Title	Proposal of motivating Thai construction workers by recognizing their behaviour to wear personal protective equipment
Sub Title	
Author	Jianpinitnan, Roongratsamee(Toma, Tetsuya) 当麻, 哲哉
Publisher	慶應義塾大学大学院システムデザイン・マネジメント研究科
Publication year	2018
Jtitle	
JaLC DOI	
Abstract	
Notes	修士学位論文. 2018年度システムデザイン・マネジメント学 第303号
Genre	Thesis or Dissertation
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=K040002001-00002018-0002

Master's Dissertation **2018**

Proposal of Motivating Thai Construction Workers by Recognizing Their Behaviour to Wear Personal Protective Equipment

Roongratsamee Jianpinitnan

(Student ID Number: 81634520)

Supervisor: Professor Tetsuya Toma

September 2018

Graduate School of System Design and Management, Keio University

Major in System Design and Management

SUMMARY OF MASTER'S DISSERTATION

Student Identification Number	81634520	Name	Roongratsamee Jianpinitnan

Title

Proposal of Motivating Thai Construction Workers by Recognizing Their Behaviour to Wear Personal Protective Equipment

Abstract

Due to the management issue, especially in the "quality" aspect, it is difficult for Thai construction owners to increase their productivity. To improve the quality of the work and mitigate the number of accidents, construction companies should invest more in safety culture. Safety culture will be successful if there is involvement of every stakeholder ranging from the top (owner) to bottom (worker) levels. Apparently, they still have different perspectives on safety culture. Bottom levels tend to have low safety awareness and motivation. The top major unsafe act which leads to an accident in Thai construction is the failure of workers to wear Personal Protective Equipment (PPE). Thus, investigating to get an appropriate incentive to make workers want to wear Personal Protective Equipment (PPE) with their own willingness, not forcing to wear is a key idea to improve Safety culture in Thailand. This solution is the starting point of Thai safety culture, which may improve quality and productivity in Thai construction projects. Besides, it may consequently moderate project management issue in Thai construction projects.

This research is focused on motivating construction workers to wear PPE. Safety motivation is a key factor affecting safety performance and worker performance. In order to increase the worker's motivation, an appropriate incentive for workers is needed. Through the results from surveys and experiments, little interviews with a contractor owner, and managers, recognition cannot be the main incentive award for construction workers in Thailand. Recognition without reward (non-financial) is not enough for Thai construction workers to be motivated. Therefore, there must be a financial reward system applying in this incentive program for Thai construction industry. This research found a key to make workers have positive perspectives towards personal protective equipment (PPE) and the result showed that workers' willingness to keep wearing personal protective equipment also have changed to the way this research is expected to be.

Key Word (5 words): Incentive; Safety; Motivation; Sticker Rewards; Personal Protective Equipment

Table of Contents

List of Figures

List of Tables

CHAPTER 1: INTRODUCTION

1.1 Background of Study

In Thai construction industry, especially small and medium-sized construction companies have been suffering from the project management problem. They hardly manage the project quality high and deliveries on time without cost overruns. Many studies also mentioned that "poor management is the main reason for poor construction productivity" (Makulsawatudom & Emsley, 2001, p. 209). The obvious issue that Thai construction companies are currently facing is the lack of construction workforce, the turnover rate in each project is getting higher which leads to "quality" issue, not only quality of the work but also the workers' performance.

Nowadays, quality and safety are the two main issues in the construction industry. Alves Dias and Coble found that "Construction safety is a standard of quality that is indicated in the contract and required by the client" (Misnan & Mohammed, 2007, p. 14). The construction industry has a high occupational accident rate in comparison to other industries. It is the industry with unique characteristics and complex system as its involved many stakeholders and often operates under the risk and dangerous condition which causes the high rate of accidents. To improve the quality of the work and mitigate the number of accidents, construction companies should invest more in safety culture. It is important to understand the key factors affecting safety performance improvement, particularly workers' safety motivation. In 2007, Aksorn and Hadikusumo revealed that the failure of workers to wear personal protective equipment is the top major unsafe act in Thai construction which lead to an accident. The factors causing this issue are mainly found in personal factors which are overconfidence, being uncomfortable, past experience. These personal factors are workers' reasons and excuses to reject wearing PPE. Regarding the issues as mentioned above, it is important to investigate on what is the main factor affecting safety performance and quality aspect as well as propose a solution to eliminate these issues.

1.2 Problems in Construction Projects

Problems are common things happened in construction works. It's because of construction projects involve many direct and indirect stakeholders such as client, contractor, worker, supplier and etc. The interaction of stakeholders is an important relation to the progress of construction works. There are three main stakeholders work close to each other in the process of managing the construction system. They are Client, Designer and Contractor as shown in Figure 1.

The commonly found problems in construction projects which this research focuses on are Shortage of skilled workforce and quality in term of construction management.

First, according to nhconcept website (n.d., para.3), shortage of skilled workforce is a crucial problem in Thai construction industry at this moment. Currently, around 2-3 million migrant workers work in the construction sectors. These migrant workers are including both skilled and unskilled workers. Finding skilled-workers is important for constructing quality buildings. Selecting unskilled workers may cause a big impact on the quality of work also leads to other project management aspects.

Second, Construction management is a process to control a construction project's time, cost and quality. Referring to the shortage of skilled-workers problem, the contractor is still facing the problem of controlling worker's quality.

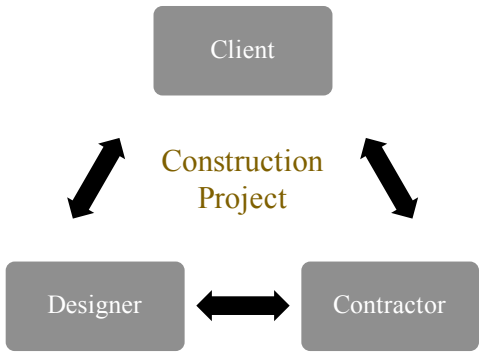


Figure 1 Stakeholders involved in construction project

1.3 Overview of Occupational Safety, Health and Environment in Thailand

In Thailand, small and medium enterprises play a significant role in driving Thai economic development. However, a huge number of accidents and diseases occurred in these enterprises (Chaikittiporn, n.d.). Thai government has recognized the importance of Occupational Safety and Health issues. The main government authority who provides the direction of occupational safety and health in Thailand is Department of Labour Protection and Welfare. They had published a report, National Profile on Occupational Safety and Health of Thailand, 2015 to summaries their action and promote their goal in reducing preventable occupational accidents and illness (Ministry of Labour, 2015, p.1).

The statistics data from the Office of Workman's Compensation Fund in the report shows the injury rate was decreased in the past 10 years (2002-2014). It obviously reflects that advancement of Thailand's labour-related safety and health measures and policies have been moving forward. However, considering the statistics on cases of occupational accidents and injuries for the year 2014 in Table 1, it is shown that construction was one of the top3 establishments with high accident and injury rates. It was also one of the top3 establishments with the high number of cases causing death. In addition, the number of construction workers who suffered from illness or decease while working still remained high.

Since 2007, Thailand's national agenda was to attain the goal of witnessing the safer and healthier workforce. The Ministry of Labour, Department of Labour Protection and Welfare of Thailand aimed to achieve this goal by monitoring and make sure that all workers are safe while working. With the establishment of the ASEAN Economic Community (AEC) in 2015, it promoted and allowed skilled-workers to freely work mobility across the region. It is a significant role for each country to take care of these migrant workers to work safely in accordance with the ASEAN agreement. In 2016, Department of Labour Protection and Welfare of Thailand, therefore, had officially produced education media on occupational safety, health and environment in construction work for Thai and migrant workers. The safety promoting video is available in 6 different languages which are in Thai, English, Laotian, Myanmar, Cambodia and Vietnamese. The purpose is to provide easy and accessible basic occupational safety knowledge for Thai and Non-Thai workers to learn how to prevent themselves from accident and injury. The Department of Labour Protection and Welfare has

emphasized that occupational safety and health won't be accomplished and become sustainable unless all sectors work together in creating safety awareness and conscience as well as continue doing practice. It is necessary and important for everyone to cooperate in order to create an organizational safety culture and then it will become Thailand's national safety culture in the future. The values of the mission from The Department of Labour Protection and Welfare are presented in Figure 2 (Safety Construction Thai, 2017).

Table 1 Cases of Occupational Accidents and Injuries by Type of Establishment, 2014

Type of Establishment/Manufacturer	No. of Decided Cases					All Cases
	Death	Disability	Loss of Organ	Leave Work >3 days	Leave Work <3days	
Survey/Mining	5	0	9	173	227	414
Food/Beverage	43	1	139	2,688	5,783	8,654
Textile/Ornament	10	0	89	1,266	2,742	4,107
Forestry/Wood Products	5	1	82	1,302	1,721	3,111
Paper Products/Printing	10	0	42	876	1,529	2,457
Chemicals/Petroleum	27	0	209	2,581	5,753	8,570
Non-metal Products	21	0	48	877	1,561	2,507
Basic Metals	8	0	115	1,349	3,663	5,135
Metal Products	30	2	345	4,465	12,127	16,969
Vehicle Assembly	11	0	112	1,547	5,357	7,027
Other Manufacturing	0	0	15	266	782	1,063
Energy/Utilities	14	0	5	159	200	378
Construction/Installation	104	4	69	4,459	7,004	9,640
Transportation	119	2	38	1,378	2,200	3,737
Commercial	107	2	115	4,081	8,865	13,170
Other Establishments	111	2	53	3,858	9,425	13,449
Total	625	14	1,485	29,328	68,940	100,392

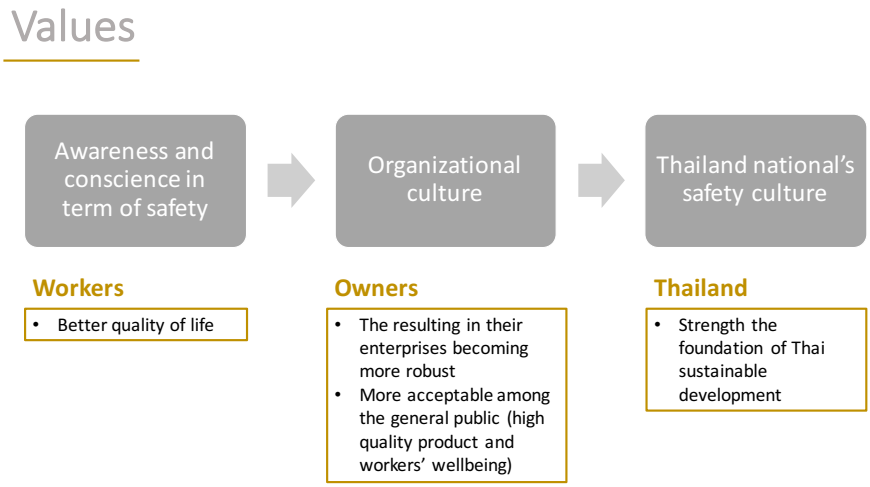


Figure 2 Values of the mission from The Department of Labour Protection and Welfare

1.4 Research Purpose

In the background described earlier, the failure of workers to wear personal protective equipment (PPE) is the major issue in causing an accident and that can be indicated as low safety performance. Therefore, the purpose of this research is to change worker's perspectives towards PPE by providing an appropriate incentive to eliminate unsafe acts in Thai construction. An appropriate incentive will increase workers' willingness to keep wearing PPE for a longer period of time and wear them in a proper way. The impact of this research may help Thai construction company to succeed in safety culture and after all, it will improve Thai construction management and productivity in Thai construction projects. The problems in Thai construction particularly, quality and safety in Thai construction can be eliminated. Since the construction industry is relied on worker productivity, increasing quality and worker's performance are crucial things to be considered. This research paper is intended to be a starting point for the future development of Thai construction industry.

1.5 Thesis Structure

This thesis structure is composed of these following chapters. Chapter 1 introduces the topic background and research purpose. Chapter 2 summarizes general background information and related literature. Chapter 3 explains findings and hypothesis. Chapter 4 describes research methodology and shows idea developments and proposal. Chapter 5 describes experiment and analysis methods. Chapter 6 discusses findings and gives recommendations for the future possibility. Chapter 7 concludes and summarizes the thesis.

CHAPTER 2: LITERATURE REVIEW

This chapter starts with reviewing existing literature related to construction management problems, safety issues in the construction industry, particularly in Thailand, safety culture, the cause of accidents, personal protective equipment (PPE), worker's motivation theories, cultural dimension theory and education gap in Thailand. With regard to these topics, this research has found the way to generate an appropriate solution for the future of Thai construction.

2.1 Construction Management and Safety

As mentioned in the problems in the construction part, construction management is a process to control a construction project's time, cost and quality. Makulsawatudom and Emsley (2001, p.290) cited that there are many studies also mentioned that "poor management is the main reason for poor construction productivity".

Most of the literature was found regarding Time delays issue (Phonton, 2012; Panthong, 2012; Toor and Ogunlana, 2008; Sambasivan and Soon, 2006). Many researchers attempted to find the causes behind project time delays. However, clients don't focus only on this aspect. They traditionally measure contractor performance by cost, quality, and time. Smallwood and Venter (2001, p.1) indicated that the environment, health and safety, productivity and worker satisfaction also affect performance relative to cost, quality and time.

In 2000, a customer satisfaction model was developed. The research conducted in the USA by Cook et al. In this model, it is composed of 5 satisfaction quality dimensions: safety; project management; contractor/customer relationship; cost, and prepared/skilled workforce. Safety in this model means contractor understand and follow safety regulations, keep a workplace safe and hire workers who have safe work habits. Furthermore, the poor image of contractors reflects contractor performance in term of low quality, high cost, late delivery, high accident rate and more (Smallwood & Venter, 2001, p.2). It, therefore, shows how safety also plays a significant role in a customer satisfaction and image of contractors. It can be seen that it matches with Misnan and Mohammed found (2007, p.14). "Construction safety is a standard of quality that is indicated in the contract and required by the client".

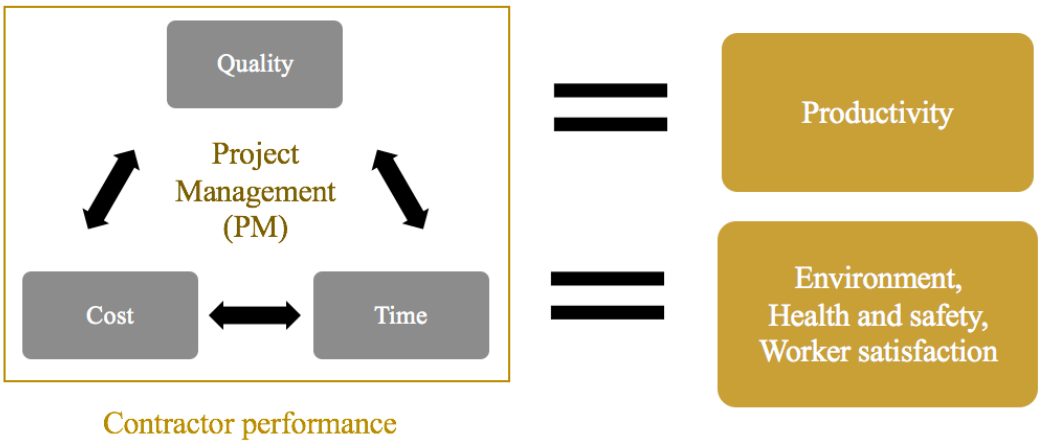


Figure 3 Project management in construction industry is related to contractor performance

2.2 Safety Culture

This Safety culture term was first introduced by the historical major accident, Chernobyl disaster in 1986. Since then, safety culture was taken into consideration as a vital element in the achievement of safety standards.

The International Atomic Energy Agency (IAEA) (2015) defines a strong safety culture as "the assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance."

2.2.1 Safety Culture Structure Model

The illustration in Figure 4 is the safety culture structure model developed by Kenichi Takano. Safety culture can be explained in details based on 2 domains. The first domain is based for organization climates which determines the overall effectiveness of the organization over worker's behaviour. Another domain is bases for organization operations. It refers to an organizational routine in performing business. These 8 components of the Safety Culture model are closely related to each other. They must be cared properly to create an effective safety culture. The model detail is described below.

The first domain consists of 4 components;

- Motivation: It is one of the key points in Safety Culture. For the improvement of safety and job satisfaction, incentives must be given to workers.
- Governance: Top management enforces all workers to comply with safety culture activities.
- Commitment: Everyone in the organization takes responsibility to keep maintaining safety.
- Communication: The involvement of all workers is needed. Everyone has to share and exchange safety information. It is, therefore, human-relations to ensure that all members coordinate to do safety.

The second domain also is composed of 4 components;

- Awareness: Workers know about risks and be able to react to hazards.
- Learning and Training: Top management provides safety knowledge and training to their workers. It helps workers to understand the safety in the workplace.
- Work Practice: It refers to continue performing safety and effectively maintain safety.
- Resource Allocation: Well prepared financial, human, and material resource for safety in the organization.

Figure 4 Safety culture structure model developed by Kenichi Takano

2.2.2 Possible Improvements for Safety Culture in Construction Industry

The construction industry has been knowing as the industry with high accident and injury rates. It can be reflected poor safety culture (Misnan et al., 2006). Improvement of occupational safety and health culture affects occupational safety and health performance. Misnan and Mohammed (2007, p.19) suggested that the root problem in safety culture in the construction industry is human behaviour. The possible improvements of worker's behaviour influence on safety performance are better planning, more effective job design, or more comfortable personal protection.

2.3 Cause of Accidents

2.3.1 Domino Theory by Herbert W. Heinrich

W.H. Heinrich (1931) stated that 88% of all accidents are caused by human's unsafe acts, 10% are caused by unsafe machines and only 2% are acts of God which are something unpreventable. He had developed domino theory, the 5 components in accident sequence are Social Environment and Ancestry, Fault of Person, Unsafe Act or Unsafe Condition, Accident, and Injury or Damage. When a domino falls, it affects other dominoes continuously. (Simachokdee, & Chalermjirarat, 2017, p.20). To prevent these sequential events, removing the cause of the accident is a key.

It can be concluded that the cause of the accident consists of 2 reasons.

- Unsafe Acts: It is the main cause of accidents which can be calculated as 85% of all accidents.
- Unsafe Condition: Only 15% of all accidents are caused by this reason.

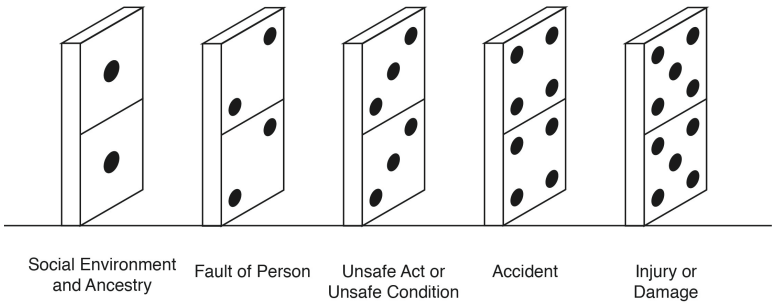


Figure 5 Heinrich's Domino theory

2.3.2 Unsafe Acts

There are many papers mentioned that worker's unsafe acts are the main reasons causing accidents and injuries, rather than poor site conditions. (Aksorn & Hadikusumo, 2007, p.2) The Unsafe acts are considered as one of the main reasons for workers' accidents in every industry, and in this case construction industry. Worker's unsafe acts may occur in 2 conditions. First, Workers don't know that their actions are unsafe. This condition can be easily solved by giving them training, frequently do the safety inspection and etc. The second condition is called "Worker's decision-to-err" which means workers know that they act unsafely but still continue doing it.

To investigate what are the major unsafe acts and the decision-to-err factors which causing accidents in Thai construction sites, Aksorn and Hadikusumo's findings were reviewed. The 3 major unsafe acts which frequently occur in Thai construction sites are the failure to wear personal protective equipment (PPE), improper lifting or handling of materials, and keeping sharp objects in dangerous locations. And, the decision-to-err factors are lack of management support, management pressure, group norms, overconfidence, being uncomfortable, past experience and laziness. Figure 6 shows the 4 major factors causing to the decision-to-err and each factor can be separated as below.

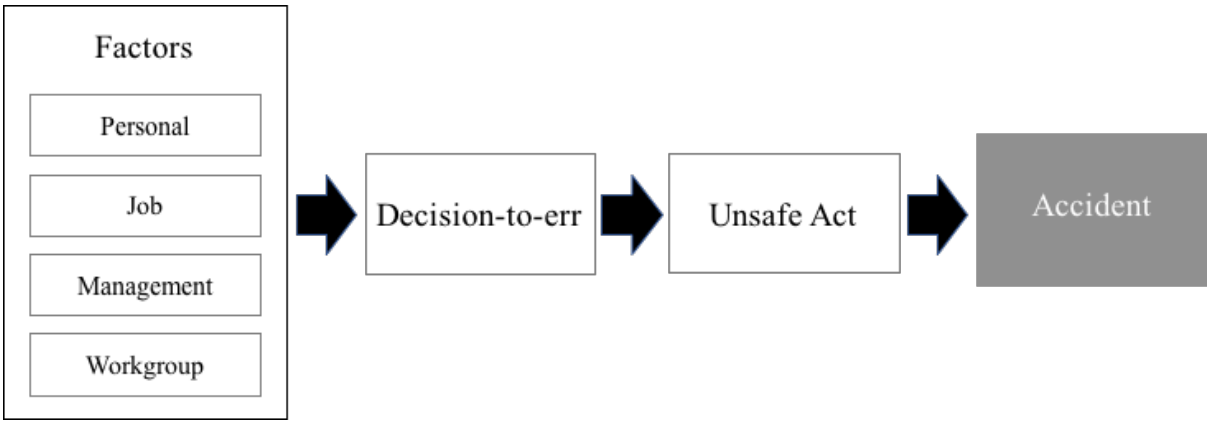


Figure 6 The Four Major Factors Contributing to the Decision-to-Err

According to this paper, the most frequently occurred unsafe act in Thai construction is the workers rarely wear PPE while doing their jobs. In addition, the 5 factors which statically related to this unsafe act are lack of management support, group norms, overconfidence, being uncomfortable, and past experience. And each of these factors is categorized into 3 major factors as listed below.

(1) Personal Factors

- Past experience:
  Workers continue doing their old habits and rejecting to change them.
- Being uncomfortable:
  PPE can be used as a good example in this case. Because PPE can be uncomfortable, especially in the hot climate regions like Thailand. For instance, workers reject wearing safety hats because it's hot and blocking their vision.
- Overconfidence:
  Workers have a feeling that "accident won't happen to me" can lead to unsafe behaviours. And these unsafe behaviours can cause an accident.

(2) Management Factor

- Management support:
  Top management must ensure to make a safe workplace, provide sufficient safety equipment, frequently safety programs and etc.

(3) Workgroup Factors

- Group norms:
  Workers follow what other people do. Even though it is unsafe to do, they still follow their group's behaviour.

Another research paper, Vitharana, De Silva and De Silva, (2015) also mentioned on the same issue about wearing PPE. Dislike to wear Personal Protective Equipment (PPE) was one of the main causes of poor safety practices in the construction site. Many workers think that safety hats cause them inconvenient to work.

The primary cause of construction site hazards stated by Department of Labour Protection and Welfare of Thailand is also related to PPE. The incorrect and improper use of PPE, lack of control to prevent falling from height, the collapse of materials, electric shock, being injured by construction machinery are most commonly found (Safety Construction Thai, 2017).

2.4 Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) is an equipment designed to be used for preventing body parts from an injury that may occur while working. (Sukhothai Thammathirat Open University, 2007, p.5) Some accidents and injuries can be prevented by wearing personal protective equipment while operating. It is important to select and use PPE properly.

This PPE is divided into several categories according to which body parts you want to protect.

- Head protection: for example, safety hats and helmets
- Face and eye protection: for example, safety glasses, goggles and light protection glasses
- Hand and arm protection: for example, leather gloves and fabric gloves
- Leg and foot protection: for example, safety shoes and boots
- Fall management equipment: for example, safety belts and harness
- Breathing apparatus: for example, masks
- Hearing protection: for example, earmuffs and earplugs

The mandatory PPE that every worker or anyone must wear before entering the construction site are safety hat and safety shoes.

2.5 Motivation

Motivation is a process of driving to a goal or objective achievement. Motivation can be divided into 2 ways, extrinsic motivation and intrinsic motivation. (Skripak, 2016, p.232)

- Extrinsic motivation: This kind of motivation will occur when we are motivated by external factors such as money and any kind of reward.
- Intrinsic motivation: It comes from internal factors such as doing something for your own enjoyment or satisfaction from job achievement†.

There has been a lot of research done by many researchers. The 2 influential theories of motivation are Hierarchy of Needs Theory and Two-Factor Theory.

2.5.1 Hierarchy of Needs Theory

Abraham Maslow presented his hierarchy of needs theory into 5 levels of needs as shown in Figure 7. In this model, lower level needs must be satisfied before we could be motivated by higher level needs.

According to Maslow's model (1943), it shows that we cannot motivate workers with recognition (Esteem needs) unless they already had enough money to buy food (Physiological needs). After they've fulfilled all needs, we can move up to the next level of needs.

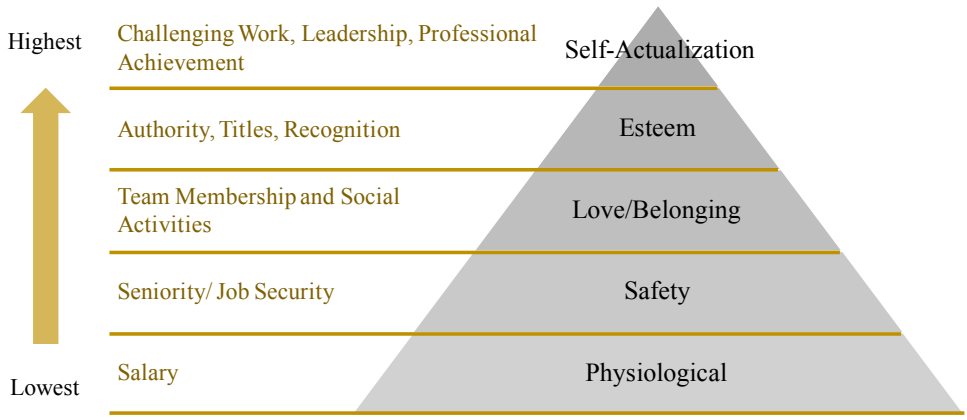


Figure 7 Maslow's Hierarchy of needs theory

2.5.2 Two-Factor Theory

Frederick Herzberg (1959) proposed another famous motivation theory which is called "Two-Factor Theory" He focused on people's motivation and job satisfaction. Based on workers' good and bad feeling about their job, he had divided work factors into main 2 factors. Figure 8 is Herzberg's two-factor model (Kuijk, n.d., para.2).

- Motivation Factors (Satisfiers) influence job satisfaction. These factors increase worker's motivation
- Hygiene Factors (Dissatisfiers) do not increase higher motivation and job satisfaction but they prevent job dissatisfaction.

In this theory, hygiene factors decrease job dissatisfaction but, it doesn't necessarily mean it will increase job satisfaction. Dissatisfaction causes among workers in a workplace (Hygiene factors) must be eliminated in order to maintain a good work environment. Then, improving motivation factors to meet worker's satisfaction will motivate workers.

According to Herzberg's two-factor theory, there are 4 combinations:

- High Hygiene and High Motivation: This is the ideal situation. Workers are motivated and have few complaints.
- High Hygiene and Low Motivation: Workers have few complaints, but they aren't motivated. They see their job as a paycheck.
- Low Hygiene and High Motivation: Workers have many complaints about their working condition, salary and etc., but they are very motivated by the challenges in their job.
- Low Hygiene and Low Motivation: This is the worst situation. Workers have many complaints and they are not motivated.

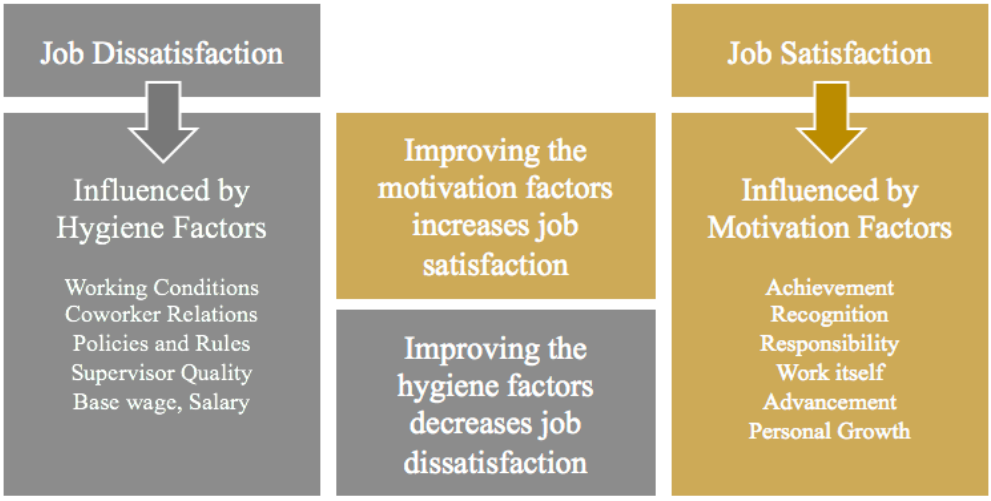


Figure 8 Herzberg's Two-Factor theory

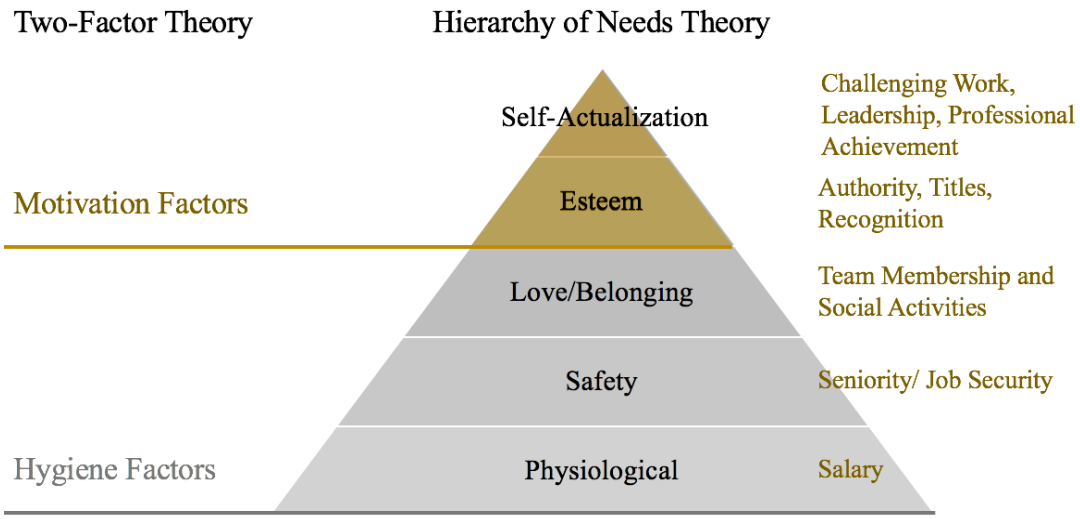


Figure 9 Hierarchy of Needs Theory and Two-factor theory

After analyzing both theories, finding interesting incentives to meet worker's satisfaction is a key point to increase higher performance, in this case motivating workers to wear PPE. Motivation factors are equivalent to Esteem and Self-Actualization needs in Maslow's model.

2.5.3 Reward, Recognition and Incentive

The distinction between reward, recognition and incentive can sometimes be confusing. To clarify these 3 terms, many studies were used in this part.

(1) Reward:

Reward means “a thing given in recognition of one's service, effort, or achievement.” according to Oxford Dictionary. Put in a simple meaning, a reward is a gift which given to workers for completing company goals. Rewards can be both recognition and incentive award. (Matheny, 2017, para.3)

Rewards are divided by Armstrong (2007) into 2 groups; financial and non-financial rewards. Financial rewards include pay and benefits. Non-financial rewards include recognition, praise and feedback.

(2) Recognition:

Recognition means “the acknowledgment of achievement, service, merit, etc." according to Dictionary.com. Recognition can be more intangible, for instance, a verbal “Thank you”.

It’s possible to give recognition without a reward, but a reward shouldn’t be given without recognition. Rewards attract workers to an organization while, recognition use for retaining workers. (Saunderson, 2013)

(3) Incentive:

Incentive means “something that incites or tends to incite to action or greater effort, as a reward offered for increased productivity.” according to Dictionary.com. Commonly, a worker incentive program works to motivate and encourage workers to work harder to meet a designated company goals. It can be concluded that incentive is a way to motivate workers to complete company goals by providing a reward and recognition as a payment.

Matheny (2017) suggested a structure to incentivize workers to have greater efforts in their daily duties which increase overall company goals, in exchange for rewards. “The reward value for meeting these goals is often translated into points, so that employees can continuously save and combine their earned points for each goal or action they complete. The

more points the employee accumulates, the larger reward he or she can redeem for those points." (Matheny, 2017, para.10)

Many studies recommended focusing more on providing rewards and recognition to workers (Harunavamwe & Kanengoni, 2013; Kwenin & Muathe & Nzulwa, 2013; Ali & Ahmed, 2009). Their findings concluded that workers have higher motivation and better job performance. This strategy is not only attracting workers but it ultimately relates to the worker's job satisfaction which helps retaining workers in the company. Nevertheless, they didn't give a certain answer to things should be given as rewards. In this thesis, finding an appropriate incentive, rewards and recognition are crucial to finalizing the proposal for motivating workers in Thai construction. Because there are also some studies suggested to use only rewards and some suggested that it's enough to use only recognition (non-financial reward). It is therefore important to select or balance both rewards and recognition for workers and find certain things to be given to workers.

2.6 Geert Hofstede's Cultural Dimension Theory

In order to understand the characteristics of the workforce in Thai construction, learning and understanding culture is one of the necessities to find a solution to develop Thai construction in the future.

The cultural dimension was conducted by Geert Hofstede. His research describes the differences in the behaviour of people in each country that are reflected and shaped up their particular culture. The cultural dimension consists of 6 dimensions which are Power Distance, Individualism, Masculinity, Uncertainty Avoidance, Long-Term Orientation and Indulgence. According to Geert Hofstede's work which is globally used in many academic studies, this research also used it as a reference to understand more about both Thai and migrate worker's characteristics. Unfortunately, Geert Hofstede's study doesn't include Burma, Laos and Cambodia. So, only Thai and Japanese cultures were summarized in this thesis as seen as follows.

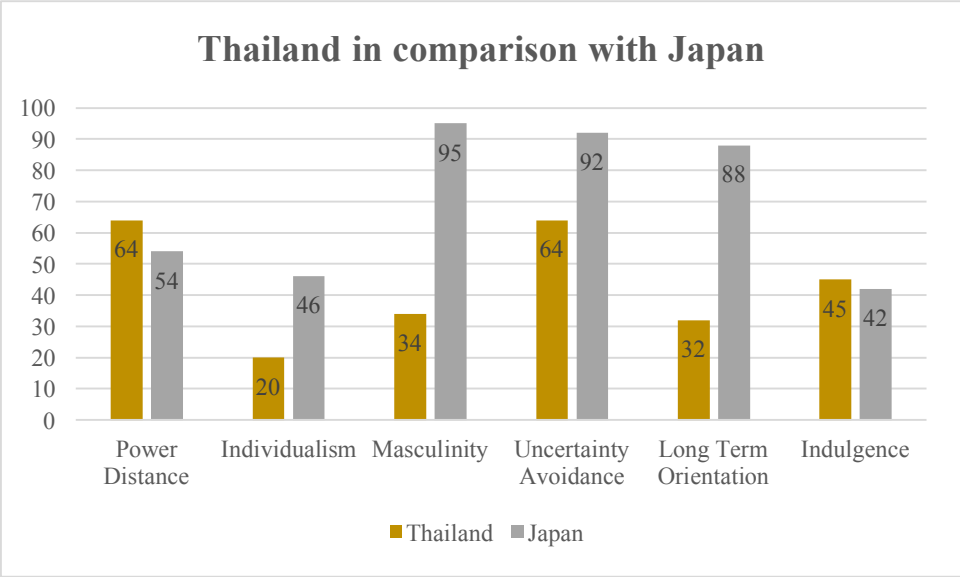


Figure 10 Cultural Dimension of Thailand in comparison with Japan

(1) Power Distance:

This dimension expresses the difference in status between individuals is not equal. Geert Hofstede defines Power Distance as "the extent to which the less powerful members of institutions and organisations within a country expect and accept that power is distributed unequally."

Thailand scores 64 on PDI index which shows that Thailand has high power distance culture. Thailand is higher discriminating between people with the social status more than Japan. High-level positions feel they are superior to their lower level positions which lead to the information flow is hierarchical and controlled.

(2) Individualism:

This dimension is defined as "the degree of interdependence a society maintains among its members." Hofstede defines this dimension as individualism and collectivism.

Individualism is the society that people focus more on themselves and their direct family. While collectivism is people in society have ideas and actions that take the feelings of others or of the group into account.

Thailand has 20 scores in this dimension which shows that Thailand is a highly collectivist country. Thai is not confrontational and sometimes in order to be part of the group, they

answer oppositely to what they thought and they are very sensitive not to feel shamed in front of their group. Japan scores 46 on this dimension which is higher than Thailand. Japanese are famous for their loyalty to their companies but it is an individualist thing to do for themselves. Japan is more Individualist than other Asian counties.

(3) Masculinity:

This dimension refers to the gender equality in the society. A high score in this dimension indicates the society with high different in male and female (Masculine). On the other hand, the society where female and male have equal rights is called Feminine. Masculine society is driven by high competition, achievement and success, whereas Feminine society focuses on quality of life rather than seeking for success. As this dimension is defined that "The fundamental issue here is what motivates people, wanting to be the best (Masculine) or liking what you do (Feminine)."

Thailand is considered as a Feminine society with a low score of 34. On the contrary, Japan is a Masculine society with a high score of 95. It reflects that Thailand has equality in gender and low competitiveness because they care for the quality of life more than being success and standing out from others.

(4) Uncertainty Avoidance:

It expresses the way that people in the society feel in uncertain and ambiguous situations.

In this dimension, Thailand scores 64 which can be considered as a society with uncertainty avoidance. However, Japan scores 92 which is one of the most uncertainty avoiding countries in the world. The reason is that Japan is usually threatened by natural disasters from earthquakes, tsunamis and more. Japanese must always prepare themselves to be ready to face these uncertain situations. Although both countries are considered as a society with uncertainty avoidance, the levels of uncertainty avoidance are different. These 2 societies are difficult to accept change and risk, they prefer to have fixed plans to avoid the unexpected. Strict rules, laws, policies, and regulations are used in order to reduce the uncertainty.

(5) Long Term Orientation:

This dimension describes “how every society has to maintain some links with its own past while dealing with the challenges of the present and future.” There are 2 types of societies. The one with a low score on this dimension is called (short-term) normative society. People in the normative society prefer to look at their past or present and focus more on achieving instant results or choosing immediate satisfaction rather than a long-term fulfilment. On the other hand, the one with a high score is called (long-term) pragmatic society. It is the society that people look for things in a long run or focus on future rewards.

In comparison with Japan, Thailand is a normative society with a score 32 in this dimension. It shows that in Thai culture, people respect their traditions and look more on short-term goals.

(6) Indulgence:

This dimension is defined as “the extent to which people try to control their desires and impulses, based on the way they were raised.” It can be divided into Indulgence and Restraint. The indulgent society is a relatively free and open society unlike the restrained society is a strict and strong control society of expression.

