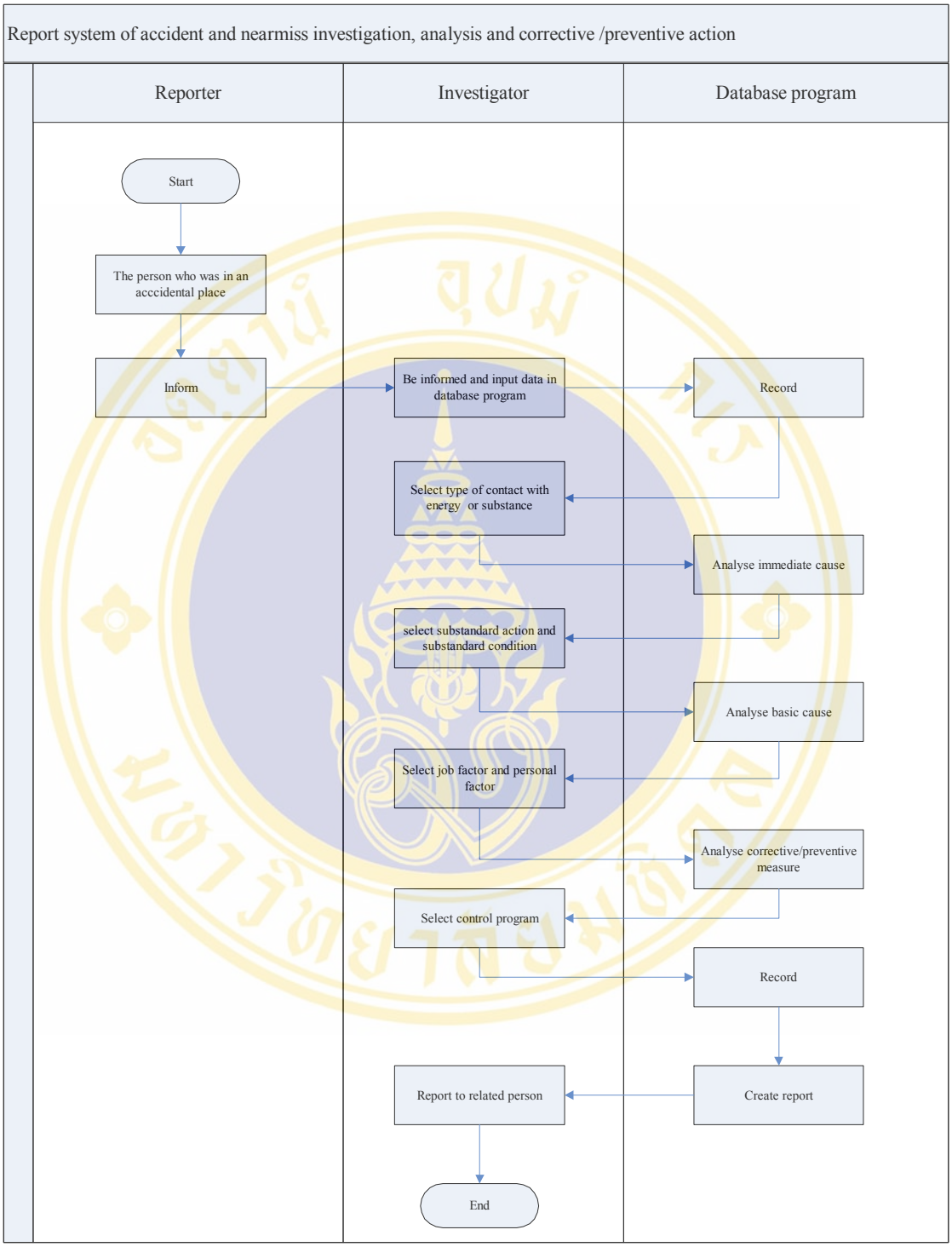

Figure 3 System flow chart

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4.2 System Analysis

In an initial step or system analysis, accident and near-miss are obtained from injuries records reported by those who are directly respond to report or those who face with the event as shown in a use case diagram in figure 4. All information are analyzed in order to identify etiological agent. In some circumstance, and investigator may conduct more details of and investigation process to conclude a final result. Before writing a summary report to identify a main cause of accident among all stakeholders. The effective prevention and control strategies also be recommended at the end of the process.

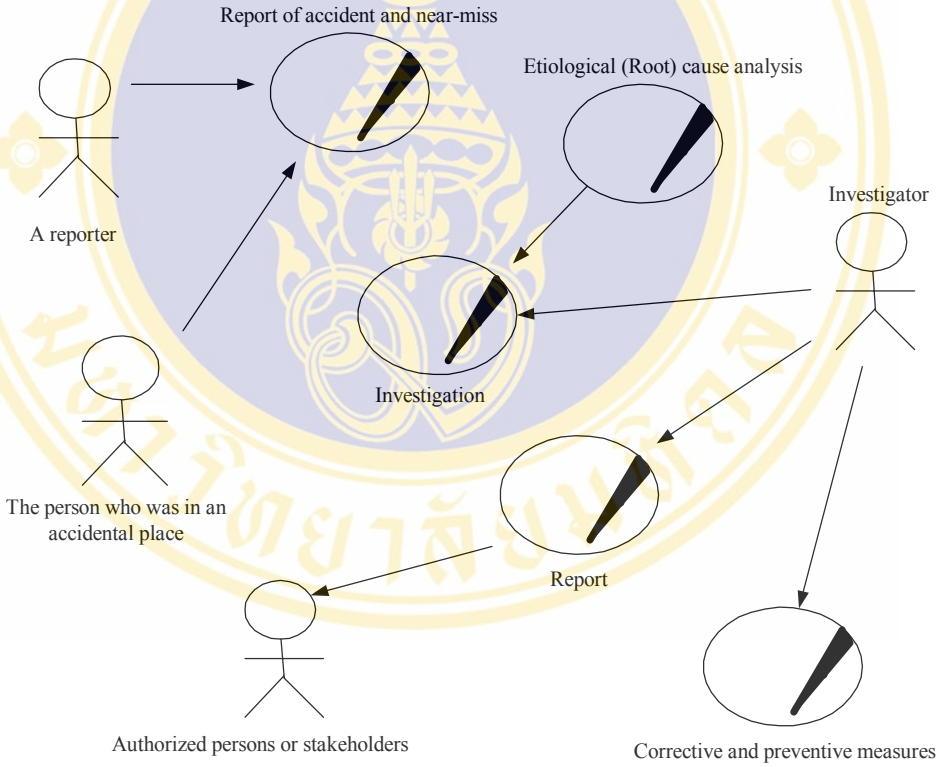

Figure 4 Use case diagram

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4.3 Evaluation of program usability

Strengths of the database program were composed of its' ability to perform on electronic version, developed from traditional version for more convenience to use and to reduce paper work. The program can apply to a LAN where both software and data are stored in a server. These appropriate are convenience for investigators and related person to conduct an accident and near-miss investigation. Moreover, routine report of event by case and month are ready to use and can easily be adapted into a new and update version when the condition is changed.

The evaluation of program usability is divided into two main parts, composed of program usability test among professional safety officers and program usability among the program experts.

4.3.1 Program usability test among professional safety officers

4.3.1.1 The characteristic of the professional safety officers

The descriptive characteristic of subjects showed in table 3. The program usability professional safety officers were 20 professional safety officers at one company. They were 11 male and 9 female. Percentage of the professional safety officers and the trained professional safety officers were 25 and 75%, respectively. The years of working experience were 12.76 ± 7.17 years and the average age were 36.20 ± 6.70 years. The years of experience in investigation were 3.66 ± 4.97 years. Most of them (75%) have their knowledge on accident investigation program usability.

Table 3 The characteristic of program usability of professional safety officers

Characteristic of professional safety officers	Number (20)	Percentage (%)
Sex		
Male	11	55.0
Female	9	45.0
Professional safety officer		
Professional Safety Officer	5	25.0
Trained Professional Safety Officer	15	75.0

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Table 3 The characteristic of program usability of professional safety officers (cont.)

Characteristic of professional safety officers	Number (20)	Percentage (%)
Microsoft Access and Visual Basic .NET		
Experienced	12	60.0
No experienced	8	40.0
Use of others accident investigation database program		
Yes	3	15.0
No	17	85.0
The knowledge of accident investigation techniques		
Yes	15	75.0
No	5	25.0
Age group (yrs)		
22 – 30	6	30.0
31 – 39	4	20.0
40 – 48	10	50.0
Mean ± SD	36.2 ± 6.7	
Min ; Max	23 ; 46	
Years of working experience (yrs)		
≤ 8	7	35.0
9 - 17	8	40.0
≥ 18	5	25.0
Mean ± SD	12.76 ± 7.17	
Min ; Max	0.3 ; 14	
Years of experience of investigation (yrs)		
≤ 5	14	70.0
6 - 11	4	20.0
≥ 12	2	10.0
Mean ± SD	3.66 ± 4.97	
Min ; Max	0 ; 16	

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4.3.1.2 The program usability

In this study, the questionnaire was created to evaluate the program usability. The questionnaire (showed in appendix) consisted of 18 questions for four parts. There were the general characteristics of the professional safety officer, the opinion of program usability, satisfaction of program usability, comments and suggestions. The researcher present and demonstrate how to use the program. The questionnaire was sent to those 20 professional safety officers.

Table 4 Program usability

Program usability	Mean ± SD	Index*
Easy to entry data	2.65 ± 0.49	Good
Sequences of data entry	2.45 ± 0.51	Fair
Completeness of required data	2.40 ± 0.59	Fair
Support and be convenient to perform the investigation	2.85 ± 0.36	Good
Help users investigate and guide the corrective/preventive action	2.70 ± 0.47	Good
Investigation result was accurate	2.55 ± 0.51	Good
Satisfaction in a database program	2.70 ± 0.47	Good
Total score	2.61 ± 0.48	Good

Remark: * Good = ≥ 2.5 (≥75%), Fair = 2.2-2.4 (60-74%), Poor = < 2.2 (<60%)

Table 4 shown the mean score of the program usability opinion was (2.61 ± 0.48). It was classified as “Good”. The maximum score was “support and be convenient to perform the investigation”, meanwhile the minimum score was found to be completed of the required data.

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Table 5 Program usability, Strength, Weakness and Program Improvement

Program usability	Number (20)	Percentage (%)
The strength of database program (can chose more than one item)		
o Format and sequences of data entry	9	45.0
o Convenient and faster of the investigation process	18	90.0
o Accuracy and completeness of analysis	9	45.0
o Etc……..	4	20.0
The weakness of this database program (can chose more than one item)		
o Difficult to enter data	1	5.0
o Lack of required data	4	20.0
o Incompletion or missing of analysis	0	0.0
o Delay of data processing	0	0.0
o Etc……..	12	60.0
Which part of the database program should be improved? (can chose more than one item)		
o Available on LAN	9	45.0
o Available on internet	7	35.0
o Linkage to database of personnel department	7	35.0
o Easy to use	1	5.0
o Etc……..	3	15.0

Table 5 showed that most of the subjects were satisfied with this database program. The strength was convenient and faster of the investigation process. The weakness of this database program was etcetera such as small font size; each database item should have pop up description. The intranet version (LAN) was also suggested from the professional safety officers.

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Table 6 The association of the program usability with the sex, age, type of professional safety officers, use of Microsoft Access and Visual Basic .NET, use of others accident investigation program, knowledge of investigation, years of working experience and years of experience to investigate.

Table 6 The association of the program usability with the sex, age, type of professional safety officers, use of Microsoft Access and Visual Basic .NET, use of others accident investigation program, knowledge of investigation, years of working experience and years of experience to investigate

Characteristic of professional safety officers	γ	p-value
Sex	-	0.450*
Age	0.373	-
Professional safety officers	-	1.000*
MS Access and VB.net experience	-	1.000*
Use of others accident investigation database program	-	1.000*
The knowledge of accident investigation techniques	-	1.000*
Years of working experiences	0.901	-
Years of experiences to investigate	0.561	-

Remark: *Obtained from χ^2 test

Table 6 reveals there were no significantly different between the program usability with sex, age, professional safety officers, Microsoft Access and VB.net experience, use of others accident investigation database program, the knowledge of accident investigation techniques, years of working experiences and years of experiences to investigate.

4.3.1.3 Comments from the professional safety officers (Number of professional safety officer = 20 persons)

- This program is more useful, if program has been linked to database of personnel department.
- The database program could implement to the investigation system. If the user would like to have more efficiency, the program have been developed to “Link and Follow-up” from process of corrective/preventive action, follow-up and record keeping.
- For reduce working time, a database program should consider linkage of man-hours database.

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- Easy to change if incorrect database has been found. Be better, if data inputting have only selection form check box or list box.
- Add input box for management's suggestions and recommendations.
- Should have user manual to explain the step of work.
- Could have guidelines for accident and near-miss inquiry.
- Clearly classified accident categories.
- Fonts in displayed windows are small.
- Explain important data, which have many choices.
- Should add the explanation of personal factors and job factors, which are obscurity.
- Should have the pop up menu and suggestion for using program.
- The program could help to easily inquire accident and more convenient work but there are some steps become complicated. The manual have to be distinct describe how to insert data. Be better, if enlarge font size.

