BEHAVIOUR BASED SAFETY CHECKLIST BASED ON BOWEC REQUIREMENTS IN CONSTRUCTION INDUSTRY (LANDED HOUSING)

SHARIFAH NURUL HAIFA BINTI SYED MOHD ANNUAR

Bachelor of Occupational Safety and Health with Honours

UNIVERSITI MALAYSIA PAHANG

UNIVERSITI MALAYSIA PAHANG

DECLARATION OF THESIS AND COPYRIGHT

Author's Full Name : SHARIFAH NURUL HAIFA BINTI SYED MOHD ANNUAR

Date of Birth : 29 MARCH 1995

Title : BEHAVIOUR BASED SAFETY CHECKLIST BASED ON BOWEC REQUIREMENTS IN CONSTRUCTION INDUSTRY (LANDED HOUSING)

Academic Session : SEMESTER 1 2018/2019

I declare that this thesis is classified as:

☐	CONFIDENTIAL	(Contains confidential information under the Official Secret Act 1997)*
☐	RESTRICTED	(Contains restricted information as specified by the organization where research was done)*
☑	OPEN ACCESS	I agree that my thesis to be published as online open access (Full Text)

I acknowledge that Universiti Malaysia Pahang reserves the following rights:

1. The Thesis is the Property of Universiti Malaysia Pahang
2. The Library of Universiti Malaysia Pahang has the right to make copies of the thesis for the purpose of research only.
3. The Library has the right to make copies of the thesis for academic exchange.

Certified by:

_____	_____
(Student's Signature)	(Supervisor's Signature)
_____	_____
950329-11-5524	EZRIN HANI BINTI SUKADARIN
Date: 9 JANUARY 2019	Date: 9 JANUARY 2019

NOTE : * If the thesis is CONFIDENTIAL or RESTRICTED, please attach a thesis declaration letter.

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor in Occupational Safety and Health (Hons)

_____

(Supervisor's Signature)

Full Name : EZRIN HANI BINTI SUKADARIN

Position : SENIOR LECTURER/ HEAD OF OCCUPATIONAL SAFETY AND HEALTH PROGRAM

Date : 9 JANUARY 2019

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

_____

(Student's Signature)

Full Name : SHARIFAH NURUL HAIFA BINTI SYED MOHD ANNUAR

ID Number : PA15014

Date : 9 JANUARY 2019

BEHAVIOUR BASED SAFETY CHECKLIST BASED ON BOWEC REQUIREMENTS IN CONSTRUCTION INDUSTRY (LANDED HOUSING)

SHARIFAH NURUL HAIFA BINTI SYED MOHD ANNUAR

Thesis submitted in fulfillment of the requirements
for the award of the degree of
Bachelor Occupational Safety and Health with Honours

Faculty of Engineering Technology

UNIVERSITI MALAYSIA PAHANG

JANUARY 2019

ACKNOWLEDGEMENTS

All praise to Allah S.W.T who give me strength and ideas in completing my thesis. Even though, there were many obstacles need to confront but it came to the end of this journey. I am indebted to wide range of people who always there for me in giving support and help. And also to the parties who gave a good contribution in term of information to complete my thesis.

First and foremost, I would to express my gratitude to Dr. Ezrin Hani Binti Sukadarin for the continuous guidance and ideas in helping me to complete my thesis. Without her guidance, I may not be able to finish my thesis. Again, special thanks to her in giving an encouragement, thoughtful critics and creative suggestions.

I would also to express my appreciation to my lovely parent for a never ending support and prayers. My higher appreciation also goes to my valuable friends who never ending give their helps for each of us, moral support, ideas and time especially my team in a same supervisor, housemates, and coursemates. And also for my siblings who always lend their hand for a help.

Thank you.

ABSTRAK

Dalam industri pembinaan (perumahan mendarat), kebanyakan kemalangan dan kecederaan yang hampir-hampir berlaku disebabkan oleh tingkah laku yang tidak selamat oleh majikan dan pekerja di tapak pembinaan (perumahan mendarat). Kekurangan pematuhan pada peraturan juga merupakan salah satu punca kemalangan dan kecederaan yang hampir-hampir berlaku dalam industri pembinaan (perumahan mendarat). Kajian ini bertujuan untuk mengenal pasti keperluan Operasi Bangunan dan Kerja-kerja Binaan Kejuruteraan (BOWEC) dan membangunkan semakan Keselamatan Berasaskan Perilaku (BBS) berdasarkan keperluan BOWEC dalam industri pembinaan (perumahan mendarat). Kajian ini juga bertujuan untuk mengesahkan senarai semak BBS dengan menggunakan kajian kes dalam industri pembinaan (perumahan mendarat). Microsoft Word dan Microsoft Access digunakan dalam kajian ini untuk membangunkan sistem untuk senarai semak BBS. Konsep yang digunakan untuk membangunkan senarai semak BBS adalah "Plan–Do–Check-Act" (PDCA). Senarai semak BBS yang dibangunkan terbahagi kepada dua bahagian, iaitu senarai semak BBS untuk majikan dan pekerja. Lokasi kajian ini adalah di Kuantan, Pahang. Untuk pengumpulan data, senarai semak BBS yang ada dalam sistem digunakan dan data dianalisis dengan menggunakan kaedah peratusan. Kaedah peratusan digunakan untuk mengira peratusan pematuhan terhadap keperluan BOWEC bagi pembinaan perumahan mendarat. Hasilnya adalah, senarai semak BBS majikan dan pekerja yang mematuhi keperluan BOWEC, adalah 82% dan 77%. Ini menunjukkan bahawa lebih daripada separuh syarikat ini memenuhi keperluan BOWEC. Kajian ini menyimpulkan dengan hasil objektifnya. Ini menunjukkan bahawa syarikat yang telah dipilih adalah syarikat yang mematuhi piawaian Akta dan Peraturan.

ABSTRACT

In the construction industry (landed housing), most of accidents and near-miss injury occur due to unsafe behaviour of the employers and employees in construction sites (landed housing). Lack of compliance with regulations is also one of the causes of accidents and near-miss injury occur in the construction industry (landed housing). This paper aims to identify Building Operations and Works of Engineering Construction (BOWEC) requirements and develop Behaviour-Based Safety (BBS) checklist based on BOWEC requirements in construction industry (landed housing). This paper also aims to validate BBS checklist by using case studies in construction industry (landed housing). A Microsoft Word and Microsoft Access are used in study to develop a system for BBS checklist. The concept used to develop BBS checklist is the Plan-Do-Check Act (PDCA). The BBS checklist was developed is divided into two parts, which are BBS checklist for employer and employees. The location of this study is at Kuantan, Pahang. For the data collection, BBS checklist which is in the system is used and the data was analysed by using percentage method. The percentage method is used to calculate the percentage of compliance with BOWEC requirements. The result shown, as of employer's and employee's BBS checklist overall complied with BOWEC requirements, is 82% and 77%. It was shown that more than half complied with BOWEC requirements. This study concludes with the result of the objectives. This shows that the company that have been chosen is the company that complies with the standards of Act and Regulation.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

%	Percentage
N	Total Number of Questions
C	Number of Complied

LIST OF ABBREVIATIONS

ABC	Antecedents-Behaviour-Consequences
BBS	Behaviour Based Safety
BOWEC	Building Operation and Works of Engineering Construction
DO IT	Define, Observes, Intervene and Test
DOSH	Department of Occupational Safety and Health
FMA	Factory and Machinery Act
OSHA	Occupational Safety and Health Act
PDCA	Plan - Do - Check - Act
SME	Subject Matter Expert

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter covers the background of study, problem statement, research objectives, research questions, scope of study, significance of study, conceptual framework, conceptual definition and conclusion.

1.2 Background of study

In developing countries, construction industry is one of an essential national backbone. There are various types of activities in construction industry and indirectly have a highly complex and hazardous environment that will cause more injuries and fatalities (Skeepers and Mbohwa, 2015). Timofeeva, Ulrikh, & Tsvetkun (2017) states based on the assessment conduct by the International Labor Organization, fatal work injuries occur annually which is approximately 60000 on the construction sites all over the world or it is means every 10 minutes one fatal work injury occur in this sector and about 17% (one out of six accidents) fatal work injuries occurs in this sector. Winge and Albrechtsen, (2018) states one of the highest numbers of fatal injuries in industry sector at Norway is construction industry. Based on DOSH (2018), the construction industry a third place in the ranking of occupational sectors with regards to the accident rate.

The construction industry known as the place that have a high level of hazard and risk to the employees (Hoła and Szóstak, 2014). It is because the employees in construction industry work at high, deal with machinery equipment and external activities (Oostakhan and Talab, 2012). Zhang and Fang (2013) stated that one of the most risky industries worldwide is construction industry. Oostakhan and Talab (2012) also states in industry, the most dangerous part is construction sector. Construction industry is the highest of accident occur compare to other industries of the world economy (Yiu, Sze, &

Chan, 2018). (Jasiulewicz-Kaczmarek, Szwedzka, & Szczuka, (2015) states most of the accidents occur in the workplace are comes from unsafe act of the employer and employees. It is means that the construction industry known as the industry that have a dirty, difficult and dangerous place compared with others industry and the accidents occur in construction industry is cause of the unsafe behaviour of the employer and employees.

In addition, in construction industry, there are consist of three level of construction which are building construction, civil/heavy construction and industrial construction. However, in Malaysia, there are many construction sites which is involving with building construction of landed housing. This is because the number of people in Malaysia becomes increase day by day. The increases of construction in Malaysia, the increases number of accidents among workers in construction sites. Many accidents involves with building construction of landed housing such as falling from height, drowning, struck by support formwork and machine related (Samuel, Adul Hamid, & Saidin Misnan, 2017). Samuel et al., (2017) also states this problem occurs among building construction of landed housing due to lack of or non-compliance with safe work procedure, lack of PPE, no warning sign and equipment failure. Lack of supervision and unsafe act of workers also contribute to increase of accident occur in construction site.

To maintain a safety and health in construction industry, a Behaviour Based Safety is a right tools to change behaviour and attitude of the employer and employees which from unsafe behaviour to safe behaviour that can prevent from accident and injury occur. BBS also act as a tecniques to motivate and improve performance of the employees (Lingard and Rowlinson, 1997). Other than that, Krause et al.'s study (as cited in Zhang and Fang, 2013) found that examined the result proved the number of incidents is decrease in five year of collected injury data from 73 construction companies who implemented BBS. To develop BBS programs, preparation of checklist is one of the part that need to consider (Oostakhan and Talab, 2012). This study was conducted to evaluate Behaviour Based Safety Checklist based on BOWEC requirements.

The important things to ensure a safety and health in construction industry, is the compliance with regulations. For the construction industry, it is must comply with Building Operations and Works of Engineering Construction (BOWEC) Regulations 1986. The BOWEC Regulations 1986 is the regulations that shall apply to building operations and to work of engineering construction (OSHA, 2018). Overall, the aim of

this research is to identify BOWEC requirements in construction industry (landed housing). Furthermore, a BBS checklist based on BOWEC requirements were developed for construction industry (landed housing) and validated the BBS checklist by using case studies in construction industry (landed housing). Nevertheless, the safety and health management is important and must be applied by both managements and employees to prevent in any dangerous hazard as well as to reduce the number of accident rate especially in construction site.

1.3 Problem Statement

Recently, there were high rate of accident and injury occur at the construction industry (landed housing) due to unsafe behaviours of the employees. It is may result to permanent disabilities and even fatalities to the person who involved with accident and injury in their workplace. The company may face with a problem which is financial loss where it increases cost of project compensation for employees and also delay project progress. Meanwhile, employees may also face with loss of job, cost of medical treatment and loss living expenditure. For example, according to DOSH (2018), the accident happened in construction site, Johor on 1 April 2018 which is died being hit by a lorry. This accident happened due to a general workers being runned over by a lorry. He was died at the scene. Based on observation stated, the accident occurred cause did not comply with safe operating procedure and employer fail to provide a safe workplace to their employees. It was shows that this accident occurred because of unsafe behaviours of the employer and employees. We can determine that majority accidents in construction site(landed housing) happened as result of unsafe behaviours.

Nowadays the construction of landed housing in Malaysia becomes increase day by day. It may contribute to increase of accidents occur in construction site (landed housing). In addition, in construction industry, there are requirement to comply with BOWEC regulations to ensure safety and health of the employer and employees in the workplace. Failure to comply with BOWEC regulations requirements can be costly in terms of fines, reputation or personal cost when there is an injury or fatality. Besides, to reduce the accidents due to behaviour of the employees at the workplace, a management need to implement a BBS programmes. In implement the BBS programmes, a checklist was developed by authors that use for observation with consideration of regulations and specifications (Zhang and Fang, 2013). It is means use a BBS checklist to identify the

behaviour employer which is may contribute to accidents occur at the construction site. However, most of the checklist that use by others researcher before, it is only based on their observation to the employees at construction sites. Today, there are still no researcher develop the BBS checklist based on BOWEC requirements in construction industry (landed housing).

Next, there is lack of management in saving data after collected the data on construction sites done manually by observer. Saving data manually with hard copy formats will cost a lot of time and searching for specific data can also be a very time-consuming process this way (Black, 2017). Besides, the find of data is difficult when a data is needs from a few years' time ago (Black, 2017). In addition, the data collected on construction sites done manually by observer maybe differ when it entry data into the computer and it makes the management difficult to review. Today, there are also still no researcher develop a system for BBS checklist based BOWEC requirements in construction industry (landed housing) to easy the observer.

1.4 Research Questions

1. What is BOWEC requirements in construction industry (landed housing)?

2. How to develop a BBS checklist based on BOWEC requirements in construction industry (landed housing)?

3. How to validate the BBS checklist by using case studies in construction industry (landed housing)?

1.5 Research Objectives

1. To identify BOWEC requirements in construction industry (landed housing).

2. To develop a BBS checklist based on BOWEC requirements in construction industry (landed housing).

3. To validate the BBS checklist by using case studies in construction industry (landed housing).

1.6 Scope of Study

This study is to identify BOWEC requirements in construction industry. In construction industry, this study only focus on construction of landed housing. Based on BOWEC requirements, there are consists of thirteen elements that need to focus for construction of landed housing. The BBS checklist will developed based on BOWEC requirements in construction industry (landed housing). BBS checklist will used in construction industry (landed housing) to observe behaviour of employer and employees.

1.7 Significance of Study

The target for this research is to resolve the safety issue especially related to accident and injury at construction site (landed housing) by improving the existing prevention measure such as safety management, human factors and unsafe condition of workplace. Then, it is to ensure that the contractor companies carried out their responsibilities with make safe their workers by set up the companies comply with the regulations. Besides, if the prevention measures are effectively used likes set up the companies comply with the regulations, accident and injury at the workplace may decreases. This paper focus on the application BBS based on BOWEC requirements to determine the level of the safety in construction sites (landed housing).

In addition, this study also for easy to observer to makes the observation when the BBS checklist has been in system. It is because the observer only use a smartphone or computer while makes the observation to the employer and employees in the construction sites (landed housing). Besides, makes the process of finding really convenient because the data is save date by date and time by time in a system. However, the findings of this study is to highlight the application of BBS checklist is not only important for employer but also to the employee's construction to ensure they are also give cooperation on improving the overall of safety performance. This will develop the productivity of employee's construction and also give the good image to companies. This study is to benefit the construction industry in particular and all industries in general. Moreover, this study also can be review by government to have proper standard in supervision at the construction.

1.8 Conceptual Framework

Figure 1.1 shows the framework regarding the identifying BOWEC requirements in construction industry (landed housing) and developing BBS checklist based on BOWEC requirements in construction industry (landed housing) that have been discovered from previous studies. There are several concept or theories that have been studied frequently in the past years.

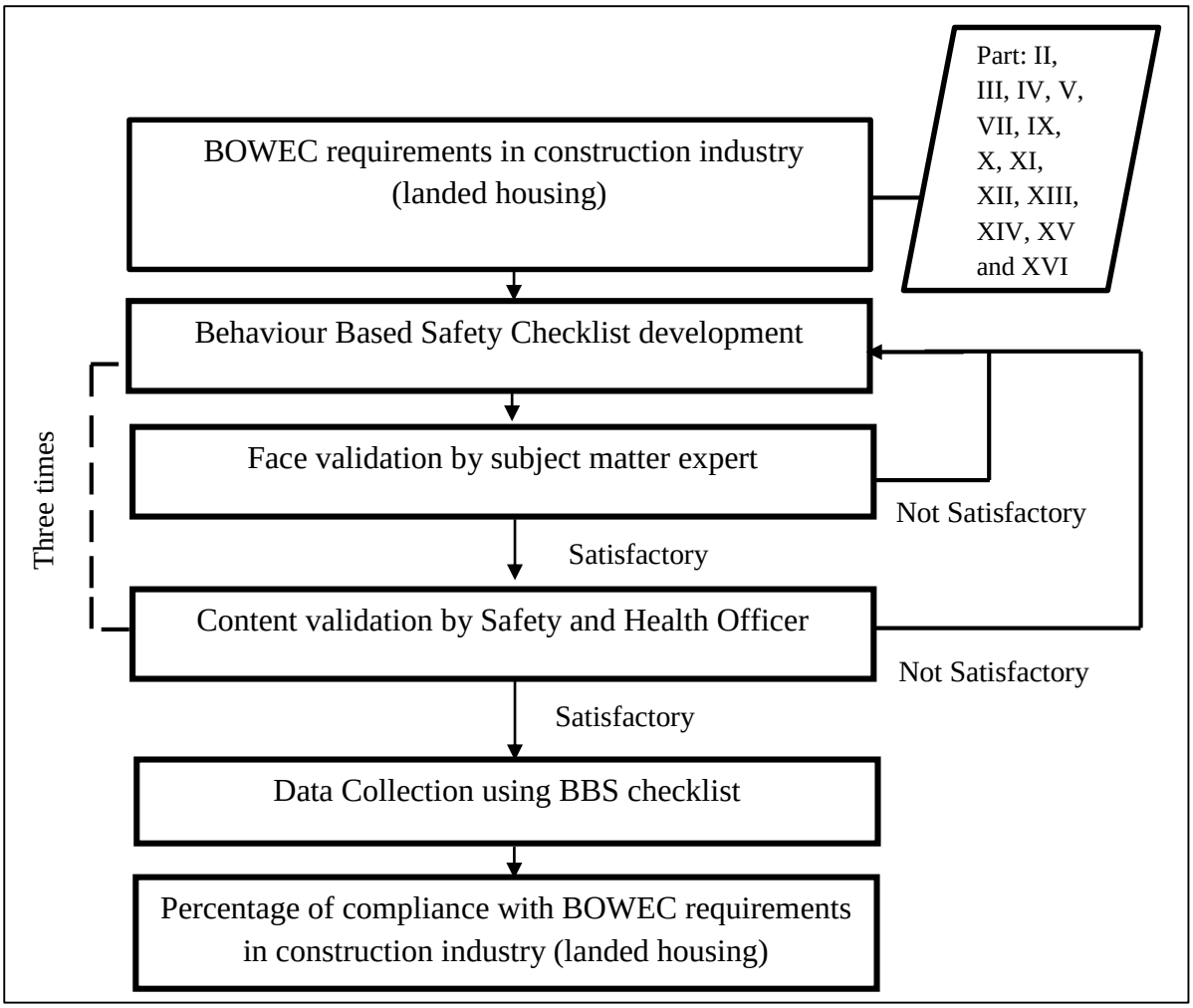


Figure 1.1 A framework of study

1.8.1 Construction industry: Construction industry is a place which various types of activities and have a high risk and hazard that may lead to accident and injury.

1.8.2 Landed housing: A house that build on the land

1.8.3 Factories and Machinery (Building Operations and Works of Engineering Construction) (Safety) Regulations 1986: The regulations that every construction

industry need to comply with it to ensure safety and health of the workers at the construction sites.

1.8.4 Behaviour: Actions made by individuals.

1.8.5 Safe Behaviour: Actions made by individuals that reduce accidents and improve safe performance.

1.8.6 Unsafe Behaviour: Actions made by individuals that increase accidents and decrease safe performance.

1.8.7 Behaviour Based Safety: Act as a technique to managing unsafe behaviours in construction industry.

1.8.8 Behaviour Based Safety Checklist: An instrument that use for evaluate behaviour of employees at the workplace.

1.8.9 Subject Matter Expert: The Subject Matter Expert is that individual who exhibits the highest level of expertise in performing a specialized job, task, or skill within the organization

18.10 Safety and Health Officer: Safety and Health Officer known as a person who need to ensure safety and health people in workplace to minimise the risk of harm or injury at work.