Thailand and Japan cannot be determined by this dimension because both of them have intermediate scores of 45 and 42. Even so, these low scores are considered a culture of Restraint. The social norms are a bit strict for people to express themselves freely and differently from others.

2.7 Education Gap in Thailand

There is a gap and unequal in education quality in Thai children. The Program for International Student Assessment (PISA) results that only 1.4 percent of Thai students showed excellent problem solving and analytical reasoning skills. For Thailand to reduce this gap, those children from poor households especially in rural area need to receive similar level of education as those children living in Bangkok. The research from Sondergaard and Lathapipat (2017) suggests that there are two primary reasons of this gap which needed to be considered. First, many rural children do not have proper care and get to school by the age of

six. It reflects that children may not be supported in education by their families. Second, the quality of teacher is not on the level. As an example, 20 percent of teachers in Bangkok have a graduate degree in comparison with only 9 percent of teachers in the province of Mae Hong Son. It shows how unequal and education staff shortages have influenced on the education gap in Thailand. It is a crucial step for Thailand to be prepared its children for a competitive workforce by giving an early and similar education support to all children across the nation.

CHAPTER 3: HYPOTHESIS

This chapter explains the research methodology which has been conducted to create a research hypothesis and find key points for further idea development in the next chapter.

3.1 Causal Loop

The causal loop diagram represents components found in construction issue in Thailand. The model is developed from information in the literature, interview and my observation on the construction management and safety in construction. The purpose of this diagram is to understand cause and effect in the improvement of project management and to find a key factor to eliminate construction issue in Thailand. Starting from the quality aspect, it affects a company's reputation (included the image of contractor performance and customer satisfaction). Because of good reputation, they have more chance to win the bidding on construction projects and survive in the industry. Then, a company will have more budget to employ skilled-workers to enhance time and cost aspect. Every business needs profit to expand their operation and service. So, Safety culture must be invested by the contractor. It affects safety performance, mitigates accident, workers maintain healthily. When workers have a better quality of life, they can performance better. Sandbhor and Botre (2014) said that worker performance is a major contributor to improve construction productivity since the construction industry is the industry that relied on manpower. Nevertheless, in this current situation, it is difficult to increase safety performance although the company invest more in safety culture. Pungvongsanuraks and Chinda (2010) said that workers think the safety training is too academic and has no meaning to be practically improved. They have less optimism in safety training than the management team. It means that if the company provided them with too much training or too many rules, workers won't feel good to work in this kind of situation. They will lose their motivation to maintain safety. Consequently, their safety performance will also be affected and turn this loop to a balancing loop. That's a reason why Thai construction owner has no willingness to invest more in safety culture. They cannot see the safety performance will be improved by investing more in Safety culture and it causes workers to lose their safety motivation.

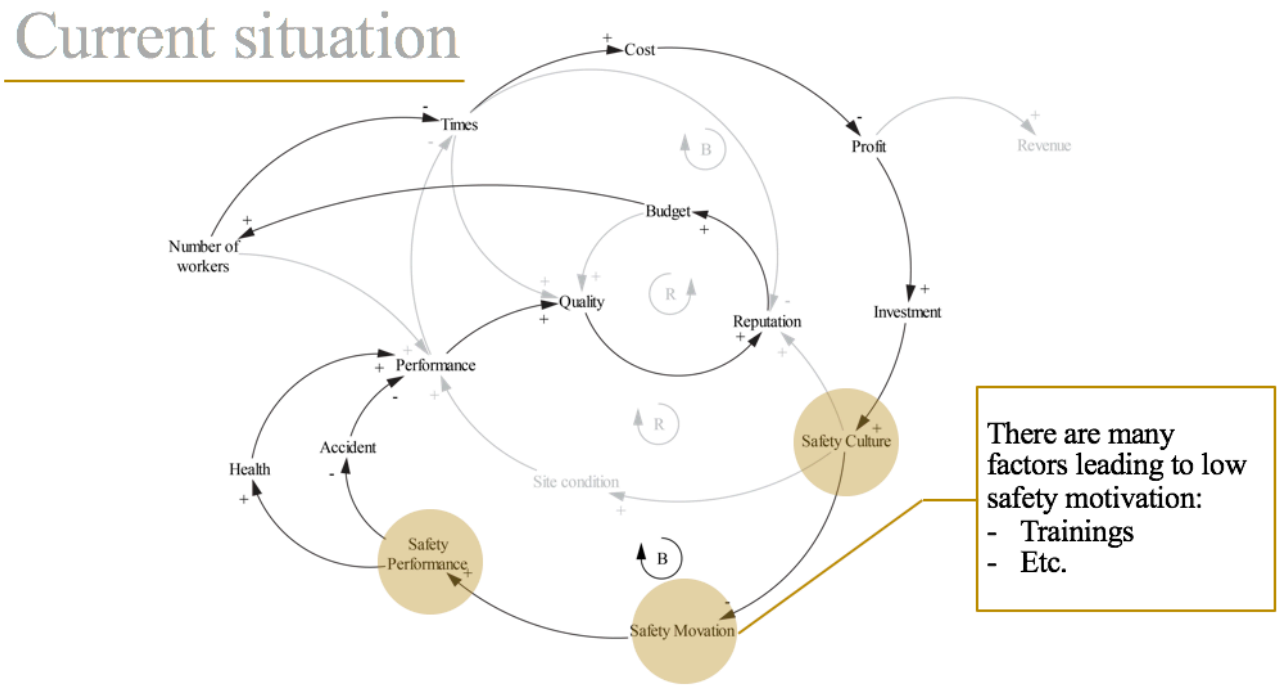


Figure 11 Causal loop of current situation in Thai construction.

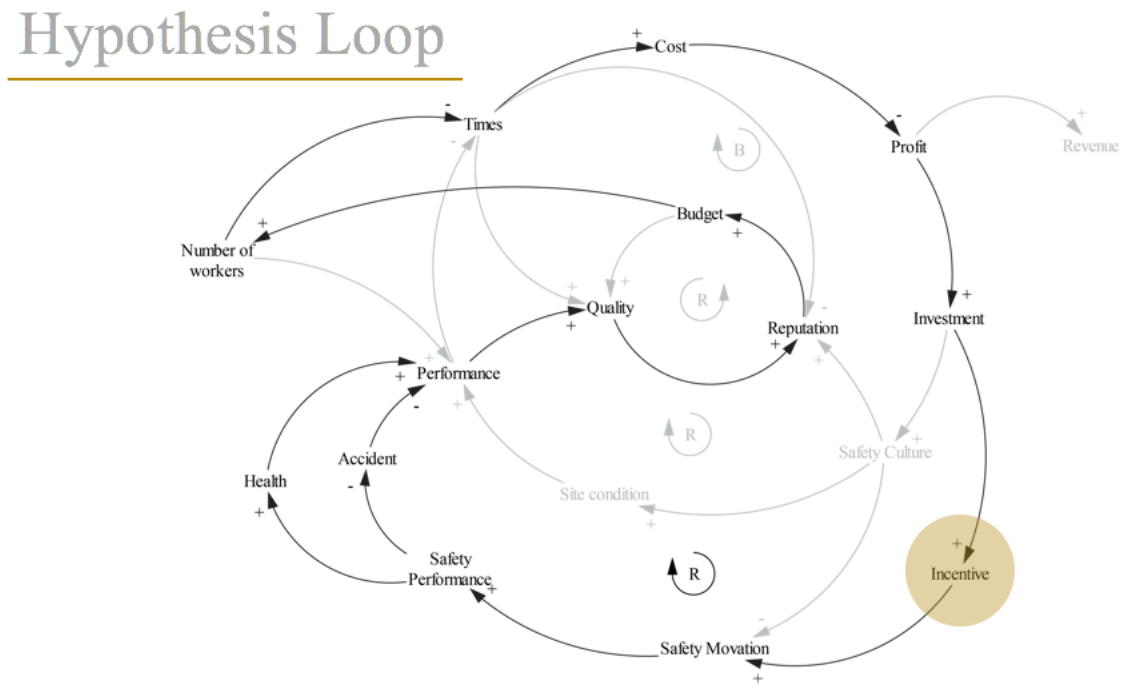


Figure 12 Causal loop of hypothesis

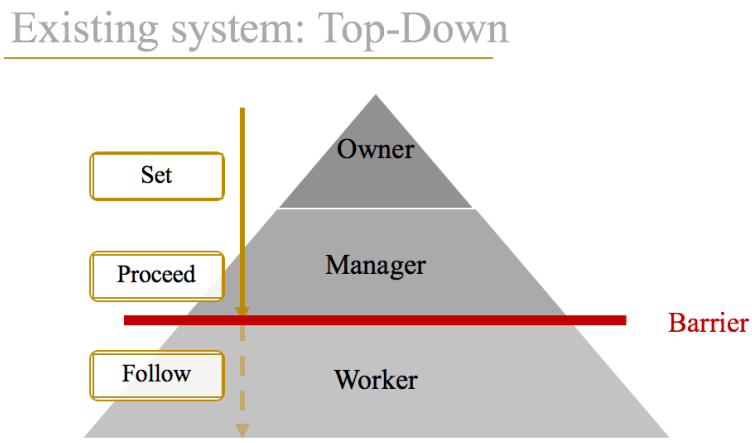


Figure 13 Existing system in Thai construction

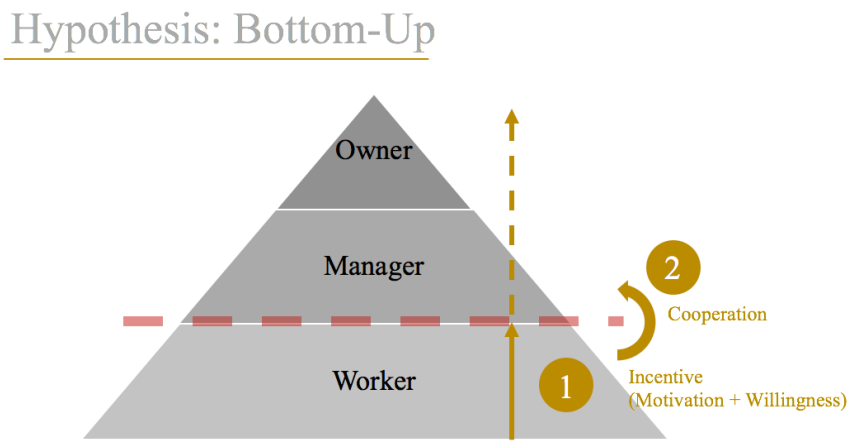


Figure 14 New system for Thai construction

Due to the fact that Thailand is considered a country with a high-power distance, it causes a huge gap between the management team and workers. (Pungvongsanuraks & Chinda, 2010, p.186) The existing system that top level (contractor owner) is the one who sets the rules and the bottom level (worker) has to follow the rules as shown in Figure 13. In the case of safety, workers just follow the safety rules because this is their task, but they don't fully understand what the owner is trying to do. They have different perspectives on safety awareness. Therefore, this research will start oppositely from bottom to top levels. To motivate workers, an incentive is needed to be used. It will increase a worker's safety motivation to be more open to wear PPE that the company has prepared for them (cooperation) as you can see from Figure 14. Both Top-Down and Bottom-Up approaches should proceed simultaneously for the sake of an organization to smoothly operating.

If the safety culture improved, safety motivation increased and workers would have good safety performance. This is the ideal loop that everyone expected it to be. In the reality, although the construction company has invested in safety culture, the company still needs to improve their worker's motivation for better safety performance. After added incentive in the causal loop diagram, it affects Safety motivation by changing negative motivation to positive motivation and changes from a balancing loop to a reinforcing loop. In conclusion, an owner should invest more on the incentive that will increase workers' safety motivation in this case, to wear PPE. To make the hypothesis loop comes true, the next step to do is finding appropriate incentives for construction workers. When workers have more willingness to wear PPE, it may lead them to be more optimistic about safety and this behaviour will slowly become their daily routine. Then, this loop can be called as "I want to do" loop.

CHAPTER 4: PROPOSAL

This chapter explains and shows the idea developments and how this research title becomes "Proposal of Motivating Thai Construction Workers by Recognizing Their behaviour to Wear Personal Protective Equipment". Also, describes the methodology used in this research. The proposal has been done in 2 steps of idea development.

4.1 Flow of Research

Before going to the idea development sections, it's better to understand how this chapter and other chapters in this research have been constructed. According to Figure 15, it shows the flow of this research. It begins with issue finding and things to be considered. After that, the proposal section is started. In the proposal section, it consists of Idea development1, Finding key points, Design1 analysis and Idea development2. Evaluation and Conclusion are not included in this chapter.

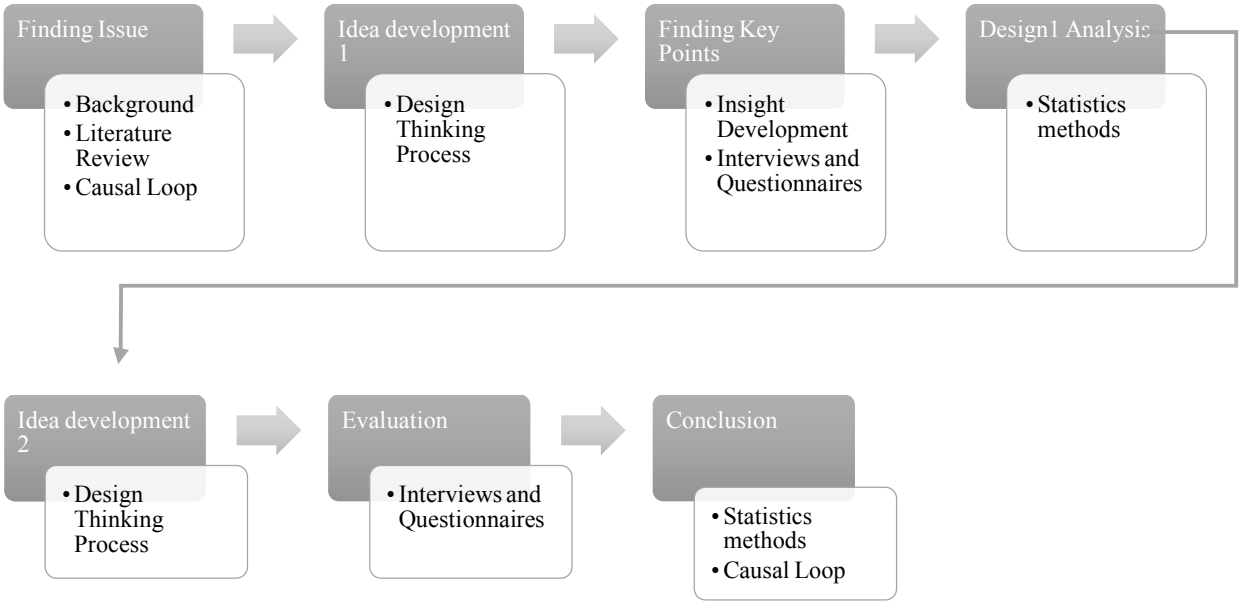


Figure 15 Flow of research

The methodologies were used in this section are Design thinking process and Survey research.

Design Thinking Process is divided into 5 steps, Empathize, Define, Ideate, Prototype, and Test. Empathize and Define are the steps to understand users and find the problem to be solved. Next, ideate is the process of using creativity and perspective to generate an idea. Lastly, Prototype and Test are the steps to develop a prototype of the idea and test the idea whether it can meet user's needs and solve the problems or not.

4.2 Idea Development 1

4.2.1 Empathize

As shown in Figure 16, people still don't aware of the idea of a safe workplace. Even on social media like Instagram or YouTube, Image of construction works in Thai people perception is not related to safety. It reflects an ongoing issue across Thailand, about proper care of safety in construction especially, in worker's behaviour.

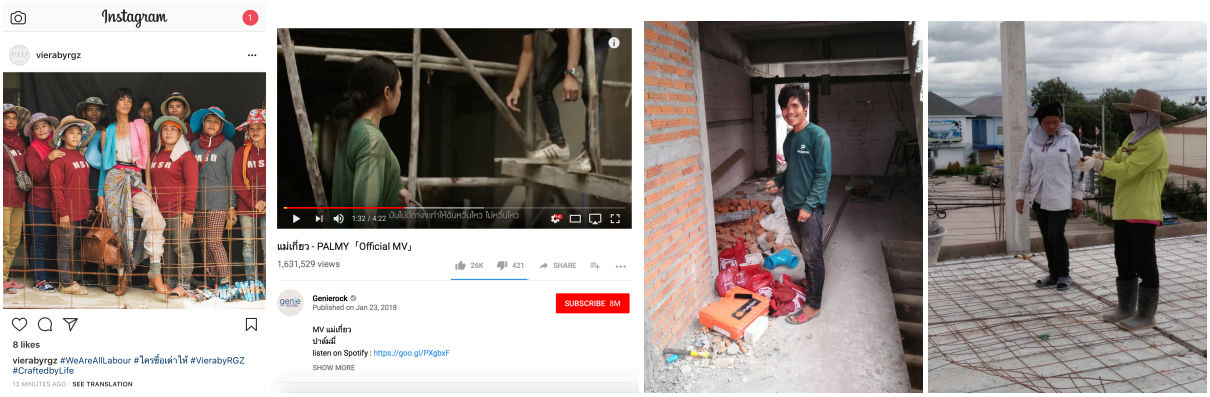


Figure 16 Image of construction works in Thai people perception

According to the fun theory project from Volkswagen in 2009, the project's concept was very interesting. They believe that fun can change human behaviour for a better. The Fun Theory states that "if things are more fun, they are better" (Titan-learning, n.d., para. 1). The famous activity from this concept that went viral is the video of Piano stairs. The piano stairs change people behaviour from using stairs over the escalator. There were many people using stairs because of the sounds that were created while people are walking up and down. It was a fun activity for everyone in the video.

After deciding on using "Fun" as an incentive for Thai construction workers. The idea development had begun here.

4.2.2 Define

Problem definition was created as below:

"How might we make workers have fun or enjoy to wear PPE?"

Figure 17 Problem definition1

4.2.3 Ideate

During the third step of Design thinking process, brainstorm technique was used to find interesting and out of the box solution. The problem definition was “How might we make workers have fun or enjoy to wear PPE?”. With this problem statement and brainstorm technique, “Game” had come out as a solution.

(1) Solution

There are two solution approaches for workers and construction owner. The approach for the owner is the suggestions to reinforce the safety culture of the company. For instance, strictly provide safety training for workers. It is important to proceed with these two approaches simultaneously, which will make this solution work. However, this research focuses mainly on approach to motivate and change worker’s behaviour.

The PPE is a helmet and safety shoes which are the mandatory items to wear before entering a construction site.

Table 2 Solution for workers and an owner

Target	Solution
1 workers	Create a game - PPE is Gaming devices. - Construction site is the Gaming field.
2 Owner	Give suggestions to improve company’s safety culture.

(2) How this game works?

Prensky (2001) states that "So fun, in the sense of enjoyment and pleasure, puts us in a relaxed, receptive frame of mind for learning. Play, in addition to providing pleasure, increases our involvement, which also helps us learn…. Games are a subset of both play and fun." (Prensky, 2001, p. 117-118). According to that, games can be a useful tool to solve Thai construction safety issue. Prensky created six key structural elements of games to make games are more engaging. According to Prensky's study, the PPE game is developed based on these 6 elements as listed below.

- Rules: Workers have to wear PPE all the time and have to return them before leaving the site.
- Goals or Objectives: The goal for workers is to get the highest score.
- Outcomes and Feedback: Using the idea of tracking devices to measure their progress against the goals.
- Conflict/Competition/Challenge/Opposition: Workers get motivated by a rewarding system to stimulate competition among workers.
- Interaction: Interaction with PPE and among workers (social interaction).
- Representation: Remind workers to keep safety at all time.

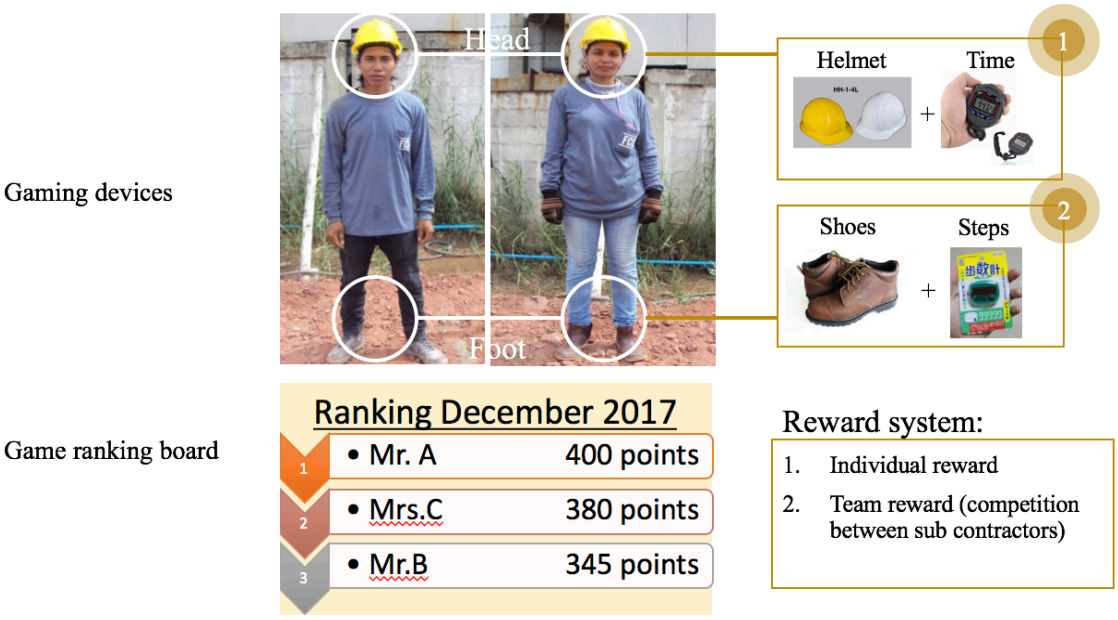


Figure 18 Game design for increasing safety motivation

Wearing hours and the number of steps will be converted into points. These points will be displayed on the site billboard. A worker who has the highest points will get a reward from the company.

This game will build up a situation of competing with themselves and other people (Individual reward) and it can be scaled up to the competition among sub-contractors (Team reward) later.

At this stage, Hypothesis is:

"Fun enjoyable personal protective equipment and strategy for workers will change worker's behaviour and increase willingness to keep safety motivation high."

4.2.4 Prototype

To do this, the tracking devices are required for this game. As mentioned in the Ideate step, a helmet and safety shoes have to be redesigned.

- Timer records time events and displays on the screen. A timer will be attached to a helmet to measure how long does a worker wear.
- Pedometer is a device to record the number of steps. In this game design, this device will be attached to safety shoes. It is a great way to actively motivate the worker to keep wearing safety shoes while working at the construction site.

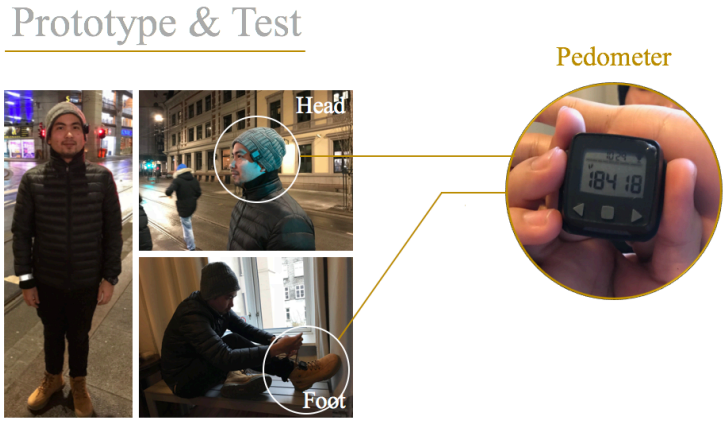


Figure 19 Prototyping with a pedometer

4.2.5 Test

The test of this research was held in the Netherlands and Thailand, in early 2018. In each experiment, it took around one to two hours to proceed. The participants were both Thai male and Thai female who were in the age 20s. The purpose of this experiment is to ensure that the game idea has answered these questions:

- Do they enjoy or have fun using PPE?
- Do they change their behaviours?

There are 3 steps in each experiment as you can see in the Table 3.

Table 3 Ways to test the gaming idea

Step	How to do
1	- Ask participants to wear a hat and boots (or sneaker)
2	- Ask participants to wear a hat and boots (or sneaker) - Explain how the experiment works (tracking devices)
3	- Ask testers to wear a hat and boots (or sneaker) - Explain how the experiment works (tracking devices) - Tell them that there is a reward for the winner

The Netherlands

Thailand

Figure 20 Photos from the experiment in the Netherlands and Thailand in early 2018

The results were collected in both the Netherlands and Thailand. The weathers on the experiment days were very different. The Netherland weather was cloudy and rainy. The temperature was around 5-10 degrees. On the other hand, Thailand was sunny with the temperature around 30 degrees.

The results were very similar even though, there were differences in weather, temperature and location. Even so, Female tended to have higher motivation and strictly follows the rules than male.

The insights that were found in this prototyping are:

- Environmental context affects their behaviours.
- Shape and objective of hats change their behaviours.
- What kind of rewards do they want?
- Not only fun can change human behaviours but, competition also motivates them to change their behaviours.

These insights will be a useful information in developing and improve Personal Protective Equipment (PPE) design to be more effective in the next idea development.

Table 4 Testing results

Round	The Netherlands	Thailand
1	- Male participant always took off his hat when he got inside a building or it's hot.	- Male participant always took off his hat when he got inside a building or it's hot.
2	- Male participant worn a hat longer but he still asked for a permission to take his hat off when he's inside a building or it's hot.	- Male participant worn a hat longer but, he still asked for a permission to take his hat off when he's inside a building or it's hot.
3	- Reward stimulated them to wear hats even they were inside a building.	- Reward stimulated them to wear hats even they were inside a building. - Male participant had less motivation.

4.3 Idea Development 2

4.3.1 Empathize

Design thinking process was used again in this idea developments. The study of stakeholders was conducted through survey questionnaire which entails the information on the general information of the respondents, safety knowledge and experience, opinion on current safety situation and opinion on wearing personal protective equipment (PPE). There were 2 types of questions, closed question (multiple choice) and open question. The format of the questionnaire was used depending on work groups.

Workers in the construction site can be separated into 3 groups;

- Management and technical workers are workers who have high education qualifications, trained in design, management and supervise the construction site. Workers in this group are architect, project manager and engineer.
- Skilled workers are workers who have high knowledge and experience in construction activities. For example, foreman, carpenter, plasterer.
- Semi-skilled and Unskilled workers have little knowledge and mostly work as site labour workforce. They are general workers.

Skilled workers, Semi-skilled and Unskilled workers mainly work in the construction site. They are groups of people who are exposed to many risk of being injured, death and illness. (Vitharana & De Silva & De Silva, 2015, p.35)

(1) Statistical analysis and results

Survey research is a method of collecting information and questionnaire is a set of questions used for survey purpose. The questionnaire was conducted in this research to find the key information to generate an idea. After that, Statistics analysis was done to find necessary evidence to develop further development for this research proposal. In this survey section, there were 2 types of questionnaire. 28 questions were provided for skilled workers, semi-skilled and unskilled workers and 35 questions were created for management, technical and skilled workers. The purpose of these questionnaires was to find the significant differences

between workers' behaviours and other variables. The groups were divided by their wearing PPE behaviours, wearing every time and not wearing every time as seen in Figure 21.

Table 5 shows the number of respondents was 135 respondents in total. In this part, the respondents were separated into 2 groups based on their job position. 88 respondents (65.2%) were Skilled workers, Semi-skilled and Unskilled workers who mainly work in a construction site and 47 respondents (34.8%) were Management, Technical and Skilled workers who work in both an office and a construction site. The questionnaires were distributed to workers in Fahchun development co., Ltd, a medium-sized construction company in Thailand and those people who work in Thai construction industry.

According to Figure 21, it shows how the questionnaire results were collected. There were 2 groups as they are listed down below:

Group 1: Within the skilled workers, semi-skilled and unskilled workers, their wearing PPE behaviours were divided into Every time and Not every time.

Group 2: Within the management, technical and skilled workers, their wearing PPE behaviours were divided into Every time and Not every time.

Table 5 The number of respondents in 2 categories

	Respondent	N	Percentage (%)
Job Position	Skilled workers, Semi-skilled and Unskilled workers	88	65.2
	Management, Technical and Skilled workers	47	34.8
	Total	135	100

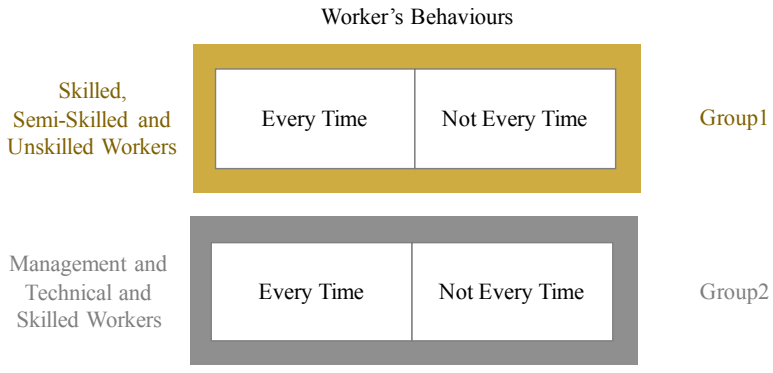


Figure 21 Groups of respondents

Table 6 Similarities and Differences of questionnaires and Types of Statistical Tests

Pair	Group1	Group2	Test
1	1. Gender	1. Gender	Chi-Square
2	2. Age	2. Age	Chi-Square
3	3. Nationality	3. Nationality	Chi-Square
4	4Thai language ability (Understanding and Communication)	4Thai language ability (Understanding and Communication)	Chi-Square
5	5. Educational background	5. Educational background	Chi-Square
6	6. Personal status	6. Personal status	Chi-Square
7	7. Job title	7. Job title	Chi-Square
8	8. Employment status	8. Employment status	Chi-Square
9	9. Monthly income (Baht)	9. Monthly income (Baht)	Chi-Square
10	10. What company and company type do you belong to? (E.g. Fahchun Development Co Ltd)	10. What company or department and company type do you belong to? (If you don't want to give your company name, please answer only your department name.)	-
11	11. What company size are you currently working on?	11. What company size are you currently working on?	-
12	12. Work experience	12. Work experience	Chi-Square
13	13. Working hours in a day	13. Working hours in a day	Chi-Square
14	14. What level do you feel satisfied with your job?	14. What level do you feel satisfied with your job?	Chi-Square
		15. Are you satisfied with the current safety situation in Thai construction especially in your company?	Percentage
		16. Do you think safety is important for the future of Thai construction?	Percentage
		17. Who do you think should response to safety in Thai construction?	Percentage
15	15. Who do you think should response to safety in the construction site?	18. Who do you think should response to safety in the construction site?	Chi-Square
		19. If you think of safety, what do you think of? (Please specify as many as possible)	Percentage

Table 6 Similarities and Differences of questionnaires and Types of Statistical Tests (Continued)

Pair	Group1	Group2	Test
16	16. Did you have any basic construction safety knowledge before joining the company?	20. Did you have any basic construction safety knowledge before joining the company?	Chi-Square
17	17. What level do you concern about safety?	21. What level do you concern about safety?	Chi-Square
18	18. If you think of personal protective equipment (PPE), what items do you think of? (Please specify as many as possible)	22. If you think of personal protective equipment (PPE), what items do you think of? (Please specify as many as possible)	Percentage
19	19. Do you wear PPE while working in the construction site?	23. Do you wear PPE while working in the construction site?	
20	20. If you didn't answer "Every time", what is the reason not wear them? (Please specify)	24. If you didn't answer "Every time", what is the reason not wear them? (Please specify)	Percentage
21	21. Is there any safety training session on how to use PPE in your company?	25. Is there any safety training session on how to use PPE in your company?	Chi-Square
22	22. If you answered "Yes", how often does your company provide a training session?	26. If you answered "Yes", how often does your company provide a training session?	Chi-Square
23	23. Have you ever been injured or experienced in an accident from not wearing PPE? If your answer is "yes", please specify	27. Have you ever been injured or experienced in an accident from not wearing PPE? If your answer is "yes", please specify	Chi-Square, Percentage
24	24. In your company, have any of your colleagues, friends or co-workers ever been injured or experienced in an accident from not wearing PPE? If your answer is "yes", please specify	28. In your company, have any employees ever been injured or experienced in an accident from not wearing PPE? If your answer is "yes", please specify	Chi-Square, Percentage
25	25. Do you agree that wearing PPE will mitigate the number of accidents?	29. Do you agree that wearing PPE will mitigate the number of accidents?	Chi-Square
26	26. What do you think is the main reason of wearing PPE?	30. What do you think is the main reason of wearing PPE?	Chi-Square
27	27. In your perspective, what are the incentives other than money for you and workers to wear PPE? (Please specify)	31. In your perspective, what are the incentives other than money for you and workers to wear PPE? (Please specify)	Percentage
		32. What helps you order the workers to wear PPE? (Please specify)	Percentage
		33. How much cost can you spend for each workers' safety? (Please specify)	Percentage

Table 6 Similarities and Differences of questionnaires and Types of Statistical Tests (Continued)

Pair	Group1	Group2	Test
28	28. If there is a reward for those people who always keep safety in mind and always wear PPE while working. What do you think the reward should be? (Please specify)	34. If there is a reward for those people who always keep safety in mind and always wear PPE while working. What do you think the reward should be? (Please specify)	Percentage
		35. Do you have any suggestion on improving safety in Thai construction? (Please specify)	Percentage

Chi-square test was conducted in this survey. It was used to find whether there is a significant difference between the 2 variables. This part was an examination of the relationship between questions (gender, Age, Nationality and etc.) and Worker's wearing PPE behaviour (Every time and Not every time) in both workforce groups. Table 6 shows similarities and differences of questionnaires and types of statistical tests were used in this analysis. Question19 is highlighted in yellow as it was used as the dependent variable. The questions with P-value not greater than 0.05, it means both variables are dependent (Significant difference). On the contrary, the questions with P-value more than 0.05, they are independent and have no relationship with each other (No significant difference).

As it shows in Table 7, the number of questions with significance in group 1 and 2 were different. The significances were found mostly in group 1. The questions with the significant difference were found as they are highlighted in pink.

.

Table 7 Relationship between Wearing behaviors and other variables in Group1 and 2

	Question	Wearing PPE behavior (Group1)		Chi-square (Sig.)	Wearing PPE behavior (Group4)		Chi-square (Sig.)
		Every time (%) (n=55)	Not every time (%) (n=33)		Every time (%) (n=20)	Not every time (%) (n=27)	
1	Gender						
	Male (n=78)	50.9	75.8	5.316	60	48.1	0.648
	Female (n=57)	49.1	24.2	(0.021*)	40	51.9	(0.421)
2	Age						
	Under25 (n=35)	32.7	30.3		10	18.5	
	26-35 (n=48)	30.9	21.2	1.801	55	48.1	5.094
	36-45 (n=32)	21.8	33.3	(0.615)	30	11.1	(0.165[a])
	More than 46 (n=20)	14.5	15.2		5	22.2	
3	Nationality						
	Thai (n=102)	49.1	84.8	11.252	100	100	.
	Non-Thai (n=33)	50.9	15.2	(0.001**)	-	-	.
4	Thai Language Ability						
	Excellent (n=74)	21.8	45.5	5.418	90	59.3	5.426 (0.020*)
	Other (n=61)	78.2	54.5	(0.020*)	10	40.7	
5	Educational background						
	Elementary or Lower (n=52)	63.6	51.1		-	-	
	Middle/High school (n=31)	23.6	42.4	6.686	15	3.7	4.822
	Vocational/High vocational (n=16)	12.7	3	(0.083[b,c])	5	25.9	(0.090[a])
	Bachelor or Higher (n=36)	0.0	3		80	70.4	
6	Personal Status						
	Single/Widowed/Divorced (n=71)	41.8	36.4	0.256	75	77.8	0.049
	Married (n=64)	58.2	63.6	(0.613)	25	22.2	(0.824[a])

Table 7 Relationship between Wearing behaviors and other variables in Group1 and 2 (Continued)

	Question	Wearing PPE behavior (Group1)		Chi-square (Sig.)	Wearing PPE behavior (Group4)		Chi-square (Sig.)
		Every time (%) (n=55)	Not every time (%) (n=33)		Every time (%) (n=20)	Not every time (%) (n=27)	
7	Job title						
	Steel fixer (n=16)	21.8	12.1		-	-	
	Plasterer (n=16)	20	15.2		-	-	
	General worker (n=39)	45.5	42.4		-	-	
	Other (1) (n=17)	12.7	30.3	4.674	-	-	6.752
	Architect (n=20)	-	-	(0.197)	35	48.1	(0.080[a])
	Management and Technical worker (n=15)	-	-		40	25.9	
		-	-		10	25.9	
	Administration related worker (n=9)	-	-		15	0	
	Other (2) (n=3)						
8	Employment Status						
	Full-time (n=93)	61.8	51.5	0.898	85	7.4	0.697
	Part-time (n=42)	38.2	48.5	(0.343)	15	92.6	(0.404[a])
9	Monthly Income (Baht)						
	5,000-10,000 (n=54)	49.1	72.7	4.729	15	0	4.516
	10,001-20,000 (n=49)	50.9	27.3	(0.030*)	20	29.6	(0.105[a])
	More than 20,000 (n=32)	-	-		65	70.4	
12	Work Experience						
	Under 5 years (n=79)	47.3	75.8	6.868	60	59.3	0.003
	More than 5 years (n=56)	52.7	24.2	(0.009**)	40	40.7	(0.959)
13	Working hours in a day						
	Less than 8 hours (n=41)	32.7	27.3	0.289	35	25.9	0.452
	More than 8 hours (n=94)	67.3	72.7	(0.591)	65	74.1	(0.501)
14	Job Satisfaction						
	Very satisfied (n=46)	50.9	18.2	9.318	45	11.1	6.94
	Other (n=89)	49.1	81.8	(0.002**)	55	88.9	(0.008**)

Table 7 Relationship between Wearing behaviors and other variables in Group1 and 2 (Continued)

	Question	Wearing PPE behavior (Group1)		Chi-square (Sig.)	Wearing PPE behavior (Group4)		Chi-square (Sig.)
		Every time (%) (n=55)	Not every time (%) (n=33)		Every time (%) (n=20)	Not every time (%) (n=27)	
15	Safety Responder						
	One particular position (n=36)	38.2	33.3	0.21	10	7.4	0.099
	Everyone (n=99)	61.8	66.7	(0.647)	90	92.6	(0.753[a])
16	Basic Safety knowledge						
	Had (n=119)	96.4	75.8	8.695	90	85.2	0.239
	Didn't have (n=16)	3.6	24.2	(0.003[**, b])	10	14.8	(0.625[a])
17	Levels of Safety Concern						
	Extremely (n=78)	63.6	33.3	7.591	90	51.9	7.695
	Other (n=57)	36.4	66.7	(0.006[**])	10	48.1	(0.006[**])
21	Company Safety Training						
	Yes (n=85)	65.5	69.7	0.168	65	48.1	1.32
	No (n=50)	34.5	30.3	(0.682)	35	51.9	(0.251)
23	Injury or accident experience						
	Have had (n=14)	10.9	6.1	0.587	15	11.1	0.156
	Haven't had (n=121)	89.1	93.9	(0.444[b])	85	88.9	(0.693[a])
24	Colleague's injury or accident experience						
	Have seen (n=42)	23.6	60.6	12.027	15	22.2	0.387
	Haven't seen (n=93)	76.4	39.4	(0.001[**])	85	77.8	(0.534[a])
25	Wearing PPE mitigates accidents						
	Strongly agree (n=56)	43.6	24.2	3.352	55	48.1	0.216
	Other (n=79)	56.4	75.8	(0.067)	45	51.9	(0.642)
26	Main Reason to Wear PPE						
	Protect yourself (n=126)	92.7	90.9	0.093	95	96.3	0.047
	Other (n=9)	7.3	9.1	(0.760[b])	5	3.7	(0.828[a,c])

****** **The Chi-square statistic is significant at the 0.01 level.**

***** **The Chi-square statistic is significant at the 0.05 level.**

a, b **More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.**

c **The minimum expected cell count in this subtable is less than one. Chi-square results may be invalid.**

When analysing the results, question 10 and 11 were removed due to most of the workers in group 1 don't know their company details. The answers were inaccurate to be shown and used in this research.

