

**ESTIMATION OF OCCUPATIONAL ACCIDENT AND ACCIDENT  
PREVENTION COST IN WOOD BASED RELATED INDUSTRIES.**

**HOOD BIN ATAN**

Submitted to the Faculty of Mechanical Engineering  
as a partial fulfillment for the degree of  
Master of Engineering (Industrial Engineering)

FACULTY OF MECHANICAL ENGINEERING  
UNIVERSITI TEKNOLOGI MALAYSIA

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**Specially dedicated to my wife,  
my son and daughters, parents and  
to my friends**

## ACKNOWLEDGEMENT

Praise to Mighty Allah for His Grace and Mercy in helping me throughout this research and to guide me in completing this study in time.

I would like to express my thanks to my honorable supervisor, Dr. Jafri bin Mohd Rohani who has really put his full effort through his academic knowledge, guidance, support and encouragement during the preparation of this study. May Allah bless him for what he has done.

I want to extend my appreciation for the love and support I received from my family, parents and everyone who has directly and indirectly contributed to the completion and achievement of this project.

Last but not least, I would like to thank to all the company staff involved in this project and apologized to them if I bring any inconveniences.

## ABSTRACT

The objective of the study is to estimate occupational accident cost in manufacturing industries, especially in wood based related industries. The study attempts to identify, define, and classify the cost components of occupational accident related cost and to catalogue the various economic approaches used to estimate the entire costs of occupational accident and to propose the risk prevention plan. The study uses local specific approach by reviewing company historical records on occupational accident as reported in JKPP 6, JKPP 8, JKPP 9 and company internal investigation reports. For each occupational accident, the site safety officer in charge, human resource and account employee, supervisor, victim, related co-workers and relatives were interviewed in order to estimate direct costs, indirect costs, prevention costs and others personal cost related to the accident. Other related information such as personal data of the victim, type of injuries, location of injuries and cause of injuries were recorded. A total of 24 occupational accidents data for the past five years were analyzed in the cost of accident summary report to determine the overall ratio of direct to indirect cost and ratio of total cost of accident to prevention cost. Further analysis was carried out to determine the most significant cost of accident related to demographic profiles for Malaysian and Non Malaysian employees. Result obtained from the analysis has been integrated into existing Hazard Identification, Risk Assessment and Risk Control (HIRARC) format during the risk assessment in the selected manufacturing process within the company. The estimated potential cost of accident and cost of prevention was added to the existing report for HIRARC. In conclusion, this study has determined the ratio of direct to indirect cost of occupational accident and to propose the risk prevention plan with additional information on cost of accident and cost of prevention.

**Keywords:** *Accident Cost Estimation, Direct Cost, Indirect Cost, Risk Assessment*

## **ABSTRAK**

Objektif kajian ini adalah untuk menganggarkan kos kemalangan pekerjaan dalam industri pembuatan, terutama dalam industri yang berasaskan kayu. Kajian ini bertujuan untuk mengenal pasti, menentukan, dan mengelaskan komponen kos kemalangan berkaitan pekerjaan didalam pelbagai kategori. Pendekatan ekonomi digunakan untuk menganggarkan keseluruhan kos risiko kemalangan ditempat kerja di dalam industri pembuatan dan mencadangkan tahap pencegahan yang perlu. Kajian ini menggunakan pendekatan khusus tempatan dengan menyemak rekod sejarah kemalangan lalu di syarikat terpilih sepertimana yang telah dilaporkan didalam laporan kemalangan pekerjaan rasmi JKKP 6, JKKP 8, JKKP 9 dan laporan siasatan dalaman syarikat. Bagi setiap kes kemalangan pekerjaan, pegawai keselamatan syarikat, pihak sumber manusia, pekerja, penyelia, mangsa, rakan sekerja dan yang berkaitan akan di temuramah untuk menganggarkan kos langsung, kos tidak langsung, kos pencegahan dan lain-lain yang berkaitan dengan kos kemalangan yang ditanggung oleh mangsa. Maklumat berkaitan seperti data peribadi mangsa, jenis kecederaan, lokasi kecederaan dan sebab-sebab kecederaan direkodkan. Sejumlah 24 data kemalangan pekerjaan telah berjaya di analisa. Data kemalangan tersebut di ringkaskan untuk menentukan nisbah keseluruhan kos kemalangan langsung dan kos tidak langsung dan juga nisbah jumlah kos pencegahan kemalangan. Analisa lanjut juga dijalankan untuk menentukan perbandingan kos kemalangan pekerja tempatan dan pekerja asing. Kajian seterusnya ke atas data berkaitan kos kemalangan tersebut digunakan ke dalam analisa Mengenalpasti bahaya, Penaksiran Risiko dan Kawalan Risiko (HIRARC). Anggaran kos kemalangan dan kos pencegahan kemalangan telah di masukan didalam laporan HIRARC sedia ada. Kesimpulannya, kajian ini telah berjaya menentukan komponen kos kemalangan di tempat kerja, sama ada kos langsung atau tidak langsung. Nisbah kos kemalangan di antara kos langsung dan tidak langsung, nisbah kos kemalangan dan kos pencegahan kemalangan telah berjaya di anggarkan. Laporan Risiko Kemalangan HIRARC yang sedia ada telah di perbaiki dengan memasukkan data berkenaan dengan anggaran kos kemalangan dan kos pencegahan kemalangan.

**Katakunci:** *Anggaran Kos Kemalangan, Kos Langsung, Kos tidak Langsung Penilaian Risiko*

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**LIST OF ABBREVIATIONS**

SOCISO	Social Security Organisation
PERKESO	Pertubuhan Keselamatan Sosial
DOSH	Department of Occupational Safety and Health
JSA	Job Safety Analysis
HAZOP	Hazardous Operation
CHRA	Chemical Hazardous Risk Assessment
HIRARC	Hazard Identification, Risk Assessment and Risk Control
SHE	Safety and Health Environment
HUK	Hilang upaya Kekal
HUS	Hilang Upaya Sementara
FOT	Faedah Orang Tanggungan
PD	Permanent Disability
TD	Temporary Disability
F	Fatal
NIOSH	National Institute of Occupation Safety and Health

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

##### **1.1.1 General**

Workplace accidents are a substantial expense to society and individual companies. The costs for workplace accidents are expensive and the amount of money paid either directly or indirectly is increasing in this modern era. Aside from direct cost such as medical and hospitalization cost, property damage cost and medical treatment cost, there are also some indirect cost worker's comfort in doing her/his duties and rehabilitation cost, lost time injuries cost, productivity loses and others hidden cost of which inevitable as a result from each workplace accident. The high percentage of working accidents is more related to management compared to engineering. It is the highest level of management that determines policies of Safety and Health Environment (SHE) such as working condition, quality of production, and quality of devices/machines that are being used.

