CHAPTER 3
METHODOLOGY

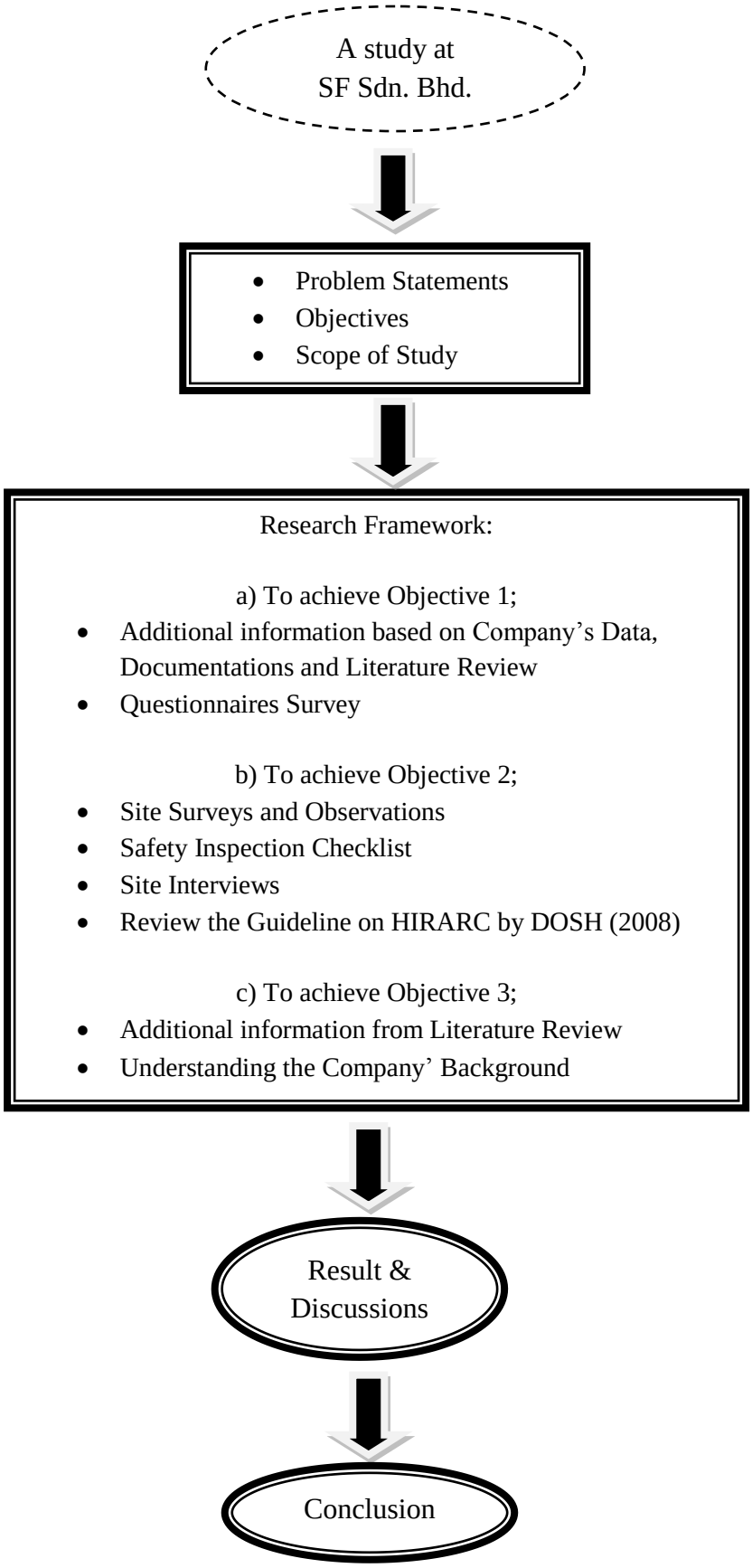
3.1 Introduction

The purpose of this chapter is to discuss the methodology applied in order to achieve the research objectives presented earlier. The study is conducted in two years time in an organization named SF Sdn. Bhd, a steel factory which is located at Selangor. The research methodology consists of a series of chronological processes that requires a step by step approach in order to achieve the research objectives with the main concern of study in developing the OSH Conceptual Model, based on review of OSHMS implementation.