4.3.2 Program usability among the program experts

4.3.2.1 Opinion of program development

The questionnaire was created for evaluation the opinion of program development. The sample of questionnaire, showed in appendix, consisted of 18 questions for 3 parts. There were the general characteristics of the programmer, the opinion of program development and the comments and suggestions. The questionnaire and the program were sent to those 6 programmers.

Table 7 Opinion of Program design and development

Program design and development	Mean ± SD	Index
Accuracy of design and development	2.50 ± 0.54	Good
Appropriated tools were selected for program development	2.83 ± 0.40	Good
Accuracy in writing E-R Diagram	2.67 ± 0.51	Good
Appropriateness for Normalization process	2.67 ± 0.51	Good
Completeness of database program	2.00 ± 0.63	Fair

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Table 7 Opinion of Program design and development (cont.)

Program design and development	Mean ± SD	Index
Suitable of data for testing	2.50 ± 0.54	Good
User friendly "Graphic User Interface"	2.17 ± 0.75	Fair
Total score	2.47 ± 0.55	Good

Remark: * Good = ≥ 2.5 (≥75%) , Fair = 2.2-2.4 (60-74%), Poor = < 2.2 (<60%)

The result showed the mean score of the program design and development opinion (2.47±0.55). It was classified as "Good". The maximum score was "Appropriated tools were selected for program development", meanwhile the minimum score was found user friendly.

4.3.2.2 Comments from the programmer. (Number of programmer = 6 persons)

- Change the database from Microsoft Access to SQL server or Oracle for serving many of user and data.
- If the speed of CPU higher than Intel Pentium II 500 MHz, the more rapid processing will obtain.

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CHAPTER V
DISCUSSION

The database program was constructed using the Microsoft Access and the Visual Basic version 7.0 (VB.NET) as software to support. The program supported the professional safety officers to investigate and guide the corrective/preventive action. The contents consisted of general information of accident/near-miss, data of accident/near-miss, accident/near-miss analysis, picture attachment, accident/near-miss analysis and corrective/preventive action and comments of management person.

The Microsoft Access and The Visual Basic 7.0 (VB.NET) were selected for program development. Software provides the features that are the most important issue to the programmers and users such as Graphic-User-Interface (GUI), multimedia, database processing etc. Pornpimol Wangsri (22) studied on Chemical substances and hazardous materials database for professional safety officers in the electrical group. Microsoft Access and Visual Basic were chosen for the database development in her study. She confirmed that the characteristics of the software were good and effective structure, user friendly and attractively and clear in the communication to the system.

The professional safety officers of one company performed the program usability test. Wichansky AM (23) mentioned that usability testing is a widely used technique to evaluate user performance and acceptance of the system. Although usability testing may not be the most efficient technique for discovery of usability problems but it still be a reliable way to estimate quantitatively users' performance and subjective satisfaction with systems. 'Quick and clean' usability testing methods are needed to provide valid and reliable data on how well tester use systems. The questionnaire was distributed to 20 professional safety officers. The return rated was 100%. Phone called was done on the next day for questionnaire’s follow-up. The strength of the database program was supported all of the professional safety officers to perform accident investigation, to help users investigate and guide the corrective/preventive action.

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Computer technology broadly use in the workplace. Pornpimol Wangsri (22) indicated that result showed 84.8% of the professional safety officers indicated that this database could enhance the work capability. Computer aid technology can be applied on occupational health and safety work concerned. In this study found that professional safety officers agreed with “Support and be convenient to perform the investigation” of the database program. The result showed 87% of professional safety officers indicated that this database program support and be convenient to perform the investigation. However there were some improved points from the professional safety officers. Most of the professional safety officers recommended that the appearance of the database such as font size should be enlarged. According to the sensation and perception (24, 25), the appearance is the stimuli to induce the response of the professional safety officers. The font size was the major concern from the professional safety officers who averaged age is 36.2 years. Keane EM, O'Connor M, Coakley D and Walsh JB (26) confirmed that poor vision is common found in the elderly population.

This study showed no association between the program usability opinions with the sex, age, type of professional safety officers, experienced in use of Microsoft Access and Visual Basic .NET, use of others accident investigation database program, the knowledge of accident investigation techniques, years of working experience and years of experience to investigate. Therefore, lacking of information or insufficient knowledge to perform appropriate accident investigation was not the problem. It indicated that this database program is practical for professional safety officers.

The benefit of this program was evaluated in this study. The mean score of the program usability opinion was “Good”. These benefits were to support and be convenience to perform the investigation, to help users investigate and guide the corrective/preventive action. It confirmed that program could be the strategy for corrective/preventive action in order to use for prevention of recurrence of accident and near-miss. It could be recommended that this database program would serve as a guideline to standardize the investigation procedure of an organization.

The opinion of program usability of professional safety officers was “Fair” in “Sequence of data entry”. The researcher designed the sequence to input data as tab. The advantage of this appearance was grouping of all related information, which can

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facilitate the data entry. “Fair” may be from unfamiliar of the professional safety officers. The same reason of “Fair” was found in “Completeness of required data”. In additions, user suggested that this database program should have the tab for the comments and suggestions from management person. This database program is improved following the suggestion during the trail phase.

The programmers were asked to perform the program a design and development opinion test. The questionnaire was distributed to 6 programmers. Phone called was done on the next day for questionnaire’s follow-up also. The return rated was 100%. The result showed the strength of the program from the programmer’s point of view were the appropriate software for program development as the accuracy in writing E-R Diagram and suitability for Normalization process. The recommendation of programmers to improve the weak-point of the program was database server. The server should be changed from Microsoft Access to be SQL server or Oracle. These servers can contain more data and serve as appropriate data pool.

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CHAPTER VI
CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

A database program for accident and near-miss investigation: system analysis for corrective/preventive action was developed by Microsoft Visual Basis 7.0 (VB.NET) and Microsoft Access. This database program is able to analyze all input data for the corrective and preventive action. The size of the program was 6 megabytes.

The methodology consisted of 4 mains steps: 1) collecting data of accident/near-miss investigation, which based on principle of loss control management, 2) development of database program, 3) verification of a database program and 4) writing user manual. Data collected form the steps of collecting and developing will be gathered to construct a database program.

The contents of program consisted of 6 tabs as 1) general information of accident/near-miss, 2) data of accident/near-miss, 3) picture attachment, 4) accident/near-miss analysis, 5) accident/near-miss analysis and corrective/preventive action and 6) comments of management person.

The database program was tested for the program usability opinion. The questionnaire was sent to those 20 professional safety officers. The return rated was 100%. The results of the evaluation of program usability opinion showed that the database program can help those investigators who have no experiences perform accident investigation. There were showed no association between the program usability attitudes with the sex, age, type of professional safety officers, use of Microsoft Access and Visual Basic .NET, use of others accident investigation program, knowledge of investigation, years of working experience and years of experience to investigate in this study. This database program is easy to use and not complicated for most of the professional safety officers. Therefore, lacking of information or insufficient knowledge to perform accident investigation was not the

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problem. It indicated that this database program is practical for professional safety officers to use in their work.

The programmers were asked to perform the program a design and development opinion. The questionnaire was distributed to 6 programmers. The return rated was 100%. The result showed the strength of the program from the programmer's point of view were the appropriate software for program development as the accuracy in writing E-R Diagram and suitability for Normalization process. The recommendation of programmers to improve the weak-point of the program was database server. It confirmed that this database program was developed and designed properly.

In addition the user manual can help professional safety officers to understand the database program. The improvement points were the font size and the appearance of the database program.

6.2 Recommendation

6.2.1 For professional safety officers

The study of the database program was appropriate to investigate the general job-related accident and near-miss because database has limitation. This database program is practical for professional safety officers.

6.2.2 For further study

In the future, the following statements are recommendation for further development to increase the capability of the program should be composed of.

1. The font size, font style, must be taken into consideration for better understanding of the database.
2. Risk assessment of each accident and near-miss, investigator should perform the risk assessment for each accident and near-miss, which is required by the law.
3. Network investigation and report of the result should be sent directly via e-mail to related person or to all stakeholders.

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APPENDIX

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แบบประเมินการใช้งาน (Evaluation of Program Usability form)

โปรแกรมฐานข้อมูลสำหรับการสอบสวนอุบัติเหตุและเหตุการณ์ผิดปกติและระบบการวิเคราะห์มาตรการแก้ไข/ป้องกัน (A database program for accident and near-miss investigation: System analysis for corrective/preventive action)

<u>ส่วนที่ 1</u> : ข้อมูลทั่วไปเกี่ยวกับผู้ตอบแบบสอบถาม (กรอกข้อมูล หรือทำเครื่องหมาย ✓ หน้าข้อความที่เลือก)

1. เพศ ❑ หญิง ❑ ชาย
2. เจ้าหน้าที่ความปลอดภัยในการทำงาน ❑ จป.วิชาชีพ ❑ อบรม 180 ชั่วโมง
3. การใช้งาน Microsoft Access และ Visual Basic .NET ❑ เคย ❑ ไม่เคย
4. การใช้งานโปรแกรมการสอบสวนอุบัติเหตุอื่นๆ ❑ เคย ❑ ไม่เคย
5. มีความรู้เกี่ยวกับการสอบสวนอุบัติเหตุ ❑ มี ❑ ไม่มี
6. อายุ ……..ปี
7. ประสบการณ์ในการทำงาน .....ปี
8. ประสบการณ์ในการสอบสวนอุบัติเหตุ .....ปี

<u>ส่วนที่ 2</u> : ความคิดเห็นเกี่ยวกับการใช้งานโปรแกรม (โปรดทำเครื่องหมาย ✓ หน้าข้อที่เลือก)

1. ความยาก-ง่ายในการป้อนข้อมูล ❑ ยาก (1) ❑ ปานกลาง (2) ❑ ง่าย (3)
2. ลำดับของการป้อนข้อมูล ❑ ยาก (1) ❑ ปานกลาง (2) ❑ ง่าย (3)
3. ความครบถ้วนของข้อมูล/เนื้อหาที่ป้อน ❑ ไม่ครบ (1) ❑ ปานกลาง (2) ❑ ครบถ้วน (3)
4. ช่วยให้ท่านทำงานสะดวกขึ้นหรือไม่ ❑ ไม่สะดวก (1) ❑ ปานกลาง (2) ❑ สะดวก (3)
5. ช่วยในการสอบสวน วิเคราะห์สาเหตุ เสนอแนะมาตรการแก้ไข/ป้องกัน ❑ ไม่ช่วย (1) ❑ ปานกลาง (2) ❑ ช่วย (3)
6. ความเชื่อถือในความถูกต้องของการวิเคราะห์ ❑ ไม่น่าเชื่อ (1) ❑ ปานกลาง (2) ❑ เชื่อได้ (3)
7. ความพึงพอใจในภาพรวมของการใช้งาน ❑ ไม่พอใจ (1) ❑ ปานกลาง (2) ❑ พอใจ (3)

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ส่วนที่ 3 : ความพอใจในการใช้งานโปรแกรม (โปรดทำเครื่องหมาย ✓ หน้าข้อที่เลือก)

1. คุณคิดว่า จุดเด่นของโปรแกรมนี้คือ (เลือกได้มากกว่า 1 ข้อ)
   - ❑ รูปแบบและขั้นตอนในการป้อนข้อมูล
   - ❑ ความสะดวกรวดเร็วในการทำงาน
   - ❑ ความถูกต้อง สมบูรณ์ของผลลัพธ์ที่แสดง
   - ❑ อื่นๆ (โปรดระบุ).....
2. คุณคิดว่า จุดด้อยของโปรแกรมนี้คือ (เลือกได้มากกว่า 1 ข้อ)
   - ❑ ขั้นตอนในการป้อนข้อมูลยุ่งยาก
   - ❑ ข้อมูลที่จำเป็นไม่ครบถ้วน
   - ❑ โปรแกรมประมวลผลไม่ถูกต้อง
   - ❑ โปรแกรมประมวลผลช้า
   - ❑ อื่นๆ (โปรดระบุ).....
3. คุณคิดว่าควรพัฒนาและปรับปรุงโปรแกรมนี้ในส่วนใดบ้าง (เลือกได้มากกว่า 1 ข้อ)
   - ❑ การใช้งานในระบบ LAN
   - ❑ การใช้งานในระบบ Internet
   - ❑ การเชื่อมโยงข้อมูลกับฝ่ายบุคคล
   - ❑ ความเข้าใจง่ายของการกรอกข้อมูล
   - ❑ อื่นๆ (โปรดระบุ).....