1.8.11 Face Validity: A validation of study whether the item used to study relevant, reasonable or clear

1.8.12 Content Validity: A validation of contents or elements in the study

1.9 Conceptual Definition

1.9.1 Construction Industry: Construction industry is a high hazard industry that comprises a wide range of activities involving construction, alteration, and/or repair (OSHA, 2018)

1.9.2 Landed housing: A house which build on the land below and surrounding it belongs to the owner of the house (Lau, 2018)

1.9.3 Factories and Machinery (Building Operations and Works of Engineering Construction) (Safety) Regulations 1986: These Regulations shall apply to building operations and to works of engineering construction (OSHA, 2018).

1.9.4 Behaviour: Behaviour is known as anything someone does or says. In other terms, behaviour are the actions or reactions of persons in response to external or internal stimuli (Choudhry, 2014).

1.9.5 Safe Behaviour: Safe behaviour is regarded as a critical work related skill (Galloway, 2015)

1.9.6 Unsafe behaviour: Unsafe behaviour act as an early warning system for accidents incidents (Galloway, 2015)

1.9.7 Behaviour Based Safety: Refers to the use of applied behaviour analysis models to achieve continuous improvement in safety performance (OSHA, 2018)

1.9.8 Behaviour Based Safety Checklist: A tool which is use to successful of behavioural- observation- feedback session (Geller, 2018)

1.9.9 Subject Matter Expert: A subject matter expert is an individual with a deep understanding of a particular process, functions, technology, machine, material or type of equipment (Reh, 2018)

1.9.10 Safety and Health Officer: A person who managing matters regarding safety and health at the workplace (DOSH, 2018)

1.9.11 Face Validity: Face validity refers to researchers' subjective assessments of the presentation and relevance of the measuring instrument as to whether the items in the instrument appear to be relevant, reasonable, unambiguous and clear (Oluwatayo, 2012).

1.9.12 Content Validity: Content validity refers to whether the content of the questions or items measured in the instrument are representative and adequate when attempting to measure phenomena (Sangoseni et al., 2013).

1.10 Conclusion

In this chapter, a problem statement of this title are high rate of accident and injury due to unsafe behaviours of the employer and employees, most of the checklist that use by others researcher before it only based on their observation to the employees at construction site and lack of management in saving data after collected the data on construction sites. The objectives of this study are to identify BOWEC requirements in construction industry (landed housing), to develop a BBS checklist based on BOWEC requirements in construction industry (landed housing) and to validate the BBS checklist by using case studies in construction industry (landed housing). The scope study of this research are based on BOWEC requirements in construction industry (landed housing). It is only focus parts and elements in BOWEC which is requirements for construction of landed housing. By identifying BOWEC requirements in construction industry (landed housing), the BBS checklist will developed by using Microsoft Office 2013 (Microsoft Words and Microsoft Access). For the significance study, application of BBS important to the construction workers, develop productivity of construction workers and give good reputation to companies and can be used as a reference.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter is about to gather the information for the research study and to highlight as an exemplary studies. The literature review was obtained from the source of journal articles, case study, reference books and web sites which have relates to the research study. It is also used to determine the comparison and contrast of the ideas from the different researchers. In this study, the literature review describes the definition of behaviour, focus on Behaviour Based Safety, Behaviour Based Safety in Construction Industry, DO IT process, Behaviour Based Safety Checklist, BOWEC requirements, Behaviour Based Safety Checklist based on BOWEC requirements and Behaviour Based Safety Checklist in a System. From the literature review, the key concept of the study also can be found by the clear meaning that have been presented from the previous researchers.

2.2 Behaviour

Dejoy's study (as cited in Guo, Goh, & Le Xin Wong, 2018) states the origins of BBS is from behaviourism that also known as behaviour modification, applied behavioural analysis and operant behavioural analysis. Besides, Choudhry (2014) states behaviour is known as anything someone does or says. In other terms, behaviour are the actions or reactions of persons in response to external or internal stimuli (Choudhry, 2014). A behaviours of the workers that they perform in their job can effect on their health and safety whether in direct or immediate effect (Guo et al., 2018). Approximately 80% accidents occur at the construction industry are comes from unsafe behaviours of the workers (Yu et al., 2017). According to Heinrich's Domino Theory, one of the root cause accidents is an unsafe acts together with an unsafe conditions which are 88% from unsafe

act and 10% from unsafe conditions. In addition, Jasiulewicz-Kaczmarek et al., (2015) states, H. W. Heinrich was proving 10% of accidents were caused of unsafe conditions in the workplace, while 88% of accidents were caused of unsafe act of the employees. It is shows that the statement is true because a previous researcher were used this statement in their research.

Futhermore, Heinrich's Domino Theory also stated removing a single domino in the sequence of accident steps would interrupt the process, thus can prevent accident. The key domino proposed to be removed from the sequence is third domino which is an unsafe act and/ or unsafe condition. The reasons that the accidents occur at the workplaces comes from behaviours of the workers. The Figure 2.1 below shows an example of unsafe act which usually done by the workers at the construction sites.

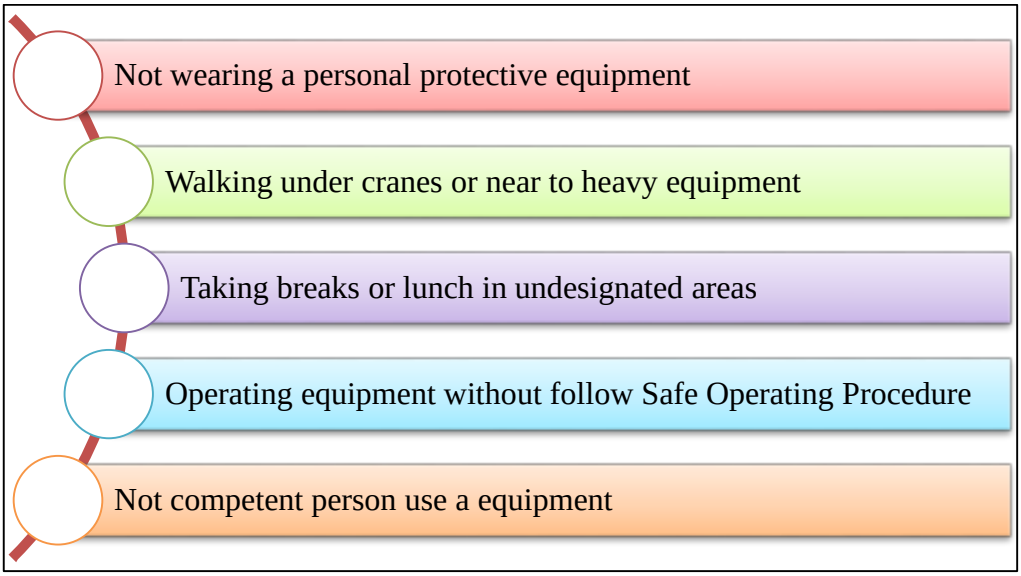


Figure 2.1 Examples of unsafe act in construction sites
Sources: Gonzales (2018)

However, to prevent accidents in the workplace, it is must find deficiencies which make individuals vulnerable to unsafe behaviour and then start attempting to resolve them (Mohammadfam, Ghasemi, Kalatpour, & Moghimbeigi, 2017).

2.3 Behaviour Based Safety

BBS is the tool to help the companies that need to change the employee's behaviours and attitude to maintain the safety and health practice in the workplace (Jasiulewicz-Kaczmarek et al., 2015). Besides, BBS also is a tecniques to motivate and

improve performance of the employees (Lingard and Rowlinson, 1997). Since 1980s, BBS has been applied in Europe and North America act as a method for accident prevention (Li, Lu, Hsu, Gray, and Huang, 2015). The concept of BBS is likes application psychological research on human behaviour. The aim of BBS to change the behaviour of the employees from unsafe behaviour to safe behaviour. Jasiulewicz-Kaczmarek et al., (2015) states by applying BBS in the workplaces, there showed a numerous benefit likes less the number of accidents or injuries and increase awareness of employees which are wear a personal protective equipment and follow SOP in deal with machines, devices and tools in the workplace. Based on the previous study, there are shows that most effective method to prevent from any accidents and injuries or other terms to human unsafe behaviours in the workplace is by applying BBS.

Other than that, Krause et al.'s (1999) study (as cited in Zhang and Fang, 2013) stated examined the result proved the number of incidents is decrease in five year of collected injury data from 73 construction companies who implemented BBS. The employer needs to have a tactics to ensure safety and health of the employees in the workplace which not only focus on physical working environment but also on employee's behaviours, attitudes and beliefs (Zin and Ismail, 2012). However, if the workers are not able to perceive and identify hazards, the BBS management techniques cannot to work at the workplace (Lingard and Rowlinson, 1997). Choudhry (2014) states to ensure the BBS techniques are success among the employees in the workplace, the supervisor or employer need to reward them by providing a recognition and praise when the employees achieved the target of the company which safe behaviours in the workplace. BBS techniques helps the organizational improve their safety culture likes improve their knowledge about safety in the workplace, works with machines by following SOP and improving safety communication among the organizational. By the way, BBS management is a good techniques that can be applied to all country's culture because it is a best approach for raising safe behaviour of workers Choudhry, (2014).

2.4 Behaviour Based Safety in Construction Industry

Based on previous researcher, they stated most of the accidents occur at construction industry is comes from unsafe behaviour of the employer and employees. Then, BBS is a good techniques to identify the level of behaviours employer and employees in construction sites. Yu et al., (2017) stated BBS is act as effective approach

to managing unsafe behaviours in construction industry. However, the use of BBS in the construction industry has been limited and although other industries has been widely accepted the BBS but it is cannot be directly used “as is” in the construction industry (Salem et al., 2007). Based on previous study, the studies of construction sector have inform that even in construction sites the BBS technique still can be treat (Oostakhan and Talab, 2012).

BBS is the prevention of any accidents and injuries in the construction sites and it is involves the application of safety procedures based on the behaviours of the employees in the construction sites (Jasiulewicz-Kaczmarek et al., 2015). The aim of application BBS program in the construction sites is to reduce unsafe behaviours (Guo et al., 2018). Choudhry, (2014) states, based on their result’s study, it is shows that all country’s culture can apply BBS techniques because it is a good approach for improving safety of the workers and it has industry wide application for ongoing construction projects. It is means that the application of BBS technique in construction sites can give a good impact to the companies in term of safety likes reduce of accident occur that from unsafe behaviours and decrease expenses to the medical treatment.

2.5 DO IT Process

The DO IT process is commonly used in the BBS programs to accurately measure the BBS of the employees. Chen and Tian (2012) states for the BBS implement and procedure, it is based on “DO IT” application process.

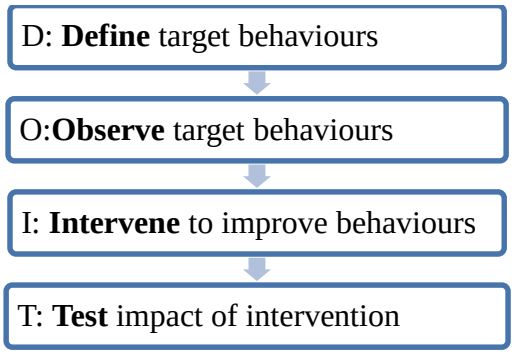


Figure 2.2 DO IT application process
Sources: Chen and Tian (2012)

The first step of the DO IT process is define. This step is to teach employees on how to pinpoint safe and at-risk behaviours and hazardous conditions (Boyce, 2018). As

mentioned in Geller, (2005) the first step is defining certain target behaviours. These can be at-risk behaviours that need to occur less often or safe behaviours that need to occur more often (Geller, 2005). By knowing the define target behaviours, the identified at- risk behaviour is focused and proceed to the next step which is observation. The second step of the DO IT process is observe. This step is informs employees about how to use a critical behaviour checklist to measure how often safe versus at-risk behaviours occurs (Boyce, 2018).

In addition, during second step, employees at risk behaviour or safe behaviour when performing the task is observed by using checklist. The completed checklist is then collected and used as primary source of information for the intervention step. In short, this step focuses on "what people do, analyse why they do it and then applies a research supported intervention technique to improve behavioural processes" (Geller, 2005). Then, emphasized that the designed and implementation of interventions is an attempt to minimize the occurrence of at-risk behaviour and boost at the safe behaviour. The antecedents, behaviours and consequences (ABC) model is widely used in the industry to decrease human at-risk behaviour and increase safe behaviour during intervention stages (Geller, 2005). The Figure 2.3 below shows an explanation of ABC model.

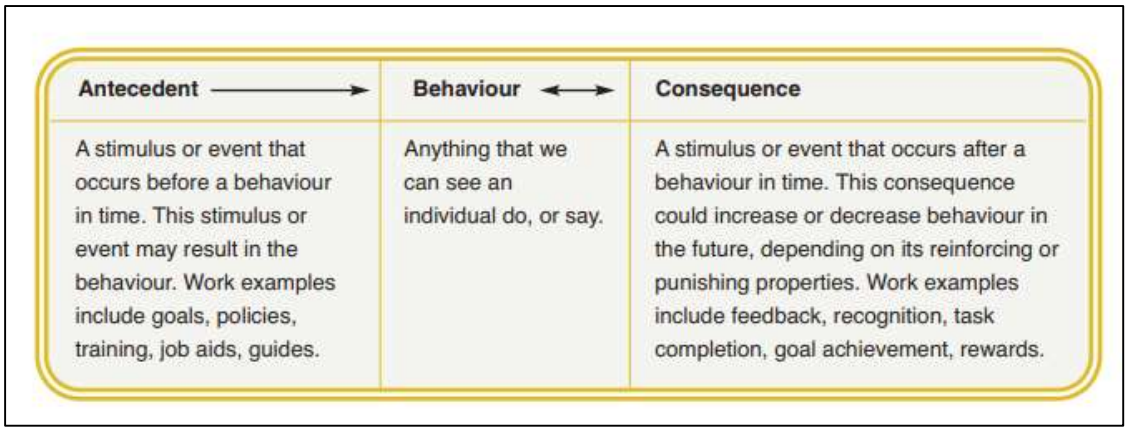


Figure 2.3 Explanation of ABC model

Sources: Behaviour Based Safety Guide (2018)

The final step of DO IT process is test. It is enables employees to determine the effects of their interventions with visual inspection of publicly posted graphs of behavioural data (Boyce, 2018). Most importance, this process allows employees to continuously monitor their overall safety performance and promote change as necessary (Boyce, 2018). This step has makes the target behaviours continuously observed and

recorded. The observations can make the process continues for an indefinite period and may provide additional information for the intervention stage (Geller, 2005). As a result, there is no longer has any accidents, incidents or problems occurred in the workplace.

However, Geller (2005) explained that the test step of DO IT process provides information that is required for refine or replace a behaviour change intervention. The participants can turn their attention to other behaviours once they reached the desired frequency. In short, DO IT approach in behaviour based safety program is the great solution to poor safety performance. The employees can learn more about how to improve the safety performance every time they had been evaluated.

2.6 Behaviour Based Safety Checklist

BBS checklist is use for evaluate behaviour of employees at the workplace especially in construction industry (Oostakhan and Talab, 2012). The checklist is based on observations behaviours. In 2007, Salem et al., also stated the BBS checklist was created based on observation of employees at the workplace. Based on observation to randomly selected employees, two important elements were included in the BBS Checklist (Zin and Ismail, 2012). Figure 2.4 below shows an elements in the BBS checklist.

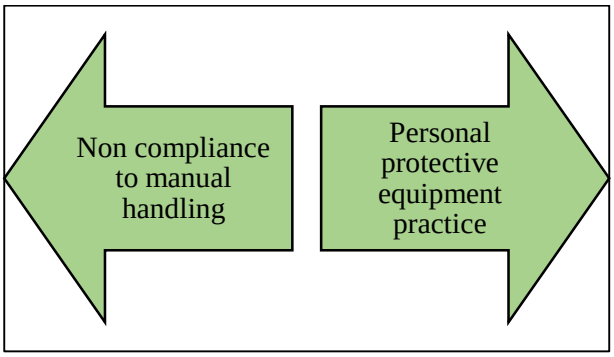


Figure 2.4 Elements in the BBS Checklist
Sources: Zin and Ismail (2012)

In addition, Chen and Tian, (2012) states use observation method to observe the employee's behaviour to put in BBS checklist. Lingard and Rowlinson, (1997) states there are consist of four categories of safety behaviour that were identified by directly

observing of employees at work. Figure 2.5 shows categories of safety behaviours in the BBS checklist.

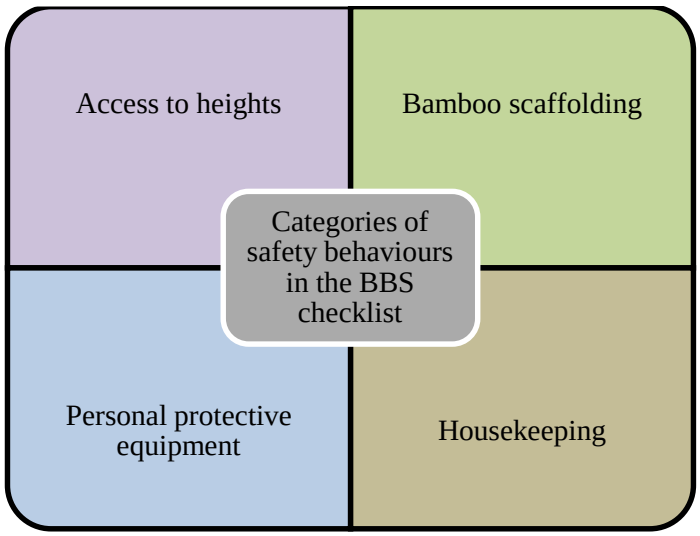


Figure 2.5 Categories of safety behaviours in the BBS checklist
Sources: Lingard and Rowlinson (1997)

Moreover, develop a BBS checklist with consist of nine categories of safety behaviour in the checklist (Guo et al., 2018 : Zhang and Fang, 2013). Figure 2.6 below shows categories of safety behaviours in the checklist.

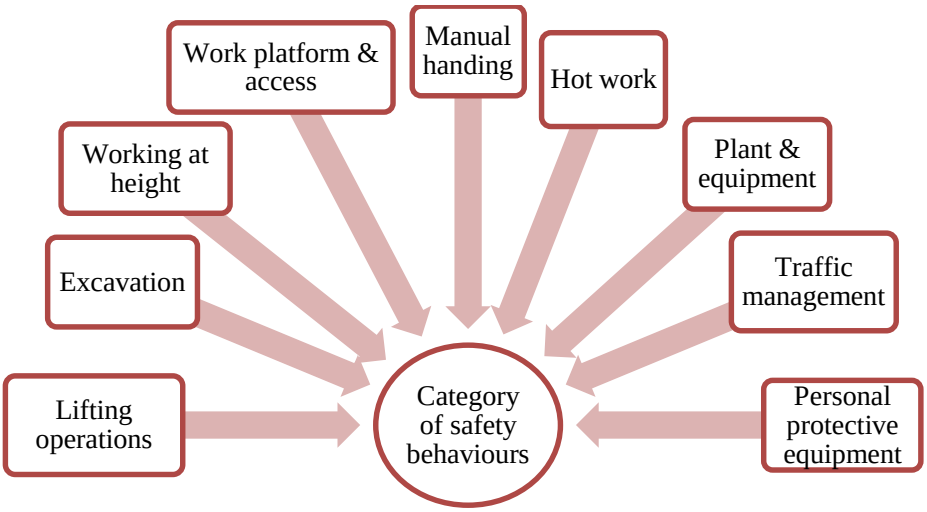


Figure 2.6 Categories of safety behaviours in the checklist
Sources: Guo et al. (2018) and Zhang and Fang (2013)

Guo et al., (2018) also states the observers will be train before act as observers and during the observe, each observer will monitor one worker at each time (on a daily basis: morning and afternoon) with using BBS checklist. All the observers will take times

around 10- 15 minutes for each observe session and behaviour of the employees which safe and unsafe will record on the checklist. In short, most of the previous researchers show that to develop BBS checklist it is must from observation of the employees at the workplace first to identify element that need to put in BBS checklist. Then, in BBS checklist it consist various types of category or elements depands on the most behaviour of the employees in the workplace that the researchers choose to observe.