According to this table, there are 10 questions found as a significant difference. In group 1 (skilled, semi-skilled and unskilled workers), 55 workers wear PPE every time (62.5%) and 33 workers don't wear PPE every time (37.5%). In group 2 (management, technical and skilled workers), 20 workers wear PPE every time (42.6%) and 27 workers don't wear PPE every time (57.4%). The result showed workers in group 1 wear PPE every time more than workers in group 2. Next, this table is described in more details on the questions (variables) with a significant difference as showed down below.

a. Gender:

The result showed that gender was only related to the wearing PPE behaviours in group 1. In group 1, workers who answered that they wear PPE every time were 50.9% male and 49.1% female. Those who answered that they don't wear PPE every time were 75.8% male and 24.2% female. The table says that females wear PPE every time more than males.

b. Nationality:

The result showed that nationality was only related to the wearing PPE behaviours in group 1. In group 1, Wearing PPE every time was answered by 49.1% of Thai and 50.9% of Non-Thai. On the other hand, in the group of workers who don't wear PPE every time, there were Thai 84.8% and Non-Thai 15.2%. The table says that Non-Thai workers wear PPE every time more than Thai workers.

c. Thai language ability:

The result showed that Thai language ability was related to the wearing PPE behaviours in both group 1 and group 2. Workers wear PPE every time in group 1, there were 21.8% of workers believe that they have excellent Thai language ability and 78.2% of workers don't believe that they have excellent Thai language ability. Those workers who don't wear PPE

every time in group 1, there were 45.5% believe that they have excellent Thai language ability and 54.5% of workers don't believe that they have excellent Thai language ability. Contrast with group 2, there were 90% of workers believe that they have excellent Thai language ability and 10% of workers don't believe that they have excellent Thai language ability have wearing PPE every time behaviour. 59.3% of the workers don't wear PPE every time group have excellent Thai language ability and 40.7% weren't excellent in Thai language. The table says that in group 1, workers who don't believe that they have excellent Thai language ability wear PPE every time more than those who believe that they have excellent Thai language ability. Unlike group 2 that workers who believe that they have excellent Thai language ability wear PPE every time more than those who don't believe that they have excellent Thai language ability.

d. Monthly income (Baht):

The result showed that monthly income was only related to the wearing PPE behaviours in group 1. Workers in group 1, who answered that they wear PPE every time, there were 49.1% of workers whose monthly income is between 5,000-10,000 baht and 50.9% of workers whose monthly income is 10,001-20,000 baht. On the contrary, 72.7% of workers whose monthly income is between 5,000-10,000 baht don't wear PPE every time. While 27.3% of workers have monthly income is 10,001-20,000 baht. The table says that workers with 10,001-20,000 baht income wear PPE every time more than workers with 5,000-10,000 baht monthly income.

e. Work Experience:

The result showed that work experience was only related to the wearing PPE behaviours in group 1. 47.3% of workers wear PPE every time have work experience under 5 years and 52.7% have work experience more than 5 years. 75.8% of workers who don't wear PPE every time have work experience under 5 years while 24.2% have work experience more than 5 years. The table says that workers with experience more than 5 years wear PPE every time more than workers with experience under 5 years.

f. Job Satisfaction:

The result showed that job satisfaction was related to the wearing PPE behaviours in both group 1 and group 2. In group 1, workers who wear PPE every time were divided to 50.9% of workers feel very satisfied with their job and 49.1% of workers don't feel very satisfied with their job. On the other hand, 18.2% of workers who don't wear PPE every time feel very satisfied with their job and 81.8% of workers who don't feel very satisfied with their job. In group 2, there were 45% of workers feel very satisfied with their jobs and 55% of workers don't feel very satisfied with their jobs answered that they wear PPE every time. It can be concluded that workers who feel very satisfied with their jobs wear PPE every time more than those who don't feel very satisfied with their jobs. This result can be referred to Two-Factor theory. Respondents in this survey were in High Hygiene and Low Motivation group, Low Hygiene and High Motivation group and Low Hygiene and Low Motivation group. The ideal situation which we are aiming for is workers with High Hygiene and High Motivation.

g. Basic safety knowledge:

The result showed that basic safety knowledge was only related to the wearing PPE behaviours in group 1. In group 1, 96.4% of workers who wear PPE every time had basic safety knowledge before joining the company, only 3.6% of workers didn't have basic knowledge. 75.8% of workers with opposite behaviour had basic safety knowledge before joining company and 24.2% of workers who didn't have basic safety knowledge. The table says that workers with basic safety knowledge wear PPE every time more than workers without basic safety knowledge.

h. Safety Concern:

The result showed that levels of safety concern was related to the wearing PPE behaviours in both groups. In wearing PPE every time behaviour, there were 63.6% of workers who extremely concerned about safety and 36.4% of workers aren't extremely concerned about safety. In the opposite behaviour group, 75.8% of workers are extremely concerned about safety and 24.2% of workers aren't extremely concerned about safety. In group 2, there were 90% of workers who don't wear PPE every time are extremely concerned about safety and only 10% of workers aren't extremely concerned about safety. 51.9% of workers in not wearing PPE every time behaviour are extremely concerned about safety and 48.1% of

workers aren't extremely concerned about safety. The table shows that in both groups, workers who are extremely concerned about safety wear PPE every time more than those who aren't extremely concerned about safety.

i. Colleague's injury experience:

The result showed that seeing colleague's injury was related to the wearing PPE behaviours in group 1. The percentage of workers who wear PPE every time in group 1 was 23.6% of workers have seen their colleague's injury or accident before and 76.4% of workers haven't seen their colleague's injury or accident before. Surprisingly, in workers who don't wear PPE every time group, 60.6% of workers who haven't seen colleague's injury or accident wear PPE every time more than those who have seen colleague's injury or accident before (39.4%).

Due to the number of workers answered in this question was unequal to other questions, the table was thus constructed separately. There were 59 workers in group 1 and 26 workers in group 2 who says yes in the question 21, "Is there any safety training session on how to use PPE in your company?" The table shows that safety training frequency was only related to the wearing PPE behaviours in group 1. While group 2 has no significant difference. There were 33.3% of workers who have a safety training 4-7 times a week, 52.8% of workers have safety training 1-3 times a week and 13.9% occasionally have a safety training. These workers are the workers who wear PPE every time. In workers don't wear PPE every time group, there were 4.3% of workers who have a safety training 4-7 times a week, 65.2% have a safety training 1-3 times a week and30.4% have a safety training once every 2 weeks and more. In this table, workers who have a safety training 4-7 times a week wear PPE every time more than workers who have a safety training 1-3 times a week or once every 2 weeks and more. In spite of the result that more frequent safety training affects workers to wear PPE every time, it doesn't mean workers do that with their own willingness. Referring to Pungvongsanuraks and Chinda research paper (2010), workers have less optimism about safety training than the management team.

Table 8 Relationship between Wearing behaviors and other variables in Group1 and 2

	Question	Wearing PPE behavior (Group1)		Chi-square (Sig.)	Wearing PPE behavior (Group4)		Chi-square (Sig.)
		Every time (%) (n=36)	Not every time (%) (n=23)		Every time (%) (n=13)	Not every time (%) (n=13)	
22	Safety Training Frequency						
	4-7 times a week (n=15)	33.3	4.3	7.617	15.4	0	2.895
	1-3 times a week (n=47)	52.8	65.2	(.022*)	53.8	46.2	(0.235[a,c])
	Once every 2 weeks and more (n=23)	13.9	30.4		30.8	53.8	

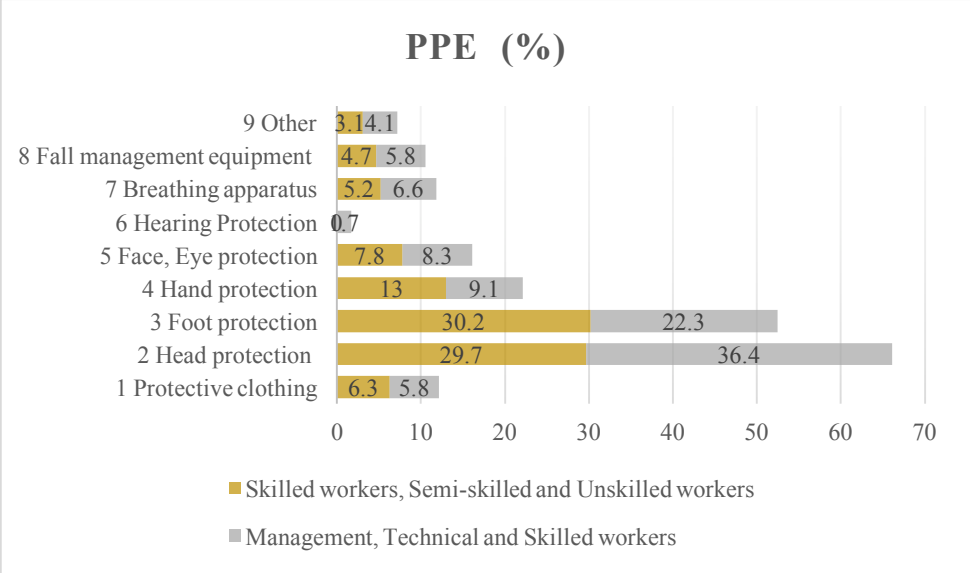


Figure 22 Analysis result of PPE categories

This bar graph shows the categories of PPE which workers in both groups had answered in the questionnaires. There were 313 answers in total, 192 answers were from skilled, semi-skilled and unskilled workers and 121 answers were from management, technical and skilled workers. Due to unequal numbers of workers in these 2 groups, this bar graph is showed in percentage. These PPE categories were referred from the PPE checklist of Fahchun

development co., Ltd, which they are currently using. The top 3 answers from skilled, semi-skilled and unskilled workers were Foot protection (30.2%), Head protection (29.7%) and Hand protection (13.0%). Conversely, the answers from management, technical and skilled workers were Head protection (36.4%), Foot protection (22.3%) and Hand protection (9.1%) respectively. As we can see from the overall shape of this bar graph, the top 3 answers from both groups are Head protection, Foot protection and Hand protection. In this research, therefore, decided to initially focus on the development of Head protection category.

To investigate the factors not to wear PPE, Aksorn and Hadikusumo work was referred here to categorize workers' answers. The unsafe acts of workers are caused by decisions-to-err. In this case, not wearing PPE is the unsafe act which consequently leads to injuries and accidents in the construction site.

There were 27 answers collected from Skilled, Semi-skilled and Unskilled workers (54%) and 23 answers were collected from Management, Technical and Skilled workers (46%). Due to the unequal number of workers in these 2 groups, the bar graph in Figure 23 is showed in percentage.

In this questionnaire survey, the decisions-to-err were ranked in this order, Overconfidence, Being in a hurry, Laziness, Lack of management, Past experience and Being uncomfortable. In this survey, there was no answer categorized as Group norms. 60.9% of the answers from Management, Technical and Skilled workers were in Overconfidence category. This workers group believe that there won't be any accidents happened to them as they mostly work in the office and take less time working at the construction site. In addition to the main reasons found related to the failure to wear PPE, there were 2 more reasons found here in this questionnaire result as well, they were Laziness and Being in hurry. Skilled, Semi-skilled and Unskilled workers answered 33.3% in Being in hurry category. Being in a hurry means supervisors pressure workers to complete jobs faster. This pressure causes workers to neglect to do proper safety practices to quickly get jobs done So, it means there is time pressure caused workers to skip good safety practices to complete their tasks faster in Thai construction. This action is also related to Laziness category which 18.5% of Skilled, Semi-skilled and Unskilled workers answered. The definition of Laziness is workers use wrong

tools or take shortcuts to save completing time. For example, workers don't wear any eye protection while welding. Lack of management reason was part of the management factor. Overall, this bar graph in Figure 24 shows Personal factors are the highest in comparison to other factors. Personal factors consist of many reasons including Overconfidence, Being uncomfortable, Past experience, Laziness and Being in hurry. As a result, the crucial point which this research further do is to find a solution to reduce Personal factors.

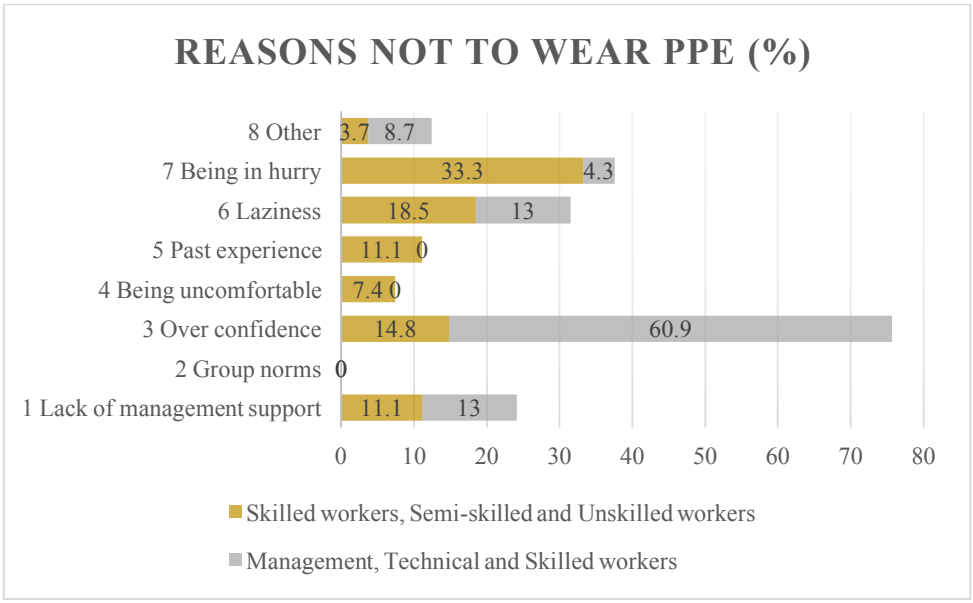


Figure 23 Analysis result of reasons not to wear PPE

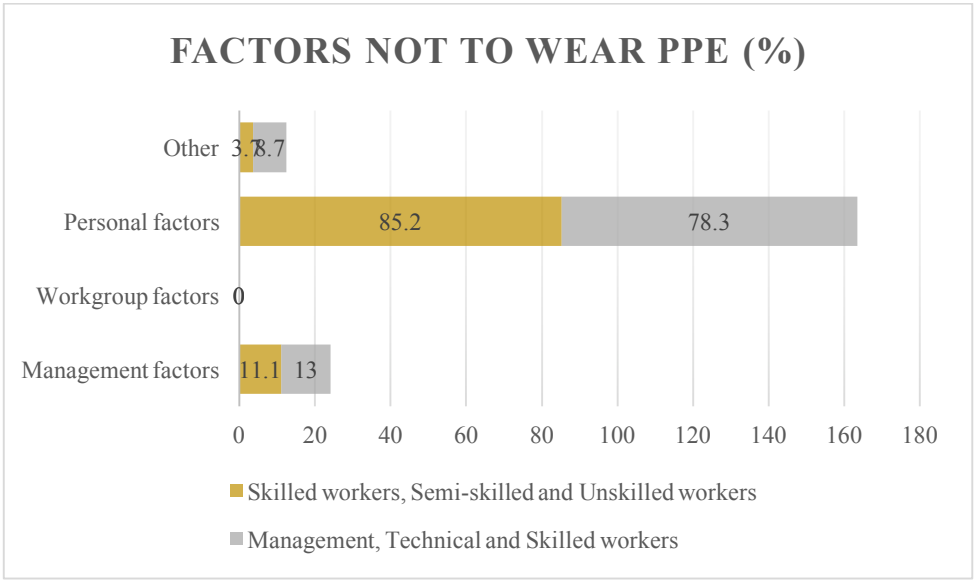


Figure 24 Analysis result of factors not to wear PPE

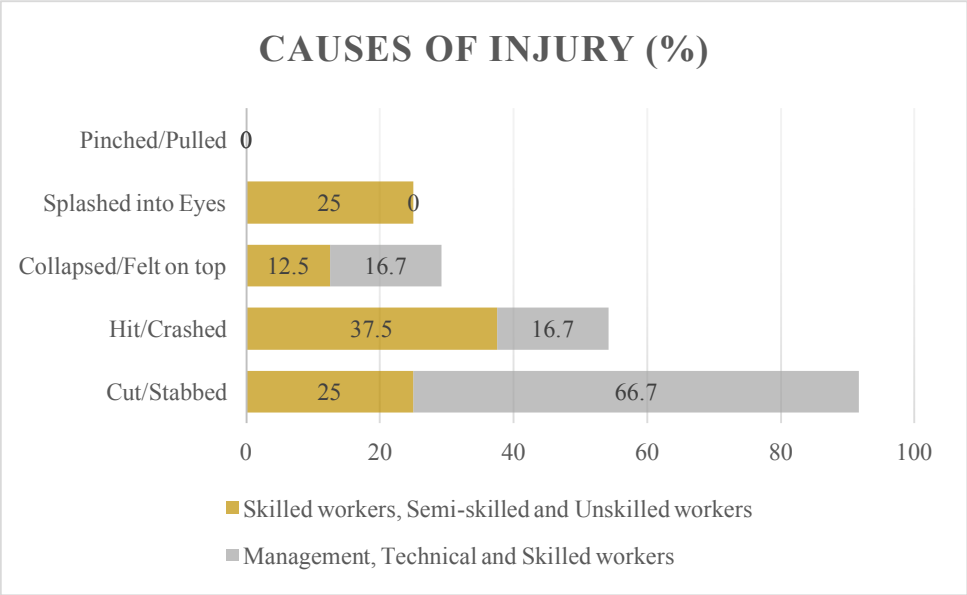


Figure 25 Analysis result of causes of injury that workers had experienced before

After collecting the answers from both groups, the causes of injury were categorized based on National profile on occupational safety and health of Thailand, 2015. There were 8 answers from skilled, semi-skilled and unskilled workers and 6 answers from management, technical and skilled workers. In comparison to the proportion of answers and number of workers in each group, it shows that 12.8% of from management, technical and skilled workers had accident and injury experience. On the other hand, 9.1% of field workers had accident and injury experience. With Regard to the previous result that skilled, semi-skilled and unskilled workers wear PPE every time more than Office and Field workers. Thus, not wearing PPE every time may increase the number of injury and accident.

Due to unequal numbers of answers in these 2 groups, this bar graph is showed in percentage. The causes of injury percentage are arranged in this order, Cut/Stabbed, Hit/Crashed, Collapsed/Felt on top and Splashed into eyes.

Figure 26 shows the percentage of workers who have seen their colleagues get injured or accident before. There were 37 answers from skilled, semi-skilled and unskilled workers and 11 answers from management, technical and skilled workers. In contrast to the previous

graph, the causes of injury are arranged in this order, Cut/Stabbed, Collapsed/Felt on top, Hit/Crashed, Splashed into eyes, and Pinched/Pulled.

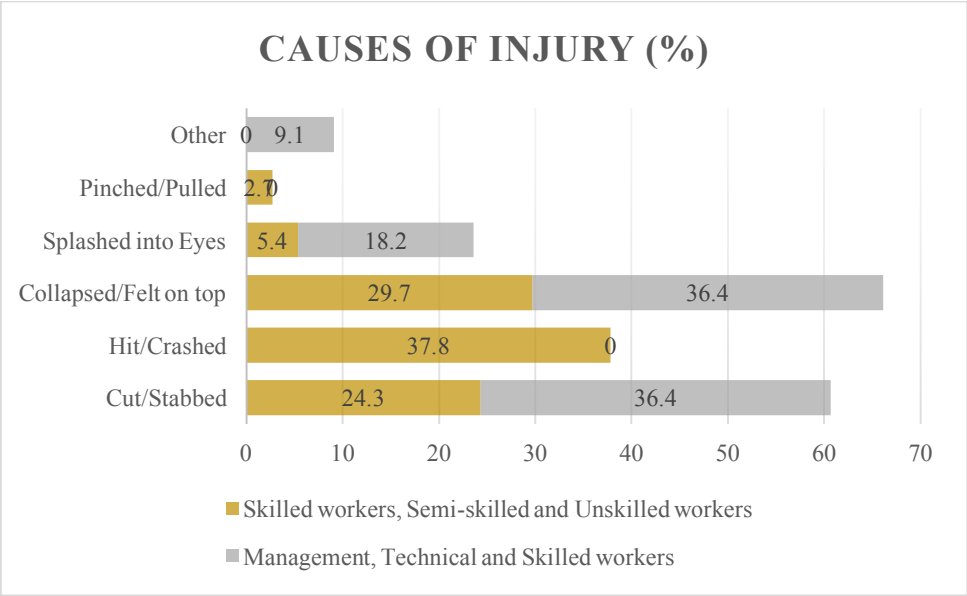


Figure 26 Analysis result of causes of injury that workers had seen before

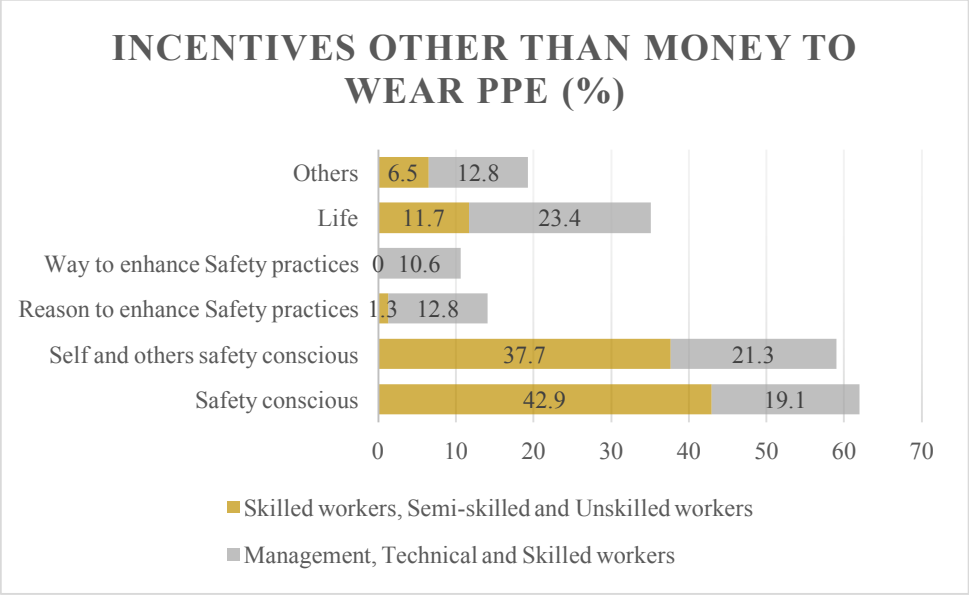


Figure 27 Analysis result of incentives other than money to wear PPE

There were 77 answers from skilled, semi-skilled and unskilled workers (62.1%) and 47 answers from management, technical and skilled workers (37.9%). To understand and see the current incentives that most workers have in mind, a graph was plotted here as shown in Figure 27. It indicates that field workers mostly answered in related to Safety conscious whereas office and field workers widely answered in all categories. This maybe because some management, technical and skilled workers are positioning as a supervisor who takes a lead in safety practices. In the overall, Safety conscious, and Self and other safety conscious approximately took 50% in both groups' answers.

In relation to increasing workers' motivation, rewards are incentive awards to drive workers to attain a goal. There are 137 answers which collected and analyzed to find an appropriate reward to increase workers' motivation to keep wearing PPE, 87 answers were from skilled, semi-skilled and unskilled workers and 50 answers were from management, technical and skilled workers. Due to unequal numbers of workers in these 2 groups, this bar graph is showed in percentage. As expected, money was the highest answer received by both groups. Secondly, honour was something that workers are looking for. Then, safety equipment was also wanted. However, if we look in detail, there were differences in their answers. Field workers have more interested in money (55.2%), honour and safety equipment are in the same ratio (18.4%) and only 2.3% are interested in welfare. On the other hand, 44% of office and field workers' answers are money, 26% in honour category, 10% in welfare and 8% in safety equipment. In conclusion, besides money, skilled, semi-skilled and unskilled workers tend to have more interest in tangible rewards like safety equipment, trophy and more. In contrast, office and field workers tend to have more interest in compliment and welfare. According to this finding, it is important to find an appropriate rewarding system (incentive) for both groups.

Figure 28 Analysis result of rewards which workers want

The questions which were answered by the management, technical and skilled workers (Group 2) are described in this part. There were 4 more questions in the management team questionnaire. Question 19, 32, 33, 35 were analyzed and explained in graphs as you can see in Figure 29, 30, 31, 32.

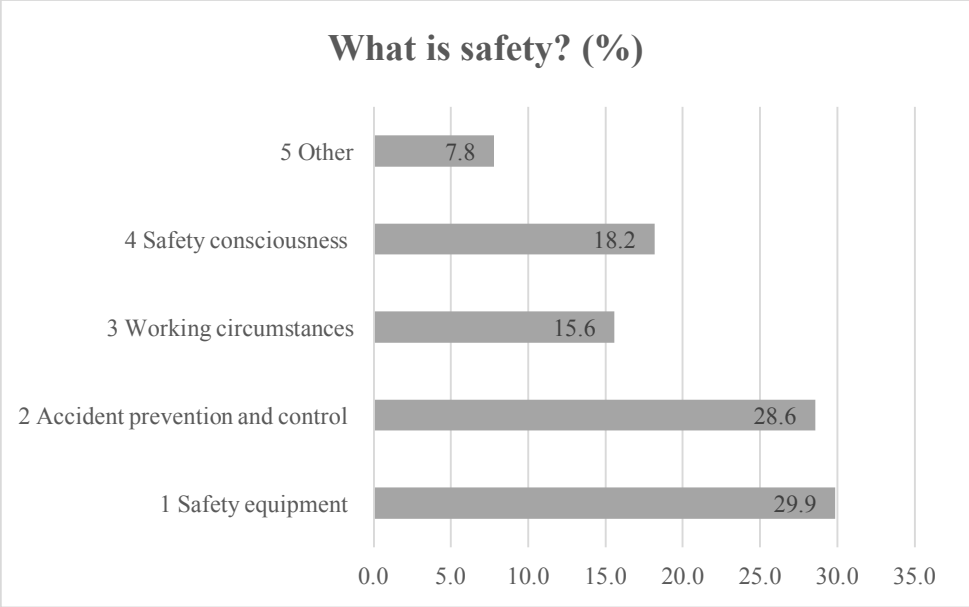


Figure 29 Analysis result of what is safety

This graph shows the percentage of major 4 safety meanings that workers can think of. There were total 77 answers collected in question 19. The highest percentage was safety equipment (29.9%), then following with accident prevention and control category (28.6%), safety consciousness (18.2%) and lastly, working circumstances (15.6%). These results reflected that workers still think that safety equipment and accident prevention and control categories are relative to the meaning of safety. The accident prevention and control, for instance, Safety control system to prevent an accident while working.

In order to control workers to wear PPE, the management team has to come up with the way to persuade their lower level team to do so. There were 52 answers to this question. This graph in Figure 30 illustrates that the management team mostly used safety consciousness (28.8%) to help them order their workers. The meaning of safety consciousness is to inform and cultivate safety for every worker. The second highest percentage was regulation and compulsion (23.1%). It was not surprising that the management team uses strict regulation to control workers to wear PPE. Then, the ways that the management team used were a negative incentive (13.5%), reason explanation (11.5%), safety routine (7.7%) and positive incentive (5.8%) respectively.

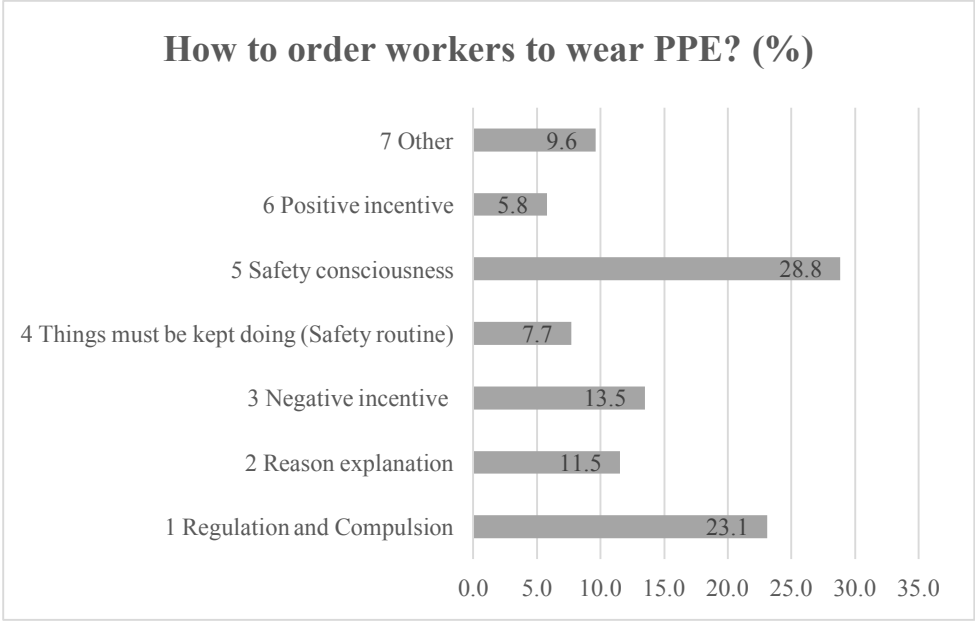


Figure 30 Analysis result of how to order workers to wear PPE

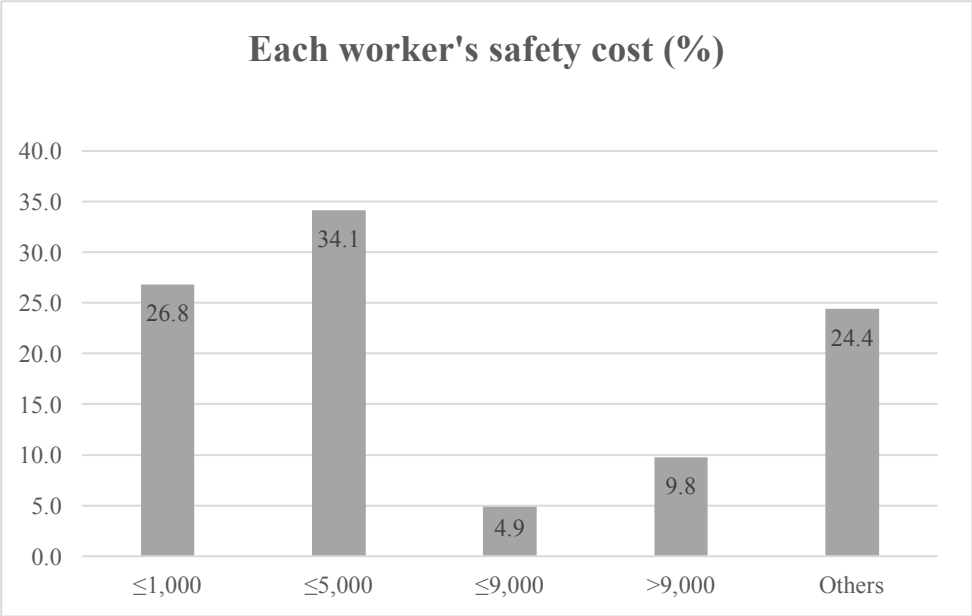


Figure 31 Analysis result of worker's safety cost

To estimate the cost which will be spent on safety investment for workers, question 33 was used in the management team questionnaire. There were 41 answers collected in this question. According to this bar graph, it says the management team mostly agreed to spend around 1,001 – 5,000 baht per worker (34.1%). Followed by the answer ≤1,000 bath per person was 26.8%, 9.8% of answers in cost more than 9,000 baht and lastly 4.9% of answers in ≤9,000 bath per person. These results can be used to estimate the initial safety investment for construction company owner to be prepared in advance.

Figure 32 shows the percentage of suggestions from the management team. There were 41 answers collected in this question. The highest percentage answer was 26.8%, providing strict standard or regulations on safety. Second, cultivating safety consciousness to workers was 22%. Third, working more on safety management was 12.2%. Then, worker must constantly develop themselves (9.8%), higher quality of PPE (7.3%), Contractor must take more responsibility in safety (7.3%), Investing more in safety (4.9%), Thai government should be more responsible for safety (4.9%) and frequently provide training (4.9%) respectively. These were the suggestions from management team which will improve safety in the future of Thai construction.

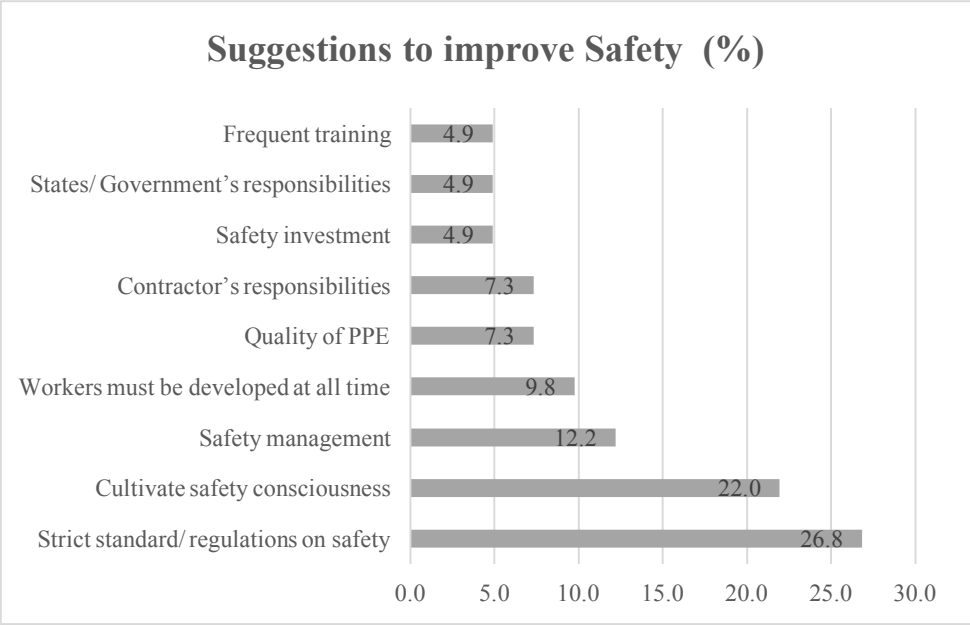


Figure 32 Analysis result of Suggestions to improve Safety

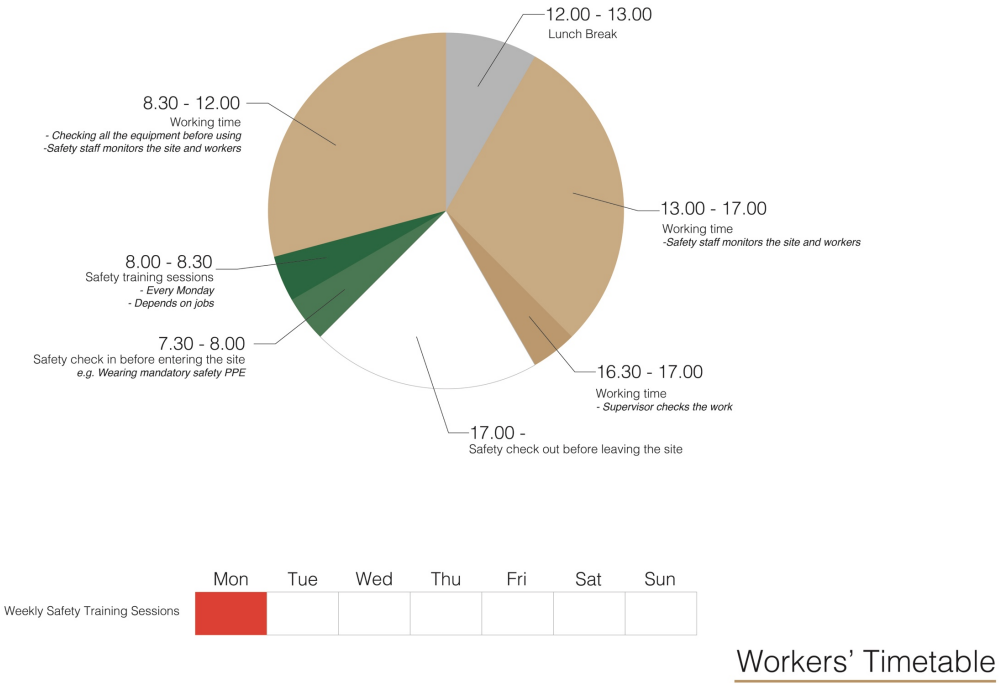


Figure 33 Construction workers' timetable in Fahchun Development Co., Ltd

Workers normally start their work at 8.00 every day from Monday to Sunday. Safety manager from Fahchun development company whom I interviewed said that there is a safety talk (training) every Monday. But, there is also some exceptional where workers can optionally participate in. The safety training is held depending on the worker's job. Workers' daily routine begins with a safety check before entering the site from 7.30 to 8.00. After that,

safety training will start. Workers continue working until 12.00 and have a lunch break for an hour. The afternoon work starts at 13.00 and finishes at 17.00. Around 30 minutes before the work is done, supervisors check the site.

4.3.2 Define

When analyzing information from the questionnaires, there were many interesting results found. To scope down the key purpose of this research, problem definition was created as below:

"How might we motivate workers to wear PPE with their own willingness?"

Refer to the problem definition, the stakeholder requirements found in the survey and interview are used for developing a solution. Workers who generally work in the construction site were motivated by money, good safety equipment and honour (recognition). Management, Technical and Skilled workers were motivated by money and honour. As a result, money is an incentive award for both groups. However, after an interview with a construction owner, He cannot give money as a reward to all workers. Civil Service Bureau (2018, p.6) also suggested that money is not the only way to motivate workers, there are other ways to motivate workers. For instance, when lower-level workers are asked about their career, they remember the moment where their efforts are recognized and appreciated by their supervisor and colleagues. People don't change their behaviour unless it makes a difference for them to do so." It reflects that incentive awards must be valued enough for workers to attain a goal. In reference to motivation theories, money is the lowest needs which human strives to get it. And in hygiene factors, money is one of the factors maintaining worker's job satisfaction to work. Money thus, cannot be an appropriate incentive award to motivate workers in a long-term but, needed to be fulfilled in the beginning. This reward system (incentive) gives an opportunity for workers to perform good safety behaviour and be recognized by the top-level positions and their colleagues also, be able to receive a reward as payment of doing a good job.

The system has developed based on stakeholder requirements. Table 9 shows the list of stakeholders' requirements which is needed to be appropriately fulfilled in this system design.

Figure 34 Final problem definition

Table 9 Main stakeholders and their requirements

	Stakeholder (User)	Requirement (Need)	
1	Skilled, Semi-Skilled and Unskilled Workers	Want an attractive incentive award as a reward	Money
			Safety equipment/ Honor
2	Management and Technical and Skilled Workers	Want an attractive incentive award as a reward	Money
			Honor
3	Construction owner	High safety performance	
		Affordable incentive	

4.3.3 Ideate

(1) Design

Firstly, to create a rewards system for workers, the six key structural elements of games from a book called Digital Game-Based Learning by Marc Prensky were used as a reference base as if in the idea development1:

- Rules: Workers have to wear PPE all the time and have to start wearing and return them before leaving the site.
- Goals or Objectives: The goal for workers is to get the highest wearing hours in percentage.
- Outcomes and Feedback: Using the idea of tracking devices and thermometer sensor to measure their progress against the goals.