ส่วนที่ 4 : วิจารณ์และข้อเสนอแนะ

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แบบสอบถามคิดเห็นของผู้เชี่ยวชาญด้านการพัฒนาโปรแกรม

(Evaluation form of Program design and development)

โปรแกรมฐานข้อมูลสำหรับการสอบสวนอุบัติเหตุและเหตุการณ์ผิดปกติและระบบการวิเคราะห์มาตรการแก้ไข/ป้องกัน (A database program for accident and near-miss investigation : System analysis for corrective/preventive action)

ส่วนที่ 1 : ข้อมูลเกี่ยวกับผู้กรอกแบบสอบถาม (กรอกข้อมูล หรือทำเครื่องหมาย ✓ หน้าข้อความที่เลือก)

1. ชื่อ-นามสกุล .....
2. เพศ ❑ หญิง ❑ ชาย
3. การศึกษา ❑ ต่ำกว่าปริญญาตรี ❑ ปริญญาตรี
   ❑ ปริญญาโท ❑ อื่นๆ ระบุ .....
4. ตำแหน่ง .....

ส่วนที่ 2 : ทัศนคติและความคิดเห็นต่อการพัฒนาโปรแกรม (ทำเครื่องหมาย ✓ ลงในช่องระดับที่เลือก)

เกี่ยวกับโปรแกรมที่พัฒนา	ระดับ		
	น้อย(1)	ปานกลาง(2)	มาก(3)
1. ความถูกต้องของขั้นตอนการออกแบบและพัฒนาโปรแกรม			
2. ความเหมาะสมของการเลือกใช้เครื่องมือการพัฒนาโปรแกรม			
3. ความถูกต้องของการเขียน E-R Diagram			
4. ความเหมาะสมของการทำ Normalization			
5. ความสมบูรณ์ของโปรแกรมที่พัฒนา			
6. ความเหมาะสมของข้อมูลที่ใช้ทดสอบ			
7. ความเข้าใจง่ายของการออกแบบหน้าจอ (Graphic User Interface)			

ส่วนที่ 3 : วิจารณ์และข้อเสนอแนะเกี่ยวกับการพัฒนาโปรแกรม

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คู่มือการใช้

A database program for accident and near-miss investigation: system analysis for corrective/preventive action

สำหรับ

เจ้าหน้าที่ความปลอดภัยในการทำงาน

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สารบัญ

	หน้า
การเปิดโปรแกรมฐานข้อมูล	1
การใช้โปรแกรมฐานข้อมูล	1
การเพิ่มเติมข้อมูลข้อมูลทั่วไปของเหตุการณ์	2
การเพิ่มเติมข้อมูลรายละเอียดผู้บาดเจ็บ/เจ็บป่วย	4
การวางรูปภาพประกอบการเกิดอุบัติเหตุ/เหตุการณ์เกือบเกิดอุบัติเหตุ	5
การวิเคราะห์อุบัติเหตุ/เหตุการณ์เกือบเกิดอุบัติเหตุ	6
การกำหนดมาตรการแก้ไข/ป้องกัน	13
การเพิ่มเติมข้อมูลความคิดเห็นของผู้บริหาร	15
การพิมพ์รายงาน	16
การแก้ไขฐานข้อมูลพนักงาน	17
การเพิ่ม/แก้ไขข้อมูลสาเหตุเบื้องต้น (Immediate cause)	18
การเพิ่ม/แก้ไขข้อมูลสาเหตุพื้นฐาน (Basic cause)	18
การเพิ่ม/แก้ไขข้อมูลความต้องการโปรแกรมควบคุม (Control action needs)	19

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การเปิดโปรแกรมฐานข้อมูล

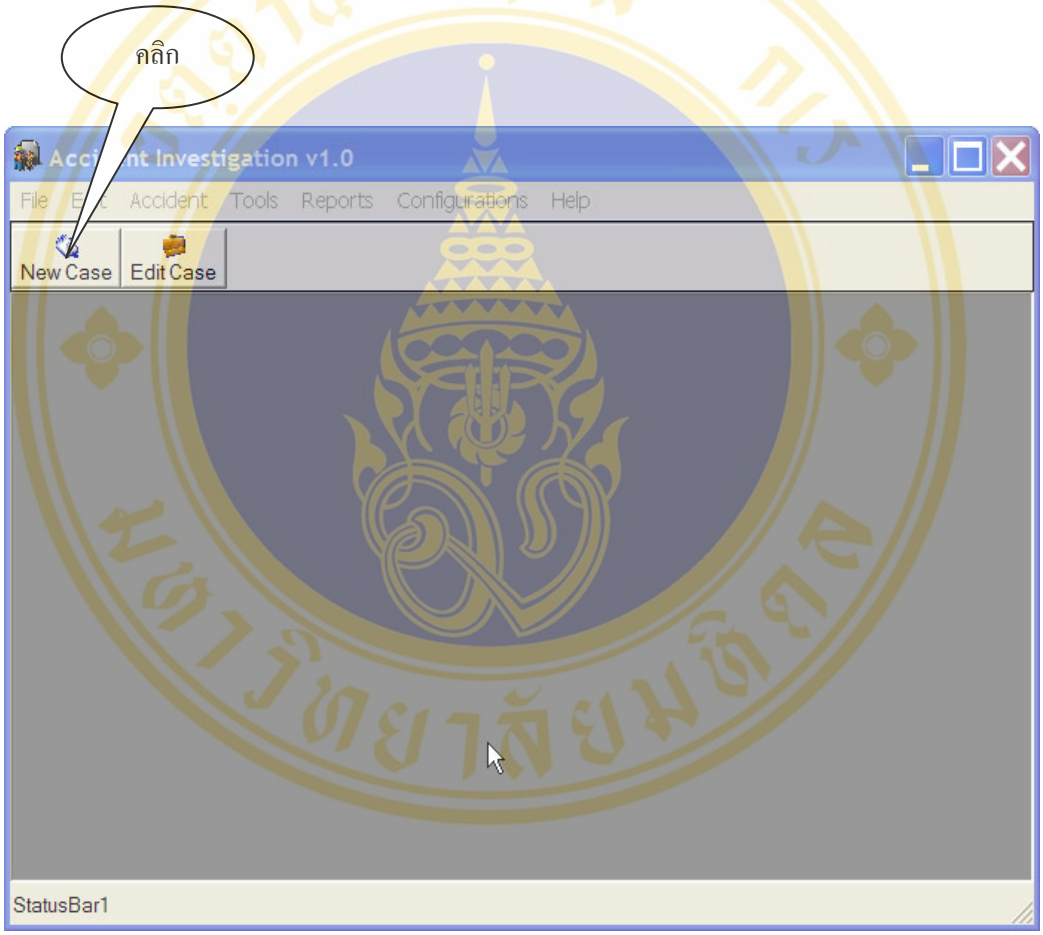
กรณีที่ USER ไม่มี Visual Basic ต้องทำการ Install โปรแกรม Visual Basic ก่อน

หลังจากที่ได้ Install program แล้ว จะปรากฏไอคอน ที่

desktop

- ดับเบิลคลิกที่ไอคอน

จะปรากฏ Windows ดังรูป



- คลิกที่ไอคอน

จะปรากฏ Windows เพื่อป้อนข้อมูลที่เกี่ยวข้อง

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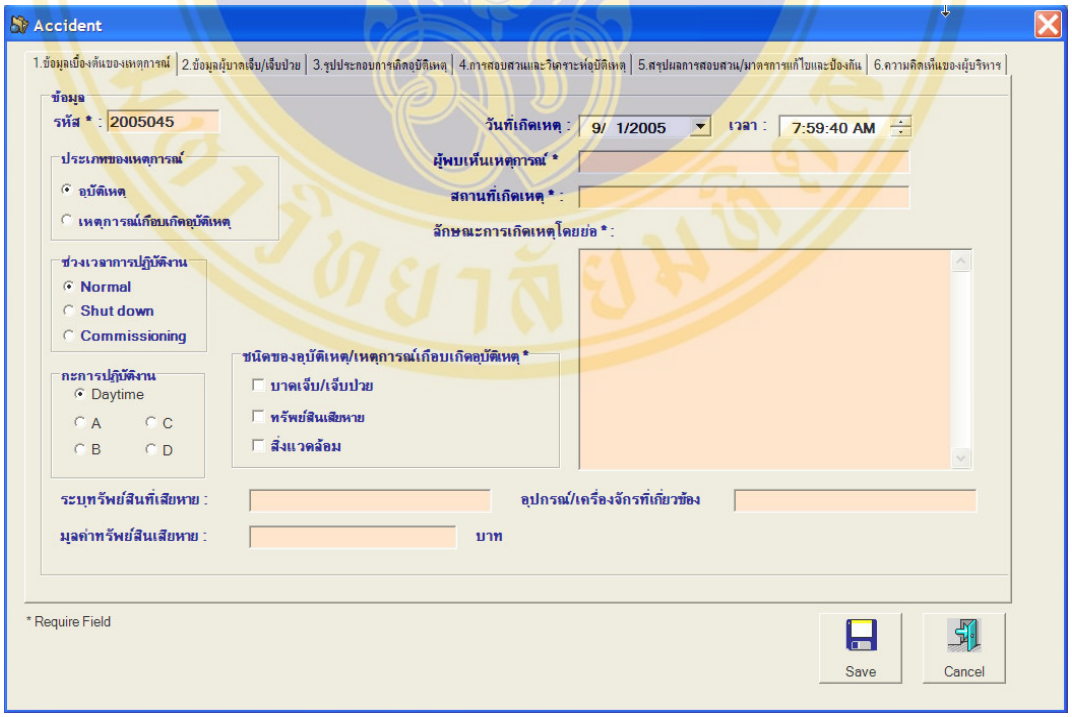
โปรแกรมประกอบด้วย 6 tab ดังนี้

1. ข้อมูลเบื้องต้นของเหตุการณ์
2. ข้อมูลผู้บาดเจ็บ/เจ็บป่วย
3. รูปประกอบการเกิดเหตุ
4. การสอบสวนและวิเคราะห์อุบัติเหตุ
5. สรุปการสอบสวน/วิเคราะห์การแก้ไขและป้องกัน
6. ความคิดเห็นของผู้บริหาร

Tab 1 ข้อมูลเบื้องต้นของเหตุการณ์

- ผู้สอบสวนจะต้องกรอกข้อมูลผู้พบเห็นเหตุการณ์ สถานที่เกิดเหตุ ลักษณะการเกิดเหตุโดยย่อ ระบุทรัพย์สินที่เสียหาย อุปกรณ์/เครื่องจักรที่เกี่ยวข้อง มูลค่าทรัพย์สินเสียหาย
- เลือกประเภทของเหตุการณ์ ช่วงเวลาปฏิบัติงาน และกะการปฏิบัติงานจาก Radio button
- เลือกชนิดของอุบัติเหตุ/เหตุการณ์ผิดปกติ จาก Check box



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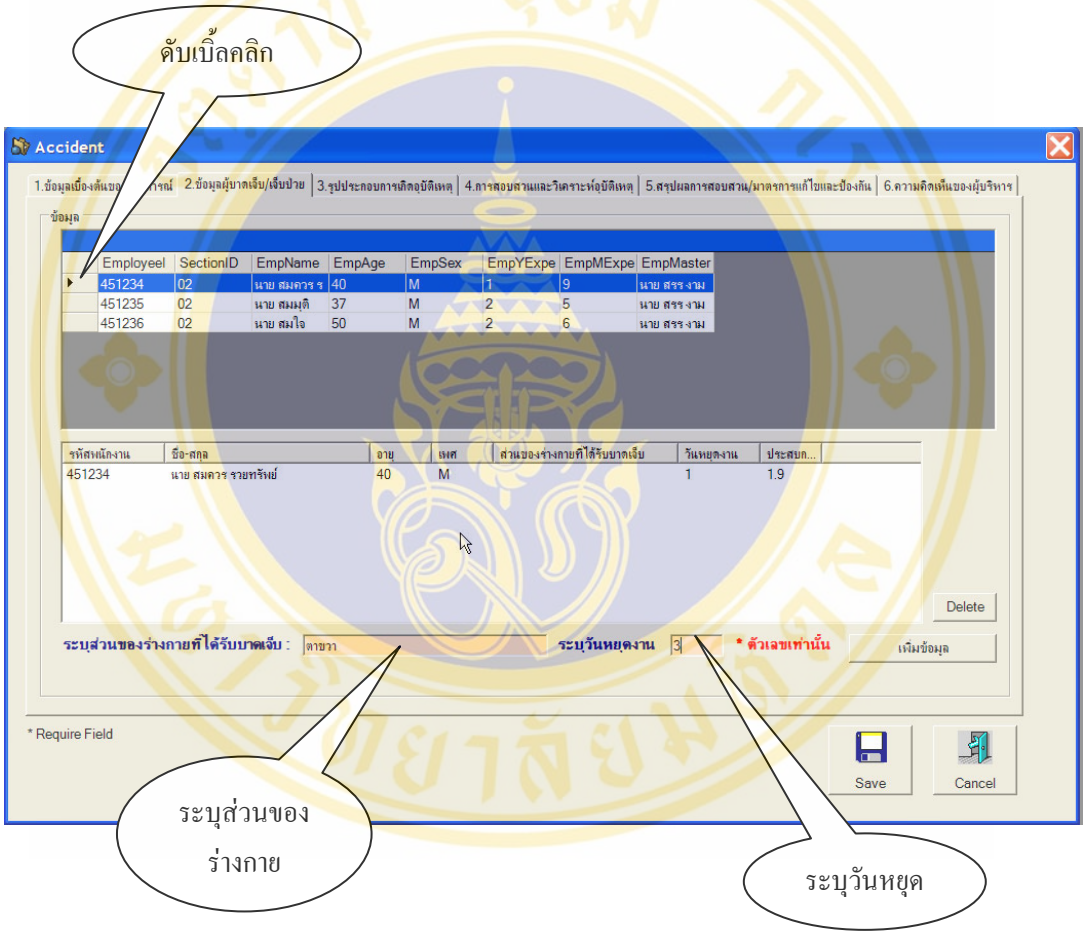
Tab 2 ข้อมูลผู้บาดเจ็บ/เจ็บป่วย