In achieve the objectives of the study, the selected method used were listed as follows; (1) Additional information based on Company's Data, Documentations and Literature Review (2) Questionnaires Survey (3) Site Surveys and Observations (4) Site Interviews (5) Safety Inspection Checklist (6) Review the Guideline on HIRARC by DOSH (2008) and (7) Understanding the Company' Background (as summarized in The Research Framework, Sec. 3.2)

3.2 The Research Framework

In this study, the Research Framework for ESH at steel factory as follows;



3.3 Additional Information based on Company's Data, Documentations and Literature Review

In order to achieve the first objective, it is important to review the implementation of ESH at the steel factory based on related recommended OSHMS models in the existing of OHSAS 18001 Standard and Guidelines and from the information of Company's data and documentation that have been obtained from the ESH Department. These methods also need to get some literature reviews from related research on journals and any paper presented that selected as it is commonly recognized that they are of appropriate international standards. The indicated keys of OHSMS elements, are appropriate to be used in various industries, and are simple to interpret.

Some regulations, international guidelines and various safety and health models were reviewed in this study, details as in the list below;

(1) OSHA 1994

(2) OSH-MS1722: Malaysia- Guideline on OSHMS by DOSH

(3) OSHMS in International Countries; Standards and Guidelines

  (i) OHSAS 18001 (1996)

  (ii) ILO-OSH (2001)

  (iii) BS 8800 (2004)

  (iv) OHSAS 18001 (2007)

(4) Models in OSHMS

  (i) ILO- Occupational Safety and Health Management Systems (2001) Model

  (ii) Managing Outstanding Safety Model

  (iii) European Agency for Safety and Health at Work (EU-OSHA) Model

  (iv) National Occupational Health and Safety Commission (NOHSC) Model

3.4 Questionnaires Survey

Other than that, a survey using a questionnaire was adopted in order to obtain an understanding of the relevant issues based on the study's objective 1. This approach was employed as it is the most common technique to evaluate safety-critical factors and participants remain anonymous (Kho *et al.,* 2005; and Von Thaden *et al.,* 2003). The purpose of the questionnaires' survey is to explore the employees behaviour towards the ESH, extract the knowledge of detailed information and safety awareness level.

In this study, a set of questionnaires were distributed to 100 employees randomly. This Questionnaires Sample (Appendix 5) were focusing on OSHMS implement and expose to ESH hazards. It was divided into six parts which cover aspects on personal information, attitude in a work environment, management, safety and policy, PPE and effectiveness of training and programme. 100 of employees were choosen randomly, from different section/ department of workplace which concentrates on the production processes.

Majority of employees contributed in this questionnaire are Malaysian, ages of below 40; (1) willingness to fulfill the distributed questionnaires and (2) easily understand the language used (English and *Bahasa Melayu*) compared to the foreign employees. A sample size of 30 is normally used as a cutoff value as the sampling distribution of 30 or more is regarded as normally distributed (Dawson & Trapp, 2004).

3.4.1 Questionnaires Analysis

The internal-consistency reliability (alpha model) of the questionnaire survey (Appendix 5) will be analyzed with SPSS 18, based on average inter-item correlation.

a) Type of Questions

Type of 41 questions consists of multiple choice questions as Likert-scale type, in terms of five degrees of agreement; “Strongly Disagree”, Disagree”, “Undecided”, “Agree” “Strongly Agree”. Multiple choice questions consist; “Yes”, “No”, “Don’t know”, and the Answers include; “Very Satisfied”, “Satisfied”, “Dissatisfied” “Very dissatisfied”.

b) Questionnaire Parts

Part 1: Personal Information
Part 2: Attitude in a Work Environment
Part 3: Management
Part 4: Safety and Policy
Part 5: PPE
Part 6: Effectiveness of Training and Programme of Employees

c) Percentage Score

To reflect degree of each response’s attitude (Table 3.1)

Table 3.1: Core for Answers in Analysis Purpose of SPSS

ANALYSIS PURPOSE	ANSWER	CORE
Multiple Choices Question	Yes	1
	No	2
	Don’t Know	3
Likert Scale 1	Strongly Disagree	1
	Disagree	2
	Undecided	3
	Agree	4
	Strongly Agree	5
Likert Scale 2	Very Satisfied	1
	Satisfied	2
	Dissatisfied	3

3.4.2 Demographic Profile

This section depicts the personal information of 100 respondents who participated in this study. The backgrounds of respondents were captured in Section 1 in Questionnaire section and descriptive statistics are used to present the results of demographic profile.