- Conflict/Competition/Challenge/Opposition: Workers get motivated by a rewarding system to stimulate competition among workers and his/herself.
- Interaction: Interaction with PPE and among workers (social interaction, teamwork).
- Representation: Remind workers to keep wearing PPE at all time.

(2) Helmet Design

The top answer from the questionnaires was “Head protection”. Therefore, a safety hat or a helmet was selected to develop as the main personal protective equipment in this proposed design. Moreover, it is one of the mandatory PPE to wear before entering the construction site. The other safety items are worn depending on positions.

Another interesting result on job title question showed that workers still cannot specify their job title clearly. There was some ambiguous job title for some workers. The same title may have different roles. Also, there is no proper name list of workers who work in the site which is difficult to inspect on what PPE they have to wear. Therefore, the worker information will be shown on a helmet.

Weather is a factor reducing worker performance which also affects labour productivity. (Senouci & Al Abbasi & Eldin, 2018, p.36) From my observation and interviews with all stakeholders, they all mentioned the weather in the workplace is extremely hot and humid. Many workers feel uncomfortable and reject to wear PPE. It is one of the factors causing the failure to wear PPE.

(3) Temperature Sensing Technology

The Temp Traq disposable body temperature monitoring device is a Bluetooth wearable temperature monitor. It is a patch which can record and sends alerts of body temperature to a mobile device. Although its battery lasts within 48 hours, its technology is interesting to be referred. The technology that has been used in this product is a temperature sensor. (Tem Traq, 2016)

In the development of this research, this product technology and idea can be applied to the development of this research proposal. It shows how this temperature sensing idea can be implemented in reality.

As seen in Figure 35, it presents the final look of the helmet. The helmet consists of 3 parts

- Front: Nametag:
    - Worker's information (Name, Gender, Worker number, Job title) is shown on the helmet.
- Back: Thermometer and Timer:
    - As workers have to work in a hot climate. Worker's body temperature is measured to prevent Heatstroke.
    - Temperature sensing measures and converts body temperature to wearing helmet hours. Then wearing helmet hours is calculated in percentage.
- Side: Sticker rewards:
    - Stickers are placed on the side of a helmet. It is an area where everyone can see.

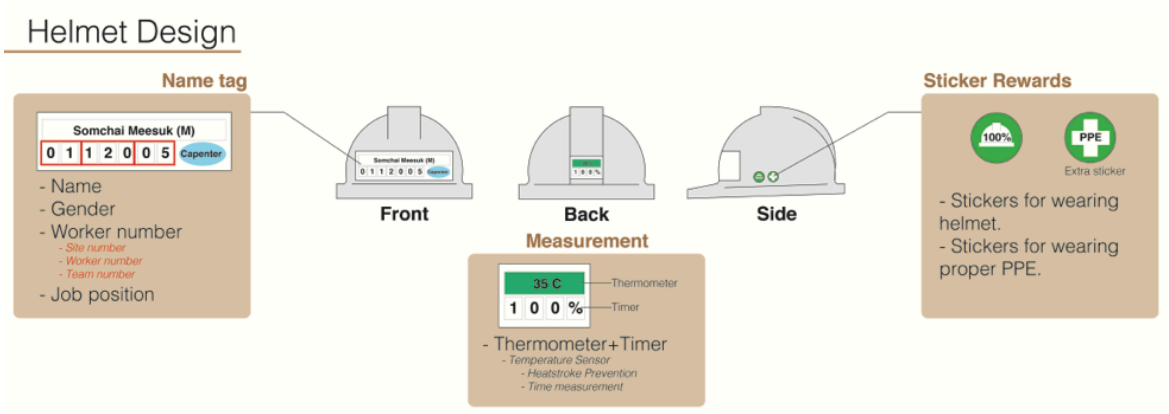


Figure 35 Helmet design

(4) What is the Sticker Reward?

The sticker reward idea was inspired by the kid's reward chart. This sticker rewards system motivates kids to keep doing good behaviour to get the prize they are striving for. Kids also feel that they were recognized by their parents. In Thai construction, worker's safe work behaviour will be incited by using this sticker rewards system. In the end, workers are able to get the rewards and recognition they want.

(5) How this sticker rewards system works?

This system has 3 phases;

1. Preparation:
    - Every worker wears a helmet at the same time in the safe zone.
    - Foreman and Headman inspect every worker wears PPE by using the checklist (Depend on workers' position).
2. Storing PPE:
    - Every worker takes off helmet at the same time in the safe zone.
    - Foreman and Headman inspect workers whether they keep all PPE in their own locker (Storage) or not by using the checklist (Depend on workers' position).

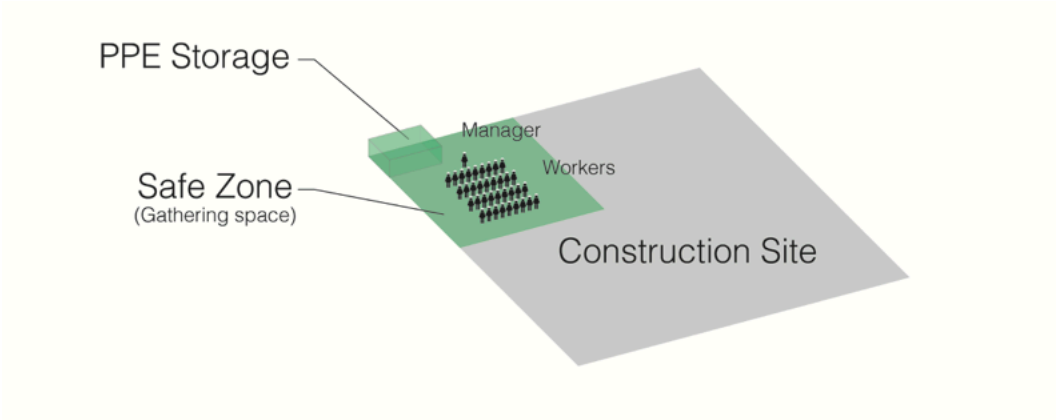


Figure 36 Location and system design for increasing motivation of wearing PPE

3. Rewarding:
    - Every worker will receive a point collection booklet. Every day after storing PPE in a locker, workers will be evaluated and get a sticker as a reward.
    - Monthly reward announcement will be held once a month. A supervisor will give a helmet sticker to a worker who has already collected 30 stickers in their booklet (Wearing a helmet or Wearing proper PPE).
    - Annual reward announcement will be held once a year. CEO will give a certificate and monetary benefits (Gift card) to a worker who has collected 6 helmet stickers or more (Wearing a helmet or Wearing proper PPE).

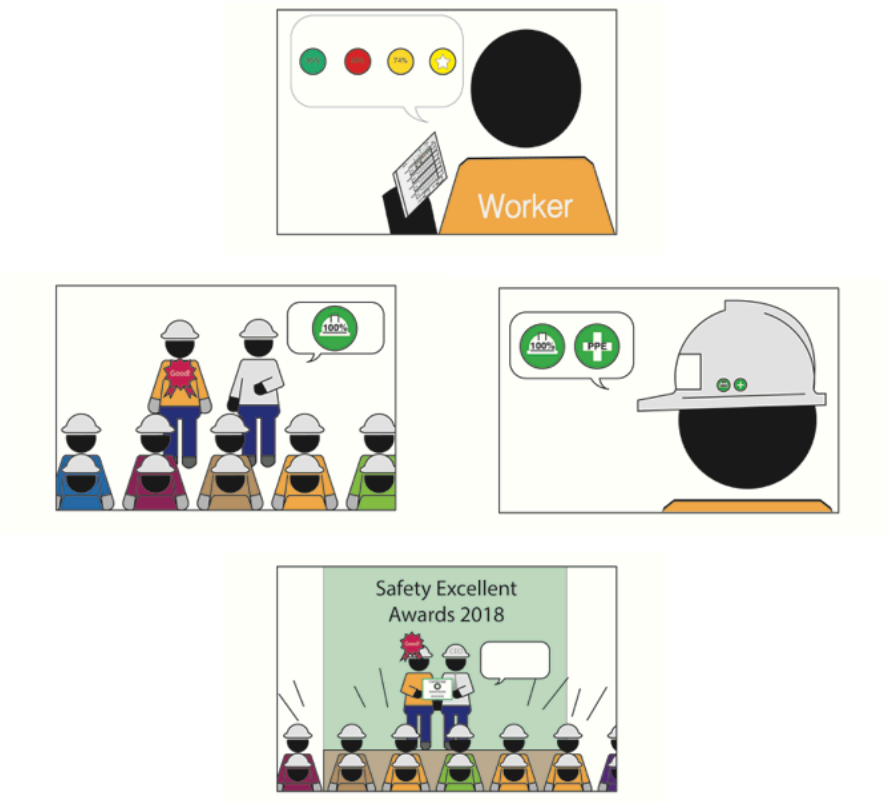


Figure 37 Sticker rewarding system for increasing motivation to wear PPE

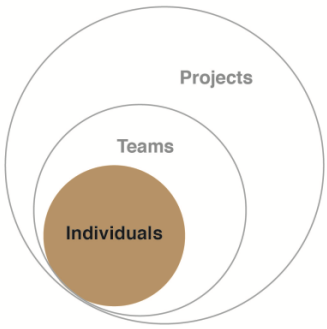


Figure 38 Three rewarding types

This system can be used in a larger scale as you can see in Figure 38. There are 3 rewarding types; Individual rewards, Team rewards and Project rewards

a. Individual rewards

To motivate workers to wear PPE in longer time with their own willingness is the point of this idea development.

How to get a sticker on a booklet?

In this system, workers have 2 ways to get stickers as you can see in Table 10 and Table 11.

- Wearing Helmet

As this system is developed based on the worker's timetable. In fact, workers must wear PPE all the time while on duty. So, workers should wear a helmet for 8 hours per day.

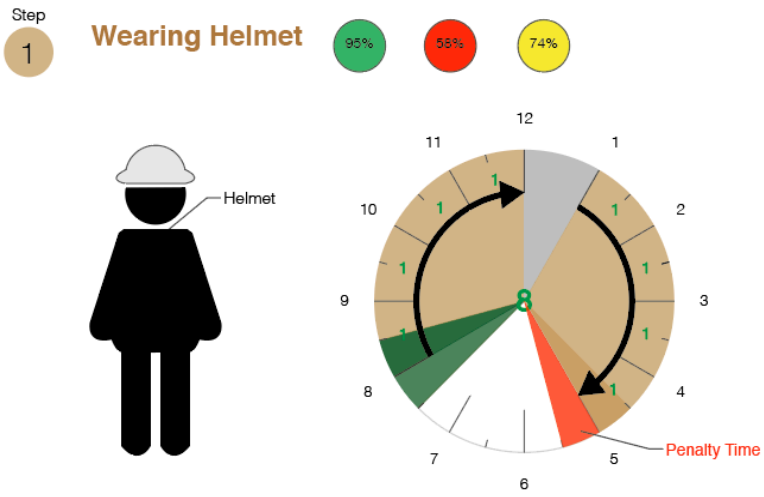
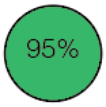


Figure 39 Stickers and rules of wearing helmet

Table 10 Stickers and rules of wearing helmet

Sticker type	Rule
	- Worker who wears a helmet more than 90% (~7 hrs 12 mins) will get a green sticker.
	- Worker who wears a helmet less than 90% but more than 60% will get a yellow sticker.
	- Worker who wears a helmet less than 60% (~4 hrs 48 mins) must go to a monthly safety training / lecture after working time (Penalty).

- Wearing Proper PPE (Extra sticker)

Another purpose of this research is to motivate workers to wear PPE properly and to ensure that every worker wear PPE in accordance with their role.

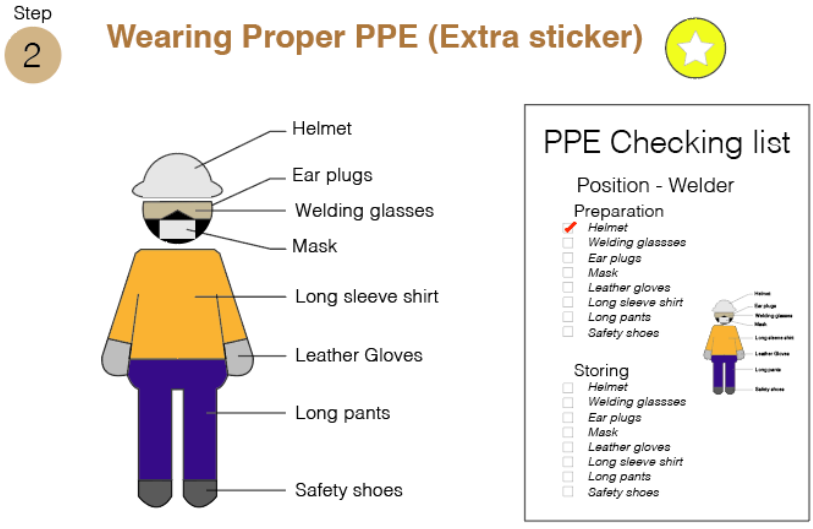


Figure 40 Extra sticker and PPE checklist

Table 11 Extra sticker and rules of wearing proper PPE

Sticker type	Rule
	- Each position wears their own proper PPE. Ex. Welder wears a Helmet, Welding glasses, Earplugs, Mask, Leather gloves, Long sleeve shirt, Long pants and Safety shoes.

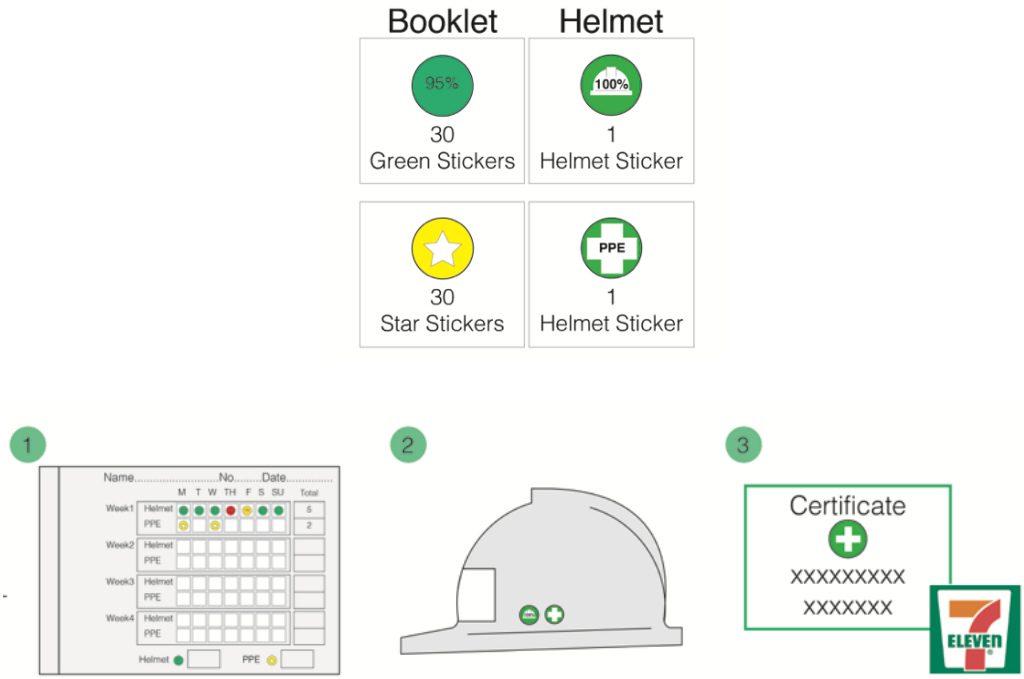


Figure 41 Incentive program with financial and non-financial rewards

Individual rewards

Figure 42 Illustration of a worker receiving individual rewards

b. Team reward

The construction industry is the industry with unique characteristics and complex system as its involved many stakeholders. The illustration in Figure 43 shows that within one construction site, there are many sub-contractors working in. These sub-contractors are hired by the main contractor to help to build up the overall project. Some of them may start working since the beginning of the project, but some may come at last. Each team starts their work in different periods. A comment from sub-contractor was mostly related to PPE. Because currently PPE is prepared by sub-contractor or workers have to buy it themselves. It results in a lack of management support from the main contractor. The interesting problem was picked to be a need which has to be fulfilled to give a good working condition for sub-contractors to perform good safety and comply with the company rules. Even though we knew the PPE is needed but, the main contractor couldn't afford and give them to all. As a result, the main contractor wants a good result to prove that this huge investment is worth enough. This team reward system will be helpful for both the main contractor and sub-contractors. The recognition from the main contractor company is needed for sub-contractors. They will wear PPE to strive for better quality and comfortable PPE.

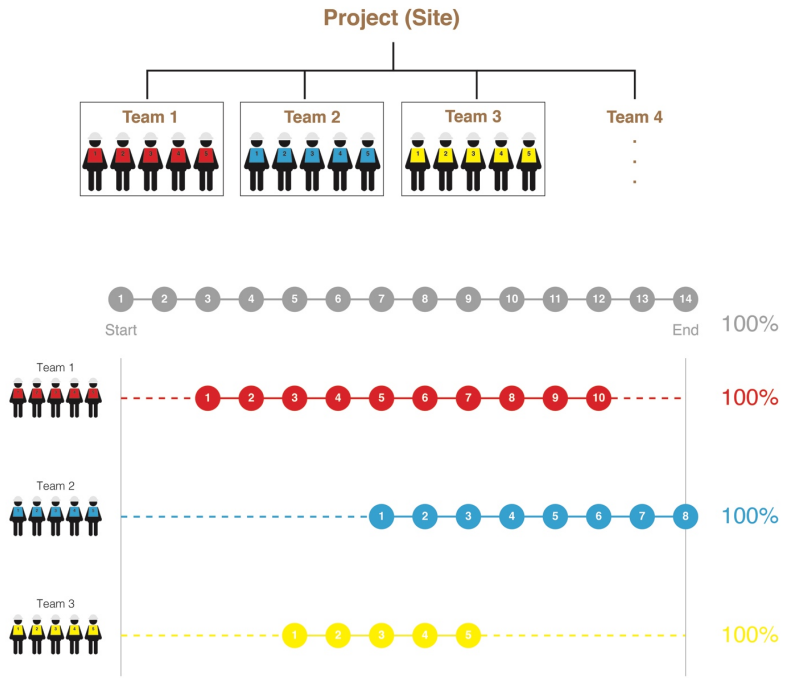


Figure 43 Structure of construction site and Sub-contractors' schedule

How to get team rewards?

- Headman strictly supervises a team and workers look after each other.
- Each team accumulates all workers' wearing hours (%) The system rules are similar to the individual rewards system. All members of the team which have wearing hours less than 60% must go to a monthly safety training/lecture after working time (Penalty).
- The Team that has the highest wearing hours (%) and the number of workers who have stickers on the helmet will get a Trophy and PPE or additional options for PPE as rewards.

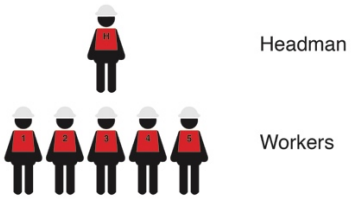


Figure 44 Structure of team

$$\text{Team's wearing hours (\%)} = \frac{\text{Sum of all workers' working hours}}{\text{Working Hours}} \times 100$$

Figure 45 Wearing hours formula

Figure 46 Team Rewards

Team rewards

Figure 47 Illustration of a worker receiving team rewards

c. Project reward

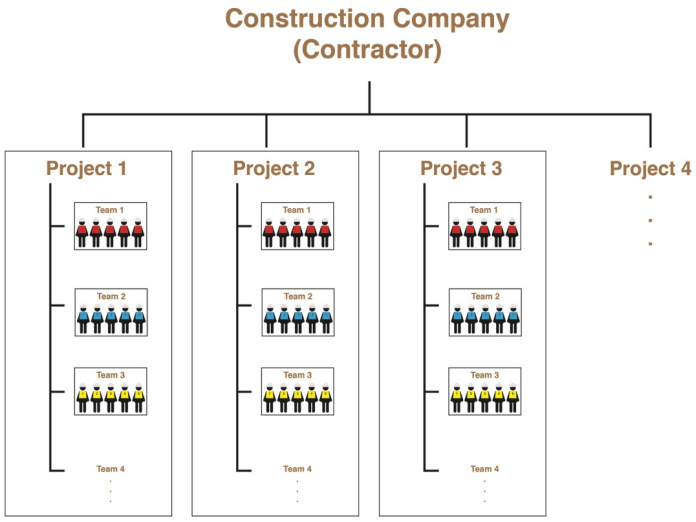


Figure 48 Structure of construction company

The construction company may handle many projects at the same time. The safety standard setting is required to achieve high safety performance. Every project should remain the same or higher safety performance. To attain this goal, everyone involved in the same project, from top to low level positions must cooperate to do so. This project rewards system is purposely designed for management, technical and skilled workers who do management and supervise the construction site. As their key incentive awards to perform safety are money and honor, this system stimulates a situation for them to achieve a goal.

How to get project rewards?

- Project manager and High position workers strictly supervise the project, teams and workers look after each other. To complete these steps, management, technical and skilled workers must monitor and ensure that everyone complies with the system rules. They must submit reports to the headquarter for future development.
- Each project manager accumulates all workers' wearing hours (%). This is their duty to provide a monthly safety training/lecture for those teams that have wearing hours less than 60%.

- The Project which has the highest wearing hours (%), the number of workers who have stickers on the helmet and no accident or the lowest accident rate in the construction site will get a Trophy + Manager/ Higher position workers get a gift voucher (500 baht each person) (Reward).

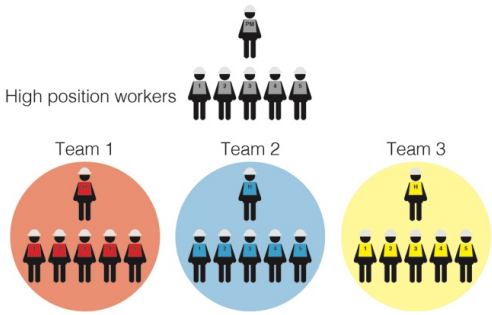


Figure 49 Structure of site project management

$$\text{Project's wearing hours (\%)} = \frac{\text{Sum of all workers' working hours}}{\text{Working Hours}} \times 100$$

Figure 50 Wearing hours formula

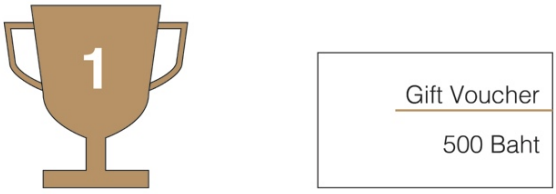


Figure 51 Project Reward

Project rewards

Figure 52 Illustration of a worker receiving project rewards

(6) Suggestions for construction owner

The solution approach for an owner is to give suggestions to reinforce the safety culture of the company. It seems like an enormous investment to improve organizational safety culture., For instance, strictly provide safety training for workers, providing PPE for every worker and etc. It is important to proceed with these two approaches simultaneously, which will make this solution works.

4.3.4 Prototype:

Prototype is a scaled-down, rough version of the product. This step is used for testing and find out whether the product or idea are implemented successfully or not. Due to lack of technology and ability to make the prototype helmet works, a mock-up prototype helmet was easily created by printing all elements on paper and attached them on the helmet to simply visualize the final look. In addition, a sticker collecting book mockup also simply made to shows the rough idea of how it will be used by the users. The testing step will be talked in the next chapter. Comfortableness is also important. It can be a key idea in further design development. In order to make comfortable prototype PPE, Japanese PPE was used as an example.

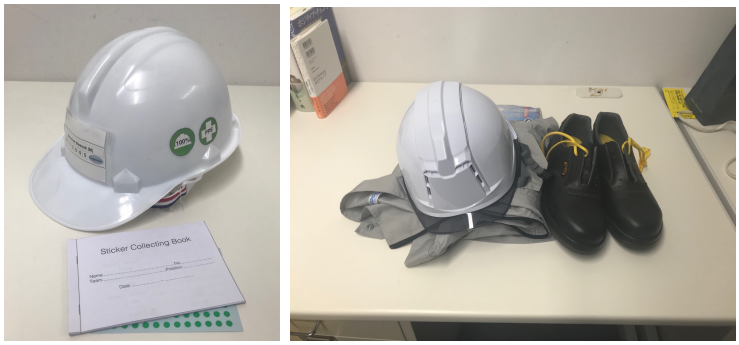


Figure 53 Prototype helmet and Japanese PPE

CHAPTER 5: Experiment

5.1 Test and Analysis

The experiment was conducted in the construction site located in Ayutthaya, Thailand on June 14th, 2018. It was done by construction workers from a medium sized construction company in Thailand. The selected company name is Fahthai Corporation co., Ltd.

Due to the tight working schedule in the construction site, the experiment was held within one and a half hour. It started at 13.30 and finished around 15.00. It was an interview and questionnaires checking on workers' feeling and perspective have changed after listened to the research idea or not.

The questionnaire was created to check and ensure that worker's perspective towards PPE has changed and their willingness to wear PPE has increased. All the participants were gathered together in one place. The storyboard illustration was used in this experiment. It helped in explaining the system in easier understanding for all workers. Furthermore, workers had tried on a prototyping helmet and high-quality Japanese PPE.

Before listening to the proposal, workers were asked to fill in their general information, do the occupational health and safety attitude test, safety practices test and questionnaire regarding current safety system situation. After listened to the proposal, the post-questionnaire was distributed to workers once again. In the next step, the result will be used in the statistical analysis to compare the results from pre-questionnaire and post-questionnaire.

The first step in the experiment was composed of 4 sets of pre-questionnaire. Firstly, participants filled in their general information. Second, the Occupational Health and Safety Attitudes and Practices questionnaire used for this research is based on Thesis developed by Thawat Luagwasutha. The safety attitudes questionnaire consisted of 15 questions, each related to a worker's safety attitude. Then, there were 25 questions related to safety practices in the workplace. After that, the questionnaire asking about current safety system was

distributed before listened to the proposal. The last questionnaire in this pre-questionnaire section consisted of 12 questions. The last step in the experiment was Post-Questionnaire, it was composed of 7 questions about the proposed safety system.

Table 12 Experiment steps

Step	How to do an experiment
1	Pre-Questionnaires 1. General information of the participants (11) 2. Questions on workers' attitude about occupational health and safety (15) 3. Questions about workers' safety practices (25) 4. Questions about the current safety system (12)
2	Give a presentation on the proposed idea and Let workers try on a prototype helmet and Japanese PPE
3	Post-Questionnaire 5. Questions about the proposed safety system (7)

5.1.1 Data Analysis Method

All collected data will be processed and analyzed as follows:

1. General information of participants was analyzed using descriptive statistics, frequency distribution and the percentage was drawn in Table 18
2. Statistical analysis of Occupational Health and Safety Attitudes and Practices, the data were analyzed by mean, standard deviation, and level of attitude and practices as drawn in Table 20 and 22.
3. Comparison of the current safety system and the proposed idea was analyzed by using the Paired t-test as drawn in Table 24.

(1) Scoring criteria

Analysis of Occupational Health and Safety Attitudes and Practices questionnaires were based on Likert rating scale. There were 5 level; Strongly agree, Agree, Unsure, Disagree and Strongly disagree. The scoring criteria are as displayed in Table 13 And14

Table 13 Scoring criteria for Occupational Health and Safety Attitudes in workplace

Positive question		Negative question	
Strongly agree	5 points	Strongly agree	1 point
Agree	4 points	Agree	2 points
Unsure	3 points	Unsure	3 points
Disagree	2 points	Disagree	4 points
Strongly disagree	1 point	Strongly disagree	5 points

Table 14 Scoring criteria for Occupational Health and Safety Practices in workplace

Positive question		Negative question	
Strongly agree	5 points	Strongly agree	1 point
Agree	4 points	Agree	2 points
Unsure	3 points	Unsure	3 points
Disagree	2 points	Disagree	4 points
Strongly disagree	1 point	Strongly disagree	5 points

According to the Laungwasutha's questionnaire (2013), the questions in both Occupational Health and Safety Attitudes and Practices questionnaires were composed of 2 types of question, positive questions and negative questions. Table 13 and Table 14 Show the scoring criteria for score calculation.

In the data analysis, the scores from the scoring criteria were evaluated to determine the class interval of a frequency distribution using the formula developed by Wisakha Phoochinda (2010)

$$\text{Class interval} = \frac{\textbf{Highest Value} - \textbf{Lowest Value}}{\textbf{Number of Classes}}$$

$$= \frac{\mathbf{5-1}}{\mathbf{5}}$$

$$= 0.8$$

Table 15 Scoring criteria on levels of attitude and practices of Occupational Health and Safety in workplace

Score	Levels of attitude	Score	Levels of safety practices
4.21-5.00	Excellent	4.21-5.00	Excellent
3.41-4.20	Very good	3.41-4.20	Very good
2.61-3.40	Good	2.61-3.40	Good
1.81-2.60	Fair	1.81-2.60	Fair
1.00-1.80	Poor	1.00-1.80	Poor

Table 16 Likert Scale and Scoring criteria

5	4	3	2	1
4.21-5.00	3.41-4.20	2.61-3.40	1.81-2.60	1.00-1.80
Extremely	Moderately	Somewhat	Slightly	Not at all
Very satisfied	Satisfied	Unsure	Dissatisfied	Very dissatisfied
Very positive	Positive	Neutral	Negative	Very negative

Table 17 below shows lists of questions and the name of tests that will be used for analyzing changes before and after in the same group of people. The questions highlighted in yellow were similar questions but ask in different times (before-after listen to the proposal).

Table 17 Comparison of pre-post questionnaire and used statistics test

Pair	Pre-Questionnaire	Post-Questionnaire	Test
1	4.1 What do you think of the strictness of company's current safety system?	5.1 What do you think of the strictness of proposed safety system?	Paired T-test
2	4.2 Are you satisfied with your current quality of life?	5.2 If the proposed safety system is implemented in reality, will you be satisfied with your quality of life?	Paired T-test
3	4.3 Are you satisfied with the current safety system?	5.3 Are you satisfied with the proposed safety system?	Paired T-test
	4.4 Do you think you have enough personal protective equipment?		
	4.5 The PPE you are using today. Does the company provide for you or Do you buy them yourself?		
4	4.6 What do you think of the quality of personal protective equipment you are using today?	5.4 What do you think of the quality of personal protective equipment you have seen today?	Paired T-test
	4.7 After using personal protective equipment, where do you store your equipment?		
5	4.8 What is your perspective towards personal protective equipment?	5.5 After seeing and trying on the personal protective equipment offered here. What is your perspective towards personal protective equipment?	Paired T-test
	4.9 Do you think personal protective equipment is important to your life?		
6	4.10 Do you feel "I want to wear" or "I have to wear" personal protective equipment? E.g. I want to wear it because I have it or I have to wear it because of the company's rules.	5.6 If the proposed safety system is implemented in reality, will you feel "I want to wear" or "I have to wear" personal protective equipment after listening to the proposed safety system?	Chi-Square
	4.11 Have you ever received a compliment from wearing personal protective equipment or following the safety procedures correctly before?		
7	4.12 Are you proud to be honored for wearing personal protective equipment?	5.7 If the proposed safety system is implemented in reality, will you proud to be honored for wearing personal protective equipment?	Paired T-test

Figure 54 Photos collection from the experiment (Pre-questionnaire)

Figure 55 Photos collection from the experiment (Proposal presentation)

Time: 15.10

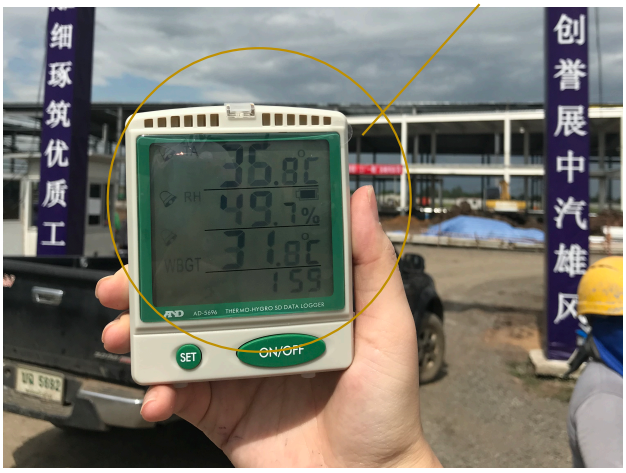


Figure 56 Photos collection from the experiment (Post-questionnaire)

5.1.2 Analysis Results

(1) General information of participants

Table 18 Frequency distribution of participants' general information1

	General information	(N=19)	Percentage (%)
1	Gender		
	Male	12	63.2
	Female	7	36.8
2	Age		
	Under25	5	26.3
	26-35	7	36.8
	36-45	3	15.8
	More than 46	4	21.1
3	Nationality		
	Thai	16	84.2
	Non-Thai	3	15.8
4	Job Position		
	Skilled, Semi-skilled and Unskilled Worker Management, technical and skilled Worker	16	84.2
		3	15.8
5	Work Experience		
	Under 5 years	8	42.1
	More than 5 years	11	57.9
6	Job Satisfaction		
	Very satisfied	2	10.5
	Other	17	89.5
7	Safety Concern		
	Extremely	15	78.9
	Other	4	21.1
8	Wearing PPE behavior		
	Every time	12	63.2
	Not every time	7	36.9
9	Have injury experience		
	Yes	6	31.6
	No	13	68.4
10	Colleague's injury experience		
	Have seen	8	42.1
	Haven't seen	11	57.9

Table 18 displays a frequency distribution table of the participants' general information. The majority of participants were 12 males (63.2%) and 7 females (36.8%). Most of the participants were aged 26-35 years old, 7 people (36.8%), followed by 5 people (26.3%) with age under 25, more than 46 were 4 people (21.1%) and 3 workers aged 36-45 (15.8%). This experiment was mostly Thai workers took part in it; 16 people (84.2%), only 3 people were Non-Thai workers (15.8%). There were 16 people from the skilled, semi-skilled and unskilled workforce (84.2%) and 3 people from management, technical and skilled workforce (15.8%). The study found that 8 people (42.1%) are workers with work experience under 5 years and 11 people (57.9%) with more than 5 years' work experience. 17 participants (89.5%) answered that they are not very satisfied with their job, only 2 people feel very satisfied (10.5%). 15 participants were extremely concerned about their safety (78.9%) and 4 people answered oppositely (21.1%). There were 12 participants wear PPE every time (63.2%) and 7 participants don't wear PPE every time (36.9%). Most of the participants had no experience in injury or accident, 13 participants (68.4%). There were 6 people had injured before (31.6%). Also, 11 people haven't seen their colleague gets injured before but 8 people have seen it (57.9%).

Some participants answered more than 2 answers in this question11. Table 19 was thus constructed separately because the total number of answers were 45. The majority of answers were in Head protection and Foot protection categories which were similar to the survey result in the idea development 2 section. It can be described that in workers' perception of PPE were helmets and safety shoes which this proposal was developed from.

Table 19 Frequency distribution of participants' general information2

	General information	(N=45)	Percentage (%)
11	PPE		
	Head protection	16	35.6
	Foot protection	14	31.1
	Hand protection	7	15.6
	Face, Eye protection	8	17.8

(2) Occupational Health and Safety Attitudes

From Table 20, the statistical analysis of workers' occupational health and safety attitude responding to the questionnaire was presented in Mean, Standard deviation and Attitude levels. The average score was 3.6702 which equally to workers had very good average safety attitude. The levels of attitude found in this part were Excellent, Very good, Good, Fair and Poor, respectively. The questions highlighted in yellow were negative questions and these 5 questions indicated as a bad attitude as highlighted in red. Question13, "Do you believe in your expertise. Even if you take a shortcut, it will not cause any accidents?" was answered as Good safety attitude with the average score of 2.7368. Next, question 2, "Do you think the following company's safety rules is caused uncomfortable and time delays?" was responded to Fair safety attitude with an average score of 2.3684. Lastly, question6, 12 and 14 were found as Poor safety attitude. The average score was 1.6316, 1.3158 and 1 respectively. Overall, workers have very good safety attitude, but in the colour highlighted questions must be improved.

Table 21 shows the comparison of both workforces. There are 4 questions highlighted in green. The green colour indicates the questions with different attitude levels between both groups. Apparently, the results of question2 were very different. The skilled, semi-skilled and unskilled worker had a fair attitude with an average score of 2.125 while, management, technical and skilled worker had a very good attitude with an average score of 3.6667. The attitude levels of the skilled, semi-skilled and unskilled worker in question 3,5 and 9 were very good with average scores of 4.19, 4.06 and 3.81. In contrast to management, technical and skilled worker who had good, good and excellent attitude levels. The order of average scores in this group were 3, 3 and 4.33.

Table 20 Average score, Standard deviation and the levels of workers' safety attitude

No.	Workers' attitude on occupational health and safety	$\bar{x}$	S.D.	Level of attitudes
1	Do you think all employees must be trained in the occupational health and safety program?	5	0	Excellent
2	Do you think following company's safety rules is caused uncomfortable and time delays?	2.3684	1.34208	Fair
3	Do you think punishing employees who do not comply with company's safety rules can mitigate the accidents?	4	1.414	Very good
4	Do you think being trained on occupational health and safety program will give you the knowledge and the ability to prevent accidents?	4.89	0.459	Excellent
5	Do you feel safe when wearing personal protective equipment every time while working?	3.89	1.049	Very good
6	Do you think that you do not need to comply with all the safety rules, especially those you do not think it's necessary?	1.6316	0.76089	Poor
7	Do you think an accident prevention is your responsibility?	4.89	0.315	Excellent
8	Do you believe that most accidents happen is caused by unsafe acts?	4.58	0.769	Excellent
9	Do you think even a minor accident, you will always report to the supervisor?	3.89	0.994	Very good
10	Do you think if you have planned and followed the safety instructions, you are sure that it will help you work safely?	5	0	Excellent
11	Do you think all employees should involve in giving feedback and suggestions on safety?	5	0	Excellent
12	Do you believe that accidents are beyond control and cannot be prevented?	1.3158	0.47757	Poor
13	Do you believe in your expertise? Even if you take a shortcut, it will not cause any accidents.	2.7368	1.6945	Good
14	Do you think the accident investigation is a punishment for employees rather than giving an advice or solution?	1	0	Poor
15	Do you think safety while working is part of your job and it is important as producing work?	4.84	0.375	Excellent
Average attitude levels workers on occupational health and safety		3.6702	0.2735	Very good

Table 21 Comparison of Average score, Standard deviation and the levels of safety attitude in 2 worker groups

No	Skilled, semi-skilled and unskilled worker (n=16)			Management, technical and skilled worker (n=3)		
	$\bar{x}$	S.D.	Levels of attitude	$\bar{x}$	S.D.	Levels of attitude
1	5	0	Excellent	5	0	Excellent
2	2.125	1.25831	Fair	3.6667	1.1547	Very good
3	4.19	1.276	Very good	3	2	Good
4	4.88	0.5	Excellent	5	0	Excellent
5	4.06	0.854	Very good	3	1.732	Good
6	1.75	0.7746	Poor	1	0	Poor
7	4.88	0.342	Excellent	5	0	Excellent
8	4.5	0.816	Excellent	5	0	Excellent
9	3.81	1.047	Very good	4.33	0.577	Excellent
10	5	0	Excellent	5	0	Excellent
11	5	0	Excellent	5	0	Excellent
12	1.375	0.5	Poor	1	0	Poor
13	2.6875	1.70171	Good	3	2	Good
14	1	0	Poor	1	0	Poor
15	4.81	0.403	Excellent	5	0	Excellent
Average Attitude	3.6708	0.28749	Very good	3.6667	0.23094	Very good

(3) Occupational Health and Safety Practices

From Table 22, the statistical analysis of workers' occupational health and safety practices responding to the questionnaire was presented in Mean, Standard deviation and Safety practices levels. The average safety practices level was very good with the average score of 4.1642. The levels of safety practices found in this part were Excellent, Very good, Good, respectively. The questions highlighted in yellow were negative questions. These 5 questions and one more question indicated as bad attitude as highlighted in red. Question6, 7, 12, 14, 16 and 21 were responded to Good safety practices with average scores of 3.1579, 2.6316,

3.3684, 2.95, 3.3158 and 3.0526 respectively. Overall, workers have very good safety practices, but in the colour highlighted questions must be improved.