- ผู้สอบสวนเลือกรายชื่อผู้บาดเจ็บ/เจ็บป่วยจากดาต้าเบสได้โดยดับเบิ้ลคลิกที่หน้ารหัสของพนักงาน ซึ่งผู้ใช้งานต้องระบุ “ส่วนของร่างกายที่ได้รับบาดเจ็บ” และ “วันหยุดงาน” แล้วคลิกที่ปุ่ม เพิ่มข้อมูล ส่วนของร่างกายที่ได้รับบาดเจ็บและวันหยุดงานจะขึ้นไปแสดงในบรรทัดเดียวกับรายชื่อพนักงาน เพิ่มข้อมูล ถ้าต้องการลบข้อมูล คลิกที่ปุ่ม Delete



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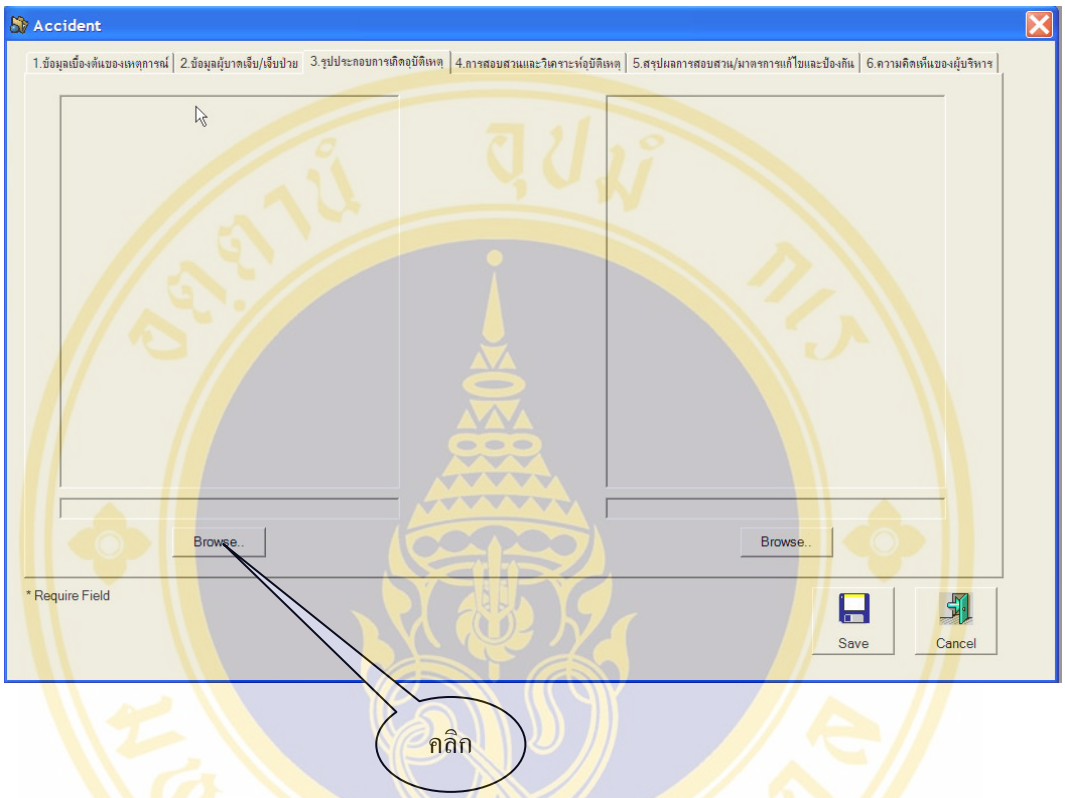
Tab 3 การวางรูปการเกิดอุบัติเหตุ/เหตุการณ์เกือบเกิดอุบัติเหตุ



- เมื่อคลิกปุ่ม Browse.. จะปรากฏ Windows เพื่อเลือกรูปที่ต้องการ
- เมื่อได้รูปที่ต้องการแล้วคลิกปุ่ม Open รูปที่เลือกไว้จะไปปรากฏ

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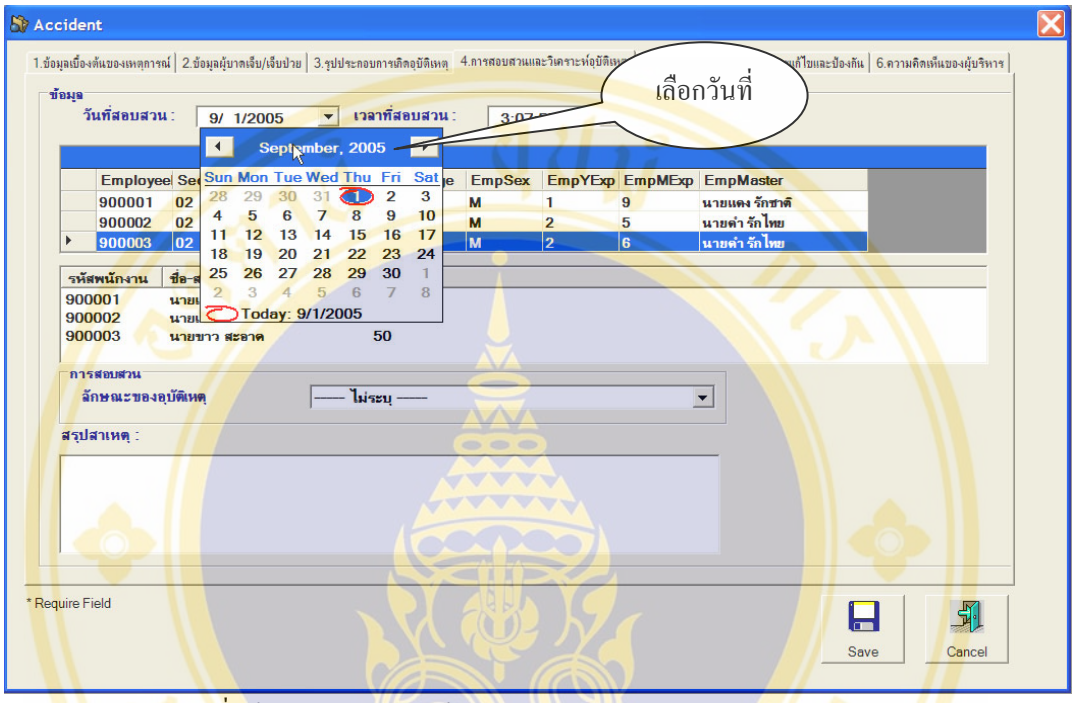
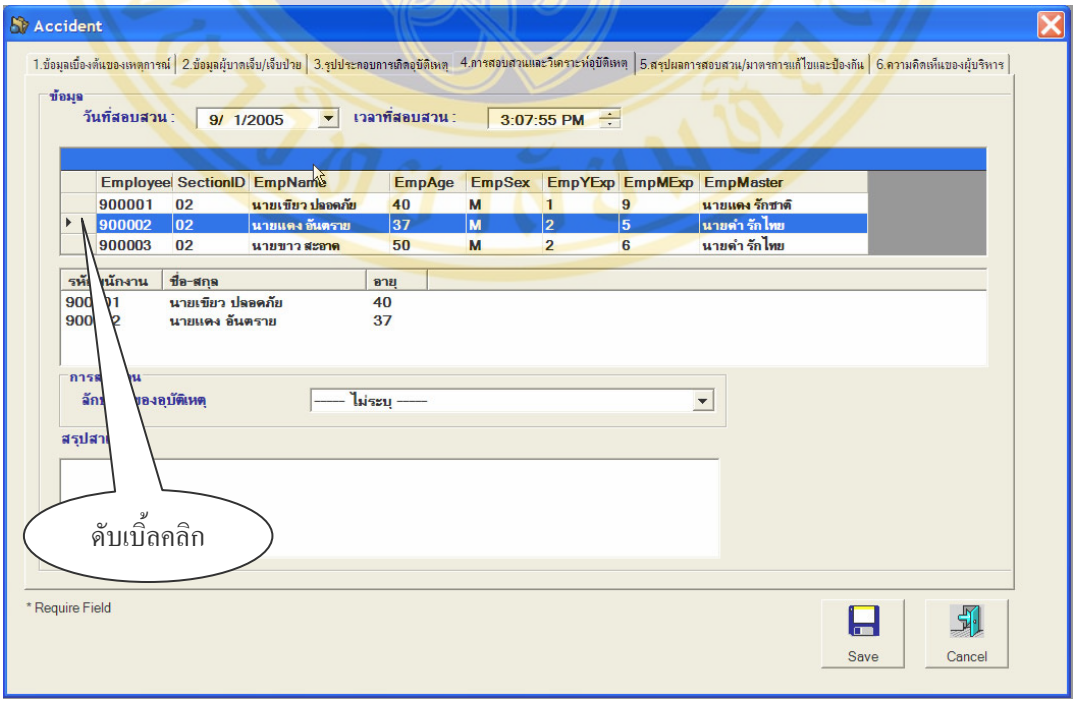
Tab 4 การสอบสวนและวิเคราะห์อุบัติเหตุ

1. เลือกวันที่และเวลาที่สอบสวน



2. เลือกรายชื่อผู้สอบสวนจากฐานข้อมูล



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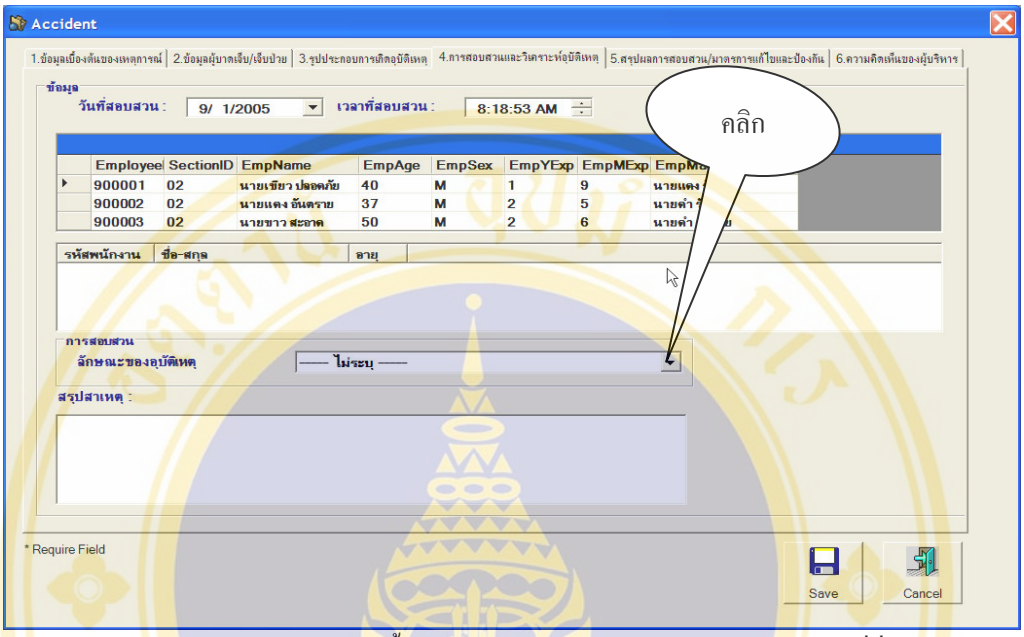
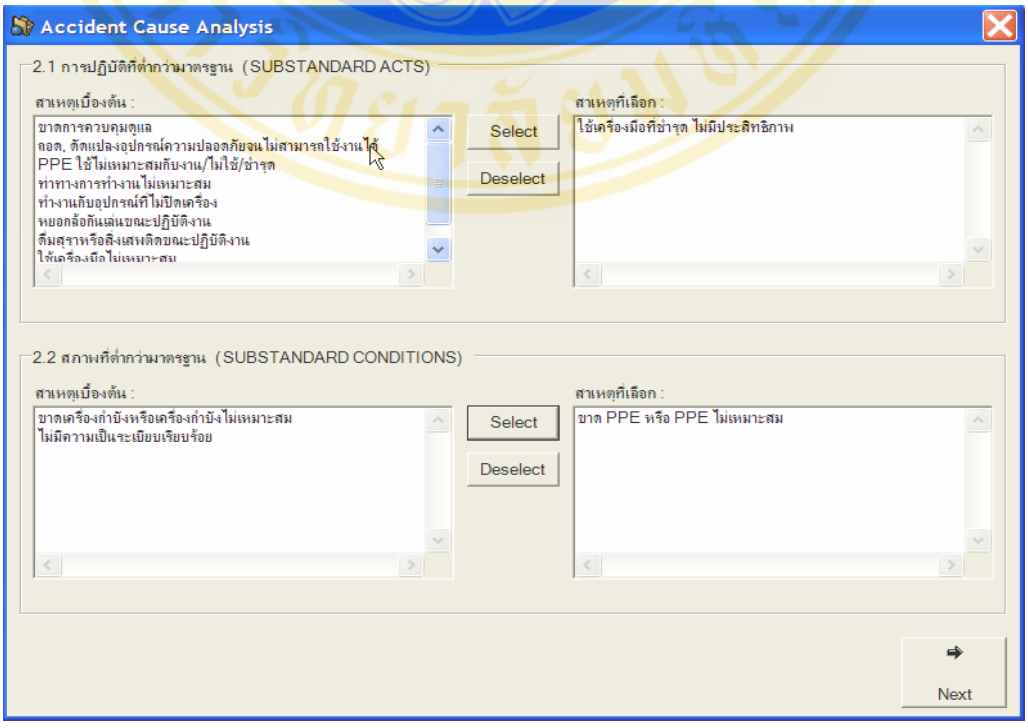
3. การสอบสวนคลิกเลือก “ลักษณะของอุบัติเหตุ” จาก Drop down listbox จะปรากฏ Windows ดังนี้