To analyze the effective of implementation of Safety and Health Environment Management System in the wood based related industries, this study will use assessment analysis method of the workplace accident costs as the parameter of assessment on effective implementation of Safety and Health Environment Management System.

Hazard in a working environment can be defined as a condition, or combination from various conditions, where when not corrected could result in an accident, disease, or damage of property but also, hazard in a working environment is a condition of working environment where there is a variable or many variables that has potential in creating accidents, serious damage, disease, or losses.

According to Heinrich (1980), accident is an event that occurs coincidentally, unplanned, and unexpected, where action and reaction happened between objects, matter, or materials, with human, hence causing injury. Accidents that occur have many causes that generally can be prevented in the first place. Efforts in preventing accident can be performed by correcting, or at least minimize every hazard that can be identified. An accurate analysis toward danger potential in a working environment is one effort to control issue of Safety and Health Environment and can be used as a tool to implement Safety and Health Environment Management System. Therefore, identification and elimination toward danger potential is a main key in preventing accidents in a working environment.

In this study, evaluation of Safety and Health Environment Management System is analyzed using methods that will determine effectiveness of implementation of Safety and Health Environment Management System at the company evaluated. Other than that, this evaluation on Safety and Health Environment Management System will be supplemented with interview of the management party to retrieve accident cost assessment toward Safety and Health Environment.

### 1.1.2 Wood based industry in Malaysia

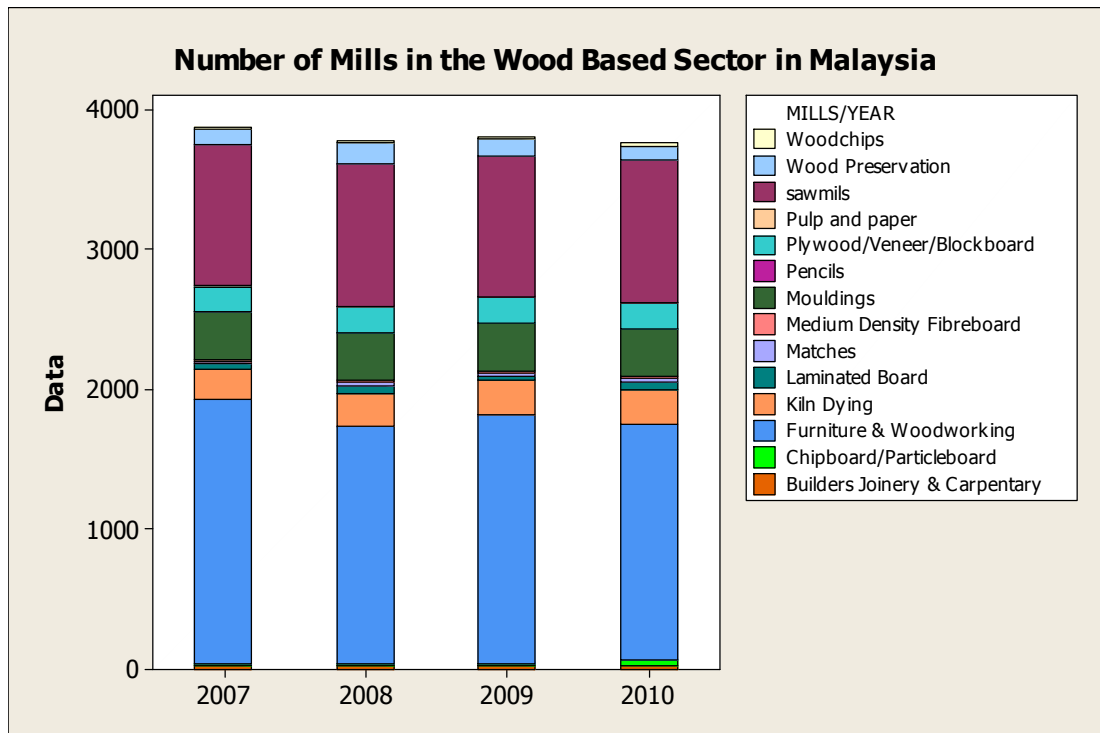
The wood-based industry in Malaysia comprises four major sub-sectors, namely:

- a) Sawn timber veneer and panel products like plywood and other reconstituted panel products such as particleboard / chipboard / fibre board;
- b) Mouldings and Builders' Joinery and Carpentry (BJC) like doors / windows and its components, panels and flooring board / parquet;
- c) Furniture; and
- d) Furniture components

The industry is predominantly owned by Malaysian and it is estimated that 80% - 90% of the companies are Small and Medium-size Enterprises (SMEs). Table 1.1 and Figure 1.1 shows the number of mills in wood-based industry in Malaysia.

**Table 1.1:** Number of Mills in the Wood-based Sector (Source: FDPM,SFD and STIC)

MILLS / YEAR	2007	2008	2009	2010
Sawmills	1,018	1,022	1,013	1,019
Plywood/Veneer/Blockboard	181	180	185	183
Mouldings	337	344	336	341
Chipboard/Particleboard	16	16	20	32
Pulp and Paper	1	1	1	1
Furniture & Woodworking	1,895	1,695	1,768	1,695
Laminated Board	29	46	33	52
Woodchips	18	17	15	21
Builder's Joinery & Carpentry	21	29	27	32
Matches	21	29	27	32
Pencils	3	3	3	1
Medium Density Fibreboard	14	14	15	15
Kiln Drying	222	236	245	236
Wood Preservation	97	150	113	99
<b>TOTAL</b>	<b>3,854</b>	<b>3,755</b>	<b>3,776</b>	<b>5,738</b>



**Figure 1.1:** Number of Mills in the Wood-based Sector (Source: FDPM,SFD and STIC)

Location-wise, most of the larger sawmills, veneer and plywood mills are located in Sabah and Sarawak. Refer to Table 1.2 (Mills in Sabah and Sarawak utilise tropical wood species for the production of sawn timber, veneer, plywood and other veneered panel products. Moreover, some 45% of the plywood mills and 60% of the mouldings mills are located in Sabah and Sarawak.