Demographic Profile Statistical Analysis

Table 3.2: Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	21 - 30	51	51.0	51.0	51.0
	31 - 40	49	49.0	49.0	100.0
	Total	100	100.0	100.0	

Table 3.3: Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	58	58.0	58.0	58.0
	Female	42	42.0	42.0	100.0
	Total	100	100.0	100.0	

Table 3.4: Salary

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 - 1000	62	62.0	62.0	62.0
	1001 - 2000	30	30.0	30.0	92.0
	2001 - 3000	7	7.0	7.0	99.0
	More than 3001	1	1.0	1.0	100.0
	Total	100	100.0	100.0	

Table 3.5: Education Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SEK REN	2	2.0	2.0	2.0
	SEK MEN	41	41.0	41.0	43.0
	SAR MUDA	20	20.0	20.0	63.0
	SAR PHD	1	1.0	1.0	64.0
	LAIN-LAIN	36	36.0	36.0	100.0
	Total	100	100.0	100.0	

Summary on Demographic Profile

The personal information's described including age, gender, salary, education and respondents' attribute of demographic profile was explained as follow:

Table 3.6: Age of Respondents

Age	Frequency	Percent
21 - 30	51	51
31 - 40	49	49
Total	100	100

Table 3.6 shows the frequency and percentage of respondents that participated in this research. Most of the respondents are aging from 21 to 30 years old which are 51 respondents out of 100 respondents and 49 percent of them are aging from 31 until 40 years old.

Table 3.7: Gender of Respondents

Gender	Frequency	Percent
Male	58	58
Female	42	42
Total	100	100

Table 3.7 describes the summaries of result for gender of respondents. The result shows that the male is more than female; 58 percents are male and 42 percents are female. It indicates that males are more cooperative to give their feedback about this study.

Table 3.8: Salary of Respondents

Salary (RM)	Frequency	Percent
0 - 1000	62	62
1001 - 2000	30	30
2001-3000	7	7
More than 3001	1	1
Total	100	100

Based on Table 3.8 above, the salary of respondents are ranges from RM1000 to more than RM3001. Majority of respondents' salary is less than RM1000 which is 60 percents as mentioned above. 30 percents of sample size said their salary is about RM1001 to RM2000. 7 percents of respondents have salary ranges from RM2001 until RM3000 and only 1 respondent has the salary of more than RM3001.

Table 3.9: Education Level of Respondents

Education	Frequency	Percent
Primary	2	2
Secondary	41	41
Degree	20	20
Master	1	1
Others	36	36
Total	100	100

Table 3.9 shows the education level of fellow respondents. The results show the majority of the respondents are from secondary level of education that consists of 41 percent. Next, the other level of education (means no educations or not stated in the list) with about 36 percent of respondents and 20 percents of sample size have degree level of education. Only one respondent is a Masters holder.

3.4.3 Exploration of Data

The Exploratory Data Analysis was conducted with the purpose of screening the normality of data distribution and reliability on employees' attitude in working environment, management, safety and policy, PPE, effectiveness of training and program. Based on Field (2005), exploring the characteristics of data is the first step in an analytical process as the objective of this stage is to purify the original item pool produced from previous literatures. Items in terms of item-to-total correlation and violate the predicted factor structure are to be investigated and may be discarded.

According to Pallant (2007), there are many types of procedures in exploring or screening the data which are descriptive table, histogram and box plot. These procedures could be used to inspect the outliers and to show the relationship between variables visually. The author stated that outliers could be deleted from the data set or could be given a high score which is not too different from the remaining cluster of scores. It can be a result of input mistakes or genuine scores and for further analysis, the outliers were identified, checked and corrected for further analysis.

In this study, the purification of scale in data used the normality, reliability test and correlation before researchers went further with the analysis. According to Field (2006), before proceeding to inferential analysis, normality and reliability assumptions were important to achieve data analysis procedure. All the investigated variables in this study have shown fair linear relationship.

Descriptive Statistics and Analysis

Table 3.10: Management Commitment

	N	Mean	Std. Deviation
A positive approach to controlling safety	100	4.36	.503
Management speak out to employees about the importance of safety	100	4.29	.537
Investigate the cause	100	4.19	.734
Safety briefing	100	4.11	.680
Recognizes and makes use of abilities and skills	100	4.10	.577
Consistently at workplace	100	4.05	.657
Flexible and understands the importance	100	4.02	.568
Open and comfortable	100	3.83	.877
Valid N (listwise)	100		

Table 3.11: Attitude In Work Environment

	N	Mean	Std. Dev.
Training is provided	100	4.30	.595
Treated with respect by management and people	100	4.16	.662
Efficiently and effectively	100	4.15	.386
Encouraged to develop new and more efficient	100	4.13	.485
Job requirements	100	4.12	.608
Employees work well together	100	3.94	.814
Access to the information	100	3.84	.647
I would recommend others to work for company	100	3.70	.674
Decision making	100	3.64	.847
Valid N (listwise)			

Table 3.12: Safety and Policy

	N	Mean	Std. Deviation
The legislation that covering the health and safety at workplace	100	4.15	.359
The mission statement put forth	100	3.97	.437
Any penalty/fines if employee do not follow the safety regulation at workplace	100	3.87	.734
Corrective action	100	3.83	.922
Reduce accidents at work place	100	3.41	1.256
Insurance claim form are understandable and easy to file	100	3.39	.840
Fairness	100	1.69	.929