- ผู้สอบสวนเลือกสาเหตุเบื้องต้น (Immediate cause) การปฏิบัติที่ต่ำกว่ามาตรฐาน (Substandard practices) และสภาพที่ต่ำกว่ามาตรฐาน (Substandard conditions) โดยคลิกที่หัวข้อที่ต้องการแล้วคลิกที่ Select หัวข้อจะไปปรากฏที่ “สาเหตุที่เลือก” และถ้าต้องการยกเลิก ให้คลิก Deselect



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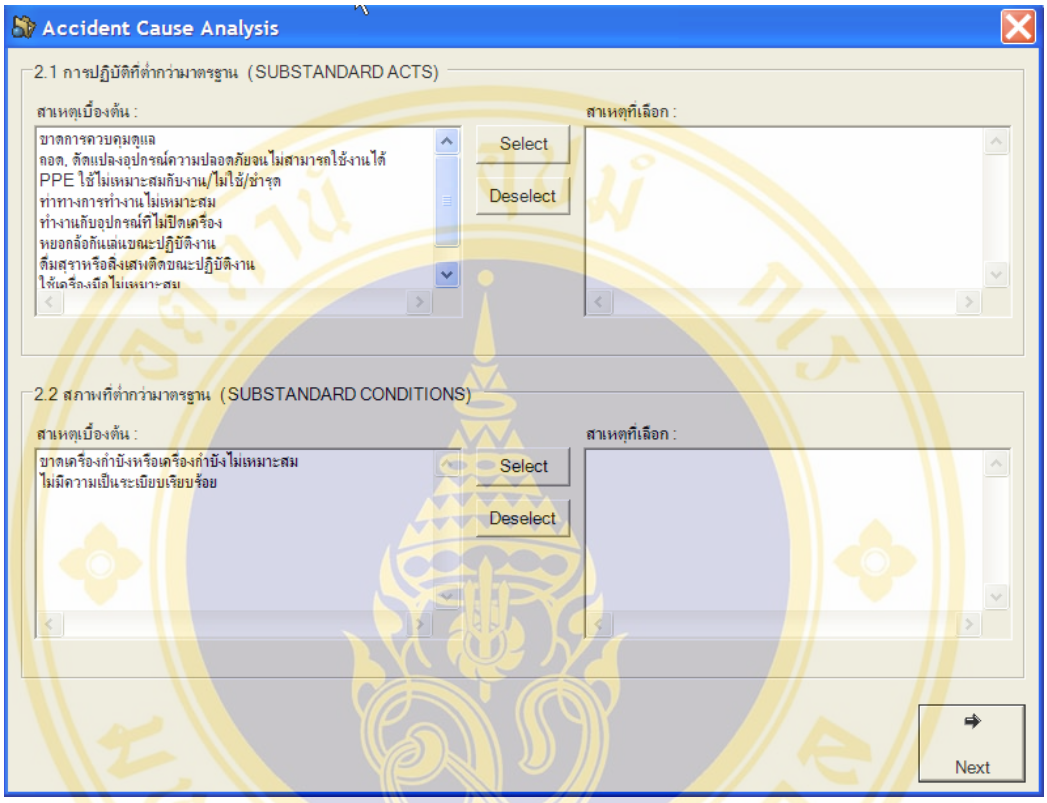
- เมื่อเลือกการปฏิบัติที่ต่ำกว่ามาตรฐานและสภาพที่ต่ำกว่ามาตรฐานแล้วคลิก

จะปรากฏ Windows ดังรูป



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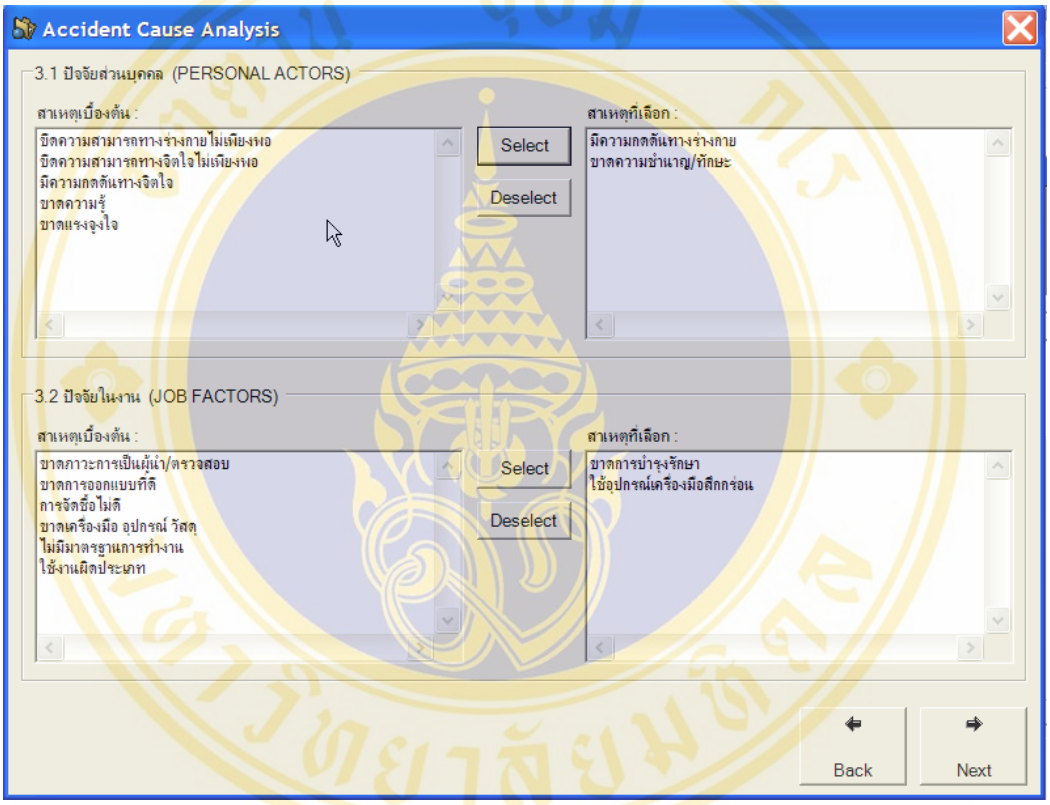
- ผู้สอบสวนจะร่วมกันพิจารณาเพื่อเลือกสาเหตุพื้นฐาน (Basic cause) ซึ่งจะต้องพิจารณาปัจจัยส่วนบุคคล (Personal factors) และปัจจัยในงาน (Job factors) โดยคลิกที่หัวข้อที่ต้องการแล้วคลิกที่ Select หัวข้อจะไปปรากฏที่ "สาเหตุที่เลือก" และถ้าต้องการยกเลิก ให้คลิก Deselect



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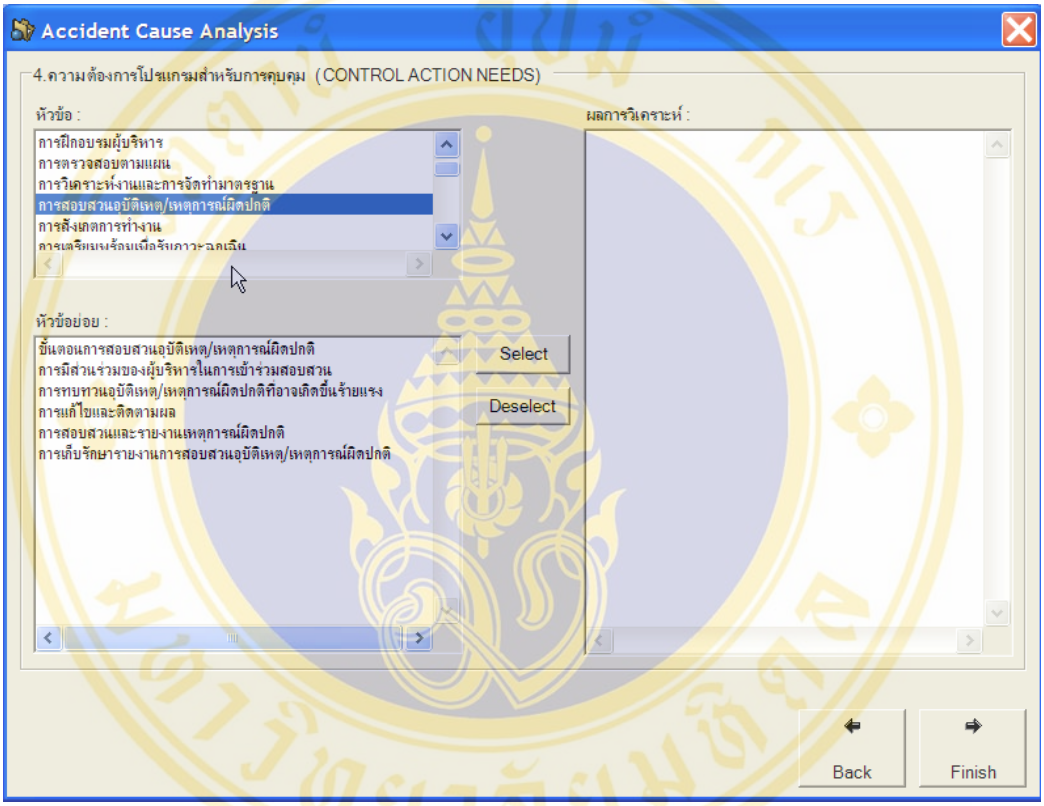
- เมื่อเลือกปัจจัยส่วนบุคคลและปัจจัยในงานเสร็จเรียบร้อยแล้วคลิก

จะปรากฏ Windows เพื่อพิจารณาเลือกหัวข้อ 4. ความต้องการโปรแกรมควบคุม (Control action needs) ดังรูป



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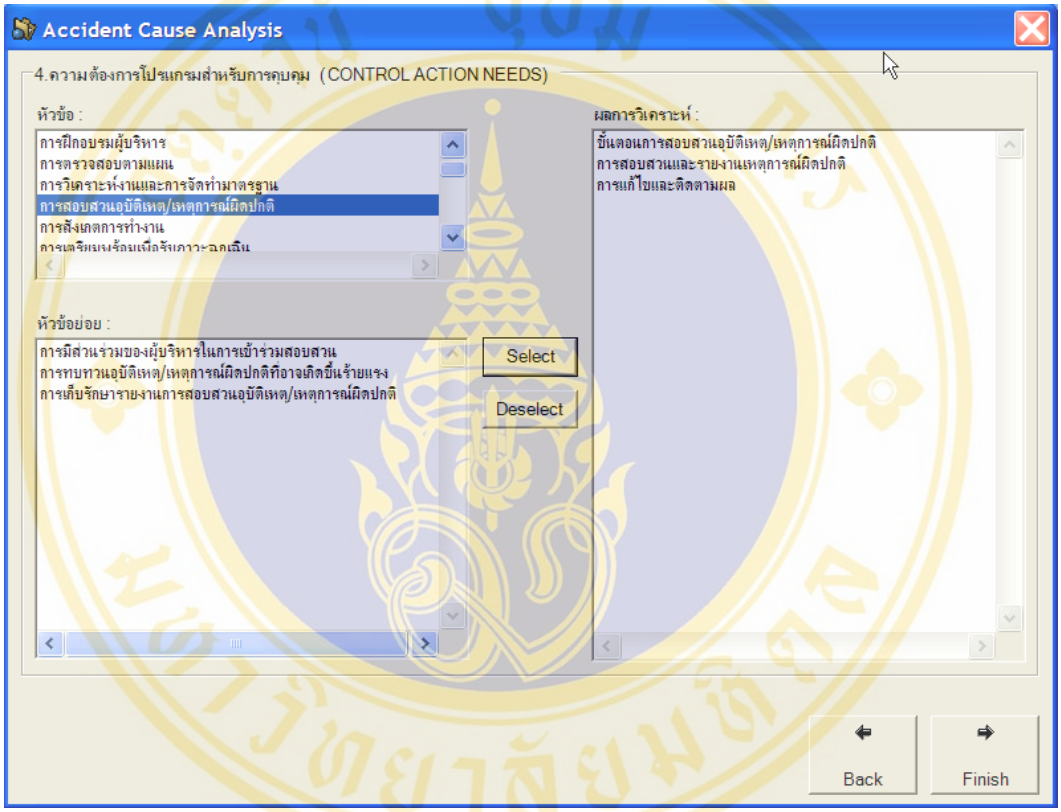
- เมื่อคลิกที่หัวข้อจะปรากฏหัวข้อย่อยถ้าต้องการเลือกหัวข้อย่อยใดให้คลิกไปที่หัวข้อนั้น แล้วคลิก Select หัวข้อจะไปปรากฏที่ “ผลการวิเคราะห์” และถ้าต้องการยกเลิก ให้คลิก Deselect