**Table 1.2:** Location of wood based industries in Malaysia (Source: FDPM,SFD and STIC)

Type		2000	2008*
Sawmills	Peninsular Malaysia	667	667
	Sabah	215	175
	Sarawak	244	180
	Total	1,126	1,022
Plywood/ Veneer mills	Peninsular Malaysia	50	63
	Sabah	80	63
	Sarawak	53	54
	Total	183	180
<b>Grand Total</b>		<b>1,309</b>	<b>1,202</b>

Sources : FDPM, SFD and STIC

Note : \* estimate

Many of these new mills involved in downstream product manufacture use modern machinery. The downstream processing mills for the production of fibreboard, BJC as well as furniture and furniture components, however, are primarily located in Peninsular Malaysia. These mills mainly utilise rubber wood sourced from sustainable plantations such as The Federal Land Development Authority (FELDA) and other plantation majors.

Malaysian furniture manufacturers produce a wide range of furniture from office, kitchen, bedroom, dining room, occasional, living room, upholstered furniture / sofa, outdoor and garden furniture. Furniture is made from not only wood, but also all types of materials from rattan, metal, fabrics, plastic, glass, marble and other composite materials. More than 85% of furniture is wood-based where some 80% are produced from rubber wood. Furniture manufacturers are located mostly in Johor, Selangor, Sarawak, Perak and Melaka.

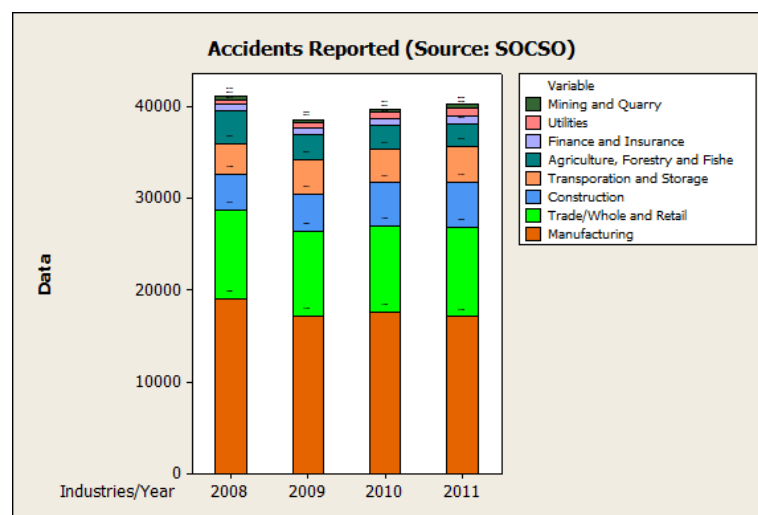
## 1.2 Problem Statements

### 1.2.1 Statistic on Workplace Accident in Malaysia

The statistic related to workplace accident is available at DOSH or SOCSO office. This government department was established to handle specific issues related to safety and health program in Malaysia.

Social Security Organisation (SOCSO) or PERKESO was established in 1971 under the Ministry of Human Resources (formerly known as the Ministry of Labour) to implement and administer the Social Security schemes under the Social Security Act 1969, the Employment Injury Scheme and Disability Scheme. Under this scheme, employees are given job protection related disasters, including accidents in the course of employment, occupational disease, disability and death.

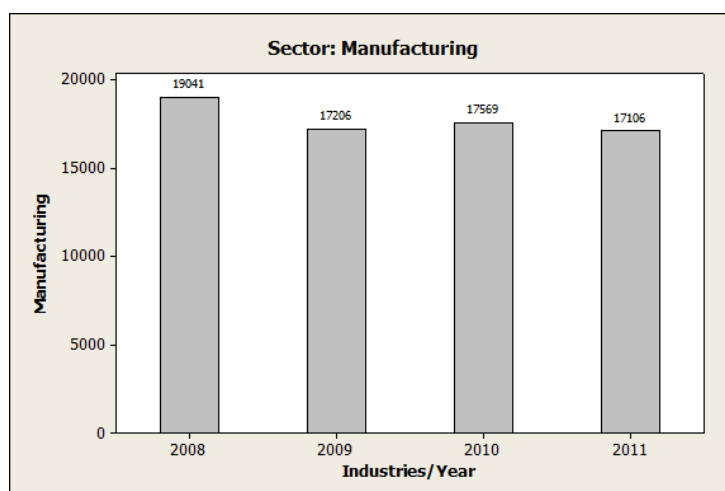
Based on recent statistic on accident reported as shown in figure 1, in average a total of 40 000 cases were reported annually. Manufacturing sector contribute almost half of the population.



**Figure 1.2:** Stacked Bar Chart on Accidents Reported by Industries/Year (Source: SOCSO)

Figure 1.2 is the statistic from SOCSO pertaining to accident reported in the manufacturing sector. Observed, there are no significant changes since 2009 with the average or accident reported is 17000 cases.