However, to know the level of behaviours whether there are at safe or unsafe behaviour, a calculation is need to do. The rating system will use and this value was termed as the safety rating (Salem, Lothlikar, Genaidy, & Abdelhamid, 2007). Figure 2.7 below shows a rating system for identify level of behaviours by one of the researcher before this.

Rating = [Σ (Safe Behaviours) – Σ (Unsafe Behaviours)] /
[Σ (Safe and Unsafe Behaviours)]

: -1 (worst possible behaviour which very unsafe)
: 0 (exhibited which an equal number of safe and unsafe behaviours)
: 1 (best possible behaviour which safe as suggested by the company)

Figure 2.7 Rating system for identify level of behaviours
Sources: Salem et al. (2007)

To obtain and analysed the data, two techniques will use (Zin and Ismail, 2012). Figure 2.8 below shows a techniques for obtain and analysed data.

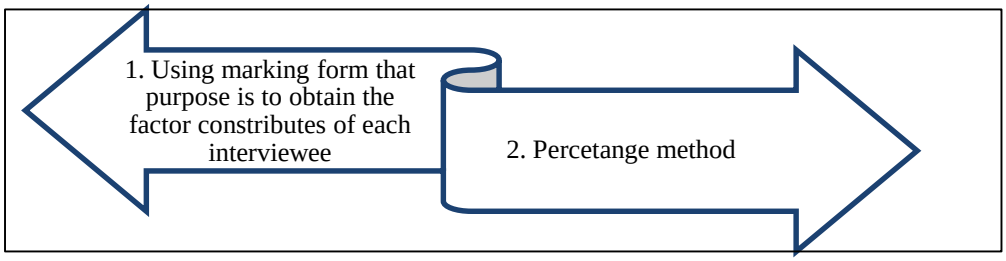


Figure 2.8 Techniques for obtain and analysed data
Sources: Zin and Ismail (2012)

Zin and Ismail, (2012) states that the researcher use this technique to analyse the factor that contributes to behavioural safety compliance factors.

Hence, based on previous study, to develop BBS checklist, different researcher have different elements in BBS checklist because it is based on their observation of the employees at the workplace and different researcher used different measurement to analyse and conclude the data whether it is safe or unsafe behaviours.

2.7 BOWEC Requirements

Other than that, DOSH and other government agencies have regulations that lay down the legal requirements to ensure the safety and health of not only the workers at the place of work but also the public as well. For the regulation use in the construction industry is Factories and Machinery (Building Operations and Works of Engineering Construction) (Safety) Regulations 1986 to ensure safety and health of the employees at workplace (DOSH, 2018). This regulation contains Xvii parts. Figure 2.9 below shows, list of parts in BOWEC regulations 1986.

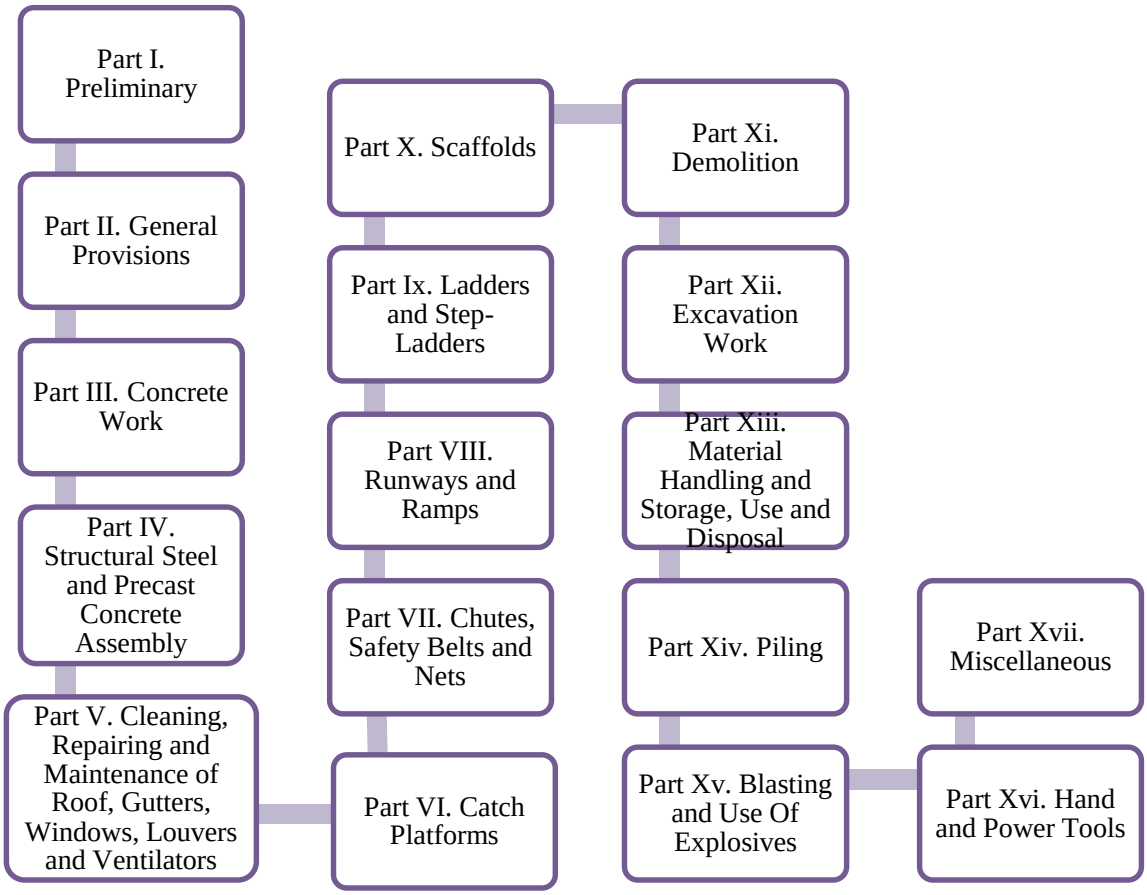


Figure 2.9 List of parts in BOWEC Regulations 1986

Sources: DOSH (2018)

This regulations applies to all place of work in building operation and work of engineering construction activity in Malaysia covered by the Occupational Safety And Health Act 1994 (Act 514), the Factories And Machinery Act 1967 (Act 139) and all the regulations made there under.

2.8 Behaviour Based Safety Checklist based on BOWEC Requirements

The elements in BBS checklist that used by researcher before based on their observation to the employees is actly is the regulation that listed in BOWEC regulations. For example, element in BBS checklist which is personal protective equipment in construction site (Guo et al., 2018: Zhang and Fang, 2013). This is the Part II which General provision in BOWEC regulations. It is means that to identify the safety and health of the employees in construction industry it is must comply BOWEC regulations. However, most of the checklist that use by others researcher before this, it is only based on their observation to the employees at the workplace. The Table 2.1 shows an elements in BBS checklist which is only focus in construction industry (landed housing) based on BOWEC requirements.

Table 2.1 Elements in BBS checklist in construction industry (landed housing) based on BOWEC requirements

PART	ELEMENTS
II.	General provisions
III.	Concrete work in construction site
IV.	Assembly of structural steel and precast concrete in construction site
V.	Cleaning, repairing, maintenance of roof, gutters, windows, louvres and ventilators in construction site
VII.	Use safety belts in construction site
IX.	Use of ladders and step-ladders in construction site
X.	Use of scaffolds in construction site
XI.	Demolition Work in construction site
XII.	Excavation work in construction site
XIII.	Handling and storage, use and disposal of material in construction site
XIV.	Use of piling in construction site
XV.	Blasting Work and Use of Explosives in construction site
XVI.	Use hand and power tools in construction site

All this elements are the duties of employer and employees in construction industry (landed housing). The employer and employees should carried out their responsibilities to ensure safety and health at the construction sites (landed housing).

2.9 Behaviour Based Safety Checklist in a System

When the data in a system, it makes the process of finding really convenient because the data is save date by date and time by time (Black, 2017). The find of data is convenient when a data is needs from a few years' time ago (Black, 2017). For example, successful newspapers keep their photos safely stored in a data archive and the data archive can be opened and used later on to find the photos, if needs be (Black, 2017). In addition, when the data in a system, it is easy for management to review and makes fast decision to takes action of any cases. To develop the BBS checklist into a system, tools such as Microsoft Words and Microsoft Access will use.

Microsoft word is used to create and edit the documents that in professional looking (Sharma, 2017). For the Microsoft Access, it is used to develop a system and store information for reporting, referencing and analysis (Balter, 2013). Then, for the method to develop this system it is use PDCA cycle method. The PDCA cycle is a renowned continuous quality improvement approach and has been widely used by many successful companies as a strategic weapon for enhancing organizational performance (Beshah B, 2014). Figure 2.10 shows the PDCA cycle model.

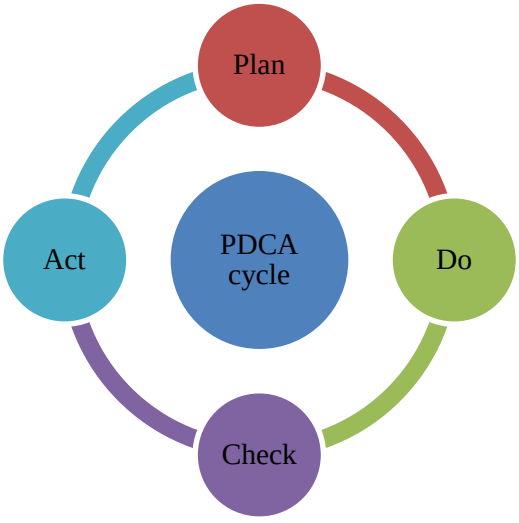


Figure 2.10 PDCA cycle model

Sources: Beshah B (2014)

The first step of PDCA cycle is Plan. Then, for the second step is Do and third step Check. The last step is Act. Richard et al.,'s study (as cited in Beshah B, 2014) in PDCA cycle, there are important characteristics and contents of the four stages of PDCA cycle. The important characteristics and contents of the four stages are shown in the Figure 2.11 below.

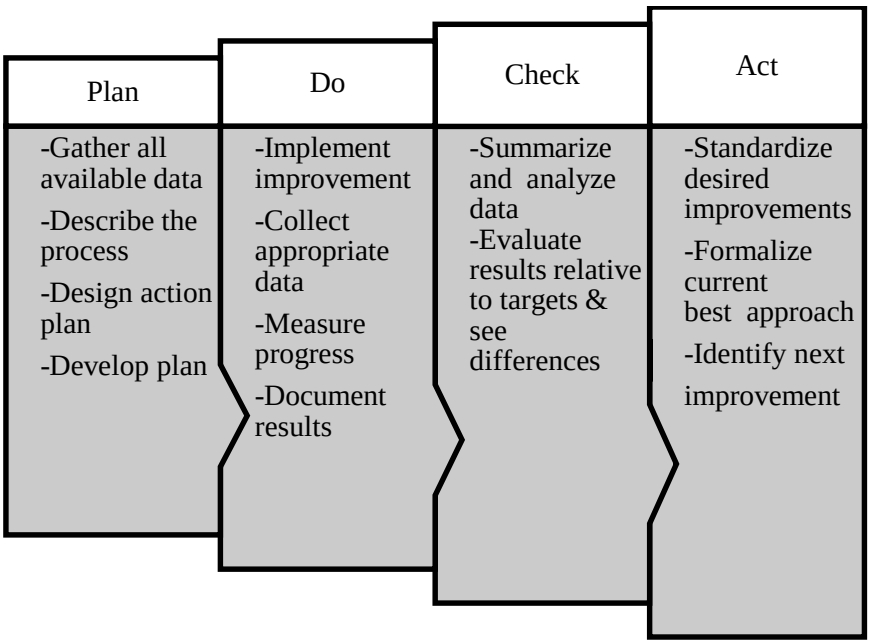


Figure 2.11 Four stages of PDCA cycle
Sources: Beshah B (2014)

Based on previous study which is Melo et al., (2017) stated by using the Unmanned Aerial Vehicles/Systems (UAV/UAS) for transportation and jobsite monitoring, the result show the safety inspection on jobsites increase. It is means that the system give easy to inspector to do the safety inspection at the job site and other means better visualization of working conditions. Then, by makes BBS checklist into a system it is towards fourth industrial revolution. Based on Malaymail Online, (2017) stated that the Industrial Revolution 4.0 was very important because many functions in first, second and third revolution were replaced by fourth revolution with automation aided by software and he also said in his blog entry that nowadays industry was also important because it increase the efficiency of management and delivery system because all transactions were carried out digitally (Malaymail Online, 2017). So, by develop this BBS checklist into a system, it is towards Industry 4.0 that changes from traditional style

to the technologies style where people only needs to use smartphone and computer to observe the behaviour of the employees in the construction site and no need the piece of checklist's paper.

2.10 Conclusion

In a nutshell, approximately 80% accidents occur at the construction industry are comes from unsafe behaviours of the employees (Yu et al., 2017). To prevent from injury and accident in the workplace due to unsafe behaviours of the employer and employees, BBS is a right techniques to motivate and improve performance of the persons in the workplace (Lingard and Rowlinson, 1997). BBS is the prevention of any accidents and injuries in the construction sites and it is involves the application of safety procedures based on the behaviours of the employees in the construction sites (Jasiulewicz-Kaczmarek et al., 2015). However, the DO IT process is commonly used in the BBS programs to accurately measure the BBS of the employees.

Then, BBS checklist is important things which use for evaluate behaviour of employer and employees at the workplace especially in construction industry. In addition, DOSH and other government agencies have regulations that lay down the legal requirements to ensure the safety and health of the employer and employees in construction site. One of the regulations use for construction industry is BOWEC regulations 1986. The checklist of BBS that use for observe the employer and employees in construction site based on BOWEC requirements can decrease unsafe behaviour and increase safe behaviour of the employer and employees in construction. Furthermore, the developing BBS checklist in a system easy to observer to makes the observation and makes the process of finding really convenient because the data is save date by date and time by time.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter shows the methodology used for the research in order to achieve the objectives. Data collection or information will be obtained by different resources. This study also shows how data is analysed by methods used.

3.2 Study Design

The study design for this research is a case study. A case study known as a research approach and it is used to generate an in-depth, multi-faceted understanding of a complex issue in its real-life context (Sarah Crowe, 2011). The study design for this research is showed in Figure 3.1.

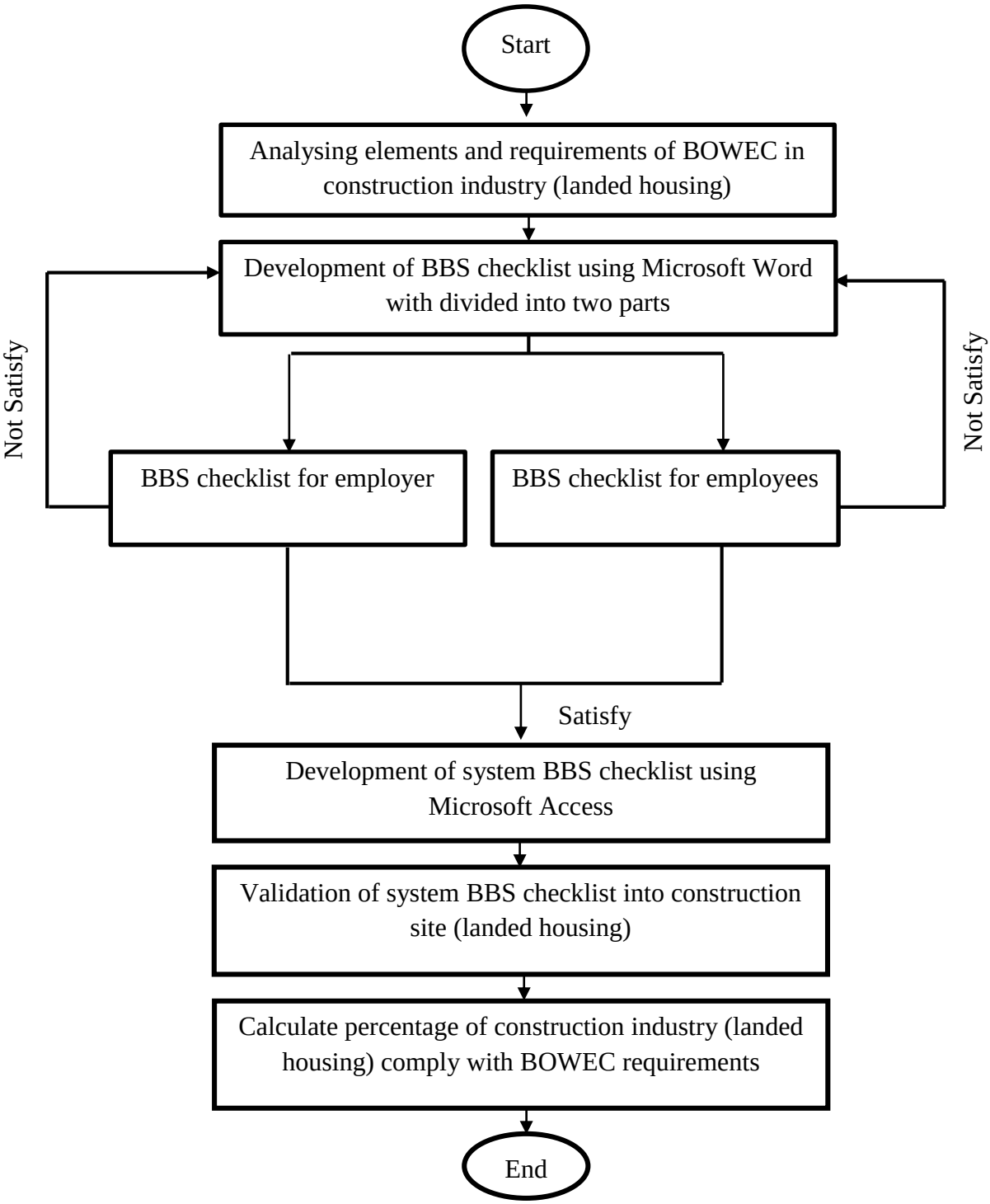


Figure 3.1 Process flow of research

Figure 3.1 has shown the process flow of this research. To develop a BBS checklist, the elements and requirements of BOWEC in construction industry (landed housing) must analyse first. Then, the BBS checklist will develop using Microsoft Words based on BOWEC requirements in construction industry (landed housing) with divided into two parts which are BBS

checklist for employer and BBS checklist for employees. A system of BBS checklist also will develop after validation of BBS checklist by using Microsoft Access. A BBS checklist in a system will validate into construction industry (landed housing) to calculate the percentage of comply with BOWEC requirements.

However, the concept of Plan-Do-Check-Act (PDCA) is used in this study to develop a BBS checklist. For the continual improvement of a product or process the PDCA Cycle is a right concept because it is a systematic series of steps for gaining learning and knowledge (Taylor et al., 2014). Plan-Do-Check-Act (PDCA) consist of four- step management method. "Plan" is applied to study and understand the elements and requirements of BOWEC. Do" is applied to develop a BBS checklist. "Check" is applied to validate the BBS checklist in a system by using real data that collected. Lastly, "Act" is applied to make the BBS checklist is more functional as possible.

3.2.1 Analysing Elements and Requirements of BOWEC

Analysed, studied and understood of the elements of BOWEC as specified by DOSH by do a literature review. In addition, interviewed a practitioner to add some information and knowledge about the elements and requirements of this regulation. The elements and requirements of this regulation is analyse through document review and interview and vital information. Then, develop BBS checklist by using analyse elements and requirements of this regulation.

3.2.2 Development of BBS Checklist

To develop a BBS checklist, a Microsoft Word was used. The BBS checklist is summarizes the elements of BOWEC requirements for construction industry (landed housing). Furthermore, in developing the BBS checklist, feedback loop is used because in the concept feedback loop is an important element of management system. The feedback loop used for validation of BBS checklist. A feedback loop can be positive or negative and also used to ensure the BBS checklist comply with the regulation completely by rechecking requirement again. The elements and requirements of BOWEC will be analysed and studied again if in the developing of BBS checklist are found the lacks. So, after reanalysed and restudied if found a lacks in developing of BBS checklist, the BBS checklist in a system will develop.

3.2.3 Development of BBS Checklist in a System

To develop a system of BBS checklist, a Microsoft Access was used to construct it. This system which based on Microsoft Access enables the user to input data, manage and track information. There are thirteen sub sections inside the system of BBS checklist based on construction industry (landed housing) as stated in BOWEC requirements.