Table 22 Average score, Standard deviation and the levels of workers' safety practices

No.	Workers' safety practices	$\bar{x}$	S.D.	Level of safety practices
1	Do you study and understand the company's safety rules?	4.74	0.452	Excellent
2	Do you comply with the company's safety rules?	4.58	0.507	Excellent
3	Do you follow safe work procedures?	4.26	0.806	Excellent
4	Do you study the equipment or machine manual before operating?	3.95	0.911	Very good
5	Do you check the availability of equipment or machinery both before and after use?	4	0.745	Very good
6	Do you tease and talk to others while working?	3.1579	0.89834	Good
7	Do you work although you do not have a good physical condition such as illness, fatigue, or binge drinking?	2.6316	1.11607	Good
8	Do you wear personal protective equipment that company has provided for you while working?	4.58	0.838	Excellent
9	Do you dress appropriately for your job while you are working?	4.58	0.507	Excellent
10	Do you always follow the instructions and warnings from supervisors?	4.68	0.478	Excellent
11	Do you select the right equipment for your job?	4.63	0.496	Excellent
12	When you find that the machine tool or equipment is defective. Do you correct immediately even though it's not your duty?	3.3684	1.42246	Good
13	Do you strictly follow the safety signs or safety symbols?	4.47	0.612	Excellent
14	Do you take a shortcut to complete the task on time?	2.95	1.129	Good
15	When you find an accident or something that might be dangerous. Do you notify the supervisor immediately?	4.58	0.838	Excellent
16	Do you remove the cover or protective device from the machine for easy operation?	3.3158	1.33552	Good
17	Do you remind your colleagues about the importance of safety practices?	4.16	1.068	Very good
18	Do you observe the operation of tools, machinery and equipment that work normally or not?	4.47	0.513	Excellent
19	Do you keep the equipment in place after use?	4.74	0.452	Excellent

Table 22 Average score, Standard deviation and the levels of workers' safety practices (Continued)

No.	Workers' safety practices	$\bar{x}$	S.D.	Level of safety practices
20	Do you follow the safety news from the company noticed board or announcement?	4.58	0.692	Excellent
21	While you are working, you always think about issues that give a cause for concern, such as family problems.	3.0526	1.50826	Good
22	Do you participate in activities to promote safety at workplace that the company held?	4.79	0.535	Excellent
23	Do you keep the workplace area clean?	4.05	0.621	Very good
24	Do you use the safety knowledge gained from the training in practice?	4.79	0.419	Excellent
25	When you operate and find that the machine is defective or malfunctioning, will you stop working immediately.	5	0	Excellent
Average Safety Practices		4.1642	0.29751	Very good

Looking at the analysis result from both groups, there were differences in 8 questions as highlighted in green. Within these questions, the questions with red font colour were found extremely different between 2 groups. The results from the questions highlighted in green but without red font colour were different but, there was not a big gap between them.

- Starting with question7, "Do you work although you do not have a good physical condition such as illness, fatigue, or binge drinking?". The skilled, semi-skilled and unskilled worker had fair safety practices with an average score of 2.4375 while, management, technical and skilled worker had very good safety practices with an average score of 3.6667.
- Question14, "Do you take a shortcut to complete the task on time?" The skilled, semi-skilled and unskilled worker had good safety practices with an average score of 3.3125 while, management, technical and skilled worker had poor safety practices with an average score of 1.67.
- Question16, "Do you remove the cover or protective device from the machine for easy operation?". The skilled, semi-skilled and unskilled worker had good safety practices with an average score of 3 while, management, technical and skilled worker had excellent safety practices with an average score of 5.

Table 23 Comparison of Average score, Standard deviation and the levels of safety practices in 2 worker groups

No	Skilled, semi-skilled and unskilled worker (n=16)			Management, technical and skilled worker (n=3)		
	$\bar{x}$	S.D.	Levels of safety practices	$\bar{x}$	S.D.	Level of safety practices
1	4.69	0.479	Excellent	5	0	Excellent
2	4.56	0.512	Excellent	4.67	0.577	Excellent
3	4.31	0.793	Excellent	4	1	Very good
4	3.94	0.929	Very good	4	1	Very good
5	3.94	0.68	Very good	4.33	1.155	Excellent
6	3.125	0.95743	Good	3.3333	0.57735	Good
7	2.4375	1.03078	Fair	3.6667	1.1547	Very good
8	4.63	0.806	Excellent	4.33	1.155	Excellent
9	4.56	0.512	Excellent	4.67	0.577	Excellent
10	4.69	0.479	Excellent	4.67	0.577	Excellent
11	4.56	0.512	Excellent	5	0	Excellent
12	3.3125	1.49304	Good	3.6667	1.1547	Very good
13	4.44	0.629	Excellent	4.67	0.577	Excellent
14	3.19	0.981	Good	1.67	1.155	Poor
15	4.69	0.602	Excellent	4	1.732	Very good
16	3	1.21106	Good	5	0	Excellent
17	4.12	1.088	Very good	4.33	1.155	Excellent
18	4.5	0.516	Excellent	4.33	0.577	Excellent
19	4.75	0.447	Excellent	4.67	0.577	Excellent
20	4.63	0.619	Excellent	4.33	1.155	Excellent
21	3.125	1.62788	Good	2.6667	0.57735	Good
22	4.88	0.342	Excellent	4.33	1.155	Excellent
23	4.06	0.574	Very good	4	1	Very good
24	4.75	0.447	Excellent	5	0	Excellent

Table 23 Comparison of Average score, Standard deviation and the levels of safety practices in 2 worker groups (Continued)

No	Skilled, semi-skilled and unskilled worker (n=16)			Management, technical and skilled worker (n=3)		
	$\bar{x}$	S.D.	Levels of safety practices	$\bar{x}$	S.D.	Level of safety practices
25	5	0	Excellent	5	0	Excellent
Average Safety Practices	4.155	0.29426	Very good	4.2133	0.37807	Excellent

(4) Pre-Post questionnaires on current safety system and the proposed safety system

The Comparison of opinions on current safety system and the proposed safety system were investigated by using Paired T-Test The results showed the change in workers' perspectives, feelings towards PPE between before and after the experiment. Paired t-test was used to check the statistical significance of the outcomes before and after of this research. The average scores for each paired question are outlined in Table 24, 25 and 26. The red colour highlighted indicated the result with a significant difference.

a. Comparison of strictness of the company's current safety system and the proposed safety system

The average score for all workers (19 people) after the experiment was significantly lower than before the experiment. Workers thought that this proposal is somewhat strict. While the management team said it's slightly strict.

b. Comparison of satisfaction on the current quality of life and future quality of life

It could determine that there was no significant difference in worker's satisfaction on the quality of life. There was no change in both groups.

c. Comparison of satisfaction on the current safety system and the proposed safety system

The average score for all workers (19 people) after the experiment was significantly lower than before the experiment. Workers already felt very satisfied with the current safety system and have no interest in the proposal. There was no significance in the management team.

d. Comparison of the quality of current personal protective equipment and the proposed personal protective equipment

The average score for all workers (19 people) after the experiment was significantly higher than before the experiment. It could determine that Japanese PPE obviously has better quality and design.

e. Comparison of worker's perspective towards personal protective equipment before and after the experiment

The average score for all workers (19 people) after the experiment was significantly higher than before the experiment. This is because workers noticed the Japanese PPE has high quality and nice design. During the experiment, the workers seemed very interested in Japanese PPE. They were really happy to try on those PPE. Many positive feedbacks were received.

f. Comparison of feeling proud to be honoured by wearing personal protective equipment before and after the experiment

The average score for all workers (19 people) after the experiment was significantly higher than before the experiment. According to the result from question 4.11, "Have you ever received a compliment from wearing personal protective equipment or following the safety procedures correctly before?" 42.1% of the participants have never received any compliment before. They were not sure about their feeling of being recognized by others as the result in pre-questionnaire was somewhat proud. But the proposed idea gave them a more concrete outlook on what they going to receive after doing good. They changed their opinion to extremely proud.

Table 24 Comparison of workers' opinion on the current safety system and proposed idea

Pair	Pre-Questionnaire (n=19)			Post-Questionnaire (n=19)			Sig. (2-tailed)
	$\bar{x}$	S.D.	Levels	$\bar{x}$	S.D.	Levels	
1 Strictness of safety system	4.42	0.507	Extremely strict	2.84	1.302	Somewhat strict	0.001**
2 Satisfaction on quality of life	4.21	0.787	Very satisfied	4.05	1.079	Satisfied	0.42
3 Satisfaction on safety system	4.68	0.671	Very satisfied	3.95	0.848	Satisfied	0.003**
4 Quality of PPE	3.84	0.602	Very good	4.42	0.607	Excellent	0.001**
5 Perspective towards PPE	3.89	0.658	Positive	4.53	0.612	Very positive	0.001**
7 Feeling proud from wearing PPE	3.32	1.416	Somewhat proud	4.68	0.749	Extremely proud	0.002**

**** = The Paired T-Test statistic is significant at the .01 level.**

Table 25 Comparison of skilled, semi-skilled and unskilled workers' opinion on the current safety system and proposed idea

Pair	Pre-Questionnaire (n=16)			Post-Questionnaire (n=16)			Sig. (2-tailed)
	$\bar{x}$	S.D.	Levels	$\bar{x}$	S.D.	Levels	
1	4.31	0.479	Extremely strict	3	1.317	Somewhat strict	0.006**
2	4.13	0.806	Satisfied	4	1.095	Satisfied	0.58
3	4.63	0.719	Very satisfied	3.88	0.806	Satisfied	0.006**
4	3.81	0.544	Very good	4.38	0.619	Excellent	0.003**
5	3.81	0.544	Positive	4.5	0.632	Very positive	0.001**
7	3.19	1.471	Somewhat proud	4.63	0.806	Extremely proud	0.006**

**** = The Paired T-Test statistic is significant at the .01 level.**

Table 26 Comparison of management, technical and skilled workers' opinion on the current safety system and proposed idea

Pair	Pre-Questionnaire (n=3)			Post-Questionnaire (n=3)			Sig. (2-tailed)
	$\bar{x}$	S.D.	Levels	$\bar{x}$	S.D.	Levels	
1	5	0	Extremely strict	2	1	Slightly strict	0.035*
2	4.67	0.577	Very satisfied	4.33	1.155	Very satisfied	0.423
3	5	0	Very satisfied	4.33	1.155	Very satisfied	0.423
4	4	1	Very good	4.67	0.577	Excellent	0.184
5	4.33	1.155	Very positive	4.67	0.577	Very positive	0.423
7	4	1	Moderately proud	5	0	Extremely proud	0.225

**** = The Paired T-Test statistic is significant at the .01 level.**

Table 27 Average score, Standard deviation and the levels of workers' answer

Question		Pre-Questionnaire		
		$\bar{x}$	S.D.	Levels
4.4 Sufficiency of PPE	Total (n=19)	3.37	1.165	Somewhat enough
	Skilled, semi-skilled and unskilled worker (n=16)	3.31	0.946	Somewhat enough
	Management, technical and skilled worker (n=3)	3.67	2.309	Moderate enough
4.9 Importance of PPE to your life	Total (n=19)	4.89	0.315	Extremely important
	Skilled, semi-skilled and unskilled worker (n=16)	4.94	0.25	Extremely important
	Management, technical and skilled worker (n=3)	4.67	0.577	Extremely important

At the present, there is still insufficiency of PPE. Looking at results, it showed that workers still don't have enough PPE. This can be referred to as the result in question4.4 as shown in Table 27. To solve this problem, a construction company should support more PPE to satisfy workers' need first.

The construction site where the experiment was done has a very high safety standard due to the client requirement. From the question 4.9 result, workers know how important the PPE is and they admitted that PPE is extremely important to their life. But, there were still some workers don't wear them every time while working on the site.

Figure 57 illustrates that 36.8% of workers bought PPE by themselves and 63.2% of the total number of workers answered both buy PPE themselves and the company provides for them. The percentage of answers from skilled, semi-skilled and unskilled worker and management, technical and skilled worker were very similar. This indicated that at this moment, the construction company hasn't invested and given PPE to workers. The lack of safety management is still a problem in the construction industry.

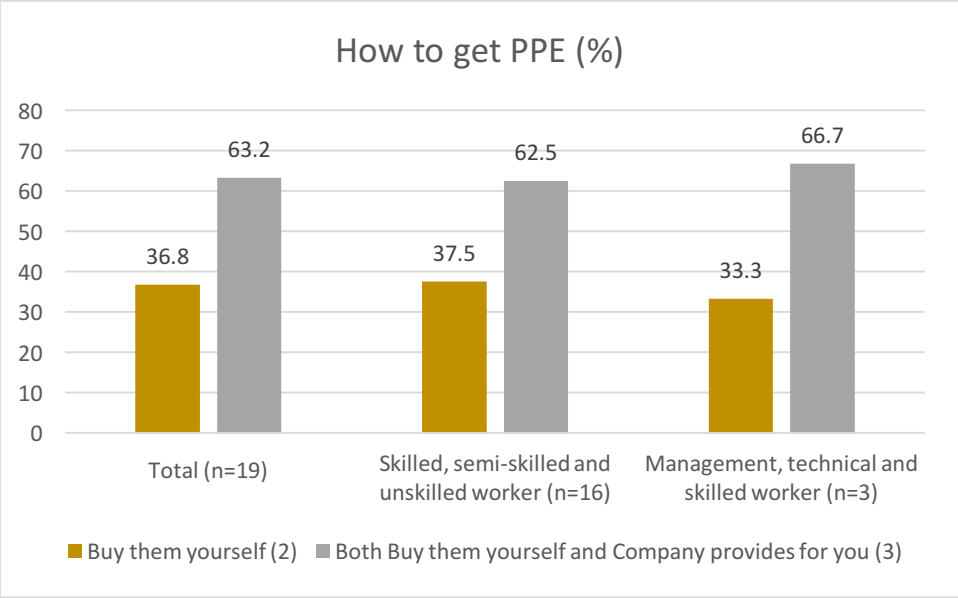


Figure 57 How workers get PPE

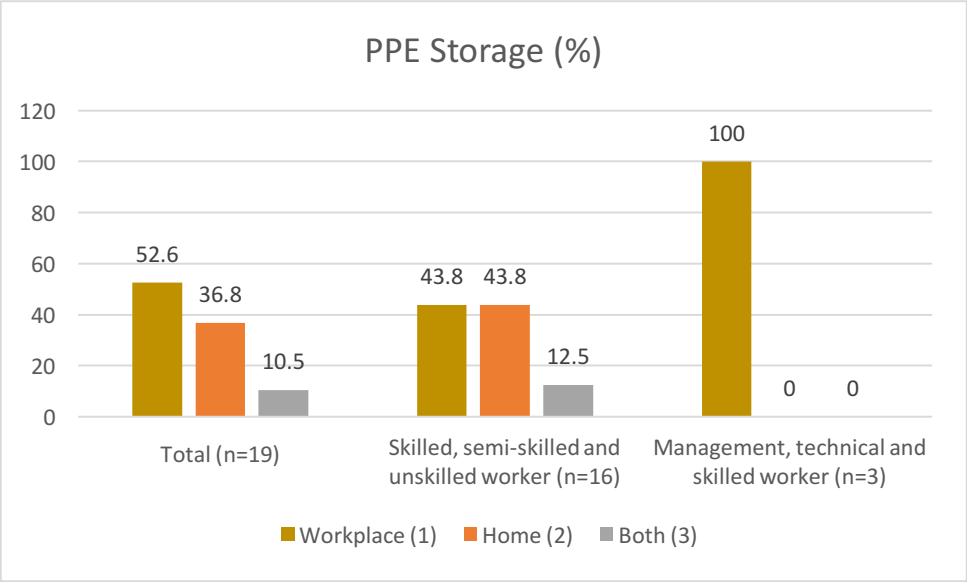


Figure 58 The location workers keep their PPE

From my observation, workers in Thai construction industry have to carry PPE back to their place after work. This question was created to see whether it's true or not. As seen in Figure 58 it depicts the opposite result from my expectation. 52.6% of total workers keep their PPE in the workplace, only 36.8% keep it at home and 10.5% keep in both places. However, the result in skilled, semi-skilled and unskilled workers group was close to what I expected, the percentage of keeping at the workplace and keeping at home was equally 43.8% and 12.5% keep in both places. While, 100% of management, technical and skilled workers keep their PPE in the workplace. To find out the reason behind these results, interview finding was clearly explained it. In the construction site, management, technical and skilled workers work in both construction field and office. They have their own space where they can store their PPE. On the other hand, skilled, semi-skilled and unskilled workers work mainly at the construction site. And small and medium-sized construction companies don't provide any locker or space for workers to keep their belonging. It shows a huge gap in power distance and equality between the management team and workers.

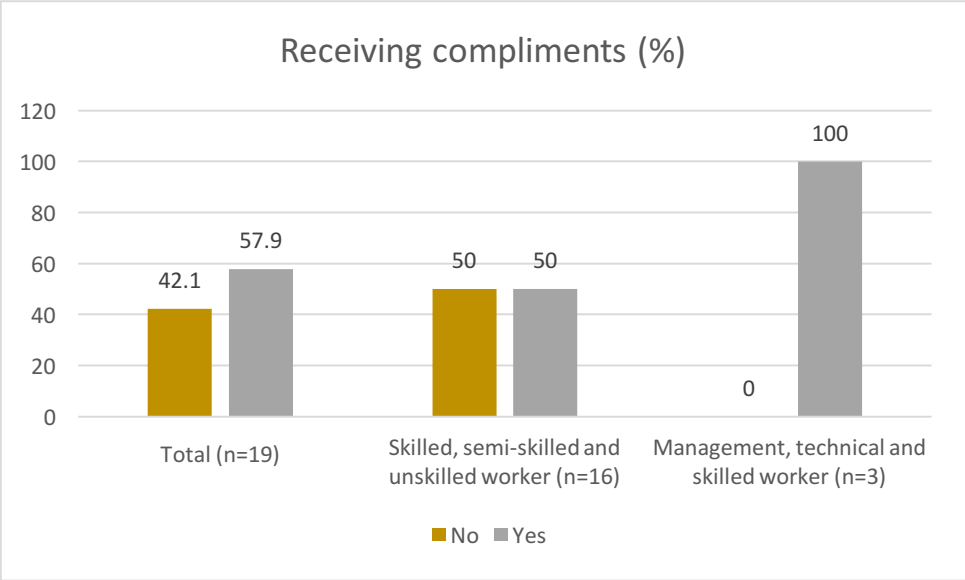


Figure 59 Receiving compliments experience

Table 28 Relationship between receiving a compliment experience and honorable feeling.

	Honorable feeling	Has received a compliment		Chi-square (Sig.)
		No	Yes	
Total (n=19)	Not proud	42.1	26.3	6.378 ($0.012^{*,b}$)
	Proud	0	31.6	
Skilled, semi-skilled and unskilled worker (n=16)	Not proud	50	18.8	7.273 ($.007^{*,b}$)
	Proud	0	31.3	
Management, technical and skilled worker (n=3)	Not proud	-	66.7	-
	Proud	-	33.3	

***** **The Chi-square statistic is significant at the 0.05 level.**

b **More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.**

One of the key incentive awards in this proposal is recognition. Before checking on the impact of recognition, it's better to know that workers have ever received any compliments by having good safety behaivour or wearing PPE. The result was 57.9% have received compliments before and 42.3% haven't received any before. 100% of management, technical and skilled workers answered yes as they have received before. In contrast to skilled, semi-

skilled and unskilled workers, their answers were split fifty-fifty. It reflected that 50% of workers never perceived the moment of being recognized by someone else.

Chi-square test results showed that receiving a compliment experience is related to the honorable feeling. Workers who never received any compliment don't feel proud to be honor. Unlike workers who have received compliments before feel proud. It shows that recognition can be a good incentive award but how to use it to motivate workers?

Chi-square test was conducted on this paired question 5 to investigate the relationship between workers' feeling before and after listening to the proposal presentation. From the average score and overall results for both workforces seen in Table 29, it shows that there was a significant difference (P = 0.004) only in skilled, semi-skilled and unskilled workers group but, management, technical and skilled workers had no difference in this question.

The main purpose of this questionnaire is to check and ensure that this proposal has an impact on workers' perspective and increase their own willingness to wear PPE. The result was impressive as there was a big change as displayed in Figure 60. Overall, Figure 60 shows the pre-questionnaire result was 79% of the total participants felt that they have to wear PPE, only 21% who answered that they want to wear PPE. Looking at the post-questionnaire result, the percentage of answers conversely changed to 68% of workers want to wear PPE and 32% of workers still answered that they have to wear PPE.

Figure 60 Worker's feeling before and after experiment

Table 29 Relationship between worker's feeling before and after experiment.

	Questionnaire	Worker's feeling		Chi-square (Sig.)
		Want to wear (%)	Have to wear (%)	
Total (n=19)	Pre	21.1	78.9	8.622 (0.003**)
	Post	68.4	31.6	
Skilled, semi-skilled and unskilled worker (n=16)	Pre	18.8	81.3	8.127 (0.004**)
	Post	68.8	31.3	
Management, technical and skilled worker (n=3)	Pre	33.3	66.7	0.667 (0.414[a])
	Post	66.7	33.3	

****** **The Chi-square statistic is significant at the 0.01 level.**

a **More than 20% of cells in this subtable have expected cell counts less than 5. Chi-square results may be invalid.**

CHAPTER 6: DISCUSSION

6.1 Recognition with Rewards

As the results of this research were different from the survey questionnaires in the idea development phase, the money reward couldn't motivate workers to wear PPE. In this case, Japanese high-quality PPE was the main need that workers wanted in the experiment. This research showed that Steve Jobs was right when he said, "Customers don't know what they want until you show it to them." In this case, construction workers didn't know on what they want until this research experiment showed them exactly what they want.

Due to the amount of monetary gift (a gift card) in both individual and project rewards were too little, the proposed rewards couldn't satisfy workers. On the other hands, team rewards were found to be more effective at motivating workers to wear PPE than individual rewards or project rewards. The reward that workers want is Japanese PPE as it represents high quality and good design PPE. The experiment results showed that workers have their own willingness to get rewards for themselves, it reflected in their feelings and perspectives towards PPE. Workers had better perspectives towards PPE and the result showed that workers' willingness to wear PPE also have changed to the way it supposes to be. Workers have a feeling to wear PPE in a longer period of time and want to wear them in a proper way. The reasons behind the behavioural change are:

- PPE Image change: Workers have a better perspective on PPE. Before this experiment, workers felt that wearing PPE makes them look ridiculous. But after the experiment, they felt that wearing PPE makes them look cool and smart.

- High quality and Good design PPE: Workers thought that the prototype PPE are more comfortable and suitable for the hot climate, for instance, shoes are lighter and more durable than the one they currently use.

- The created condition for job satisfaction: Job satisfaction is a crucial thing that needs to be considered. According to motivation theories, improving motivation factors to meet worker's satisfaction will motivate workers. This proposal gives a way to get

PPE (reward) and a certificate as a result of recognition and achievement (motivation factors).

6.2 Temperature Sensor

Because of the cost of a temperature sensing helmet is high, it causes a huge investment for a construction owner. The main purpose of the temperature sensor is only to prevent cheating among workers. The temperature sensing helmet itself is not so important in the case of a worker doesn't cheat. If a construction owner trusts their workers, using only stickers may be a better solution for Thai construction owner to initially invest.

6.3 Limitation

Due to the experiment was done in one certain construction site with strictly safety performance required from their client. Many workers have already worn a helmet and PPE properly. From the questionnaire results in the experiment, it could determine that workers wear PPE because of strict rules. They feel that they have to do, but it's not from their own willingness to wear. Some workers complaint about the strict safety rules. For instance, they have to pay an expensive fine because of smoking inside the construction site. The result from this experiment might not be applied to every construction site as the result was limited to the certain construction site. The other construction sites might have different conditions compared to the selected one. Furthermore, the limitation of time and the number of participants caused the results. The study can be more complete if this limitation is overcome.

6.4 Future Development

The experiment can be done in other kinds of construction site. This research should be more carried out and develop a better solution an appropriate and acceptable incentive approved by all the stakeholders. If it is possible, this proposal should be experimented in real working condition and evaluate the results again. Thai construction workers might change their satisfaction with the proposed safety system. Because of the results, around half of workers don't know the feeling of receiving a compliment. If they could try on this experiment, they might change their satisfaction with the proposed safety system and there might be interesting and accurate results which can be developed in the future.

CHAPTER 7: CONCLUSION

The purpose of this research is to change worker's perspectives towards personal protective equipment (PPE) by providing appropriate incentives to eliminate unsafe acts in Thai construction. An appropriate incentive program in this proposal was a sticker reward which used as a tangible way for workers to receive recognition and rewards. As their key incentive awards to perform safety are both financial and non-financial rewards; money, safety equipment and honour. This proposal stimulated a situation for workers to achieve company goals by giving them recognition and rewards as a payment. However, the results revealed that recognition alone doesn't work unless workers have enough fulfilment in their life first. Since there is still a problem of insufficiency of PPE, these worker's needs must be fulfilled first. Then, they will look for higher needs like recognition. Even though workers feel good about they are being recognized, recognition without reward (non-financial) is not enough for Thai construction workers to be motivated. Therefore, there must be a financial reward system applying in this incentive program for Thai construction industry. The impact of this research may eliminate the problems in Thai construction particularly, quality and safety in Thai construction. This research paper might be a little part of a long safety improvement journey, or it may be a starting point for the future development of Thai construction industry.

Since the construction industry is the industry that relied on worker productivity. In order to maintain and increase quality workforce, safety must come into play. Construction industry is the industry with high accident and injury rates. High accident rate causes massive labors losses and accident pay. Improving safety performance can reduce accidents. This improvement won't happen without the support from all stakeholders to create safety culture. Safety culture must be understood by all stakeholders including client, contractor, worker and government. Because one stakeholder cannot successfully proceed without support. Everyone must involve and cooperate in this development for the future of Thai construction. One of the root problem in Safety culture is from worker's behavior. Due to the current situation where workers don't fully understand and have different perspective on safety awareness. Despite of huge safety culture investment, it wouldn't succeed. Because of workers have less optimism to safety training than the top management team. They easily lost their motivation and feel bad to work in this kind of situation. Company therefore needs to improve their

worker's motivation for better safety performance. Referring to Aksorn and Hadikusumo paper, the failure of workers to wear personal protective equipment is the major issue in causing an accident and that can be indicated as low safety performance. As Safety motivation is a key factor affecting on safety performance and causing from safety culture. In order to increase worker's motivation, an appropriate incentive for workers is needed.

Acknowledgement

This thesis would not be completed without encouragement and assistance that I have received from many individuals and organisations.

First of all, I would like to express the deepest appreciation to Professor Tetsuya Toma, who always encouraged and guided me through the whole process of making this thesis. I would like to thank co-advisor Professor Naoko Taniguchi for her suggestions and assistance on statistical problems. I sincerely appreciate the assistance from Professor Kenichi Takano whose safety knowledge and guidance were helped me find the direction of this research. I also thanks to Professor Shinichiro Haruyama and Professor Vittal Anatamula who gave valuable comments and supports. Without their guidance and supports, this dissertation would not have been possible.

I would like to sincerely thank Fahchun Development co., Ltd., Fahthai Corporation co., Ltd. and their sub-contractor companies for cooperation that I was able to collect necessary information and data from survey questionnaires and during the experiment. Moreover, I would like to thank the respondents of the online questionnaire who helped me answering the questionnaire in order to get informative data. To Ms Suarpha Vangvasu, Mr Watcharapol Taemeyachat, Ms Tirada Jianpinitnan and Mr Siripong Jianphinitnan, I am extremely grateful for your kind help in participating in my prototype and test. I would like to thank Mr Suravit Kulsirorat for teaching me how to use SPSS. In addition, I would like to thank all those who helped me in direct and indirect contribution in this research.

I would like to sincerely appreciate the assistance of many alumni and doctoral students of SDM, Keio University. Thank you especially to Mr Kazuhide Abe, Mr Iwane Maida, Mr Motoki Asai and Mr Tetsuya Shiba for sharing your expertise, listening and giving me encouragement and guidance.

Furthermore, my heartfelt thanks to all of my friends, who always been there for me, gave me both in academic and emotional support. I shall never forget the help and support from all of you.

Finally, I would like to express my gratitude and appreciation to my beloved family for their love, time, care and encouragement throughout the year of my study in Japan and this research. Thank you for believing in me.

Reference

Aksorn, T., & Hadikusumo, B.H.W. (2007). The Unsafe Acts and the Decision-to-Err Factors of Thai Construction Workers. *Journal of Construction in Developing Countries, Vol.12 No.1, 2007*, 2-15. Retrieved from http://www.hbp.usm.my/JCDC/input/JCDC%20Vol%2012(1)/1_Thanet%20&%20Hadikusumo_.2doc.pdf

Ali, R. & Ahmed, M.S. (2009). The Impact Of Reward And Recognition Programs On Employee's Motivation And Satisfaction: An Empirical Study. *International Review of Business Research Papers Vol. 5 No. 4*. 270-279. Retrieved from https://www.bizresearchpapers.com/22.Reena.pdf

Armstrong, M. (2007). *A Handbook of Employee Reward Management and Practice* (2nd ed.). Retrieved from https://hrproblog.files.wordpress.com/2012/05/a_handbook_of_employee_reward_management_and_practice.pdf

Chaikittiporn, C. (n.d.). Enhancing Occupational Safety and Health in Thailand, 1-7. Retrieved from http://www1.kosha.or.kr/aposho/aposho/documents/comprehensive.do?mode=download&articleNo=60858&attachNo=51873

Civil Service Bureau. (2018*). Guide on stuff motivation.* Retrieved from www.csb.gov.hk/english/publication/files

Harunavamwe, M. & Kanengoni, H. (2013). The Impact of Monetary and Non-Monetary Rewards on Motivation among Lower Level Employees in Selected Retail Shops. *African Journal of Business Management, Vol. 7(38),* 3929-3935. DOI: 10.5897/AJBM2012.1381

HofstedeI Insights. (n.d.). *COUNTRY COMPARISON* [Website]. Retrieved Retrieved August 10, 2018, from HofstedeI Insights website: https://www.hofstede-insights.com/country-comparison/japan,thailand/

International Atomic Energy Agency. (2015) *Safety Culture After the Fukushima accident* [Website]. Retrieved July 15, 2018, from http://www-ns.iaea.org/tech-areas/operational-safety/safety-culture-home.asp

Kuijk, A. (n.d.). Two Factor Theory by Frederick Herzberg [Website]. Retrieved July 15, 2018, from Toolshero website: https://www.toolshero.com/management/two-factor-theory-herzberg/

Kwenin, D. O. & Muathe, S. & Nzulwa, R. (2013). The Influence of Employee Rewards, Human Resource Policies and Job Satisfaction on the Retention of Employees in Vodafone Ghana Limited. *European Journal of Business and Management, Vol.5, No.12*, 13-20. Retrieved from http://ir-library.ku.ac.ke/bitstream/handle/123456789/7051/The%20Influence%20of%20Employee%20Rewards,%20Human%20Resource%20Policies.pdf?sequence=4

Laungwasutha, T. (2013). *Knowledge, Attitudes and Safety Practices in the Workplace of Employees a Case Study of Cotco Metalworks Co, Ltd, Rayong Province* (Master thesis, National Institute of Development Administration, Bangkok, Thailand). Retrieved from http://library1.nida.ac.th/termpaper6/sd/2557/20009.pdf

Makulsawatudom, A., & Emsley, M. (2001). Factors affecting the productivity of the construction industry in Thailand: the project managers' perception. *17th Annual ARCOM Conference*. 281-291. Retrieved from https://pdfs.semanticscholar.org/98b3/8d050cb2cc1295d078abbe3c3018db8de60f.pdf

Matheny, A. (2017). *WHAT'S THE DIFFERENCE BETWEEN REWARD, RECOGNITION AND INCENTIVE?* [Website]. Retrieved August 10, 2018, from Awards network website: https://blog.awardsnetwork.com/whats-the-difference-between-reward-recognition-and-incentive

Ministry of Labour. (2015). *National Profile on Occupational Safety and Health of Thailand, 2015.* Retrieved from http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/policy/wcms_436936.pdf

Misnan, M S, Mohammed, A H, Bakri, A and Zin, R M (2006). Occupational Safety and Health (OSH) Management System: Towards Development of Safety and Health Culture. *The 6th Asia Pacific Structural Engineering and Construction Conference 2006* (APSEC 2006). 5-6 September. Kuala Lumpur. Universiti Teknologi Malaysia. C19-C28.

Misnan, M. S., & Mohammed, A. H. (2007). Development of Safety Culture in the Construction Industry: a Conceptual Framework. *Procs 23rd Annual ARCOM Conference*, 13-22. Retrieved from http://www.arcom.ac.uk/-docs/proceedings/ar2007-0013-0022_Misnan_and_Mohammed.pdf

Nhconcept. (n.d.). *Problems in Construction* [Website]. Retrieved July 15, 2018, from Nhconcept website: http://www.nhconcept.com/blog/**ปัญหาการก่อสร้าง/**

Panthong, K. (2012). The Study of Optimization to Minimize Delays in The Construction of

The Waste Water Treatment: A Case Study of TT Co., Ltd., 1-15. Retrieved from http://postgrads.mfu.ac.th/images/Plan-B/5751209251%20-%20กฤตภาส%20ปานทอง%20Logis.pdf

Phonton, B. (2012). Construction Delay Factors of E-Gate Controlling System Installation: Case Study of Bangkok Port, 1-21. Retrieved from Rajamangala University of Technology Thanyaburi Research Repository database.

Phoochinda, W. (2012). Environmental Research Methodology and Statistics (2nd ed.). Bangkok, Thailand: Bangkok Block.

Prensky, M. (2001) *Digital Game-Based Learning.* Retrieved from http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Game-Based%20Learning-Ch5.pdf

Pungvongsanuraks, P., & Chinda, T. (2010). Investigation of Safety Perceptions of Management and Workers in Thai Construction Industry. *Suranaree J. Sci. Technol. 17(2),* 177-191. Retrieved from http://www.thaiscience.info/Journals/Article/SJST/10890504.pdf

Safety Construction Thai. (2017, January 3). ความปลอดภัยงานก่อสร้าง ภาษาอังกฤษ English Language. [Video File]. Retrieved from https://www.youtube.com/watch?v=oVQFYg28S_w&t=32s

Sandbhor, S., & Botre, R. (2014). Applying total interpretive structural modeling to study factors affecting construction labour productivity. *Australasian Journal of Construction Economics and Building, 14 (1)*. 20-31. DOI: http://dx.doi.org/10.5130/AJCEB.v14i1.3753

Sambasivan, M., & Soon, Y.W. (2007). Causes and effects of delays in Malaysian construction industry. *International Journal of Project Management 25(5),* 517-526. DOI:10.1016/j.ijproman.2006.11.007

Saunderson, R. (2013). *Top 10 Differences Between Rewards and Recognition* [Website]. Retrieved August 10, 2018, from Incentive website: http://www.incentivemag.com/Strategy/Ask-the-Experts/Roy-Saunderson/Top-10-Differences-Between-Rewards-and-Recognition/

Senouci, A., & Al Abbasi, M., & Eldin, N. N. (2018). Impact of weather conditions on construction labour productivity in Qatar. *Middle East J. Management, Vol.5, No. 1, 2018.* 34-49. DOI:10.1504/MEJM.2018.10009613

Simachokdee, V., & Chalermjirarat, W. (2007). *Safety Administration and Engineering in Factory (27th ed.).* Bangkok, Thailand: Technology Promotion Association (Thailand-Japan).

Skripak, S. J. (2016). *Fundamentals of Business*. Retrieved from https://vtechworks.lib.vt.edu/bitstream/handle/10919/70961/Chapter%2010%20Motivating%20Employees.pdf?sequence=15&isAllowed=y

Sondergaard, L. & Lathapipat, D. (2017). *Education gap too wide for leap to Thailand 4.0* [Website]. Retrieved August 10, 2018, from The Nation website: http://www.nationmultimedia.com/detail/opinion/30304828

Smallwood, J., & Venter, D. (2001). The Performance of Contractors: Clients' Perception. *CIB World Building Congress, April 2001, Wellington, New Zealand* ,1-11. Retrieved from http://www.irbnet.de/daten/iconda/CIB2904.pdf

Sukhothai Thammathirat Open University. (2007). *Occupational health and safety management (1st Revised ed.).* Nonthaburi, Thailand: Sukhothai Thammathirat Open University.

Takano, K. (2016). An Applicational Study of Safety Culture Assessment Techniques into Large Scale Process Plants Focusing on Petrochemical Industries. *Journal of Japan Society for Safety Engineering, vol. 55, no. 1*, p. 49.

Temp Traq. (n.d.). *Temp Traq* [Website]. Retrieved July 15, 2018, from *Temp Traq* website: https://www.temptraq.com/Home

Titanlearning. (n.d.). *What is the fun theory?* [Website]. Retrieved February 16, 2018, from https://titan-learning.com/what-is-fun-theory/

Toor, S., & Ogunlana, O.S. (2008). Problems causing delays in major construction projects in Thailand, *Construction Management and Economics*, 1-14. DOI:10.1080/01446190801905406

Vitharana, V.H.P., De Silva, G.H.M.J.S. & De Silva, S., (2015). Health hazards, risk and safety practices in construction sites – a review study. Engineer: *Journal of the Institution of Engineers, Sri Lanka. 48(3),* 35-44. DOI: http://doi.org/10.4038/engineer.v48i3.6840

Appendix A

Questionnaires in English

Questionnaires in Thai

Research questionnaire
A Study of Attitudes and Factors affect construction workers to wear Personal Protective Equipment (PPE).

Instruction Please answer all the questions by putting ✓ in ( ) or filling in the blanks (Please don't leave it blank.)