Table 3.13: Right as an Employee

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	YES	99	99.0	99.0	99.0
	NO	1	1.0	1.0	100.0
	Total	100	100.0	100.0	

Table 3.14: Company Safety Policy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	YES	78	78.0	78.0	78.0
	NO	20	20.0	20.0	98.0
	DONT KNOW	2	2.0	2.0	100.0
	Total	100	100.0	100.0	

Table 3.15: Personal Protection Equipment (PPE)

	N	Mean	Std. Dev.
Wearing PPE while working is very important	100	4.23	.423
Know Personal Protective Equipment	100	4.08	.394
Prefer to use PPe while working	100	3.87	.720
Comfortable wearing PPE	100	3.70	.732
Valid N (listwise)	100		

3.4.4 Normality Test

Normality test can be used to determine whether the data set is well-modeled or not, or to compute how likely an underlying random variable is normally do. It can be checked through normal distribution of data and is always associated with the feel for data analysis. According to Pallant (2007), several measures such as histogram, Q-Q plot, detrained normal plot, Boxplots, Kolmogorov-Smirnov, Shapiro-Wilks and Skewness and Kurtosis can be used in testing the normality of data set. For very large sample sizes, They were statistically significant as a hypothesis test because very large simple sizes may become powerful which they detect departures from normality, but not of practical importance.

In this study, the data was examined to determine whether they were normally distributed. The satisfying parametric assumptions were capable and with that the inferential statistics can be preceded. The measurement used by examining Skewness and Kurtosis values for assessing the normality. Hair *et al.*, (1998) have supported that by mentioning in their study that the normality is more accurate measured by Skewness and Kurtosis values.

The data was studied to determine whether they were normally distributed and therefore capable of satisfying parametric assumptions and with that the paired sample t-test and regression analysis can be preceded. This test was applied for each variable on attitude in work environment, management, safety and policy, PPE and effectiveness of training and program employees by examining Skewness and Kurtosis, also to measure and assessed the normality. The transformation technique is necessary to apply if data is not normal and to transform it to normal data. Table below shows the Normality Test Statistical Analysis using SPSS software.

Normality Test Statistical Analysis

Table 3.16: Attitude In a Work Environment

Descriptive		Statistic	Std. Error
Mean		3.9978	.03865
95% Confidence Interval for Mean	Lower Bound	3.9211	
	Upper Bound	4.0745	
5% Trimmed Mean		4.0074	
Median		3.9444	
Variance		.149	
Std. Deviation		.38651	
Minimum		3.00	
Maximum		4.78	
Range		1.78	
Interquartile Range		.56	
Skewness		-.140	.241
Kurtosis		-.255	.478

Table 3.17: Management Commitment

Descriptive		Statistic	Std. Error
Mean		4.1188	.03707
95% Confidence Interval for Mean	Lower Bound	4.0452	
	Upper Bound	4.1923	
5% Trimmed Mean		4.1208	
Median		4.1875	
Variance		.137	
Std. Deviation		.37071	
Minimum		3.50	
Maximum		4.88	
Range		1.38	
Interquartile Range		.62	
Skewness		-.090	.241
Kurtosis		-1.261	.478

Table 3.18: Safety & Policy

Descriptive		Statistic	Std. Error
Mean		3.7700	.05167
95% Confidence Interval for Mean	Lower Bound	3.6675	
	Upper Bound	3.8725	
5% Trimmed Mean		3.7796	
Median		3.8333	
Variance		.267	
Std. Deviation		.51671	

Minimum		2.67	
Maximum		5.00	
Range		2.33	
Interquartile Range		.83	
Skewness		-.298	.241
Kurtosis		-.373	.478

Table 3.19: Personal Protection Equipment (PPE)

Descriptive		Statistic	Std. Error
Mean		3.9700	.04209
95% Confidence Interval for Mean	Lower Bound	3.8865	
	Upper Bound	4.0535	
5% Trimmed Mean		3.9722	
Median		4.0000	
Variance		.177	
Std. Deviation		.42086	
Minimum		3.00	
Maximum		5.00	
Range		2.00	
Interquartile Range		.75	
Skewness		.063	.241
Kurtosis		-.870	.478

Table 3.20: Employee's Effectiveness on Training & Programs

Descriptive		Statistic	Std. Error
Mean		4.1414	.02675
95% Confidence Interval for Mean	Lower Bound	4.0884	
	Upper Bound	4.1945	
5% Trimmed Mean		4.1492	
Median		4.1429	
Variance		.072	
Std. Deviation		.26745	
Minimum		3.43	
Maximum		4.71	
Range		1.29	
Interquartile Range		.29	
Skewness		-.400	.241
Kurtosis		-.241	.478