3.2.4 System Validation

Conducted system validation by using the real process plant data. The real process plant data is the data collected from observation in construction industry (landed housing) and interview with employer and employees as case studies. Then, through observation and interview with employer and employees from construction industries (landed housing), the system are verified and validated which based on the requirements of BOWEC. At this stage, it can be found if the companies have the gaps of compliance with the construction regulations. Other than that, the developed BBS checklist can be checked whether it is fully comply with the elements and requirements of BOWEC by calculate the percentage of comply with BOWEC requirements.

3.3 Study Location

A study location that have been conducted at the construction site (landed housing) in Kuantan, Pahang. Construction industry is selected from among of other industries because of many safety risk factors found that cause accident and injury to the workers. Moreover, the poor housekeeping by some construction company also cause this study to be selected. The study focused on the employee's construction that work at the selected construction site and employer whom were responsible on ensure the safety and health of their employees. The documents and process plant data will be collected to validate the developed BBS checklist.

3.4 Sampling

Sampling is a finite part of statistical population to determine a characteristic of population by directly observing of a portion from population. In this study, the population is consisting of employer and employees in a construction industry (landed

housing). A sample of employer and employees is taken from construction site project of landed housing define as element in gathering information related to construction safety.

3.5 Hardware and Software

In developing this BBSSC, there are two types of requirements such as hardware and software to be used. Details of requirements will be clarified in the next subchapter.

3.5.1 Hardware Requirements

For the hardware requirements in developing this project, used laptop which is specification will be displayed in the table below. To develop this project, it will require laptop with enough space and memory. The additional hardware also used in order to back up the project.

The Table 3.1 below shows the hardware item that is use throughout the developing phase of the project. Laptop is important hardware that use to create a system and preparing the document for proposal, printer is used to print all document that related to the project. Then, to save the document, hard disk or thumb drive is needed.

Table 3.1 Hardware items for development phase

HARDWARE	VERSION	FUNCTION/PURPOSE
Asus X453M	1709	To develop and create the system
Printer	Canon E500	To print document
External Disk	Western Digital Black	To backup and save documentation

3.5.2 Software Requirements

To develop this BBS checklist in a system, the list of software used and the purpose of the software will be elaborated at table 3.2 below. The interface for BBS checklist is created by using Microsoft Access 2013. The main reason choosing Microsoft Access 2013 is because the platform is not heavy and easy to implement. Below are the description of the software and purpose for using it.

Table 3.2 Software items for development phase

SOFTWARE	VERSION	FUNCTION/PURPOSE

Microsoft Office 2013 (Microsoft words and Microsoft Access)	2013 Pro	A software for write a framework by use Microsoft words and store information for reporting, referencing and analysis by use Microsoft Access.
Window 10 Pro	Pro x64 bit	Used for running the operating system of software in the development process

3.6 Data Collection and Analysis Procedure

To collect and analysed the data, two techniques will use. The first technique is using marking form. Regarding to this study, BBS checklist is as a marking form that purpose is to collect the data for identify behaviour of employer and employees in construction industry (landed housing). Then, second technique is percentage method. For this second technique, a calculation of percentage to compliance or non-compliance with BOWEC requirements will calculate. Figure 3.2 below shows an equation to calculate the percentage of BBS checklist complied with BOWEC requirements.

Format calculation: Eq 1

$$\frac{C = Number\ of\ complied}{N = Total\ number\ of\ questions\ by\ each\ part} \times 100\%$$

3.7 Research Ethical

The study is conducted under a good relationship between researchers, employees and employer in construction site. The aims of research as well as general knowledge are shared and discussed for understanding each other and to remove any doubt and distrust between the researcher, respondent as well as the management. The collected data will properly manage and scheduled wisely to avoid any construction work process disruptions cause by the study and also to finish the study successfully.

During the data collection, they will be treated in a good manner. Moreover, in observation session, any sensitive issues or comment of the respondents will not be touch completely. The details of the company and also the personal details will be kept in secret

from outsider because of privacy concern. In fact, this study is process for study purpose only.

The respondents will equally and fairly treat to prevent bias toward them and also the result. Furthermore, the respondents will be given a briefing so they can understand the purposes of this study and understanding their roles as selected respondent.

3.8 Conclusion

In this chapter, a case study was used as a study design. A location for this study is in Kuantan, Pahang. A respondents which are employer and employees are taken from construction industry (landed housing). The concept of Plan-Do-Check-Act (PDCA) is used in this study to develop a BBS checklist. The BBS checklist will developed by using Microsoft Office 2013 (Microsoft Words and Microsoft Access). The collect and analyse data, will use two techniques. The first technique is using marking form. Regarding to this study, BBS checklist is as a marking form that purpose is to collect the data for identify behaviour of employer and employees in construction industry (landed housing). Then, second technique is percentage method. For the second technique, a calculation of percentage to compliance or non-compliance with BOWEC requirements will calculate.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter describes the result obtained from the data analysis that have been fulfil from the requirement of Chapter 3 and then followed by a discussion of the research findings. The findings relate to the research questions and research objective that guided in this study. The data analysis will be discuss to the detail based on graph shown that resulted from the percentage method.

4.2 Behaviour Based Safety Checklist development

Develop BBS checklist by extract from BOWEC Regulations. In the BBS checklist it contains of 13 parts from BOWEC Regulations that are need to focusing for construction industry (landed housing). In the BBS checklist, there are also divides into two parts which are the duties of employer and duties of employees in construction site. The table 4.1 shows an elements in BBS checklist which is only focus in construction industry (landed housing) based on BOWEC requirements.

Table 4.1 Elements in BBS checklist in construction industry (landed housing) based on BOWEC requirements

PART	ELEMENTS
I.	General provisions
II.	Concrete work in construction site
III.	Assembly of structural steel and precast concrete in construction site
IV.	Good and safe condition of roof, gutters, windows, louvres and ventilators in construction site
V.	Use of safety belts in construction site
VI.	Use of ladders and step-ladders in construction site

VII.	Use of scaffolds in construction site
VIII.	Demolition work in construction site
IX.	Excavation work in construction site
X.	Handling and storage, use and disposal of material in construction site
XI.	Use of piling in construction site
XII.	Blasting work and use of explosives in construction site
XIII.	Use hand and power tools in construction site

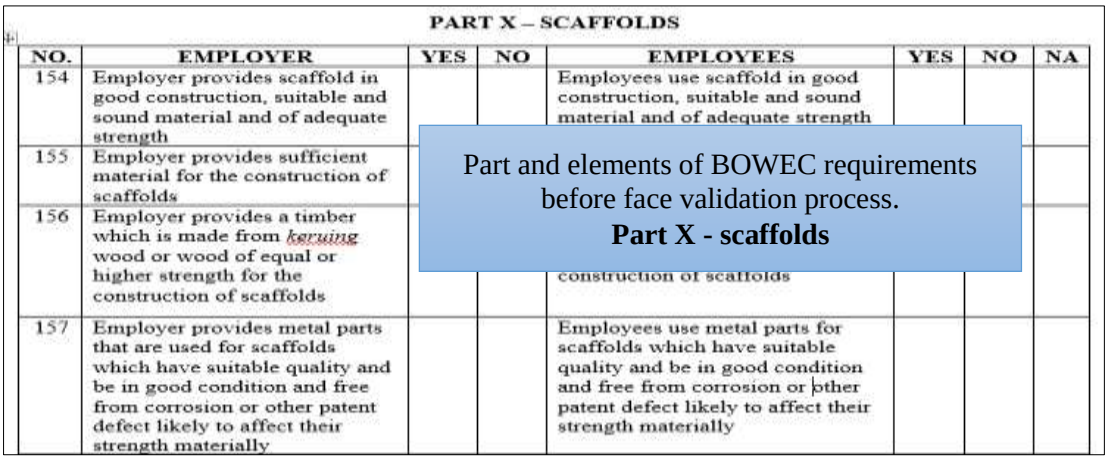
All this elements are the duties of employer and employees which is should carried out their responsibilities to ensure safety and health at the construction sites.

4.3 Checklist Evaluation

Checklist evaluation was conducted to validate the BBS checklist. BBS checklist was validated by two phase. First phase of validation is face validity. This face validity is by subject matter expert (SME). Second phase of validation is content validity. This content validity is by Safety and Health Officer in construction industry (landed housing). For the content validity, the validation occur two times which are at the off-site and on-site.

4.3.1 Face Validity

The first phase of validation is face validity have been done by subject matter expert (SME). For this phase, there is one recommendation by SME for improvement of BBS checklist. The recommendation is change of parts and elements in the BOWEC regulations requirements with own idea to use in the development of BBS checklist. Figure 4.1 and 4.2 below shows an example for improvement of BBS checklist as recommended by SME. It is shows an examples of BBS checklist before and after face validation process by SME. An improvement have been done by changes the parts and elements in BOWEC requirements into own idea.

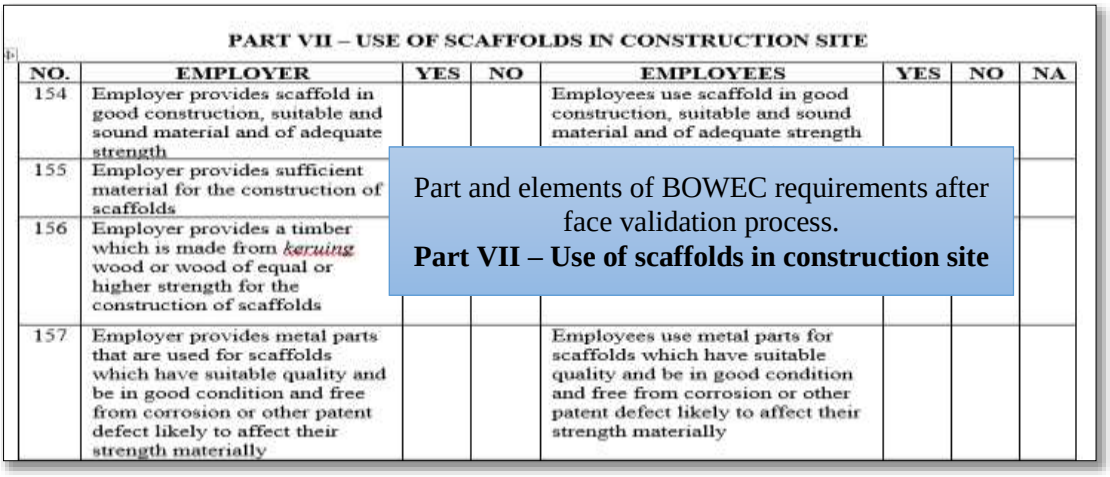


PART X – SCAFFOLDS

NO.	EMPLOYER	YES	NO	EMPLOYEES	YES	NO	NA
154	Employer provides scaffold in good construction, suitable and sound material and of adequate strength			Employees use scaffold in good construction, suitable and sound material and of adequate strength			
155	Employer provides sufficient material for the construction of scaffolds						
156	Employer provides a timber which is made from *keruing* wood or wood of equal or higher strength for the construction of scaffolds			construction of scaffolds			
157	Employer provides metal parts that are used for scaffolds which have suitable quality and be in good condition and free from corrosion or other patent defect likely to affect their strength materially			Employees use metal parts for scaffolds which have suitable quality and be in good condition and free from corrosion or other patent defect likely to affect their strength materially			

Part and elements of BOWEC requirements before face validation process.
Part X - scaffolds

Figure 4.1 Example of BBS checklist before face validation process



PART VII – USE OF SCAFFOLDS IN CONSTRUCTION SITE

NO.	EMPLOYER	YES	NO	EMPLOYEES	YES	NO	NA
154	Employer provides scaffold in good construction, suitable and sound material and of adequate strength			Employees use scaffold in good construction, suitable and sound material and of adequate strength			
155	Employer provides sufficient material for the construction of scaffolds						
156	Employer provides a timber which is made from *keruing* wood or wood of equal or higher strength for the construction of scaffolds						
157	Employer provides metal parts that are used for scaffolds which have suitable quality and be in good condition and free from corrosion or other patent defect likely to affect their strength materially			Employees use metal parts for scaffolds which have suitable quality and be in good condition and free from corrosion or other patent defect likely to affect their strength materially			

Part and elements of BOWEC requirements after face validation process.
Part VII – Use of scaffolds in construction site

Figure 4.2: Example of BBS checklist after face validation process

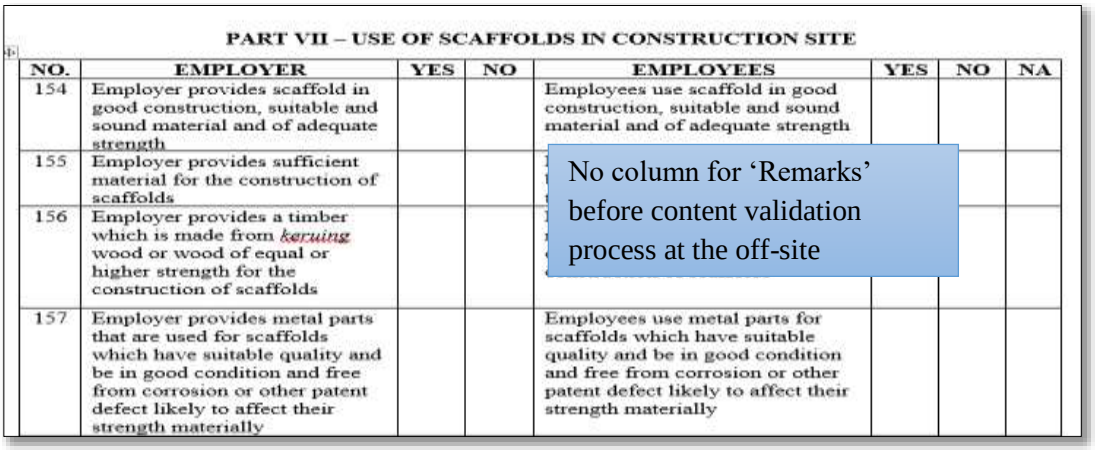
4.3.2 Content Validity

The second phase of validation is content validity have been done by Safety and Health Officer who is comes from construction industry (landed housing) background. For second phase of validation, the validation was conducted two times which is at off-site and on- site. This two times of validation is conducted by different Safety Officers.

4.3.2.1 Off-Site Content Validity

Off-site content validity has been done by a Safety and Health Officer who is comes from construction industry (landed housing) background. Based on her recommendation, she was recommend to add a column for put a "remarks". The purpose of this "remarks" is for makes a notes if some information need to add during process of collection data are going. She also said all elements in the BBS checklist that have been

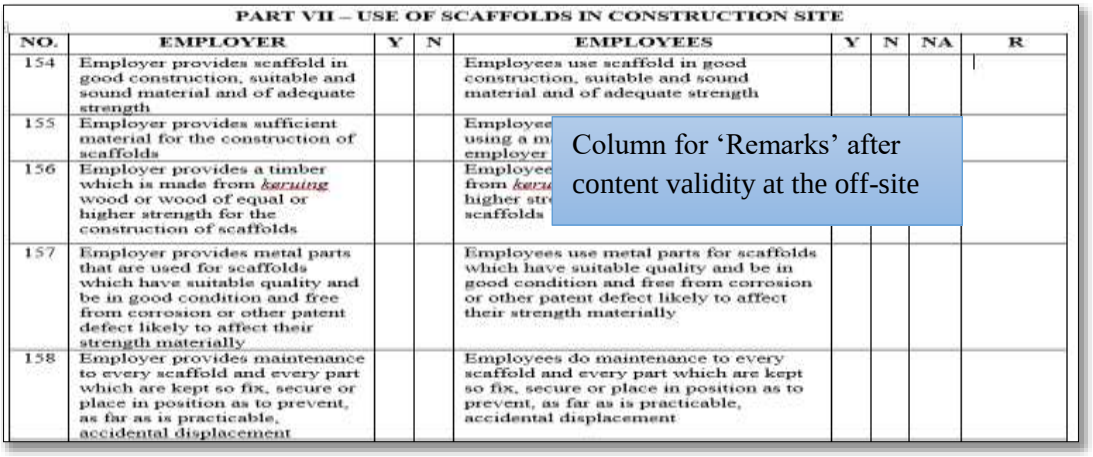
summarized by me from BOWEC requirements are valid for use in construction site. Figure 4.3 and 4.4 below shows an examples for improvement of BBS checklist have been made based on recommendation by Safety and Health Officer. An improvement have been done by add a column for "remarks" in the BBS checklist.



PART VII – USE OF SCAFFOLDS IN CONSTRUCTION SITE

NO.	EMPLOYER	YES	NO	EMPLOYEES	YES	NO	NA
154	Employer provides scaffold in good construction, suitable and sound material and of adequate strength			Employees use scaffold in good construction, suitable and sound material and of adequate strength			
155	Employer provides sufficient material for the construction of scaffolds						
156	Employer provides a timber which is made from *keruing* wood or wood of equal or higher strength for the construction of scaffolds						
157	Employer provides metal parts that are used for scaffolds which have suitable quality and be in good condition and free from corrosion or other patent defect likely to affect their strength materially			Employees use metal parts for scaffolds which have suitable quality and be in good condition and free from corrosion or other patent defect likely to affect their strength materially			

Figure 4.3 Example of BBS checklist before content validation process at the off-site



PART VII – USE OF SCAFFOLDS IN CONSTRUCTION SITE

NO.	EMPLOYER	Y	N	EMPLOYEES	Y	N	NA	R
154	Employer provides scaffold in good construction, suitable and sound material and of adequate strength			Employees use scaffold in good construction, suitable and sound material and of adequate strength				
155	Employer provides sufficient material for the construction of scaffolds			Employee using a m employer				
156	Employer provides a timber which is made from *keruing* wood or wood of equal or higher strength for the construction of scaffolds			Employee from *keru* higher str scaffolds				
157	Employer provides metal parts that are used for scaffolds which have suitable quality and be in good condition and free from corrosion or other patent defect likely to affect their strength materially			Employees use metal parts for scaffolds which have suitable quality and be in good condition and free from corrosion or other patent defect likely to affect their strength materially				
158	Employer provides maintenance to every scaffold and every part which are kept so fix, secure or place in position as to prevent, as far as is practicable, accidental displacement			Employees do maintenance to every scaffold and every part which are kept so fix, secure or place in position as to prevent, as far as is practicable, accidental displacement				

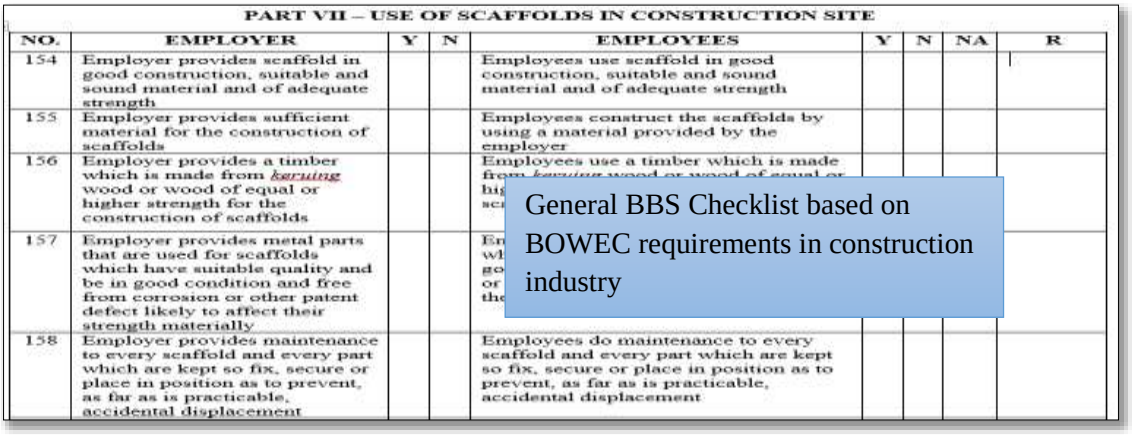
Figure 4.4 Example of BBS checklist after content validation process at the off-site

4.3.2.2 On-Site Content Validity

On site content validity has been done by a Safety and Health Officer who is also comes from construction industry (landed housing) background. Based on the contents which is element that in the BBS checklist as comment by him, he was recommend to makes it more simple and easy to understand. He also said need to summarize the BBS checklist as short as possible but can understand to all level of organization in construction site. Besides, he also recommend to makes the scope of elements in BBS

checklist becomes smaller and specific by only focus to one types of construction. He was recommended to choose construction site for landed housing. It is because due to construction site of landed housing becomes increase day by day. Furthermore, based on BBS checklist before, there are cover from part II until part XVI in BOWEC Regulations. By discussion with Safety and Health Officer, he said this checklist are too general to conduct a collection data. In construction industry (landed housing), there are only a few elements in BOWEC Regulations are need to focus. Figure 4.5, 4.6 and 4.7 below shows an examples for improvements of BBS checklist have been made based on recommendation by Safety and Health Officer.