---

1. Low level workers

No.	Question
A. General information of the respondents	
1	Gender ( ) Male ( ) Female
2	Age ( ) Under 15 ( ) 15 - 20 ( ) 21 - 25 ( ) 26 - 30 ( ) 31 - 35 ( ) 36 - 40 ( ) 41 - 45 ( ) 46 - 50 ( ) More than 51
3	Nationality ( ) Thai ( ) Burmese ( ) Laotian ( ) Khmer ( ) Other.....
4	Thai language ability (Understanding and Communication) ( ) Poor ( ) Fair ( ) Good ( ) Very good ( ) Excellent
5	Educational background ( ) Lower than elementary school ( ) Elementary school ( ) Middle school ( ) High school ( ) Vocational diploma ( ) High vocational diploma ( ) Bachelor ( ) Master or higher
6	Personal status ( ) Single ( ) Married ( ) Widowed/ Divorced/ Separated
7	Job title ( ) Carpenter ( ) Steel fixer ( ) Plasterer ( ) General worker ( ) Other.....
8	Employment status ( ) Full - time ( ) Part - time
9	Monthly income (Baht) ( ) Less than 5,000 ( ) 5,001 – 7,500 ( ) 7,501 – 10,000 ( ) 10,001 – 12,500 ( ) 12,501 – 15,000 ( ) More than 15,000
10	What company and company type do you belong to? (E.g. Fahchun Development Co Ltd) (Please specify)..... ( ) Contractor ( ) Sub-contractor ( ) Design firm ( ) Other.....
11	What company size are you currently working on? ( ) Small (<50 employees) ( ) Medium (50 - 200 employees) ( ) Large (>200 employees)
12	Work experience ( ) No experience ( ) Under 1 year ( ) 1 – 5 years ( ) 6 – 10 years ( ) Over 10 years
13	Working hours in a day ( ) Less than 4 hours ( ) 4 - 6 hours ( ) 6 - 8 hours ( ) 8 - 10 hours ( ) 10 - 12 hours ( ) Over 12 hours
14	What level do you feel satisfied with your job? ( ) Very dissatisfied ( ) Dissatisfied ( ) Unsure ( ) Satisfied ( ) Very satisfied
B. Safety knowledge and experience	

15	Who do you think should response to safety in the construction site? ( ) Manager ( ) Supervisor ( ) Worker ( ) Everyone ( ) Other.....
16	Did you have any basic construction safety knowledge before joining the company? ( ) Yes ( ) No
17	What level do you concern about safety? ( ) Not at all ( ) Slightly ( ) Somewhat ( ) Moderately ( ) Extremely
18	If you think of personal protective equipment (PPE), what items do you think of? (Please specify as many as possible) ....
19	Do you wear PPE while working in the construction site? ( ) Never ( ) Almost never ( ) Occasionally/Sometimes ( ) Almost every time ( ) Every time
20	If you didn't answer "Every time", what is the reason to not wearing them? (Please specify)..... .....
21	Is there any safety training session on how to use PPE in your company? ( ) Yes ( ) No
22	If you answered "Yes", how often does your company provide a training session? ( ) Everyday ( ) 4-5 times a week ( ) 2-3 times a week ( ) Once a week ( ) Once every 2 weeks ( ) Other.....
23	Have you ever been injured or experienced in an accident from not wearing PPE? (If your answer is yes, please specify) ( ) Yes ..... ( ) No
24	In your company, have any of your colleagues, friends or co-workers ever been injured or experienced in an accident from not wearing PPE? (If your answer is yes, please specify) ( ) Yes ..... ( ) No
C. Opinion on wearing personal protective equipment (PPE)	
25	Do you think wearing PPE will mitigate the number of accidents? ( ) Strongly disagree ( ) Disagree ( ) Neither agree or disagree ( ) Agree ( ) Strongly agree
26	What do you think is the main reason of wearing PPE? ( ) Protect yourself ( ) Company's rule ( ) Other.....
27	In your perspective, what are the incentives other than money for you and workers to wear PPE? (Please specify).....

	.....
28	If there is a reward for those people who always keep safety in mind and always wear PPE while working, what do you think the reward should be? (Please specify)..... .....

Suggestions.....

.....

Research questionnaire
A Study of Attitudes and Factors affect construction workers to wear Personal Protective Equipment (PPE).

Instruction Please answer all the questions by putting ✓ in ( ) or filling in the blanks

---

2. High level workers

No.	Question
	A. General information of the respondents
1	Gender ( ) Male ( ) Female
2	Age ( ) Under 15 ( ) 15 - 20 ( ) 21 - 25 ( ) 26 - 30 ( ) 31 - 35 ( ) 36 - 40 ( ) 41 - 45 ( ) 46 - 50 ( ) More than 51
3	Nationality ( ) Thai ( ) Burmese ( ) Laotian ( ) Khmer ( ) Other.....
4	Thai language ability (Understanding and Communication) ( ) Poor ( ) Fair ( ) Good ( ) Very good ( ) Excellent
5	Educational background ( ) Lower than elementary school ( ) Elementary school ( ) Middle school ( ) High school ( ) Vocational diploma ( ) High vocational diploma ( ) Bachelor ( ) Master or higher
6	Personal status ( ) Single ( ) Married ( ) Widowed/ Divorced/ Separated
7	Job title ( ) Engineer ( ) Architect ( ) Manager ( ) Foreman ( ) Other.....
8	Employment status ( ) Full - time ( ) Part - time
9	Monthly income (Baht) ( ) Less than 10,000 ( ) 10,001 – 15,000 ( ) 15,001 – 20,000 ( ) 20,001 – 25,000 ( ) 25,001 – 30,000 ( ) More than 30,000
10	What company or department and company type do you belong to? (If you don't want to give your company name, please answer only your department name.) ..... ( ) Contractor ( ) Sub-contractor ( ) Design firm ( ) Other.....
11	What company size are you currently working on? ( ) Small (<50 employees) ( ) Medium (50 - 200 employees) ( ) Large (>200 employees)
12	Work experience ( ) No experience ( ) Under 1 year ( ) 1 – 5 years ( ) 6 – 10 years ( ) Over 10 years
13	Working hours in a day ( ) Less than 4 hours ( ) 4 - 6 hours ( ) 6 - 8 hours ( ) 8 - 10 hours ( ) 10 - 12 hours ( ) Over 12 hours
14	What level do you feel satisfied with your job? ( ) Very dissatisfied ( ) Dissatisfied ( ) Unsure ( ) Satisfied ( ) Very satisfied
	B. Opinion on current safety situation

15	Are you satisfied with the current safety situation in Thai construction especially in your company? ( ) Very dissatisfied ( ) Dissatisfied ( ) Unsure ( ) Satisfied ( ) Very satisfied
16	Do you think safety is important for the future of Thai construction? ( ) Not at all important ( ) Low important ( ) Neutral ( ) Very important ( ) Extremely important
17	Who do you think should response to safety in Thai construction? ( ) Contractor owner ( ) Construction industry (e.g. Developer) ( ) Government ( ) Other.....
18	Who do you think should response to safety in the construction site? ( ) Manager ( ) Foreman ( ) Worker ( ) Everyone ( ) Other.....
	C. Safety knowledge and experience
19	If you think of safety, what do you think of? (Please specify as many as possible) ....
20	Did you have any basic construction safety knowledge before joining the company? ( ) Yes ( ) No
21	What level do you concern about safety? ( ) Not at all ( ) Slightly
	( ) Somewhat ( ) Moderately ( ) Extremely
22	If you think of personal protective equipment (PPE), what items do you think of? (Please specify as many as possible) ....
23	Do you wear PPE while working in the construction site? ( ) Never ( ) Almost never ( ) Occasionally/Sometimes ( ) Almost every time ( ) Every time
24	If you didn't answer "Every time", what is the reason not wear them? (Please specify)..... .....
25	Is there any safety training session on how to use PPE in your company? ( ) Yes ( ) No
26	If you answered "Yes", how often does your company provide a training session? ( ) Everyday ( ) 4-5 times a week ( ) 2-3 times a week ( ) Once a week ( ) Once every 2 weeks ( ) Other.....
27	Have you ever been injured or experienced in an accident from not wearing PPE? (If your answer is "yes", please specify) ( ) Yes ..... ( ) No

28	In your company, have any employees ever been injured or experienced in an accident from not wearing PPE? (If your answer is "yes", please specify) ( ) Yes ..... ( ) No
	D. Opinion on wearing personal protective equipment (PPE)
29	Do you agree that wearing PPE will mitigate the number of accidents? ( ) Strongly disagree ( ) Disagree ( ) Neither agree or disagree ( ) Agree ( ) Strongly agree
30	What do you think is the main reason of wearing PPE? ( ) Protect yourself ( ) Company's rule ( ) Other.....
31	In your perspective, what are the incentives other than money for you and workers to wear PPE? (Please specify)..... .....
32	What helps you order the workers to wear PPE? (Please specify)..... .....
33	How much cost can you spend for each workers' safety? (Please specify)..... .....
34	If there is a reward for those people who always keep safety in mind and always wear PPE while working. What do you think the reward should be? (Please specify)..... .....
35	Do you have any suggestion on improving safety in Thai construction? (Please specify).....

	.....

Suggestions.....
.....

แบบสำรวจเพื่อการวิจัย

เรื่อง การศึกษาทัศนคติและปัจจัยของคนงานก่อสร้างเกี่ยวกับการสวมใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคล

คำชี้แจง กรุณาทำเครื่องหมาย ✓ ลงใน ( ) หรือเติมข้อความลงในช่องว่างตามความเป็นจริง

---

1. คนงานก่อสร้าง

ข้อที่	ข้อคำถาม
	ก. ข้อมูลทั่วไปของผู้ตอบแบบสอบถาม
1	เพศ ( ) ชาย ( ) หญิง
2	อายุ ( ) ต่ำกว่า 15 ปี ( ) 15 - 20 ปี ( ) 21 - 25 ปี ( ) 26 - 30 ปี ( ) 31 - 35 ปี ( ) 36 - 40 ปี ( ) 41 - 45 ปี ( ) 46 - 50 ปี ( ) มากกว่า 51 ปี
3	สัญชาติ ( ) ไทย ( ) พม่า ( ) ลาว ( ) กัมพูชา ( ) อื่นๆ (ระบุ).....
4	ความเข้าใจและการสื่อสารภาษาไทย ( ) แย่ ( ) พอใช้ ( ) ปานกลาง ( ) ดี ( ) ดีมาก
5	ระดับการศึกษา ( ) ต่ำกว่าประถมศึกษา ( ) ประถมศึกษา ( ) มัธยมศึกษาตอนต้น ( ) มัธยมศึกษาตอนปลาย ( ) ปวช. ( ) ปวส. ( ) ปริญญาตรี ( ) ปริญญาโทหรือสูงกว่า
6	สถานภาพ ( ) โสด ( ) สมรส ( ) ม่าย/ หย่า/ แยกกันอยู่
7	ตำแหน่งงานที่ปฏิบัติ ( ) ช่างไม้ ( ) ช่างเหล็ก ( ) ช่างปูน ( ) คนงานทั่วไป ( ) อื่นๆ (ระบุ).....
8	ลักษณะงาน ( ) งานประจำ ( ) งานไม่ประจำ
9	รายได้ต่อเดือน ( ) ต่ำกว่า 5,000 บาท ( ) 5,001 – 7,500 บาท ( ) 7,501 – 10,000 บาท ( ) 10,001 – 12,500 บาท ( ) 12,501 – 15,000 บาท ( ) มากกว่า 15,000 บาท
10	ชื่อบริษัทและสังกัดหน่วยงานที่เกี่ยวข้อง (เช่น บริษัท ฟ้าชวน ดีเวลล็อปเมนต์ จำกัด) โปรดระบุ..... ( ) ผู้รับเหมาหลัก ( ) ผู้รับเหมาช่วย ( ) บริษัทออกแบบ ( ) อื่นๆ (ระบุ).....
11	ขนาดของบริษัทที่ท่านกำลังทำงานอยู่ ( ) เล็ก (<50 คน) ( ) กลาง (50 - 200 คน) ( ) ใหญ่ (>200 คน)
12	ประสบการณ์ทำงาน ( ) ไม่มีประสบการณ์ ( ) น้อยกว่า 1 ปี ( ) 1 – 5 ปี ( ) 6 – 10 ปี ( ) มากกว่า 10 ปี
13	เวลาทำงานต่อวัน ( ) น้อยกว่า 4 ชั่วโมง ( ) 4 - 6 ชั่วโมง ( ) 6 - 8 ชั่วโมง ( ) 8 - 10 ชั่วโมง ( ) 10 - 12 ชั่วโมง ( ) มากกว่า 12 ชั่วโมง
14	ท่านรู้สึกพึงพอใจในหน้าที่การงานของตัวท่านเองในระดับใด ( ) น้อยที่สุด ( ) น้อย ( ) ปานกลาง ( ) มาก ( ) มากที่สุด
	ข. ความรู้และประสบการณ์ในเรื่องความปลอดภัย
15	ท่านคิดว่าใครควรรับผิดชอบในเรื่องความปลอดภัยในไซต์งาน ( ) ผู้จัดการ ( ) หัวหน้าคนงาน (ไฟร์แมน) ( ) คนงาน ( ) ทุกคน

	( ) อื่นๆ (ระบุ).....
16	ท่านมีความรู้พื้นฐานด้านความปลอดภัยในงานก่อสร้างก่อนเข้าร่วมงานหรือไม่ ( ) มี ( ) ไม่มี
17	ท่านให้ความสำคัญกับความปลอดภัยอยู่ในระดับใด ( ) น้อยที่สุด ( ) น้อย ( ) ปานกลาง ( ) มาก ( ) มากที่สุด
18	ถ้านึกถึงอุปกรณ์ป้องกันอันตรายส่วนบุคคล ท่านคิดถึงอุปกรณ์ใด โปรดระบุให้มากที่สุด ....
19	ท่านใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคลในขณะปฏิบัติงานในไซต์งานหรือไม่ ( ) ไม่เคยเลย ( ) เกือบจะไม่เคย ( ) บางครั้ง ( ) เกือบทุกครั้ง ( ) ทุกครั้ง
20	ถ้าท่านไม่ได้ตอบ “ทุกครั้ง” สาเหตุใดที่ทำให้ท่านไม่สวมใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคล โปรดระบุ ....
21	ในที่ทำงานของท่านมีการสอนหรืออบรมการใช้อุปกรณ์ป้องกันอันตรายส่วนบุคคลหรือไม่ ( ) มี ( ) ไม่มี
22	ถ้าท่านตอบ “มี” บริษัทของท่านมีการฝึกอบรมบ่อยแค่ไหน? ( ) ทุกวัน ( ) 4-5 ครั้งต่อสัปดาห์ ( ) 2-3 ครั้งต่อสัปดาห์ ( ) 1 ครั้งต่อสัปดาห์ ( ) 1 ครั้งต่อ 2 สัปดาห์ ( ) อื่นๆ (ระบุ).....

23	ท่านเคยได้รับอันตรายหรืออุบัติเหตุจากการไม่ใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคลหรือไม่ (ถ้าท่านตอบว่า “เคย” โปรดระบุประเภทของการบาดเจ็บและอุบัติเหตุ) ( ) เคย ..... ( ) ไม่เคย
24	ในที่ทำงานของท่าน มีเพื่อนร่วมงานเคยได้รับอันตรายหรืออุบัติเหตุจากการไม่ใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคลหรือไม่ (ถ้าท่านตอบว่า “เคย” โปรดระบุประเภทของการบาดเจ็บและอุบัติเหตุ) ( ) เคย ..... ( ) ไม่เคย
	ค. ความเห็นเกี่ยวกับการใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคล
25	ท่านเห็นด้วยหรือไม่ว่าการใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคลจะลดจำนวนการเกิดอุบัติเหตุได้ ( ) ไม่เห็นด้วยอย่างยิ่ง ( ) ไม่เห็นด้วย ( ) ไม่แน่ใจ ( ) เห็นด้วย ( ) เห็นด้วยอย่างยิ่ง
26	ท่านคิดว่าอะไรเป็นสาเหตุสำคัญในการใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคล ( ) เพื่อป้องกันตัวเอง ( ) กฎระเบียบของบริษัท ( ) อื่นๆ (ระบุ).....
27	ในความเห็นของท่าน ท่านคิดว่าสิ่งใดเป็นแรงจูงใจนอกเหนือจากเรื่องเงินในการใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคลของท่านและคนงานท่านอื่น โปรดระบุ ....
28	ถ้าทางบริษัทมีการมอบรางวัลให้กับบุคคลที่คำนึงถึงความปลอดภัยขณะปฏิบัติงานและสวมใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคลทุกครั้ง ท่านคิดว่ารางวัลนั้นควรเป็นสิ่งใด โปรดระบุ ....

ข้อเสนอแนะ.....

แบบสำรวจเพื่อการวิจัย

เรื่อง การศึกษาทัศนคติและปัจจัยของคนงานก่อสร้างเกี่ยวกับการสวมใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคล

คำชี้แจง กรุณาทำเครื่องหมาย ✓ ลงใน ( ) หรือเติมข้อความลงในช่องว่างตามความเป็นจริง

---

2. เจ้าหน้าที่ที่เกี่ยวข้องกับงานก่อสร้าง

ข้อที่	ข้อคำถาม
	ก. ข้อมูลทั่วไปของผู้ตอบแบบสอบถาม
1	เพศ ( ) ชาย ( ) หญิง
2	อายุ ( ) ต่ำกว่า 15 ปี ( ) 15 - 20 ปี ( ) 21 - 25 ปี ( ) 26 - 30 ปี ( ) 31 - 35 ปี ( ) 36 - 40 ปี ( ) 41 - 45 ปี ( ) 46 - 50 ปี ( ) มากกว่า 51 ปี
3	สัญชาติ ( ) ไทย ( ) พม่า ( ) ลาว ( ) กัมพูชา ( ) อื่นๆ (ระบุ).....
4	ความเข้าใจและการสื่อสารภาษาไทย ( ) แย่ ( ) พอใช้ ( ) ปานกลาง ( ) ดี ( ) ดีมาก
5	ระดับการศึกษา ( ) ต่ำกว่าประถมศึกษา ( ) ประถมศึกษา ( ) มัธยมศึกษาตอนต้น ( ) มัธยมศึกษาตอนปลาย ( ) ปวช. ( ) ปวส. ( ) ปริญญาตรี ( ) ปริญญาโทหรือสูงกว่า
6	สถานภาพ ( ) โสด ( ) สมรส ( ) ม่าย/ หย่า/ แยกกันอยู่
7	ตำแหน่งงานที่ปฏิบัติ ( ) วิศวกร ( ) สถาปนิก ( ) ผู้จัดการ ( ) หัวหน้าคนงาน (โฟร์แมน)
	( ) อื่นๆ (ระบุ).....
8	ลักษณะงาน ( ) งานประจำ ( ) งานไม่ประจำ
9	รายได้ต่อเดือน (บาท) ( ) ต่ำกว่า 10,000 บาท ( ) 10,001 – 15,000 บาท ( ) 15,001 – 20,000 บาท ( ) 20,001 – 25,000 บาท ( ) 25,001 – 30,000 บาท ( ) มากกว่า 30,000 บาท
10	ชื่อบริษัทหรือแผนก และสังกัดหน่วยงานที่เกี่ยวข้อง (ถ้าท่านไม่ต้องการที่จะแจ้งชื่อบริษัทของท่าน กรุณาระบุแค่ชื่อของแผนกที่ท่านทำงานเท่านั้น) โปรดระบุ..... ( ) ผู้รับเหมาหลัก ( ) ผู้รับเหมาช่วย ( ) บริษัทออกแบบ ( ) อื่นๆ (ระบุ).....
11	ขนาดของบริษัทที่ท่านกำลังทำงานอยู่ ( ) เล็ก (<50 คน) ( ) กลาง (50 - 200 คน) ( ) ใหญ่ (>200 คน)
12	ประสบการณ์ทำงาน ( ) ไม่มีประสบการณ์ ( ) น้อยกว่า 1 ปี ( ) 1 – 5 ปี ( ) 6 – 10 ปี ( ) มากกว่า 10 ปี
13	เวลาทำงานต่อวัน ( ) น้อยกว่า 4 ชั่วโมง ( ) 4 - 6 ชั่วโมง ( ) 6 - 8 ชั่วโมง ( ) 8 - 10 ชั่วโมง ( ) 10 - 12 ชั่วโมง ( ) มากกว่า 12 ชั่วโมง
14	ท่านรู้สึกพึงพอใจในหน้าที่การงานของตัวท่านเองในระดับใด ( ) น้อยที่สุด ( ) น้อย ( ) ปานกลาง ( ) มาก ( ) มากที่สุด
	ข. ความเห็นเกี่ยวกับสถานการณ์ความปลอดภัยในปัจจุบัน
15	ท่านรู้สึกพึงพอใจกับสถานการณ์ความปลอดภัยของการก่อสร้างไทยในปัจจุบันโดยเฉพาะอย่างยิ่งในบริษัทของท่านเองในระดับใด ( ) น้อยที่สุด

	( ) น้อย ( ) ปานกลาง ( ) มาก ( ) มากที่สุด
16	ท่านคิดว่าความปลอดภัยนั้นสำคัญต่ออนาคตของการก่อสร้างไทยหรือไม่ ( ) สำคัญน้อยที่สุด ( ) สำคัญน้อย ( ) สำคัญปานกลาง ( ) สำคัญมาก ( ) สำคัญมากที่สุด
17	ท่านคิดว่าใครควรรับผิดชอบในเรื่องความปลอดภัยในการก่อสร้างไทย ( ) เจ้าของบริษัทผู้รับเหมา ( ) อุตสาหกรรมการก่อสร้าง (เช่น นักพัฒนาอสังหาฯ) ( ) รัฐบาล ( ) อื่นๆ (ระบุ).....
18	ท่านคิดว่าใครควรรับผิดชอบในเรื่องความปลอดภัยในไซต์งาน ( ) ผู้จัดการ ( ) หัวหน้าคนงาน (โฟร์แมน) ( ) คนงาน ( ) ทุกคน ( ) อื่นๆ (ระบุ).....
	ค. ความรู้และประสบการณ์ในเรื่องความปลอดภัย
19	ถ้าคิดถึงความปลอดภัย ท่านคิดถึงอะไร โปรดระบุให้มากที่สุด ....
20	ท่านมีความรู้พื้นฐานด้านความปลอดภัยในงานก่อสร้างก่อนเข้าร่วมงานหรือไม่ ( ) มี ( ) ไม่มี
21	ท่านให้ความสำคัญกับความปลอดภัยอยู่ในระดับใด ( ) น้อยที่สุด ( ) น้อย ( ) ปานกลาง ( ) มาก

	( ) มากที่สุด
22	ถ้านึกถึงอุปกรณ์ป้องกันอันตรายส่วนบุคคล ท่านคิดถึงอุปกรณ์ใด โปรดระบุให้มากที่สุด ....
23	ท่านใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคลในขณะปฏิบัติงานในไซต์งานหรือไม่ ( ) ไม่เคยเลย ( ) เกือบจะไม่เคย ( ) บางครั้ง ( ) เกือบทุกครั้ง ( ) ทุกครั้ง
24	ถ้าท่านไม่ได้ตอบ “ทุกครั้ง” สาเหตุใดที่ทำให้ท่านไม่สวมใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคล โปรดระบุ ....
25	ในที่ทำงานของท่านมีการสอนหรืออบรมการใช้อุปกรณ์ป้องกันอันตรายส่วนบุคคลหรือไม่ ( ) มี ( ) ไม่มี
26	ถ้าท่านตอบ “มี” บริษัทของท่านมีการฝึกอบรมบ่อยแค่ไหน? ( ) ทุกวัน ( ) 4-5 ครั้งต่อสัปดาห์ ( ) 2-3 ครั้งต่อสัปดาห์ ( ) 1 ครั้งต่อสัปดาห์ ( ) 1 ครั้งต่อ 2 สัปดาห์ ( ) อื่นๆ (ระบุ).....
27	ท่านเคยได้รับอันตรายหรืออุบัติเหตุจากการไม่ใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคลหรือไม่ (ถ้าท่านตอบว่า “เคย” โปรดระบุประเภทของการบาดเจ็บและอุบัติเหตุ) ( ) เคย ..... ( ) ไม่เคย
28	ในที่ทำงานของท่าน มีพนักงานเคยได้รับอันตรายหรืออุบัติเหตุจากการไม่ใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคลหรือไม่ (ถ้าท่านตอบว่า “เคย” โปรดระบุประเภทของการบาดเจ็บและอุบัติเหตุ) ( ) เคย .....

	( ) ไม่เคย
	ง. ความเห็นเกี่ยวกับการใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคล
29	ท่านเห็นด้วยหรือไม่ว่าการใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคลจะลดจำนวนการเกิดอุบัติเหตุได้ ( ) ไม่เห็นด้วยอย่างยิ่ง ( ) ไม่เห็นด้วย ( ) ไม่แน่ใจ ( ) เห็นด้วย ( ) เห็นด้วยอย่างยิ่ง
30	ท่านคิดว่าอะไรเป็นสาเหตุสำคัญในการใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคล ( ) เพื่อป้องกันตัวเอง ( ) กฎระเบียบของบริษัท ( ) อื่นๆ (ระบุ).....
31	ในความเห็นของท่าน ท่านคิดว่าสิ่งใดเป็นแรงจูงใจนอกเหนือจากเรื่องเงินในการใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคลของท่านและคนงานท่านอื่น โปรดระบุ ....
32	อะไรที่ช่วยให้ท่านสั่งให้คนงานสวมใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคลได้ โปรดระบุ ....
33	ท่านคิดว่าค่าใช้จ่ายเท่าไรที่ท่านสามารถจ่ายเพื่อความปลอดภัยของคนงานแต่ละคนได้ โปรดระบุ ....
34	ถ้าทางบริษัทมีการมอบรางวัลให้กับบุคคลที่คำนึงถึงความปลอดภัยขณะปฏิบัติงานและสวมใส่อุปกรณ์ป้องกันอันตรายส่วนบุคคลทุกครั้ง ท่านคิดว่ารางวัลนั้นควรเป็นสิ่งใด โปรดระบุ ....
35	ท่านมีคำแนะนำในการปรับปรุงความปลอดภัยในการก่อสร้างของไทยอย่างไร

	โปรดระบุ ....

ข้อเสนอแนะ

.....

.....

.....

.....

Appendix B

Questionnaires responses

Summary of questionnaire results (Idea Development2)

QUESTIONS RESPONSES 88

88 responses

SUMMARY INDIVIDUAL

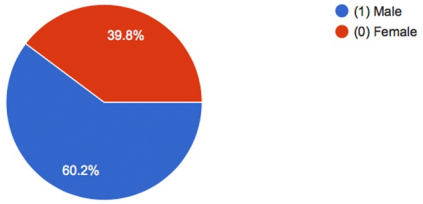
Accepting responses

1. Low level workers

A. General information of the respondents

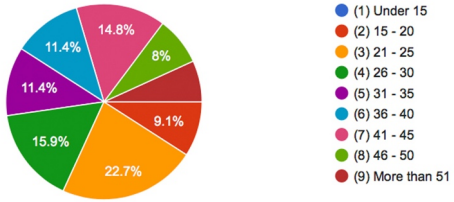
* 1. Gender

88 responses



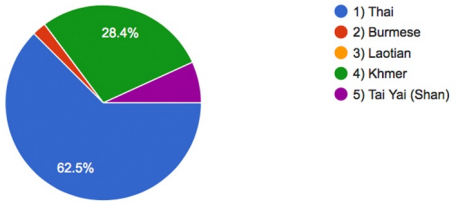
* 2. Age

88 responses



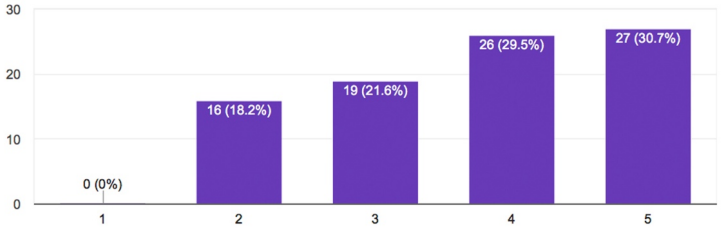
3. Nationality

88 responses



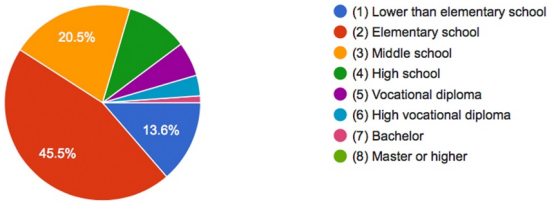
* 4. Thai language ability (Understanding and Communication)

88 responses



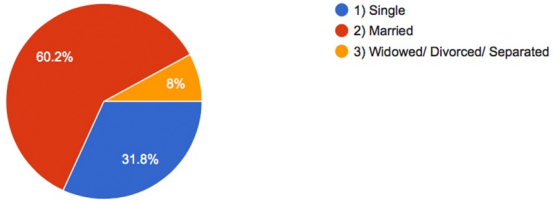
* 5. Educational background

88 responses



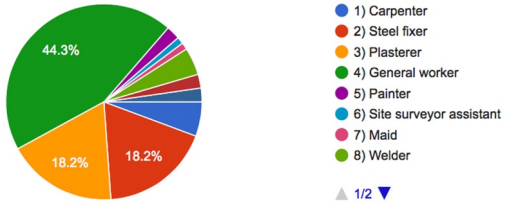
6. Personal status

88 responses



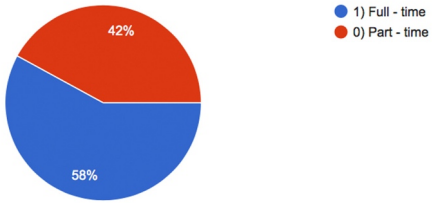
7. Job title

88 responses



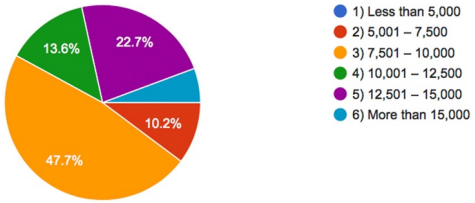
8. Employment status

88 responses



9. Monthly income (Baht)

88 responses

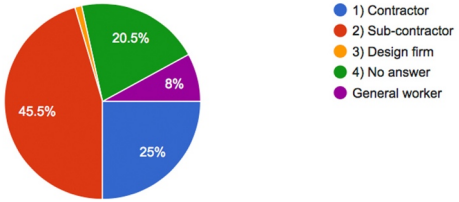


10. What company and company type do you belong to? (E.g. Fahchun Development Co Ltd)

88 responses

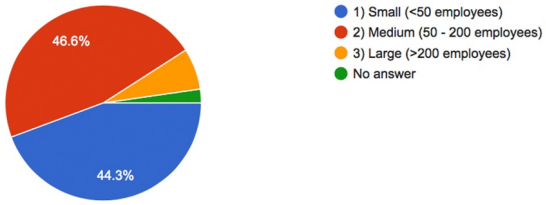
- (48)
Fah Thai Corporation Co., Ltd. (20)
Fahchun Development Co., Ltd. (16)
Narachan Civil Co., Ltd. (4)

88 responses



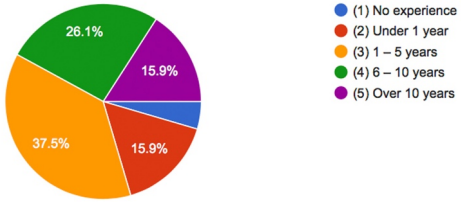
11. What company size are you currently working on?

88 responses



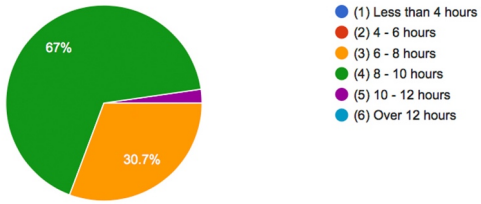
* 12. Work experience

88 responses



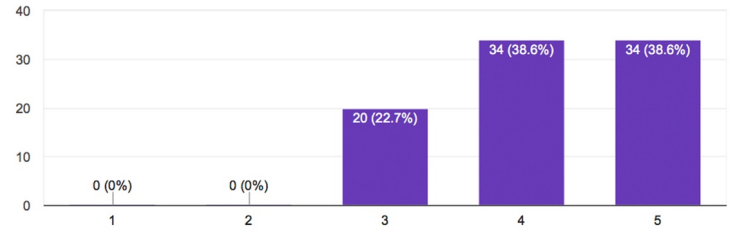
* 13. Working hours in a day

88 responses



* 14. What level do you feel satisfied with your job?

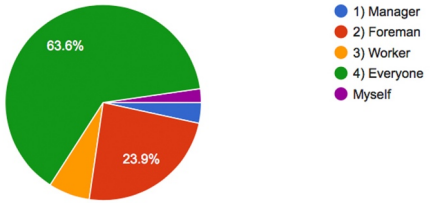
88 responses



B. Safety knowledge and experience

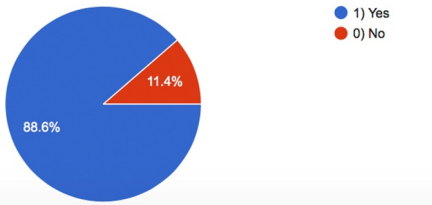
15. Who do you think should response to safety in the construction site?

88 responses



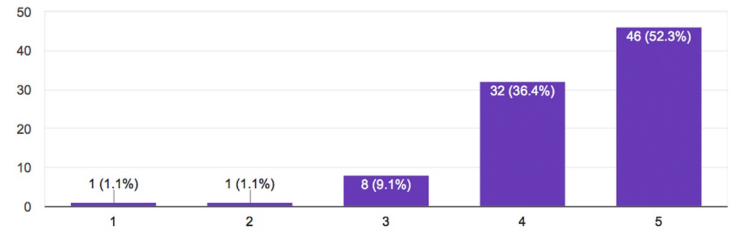
16. Did you have any basic construction safety knowledge before joining the company?

88 responses



17. * What level do you concern about safety?

88 responses



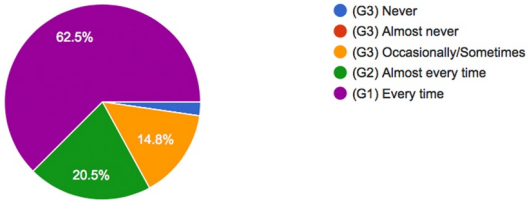
18. If you think of personal protective equipment (PPE), what items do you think of? (Please specify as many as possible)

88 responses

Hat, Shoes (14)
- (10)
Safety belt (5)
Shoes, Hat (5)
Safety hat (4)
Shoes (3)
Shoes, Safety hat (3)
Hat, Reflective shirt, Shoes (3)
Everything related to safety (2)
Everything related to the job I do (2)
Hat (2)
Welding glasses, Leather gloves (2)

** 19. Do you wear PPE while working in the construction site?

88 responses



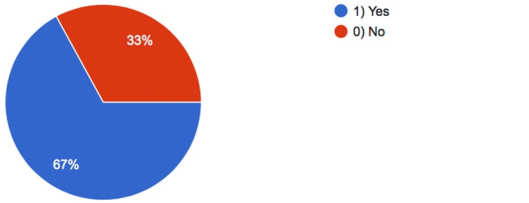
20. If you didn't answer "Every time", what is the reason not wear them? (Please specify)

35 responses

- (9)
In a hurry (9)
No harm in my job (2)
Not enough PPE (2)
Forget (2)
Don't have PPE
Never worked before - newbie
Suitability for work
Put on protective equipment when going to an area that has a potential accident
Lazy
Boring
Shoes

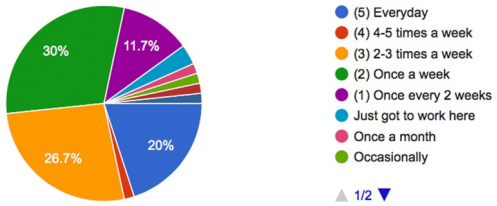
* 21. Is there any safety training session on how to use PPE in your company?

88 responses



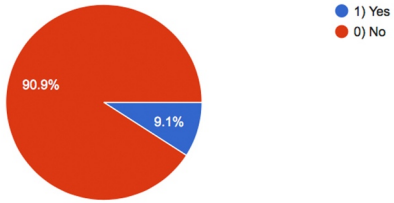
* 22. If you answered "Yes", how often does your company provide a training session?

60 responses



23. Have you ever been injured or experienced in an accident from not wearing PPE?

88 responses



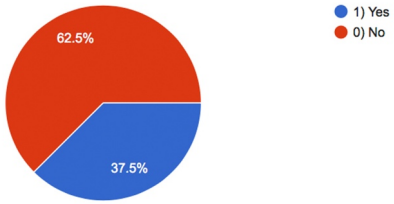
If your answer is "yes", please specify

8 responses

Kick steel (2)
Fall from the scaffolding, Paint colours splash in the eye
Get a cut
Eye injury while welding
Steel cuts on a leg
-
Get hit by steel

24. In your company, have any of your colleagues, friends or co-workers ever been injured or experienced in an accident from not wearing PPE?

88 responses



If your answer is "yes", please specify

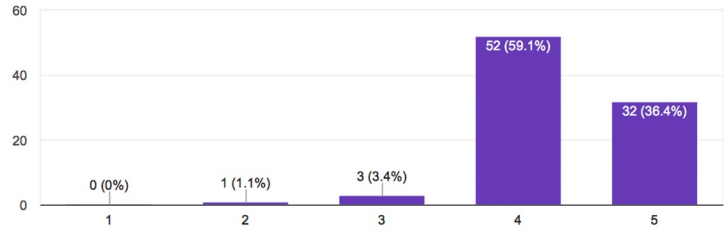
33 responses

Get hit by steel (13)
Fall from the scaffolding (5)
Step on a nail (3)
Step on steel (2)
Fall from the scaffolding, Paint colours splash in the eye
Eye injury while welding
Step on a nail, Step on steel
Glass cuts on a hand, Brick falls
Steel cuts on a leg
Fall from the roof
Fall from stairs
Get hit by steel, Steel falls

C. Opinion on wearing personal protective equipment (PPE)

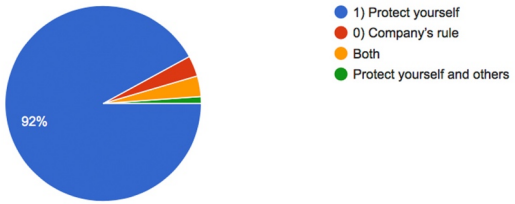
*** 25. Do you agree that wearing PPE will mitigate the number of accidents?**

88 responses



26. What do you think is the main reason of wearing PPE?

88 responses



27. In your perspective, what are the incentives other than money for you and workers to wear PPE? (Please specify)

88 responses

Safety (22)
Self safety (13)
- (11)
Life (8)
Self protection (8)
Prevent from accident (5)
Uncomfortable, Not used to wear (4)
Safety while working (4)
Colleagues have accident (3)
Self safety + Colleagues' safety (2)
Accident that caused by colleagues (2)
I want everyone to be safe.