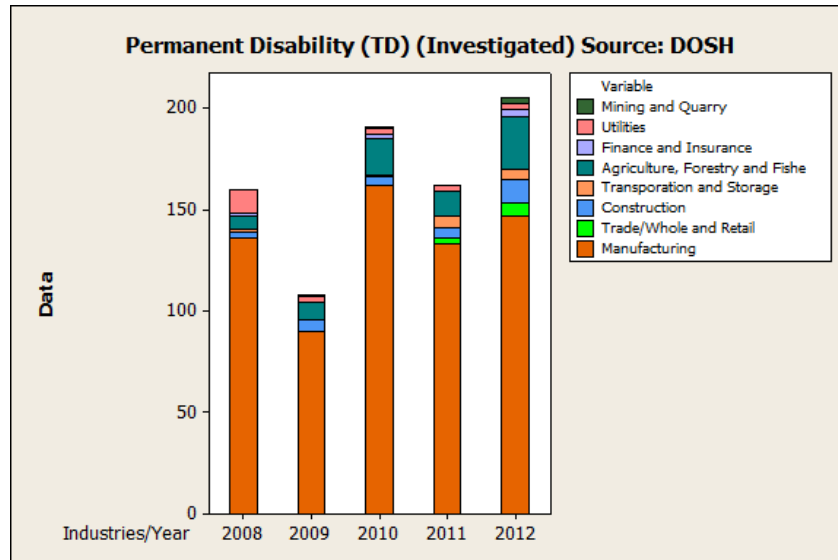


**Figure 1.3:** Stacked Bar Chart on Accidents Reported by manufacturing sector/Year (Source: SOCSO)

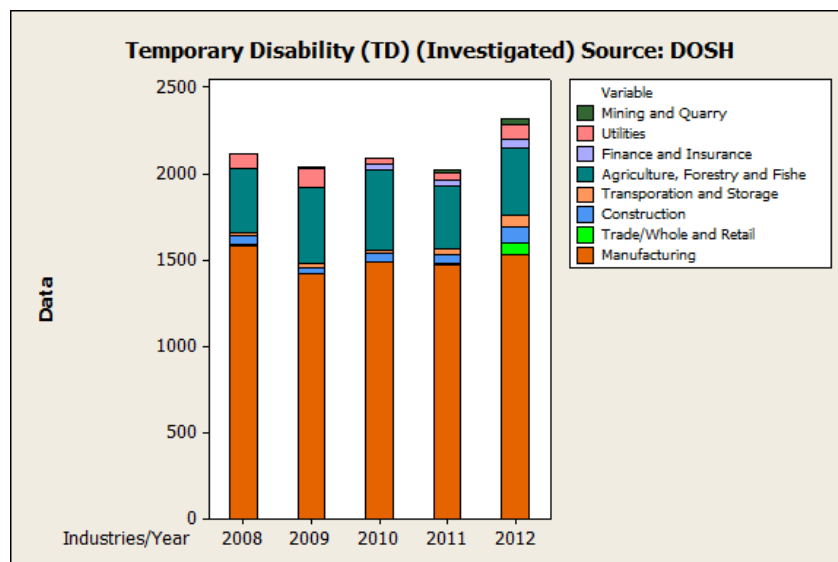
The Department of Occupational Safety and Health (DOSH) is a department under the Ministry of Human Resources. This department is responsible for ensuring the safety, health and welfare of people at work as well as protecting other people from the safety and health hazards arising from the activities sectors include Manufacturing.

As a government agency, the department is responsible for the administration and enforcement of legislations related to occupational safety and health of the country, with a vision of becoming an organisation which leads the nation in creating a safe and healthy work culture that contributes towards enhancing the quality of working life.

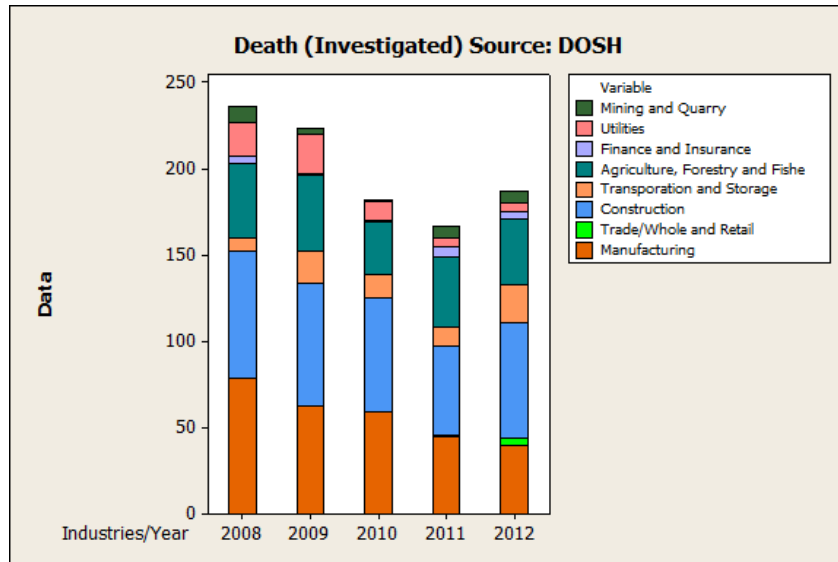
Based on statistical data from DOSH, Malaysia as shown in figure 1.3, despite sudden decrease of the number of permanent disability cases in 2011, observed the trends was increase each year. In 2012, observed that is the highest record of temporary disability cases compared to the last 4 years. (Figure 1.4)



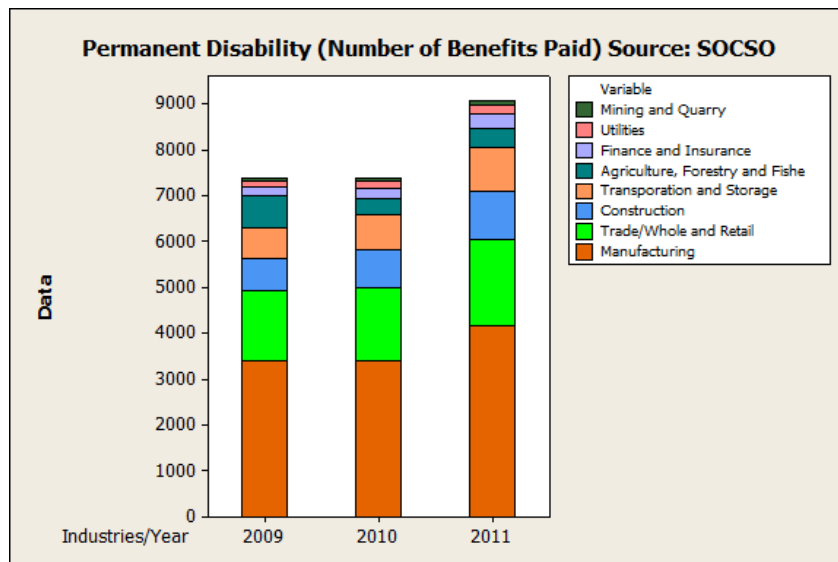
**Figure 1.4:** Stacked Bar Chart on Permanent Disability (PD) (Investigated) Industries/Year( Source: DOSH)