An improvements have been done by makes a checklist more simple, easy to understand and more specific which is focus to the types of construction was chosen. In addition, based on BBS checklist before this, there are consist of 310 checklist. So, an improvements have be done by reduce it to 45 checklist of employer and 43 checklist of employees.



PART VII – USE OF SCAFFOLDS IN CONSTRUCTION SITE

NO.	EMPLOYER	Y	N	EMPLOYEES	Y	N	NA	R
154	Employer provides scaffold in good construction, suitable and sound material and of adequate strength			Employees use scaffold in good construction, suitable and sound material and of adequate strength				
155	Employer provides sufficient material for the construction of scaffolds			Employees construct the scaffolds by using a material provided by the employer				
156	Employer provides a timber which is made from *kayuing* wood or wood of equal or higher strength for the construction of scaffolds			Employees use a timber which is made from *kayuing* wood or wood of equal or hig sc				
157	Employer provides metal parts that are used for scaffolds which have suitable quality and be in good condition and free from corrosion or other patent defect likely to affect their strength materially			En wl go or the				
158	Employer provides maintenance to every scaffold and every part which are kept so fix, secure or place in position as to prevent, as far as is practicable, accidental displacement			Employees do maintenance to every scaffold and every part which are kept so fix, secure or place in position as to prevent, as far as is practicable, accidental displacement				

General BBS Checklist based on BOWEC requirements in construction industry

Figure 4.5 Example of BBS checklist before content validation process at the on-site

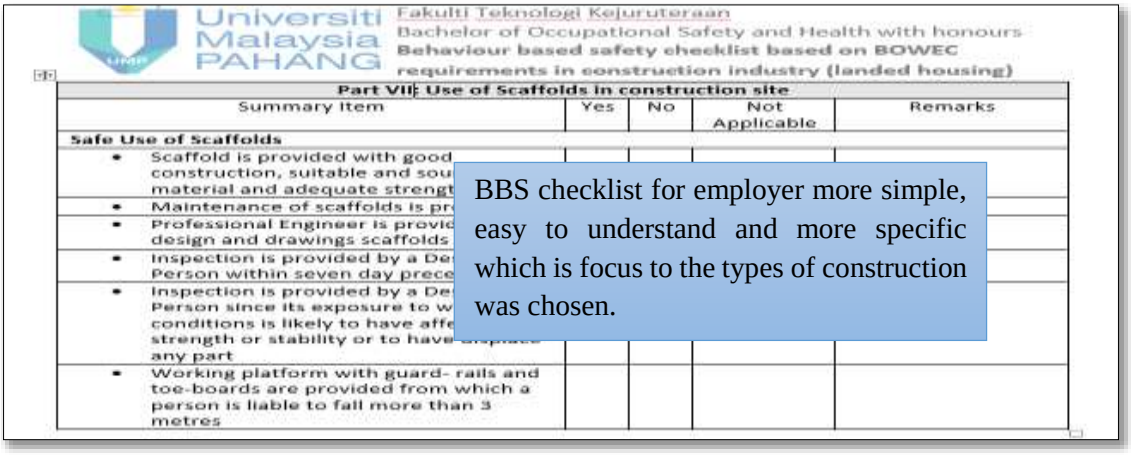


Figure 4.6 Example of BBS checklist for employer after content validation process at the on-site

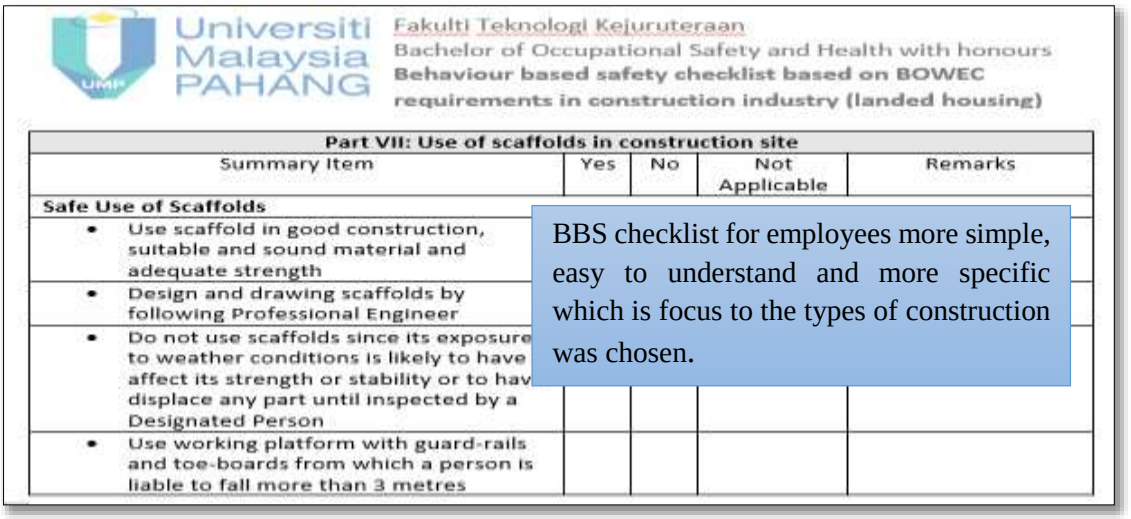


Figure 4.7 Example of BBS checklist for employees after content validation process at the on-site

4.4 Development of System for Behaviour Based Safety Checklist

BBS checklist in a system was develop by using Microsoft Access 2013 after the validation process the BBS checklist. For the Microsoft Access 2013, it was used as create a system and store information for reporting, referencing and analysis. Figure 4.8 below show an example of BBS checklist in a system.

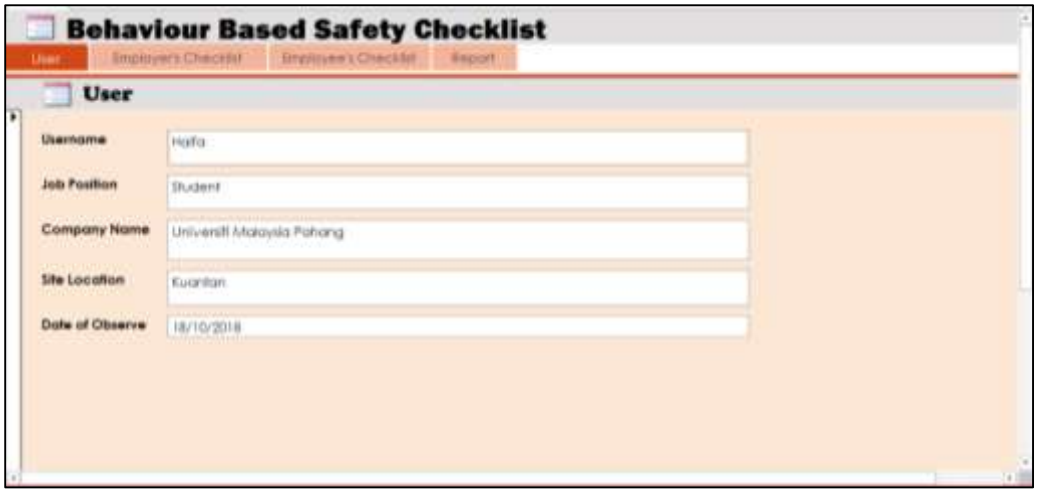


Figure 4.8 Example of BBS checklist in a system

4.5 Data Collection

In this study, the data were collected by observation and interview to employer and employees that comes from construction industry (landed housing) background. The study was conducted in Kuantan, Pahang. The type of construction was chosen as a place for collecting data is a construction site for landed housing. The instrument that used in this study is a BBS checklist. Before the interview with employer and employees took place, there was an observation session by using a checklist. Then, the interview session were conducted regarding to the checklist.

4.6 Percentage of Complied with BOWEC Requirements

The percentage of complied with BOWEC requirements was calculated after the process of collection data have been finish. Percentage method was used as a method to calculate the percentage of complied with BOWEC requirements. Table 4.2 below shows the percentage of complied with BOWEC requirements by each part of employer and employees.

Table 4.2 Percentage of employer's and employee's checklist regarding to each part by complied with BOWEC Regulation requirements

Part	Employer's Checklist	Employee's Checklist

	Total No. of question (N)	**No. of complied (C)**	$\frac{C}{N}$ **(%)**	**Total No. of question (N)**	**No. of complied (C)**	$\frac{C}{N}$ **(%)**
Part I: General Provisions	11	10	91	10	8	80
Part II: Concrete work in construction site	1	1	100	1	1	100
Part III: Assembly of structural steel and precast concrete in construction site	1	1	100	1	1	100
Part IV: Good and safe condition of roof, gutters, windows, louvres and ventilators in construction site	3	3	100	3	3	100
Part V: Use of safety belts in construction site	3	2	67	2	1	50
Part VI: Use of ladders and step-ladders in construction site	1	0	0	1	0	0
Part VII: Use of scaffolds in construction site	6	6	100	4	3	75
Part VIII: Demolition work in construction site	5	-	-	5	-	-
Part IX: Excavation work in construction site	7	4	57	7	4	57

Part X: Handling and storage, use and disposal of material in construction site	7	6	86	8	7	88
Part XI: Use of piling in construction site	6	-	-	7	-	-
Part XII: Blasting work and use of Explosives in construction site	5	-	-	5	-	-
Part XIII: Use hand and power tools in construction site	5	4	80	6	5	88
Total of questions		**61**			**60**	
Item's complied	**45**	**37**	**82**	**43**	**33**	**77**

4.6.1 Complied with BOWEC Requirements

There are consist of three part which is 100% complied with BOWEC requirements for employer's and employee's checklist. The parts are part II which is concrete work in construction site, part III which is assembly of structural steel and precast concrete in construction site and the last one part IV which is good and safe condition of roof, gutters, windows, louvres and ventilators in construction site.

4.6.1.1 Part II: Concrete Work in Construction Site

Part II which is concrete work in construction site 100% complied with BOWEC requirements for employer's and employee's checklist. The percentage of complied with BOWEC requirements of employer and employees for this part is 100% because this part mention about a Professional Engineer in construct and design concrete work. Based on BOWEC requirements, employer must provide a Professional Engineer for specification and to design all concrete work and employees must follows a specification and design all concrete work by Professional Engineer. Regarding to this site, during an interview with employer, he told that he provides a Professional Engineer for specification and to

design all concrete work. By an observation and interview with employees in this site, he told that he follows a specification and design all concrete work by Professional Engineer.

4.6.1.2 Part III: Assembly of Structural Steel and Precast Concrete in Construction Site

Part III which is structural steel and precast concrete assembly in construction site. The complied with BOWEC requirements for employer's and employee's checklist for this part are 100%. It is because this part mention about a lifting activity. Based on BOWEC requirements for employer, employer must provide a tag line, scaffolds and safety belt during lifting activity. For the BOWEC requirements for employees in this part, employees must use a tag line, scaffolds and safety belt during lifting activity. Regarding to this site, by an observation in the site and interview with employer, he told that he provides a tag line, scaffolds and safety belt during lifting activity. During an interview with employees, he also told that he use a tag line, scaffolds and safety belt during lifting activity.

4.6.1.3 Part IV: Good and Safe Condition of Roof, Gutters, Windows, Louvres and Ventilators in Construction Site

The complied with BOWEC requirements of employer's and employee's checklist for this part are 100%. It is because this part mention about a duties of employer and employees and working at height. Based on BOWEC requirements, the duties of employer and employees is provide and makes periodical cleaning and maintenance to maintain good and safe order in all means of access to roofs, gutters, windows, louvers and ventilators. For the working at height, the BOWEC requirements for employer and employees are provide and use roofing brackets or crawling boards where work is being performed on roof and provide and use procedure and measurement of BOWEC regulations for construction and installation of roofing brackets and crawling boards.

Regarding to this site, based on interviewed with employer, he told that he provides periodical cleaning and maintenance to maintain good and safe order in all means of access to roofs, gutters, windows, louvers and ventilators. By an interviewed with employees, he told that he makes periodical cleaning and maintenance to maintain good and safe order in all means of access to roofs, gutters, windows, louvers and ventilators. Besides, by an observation in the site, employer provide and employees use

roofing brackets or crawling boards when work is being performed on roof. By an interview with employer and employees, he told that he provide and use procedure and measurement of BOWEC regulations for construction and installation of roofing brackets and crawling boards.

4.6.2 Complied Vs Non – Complied with BOWEC Requirements

There are consist of six parts for complied vs non - complied with BOWEC requirements. The parts are part I which is general Provisions, part V which is use of safety belts in construction site, part VII which is use of scaffolds in construction site, part X which is handling and storage, use and disposal of material in construction site, part XIII which is use hand and power tools in construction site and part IX which is excavation work in construction site. All this part are includes with the graph for the discussion in details.

4.6.2.1 Part I: General Provisions

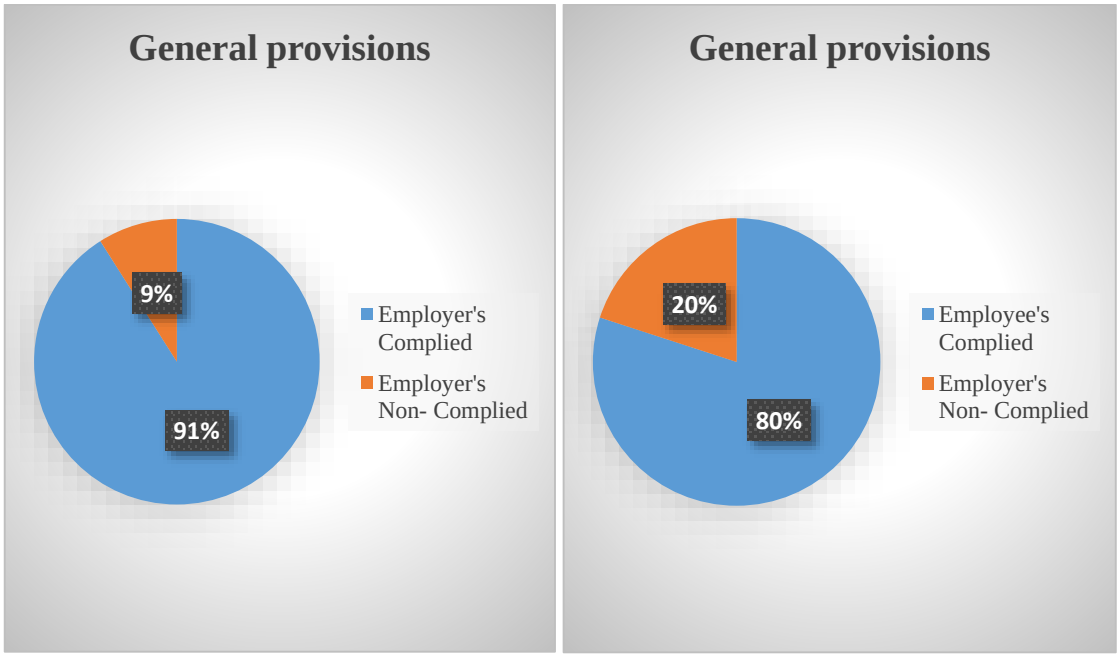


Figure 4.9 General provisions

Figure 4.9 shows that the percentage of employer and employees complied and non-complied with BOWEC requirements for the part I which is general provision. The complied with BOWEC requirements of employer and employees for this part are 91% and 80%. The reasons of non- complied with BOWEC requirements of employer is employer only provides a barricades, warning signs and guard for only certain place.

Based on BOWEC requirements, employer must provide barricades, warning signs and guard for the provision of safe workplace.

Others, for the reason of non- complied with BOWEC requirements of employees is employees use passageway, scaffold, platform or other elevated working surface in slippery condition because to reduce times. Based on BOWEC requirements, employees not allow to use a passageway, scaffold, platform or other elevated working surface in slippery condition to prevent from slipping hazard. This reason is based an interview with employees. The second reason for employees non- complied with BOWEC requirements is employees do not makes all passageway, platform and other places are free from accumulations of dirt and debris. Based on BOWEC requirements, employees must makes all passageway, platform and other places are free from accumulations of dirt and debris to prevent form tripping and cutting hazards. This reason is from an observation in the site.

4.6.2.2 Part V: Use of Safety Belts in Construction Site

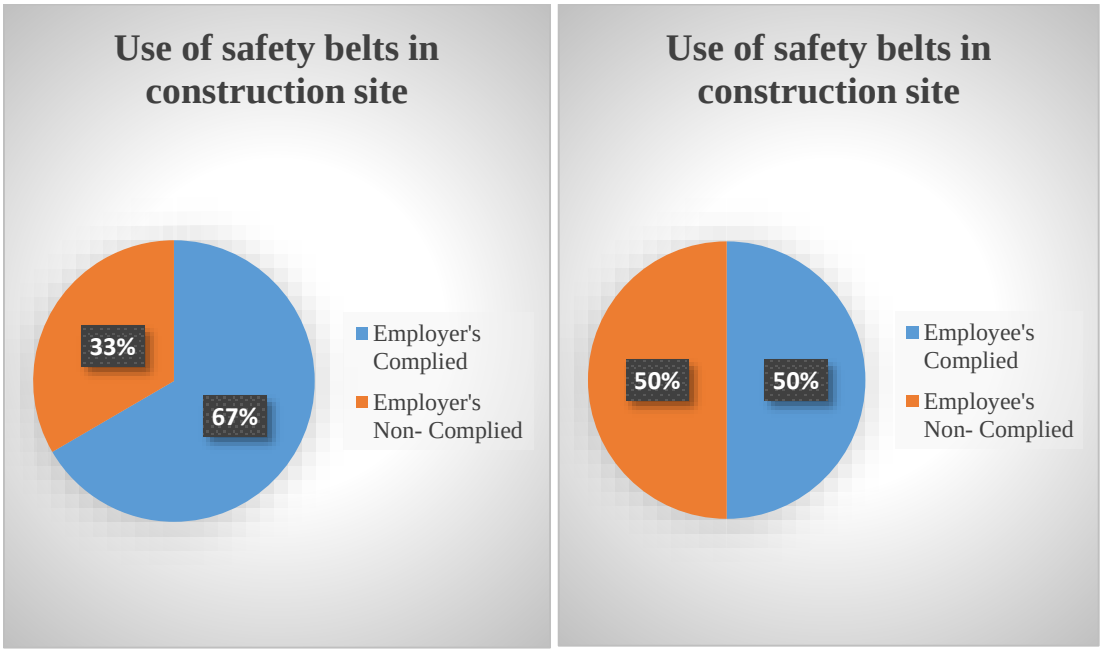


Figure 4.10 Safety belt

Figure 4.10 shows that the percentage of employer and employees complied and non-complied with BOWEC requirements for the part V which is use of safety belts in construction site. The complied with BOWEC requirements of employer and employees for this part are 67% and 50%. The reason for the non- complied with BOWEC

requirements of employer is based on an observation in the site and an interview with employer which is employer not provide a padding or wrapping to protect every life lines from contact with edges or object which may cut out or severely abrade it. Based on BOWEC requirements, employer must provide a padding or wrapping to protect every life lines from contact with edges or object which may cut out or severely abrade it. Then, for the reason of non- complied with BOWEC requirements of employees is based an observation in the site which employees not padding or wrapping every life line after use it. Based on BOWEC requirements, employees must padding or wrapping to protect every life lines from contact with edges or object which may cut out or severely abrade it.