28. If there is a reward for those people who always keep safety in mind and always wear PPE while working. What do you think the reward should be? (Please specify)

88 responses

Money (40)
Compliment (6)
- (5)
Shoes (5)
Raise wages (4)
Hat (4)
Certificate (4)
Trophy (4)
Safety equipment (2)
Money, Welfare (2)
Gratitude (Thankfulness) (2)
Motorcycle

QUESTIONS RESPONSES 47

47 responses

SUMMARY INDIVIDUAL

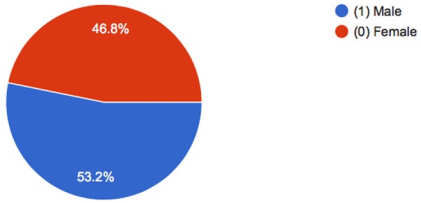
Accepting responses

2. High level workers

A. General information of the respondents

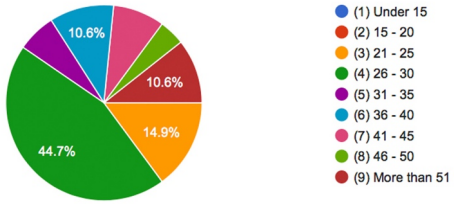
*** 1. Gender**

47 responses



*** 2. Age**

47 responses

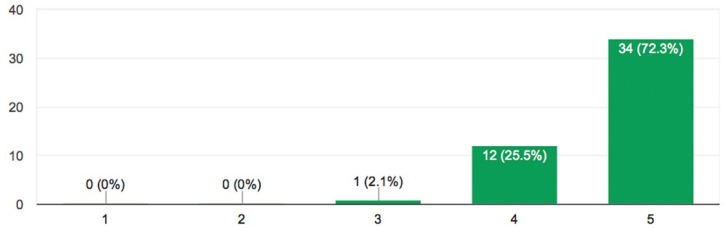


3. Nationality

47 responses

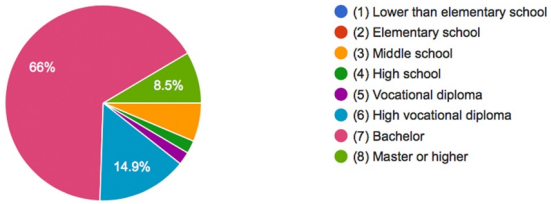
*** 4. Thai language ability (Understanding and Communication)**

47 responses



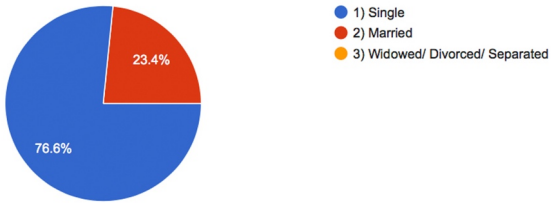
*** 5. Educational background**

47 responses



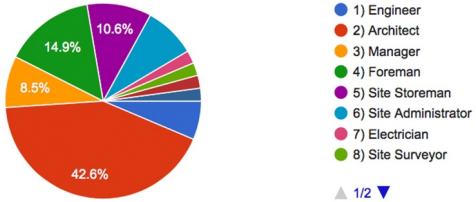
6. Personal status

47 responses



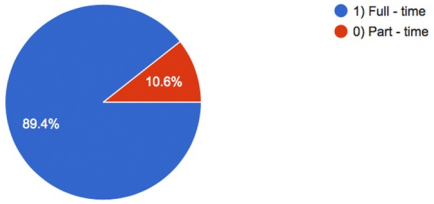
7. Job title

47 responses



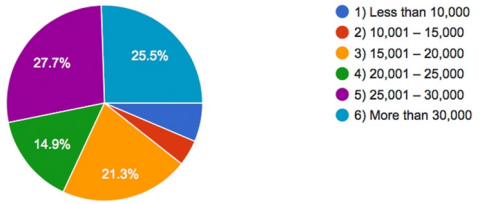
8. Employment status

47 responses



9. Monthly income (Baht)

47 responses

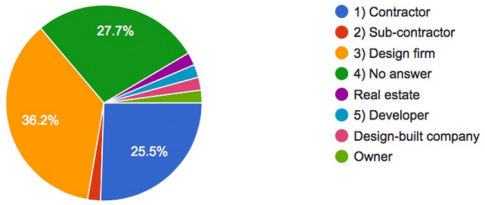


10. What company or department and company type do you belong to? (If you don't want to give your company name, please answer only your department name.)

47 responses

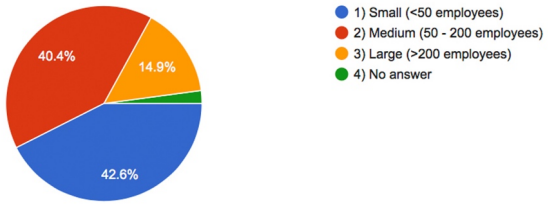
- (7)
Fahchun Development Co., Ltd. (7)
Construction department (6)
Site store management department (3)
Architectural design (3)
Interior design (3)
Design (3)
Ong&Ong (2)
Accounting department
Supervision (Foreman)
W Archtects pte ltd
Rtnq architects

47 responses



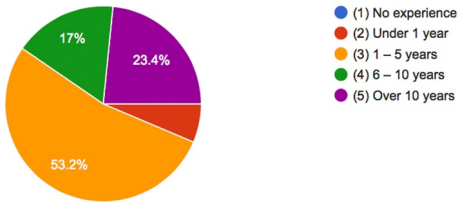
11. What company size are you currently working on?

47 responses



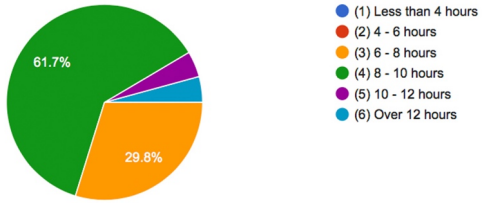
* 12. Work experience

47 responses



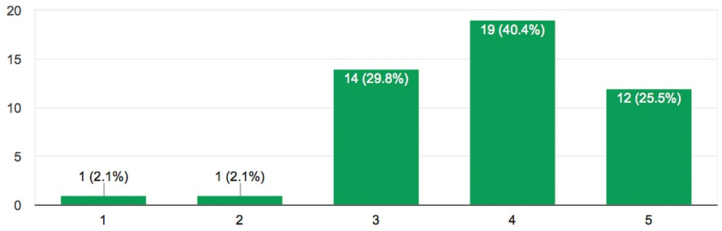
* 13. Working hours in a day

47 responses



* 14. What level do you feel satisfied with your job?

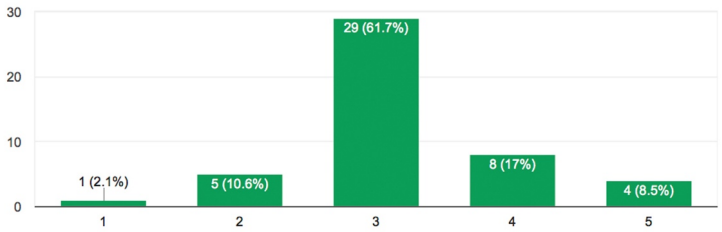
47 responses



B. Opinion on current safety situation

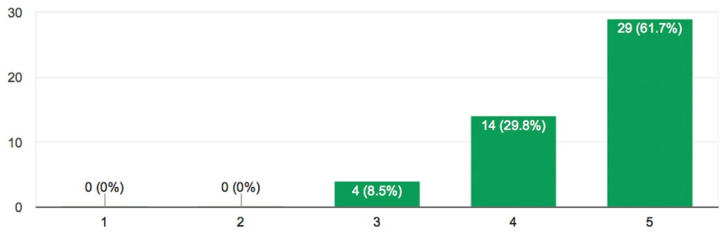
* 15. Are you satisfied with the current safety situation in Thai construction especially in your company?

47 responses



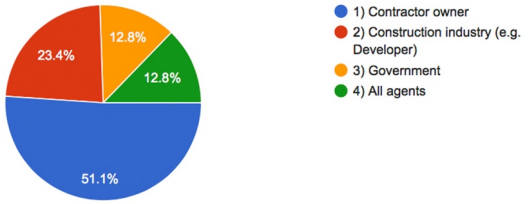
* 16. Do you think safety is important for the future of Thai construction?

47 responses



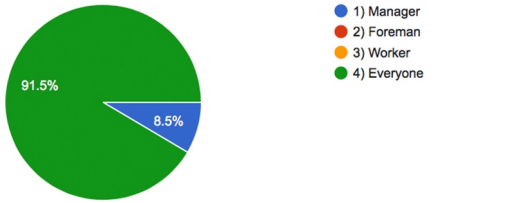
17. Who do you think should response to safety in Thai construction?

47 responses



18. Who do you think should response to safety in the construction site?

47 responses



C. Safety knowledge and experience

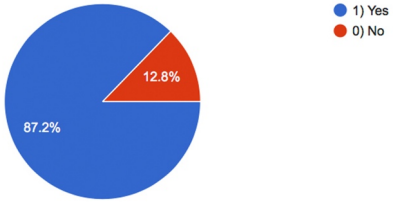
19. If you think of safety, what do you think of? (Please specify as many as possible)

47 responses

Safety equipment (6)
Working in high place (2)
- (2)
Safety while working (2)
PPE (2)
Electricity - everyday use (Attentiveness)
Working with suitable safety equipment
Hat, Shoes, Working in high place
Working in high place, Working underground
Clear identify signs, Site organisation, Equipment maintenance, Chemical separation
No accident while working, Every employees wear PPE, Every employees follow safety instruction
Safety system

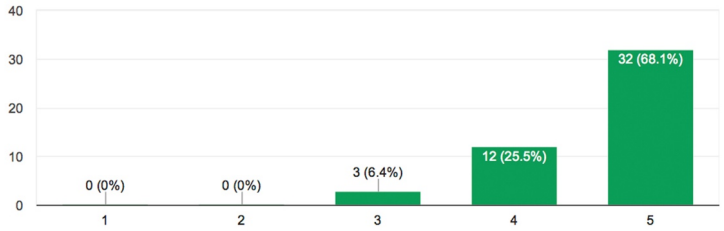
20. Did you have any basic construction safety knowledge before joining the company?

47 responses



21. * What level do you concern about safety?

47 responses



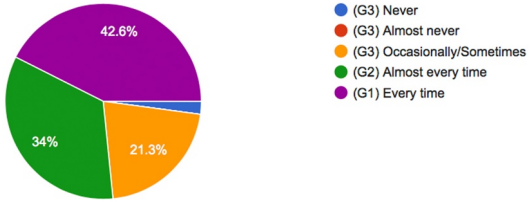
22. If you think of personal protective equipment (PPE), what items do you think of? (Please specify as many as possible)

47 responses

Safety Hat (7)
Safety Hat, Safety shoes (4)
Hat (3)
Helmet (2)
Helmet (2)
Hat, Shoes (2)
Glasses, Safety shoes, Safety Hat
Hat, Shoes, Glasses, Gloves, Welding mask, Safety belt
Safety Hat, Safety shoes, Mask
Safety Hat, Safety shoes, Safety glasses, Earplug, Reflective shirt, Safety gloves, Safety mask
Light protection glasses, Mask, Safety belt, Sneakers, Safety Hat, Leather gloves
Safety shoes, Safety Hat, Earplug, Welding glasses, Light protection glasses, Safety belt, Welding gloves, Fabric

** 23. Do you wear PPE while working in the construction site?

47 responses



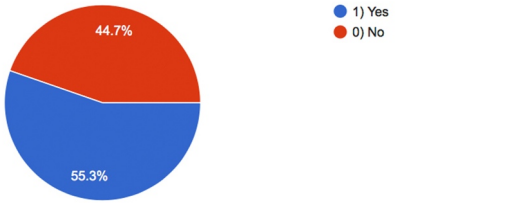
24. If you didn't answer "Every time", what is the reason not wear them? (Please specify)

27 responses

Depends on assignment (6)
- (5)
Do document work - office work (2)
Not enough PPE (2)
No harm in my job
Work is nearly finished - It's just decoration phase, not structuring
Work is nearly finished
Sometimes they are unavailable on site
Optional safety PPE
Work is nearly finished - The site is quite tidy
Forget
I didn't bring it.

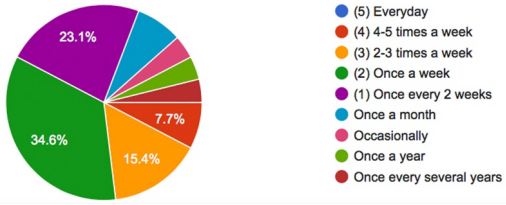
* 25. Is there any safety training session on how to use PPE in your company?

47 responses



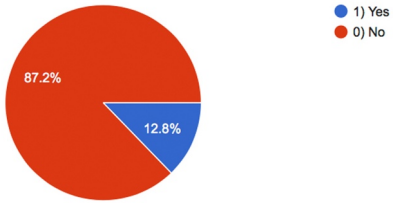
* 26. If you answered "Yes", how often does your company provide a training session?

26 responses



27. Have you ever been injured or experienced in an accident from not wearing PPE?

47 responses



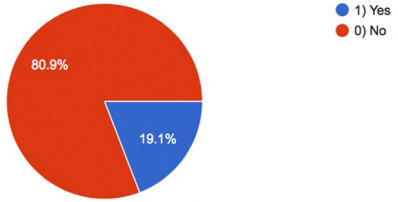
If your answer is "yes", please specify

6 responses

Step on a nail (2)
Plaster falls on head
Get cut on a finger
Head hits the scaffolding
Step on some scrap

28. In your company, have any employees ever been injured or experienced in an accident from not wearing PPE?

47 responses



If your answer is "yes", please specify

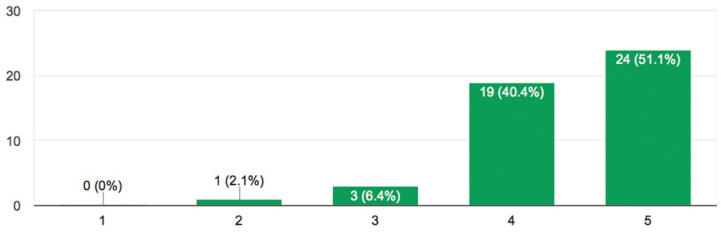
9 responses

Eye injury while cutting a tile
Some scrap gets in the eye
Fall from a scaffolding
-
Something falls on head, foot
Something fall on head, Step on something sharp
Feet injury
Step on a nail
Zinc sheet metal cuts on a leg, Step on a nail

D. Opinion on wearing personal protective equipment (PPE)

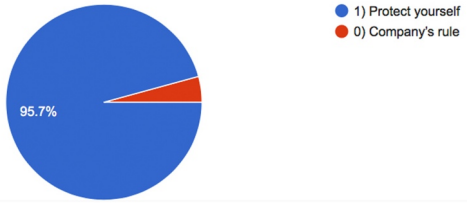
* 29. Do you agree that wearing PPE will mitigate the number of accidents?

47 responses



30. What do you think is the main reason of wearing PPE?

47 responses



31. In your perspective, what are the incentives other than money for you and workers to wear PPE? (Please specify)

47 responses

Self safety (7)
Life (5)
Safety (5)
- (3)
Family (2)
Safety while working
Wearing PPE increases confidence while working
Give some accident example
Workers' life, family
Work pain - injuries
Self protection
Accident can cause organ loss

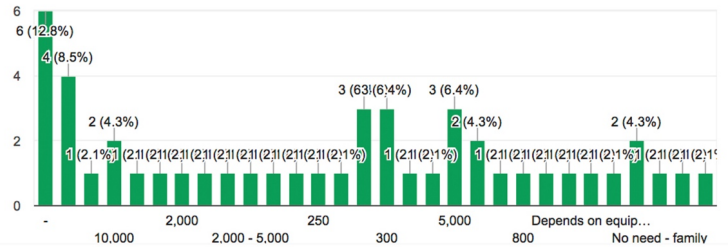
32. What helps you order the workers to wear PPE? (Please specify)

47 responses

Self safety (4)
Regulations (4)
Workers' safety (3)
Safety (3)
Reward (2)
Compulsion - forcement
Explain reasons of wearing PPE can keep you safe from an accident
Cultivate conscious - Set rules
Safety shoes
Suspend from job or Cut wages
Glasses protect from light , Mask protects from dust, Earplug protects from noise, Leather gloves are used while welding, Safety belt is used while working in high place, Safety shoes, Safety Hat
Training on the working procedures

33. How much cost can you spend for each workers' safety? (Please specify)

47 responses



34. If there is a reward for those people who always keep safety in mind and always wear PPE while working. What do you think the reward should be? (Please specify)

47 responses

Money (9)
Bonus (4)
- (3)
Raise wages (2)
Life insurance, Money (2)
Holiday (2)
Extra reward
Show on billboard + reward
Certificate + Appropriate reward
Outstanding employee
Good Safety equipment
Safety medal to remind safety

35. Do you have any suggestion on improving safety in Thai construction? (Please specify)

47 responses

- (9)
Everyone should wear PPE (3)
Cultivate safety conscious (2)
Every company should wear more PPE
Self development - be ready to work
Safety must be specified in the contract
Set a policy - every company must wear PPE
Should love your life
Be skilled in your job, Understand and recognize the responsibility of each person
Encourage construction owners to give serious importance to safety
Set safety standard
Invest 50% more on safety

Suggestions

5 responses

Safety is the 1st thing in the construction
Contractor owner should understand more about safety in every process. Safety staff should be assigned on each site, unlike current situation which safety staff comes to the site only once a month.
Should be promoted through the children so, they can persuade their parents to aware of safety.
Make a survey that will be beneficial to the development of safety significance.
Should collect data and widely spread the information

Summary of questionnaire results (Idea Development2)

18, 22 If you think of personal protective equipment (PPE), what items do you think of? (Please specify as many as possible)

	Low			High			Total		
	n	%	Ranking	n	%	Ranking	n	%	Ranking
3 Foot protection	58	30.2	1	27	22.3	2	85	26.2	2
2 Head protection	57	29.7	2	44	36.4	1	101	31.2	1
4 Hand protection	25	13.0	3	11	9.1	3	36	11.1	3
5 Face, Eye protection	15	7.8	5	10	8.3	4	25	7.7	4
7 Breathing apparatus	10	5.2	7	8	6.6	5	18	5.6	7
6 Hearing Protection	0	0.0	9	2	1.7	9	2	0.6	9
1 Protective clothing	12	6.3	6	7	5.8	6	19	5.9	6
8 Fall management equipment	9	4.7	8	7	5.8	6	16	4.9	8
9 Others	6	3.1	4	5	4.1	8	11	3.4	5
	192	100.0		121	100.0		313	96.6	

20, 24. If you didn’t answer “Every time”, what is the reason not wear them? (Please specify)

Low

Low			n			%	
Management factors	1 Lack of management support (MF-02)	Not enough PPE	2				
		Don't have PPE	1	3	3	11.1	11.1
Workgroup factors	2 Group norms (WF-01)				0	0.0	0.0
Personal factors	3 Over confidence (PF-10)	Suitability for work	1				
		No harm in my job	2				
		Put on protective equipment when going to an area that has a potential accident	1	4			14.8
	4 Being uncomfortable (PF-06)	Uncomfortable	2	2			7.4
	5 Past experience (PF-02)	Not used to wear	2				
		Never worked before – newbie	1	3			11.1
	6 Laziness (PF-01)	Lazy	1				
		Boring	1				
		Forget	2				
		Work as a surveyor	1	5			18.5
	7 Being in hurry	In a hurry	9	9	23	85.2	33.3
	8 Other	No answer	9				
		Shoes	1	1	1	3.7	3.7
			27	27	27		

High

High			n			%	
Management factors	1 Lack of management support (MF-02)	Not enough PPE	2				
		Sometimes they are unavailable on site	1	3	3	13.0	13.0
Workgroup factors	2 Group norms (WF-01)				0	0.0	0.0
Personal factors	3 Over confidence (PF-10)	Depends on assignment (6)	6				
		Do document work - office work (2)	2				
		No harm in my job	1				
		Work is nearly finished - It's just decoration phase, not structuring	1				
		Work is nearly finished	1				
		Work is nearly finished - The site is quite tidy	1				
		Optional safety PPE	1				
		Sometimes there is no construction work operating	1	14			60.9
	4 Being uncomfortable (PF-06)						0.0
	5 Past experience (PF-02)						0.0
	6 Laziness (PF-01)	I didn't bring it.	1				
		Forget	1				
		Stay at the site for a moment and don't bring them	1	3			13.0
	7 Being in hurry	In a hurry	1	1	18	78.3	4.3
	8 Other	No answer	5				
		Sneakers	1				
		Safety Hat	1	2	2	8.7	8.7
			23	23	23		

23.1, 27.1 Have you ever been injured or experienced in an accident from not wearing PPE? If your answer is "yes", please specify

Low

Causes of Injury		n		%	Ranking
Cut/Stabbed	Get a cut	1			
	Steel cuts on a leg	1	2	25.0	2
Hit/Crashed	Kick steel	2			
	Get hit by steel	1	3	37.5	1
Collapsed/Felt on top	Fall from the scaffolding	1	1	12.5	4
Splashed into Eyes	Paint colours splash in the eye	1			
	Eye injury while welding	1	2	25.0	2
Pinched/Pulled				0.0	5
Other	No answer	1			
	Total	8			

High

Causes of Injury		n		%	Ranking
Cut/Stabbed	Step on a nail (2)	2			
	Get cut on a finger	1			
	Step on some scrap	1	4	66.7	1
Hit/Crashed	Head hits the scaffolding	1	1	16.7	2
Collapsed/Felt on top	Plaster falls on head	1	1	16.7	2
Splashed into Eyes					
Pinched/Pulled					
Other					
	Total	6			

24.1, 28.1 In your company, have any employees ever been injured or experienced in an accident from not wearing PPE? If your answer is “yes”, please specify

Low

Causes of Injury		n		%	Ranking
Cut/Stabbed	Step on a nail	4			
	Step on steel	3			
	Glass cuts on a hand	1			
	Steel cuts on a leg	1	9	24.3	3
Hit/Crashed	Get hit by steel	14	14	37.8	1
Collapsed/Felt on top	Fall from the scaffolding	6			
	Brick falls	1			
	Fall from the roof	1			
	Fall from stairs	1			
	Steel falls	2	11	29.7	2
Splashed into Eyes	Paint colours splash in the eye	1			
	Eye injury while welding	1	2	5.4	4
Pinched/Pulled	Death - Conveyor belt ripped	1	1	2.7	5
Other	No answer	1			6
	Total	37	37		

High

Causes of Injury		n		%	Ranking
Cut/Stabbed	Step on something sharp	1			
	Step on a nail	2			
	Zinc sheet metal cuts on a leg	1	4	36.4	1
Hit/Crashed	Fall from the scaffolding		0	0.0	5
Collapsed/Felt on top	Fall from a scaffolding	1			
	Something falls on head	2			
	Something falls on foot	1	4	36.4	1
Splashed into Eyes	Eye injury while cutting a tile	1			
	Some scrap gets in the eye	1	2	18.2	3
Pinched/Pulled			0	0.0	5
Other	No answer	1			
	Feet injury	1	1	9.1	4
	Total	11	11		

27, 31. In your perspective, what are the incentives other than money for you and workers to wear PPE? (Please specify)

Low

Low		n		%
Safety awareness	Safety (22)	22		
	Safety while working (4)	4		
	Prevent from accident (5)	5		
	Accident prevention	1		
	Prevent from death	1	33	42.9
Self and others safety awareness	Self-safety (13)	13		
	Self-protection (8)	8		
	Self-safety + Colleagues' safety (2)	2		
	Colleagues have accident (3)	3		
	Accident that caused by colleagues (2)	2		
	I want everyone to be safe	1	29	37.7
Reason to enhance Safety practices	Give safety trainings to make everyone truly understand about safety	1	1	1.3
Way to enhance Safety practices		0	0	0.0
Life	Life (8)	8		
	My life	1	9	11.7
Others	-11	11		
	Money	1		
	Uncomfortable, Not used to wear (4)	4	5	6.5
	Total		77	

High

High		n		%
Safety awareness	Safety (6)	6		
	It is safe.	1		
	Protection	1		
	Safety while working	1	9	19.1
Self and others safety awareness	Self-safety (7)	7		
	Self-protection	1		
	Self-safety and workers' safety	1		
	Your own and everyone’s safety	1	10	21.3
Reason to enhance Safety practices	Wearing PPE increases confidence while working	1		
	Show more tangible accident results. Accident can happen all the time. And when it happened, worker may not be able to return to the same physical condition.	1		

	Give some potential accident example (case studies) to increase safety awareness for workers	1		
	Accident can cause organ loss	1		
	Give some accident example	1		
	Work pain - injuries	1	6	12.8
Way to enhance Safety practices	Knowledge	1		
	Construction standard	1		
	Compulsion - forcing	1		
	Rewards	1		
	Prepare in a convenient, suitable location.	1	5	10.6
Life	Life (5)	5		
	Safety life	1		
	Workers' life (2)	2		
	Family (3)	3	11	23.4
Others	-3	3		
	Time control, The neatness of the work, Quality control for work and worker performance	1		
	Environment, Experience, Convenience	1		
	Inconvenient, unavailable on site	1		
	Humans rights	1		
	Company's reputation	1		
	Reputation	1	6	12.8
	Total		47	

28, 34. If there is a reward for those people who always keep safety in mind and always wear PPE while working. What do you think the reward should be? (Please specify)

Low

Low		n		%
Money (48)	Money (44)	44		
	Raise wages (4)	4	48	55.2
The honorable (16)	Certificate (4)	4		
	Trophy (4)	4		
	Gratitude (Thankfulness) (2)	2		
	Compliment (6)	6	16	18.4
Safety equipment (14)	Shoes (5)	5		
	Hat (4)	4		
	Safety equipment (2)	2		
	PPE	1		
	Safety shoes	1		
	Safety hat	1		
	Welfare (e.g. Safety shoes) (2)	2	16	18.4
Welfare (4)	Welfare (2)	2	2	2.3
Anything is okay. (6)	-5	5		
	Up to the company	1		
My own preference (I want it.) (2)	Motorcycle	1		
	Diamond ring	1		
Safety (2)	Safety	1		
	Safety suggestions	1	5	5.7
	Total		87	

High

High		n		%
Money (48)	Money (14)	14		
	Bonus (4)	4		
	Raise wages (2)	2		
	Monetary benefits	1		
	Cash	1	22	44
The honorable (16)	Certificate (3)	3		
	Trophy	1		
	Show on billboard + reward	1		
	Certificate + Appropriate reward	1		
	Outstanding employee	1		

	Certificate or Trophy	1		
	Safety medal to remind safety	1		
	Certificate + set him/her as a role model	1		
	Certificate for outstanding safety efforts employee	1		
	Compliment	1		
	Praise	1	13	26
Safety equipment (14)	Good safety equipment	1		
	Safety equipment (2)	2		
	New safety equipment	1	4	8
Welfare (4)	Welfare	1		
	Life insurance (2)	2		
	Health insurance	1		
	Workers' life	1	5	10
Anything is okay. (6)		3		
My own preference (I want it.) (2)	Gift vouchers or travel voucher	1		
	Holiday	3		
	Extra reward	1		
Safety (2)	Safety	1	6	12

	Total		50	

19. If you think of safety, what do you think of? (Please specify as many as possible)

Item	Category	Ranking
Shoes	1 Safety equipment (23)	1
Safety equipment (10)		
PPE (6)		
Proper attire (Clothing) (2)		
Head protection (3)		
Clear identify signs		
Site organization	2 Accident prevention and control (22)	2
Equipment maintenance		
Chemical separation		
Every employee wears PPE		
Every employee follows safety instruction		
Keeping equipment in working condition		
Accident prevention (2)		
Protection		
Assurance		
Procedure & cautionary measures		
Safety system		
Physical Safety		
Safety control system (2)		
Construction safety		
Design responsibilities		
Safety in design		
Regulations on how to work in the construction area		
Clear rules and restriction that everyone must follow		
Supervision		
Assessment		
Safety while working in high place (5)	3 Working circumstances (12)	4
Safety while using equipment/ machines		
Safety while doing on electrical systems work		
Safety while working (2)		
Working underground		
Working in the site		
Working with suitable safety equipment		

Attentiveness (Electricity - everyday use) (3)	4 Safety consciousness (Things everyone must keep in mind and follow/ do in the site) (14)	3
Punctuality		
Remind of safety		
Principles of safety		
Basic safety		
Improvement		
Life		
Things to keep in mind		
Acknowledgement		
Do not cause any damage		
No accident while working (2)		
Hospital	5 Other (6)	5
First Aid Room		
Accident		
Pre-fabrication		
- (2)		

32. What helps you order the workers to wear PPE? (Please specify)

Item	Category	Ranking
Regulations (6)	1 Regulation and Compulsion (12)	2
Rules (2)		
Strict regulations		
Compulsion - forcing		
By force		
Standard agreement		
Explain reasons of wearing PPE can keep you safe from an accident	2 Reason explanation (6)	4
Glasses protect from light, Mask protects from dust, Earplug protects from noise, Leather gloves are used while welding, Safety belt is used while working in high place, Safety shoes, Safety Hat		
Life-threatening		
Tells about potential accidents due to not wearing a PPE		
Reason		
Potential accident examples that may arise from non-protection.		
Suspend from job	3 Negative incentive (7)	3
Cut wages (2)		
Punishment for those who disobey		
Penalties (2)		
Pay fine		
Training on the working procedures	4 Things must be kept doing (Safety routine) (4)	6
Inspection (2)		
Well organizing/ storing helps checking who takes away equipment		
Self-safety (4)	5 Safety consciousness (15)	1
Informed about self-safety		
Safety (4)		
Workers' safety (3)		
Cultivate conscious (2) - Set rules		
Create awareness for safety issues		
Family	6 Positive incentive (3)	7
Reward (2)		
Safety shoes	7 Other (5)	5
Safety Hat		
Hat		
Shoes		

Helmets		
-		

33. How much cost can you spend for each workers' safety? (Please specify)

1	2	3	4	5
≤1,000	**≤5,000**	**≤9,000**	**>9,000**	**Others**
1,000 (4)	1,000 - 1,500	5,000 – 10,000 (2)	10,000 (2)	- (6)
150	2,000 (2)		10,000 - 12,000	5% from total construction cost
250	2,000 - 3,000		20,000	Any amount
300 (3)	2,000 - 5,000			Certificate
700	2,500			Depends on equipment
800	3,000			Depends on situation
	3,000 - 5,000 (3)			Depends on situation and intensity of the case (2)
	4,000			No need - family
	5,000 (3)			Not sure
				Safety first
(11)	(14)	(2)	(4)	(16)

35. Do you have any suggestion on improving safety in Thai construction? (Please specify)

Questionnaire result	Category	Category no.	Ranking
Everyone should wear PPE (3)	Strict standard/ regulations on safety (11)	1	1
Every company should wear more PPE			
Set a policy - every company must wear PPE			
Set safety standard			
Set policy and must follow it			
Set higher safety standard			
Clear regulations			
Clear laws			
Strict regulations			
Cultivate safety conscious (2)	Cultivate safety consciousness (9)	2	2
Should love your life			
Give advices about the benefits of importance of safety			
People should be educated on how unsafe condition can affect the business/ slow down progress.			
Cultivate safety conscious starting from children (young age)			
If everyone has safety conscious, they will do it automatically			
Should take the safety in construction sites into consideration. Because it may affect the safety of the surrounding area too.			
Cultivate the use of safety equipment correctly,			
The site must always be tidy	Safety management (5)	3	5
Strict inspection			
PPE should be enough prepared for the number of people who will visit the construction site			
Should have a department who takes responsibility on safety and regularly inspection			
There should be strict regulations about safety in construction site			
Levels of safety can be adjusted depending on the type of work	Workers must be developed at all time (4)	4	4
Understand and recognize the responsibility of each person			
Be skilled in your job			

Self-development - be ready to work			
PPE should be comfortable, good price, high quality and suitable design for the climate.	Quality of PPE (3)	5	3
Cheaper PPE			
The equipment must reach standard and provided for all			
Encourage construction owners to give serious importance to safety	Contractor's responsibilities (3)	6	5
Longer construction time			
Safety must be specified in the contract			
Invest 50% more on safety	Safety investment (2)	7	7
More budget on safety			
States should pay more attention to safety by Inspecting and punish them	States/ Government's responsibilities (2)	8	7
Standard of construction materials quality			
Frequent safety lectures/courses		9	7
Give a training in multi-languages. Foreign workers will realise the effect of the accident.	Frequent training (2)		
- (9)	Unknown (9)		

Suggestions

no.	
1	Safety is the 1st thing in the construction
2	Contractor owner should understand more about safety in every process. Safety staff should be assigned on each site, unlike current situation which safety staff comes to the site only once a month.
3	Should be promoted through the children so, they can persuade their parents to aware of safety.
4	Make a survey that will be beneficial to the development of safety significance.
5	Should collect data and widely spread the information

QUESTIONS RESPONSES 19

19 responses

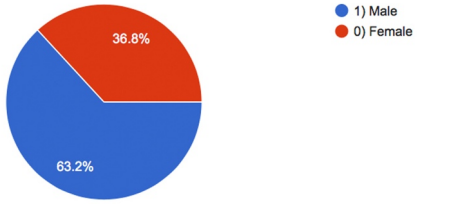
SUMMARY INDIVIDUAL

Accepting responses

1. General information of the respondents

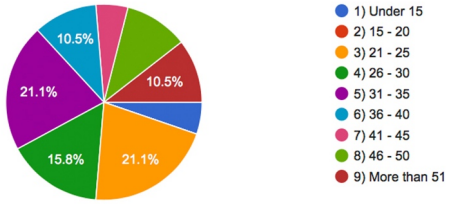
1.1 Gender

19 responses



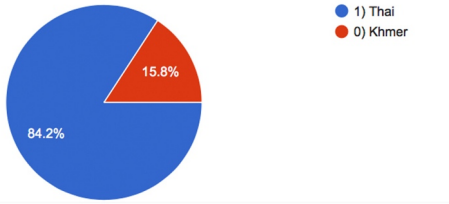
1.2 Age

19 responses



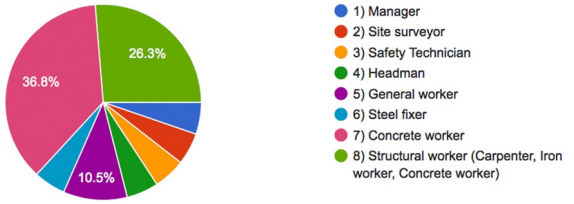
1.3 Nationality

19 responses



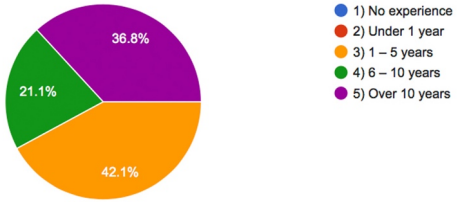
1.4 Job title

19 responses



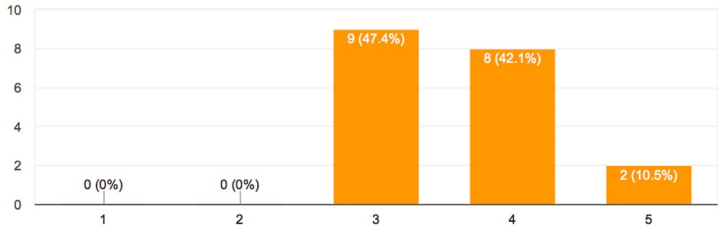
1.5 Work experience

19 responses



1.6 What level do you feel satisfied with your job?

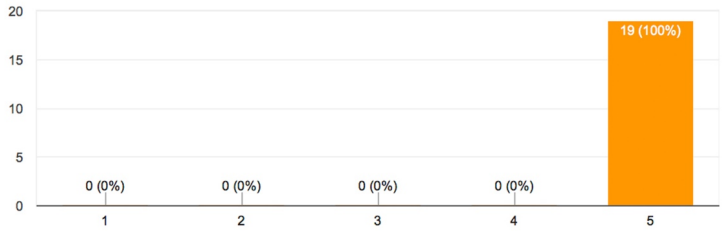
19 responses



2. Questions on workers' attitude about occupational health and safety

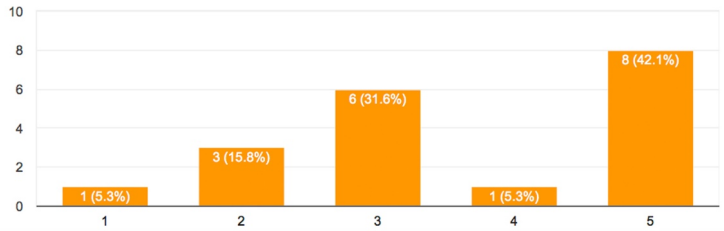
2.1 Do you think all employees must be trained in the occupational health and safety program?

19 responses



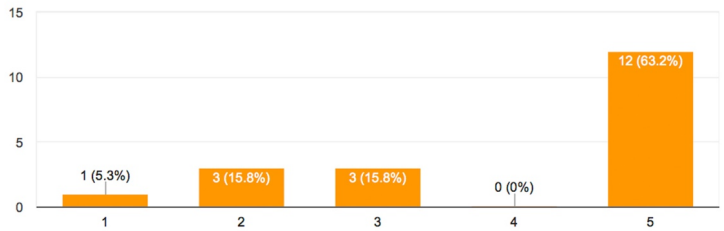
2.2 Do you think following company's safety rules is caused uncomfortable and time delays?

19 responses



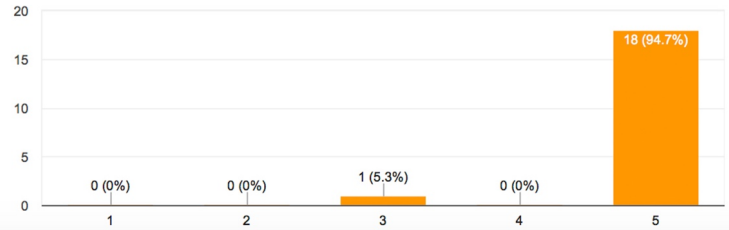
2.3 Do you think punishing employees who do not comply with company's safety rules can reduce the accident?

19 responses



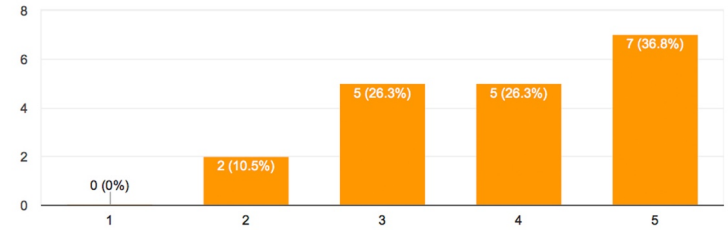
2.4 Do you think being trained on occupational health and safety program will give you the knowledge and the ability to prevent accidents?

19 responses



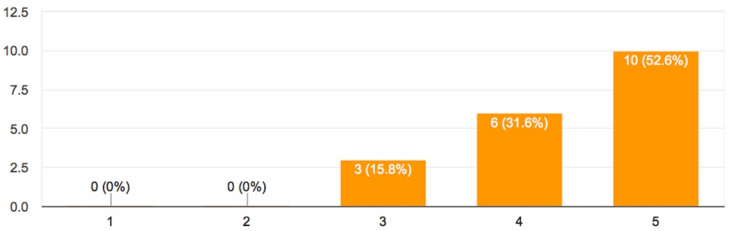
2.5 Do you feel safe when wearing personal protective equipment every time while working?

19 responses



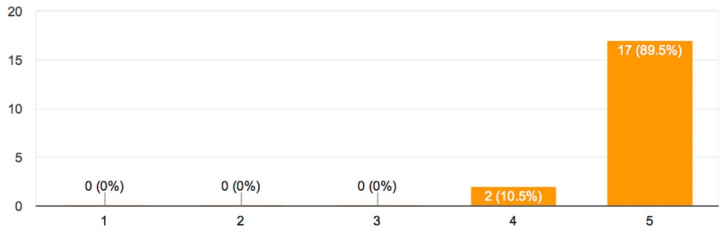
2.6 Do you think you do not need to comply with all the safety rules. Especially those you do not think it's necessary?

19 responses



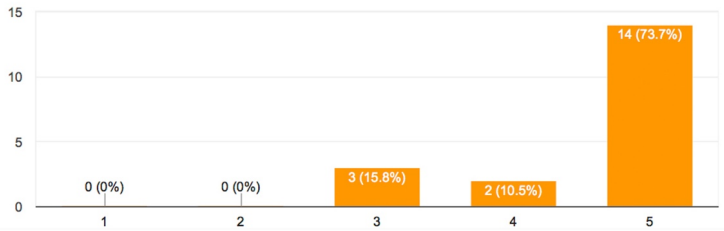
2.7 Do you think an accident prevention is your responsibility?