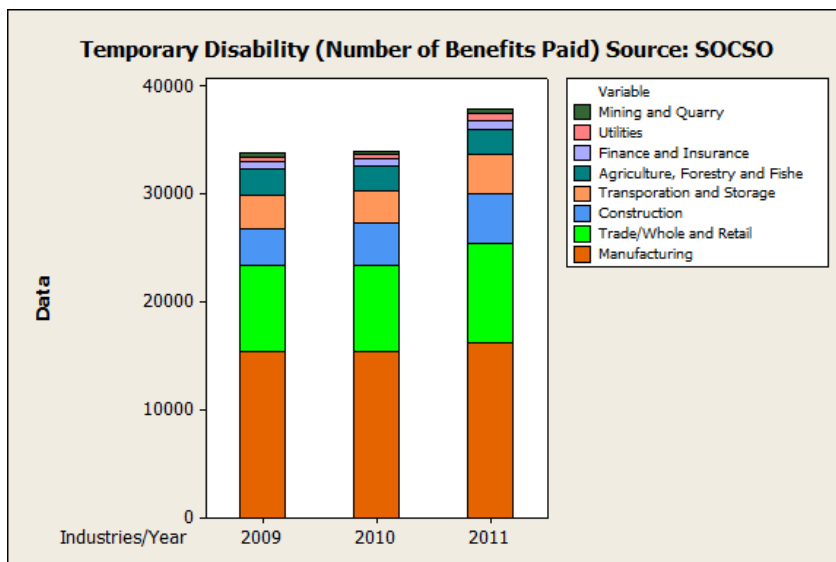
**Figure 1.5:** Stacked Bar Chart on Temporary Disability (TD) (Investigated) Industries/Year( Source: DOSH)



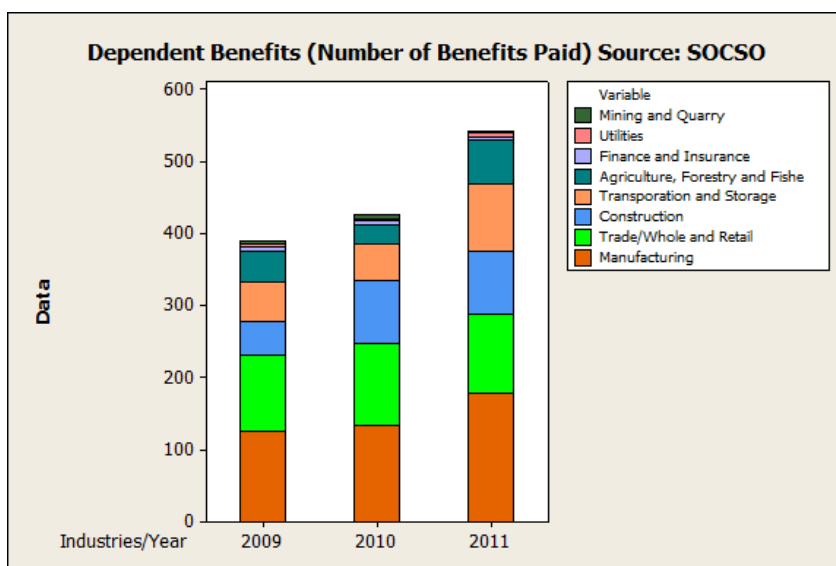
**Figure 1.6:** Stacked Bar Chart on Death (Investigated) Industries/Year( Source: DOSH)



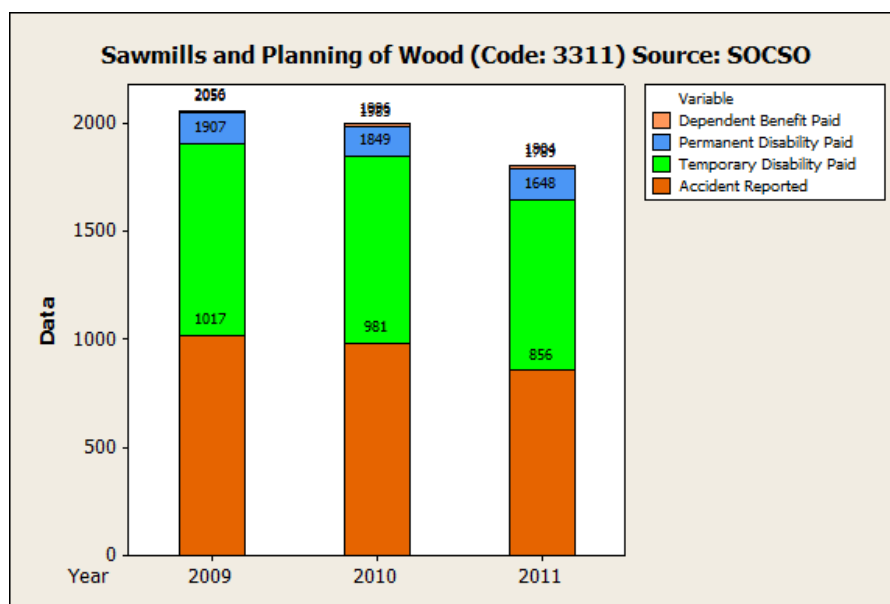
**Figure 1.7:** Stacked Bar Chart on Permanent Disability (Number of Benefits Paid) Industries/Year( Source: SOCSO)



**Figure 1.8:** Stacked Bar Chart on Temporary Disability (Number of Benefits Paid) Industries/Year( Source: SOCSO)



**Figure 1.9:** Stacked Bar Chart on Dependent benefit (Number of Benefits Paid) Industries/Year( Source: SOCSO)



**Figure 1.10:** Stacked Bar Chart on Reportable Accident (Sawmills and Planning of Wood/Year) ( Source: SOCSO)

### 1.2.2 Current study on accident cost estimation

Most organisations do not systematically calculate accident cost, owing to managers lack of knowledge and understanding of compensation mechanisms involved in accidents. Managers tend to believe that most expenses are insured and therefore do not see a real reason to calculate these costs which requires data collection. Furthermore, the common economic approach for calculating the advantages of safety investment is based on the assumption that managements regard industrial accidents as undesired side effects, while their direct and indirect costs are assumed to be a kind of sunk costs. One of the goals of the current paper is to provide tools which will help overcoming the narrow economic approach adopted by many managers.

Other possible reasons for the marginalization of accident costs by managers include: measurement difficulties, overloaded managers, biased accounting methods and the low status of safety departments. (Jallon et.al, 2010) and (Arieh et.al 2009) suggest that to manage risk properly, not only necessitates the development techniques but also to develop processes, at the personnel level as well as at the organizational level, which will take human nature into account. Appropriate mechanisms will also have to be set up to reconcile “public interest” and “risk management”. It will thus be necessary to define, implement and improve a series of processes and most importantly, provide guidance to managers.

The real challenge in evaluating the costs of industrial accidents is to develop reliable evaluation of indirect costs which are usually also the uninsured costs. Yet, researchers have recognized also the importance on indirect costs. For example, (LaBelle,2000) suggests a method for cost evaluation based on several categories: cost of time spent in relation to medical care, reduced production of the injured worker after returning to work, cost of supervision and investigation, reduced production, cost of replacement, learning and management cost and cost related to legal processes.