Summary on Normality Test

Table 3.21: Normality Test Result

Variables	Test of Normality			
	Skewness		Kurtosis	
	Statistic	Std. error	Statistic	Std. error
Attitude In Work Environment	-0.140	0.241	-0.255	0.478
Management	-0.090	0.241	-1.261	0.478
Safety And Policy	-0.298	0.241	-0.373	0.478
PPE	0.063	0.241	-0.870	0.478
Training and Program Effectiveness	-0.400	0.241	-0.241	0.478

Table 3.21 shows the Normality Test Result where all variables in the questionnaire section that were based on attitudes in working environment, management, safety and policy, PPE and effectiveness of training and program. Result shows that skewness and kurtosis are as follows; Attitude in Working Environment (skewness= -0.140, kurtosis= -0.255), Management (skewness= -0.090, kurtosis= -1.261), Safety and Policy (skewness= -0.298, kurtosis= -0.373), PPE (skewness= 0.063, kurtosis= -0.870) and Effectiveness of Training and Program Employees (skewness= -0.400, kurtosis= -0.241).

To examine the skewness and kurtosis, values between ±2 are in many cases acceptable (George and Mallery, 2005) and referring to the results, all variables showed symmetrical distribution because the values are between ±2. According to Field (2005), pattern of symmetrical can be identified from sign for kurtosis value. Positive kurtosis indicates a "peaked" distribution and negative kurtosis indicates a "flat" distribution. In this research, all variables were flat distribution and the skewness and kurtosis of all variables were statistically normally distributed. It can be concluded that these variables satisfied the normality assumption, means no transformation is necessary.

3.4.5 Reliability Test

Reliability test is being performed to test the decency of the data and were being tested for pilot and actual data to find out the consistency of respondents' answers to all the questions in the study. It tests the degree of the questions independently measured of the same concept in the sense of their correlation with one another and reliability was defined as consistency of research findings as suggested by Kvale (1996) and also shows how consistent the instrument is in measuring the designed constructs in the survey. The validity test was done to investigate the instruments on its ability in measuring what it is supposed to measure and the questionnaire is used in reliability test.

In order to test for the reliability of the instrument, the most commonly used test is Cronbach's Alpha using continuous data type. The test is performed on each variable used in the current research to attain the reliability coefficients which is Cronbach's Alpha coefficients. According to Swafford *et al.,* 2006, reliability coefficients of 0.70 are considered adequate naturally, but most researchers consider 0.60 as sufficient. Cronbach's alpha determines the degree of consistency in which the set of variables is intended to measure (Hair *et al.,* 1998).

In measuring internal consistency reliability for individual scales and overall measures, the alpha analysis was performed on each construct. In this study, the items with Cronbach's alpha above 0.70 were considered as reliable as suggested by Nunnally (1978) and would be retained to measure the average scores. This analysis is only apply to all questions in Section 2 (Attitude in a Work Environment), Sec.3 (Management), Sec. 4 (Safety and Policy), Sec. 5 (PPE) and Sec. 6 (Effectiveness Training & Programme) in the questionnaire which use Likert Scale as measurement. Tables 3.22 below show the Reliability Test Statistical Analysis.

Reliability Test Statistical Analysis & Summary

Table 3.22: Reliability Test Result

Variables	Number of items	Cronbach's Alpha
Attitude in a Work Environment	9	0.772
Management	8	0.701
Safety and Policy	6	0.702
PPE	4	0.804
Effectiveness Training and Programme of employees	7	0.893

Table 3.22 shows the result of Cronbach's Alpha for the items in the variables' attitude in a working environment, management, safety and policy, PPE, effective training and programme of employees. The Cronbach's Alpha for attitude in a working environment is 0.772, management is 0.701, safety and policy is 0.702, PPE is 0.804 and effectiveness training and program of employees is 0.893. Based on the result above, all the items in variables are relatively high and exceeded the acceptable cutting off point of 0.70 (Nunally, 1978). Thus, all items are reliable and acceptable.

3.5 Site Surveys and Observations

According to Polgar and Thomas (2000), surveys are commonly used in research for the purpose of (1) establishing the attitudes, opinions or beliefs of persons concerning certain issues, (2) studying the characteristics of population on certain variables, and (3) collecting information about the demographic. In this study, the purpose of the site surveys and observations was to come out with a comprehensive performance structure and questions, with regards to ESH issues, based on the study's objectives number two. A survey was carried out towards the study of the OSHMS focusing on employee's attitude which can investigate employee's participation, opinion, knowledge, awareness, and readiness to adopt the OSH. Reasons for choosing this design are that the researcher can collect all the completed responses within a reasonable period of time and it is cost-effective (Sekaran, 2003).