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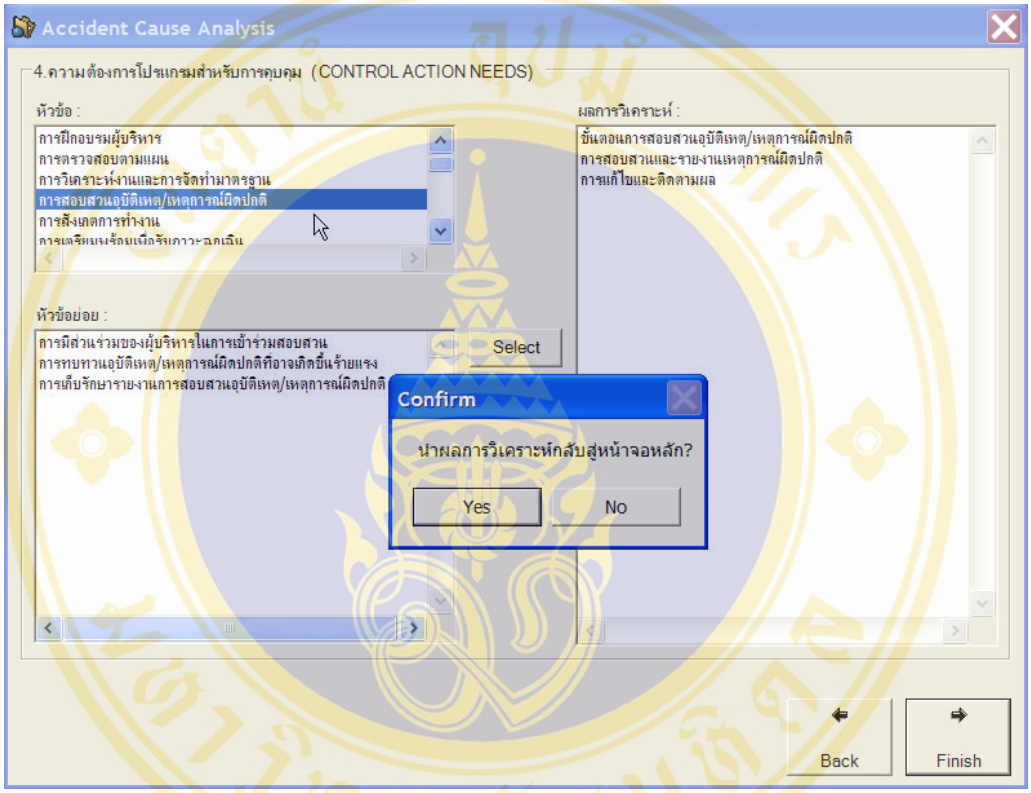
- เมื่อเลือกครบถ้วนแล้วคลิก Finish จะปรากฏ Windows ดังรูป ถ้าต้องการย้อนกลับไปหัวข้อก่อนหน้าให้คลิกที่ปุ่ม Back



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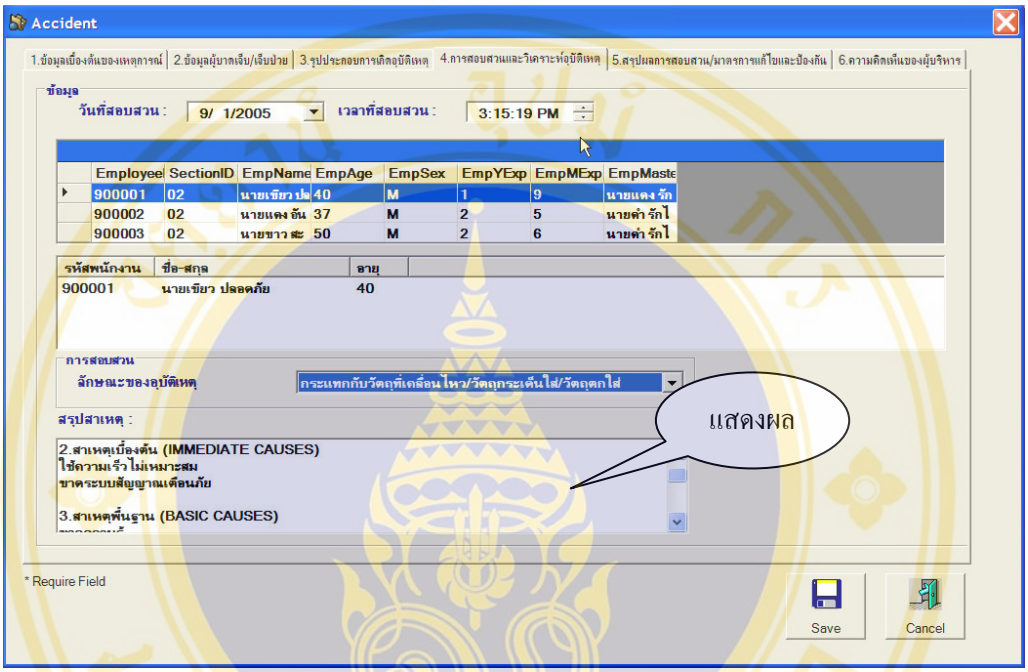
- เมื่อต้องการยืนยันให้คลิก Yes โปรแกรมก็จะมีการแสดงผลของการวิเคราะห์อุบัติเหตุ ดังรูป



- เพื่อเป็นการบันทึกข้อมูลให้คลิกที่ปุ่ม

- ถ้าต้องการยกเลิกให้คลิกที่ปุ่ม

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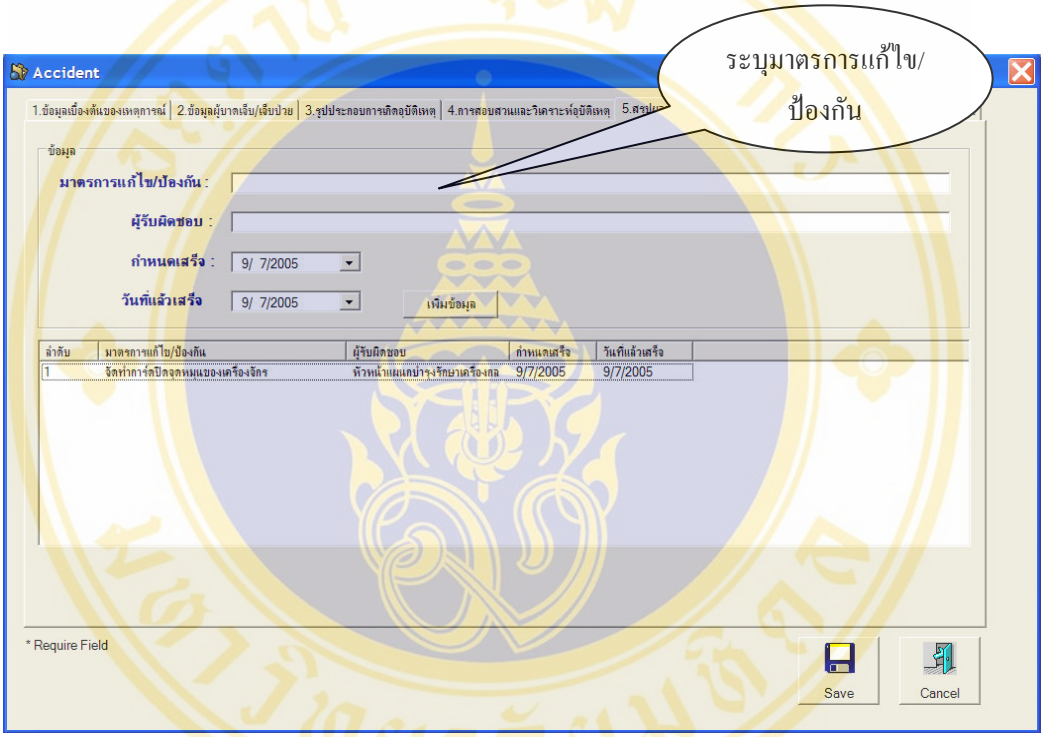
Tab 5 สรุปผลการสอบสวน/มาตรการแก้ไขและป้องกัน

- ผู้สอบสวนต้องป้อนข้อมูลสำหรับมาตรการแก้ไขและป้องกันโดยพิจารณาผลการสอบสวนและวิเคราะห์จาก Tab 5 ดังตัวอย่าง
- ผู้ใช้ป้อนข้อมูลของมาตรการแก้ไขป้องกัน ผู้รับผิดชอบ



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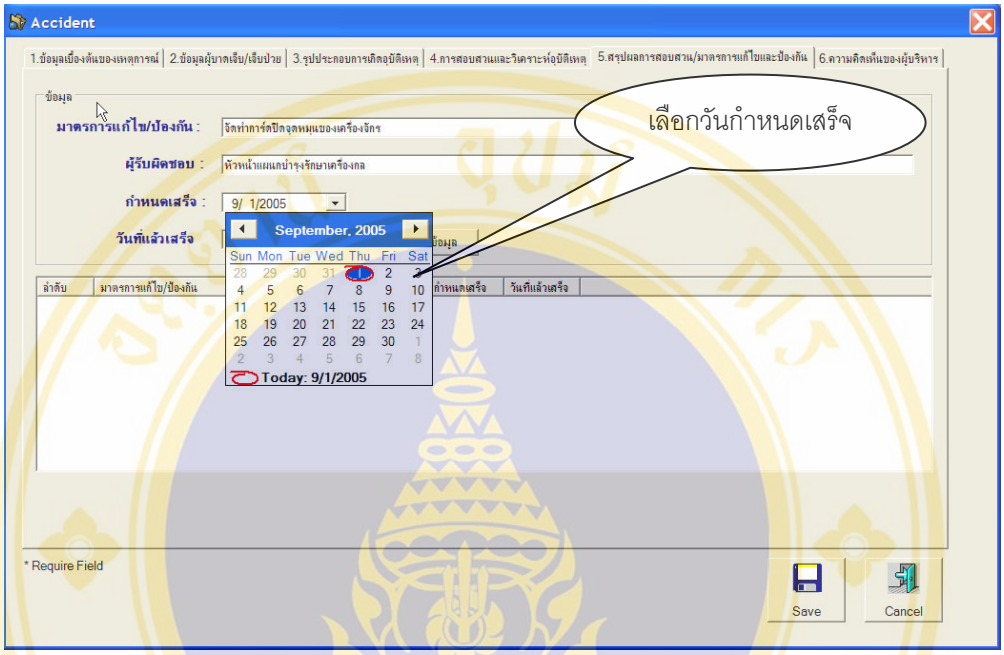
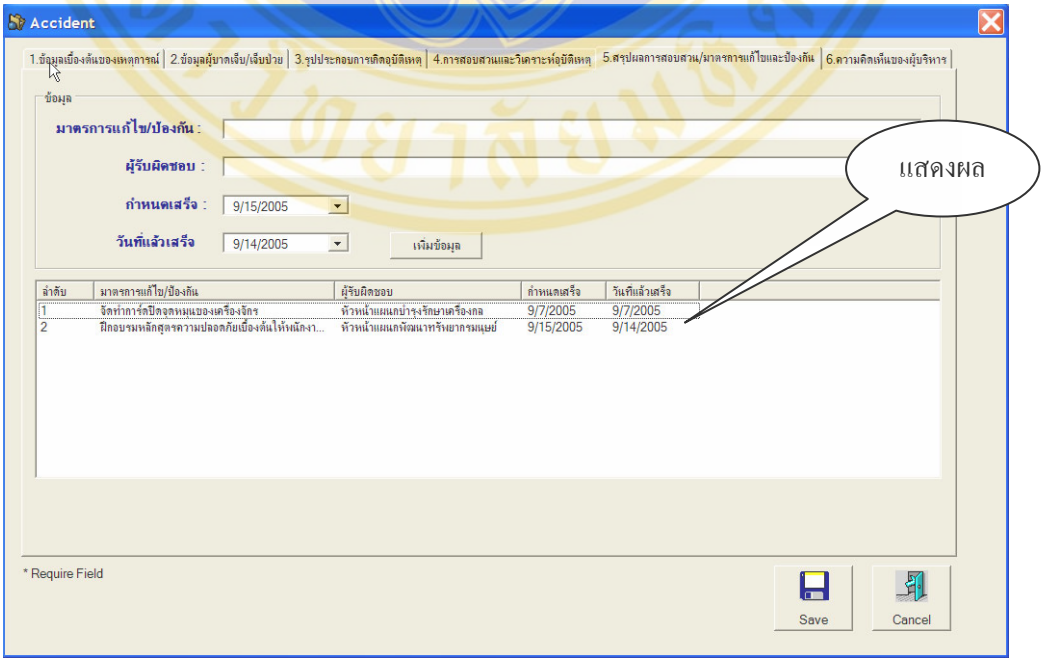
- คลิกที่ Drop down list box “กำหนดเสร็จ” เพื่อเลือกวันที่กำหนดเสร็จ