Yet, the methods used for these evaluations are relatively old and especially lack integration of central components in the production process. Therefore, they may be regarded not reliable by managers. The model we propose assume that as the workload increases, whether it is mental or physical workload, the probability of industrial accidents increases. This assumption is supported in the literature both theoretically and empirically (Jallon et.al 2009). Since the definition of a bottleneck station refers to the workload which characterizes this station, we infer that the probability for industrial accidents is relatively higher in bottleneck stations as compared to other locations in the production process.

### **1.2.3 Malaysian Legal Legislation Related to Accident Investigation and reporting.**

According to OSH Act 514, part VIII, Notification of accidents, dangerous occurrence, occupational poisoning and occupational diseases and inquiry, the employer shall notify the nearest occupational safety and health office of any accident, dangerous occurrence, occupational poisoning and occupational diseases which has occurred or is likely to occur at the place of work.

Notification of accidents, dangerous occurrence, occupational poisoning and occupational diseases (NADOOPOD) Regulations, Part II Notification of accident and dangerous accident, regulation 5(2) , whenever any accident arising out of or in connection with work which causes bodily injury to any person which prevents the person from following his normal occupation for more than four calendar days, the employer shall within 7 days, send a report thereof in an approved form to the department of occupational safety and health office.

NADOOPOD regulation part IV – maintenance of all records of accident, dangerous occurrence, occupational poisoning and occupational disease, Regulation 10. Records.

(1) Every employer and self-employed person shall record and maintain a register, in an approved form, of—

(a) all accidents and dangerous occurrences which have occurred; or  
(b) all occupational poisonings or occupational diseases which have occurred or are likely to occur, arising out of or in connection with work under his control, whether or not the accidents, dangerous occurrences, occupational poisonings and occupational diseases have been reported under sub regulation 5(1) or 7(1).

(2) The record shall be kept at the place where the work to which it relates is carried on or, if this is not practicable, at the usual place of business of the employer or self-employed person and an entry in the registry shall be kept for at least 5 years from the date on which it was made.

The approved format for reporting and notification of accidents, dangerous occurrence, occupational poisoning and occupational diseases are as below:-

1. **Form JKPP 6** – Laporan mengenai kemalangan/kejadian berbahaya OSH Act 514 NADOOPOD Regulation 2004.
2. **Form JKPP 7** – Laporan Mengenai Keracunan pekerjaan/penyakit pekerjaan OSH Act NADOOPOD Regulation 2004.

OSH Act 514 Part IV, general duties of employers and self employed persons. Section 15 (1) it shall be the duty of every employed person to ensure, so far as is practicable, the safety, health and welfare at work of all his employees.

The definition for ‘practicable’ means practicable having regard to:-

- a) the severity of the hazard or risk in question.
- b) the state of knowledge about the hazard or risk and any way of removing or mitigating the hazard or risk.
- c) the availability and suitability of ways to remove or mitigate the hazard or risk
- d) the cost of removing or mitigating the hazard or risk.

#### **1.2.4 OHSAS 18001 Standard**

This Occupational Health and Safety Assessment Series (OHSAS) guideline, and OHSAS 18001:2007, Occupational health and safety management systems — Requirements, have been developed in response to customer demand for a recognizable occupational health and safety management system standard against which their management systems can be assessed and certified, and for guidance on the implementation of such a standard.

The OHSAS Standards covering OH&S management are intended to provide organizations with the elements of an effective OH&S management system that can be integrated with other management requirements and help organizations achieve OH&S and economic objectives.



Clause 4.3.1 of the standard is the requirement for Hazard identification, risk assessment and determining controls. The organization shall establish, implement and maintain a procedure(s) for the ongoing hazard identification, risk assessment, and determination of necessary controls.

The procedure(s) for hazard identification and risk assessment shall take into account:

- a) routine and non-routine activities;
- b) activities of all persons having access to the workplace(including contractors and visitors);
- c) human behaviour, capabilities and other human factors;
- d) identified hazards originating outside the workplace capable of adversely affecting the health and safety of persons under the control of the organization within the workplace;
- e) hazards created in the vicinity of the workplace by work related activities under the control of the organization;
- f) infrastructure, equipment and materials at the workplace, whether provided by the organization or others;
- g) changes or proposed changes in the organization, its activities, or materials;
- h) modifications to the OH&S management system, including temporary changes, and their impacts on operations, processes, and activities;
- i) any applicable legal obligations relating to risk assessment and implementation of necessary controls.
- j) the design of work areas, processes, installations, machinery/equipment, operating procedures and work organization, including their adaptation to human capabilities.

## **Risk assessment**

Risk is the combination of the likelihood of an occurrence of a hazardous event or exposure(s) and the severity of injury or ill health that can be caused by the event or exposure(s). Risk assessment is a process of evaluating the risk(s) arising from a hazard(s), taking into account the adequacy of any existing controls, and deciding whether the risk(s) is acceptable. An acceptable risk is a risk that has been reduced to a level that the organization is willing to assume with respect to its legal obligation, its OH&S policy and its OH&S objectives.

The organization's methodology for hazard identification and risk assessment shall:

- a) be defined with respect to its scope, nature and timing to ensure it is proactive rather than reactive; and
- b) provide for the identification, prioritization and documentation of risks, and the application of controls, as appropriate.

Clause 4.5.3.1 of the standard is related to Incident investigation, nonconformity, corrective action and preventive action. The organization shall establish, implement and maintain a procedure(s) to record, investigate and analyse incidents in order to:

- a) determine underlying OH&S deficiencies a) and other factors that might be causing or contributing to the occurrence of incidents;
- b) identify the need for corrective action;
- c) identify opportunities for preventive action;
- d) identify opportunities for continual improvement;
- e) communicate the results of such investigations.

The investigations shall be performed in a timely manner. Any identified need for corrective action or opportunities for preventive action shall be dealt with in accordance with the relevant parts of 4.5.3.2.

The results of incident investigations shall be documented and maintained.

In order to satisfy the above OSHAS 18001 standard requirements, OSH act and regulation, many company in Malaysia typically organized to Accident according to process flow chart as shown in figure 1.11 and 1.12.