3.6 Site Interviews

An interview can be used to obtain feedbacks and offers the interviewer the opportunity that allows interviewees to express their opinions, concerns and feelings. The interview process covers the items of the company's background, and company's activities that cover potential hazards and practical methods, in minimizing the accident at factory. Each interviewee will be briefed on the research objectives where the aspects on ESH, in achieving the second objective. In this study, the interviews were conducted among the Manager, ESH Executive, Safety and Health Officer and employees to obtain information about the safety and health implemented, as follows;

1) Mr. Sabrudin B. Suren, QA Sr. Manager
2) Mr. Abdul Razak b. Ariffin, ESH Exacutive
3) Mr. Sumarlan Sinang, ESH Executive
4) Mr. Mohd Zain b. Muhammad, Safety Health Officer

3.7 Safety Inspection Checklist

In this study, the checklist is divided into seven sections: General, Environmental Controls, Equipment and Hand Tools, PPE, Machinery and Machine Safety, Noise and Hearing Conservation and Fire; Safety and Emergency Response. The Safety Inspection Checklist was prepared to study the company OSHMS compliance with OSHA 1994 and regulations.

There are two purposes in conducting the Safety Inspections Checklist; (1) it is not to find out how many things are wrong, but to determine if things are satisfactory (2) the purpose is to discover conditions that recognize the facilities approved up to the standards and regulations, also to achieve the second objectives of potential hazards and practical methods for accident reductions. By this, the inspected facilities will become safer and healthier places to work.

Inspection team is one of the most important assessors in the entire organization that functions as workplace inspectors that consist of first-line supervisors, employees and maintenance employees. Other than that, there are some company' Safety Inspection Checklist form, or information from ESH department, that related in this study. The following Safety Inspection Checklist listed were stated in Appendix Section that consist of; (1) ESH Management- Appendix 6 (2) Tool- Appendix 7 (3) Overhead crane- Appendix 8 (4) Forklift- Appendix 9 (5) Chemical- Appendix 10 (6) Fire extinguisher- Appendix 11 (7) Plant safety and housekeeping- Appendix 12 (8) Lockout and tog out- Appendix 13 (9) Electrical- Appendix 14 (10) Scrap lorry- Appendix 15 (11) Hearing conservation- Appendix 16.

Summary of the Safety Inspection Checklist (based on Table 3.23-3.29)

The summary of this safety inspection checklist, fulfilled by Mr. Sabrudin B. Suren, QA Sr. Manager during interview process are as details; (1) General; the findings reveals that out of 11 criteria, most of them were applied in the company; first aid kits, MSDS sheets, fire extinguishers, trained with PPE, emergency eyewash stations, in-house ambulance and clinic as the preparation in case of accident or incident.

(2) Environmental Control; OSHMS was practiced in terms of the environmental controls, all of the equipments were in a good manner; and the PPE was used constantly by the employees. The robotic manipulator was used for carbon injection machine, as a method to prevent the emission of airborne asbestos and hazardous materials. The scrubber was used in CRP and the dust collector system was used in steel making plant (3) Equipment and Hand Tools; All in a good working condition and there was preventive maintenance/ inspection program for employees (4) PPE; All results proved a positive feedback in PPE implementation where employees were trained about work procedures, proper use, maintenance and equipments.

(5) Machinery and Machine Safety; All the PPE, equipment and maintenance was in a good manner and employers provided the PPE when handle it (6) Hearing Conservation; company requires in-plant and environment noise levels created by plant machinery (through air), control the standards specified by government regulatory or comply with community acceptance (7) Fire Safety & Emergency Response; such systems also provide to activate fire control equipment and notify emergency services. Manual automatic systems detect a pre-determined condition and activate the alarm system automatically.

Table 3.23: General Part

No	General Part	Yes	No	Remarks
1	First aid kits responders available for each shift, well stocked, supplies adequate and available	/		
2	MSDS sheets located in close proximity to the work area where chemicals are used or stored	/		
3	Portable fire extinguishers of proper type are mounted properly, accessible, and inspected	/		
4	All chemical containers are properly labeled and hazardous materials containers are also labeled and chemicals stored in their proper containers	/		
5	Emergency eyewash stations are adequately maintained, free of obstructions and located in close proximity to the work area	/		Mostly located at Acid Pickling Line in CRM
6	Appropriate electrical systems designed for hazardous locations have been installed in spray booths and flammable liquid storage rooms	/		
7	Transportation is available for injured workers/ plan in place	/		Clinic, In-house ambulance
8	Employee receives training in the usage of the required personal protective equipment provided	/		
9	Workers are trained with proper lifting techniques/ ergonomics assigned to a job and machine	/		Done