- คลิก เพิ่มข้อมูล จะมีการแสดงผลดังรูป
- ถ้าต้องการยกเลิกให้ดับเบิ้ลคลิกที่หัวข้อของมาตรการแก้ไข/ป้องกันนั้น



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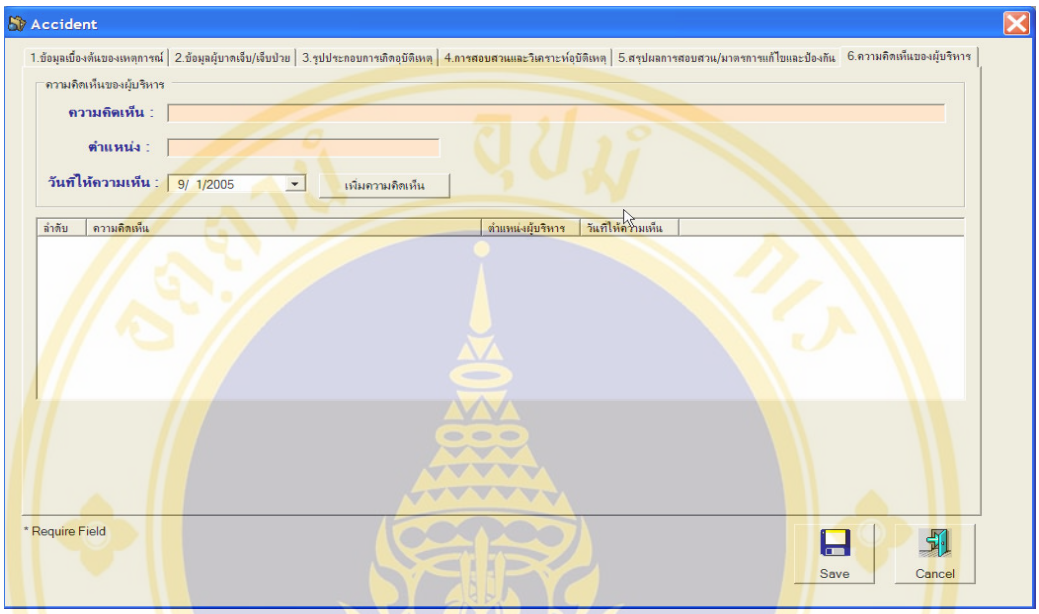
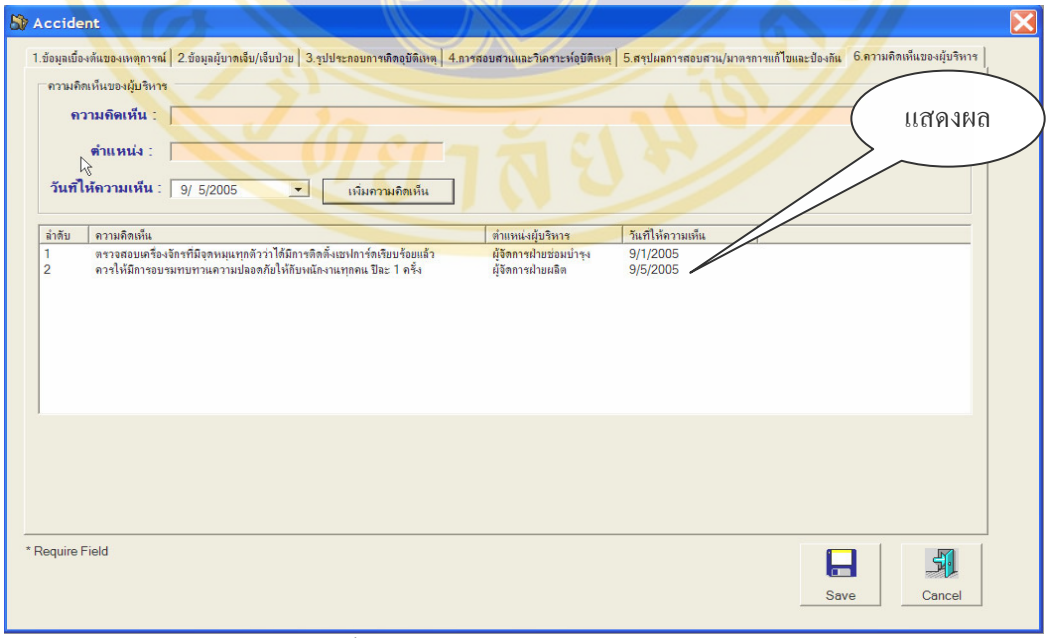
Tab 6 ความคิดเห็นของผู้บริหาร

- ผู้บริหารสามารถแสดงความคิดเห็นต่อผลการสอบสวน การวิเคราะห์อุบัติเหตุและเหตุการณ์เกือบเกิดอุบัติเหตุ รวมถึงสิ่งที่เสนอแนะเพิ่มเติมสำหรับมาตรการแก้ไข/ป้องกัน โดยระบุใน Tab 6 ดังรูป



- ถ้าต้องการแสดงความคิดเห็นให้ระบุความคิดเห็นตำแหน่งของผู้บริหาร และวันที่ให้ความคิดเห็น แล้วคลิกที่ เพิ่มความคิดเห็น เพื่อให้มีการแสดงผล



- ถ้าต้องการยกเลิกให้ดับเบิ้ลคลิกที่หัวข้อความคิดเห็น

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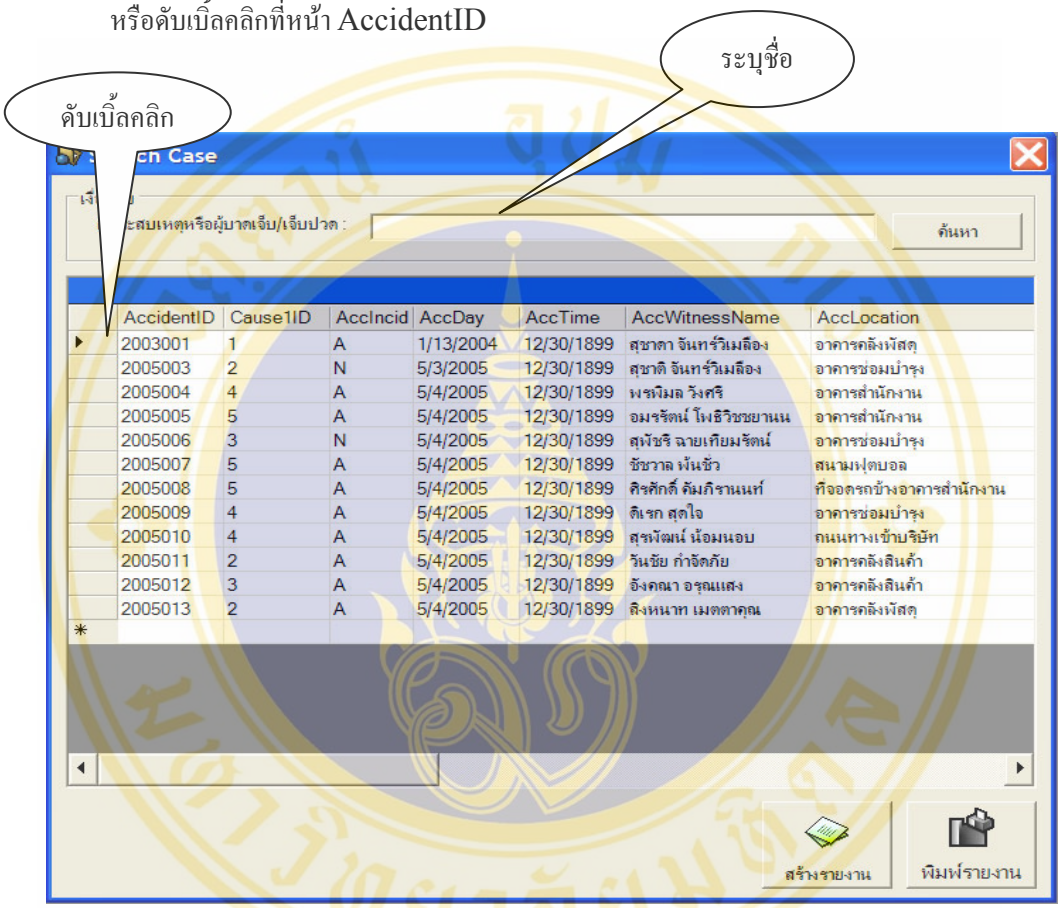
การพิมพ์รายงาน

- เลือก Reports ที่เมนูบาร์ แล้วเลือก By case จะปรากฏ Windows ดังรูป แล้วพิมพ์ชื่อผู้บาดเจ็บ หรือดับเบิ้ลคลิกที่หน้า AccidentID



แล้วคลิกที่ไอคอน

โปรแกรมจะพิมพ์รายงาน By case ให้กับผู้ใช้งาน

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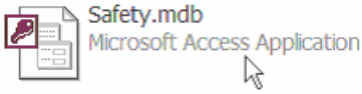
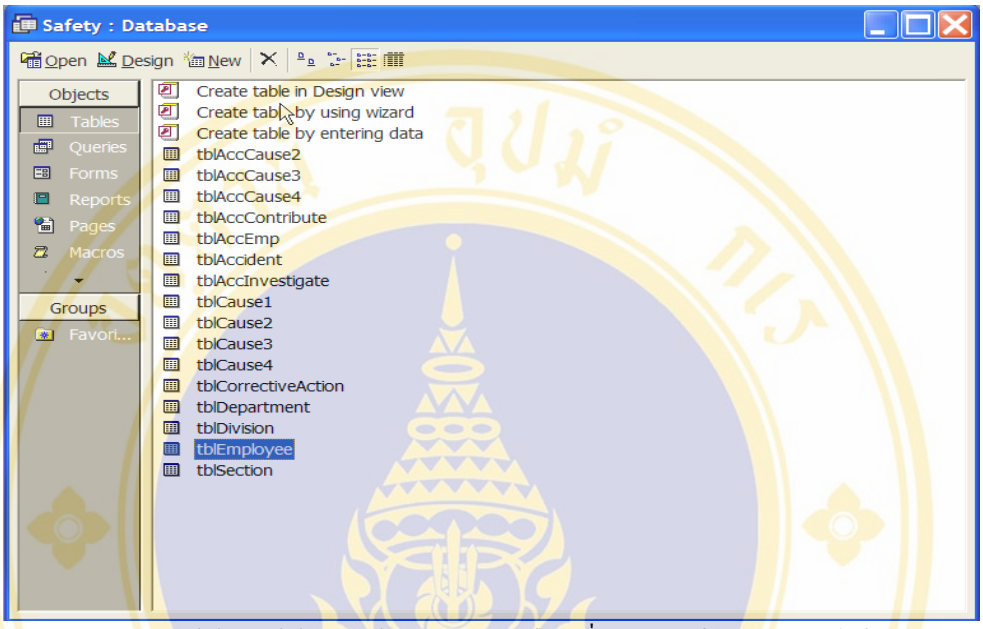
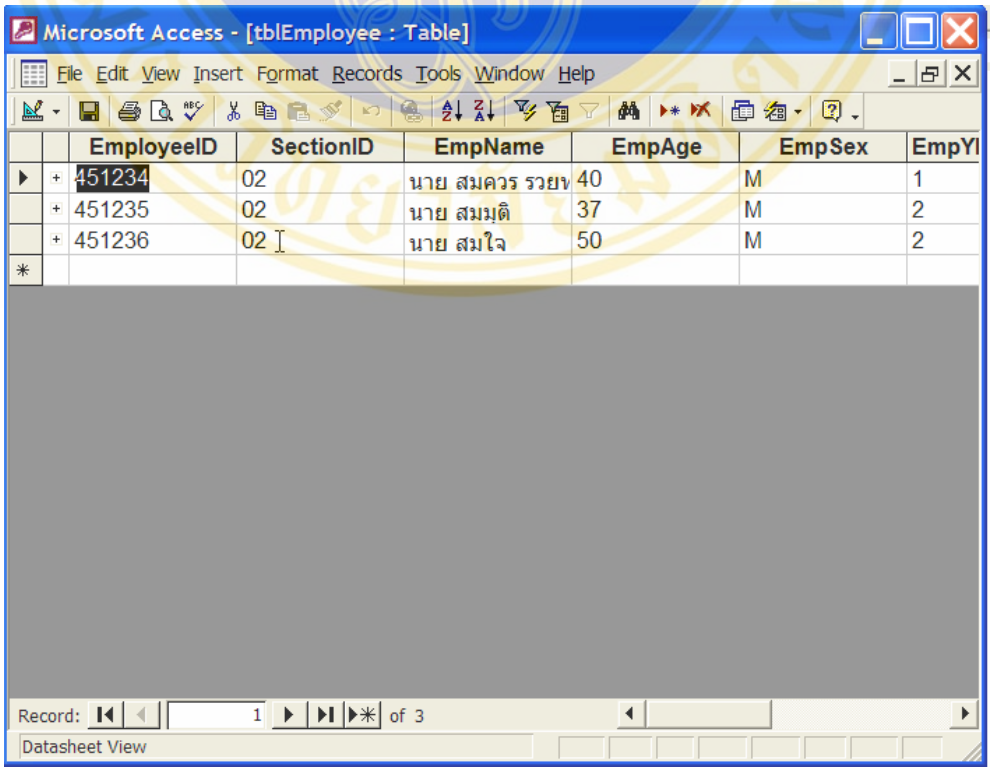
การเพิ่ม/แก้ไขฐานข้อมูลพนักงาน