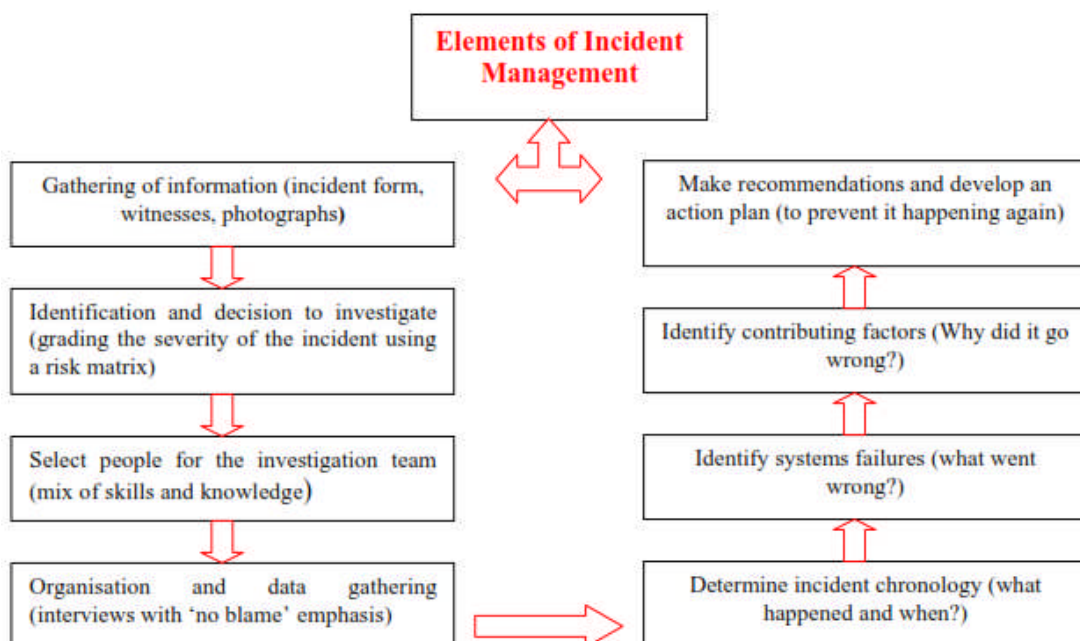


Figure 1.11 : Process flow chart on the elements of incident management

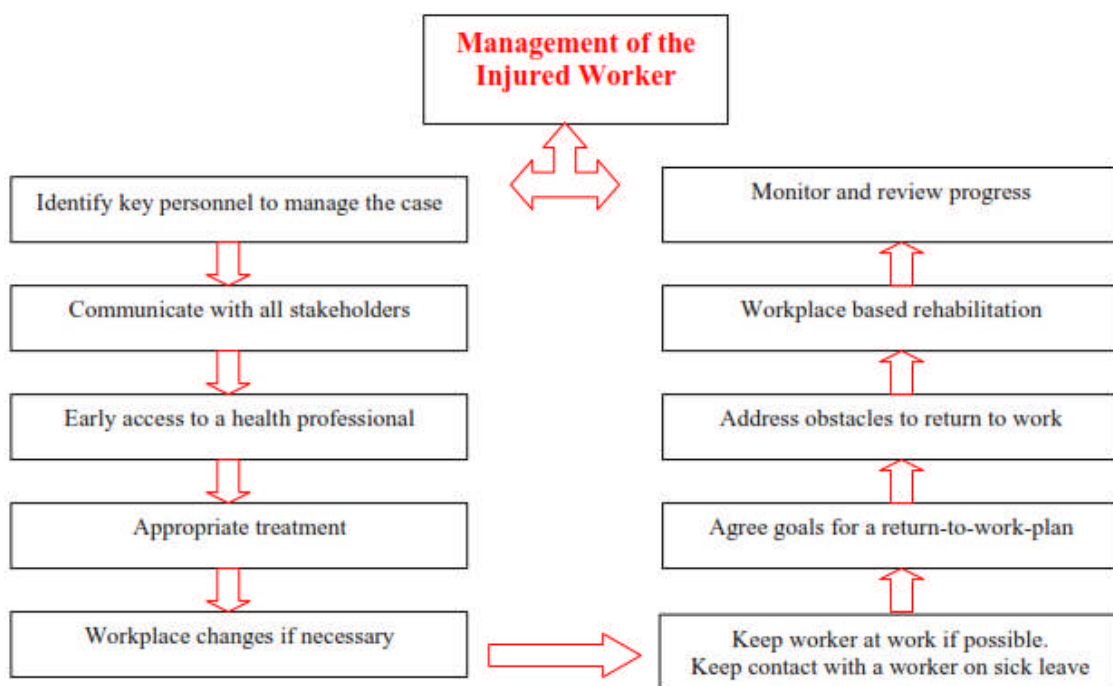


Figure 1.12 : Process flow chart on the management of injured workers.

### **1.3 Objectives**

This objective of this study is to provide an overview of the current state of knowledge regarding the calculation and evaluation of the direct and indirect costs of workplace accidents and identify the preventive action plan to eliminate or mitigate the risk of accident.

The specific objective of this study is as follows:

- i. To identify the component of occupational accident cost in the wood based related industries.
- ii. To calculate and estimate the accident cost
- iii. To propose accident prevention plan using HIRARC principles.

### **1.4 Scope**

The scope of this master project are as follows:

- i. Selected wood based related industries in Malaysia.
- ii. Data collection from the past occupational accident record.
- iii. Workplace accident cost will be studied
- iv. Only proposal for accident cost estimation

### **1.5 Thesis Arrangement**

The beginning stage of the research is very important before starting this study in order to achieve good result. The right method or methodology can obtain the effective and accurate result in final stage in this thesis. There are five chapters in this thesis.

Chapter 1 is the introduction to this thesis that has highlighted and presented the objective, scope and the overall methodology to apply for completion of this study from beginning until the end.

Chapter 2 describes the literature review by discussing the concept, tools and approach for the implementation for this study. This chapter also gives a review on accident cost calculation in order to obtain a better understanding on the accident cost estimation in this study.

Chapter 3 will explain about methodology use from start to the end of this study. This chapter will discuss on the development of user Accident cost estimation worksheet in Microsoft Excel Spreadsheet which will be used during on site assessment at the selected word based companies.

Chapter 4 will show the analysis of result obtain from the survey in the wood based industries. This chapter will explain about introducing of the Accident cost estimation worksheet for trial run and obtain the feedback and from the user. Any response, comments, feedback or strength & weaknesses discovered during assessment.

Chapter 5 will show the result and conclusion of this study. The Accident Cost assessment form will be used to obtain the feedback from end user. Response, feedback or strength & weaknesses discovered in the previous chapter will be used as a basis for improvements. This chapter includes the summary of the study and recommendations for future study.