Table 3.24: Environmental Controls

No	Environmental Controls	Yes	No	Remarks
1	Are all work areas properly lit & work area's ventilation system appropriate for the work?	/		
2	Are hazardous substances that may cause harm by inhalation, skin absorption, or contact identified?	/		
3	Are employees aware of the hazards involved with the various chemicals they may be exposed to?	/		
4	Is employee's exposure to chemicals in the workplace kept within acceptable levels? Can a less harmful method or product be used?	/		Scrubber is use in CRP. DCS use in steel making plant
5	Are wet methods used (when practicable) to prevent emission of airborne asbestos fibers, silica dust, carbon injection machine?	/		Robotic manipulator is used in CIM
6	Where heat is a problem, all fixed work areas been provided with a proper means of cooling?	/		
7	Is vacuuming dust with appropriate equipment conducted rather than blowing or sweeping?	/		
8	Are written standard operating procedures available for selection and use of respirators?	/		

Table 3.25: Equipment and Hand Tools

No	Equipment and Hand Tools	Yes	No	Remarks
1	Power tools are properly grounded/ have safety power switch	/		
2	Are all company- and employee-owned tools and equipment in good working condition?			Not all operating with tools
3	Employees are trained in the safe use of hand tools	/		
4	Do employees use appropriate safety glasses, face shields, and similar equipment when using equipment	/		
5	Do employees use eye and face protection when they drive hardened or tools, bits, or nails?		/	
6	Are tool handles wedged tightly?	/		
7	Proper guards are provided, tools are electrically grounded or double insulated			Not sure if double insulated
8	Are jacks checked periodically to ensure they are in good operating condition?	/		
9	Defective tools are removed from service	/		
10	Are broken or fractured handles on hammers, axes, or similar equipment replaced promptly?			Not sure
11	Have preventive maintenance/ inspection program	/		

Table 3.26: PPE

No	PPE	Yes	No	Remarks
1	Are all protective equipment sanitary ready to use?		/	Some disposal
2	Have all employees been trained with work procedures, and maintenance of protective clothing and equipment?	/		
3	Assessed workplace hazards require PPE, reviewed related injuries, documented assessment?	/		
4	Are protective goggles or face shields provided to employees and worn when there may be danger of flying material or caustic or corrosive materials?	/		Face shield are use for heat protect
5	Are ANSI-approved safety glasses worn at all times in areas where there is risk of eye injury?	/		Cobalt glass is use in EAF
6	Are protective gloves, aprons, or shields provided for protection against corrosive liquids, chemicals?	/		Aprons used (protect burns)
7	Are hardhats provided and worn there is a danger of falling objects and inspected periodically?	/		Compulsory in the plant vicinity
8	Do employees exposed to vehicular traffic wear high visibility garments stand out surroundings?	/		
9	Are employees required to wear safety shoes when exposed to conditions that can cause foot injuries?	/		Compulsory in the plant vicinity
10	Are there an eyewash facility and a quick-drench shower in each work area where employees are exposed to caustic or corrosive materials?	/		In CRM area

Table 3.27: Machinery & Machine Safety

No	Machinery & Machine Safety	Yes	No	Remarks
1	All machineries are properly grounded	/		
2	Air hoses are provided with safety latch to prevent accidental disconnect	/		
3	All points of operation, points of contact and other moving parts and wiring are adequately guarded	/		
4	Hazardous areas are painted with bright colors and power transmission guards are in places	/		
5	Clothing and hair restrictions are in place to prevent entanglement in machinery	/		
6	Plants or machines with “hot surfaces” are appropriately labeled		/	Thus fully automated
7	Noise exposures are adequately addressed and warnings are displayed in obvious locations	/		Ear plugs provided
8	Appropriate PPE is worn when operating machinery (eye, respiratory, hearing protection)	/		
9	Lockout/ tag out procedures follow when conducting maintenance and repairs on machinery	/		
10	Employees do not wear jewelry or loose fitting clothing while operating machinery	/		

Table 3.28: Noise: Hearing Conservation

No	Noise: Hearing Conservation	Yes	No	Remarks
1	Are noise levels measured using a sound-level meter or an octave band analyzer, and do you keep records of these levels?	/		Inside and surrounding areas audited regularly
2	Where engineering controls are not feasible, are administrative controls used to minimize employee exposure to noise?	/		Plant fully automated. Workers almost in pulpits, control room
3	Is there a preventive health program that educates employees about safe levels of noise and exposure, effects of noise on their health, and use of PPE?	/		Annual in house earring test, being conducted.
4	Are employees who are exposed to continuous noise above 85 dBA retrained annually and given periodic audiometric testing?	/		
5	Does employee working in areas where noise levels exceed 90 dBA use approved hearing PPE?	/		Provided with ear plugs

Table 3.29: Fire Safety & Emergency Response

No	Fire Safety & ER	Yes	No	Remarks
1	The area has an audible evacuation alarm	/		Office alarm system
2	External exit doors can be opened from the inside without a key and fire emergency exits are signed	/		
3	Fire control equipment is signed, regularly tested	/		Regular checks by Safety Dept.