4.6.2.3 Part VII: Use of Scaffolds in Construction Site

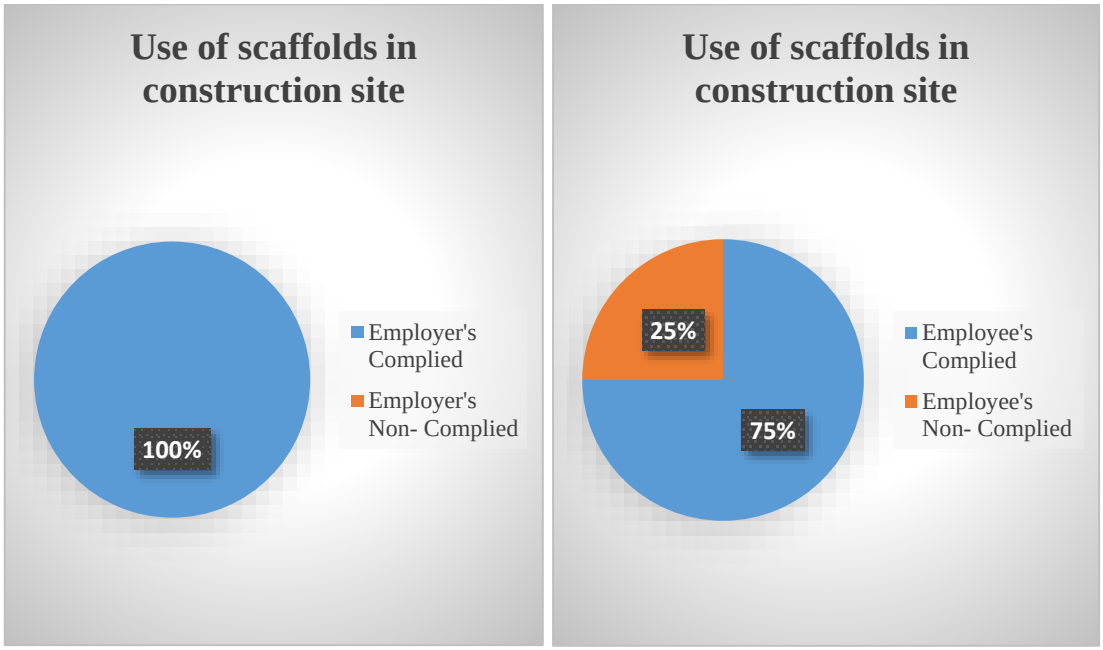


Figure 4.11 Scaffolds

Figure 4.11 shows that the percentage of employer and employees complied and non-complied with BOWEC requirements for the part VII which is use of scaffolds in construction site. For this part, employer 100% complied with BOWEC requirements but for employees, 75% complied with BOWEC requirements. The reason of the employee's non-complied with BOWEC requirements is use scaffolds although its exposure to weather conditions is likely to have affect its strength or stability or to have displace any part without inspected by a Designated Person. This reason is based an interview with employees. Based on BOWEC requirements, scaffolds are not allow to use since its

exposure to weather conditions is likely to have affect its strength or stability or to have displace any part until inspected by a Designated Person.

4.6.2.4 Part X: Handling and Storage, Use and Disposal of Material in Construction Site

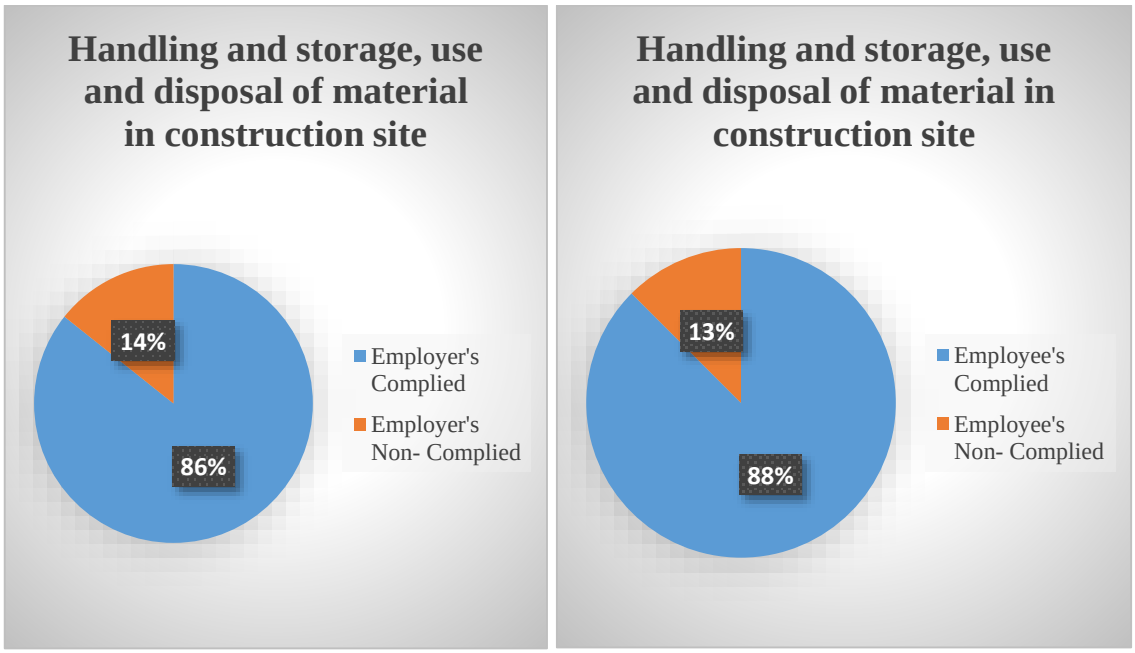


Figure 4.12 Material handling and storage, use and disposal

Figure 4.12 shows that the percentage of employer and employees complied and non-complied with BOWEC requirements for the part X which is handling and storage, use and disposal of material in construction site. The complied with BOWEC requirements of employer and employees for this part are 86% and 87%. The reason for non- complied with BOWEC requirements of employer and employees is based an interview with employer and employees which is employer not provide and employees not use fire-resistant cover containers to keep all solvent waste, oily rags and flammable liquids in fire-resistant cover containers until they are removed from worksite. Based on BOWEC requirements, fire-resistant cover containers are must provide and employees must use to keep all solvent waste, oily rags and flammable liquids in fire-resistant cover containers until they are removed from worksite.

4.6.2.5 Part XIII: Use Hand and Power Tools in Construction Site

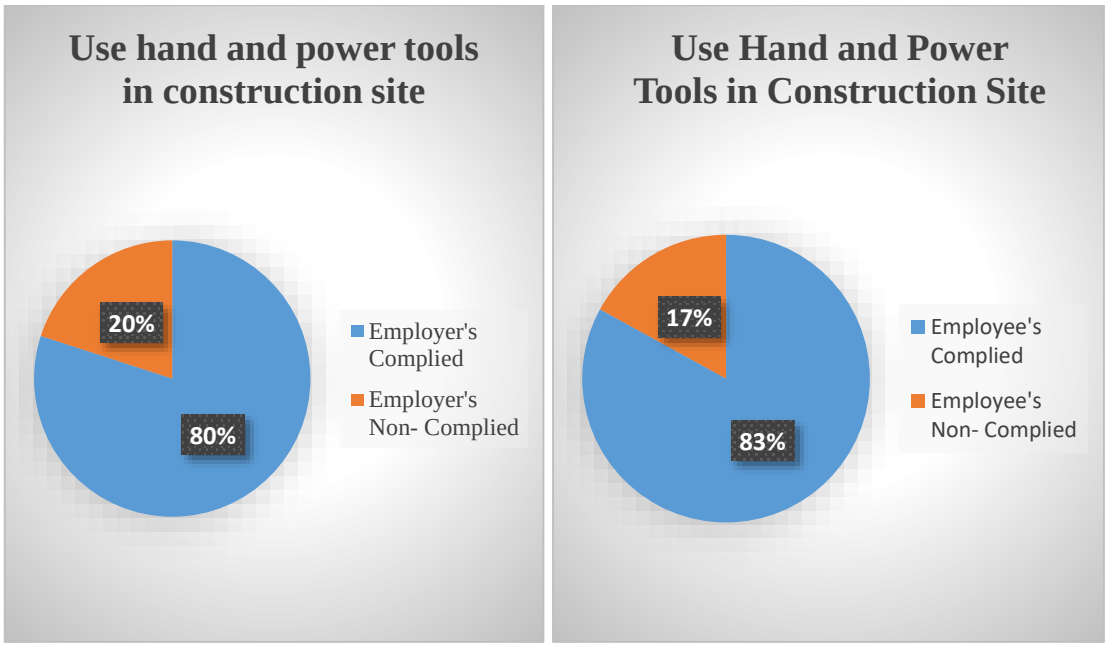


Figure 4.13 Hand and power tools

Figure 4.13 shows that the percentage of employer and employees complied and non-complied with BOWEC requirements for part XIII which is hand and power tools. The complied with BOWEC requirements of employer and employees for this part are 80% and 83%. The reason for non- complied with BOWEC requirements of employer is employer do not provide training to the employees who work with power-actuated tools. It is because he said that employees have more experiences on handling machine which is more than 5years. This reason is based an interview with employer. Based on BOWEC requirements, employer must provide training is to employees who work with power-actuated tools. Then, the reason for non- complied with BOWEC requirements of employees is based an interview with employees which is all employees are allowed to operate power-actuated tools without trained by employer. Based on BOWEC requirements, only who have been trained are allowed to operate power-actuated tools.

4.6.2.6 Part IX: Excavation Work in Construction Site

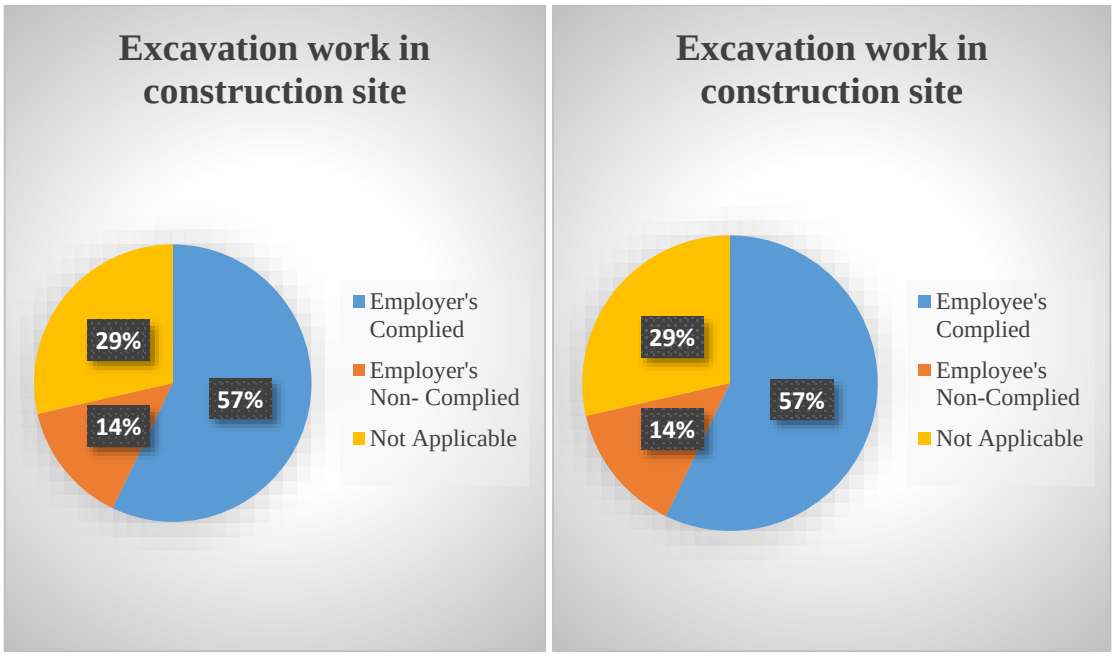


Figure 4.14 Excavation work

Figure 4.14 shows that the percentage of employer and employees complied and non-complied with BOWEC requirements and not applicable in the site for the part IX which is excavation work in construction site. The complied with BOWEC requirements of employer and employees for this part are same which is 57%.There is the reason of non- complied with BOWEC requirements of employer and employees. The reason of non- complied with BOWEC requirements of employer and employees is based an interview with employer and employees which is employer not provide and employees not use substantial guard-rails or board fences for all public walkways, sidewalks and the thoroughfares bordering on or running through any excavation because of to reduce cost. Based on BOWEC requirements to employer and employees, substantial guard-rails or board fences must provide and use for all public walkways, sidewalks and the thoroughfares bordering on or running through any excavation.

For this part, there are two items which not applicable in this site. This is based on interview with employer and employees in the site. The first item is employer not provide and employees not use warning lights or flares during darkness at all public sidewalks because excavation work at this site not operation at night. Based on BOWEC requirements to employer and employees, warning lights or flares are must provide and use during darkness at all public sidewalks to ensure safety for pedestrian and vehicular

traffic. The second item of not applicable in this site is employer not provide and employees not use warning sign and adequate barricades at position for open sides excavation where person may fall more than 3 metres because excavation work at this site not more than 3 metres due to reduce times. Based on BOWEC requirements to employer and employees, warning sign and adequate barricades are must provide and use at position for open sides excavation where person may fall more than 3 metres.

4.6.3 Non – Complied with BOWEC Requirements

There is one part which is non- complied with BOWEC requirements. The part is part VI which is use of ladders and step-ladders in construction site.

4.6.3.1 Part VI: Use of Ladders and Step- Ladders in Construction Site

In this part, there are non-complied with BOWEC requirements either employer or employees. For this part, it mention about safe use of ladders and step- ladders. Based on BOWEC requirements to the employer, employer must provide ladders and step-ladders with good construction, sound material and good strength for purpose for which it is used. Then, for BOWEC requirements to the employees, employees must use ladders and step-ladders with good construction, sound material and good strength. Regarding to this site, based an observation in the site and interview with employer and employees, employer not provide ladders and step-ladders with good construction, sound material and good strength because they only ask employees to construct ladder by using existing wood in the site. Then, employees use ladder and step-ladder not in good construction, sound material and good strength because employer not provide aluminium ladder or good wood for construct a ladder.

4.7 Percentage of Overall Complied with BOWEC Requirements

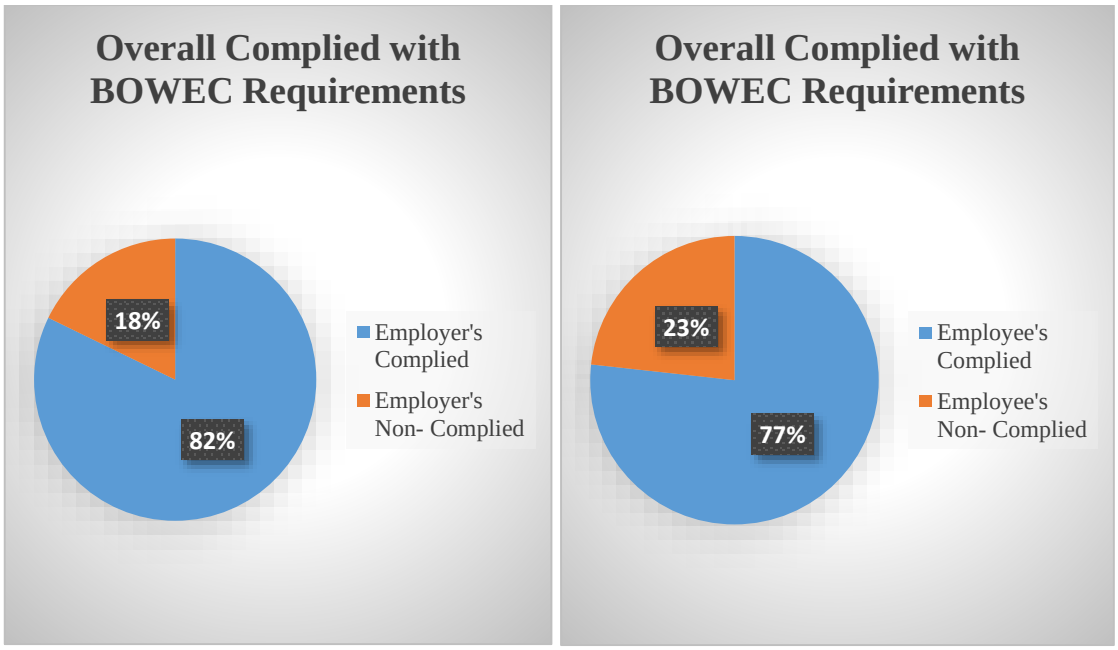


Figure 4.15 Overall comply with BOWEC requirements regarding to employer and employees

Figure 4.15 shows that the overall percentage of employer and employees complied and non-complied with BOWEC requirements. The total complied with BOWEC requirements of employer and employees are 82% and 77%. The reasons of employer complied with BOWEC requirements is based an observation in the site and an interview with employer. The first reason is employer provides adequate equipment to the employees who are exposed to drowning hazard. It is because this site has built a tank so employees in this site may exposed to drowning hazard. Employer ensure their employees to not use passageway, scaffold, platform or other elevated working surface in slippery condition by giving a toolbox every week. In addition, established a Safety Committee involving with employer and employees and cleaning are provided to roofs, gutters, windows, louvers and ventilators before use it.

A Designated Person which is Safety and Health Officer is provided to inspect every safety belt and life lines and provided Designated Person for inspection of scaffold when its exposure to weather conditions is likely to have affect its strength or stability or to have displace any part and use tag line after inspect the scaffolds (red, yellow and green) to label the level of hazard. Then, danger or warning signs are provided at all truck entrances and exits during excavation work, a Designated Person is provided to check

excavation site after every rainstorm or other hazard increasing occurrence also the reason of employer's complied with BOWEC requirements. The next reason, unauthorised persons are not allowed to enter on or around the place of material store by lock store and only authorised person can open the store and fire regulations are provided to comply all disposal waste material or debris by burning. Operation of burning for this site always after work hour at open space. The last reason for employer's complied with BOWEC requirements is hand and power tools are provided and maintained in safe condition with inspection by Safety and health Officer.

In addition, the reasons of employees complied with BOWEC requirements is based on observation in the site and interview with employees. First reason is employer attend a training provided by employer and involve with Safety Committee. Employees also wear personal protective equipment provided by employer. During lifting activity, employees use a hardness or safety belt. For the parts of concrete work, employees follows design and drawing by Professional Engineer. However, employees also use roofing brackets or crawling boards where work is being performed on roof and carry out the construction and installation of roofing brackets or crawling boards by following the procedure and measurement of BOWEC regulations. Employees use safety belt and life lines with adequate strength and use scaffolds in good construction, suitable and adequate strength also the reason of employee's complied with BOWEC requirements. In excavation work, employees use danger and warning sign at all truck entrances and exits. Employees also use suitable place to store material inside buildings under construction. Lastly, employees use guards when power operated tools are designed to accommodate guards.

4.7.1 Parts which are Not Applied in Collection Data's Site

This study only focus on construction site of landed housing. Based on BOWEC requirements, there are thirteen parts that need to focus in construction site of landed housing. However, during collecting data, there are three parts which not applied in collection data's site. The parts are part VIII which is demolition work in construction site, part XI which is use of piling in construction site and part XII which is blasting work and use of explosives in construction site. Part VIII which is demolition work in construction site is not applied in this site because this site is at ground level. Demolition occur to dismantling, razing, destroying or wrecking of any building or structure or any

part thereof. Besides, part XI which is use of piling in construction site is not applied in this site because this site not construct a piling. It is because to reduce cost. Besides, the design of this landed housing is by using rough foundation. When the design is use rough foundation, the piling is not construct. Lastly, part XII which is blasting work and use of explosives in construction site. This part also not applied in this site because this landed housing not construct on the hill and not on the rocky soil. The reason for all this parts which is not use in collection data's site is based an interview with employer.

4.8 Behaviour Based Safety Based on DO IT Process

BBS based on DO IT process consist of four step. The first step of the DO IT process is define. The second step of DO IT process is observe. The third step of DO IT process is intervene and the last step of DO IT process is test.

4.8.1 Define

Based on this study, define's step was conducted by extract parts and elements of BOWEC requirements in construction industry (landed housing). After the extract has been done, BBS checklist was developed with divided into two parts which are BBS checklist for employer and BBS checklist for employees.

4.8.2 Observe

Observe's step was conducted in this study with using BBS checklist that was developed based on BOWEC requirements in construction industry (landed housing) to observe the behaviour of the employer and employees in construction sites of landed housing.

4.8.3 Intervene

Intervene's step was conducted in this study with analysed the BBS checklist of employer and employees that was used in collecting data. After that, by makes it general only, a few strategies or technique has been notified to employer for improvement of safety in workplace. The technique is by apply antecedents, behaviours and consequences (ABC) model. It is for improve behavioural processes.