## **1.6 Conclusion**

This chapter had discussed about the introduction to this study. This chapter also has defined the objective and scope of the study in order to provide preliminary focus. The arrangement for thesis outlines also included in this chapter to ensure that is follows the task and the direction of the study. The next chapter will be discussing about the theories and that will be used on this study.

## REFERENCES

1. Abdul Hamid, A. R. and Abd Majid, M. Z. and Singh, B. (2008) “*Causes of accidents at construction sites*” Faculty of Civil Engineering, Universiti Teknologi Malaysia.
2. Act 514, Occupational Safety and Health Act (1994), Malaysian Parliament
3. Borooah, V.K. (1998) “*Determinants of workplace injuries: An econometric Analysis based on injurues compensation data for Queensland*”, University of Ulster, Northern Ireland.
4. Danna, K. and Griffin, R.W. (1999) “*Health and Well-Being in the Workplace*” Texas A&M University.
5. Dastjerdi, E. L, Naeini, H.S, and Sanjari, H. (2013) “*The Economic Cost of Health and Safety in Work Places: An Approach on the Costs Calculating Model*”, World Academy of Science, Engineering and Technology.
6. Dockrell, S. Johnson, M. and Ganly, J. (September 2007) “*Analysis of the causes and costs of Manual Handling Incidents*”, Health and Safety Authority, UK.
7. Ellefson, P.V and Kilgore, M.A. (January 2010) “*US Wood Based Industry: A review of structure and Organisation*” Department of Forest Resources University of Minnesota.

8. Fayad, R. Nuwayhid, I. Tamim, H. Kassak, K and Khogali, M. (2003) “*Cost of work-related injuries in insured workplaces in Lebanon*” Bulletin of the World Health Organization .
9. Gavious, A, Mizrahi, S, Shani, Y and Minchuk, Y. (2009) “*The costs of industrial accidents for the organization: Developing methods and tools for evaluation and cost–benefit analysis of investment in safety*”. Journal on safety, Elsevier.
10. Head, L. and Harcourt, M. (1995) “*The Direct and Indirect Costs of Workplace Accidents in New Zealand*” Wellington, New Zealand
11. Health and Safety Authority, (November 2012) “*Study on the Costs Incurred by Small Businesses as a Result of Workplace Injuries*” Indecon International Economic Consultants [www.indecon.ie](http://www.indecon.ie)
12. Hordacre, A. L. (March 2010) “*The Role of the Workplace in Return to Work*” The Australian Institute for Social Research
13. Jallon, R, Imbeau, D and Warin, N.M. (2011) “*A process mapping model for calculating indirect costs of workplace accidents*”, Journal on Safety, Elsevier
14. Jallon, R, Imbeau, D and Warin, N.M. (2011) “*Development of an indirect-cost calculation model suitable for workplace use*”, Journal on Safety, Elsevier.
15. Knegtering, B. and Pasman, H. J. (2009) “*Safety of the process industries in the 21st century: A changing need of process safety management for a changing industry*”, Journal on Safety, Elsevier.
16. Knegtering, B and Pasman, H.J. (2009) “*Safety of the process industries in the 21st century: A changing need of process safety management for a changing industry*”. Journal on safety, Elsevier



17. Labelle, J.E. (April 2000) "*Determining Total Incident Costs*" American Society of Safety Engineers.
18. Lebeau, M. and Duguay, P. (2013) "*The Costs of Occupational Injuries*," IRST Publication.
19. Li, RYM, Poon SW, (2013) "*Review on the Evolution of the Construction Accident Causation Models*", Springer
20. Medicest Private (August 2008) , "*The Cost of Workplace Stress in Australia*", [www.medibank.com.au](http://www.medibank.com.au).
21. Mottiar, Z (May 2004), "*Feasibility Study on Estimation of Costs of Workplace Accidents, work-related ill-health and non-injury incidents in Ireland*". Health and safety journal, Northern Ireland.
22. NIOSH Malaysia. (2008) "*Guidelines for Hazard Identification, Risk Assessment and Risk Control (HIRARC)*", DOSH Malaysia publication *Occupational Safety and Health (Notification of Accident, Dangerous Occurrence, Occupational Poisoning and Occupational Disease) Regulation 2004*", DOSH Malaysia
23. Okeola, O.G. (August 2009) "*Occupational Health and Safety (OHS) Assessment in the construction Industry*" Civil Engineering Conference University of Ilorin, Nigeria.
24. OSH Administration (January 2012) "*Injury and Illness Prevention Programs*" U.S. Department of Labor [www.osha.gov](http://www.osha.gov).
25. Oxenburgh, M. and Marlow, P. (2009) "*The Productivity Assessment Tool: Computer-based cost benefit analysis model for the economic assessment of occupational health and safety interventions in the workplace*" Journal on Safety, Elsevier.

26. Oxenburgh, M and Marlow, P. (2005) "*The Productivity Assessment Tool: Computer-based cost benefit analysis model for the economic assessment of occupational health and safety interventions in the workplace*", Journal on Safety, Elsevier
27. Rhee, K.Y. (2012) "*Establishment and Operation of Industrial Accident Prevention System*", Korea University of Technology and Education.
28. Rodezno, R.A. (2005) "An overview to CERSSO's self evaluation of the cost-benefit on the investment in occupational safety and health in the textile factories: A step by step methodology" Journal of Safety Research - Elsevier.
29. Seavey, D. (October 2004) "*The Cost of Frontline Turnover in Long-Term Care*", IFAS.
30. Simonds, R. and Grimaldi, J. (1956) "*Safety Management: Accident Cost and Control*". Homewood, Ill: Richard D. Irwin.
31. Sormunen, P. (May 2010) "*Cost calculation Model for work related Accidents*". Petroltecnica SPA.
32. Sullivan, C, Seymour, E and McDermott, M.R, (March 2007), "*The costs and effects of workplace accidents Twenty case studies from Ireland A report for the Health and Safety Authority*", School of Food Science and Environmental Health Dublin Institute of Technology.
33. US department of labor. (2013) "*Safety pay*" Occupational Safety and Health Association [www.OSHA.gov](http://www.OSHA.gov)
34. Washington State Department of Labor and Industries, (October, 2011) "*Cost-Benefit Analysis of the Crane Rule Washington State Department of*

*Labor and Industries*”, Occupational Safety and Health Association  
[www.OSHA.gov](http://www.OSHA.gov)