3.8 Review the Guideline on HIRARC by DOSH (2008)

3.8.1 Introduction

In this study, the simple HIRARC was done based on Guideline of HIRARC by DOSH, 2008 (Appendix 4). The review on this guideline purpose in this study is to answer the second objective which is to evaluate the effectiveness on OSHMS by identifying the potential hazards and practical methods, in minimizing the accident at steel factory.

3.8.2 Process of HIRARC

1. *Classify Work Activities (stages/ process in production)*

The process and source at each process was discussed in Section 4.3.2, Table 4.5

2. *Hazard Identifications*

Three groups of hazards; Health, Safety and Environmental (Table 4.6, 4.7, 4.8)

3. *Risk Assessments*

Risk is the determination of likelihood and severity of event sequences

(a) Likelihood of an Occurrence

Table 3.30: Likelihood (L) Rating

LIKELIHOOD (L)	EXAMPLE	RATING
Most Likely	Most likely result of the hazard/ event being realized	5
Possible	Has a good chance of occurring and is not unusual	4
Conceivable	Might be occur at sometime in future	3
Remote	Has not been known to occur after many years	2
Inconceivable	Is practically impossible and has never occurred	1

Source: Guideline of HIRARC by DOSH (2008)

(b) Severity of Hazard

Table 3.31: Severity (S) Rating

SEVERITY (S)	EXAMPLE	RATING
Catastrophic	Numerous fatalities, irrecoverable property damage, productivity	5
Fatal	Approximately one single fatality major property damage if hazard is realized	4
Serious	Non fatal injury, permanent disability	3
Minor	Disabling but not permanent injury	2
Negligible	Minor abrasions, bruises, cuts, first aid injury	1

Source: Guideline of HIRARC by DOSH (2008)

(c) Risk Matrix

A Risk Matrix was shown in Table 3.32 below and Risk can be calculated using the following formula: L (Likelihood) x S (Severity) = Relative Risk

Table 3.32: Risk Matrix

	Severity (S)				
Likelihood (L)	**1**	**2**	**3**	**4**	**5**
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

References	
	High
	Medium
	Low

Source: Guideline of HIRARC by DOSH (2008)

(d) Risk Priority

Then, the priority was determines based on the following range in Table 3.33 below. Detail Description of Hazard and Risk Priority was discussing detail in Table 4.9.

Table 3.33: Risk Priority

RISK	DESC.	ACTION
15-25	HIGH	A HIGH risk requires immediate action to control the hazard as detailed in the hierarchy of control. Actions taken must be documented on the risk assessment form including date for completion.
5-12	MEDIUM	A MEDIUM risk requires a planned approach to controlling the hazard and applies temporary measure if required. Actions taken must be documented on the risk assessment form including date for completion.
1-4	LOW	A risk identified as LOW may be considered as acceptable and further reduction may not be necessary. However, if the risk can be resolved quickly and efficiently, control measures should be implemented and recorded

Source: Guideline of HIRARC by DOSH (2008)

4. Risk and Hazard Controls

There are many environmental aspects being monitored and controlled by the management, as one of the steps in controling the hazard and minimizing the accident at existing plant. Based on Table 3.34 below, there are six environmental aspects that were monitored by management, based on regulation and monitoring, such as; (1) Effluent Discharge (2) Sewerage Discharge (3) Stack and Chimney (4) Air Quality and Noise Monitoring (5) Scheduled Waste and (6) Ground Water. In this study, there are two important environmental aspects discussed, which are Air Quality and Noise Level Monitoring, in achieve the objective number 2.

Table 3.34: Environmental Monitoring at Existing Plant

No	Environmental Aspect	Regulation and Monitoring
1	Effluent Discharge Monitoring	Followed Standard B 1. Daily analysis 2. Monthly analysis by Accreditation Lab recognized by DOE
2	Sewerage Discharge Monitoring	1. Monthly analysis by Accreditation Lab recognized by DOE
3	Stack and Chimney Monitoring	Followed Standard C (Clean Air) Regulation 1978 1. Quarterly analysis by Consultant recognized by DOE
4	Air Quality and Noise Monitoring	1. Every six months
5	Scheduled Waste Management	1. To keep inventory record and notify to DOE on monthly basis 2. To maintain the Centralized Scheduled Waste Storage inventory
6	Ground Water Monitoring	1. Daily Water Level Monitoring by staff 2. Land Subsidence Monitoring every 2 months by Consultant recognized 3. Quarterly Water Quality Analysis by Accreditation Lab recognized by DOE