- เปิดไฟล์ 

จะแสดง Windows ดังรูป



- เลือก Table “tblEmployee” จะแก้ไข/เพิ่มเติมฐานข้อมูลพนักงานได้



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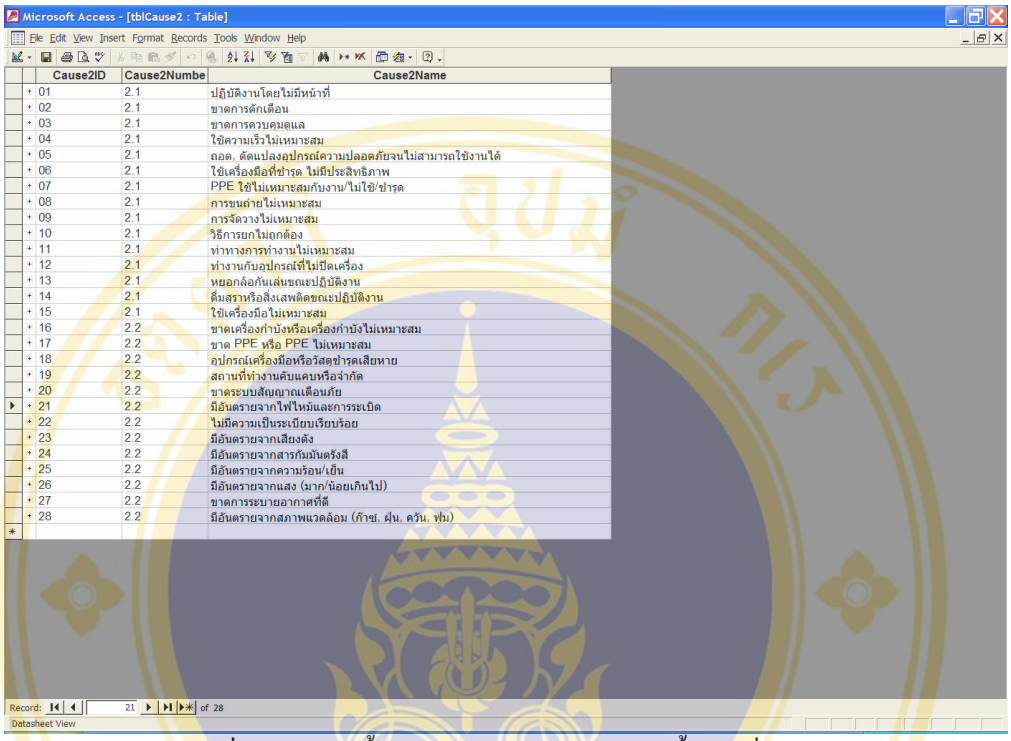
- การแก้ไข/เพิ่มเติมสาเหตุเบื้องต้น (Immediate causes) ดับเบิ้ลคลิกที่ “tblCause2”



Microsoft Access - [tblCause2 : Table]

File Edit View Insert Format Records Tools Window Help

Cause2ID	Cause2Numbe	Cause2Name
01	2.1	ปฏิบัติงานโดยไม่มีหน้าที่
02	2.1	ขาดการตักเตือน
03	2.1	ขาดการควบคุมดูแล
04	2.1	ใช้ความเร็วไม่เหมาะสม
05	2.1	ถอด, ดัดแปลงอุปกรณ์ความปลอดภัยจนไม่สามารถใช้งานได้
06	2.1	ใช้เครื่องมือที่ชำรุด ไม่มีประสิทธิภาพ
07	2.1	PPE ใช้ไม่เหมาะสมกับงาน/ไม่ใช้/ชำรุด
08	2.1	การขนถ่ายไม่เหมาะสม
09	2.1	การจัดวางไม่เหมาะสม
10	2.1	วิธีการยกไม่ถูกต้อง
11	2.1	ท่าทางการทำงานไม่เหมาะสม
12	2.1	ทำงานกับอุปกรณ์ที่ไม่ปิดเครื่อง
13	2.1	หยอกล้อกันเล่นขณะปฏิบัติงาน
14	2.1	ดื่มสุราหรือสิ่งเสพติดขณะปฏิบัติงาน
15	2.1	ใช้เครื่องมือไม่เหมาะสม
16	2.2	ขาดเครื่องกำบังหรือเครื่องกำบังไม่เหมาะสม
17	2.2	ขาด PPE หรือ PPE ไม่เหมาะสม
18	2.2	อุปกรณ์เครื่องมือหรือวัสดุชำรุดเสียหาย
19	2.2	สถานที่ทำงานคับแคบหรือจำกัด
20	2.2	ขาดระบบสัญญาณเตือนภัย
21	2.2	มีอันตรายจากไฟไหม้และการระเบิด
22	2.2	ไม่มีความเป็นระเบียบเรียบร้อย
23	2.2	มีอันตรายจากเสียงดัง
24	2.2	มีอันตรายจากสารกัมมันตรังสี
25	2.2	มีอันตรายจากความร้อน/เย็น
26	2.2	มีอันตรายจากแสง (มาก/น้อยเกินไป)
27	2.2	ขาดการระบายอากาศที่ดี
28	2.2	มีอันตรายจากสภาพแวดล้อม (ก๊าซ, ฝุ่น, ควัน, ฟูม)

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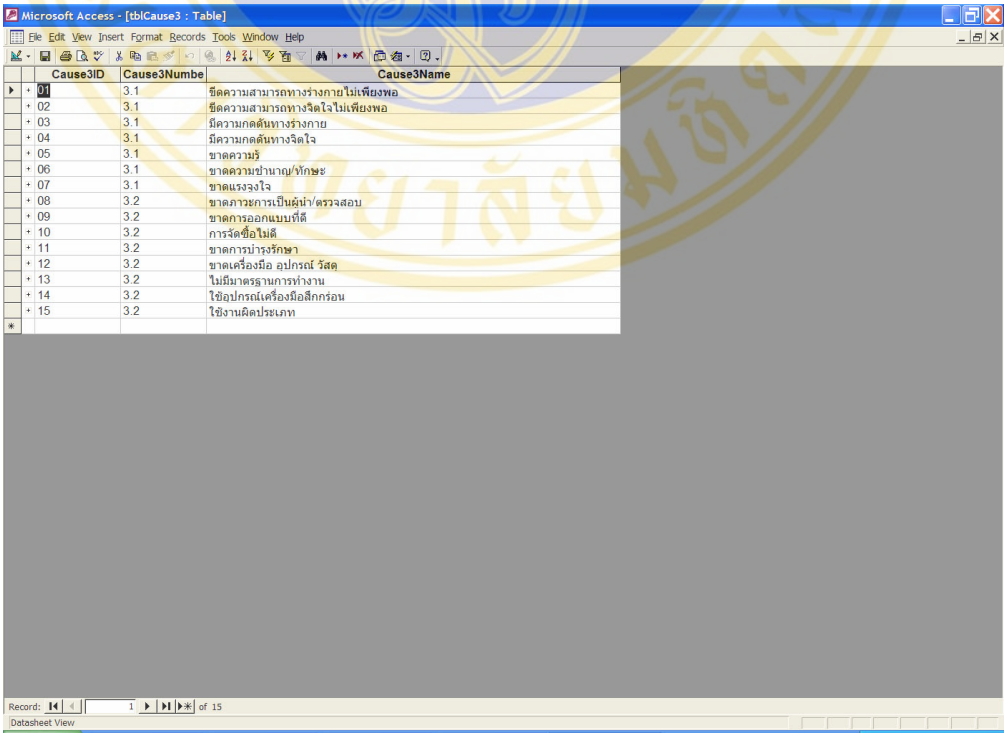
Datasheet View

- การแก้ไข/เพิ่มเติมสาเหตุพื้นฐาน (Basic causes) ดับเบิ้ลคลิกที่ “tblCause3”



Microsoft Access - [tblCause3 : Table]

File Edit View Insert Format Records Tools Window Help

Cause3ID	Cause3Numbe	Cause3Name
01	3.1	ขีดความสามารถทางร่างกายไม่เพียงพอ
02	3.1	ขีดความสามารถทางจิตใจไม่เพียงพอ
03	3.1	มีความกดดันทางร่างกาย
04	3.1	มีความกดดันทางจิตใจ
05	3.1	ขาดความรู้
06	3.1	ขาดความชำนาญ/ทักษะ
07	3.1	ขาดแรงจูงใจ
08	3.2	ขาดภาวะการเป็นผู้นำ/ตรวจสอบ
09	3.2	ขาดการออกแบบที่ดี
10	3.2	การจัดซื้อไม่ดี
11	3.2	ขาดการบำรุงรักษา
12	3.2	ขาดเครื่องมือ อุปกรณ์ วัสดุ
13	3.2	ไม่มีมาตรฐานการทำงาน
14	3.2	ใช้อุปกรณ์เครื่องมือสึกกร่อน
15	3.2	ใช้งานผิดประเภท

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Datasheet View

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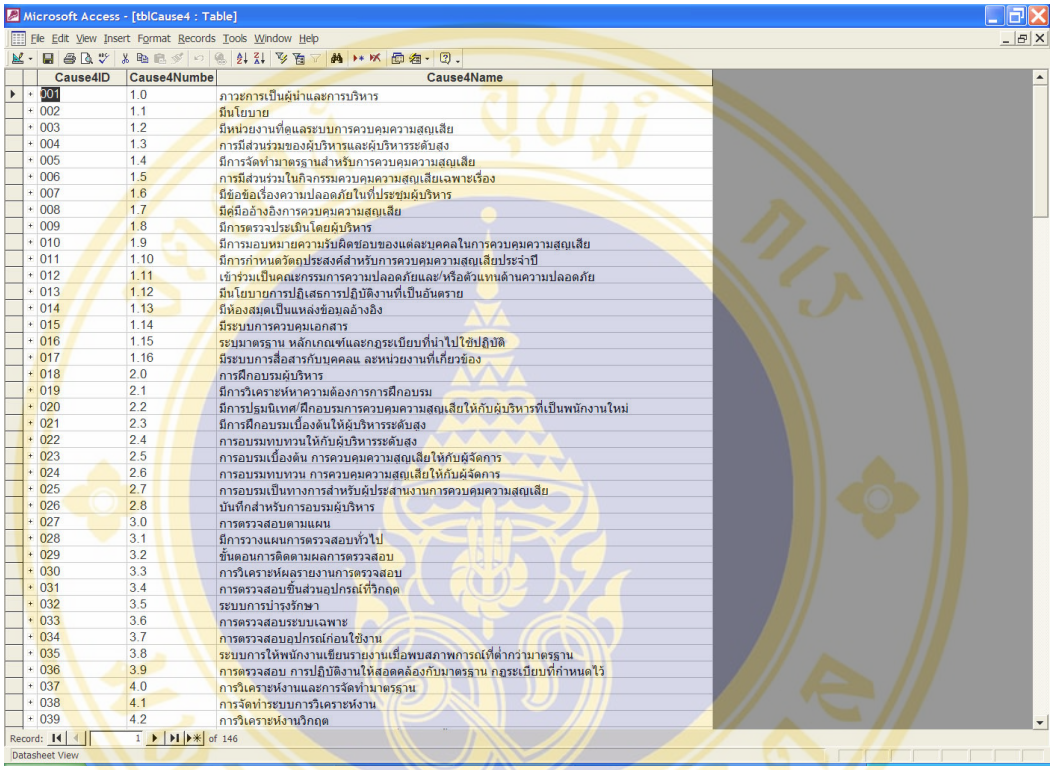
- การแก้ไข/เพิ่มเติมมาตรการแก้ไข/ป้องกันข้อมูลความต้องการโปรแกรมควบคุม (Control action needs or Corrective/preventive actions) ดับเบิ้ลคลิกที่ “tblCause4”



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