19 responses



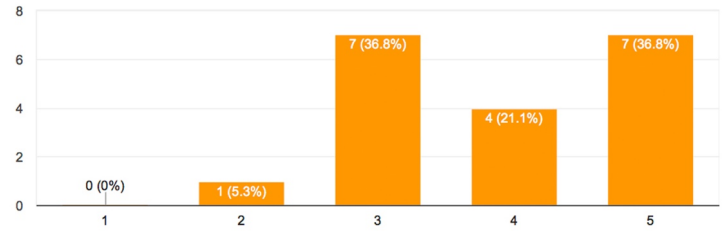
2.8 Do you believe that most accidents happen is caused by unsafe actions?

19 responses



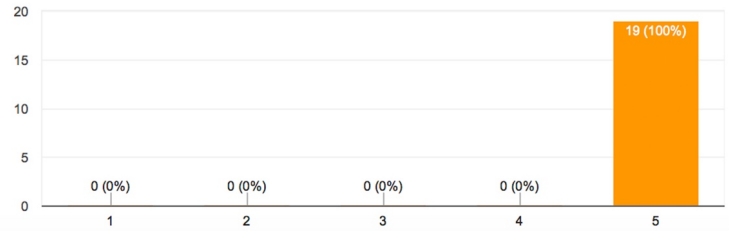
2.9 Do you think even a minor accident, you will always report to the supervisor?

19 responses



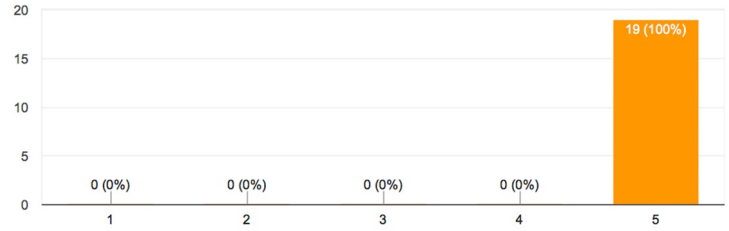
2.10 Do you think if you have planned and followed the safety instructions, you are sure that it will help you work safely?

19 responses



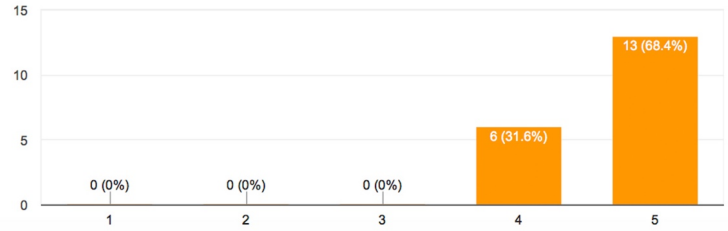
2.11 Do you think all employees should involve in giving feedback and suggestions on safety?

19 responses



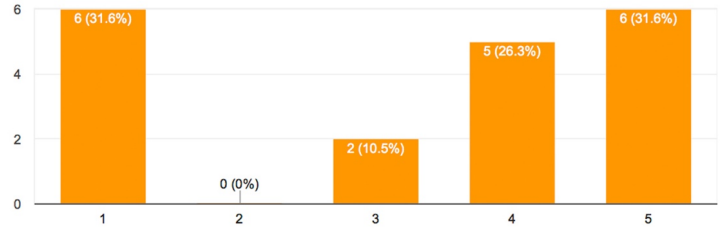
2.12 Do you believe that accidents are beyond control and cannot be prevented?

19 responses



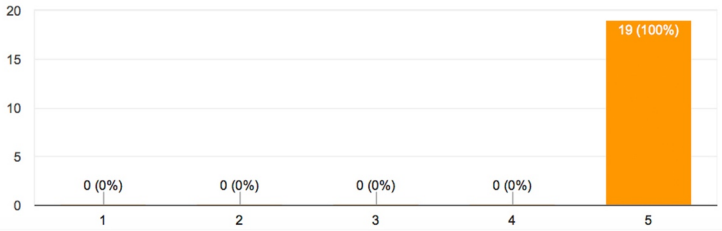
2.13 Do you believe in your expertise. Even if you take a shortcut, it will not cause any accidents?

19 responses



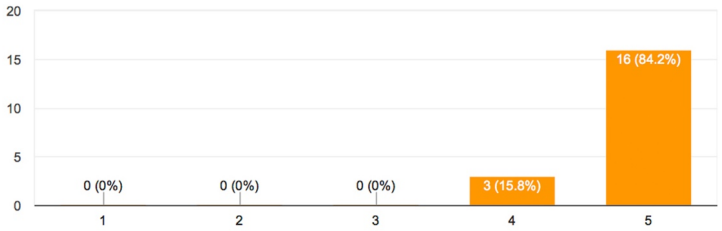
2.14 Do you think the accident investigation is a punishment for employees rather than giving an advice or solution?

19 responses



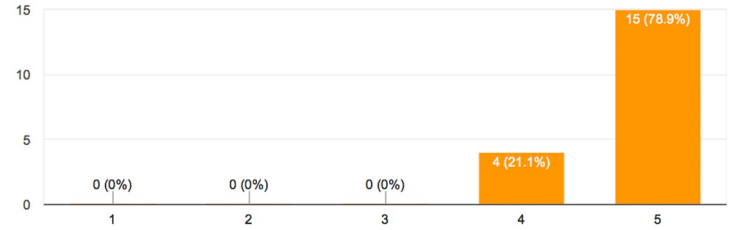
2.15 Do you think safety while working is part of your job and it is important as producing work?

19 responses



2.16 What level do you concern about safety?

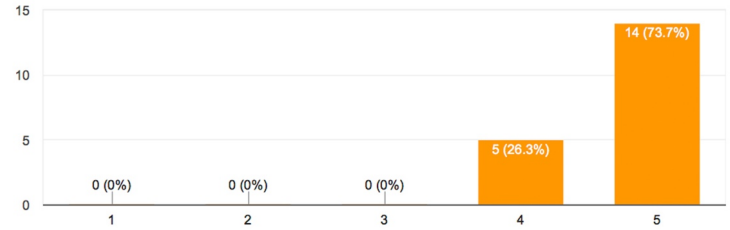
19 responses



3. Questions about workers' safety practices

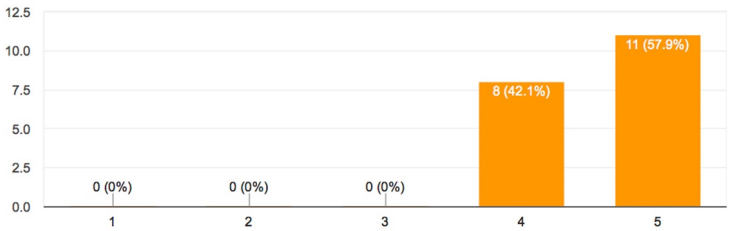
3.1 Do you study and understand the company's safety rules?

19 responses



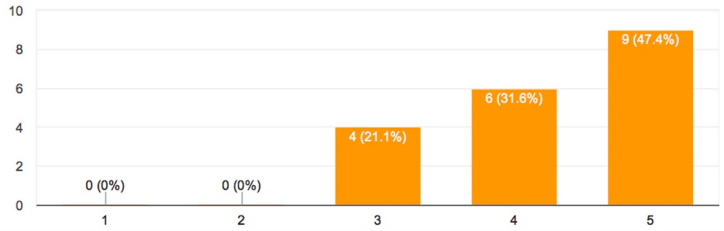
3.2 Do you comply with the company's safety rules?

19 responses



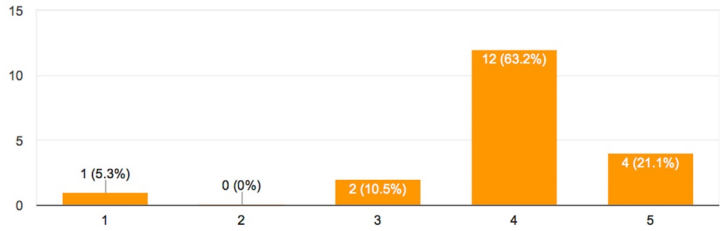
3.3 Do you follow safe work procedures?

19 responses



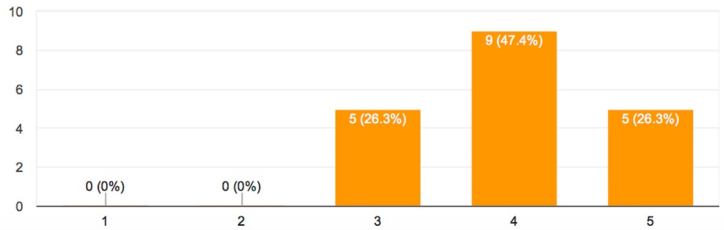
3.4 Do you study the equipment or machine manual before operating?

19 responses



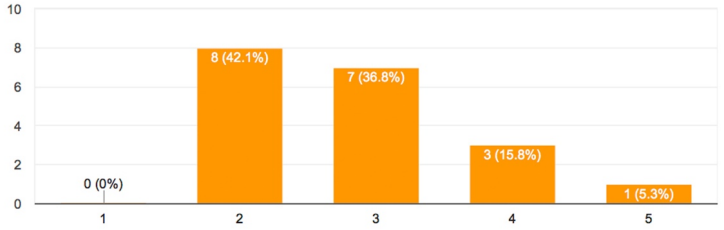
3.5 Do you check the availability of equipment or machinery both before and after use?

19 responses



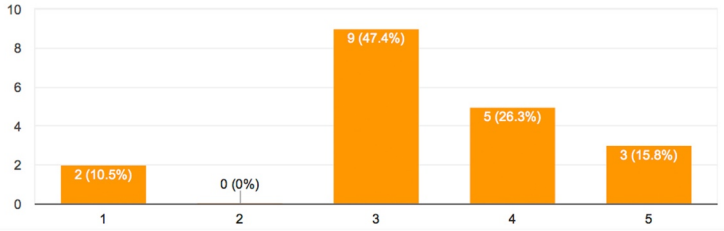
3.6 Do you tease and talk to others while working?

19 responses



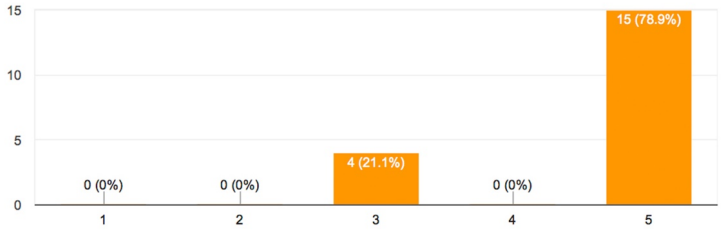
3.7 Do you work although you do not have a good physical condition such as illness, fatigue, or binge drinking?

19 responses



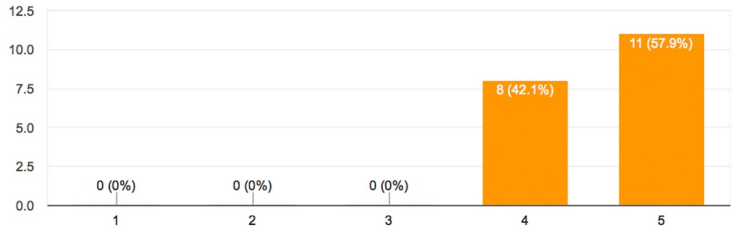
3.8 Do you wear personal protective equipment that company has provided for you while working?

19 responses



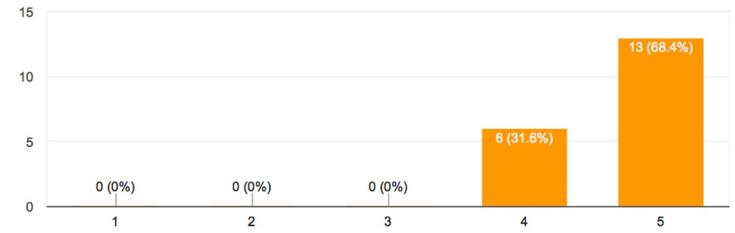
3.9 Do you dress appropriately for your job while you are working?

19 responses



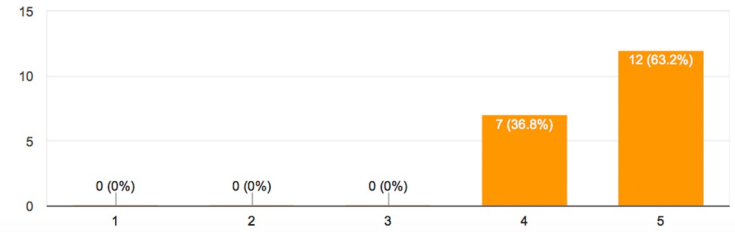
3.10 Do you always follow the instructions and warnings from supervisors?

19 responses



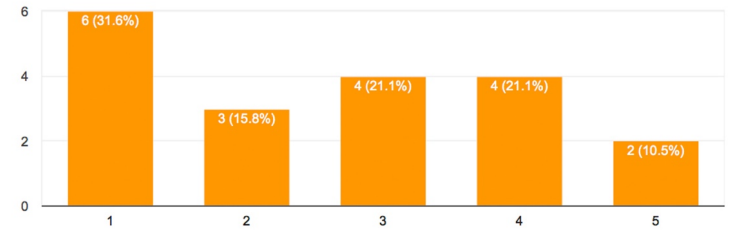
3.11 Do you select the right equipment for your job?

19 responses



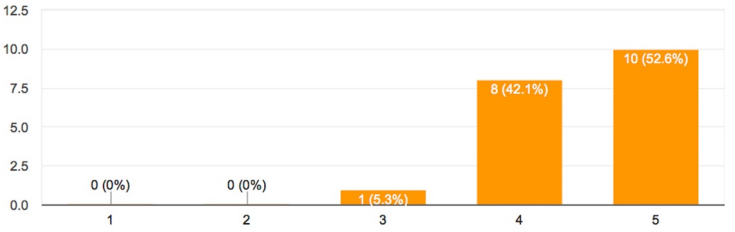
3.12 When you find that the machine tool or equipment is defective. Do you correct immediately even though it's not your duty?

19 responses



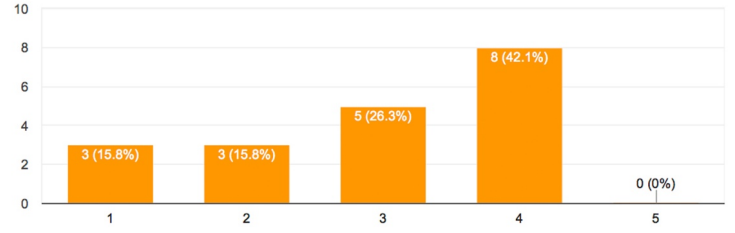
3.13 Do you strictly follow the safety signs or safety symbols?

19 responses



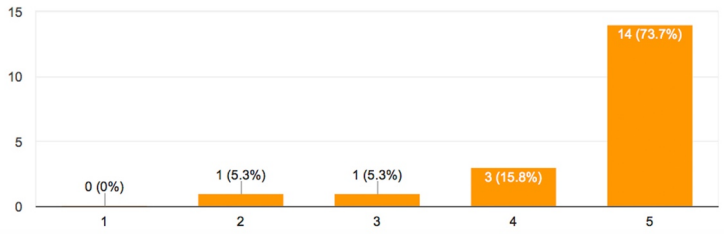
3.14 Do you take a shortcut to complete the task on time?

19 responses



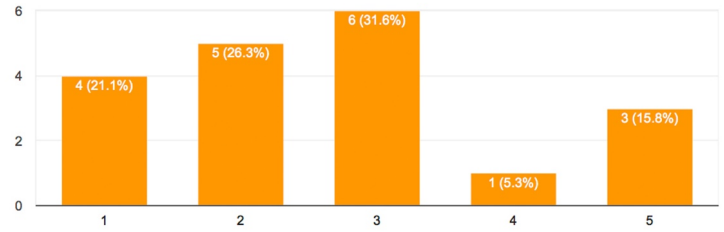
3.15 When you find an accident or something that might be dangerous. Do you notify the supervisor immediately?

19 responses



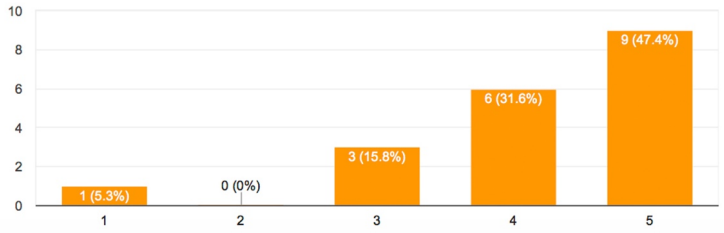
3.16 Do you remove the cover or protective device from the machine for easy operation?

19 responses



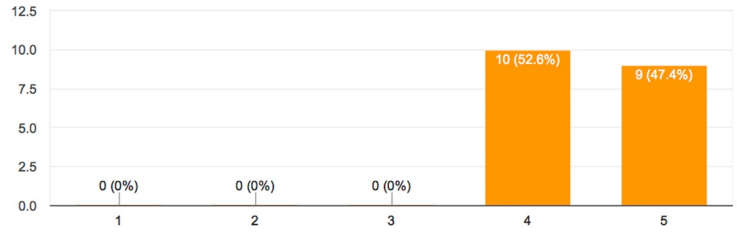
3.17 Do you remind your colleagues about the importance of safety practices?

19 responses



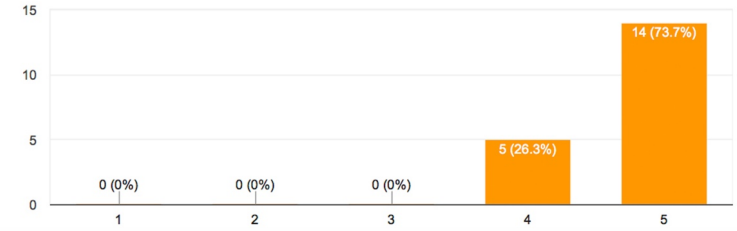
3.18 Do you observe the operation of tools, machinery and equipment that work normally or not?

19 responses



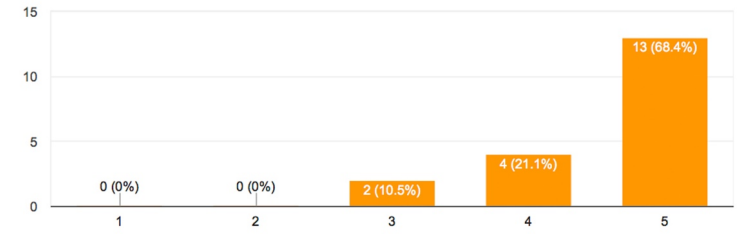
3.19 Do you keep the equipment in place after use?

19 responses



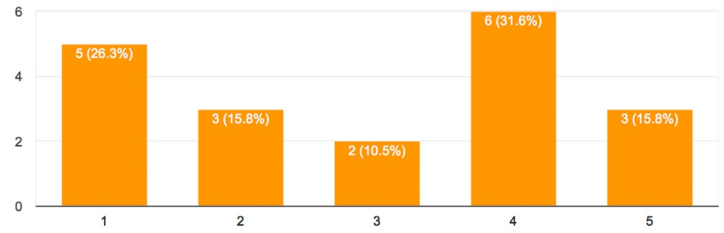
3.20 Do you follow the safety news from the company noticed board or announcement?

19 responses



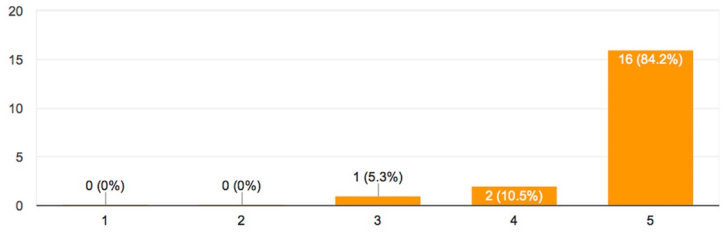
3.21 While you are working, you always think about issues that give a cause for concern, such as family problems.

19 responses



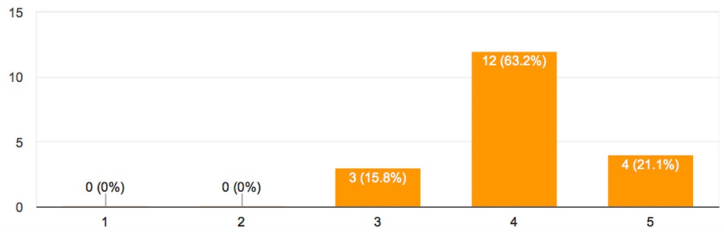
3.22 Do you participate in activities to promote safety at workplace that the company held?

19 responses



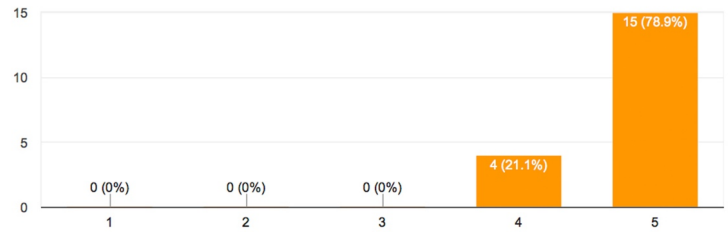
3.23 Do you keep the workplace area clean?

19 responses



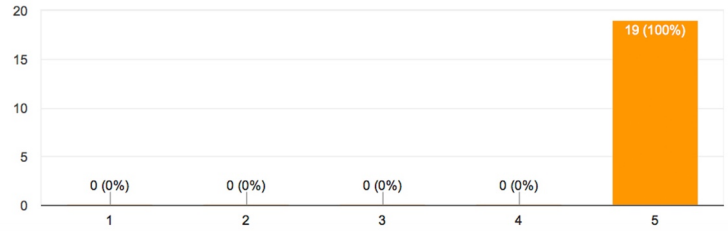
3.24 Do you use the safety knowledge gained from the training in practice?

19 responses



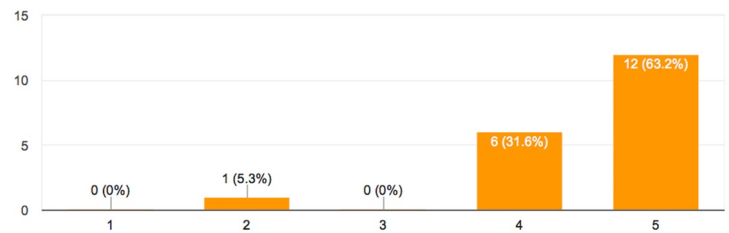
3.25 When you operate and find that the machine is defective or malfunctioning, will you stop working immediately.

19 responses



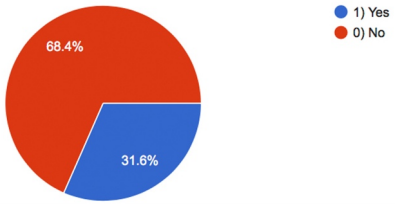
3.26 Do you wear PPE while working in the construction site?

19 responses



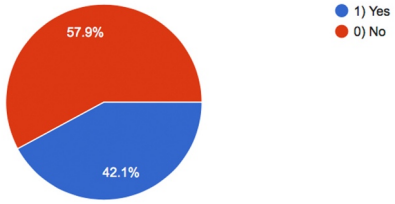
3.27 Have you ever been injured or experienced in an accident from not wearing PPE?

19 responses

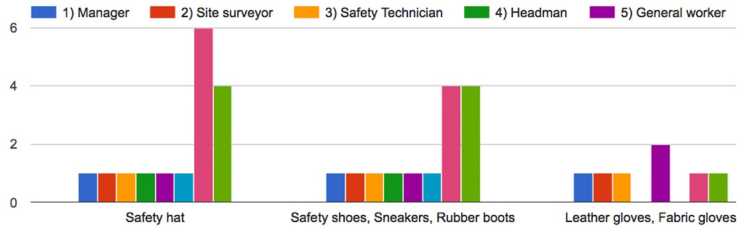


3.28 In your company, have any of your colleagues, friends or co-workers ever been injured or experienced in an accident from not wearing PPE?

19 responses



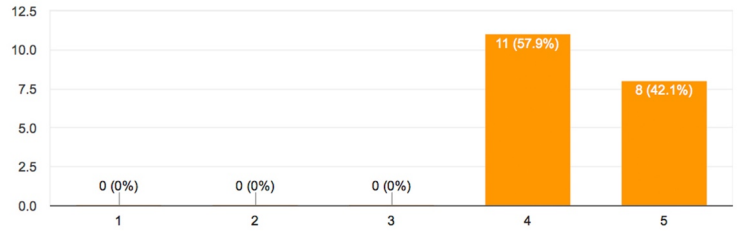
3.29 If you think of personal protective equipment (PPE), what items do you think of? (Please specify as many as possible)



4. Questions about the current safety system

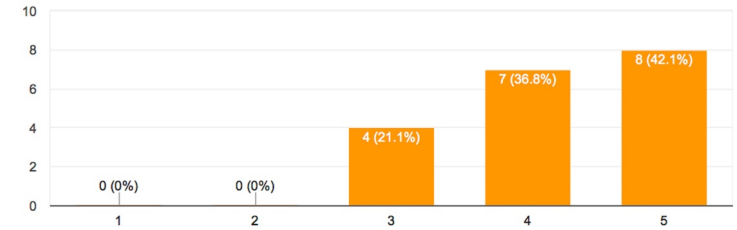
4.1 What do you think of the strictness of company's current safety system?

19 responses



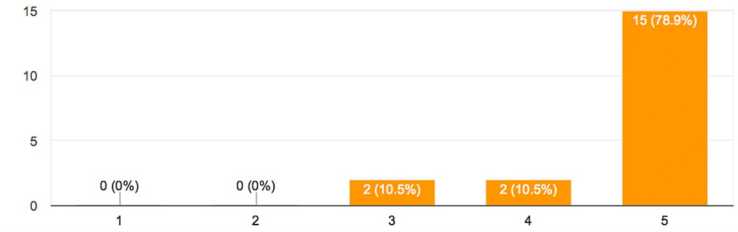
4.2 Are you satisfied with your current quality of life?

19 responses



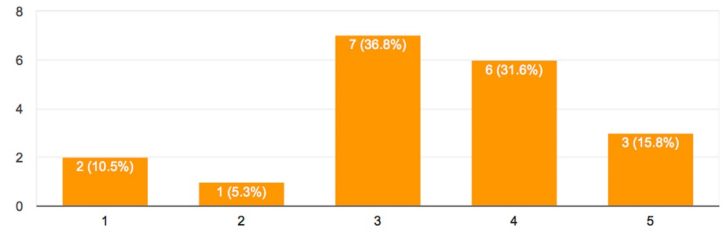
4.3 Are you satisfied with the current safety system?

19 responses



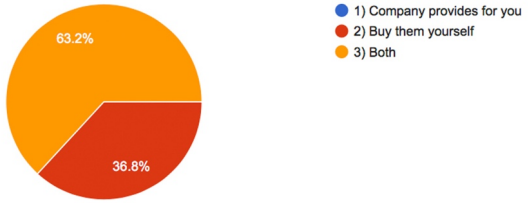
4.4 Do you think you have enough personal protective equipment?

19 responses



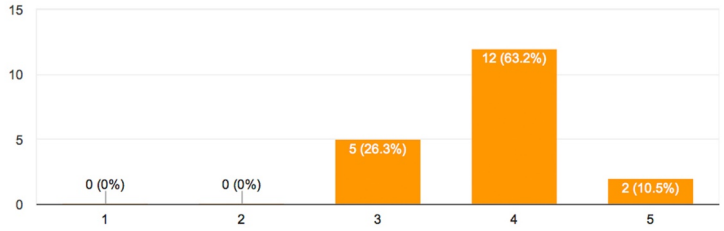
4.5 The PPE you are using today. Does the company provide for you or Do you buy them yourself?

19 responses



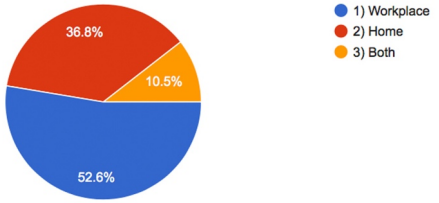
4.6 What do you think of the quality of personal protective equipment you are using today?

19 responses



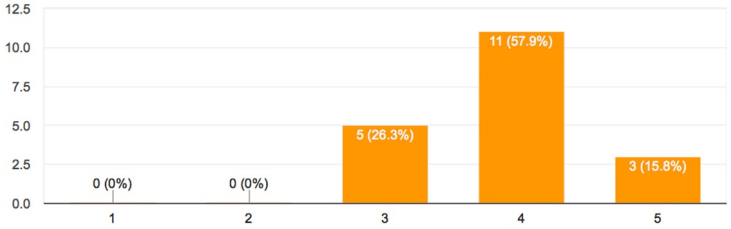
4.7 After using personal protective equipment, where do you store your equipment?

19 responses



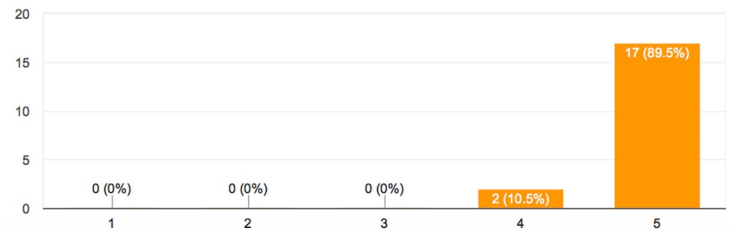
4.8 What is your perspective or attitude towards personal protective equipment?

19 responses



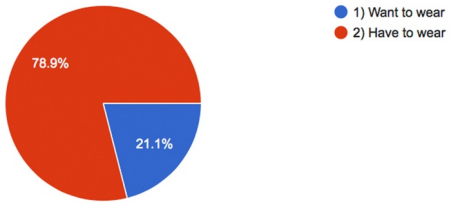
4.9 Do you think personal protective equipment is important to your life?

19 responses



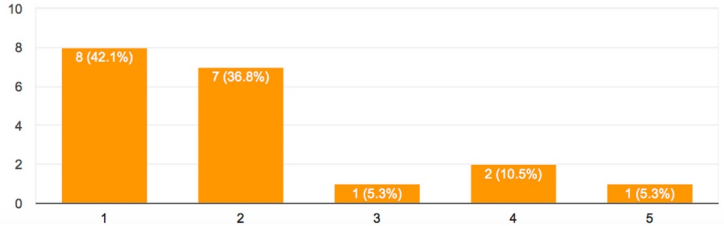
4.10 Do you feel "I want to wear" or "I have to wear" personal protective equipment? E.g. I want to wear it because I have it or I have to wear it because of the company's rules.

19 responses



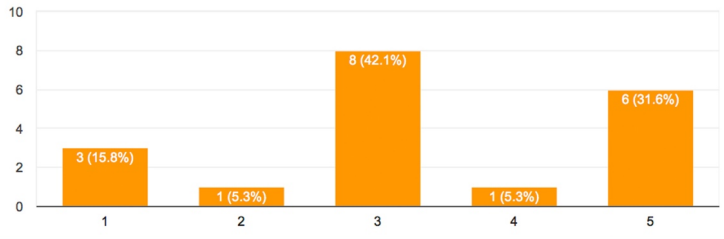
4.11 Have you ever received a compliment from wearing personal protective equipment or following the safety procedures correctly before?

19 responses



4.12 Are you proud to be honored for wearing personal protective equipment?

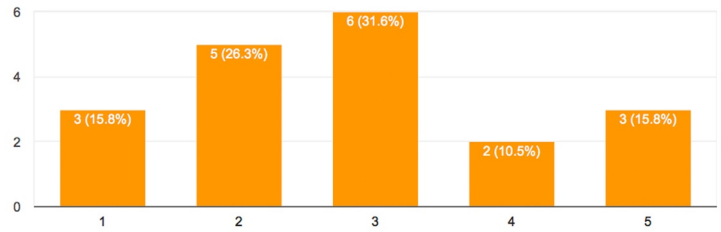
19 responses



5. Questions about the proposed safety system

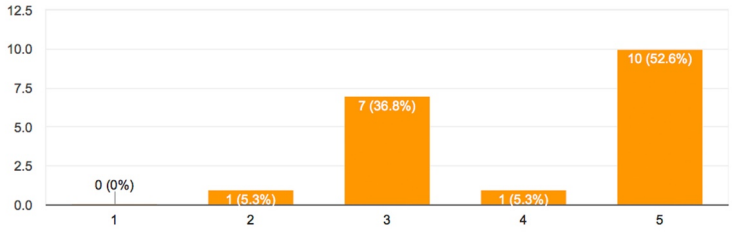
5.1 What do you think of the strictness of proposed safety system?

19 responses



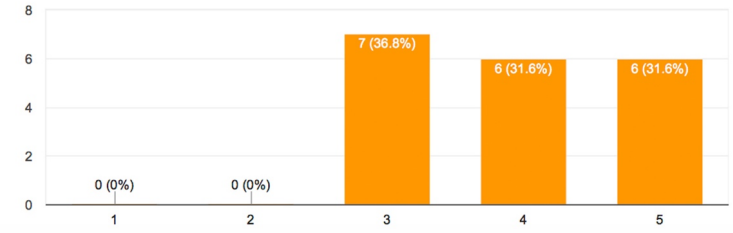
5.2 If the proposed safety system is implemented in reality, will you be satisfied with your quality of life?

19 responses



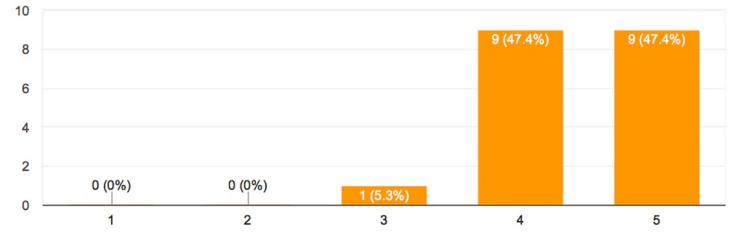
5.3 Are you satisfied with the proposed safety system?

19 responses



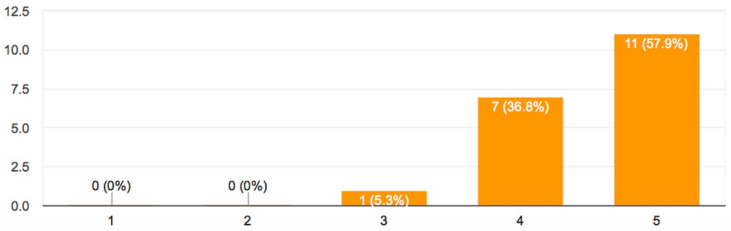
5.4 What do you think of the quality of personal protective equipment you have seen today ?

19 responses



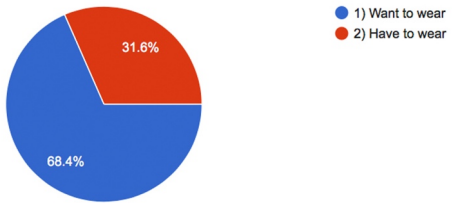
5.5 After seeing and trying on the personal protective equipment offered here. What is your perspective or attitude towards personal protective equipment?

19 responses



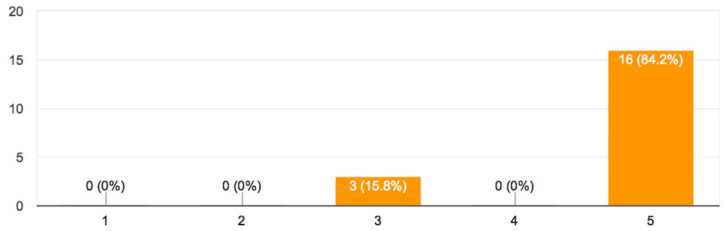
5.6 If the proposed safety system is implemented in reality, will you feel "I want to wear" or "I have to wear" personal protective equipment after listening to the proposed safety system?

19 responses



5.7 If the proposed safety system is implemented in reality, will you proud to be honored for wearing personal protective equipment?

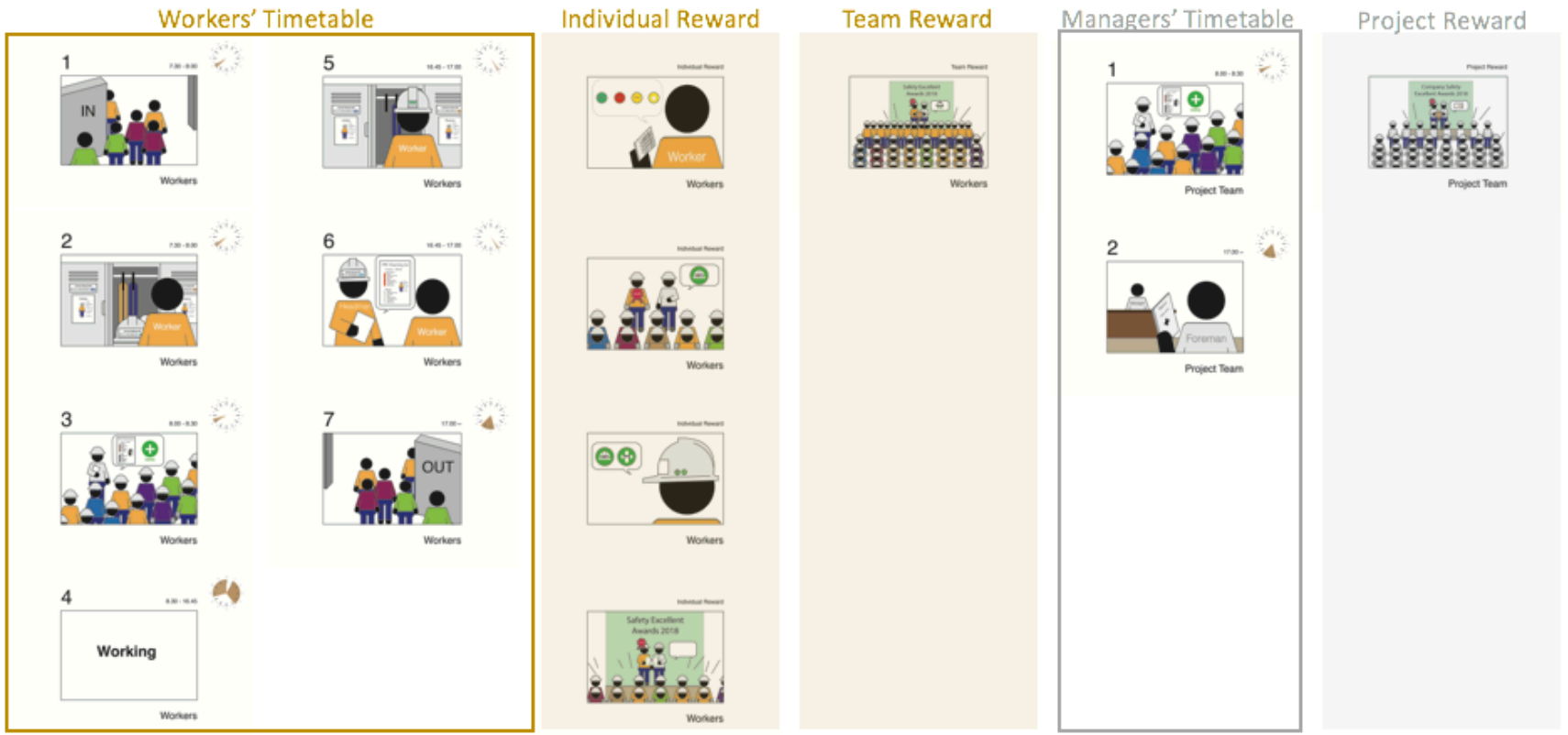
19 responses



Appendix C

Storyboard

Storyboard


Workers' Timetable
Individual Reward
Team Reward
Managers' Timetable
Project Reward
1
IN
Workers
2
Worker
Workers
3
Workers
4
Working
Workers
5
Worker
Workers
6
Worker
Workers
7
OUT
Workers
Worker
Workers
Workers
Safety Excellent Awards 2018
Workers
Workers
1
Project Team
2
Foreman
Project Team
Project Team