4.8.4 Test

This step also by makes it general only. This step is by notified to the employer to determine the effects of interventions with visual inspection of publicly posted graphs of behavioural data. This step has makes the target behaviours continuously observed and recorded.

4.9 Conclusion

In conclusion, this chapter was discussed and analysed the data collected in construction industry (landed housing). Before the collection of data, the BBS checklist will be develop based on BOWEC requirements in construction industry (landed housing). Then, the checklist evaluation was conducted to validate the BBS checklist. There are consist of two phase of checklist evaluation which are phase one face validity by subject matter expert (SME) and phase two content validity by Safety and Health Officer who are comes from construction industry background. Besides, for the phase two which is content validity, there are consist of two types which are off-site and on-site. However, the improvement of BBS checklist was done based on recommendation by SME and Safety and Health Officer. A BBS checklist in a system was developed after validation of BBS checklist has been done by using Microsoft Access 2013. A Microsoft Access 2013 is used to create the checklist in a system and store the data for reporting, referencing and analysis.

Collection of data was conducted at Kuantan, Pahang which is construction industry (landed housing) by using BBS checklist. After that, percentage of complied with BOWEC requirements was calculated by using a percentage method. For the percentage of complied with BOWEC requirements, it consists of three category which are Complied, Complied vs Non-Complied and Non- complied. Then, percentage of overall complied with BOWEC requirements also calculated. However, there are also consist of three parts in BBS checklist in a system which is the collection data's site not applied. The parts are VIII, XI and XII. All the reasons of complied and non- complied with BOWEC requirements is based on observation in the site and interview with employer and employees.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter is the last chapter for this research study. It describes summarization of the summarization of the study, the conclusion of the result obtained from the data analysis and with the recommendation for the future purpose.

5.2 Conclusion

This study developed BBS checklist based on BOWEC requirements. The concept of Plan-Do-Check-Act (PDCA) used in this study to develop a BBS checklist which only focus on construction site of landed housing. For the construction site of landed housing, there are consist of 13 parts in the BOWEC that need to be focused. Then, the BBS checklist were validated. There are two phases of validation. First phase of validation is face validity by Subject Matter Expert. Second phase of validation is content validity by Practitioner who has wise experience in construction industry (landed housing). For the second phase of validation, it occurred two times which are on-site and off-site. First phase of validation by Subject Matter Expert has been done by making improvement of BBS checklist which is rename the parts and elements in BOWEC requirements to own idea. The second phase of validation by Practitioner which is off-site has been done by making improvement of BBS checklist which is add a column for "remarks" to add some information regarding the items when a BBS checklist is use.

Then, the second phase of validation by Practitioner which is on-site has been done by making improvement of BBS checklist which is makes a checklist simple, easy to understand and more specific which is focus to the types of construction was chosen. In addition, based on BBS checklist before this, there are consist of 310 checklist. So, an

improvement have been done after validation of content validation process by reduce it to 45 checklist of employer and 43 checklist of employees. After evaluation of BBS checklist has been done, a BBS checklist in a system has been developed by using Microsoft Access 2013. For the development of BBS checklist, a Microsoft words 2013 and Microsoft Access 2013 has been used. Microsoft Words 2013 has been used to create and edit the checklist that in professional looking and Microsoft Access 2013 has been used to create a system and to store information for reporting, referencing and analysis.

BBS checklist in a system was used to collect data and the data was analysis by using percentage method. The analysis of data is calculated the percentage of complied with BOWEC requirements. The percentage of complied with BOWEC requirements is calculated by each part of employer and employees in the BBS checklist. For the percentage of complied with BOWEC requirements by each part in BBS checklist, it is consists of three category which are complied, complied vs non- complied and non-complied. The parts in BBS checklist that complied with BOWEC requirements are parts II, III and IV. Next, the parts that in category of complied vs non- complied are parts I, V, VII, IX, X and XIII. For the parts which is non- complied is part VI. Then, overall percentage complied with BOWEC requirements of employer and employees was calculated. The total complied with BOWEC requirements of employer and employees in the site that has been chosen to collect data are 82% and 77%. However, there are consist of three parts in BBS checklist does not applied in construction site of collection data. The parts are VIII, XI and XII. All the reasons of complied and non- complied with BOWEC requirements is regarding an observation in the site and interview with employer and employees.

This study concludes the result of the objectives. The BOWEC requirements in construction industry (landed housing) was analysed. The BBS checklist was developed based on BOWEC requirements in construction industry (landed housing) by using Microsoft words and Microsoft Access. The BBS checklist was validate by using case studies in construction industry (landed housing) located at Kuantan, Pahang. This shows that the company which have been chose is the company that comply with the standard of Act and Regulation. Moreover, the company took serious issues regarding to safety and health. From the safety and health report, it shows that there was no accident and a few near-miss occurred at the site. The training and tool- box meeting was provided for

workers. The company also provides CIDB course to all the workers as to protect workers welfare. The education also be given to workers by the safety programs such as safety talk, week of safety awareness and safety bulletin board which include the information of safety and health at the workplace and they have good perception toward it.

5.3 Recommendation

From the results, the recommendation needed is the company should provide more safety training and programs based on BOWEC requirements because some employees still lack on the knowledge about BOWEC requirements. It is important to provide them with the training and education to improve their knowledge regarding the BOWEC and they will more understand about the BOWEC regulations. Employer and employees involvement also need to be improved to ensure they give co-operation in improving the safety and health performance. Positive reinforcement should provide to the employees with reward them as it is can increase their safe behaviour. It is such a powerful technique for motivation of the actions of people. So, employer should encourage them more with this technique which can improve safety performance and prevent from accident or injury. The company should held a programme such as 'Zero Accident in a Month' and choose the best employee who work with safe behaviour and follow the safe working procedure by give them a reward. However, some of accident occur due to miscommunication. An employer should have two way communication with employee so that they can share their problem related with their job. This two way communication can improve a good relationship with employer and employees whereas the employee share their problems and the employer try to resolve their problems as can as reasonable.

Since this study only focus on construction site of landed housing, the future research should be done with other types of construction such as high risk building or highway construction. It is because high risk building and highway construction are more hazards compare to landed housing. Besides, this study not focus all elements in the BOWEC regulations. For the future research, it should be done by study all elements in the BOWEC regulations because BOWEC regulations is very important to comply with it for construction industry. In addition, for the system development, this study only use Microsoft Access 2013 to develop a BBS checklist in a system. For the future research, it can be use Microsoft Visual Studio or other application that can create a system because

there are have more advantages compare Microsoft Access. By use others application in creating a system, it is will makes more easy to observer when they can use a smartphone only to use a BBS checklist because a BBS checklist is done in an application or website.

5.4 Limitation of the Study

The main concern during conducting this research is resources. It is not easy to deal with construction employer and employees because it is related to the safety issue where can cause the reputation of the contractors. The study made by other researchers before also very limited because some of them have different objective and some information needed for this study is secured.

Besides, for evaluation of BBS checklist is time constraint due to need to deal with Safety and Health Officer who is need to spend time for evaluate the BBS checklist that it may affect to their job. To create a system is also time constraint due to lack of knowledge in conducting a system of computer. Furthermore, to learn with someone who are excellence in dealing with Microsoft Access also difficult due to everyone busy chasing their time on complete their Final Year Project. In addition, money constraint due need to be spend more to find the construction site of landed housing as a place for pilot study and collecting data. It costly because the factors such as fuel that need to repeated keep going to find a construction site for three days.

For the communication, it is quite difficult to have a good cooperation from the employees because most of them are foreigner. At the first, some of them refused to answer my interview because they were not understand. However, after assist by their person in- charge in supervise us, they gave the cooperation. There were also some of employee who refused to answer because worried that it may affect to their job.

In addition, since there is time and money constraints, the future research should be done with search a place for pilot study and collection data early. Then, future research also should do evaluation of BBS checklist early to avoid missing some important elements in BOWEC regulations. The plan must be made up properly to ensure there no missing or left information during the conducting the research. Another constraint is regarding to communication. To avoid from miscommunication, we must have someone

to assist during conduct the research as instance, person in-charge as this person know how to communicate with foreign employees.

REFERENCES

Albrechtsen, W. S. (2018). Accident types and barrier failures in the construction industry. *Safety Science*, 158-166.

Balter, A. (2013, May 10). *Why Use Microsoft Access?* Retrieved from informIT: http://www.informit.com/articles/article.aspx?p=2044341&seqNum=2

Black, L. (2017). *Why Information Systems are so Important to your Businesses*. Retrieved from Inspired Tech: http://www.inspiredtechs.com.au/why-information-systems-are-so-important/

Boyce, T. E. (2018). *Behavior-Based Safety Initiative Helps a Large Gold Mining Facility Win "Most Improved" Safety Award*. Retrieved from Center for behavioural safety: http://cbsafety.com/client-results/case-study-2/

Beshah B, J. K. (2014). The Plan-Do-Check-Act Cycle of Value Addition. *Industrial Engineering & Management*, *03*(01). https://doi.org/10.4172/2169-0316.1000124

Chen, D., & Tian, H. (2012). Behavior based safety for accidents prevention and positive study in China construction project. *Procedia Engineering*, *43*, 528–534. https://doi.org/10.1016/j.proeng.2012.08.092

Choudhry, R. M. (2014). Behavior-based safety on construction sites: A case study. *Accident Analysis and Prevention*, *70*, 14–23. https://doi.org/10.1016/j.aap.2014.03.007

DOSH. (2018, November 2). *Occupational Accidents Statistics by Sector Until October 2018*. Retrieved from Department of Occupational Safety and Health: http://www.dosh.gov.my/index.php/en/occupational-accident-statistics/by-sector

DOSH. (2018, April 1). *Fatal Accident Case*. Retrieved from Department of Occupational Safety and Health: http://www.dosh.gov.my/index.php?option=com_content&view=article&id=955&Itemid=369&lang=en

DOSH. (2018). Retrieved from Department of Occupational Safety and Health: http://www.dosh.gov.my/index.php/en/legislation/regulations-1/regulations-under-factories-and-machinery-act-1967-act-139

Galloway, S. M. (2015, December). *Unsafe, At-Risk, Safe Behaviors: Know the Difference*. Retrieved from ProAct Safety: https://proactsafety.com/articles/unsafe-at-risk-safe-behaviors-know-the-difference

Geller, E. S. (2005). Behavior-based safety and occupational risk management. *Behavior Modification*, *29*(3), 539–561. https://doi.org/10.1177/0145445504273287

Geller, E. (2018, October 8). *Critical behavior checklist for effective behavior-based coaching*. Retrieved from Industrial Safety & Hygiene News: https://www.ishn.com/articles/109499-critical-behavior-checklist-for-effective-behavior-based-coaching?v=preview

Gonzales, M. (2018). *Behavioral Safety- Who is responsible for safety?* . Retrieved from Safety Toolbox Topics: http://safetytoolboxtopics.com/Behavioral-Safety/behavioral-safety-who-is-responsible-for-safety.html

Guo, B. H. W., Goh, Y. M., & Le Xin Wong, K. (2018). A system dynamics view of a behavior- based safety program in the construction industry. *Safety Science*, *104*(February), 202– 215. https://doi.org/10.1016/j.ssci.2018.01.014

Hoła, B., & Szóstak, M. (2014). Analysis of the development of accident situations in the construction industry. *Procedia Engineering*, *91*(TFoCE), 429–434. https://doi.org/10.1016/j.proeng.2014.12.088

Jasiulewicz-Kaczmarek, M., Szwedzka, K., & Szczuka, M. (2015). Behaviour Based Intervention for Occupational Safety ??? Case Study. *Procedia Manufacturing*, *3*(Ahfe), 4876–4883. https://doi.org/10.1016/j.promfg.2015.07.615

Lau, B. (2018, February 23). *What is landed vs non-landed property in Singapore? Why is it called this?* Retrieved from Quora: https://www.quora.com/What-is-landed-vs-non-landed-property-in-Singapore-Why-is-it-called-this

Li, Heng, L. (2015). Proactive behavior-based safety management for construction safety improvement. *Safety Science*, 107-117.

Lingard, H., & Rowlinson, S. (1997). Behavior-Based Safety Management in Hong Kong's Construction Industry. *Journal of Safety Research*, *28*(4), 243– 256. https://doi.org/10.1016/S0022-4375(97)00010-8

Melo, R. R. S. de, Costa, D. B., Álvares, J. S., & Irizarry, J. (2017). Applicability of unmanned aerial system (UAS) for safety inspection on construction sites. *Safety Science*, *98*, 174– 185. https://doi.org/10.1016/j.ssci.2017.06.008

Mohammadfam, I., Ghasemi, F., Kalatpour, O., & Moghimbeigi, A. (2017). Constructing a Bayesian network model for improving safety behavior of employees at workplaces. *Applied Ergonomics*, *58*, 35–47. https://doi.org/10.1016/j.apergo.2016.05.006

Oluwatayo. (2012). Validity and Realibity Issues. *Educational and Social Research*, 391-400.

Oostakhan, M. & A. M. &, & Talab, A. D. (2012). Behavior-Based Safety Approach at a Large Construction Site in Iran. *Iranian Rehabilitation Journal*, *10*(February), 21–25.

OSHA. (2018). *Construction Industry*. Retrieved from Occupational Safety and Health Administration: https://www.osha.gov/doc/

Reh, F. (2018, October 2017). *What is Subject Matter Expert?* Retrieved from careers: https://www.thebalancecareers.com/subject-matter-expert-2275099

Salem, O., Lothlikar, H., Genaidy, A., & Abdelhamid, T. (2007). A behaviour-based safety approach for construction projects. *Lean Construction: A New Paradigm for Managing Capital Projects - 15th IGLC Conference*, (July), 261–270. Retrieved from https://www.engineeringvillage.com/share/document.url?mid=cpx_6e3d60139f8fc2f1 9M63da2061377553&database=cpx

Samuel, O., Adul Hamid, R., & Saidin Misnan, M. (2017). Analysis of Fatal Building Construction Accidents: Cases and Causes. *Journal of Multidisciplinary Engineering Science and Technology (JMEST)*, *4*(8), 2458–9403. Retrieved from www.jmest.orgJMESTN423523718030

Sangoseni O, H. M. (2013). Development and Validation of a Questionnaire to Assess the Effect of Online Learning on Bheaviours, Attitudes and Clinical Practices of Physical Therapists in the United States Regarding Evidence-based Clinical Practice. *Journal of Allied Health Sciences and Practice*, 1-13.

Sarah Crowe, c. a. (2011). The case study approach. *BMC Medical Research Methodology*.

Sharma, V. (2017, February 24). *Top 10 uses of MS Word in Daily Life*. Retrieved from Klient Solutech: http://www.klientsolutech.com/top-10-most-powerful-uses-of-microsoft-word/

Skeepers, N. C., & Mbohwa, C. (2015). A Study on the Leadership Behaviour, Safety Leadership and Safety Performance in the Construction Industry in South Africa. *Procedia Manufacturing*, *4*(Iess), 10–16. https://doi.org/10.1016/j.promfg.2015.11.008

Society must be prepared to face fourth industrial revolution, minister says. (2017, December 15). Retrieved from Malaymail: https://www.malaymail.com/s/1533255/society-must-be-prepared-to-face-fourth-industrial-revolution-minister-says

Taylor, M. J., McNicholas, C., Nicolay, C., Darzi, A., Bell, D., & Reed, J. E. (2014). Systematic review of the application of the plan-do-study-act method to improve quality in healthcare. *BMJ Quality and Safety*, *23*(4), 290–298. https://doi.org/10.1136/bmjqs- 2013-001862

Timofeeva, S. S., Ulrikh, D. V., & Tsvetkun, N. V. (2017). Professional Risks in Construction Industry. *Procedia Engineering*, *206*, 911–917. https://doi.org/10.1016/j.proeng.2017.10.571

Yiu, N. S. N., Sze, N. N., & Chan, D. W. M. (2018). Implementation of safety

management systems in Hong Kong construction industry – A safety practitioner's perspective. *Journal of Safety Research*, *64*, 1–9. https://doi.org/10.1016/j.jsr.2017.12.011

Yu, Y., Guo, H., Ding, Q., Li, H., & Skitmore, M. (2017). An experimental study of real-time identification of construction workers' unsafe behaviors. *Automation in Construction*, *82*(July 2016), 193–206. https://doi.org/10.1016/j.autcon.2017.05.002

Zhang, M., & Fang, D. (2013). A continuous Behavior-Based Safety strategy for persistent safety improvement in construction industry. *Automation in Construction*, *34*, 101–107. https://doi.org/10.1016/j.autcon.2012.10.019

Zin, S. M., & Ismail, F. (2012). Employers' Behavioural Safety Compliance Factors toward Occupational, Safety and Health Improvement in the Construction Industry. *Procedia -Social and Behavioral Sciences*, *36*(June 2011), 742–751. https://doi.org/10.1016/j.sbspro.2012.03.081

APPENDIX A
GANT CHART OF FINAL YEAR PROJECT I & II

Activities	SEMESTER 2 2017/2018					SEMESTER 1 2018/2019					
	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Brainstorming											
Preparing Research Proposal											
Submission of Research Proposal											
Presentation of Research Proposal											
Pilot Study								W4			
Data Collection									W7		
Preparation of Thesis											
Submission of Report										W11	
Viva											W12
Poster presentation											W14

APPENDIX B
TABLE LITERATURE REVIEW

NO	JOURNAL TITLE	AUTHOR	OBJECTIVE	SAMPLING	METHOD	FINDING
1	A system dynamics view of a behavior-based safety program in the construction industry	(Guo et al., 2018) Singapore	- Reducing unsafe behavior in nine categories. -To report a case study on a BBS program implemented in a construction project -To analyze the mixed effectiveness from a dynamic view	Case studies	-BBS elements: observations, feedback, goal setting, and interventions.	-Four interventions were used bbs program which goal setting, feedback, activity based- training and punishment with the method mesurement is observation by using Behaviour Based Safety checklist - Develop a BBS Checklist with consist of nine categories of safety behaviour in the checklist.
2	Behavior-based safety on construction sites: A case study	(Choudhry, 2014) Hong Kong	To develop and introduce a suitable method of measuring safety performance -To find ways for improving construction safety -To use a method to assess safety management, based upon proven techniques for changing work behavior thus improving site safety by fostering safe behavior.	Case studies	- Behavioral safety system and intervention program was implemented and deployed -Questionnaires and data collection process. -Use percentage rating scale for measurement level of behaviour.	- The results of intervention show large decreases in unsafe behaviors and significant increases in safe behaviors -use rating scale for measurement and has eleven point of rating. - it is shows that all country's culture can apply BBS techniques because it is a good approach for improving safety of the workers and it has industry wide application for ongoing construction projects.

3	An experimental study of real-time identification of construction workers' unsafe behaviors	(Yu et al., 2017). Beijing, China	- To improve safety performance		-An image-skeleton-based parameterized method - Carries out a series of experiments involving three types of unsafe behaviors to examine its feasibility and accuracy, and determines the value ranges of relevant key parameters.	-the results of the experiment demonstrate the feasibility and efficiency of the method, being able to identify and distinguish unsafe behaviors in real time, as well as its limitations.
4	Behavior-Based Safety Management in Hong Kong's Construction Industry	(Lingard & Rowlinson, 1997). Hong Kong	-Implementation of a behavior-based safety management program in the Hong Kong construction industry	-7 Public housing construction sites in Hong Kong	-BBS techniques: performance measurement, participative goal setting, and the provision of performance feedback.	-Categories of safety behaviours in the BBS checklist: Access to heights, Bamboo scaffolding, Personal protective equipment and Housekeeping -BBS techniques were highly effective in bringing about improved performance in site housekeeping, but significant improvements in access to heights were only observed on two of the seven sites, and was found to be no significant improvement in the use of bamboo scaffolding during the experimental intervention
5	A continuous Behavior-Based Safety strategy for persistent safety improvement in construction industry	Zhang & Fang , 2013) Beijing, China	-Proposes a continuous BBS strategy through integrating the BBS practice into management routine	-2 contruction site -workforce around 200 persons during the study, with one main contractor and 4–5	- Developed Supervisory-Based Intervention Cycle (SBIC) and a Behavior-Based Safety Tracking and Analysis System (BBSTAS) to achieve the integration at site and organizational level. -In SBIC:	- Applications of the SBIC and BBSTAS are presented and discussed, indicating that the continuous BBS strategy is a potential approach to achieve persistent safety improvement in construction industry. - Develop a BBS Checklist with consist of nine categories of safety behaviour in the checklist - Krause et al.'s, (1999) examined the result proved the number of incidents is decrease in five year of collected injury data from 73 construction companies who implemented BBS.

				subcontractors) - 2 safety officers and several safety supervisors from the main contractor	1. Feedback, goal setting and training for foremen. 2.Training for workers 3.Observation and interaction -In BBSTAS: composed of four modules (Admin, input, analysis and help)	
6	Behaviour based intervention for occupational safety – case study	(Jasiulewicz-Kaczmarek et al.,2015) Poland	-To characterize and the examples of good practices within this area implemented in businesses running in Poland.	-Case studies	- Peer observation and feedback, training and education sessions, behaviour-based incentives, prompts, and goal setting.	-By increasing the quality and frequency of safety feedback in the organization, barriers between employees both within and across organizational levels are reduced. - By applying BBS in the workplaces, there showed a numerous benefit likes less the number of accidents or injuries and increase awareness of employees
7	Behavior Based Safety for Accidents Prevention and Positive Study in China Construction Project	(Chen & Tian, 2012) China	To designed experiment course of BBS in China construction enterprise based on BBS research situation.		- DO IT Process -Safety Index (SI) change trend chart was established and SI was used to evaluate safety behavior and change trend	-The experiment results showed that BBS made remarkable performance on accident prevention and the trial employee's SI was enhanced 15% than base line during the experiment. -BBS method designed in this paper was effective and adaptable to construction enterprise in China.
8	Employers' Behavioural Safety Compliance Factors toward Occupational, Safety and Health Improvement in the Construction Industry	(Zin & Ismail, 2012) Bandung, Indonesia	- To identify employers' behavioural safety compliance factors contribute to encourage employees' towards behavioural safety compliance.	-Pilot study	-Conducting preliminary pilot study using five Likert scales of interview questionnaires survey	- two important elements were included in the BBS Checklist: no compliance to manual handling and personal protective equipment practice. - Two techniques to obtain and analyse data: 1. Using marking form that purpose is to obtain the factor contributes of each interviewee 2. Percentage method

9	A behaviour-based safety approach for construction projects	(Salem et al., 2007)	-To provide a decision support system, which will assist construction companies in implementing behaviour-based safety.	Pilot study	-Developed model rating system which can quantify and evaluate the performance of different sub-contractors working for the primary contractor	-Most of the groups participating in the study showed an improvement in at least three of the safety-based behaviours. Some groups showed improvement in more than six behaviours -There are the element of behaviour workers in workplace: ppe, housekeeping, physical environment n controls, fall protection, tool & equipment, body position & ergonomic. - The rating system will use and this value was termed as the safety rating to know the level of behaviour
10	Behavior-Based Safety Approach at a Large Construction Site in Iran	(Oostakhan & Talab, 2012). Iran	- To describe the prevention of accidents, injuries and loss in the workplace. - To understand how unsafe behaviors lead to injuries and how to eliminate them from the workplace.		-For this purpose experiment and control groups were selected and performance feedback of workers about unsafe and critical behaviors has been reviewed. -Use a T- test to calculate the data whether it is unsafe or safe behaviours	-Test results show that among the critical behaviors, using ladder correctly among the workers had good feedback, but there is still a problem in concrete pouring behavior. -Safety performance index of the experimental group has changed from 66% to 92%.
11	Constructing a Bayesian network model for improving safety behavior of employees at workplaces	(Mohammadfam, Ghasemi, Kalatpour, & Moghimbeigi, 2017) Iran	-To provide a model for managing and improving safety behavior of employees using the Bayesian networks approach.		-The data were collected using a questionnaire. -using experts' opinions and Dempster-Shafer theory.	-The result of the present study demonstrated that the majority of employees do not tend to consider safety rules, regulation, procedures and norms in their behavior at the workplace. --Safety attitude, safety knowledge, and supporting environment were the best predictor of safety behavior. - To prevent accidents in the workplace, it is must find deficiencies which make individuals vulnerable to unsafe behaviour and then start attempting to resolve them
12	Factories and Machinery (Building Operations and Works of	Regulations apply: to building operations and to works				2.6 Bowec requirements: - This guideline contains Xvii parts

	Engineering Construction) (Safety) Regulations 1986	of engineering construction				
13	Applicability of unmanned aerial system (UAS) for safety inspection on construction sites	(Melo, Costa, Álvares, & Irizarry, 2017)	-To assess the applicability of UAV for safety inspection on construction sites	- Two case studies	- Use of Unmanned Aerial Vehicles/Systems (UAV/UAS) for transportation and jobsite monitoring.	- The results show that the visual assets collected by UAV can improve the safety inspection on jobsites by means of a better visualization of working conditions
14	Malaymail Online (Society must be prepared to face fourth industrial revolution, minister says December 15, 2017 Kuala lumpur)					-Salleh said that Industrial Revolution 4.0 was significant because it replaced many functions in the first, second and third revolution with automation aided by software. - "This industry was also significant because it boosted management efficiency and delivery system because all transactions were carried out digitally," he said in his blog entry - According to Salleh, Industry 4.0 would bring significant changes including to the traditional media industry when people only needed to use the smart phone and computer to read news and no longer needed the newspaper.
15	Professional Risks in Construction Industry	(Timofeeva et al., 2017)	-Analyses the occupational risk assessment methods recommended in the normative documents and scientific publications.		-Assessment of risk in construction industry	According to the assessment results it is established that the electric and gas welder, bricklayer, concrete worker, carpenter are constructional occupations with the greatest occupational risks.
16	Behavior-based safety behavior-based safety & injury reduction:	(Sulzer-Azaroff & Austin, 2000).	to develop Behaviour Based Safety at the workplace,			fundamental elements: 1) Identify (or target) behaviors 2) Define these behaviors precisely enough to measure them reliably. departments that met or exceeded goals;

	A survey of the evidence					intervention, several 3) Develop and implement mechanism helping for measuring those behaviors in order to determine their current status and set reasonable goals. 4) Provide feedback. 5) Reinforce progress.
17	Behaviour Based Safety and occupational risk management	(Geller, 2005)	-To teach BBS to safety leaders and line workers. - A conceptual model is proposed for matching the awareness and behavior of an individual with a particular BBS intervention technique			1.Focus intervention on observable behavior 2. Look for external factors to understand and improve behavior 3. Direct with activators and motivate with consequences Focus on positive consequences to motivate behavior 5. Apply the scientific method to improve intervention? – do it process 6. Use theory to integrate information, not to limit possibilities
18	Behaviour Based Safety Initiative Helps a Large Gold Mining Facility Win "Most Improved" Safety Award	(Boyce, 2018) Northern, Nevada	-To introduce BBS to workforce -To obtain buy-in and thus motivate participation from the front-line workers. -To teach the use of CBC designed by steering team		-steering team -training	DO IT process have four step of problem solving process that teaches employees the principles of the scientific method applied to safety with a focus on observable behaviour.
19	Final Year Project (FYP) Portal	(Abdullah, 2017) Malaysia	-To evolve manual registration to online system. -To develop online system that provide supervisor availability view.		-Rapid Application Development (RAD)	- Rapid Application Development (RAD) is chosen as a software development process - Its combination elements of the system planning and systems analysis phases in the Systems Development Life Cycle (SDLC). - Microsoft Visual Studio: An integrated development environment (IDE) from Microsoft. It is used to develop computer programs for Microsoft Windows, as well as web sites, web applications and web services.

			- To automate the process of PSM supervisor task. -To develop online system with dashboard element for PSM 1 only.			
20	Why information Systems need are so important to your business	(Black, 2017) New Zealand				- Information systems are convenient when it comes to storing data you'll need in a few years' time. -For example, successful newspapers keep their photos safely stored in a data archive. The data archive can be opened and used later on to find the photos, if needs be. -Saving your data manually with registers and hard-copy formats will cost you lots of time. -Searching for specific data can also be a very time-consuming process this way. -A quality information system groups your important data by date and time, making the process of finding it really convenient.
21	The Plan-DO-Check-Act Cycle of value Addition	Beshah B (2014) Ethiopia	-To visualize and evaluate the value addition process as a continuous process using the four stages of PDCA cycle - To identify the core functions that the literature dropped out from consideration in the value addition process.			- The PDCA cycle is a renowned continuous quality improvement approach and has been widely used by many successful companies as a strategic weapon for enhancing organizational performance. - There are important characteristics and contents of the four stages of PDCA cycle.

APPENDIX C
BBS CHECKLIST FOR EMPLOYER AND EMPLOYEES

Employer's Checklist

Part I: General Provisions				
Summary Item	Yes	No	Not Applicable	Remarks
Hazards				
• Training and adequate equipment are provided for employees who are exposed to drowning hazard				
• Ensure to not use passageway, scaffold, platform or other elevated working surface in slippery condition (slipping hazard)				
• Ensure all passageways, platforms and other places are free from accumulations of dirt and debris (tripping and cutting hazards)				
Personal Protective Equipment				
• Supply by employer				
• Regular inspection is carried out				
Management				
• Appointed part time Site Safety Supervisors				
• Appointed part time Contractor Safety Supervisors				
• Established Safety Committee				
Provision of Safe Workplace				
• Stairways, ramps or runways are provided as means to access to working levels above or below				
• Barricades, warning signs and guard are provided				
• Sufficient illumination (not less than 50lux) are provided				
• Ensure all passageways, platforms and other places are free from accumulations of dirt and debris (tripping and cutting hazards)				

Part II: Concrete work in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Professional Engineer				
• A Professional Engineer is provided for specification and to design all concrete work				

Part III: Assembly of structural steel and precast concrete in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Lifting Activity				
• Tag line, scaffolds and safety belt are provided during lifting activity				

Part IV: Good and safe condition of roof, gutters, windows, louvres and ventilators in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Duties of Employer				
• Periodical cleaning and maintenance are provided to maintain good and safe order in all means of access to roofs, gutters, windows, louvers and ventilators				
Working at Height				
• Roofing brackets or crawling boards are provided where work is being performed on roof				
• Procedure and measurement of BOWEC regulations are provided for construction and installation of roofing brackets and crawling boards				

Part V: Use of safety belts in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Use Safety Belts and Life Lines				
• Safety belt and life lines are provided with adequate strength and types approved by Chief Inspector				
• A Designated Person is provided to inspect every safety belt and life lines				

• Padding, wrapping or similar means are provided to protect every life line from contact with edges or object which may cut out or severely abrade it				

Part VI: Use of ladders and step-ladders in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Use of Ladders and Step-Ladders				
• Ladders and step-ladders are provided with good construction, sound material and good strength for purpose for which it is used				

Part VII: Use of scaffolds in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Use of Scaffolds				
• Scaffold is provided with good construction, suitable and sound material and adequate strength				
• Maintenance of scaffolds is provided				
• Professional Engineer is provided for design and drawings scaffolds				
• Inspection is provided by a Designated Person within seven day preceding				
• Inspection is provided by a Designated Person since its exposure to weather conditions is likely to have affect its strength or stability or to have displace any part				
• Working platform with guard- rails and toe-boards are provided from which a person is liable to fall more than 3 metres				

Part VIII: Demolition work in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Work of Demolition				
• Warning sign and barricades are provided during demolition work				
• Ensure removed all glass and capped all electric, water, steam and other supply lines before demolition work				

• A Designated Person is provided to inspect demolition work				
• BOWEC Regulations is provided to comply all methods of demolition				
• Safe access and egress is provided to every building involved with demolition work				

Part IX: Excavation work in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Protection During Excavation Work				
• Substantial guard-rails or board fences are provided for all public walkways, sidewalks and the thoroughfares bordering on or running through any excavation				
• A flagman is provided to warn the public of the approach of trucks and to direct the trucks in and out of the property				
• Danger or warning signs are provided at all truck entrances and exits				
• Warning lights or flares are provided during darkness at all public sidewalks to ensure safety for pedestrian ad vehicular traffic				
• Provides support to stability of structure over areas to be excavate by underpinning, sheet piling, shoring and bracing according to design Professional Engineer to prevent injury to any person				
• A Designated Person is provided to check excavation site after every rainstorm or other hazard increasing occurrence and the protection against slides				
• Warning sign and adequate barricades are provided at position for open sides excavation where person may fall more than 3 metres				

Part X: Handling and storage, use and disposal of material in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Place of Material Storage, Use and Disposal				
• Ensure employees to stack, block, interlock and limit height all materials in bags, container or bundles and other material stored in tiers				
• When any material is stored in public thoroughfares, employees are ensured to locate it to prevent the least possible hazard to and interference with the traffic and the public				
• Unauthorised persons are not allowed to enter on or around the place of material store				
• Suitable place is provided to store material inside buildings under construction				
• Storage is provided to segregate unused materials				
• Fire regulations are provided to comply all disposal waste material or debris by burning				
• Fire-resistant cover containers are provided to employees to keep all solvent waste, oily rags and flammable liquids in fire-resistant cover containers until they are removed from worksite				

Part XI: Use of piling in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Protection During piling				
• A Designated Person is provided to inspect all pile-driving equipment before starting the work				
• An Approved Person is provided to examine every piling frame and its attachment at least once in every twelve months				
• A Designated Person is hired to instruct each member of the pile-driving crew in the work on what he has to do and charge the operation who personally				

directs the work and gives operating signals				
• A Designated Person is provided to supervise the testing of piles				
• A Designated Person is provided to inspect ground before placing pile driver				
• A Designated Person is provided to inspect and correct of the footing after placing a pile driver				

Part XII: Blasting work and use of explosives in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Use of Explosives				
• Provides manufacturer's instructions or a Designated Person to employees who are handle of explosives				
• Prohibit employees to smoking, open lights or sparks producing device in or around of any explosives				
• Provides warning sign in national language for storage enclosures of any explosives				
• Prohibit drilling holes contained explosives				
• Ensure all use of explosives and handling of explosives stopped immediately during a thunderstorm				
Safe Work of Blasting				
• Provides sound a warning before blasting operation to all persons within the danger zone				
• Provides life and property protection and warning notices given to all residences before the blasting operation				
• Ensure all persons in area of blasting operation seek a safe place if a thunderstorm occur and stopped the blasting operation immediately				

Part XIII: Use hand and power tools in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Use of Hand and Power Tools				
• Hand and power tools are provided and maintained in safe condition				
• When power-operated tools are designed to accommodate guards, such guards are provided when in use				
• Electrical Inspectorate Regulations are provided to insulate electric power-operated tools				
• Training is provided for employees who work with power-actuated tools				
• Method of testing in accordance with manufacturer's recommended procedure (Power Actuated Tools) is provided for employees to test the tools each day before loading to see that safety device are in proper working condition				

Employee's Checklist

Part I: General Provisions				
Summary Item	Yes	No	Not Applicable	Remarks
Hazards				
• Know about drowning hazard and employees who are exposed to drowning hazard use adequate equipment and adequate training				
• Do not use passageway, scaffold, platform or other elevated working surface in slippery condition (slipping hazard)				
• All passageways, platforms and other places are free from accumulations of dirt and debris(tripping and cutting hazards)				
Personal Protective Equipment				
• Worn when required				

• Store in closed containers for respirators				
Management				
• Know who are Site Safety Supervisors and Contractor Safety Supervisors				
• Know who are Safety Committee and involve with Safety Committee				
Provision of Safe Workplace				
• Use stairways, ramps or runways provided as means of access to working levels above or below				
• Materials and Equipment are stored in a safe place				
• Every means of access are numbered or marked				

Part II: Concrete work in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Professional Engineer				
• All concrete work follows Professional Engineer's specification and design by Professional Engineer				

Part III: Assembly of structural steel and precast concrete in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Lifting Activity				
• Use tag line, scaffolds, safety belt during lifting activity				

Part IV: Good and safe condition of roof, gutters, windows, louvres and ventilators in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Duties of Employees				
• Maintain in good and safe order all means of access to roofs, gutters, windows, louvres and ventilators				
Working At Height				
• Use roofing brackets or crawling boards where work is being performed on roof				
• Carry out the construction and installation of roofing brackets and				

crawling boards by following the procedure and measurement of BOWEC regulations				

Part V: Use of safety belts in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Use Safety Belts and Life Lines				
• Use safety belt and life lines with adequate strength				
• Use padding, wrapping or similar means to protect every life line from contact with edges or object which may cut out or severely abrade it				

Part VI: Use of ladders and step-ladders in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Use of Ladders and Step-Ladders				
• Use ladders and step-ladders with good construction, sound material and good strength				

Part VII: Use of scaffolds in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Use of Scaffolds				
• Use scaffold in good construction, suitable and sound material and adequate strength				
• Design and drawing scaffolds by following Professional Engineer				
• Do not use scaffolds since its exposure to weather conditions is likely to have affect its strength or stability or to have displace any part until inspected by a Designated Person				
• Use working platform with guard-rails and toe-boards from which a person is liable to fall more than 3 metres				

Part VIII: Demolition work in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Work of Demolition				

• Use warning sign and barricades during demolition work				
• Removed all glass and capped all electric, water, steam and other supply lines before demolition work				
• A Designated Person makes inspection for demolition work				
• Comply with BOWEC Regulations for methods of demolition				
• Use safe access and egress to every building involved with demolition work				

Part IX: Excavation work in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Protection of The Public During Excavation Work				
• Use all public walkways, sidewalks and the thoroughfares bordering on or running through any excavation with substantial guard-rails or board fences				
• Use a flagman to warn the public of the approach of trucks and to direct the trucks in and out of the property				
• Use danger or warning sign at all truck entrances and exits				
• Use warning lights or flares during darkness at all public sidewalks to ensure safety of pedestrian and vehicular traffic				
• Use underpinning, sheet piling, shoring and bracing according to the design by Professional Engineer to support stability of structure over areas to be excavate to prevent injury to any person				
• Use Designated Person to check excavation site after every rainstorm or other hazard increasing occurrence and the protection against slides				
• Use warning sign and adequate barricades at position for open sides excavation where person may fall more than 3 metres				

Part X: Handling and storage, use and disposal of material in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Place of Material Storage, Use and Disposal				
• Stack, block, interlock and limit height all materials in bags, container or bundles and other material stored in tiers				
• Where any material is stored in public thoroughfares, locate it in which to least possible hazard and interference with the traffic and public				
• Unauthorised persons do not enter on or around the place of material store				
• Use suitable place to store material inside buildings under construction				
• Use storage to segregate unused materials				
• Remove all waste materials and rubber form the immediate work area as the work progresses				
• Comply with fire regulations all disposal waste material or debris by burning				
• All solvent waste, oily rags and flammable liquids are kept in fire-resistant cover containers until they are removed from worksite				

Part XI: Use of piling in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Protection During piling				
• Chock or block in the leads or lower to the ground the hammer when the pile drive is not in use				
• Inspect all pile-driving equipment before starting the work by Designated Person				
• An Approved Person examines every piling frame and its attachment at least once in every twelve months				
• A Designated Person instructs each member of the pile-driving crew in the work he has to do and charge the				

operation who personally directs the work and gives operating signals				
• A Designated Person supervises the testing of piles				
• A Designated Person inspects ground before placing pile driver				
• A Designated Person inspects and corrects the footing after placing a pile driver				

Part XII: Blasting work and use of explosives in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Use of Explosives				
• Handle of explosives in accordance with manufacturer's instructions or immediate control by a Designated Person				
• Not smoking, open lights or sparks producing device in or around of any explosives				
• Use warning sign in national languages for storage enclosures of any explosives				
• Not drilling holes contained explosives				
• All use of explosives and handling of explosives stopped immediately during a thunderstorm				
Safe Work of Blasting				
• Sound a warning to all persons within the danger before blasting operation				
• Use life and property protection and given warning notices to all residences before blasting operation				
• Stopped a blasting operation immediately if a thunderstorm occur and person in area seek a safe place				

Part XIII: Use hand and power tools in construction site				
Summary Item	Yes	No	Not Applicable	Remarks
Safe Use of Hand and Power Tools				
• Use guards when power-operated tools are designed to accommodate guards				
• Do not use unsafe hand tools				

• Use Electrical Inspectorate Regulations to insulate electric power-operated tools				
• Stop all fuel-powered tools while being refuelled, serviced or maintained and transport, handle and store fuel safely				
• Only who have been trained are allowed to operate power-actuated tools				
• Test tools each day before loading to see safety device are in proper condition by following the method of testing in accordance with manufacturer's recommended procedure (Power Actuated Tools)				