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# *Safety Knowledge-Attitude-Behaviour (KAB) among Manufacturing Workers in Malaysia: A Proposed Research of Designing and Developing an Intervention Module.*

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ABSTRACT

Workplace accident has become a prominent issue in Malaysia this decade with the number of reported accident cases have recently shown a gradual upturn. Safety behaviour is found to be the leading cause of workplace accident, and previous researchers have found that safety knowledge and safety attitude are among the significant predictors of safety behaviour. Therefore, this paper proposes a design and development research (DDR) to produce a valid, reliable, and tested intervention module fostering safety behaviour through improving workplace safety knowledge, and also safety attitude of manufacturing workers. In terms of methodology, a DDR needs to undergo three phases, namely Phase 1 (analysis of need), Phase 2 (module design & develop), and Phase 3 (usability evaluation). In Phase 1, this paper proposes a cross-sectional study using a questionnaire to determine the relationship between safety "KAB". For Phase 2, the Nominal Group Technique (NGT) is proposed for the process of content validity. Lastly in Phase 3, a quasi-experimental design with a control group is suggested in evaluating the effectiveness of the module. This research proposal will provide an initial reference for researchers to conduct applied research for workplace accident's solution. Besides, it could also initiate the relevant authority agencies as well as the management of manufacturing companies to design and develop a valid and reliable module for workplace safety intervention.



## 1 INTRODUCTION

Workplace safety has become an important issue around the world recently. Based on the report published by the International Labour Organisation (ILO), 2.4 million occupational fatality and work-related illness cases occur each

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year across the globe. Besides, more than 330 million non-fatal accidents have been recorded (ILO, 2012). Accident at the workplace may result in adverse impacts, including the fatality of workers to the involving organisation (Zakaria et al., 2012). Moreover, the involved organisations need to bear extra costs in terms of compensations, productivity lost, as well as prosecution fees (Subramanian et al.,2016).

Workplace accidents occur due to many reasons. However, since the 1940s, it has been concluded that 88% of the industrial accidents caused by unsafe behaviour (Heinrich,1941). Besides, other researches have also found that human factor namely, unsafe behaviour is the main predictor of workplace accidents, alongside with engineering factor, technological factor, failure of work system and unsafe working environment (Bowonder,1987; Gyekye,2010).

Researchers in Malaysia have found a similar result. For example, Zakaria et al. (2012) concluded that individual factors, namely personal condition (stress & fatigue), and unsafe acts are the leading causes of accidents in Malaysia manufacturing companies, besides hazardous workplace's condition. On the other hands, Adinegara et al. (2013) revealed that the leading causes of workplace injuries in Malaysia (years 2002-2006) are unsafe conditions namely being struck by moving objects (33%), falling from height (19%), and trapped between objects (17%).

This fact is incongruent with Ayob et al.,(2018) who determined that "falling from height", and "struck by objects" are the substantial factors of workplace accidents in Malaysia. Moreover, Ayob et al. disclosed that the underlying factors towards such accidents are human factors namely lacking in supervision, less adherence to safe work technique, failure to wear personal protective equipment; and failure to comply with the safety procedures while using tools, vehicles, or machinery.

As safety behaviour becomes the leading cause of industrial accidents, previous scholars had intensively determined its factors. As a result, "safety climate"(i.e., Lu & Tsai,2008; Clarke,2006), "management safety practices" (i..e., Vinodkumar & Bhasi, 2010), "management safety commitment" (i.e., Zohar, 1980; O' Toole, 2002), "safety training" (Mashi et al., 2016) and "organisational safety climate" (Sadullah & Kanten, 2009) were found to significantly affected the safety behaviour.

On the other hand, individual factor was found to influence safety behaviour of Malaysian workers besides site condition, workgroup, contractor, supervision, project management, organisation, and society (Haroun et al.,2016). Meanwhile, some researchers have determined that the role of safety leadership among the superiors influence safety behaviour (Lu & Yang, 2010; Khdair et al., 2011; Clarke, 2013; Cooper, 2015; Mullen et al., 2011; Wu et al.,2008).

Beside all safety behaviour's predictors explained above, safety knowledge was also found to influence safety behaviour (Griffin & Neal, 2000; Vinodkumar & Bhasi, 2010; Christian et al.,2009). In terms of safety knowledge, Beus, McCord and Zohar (2016) have recently synthesised based on substantive empirical support that safety knowledge is one of the individual-level factors that affect safety behaviour. On the other hand, safety attitude is also another factor to influence safety behaviour. Additionally, Clarke (2006) found in her study that workers' safety attitude was significantly predicted their unsafe behaviours. Monazzam and Soltanzadeh (2009) classified that in general, unsafe behaviour committed in workplaces is the result of either unsafe attitudes or a poor safety outlook based on previous pieces of literature (Elkind, 1993; Mearns and Flin,1995; Cheyne et al.,1999).

Manufacturing is one of the most hazardous workplaces in Malaysia. Since decades, it becomes the sector that contributes the highest number of accidents at the workplace (DOSH 2009-2012). Sarok and Susil (2012) conducted a study in a Japanese electronic factory in Sarawak and found that the workers are mainly exposed to physical hazards namely mechanical (moving objects), ergonomic (manual handling and working with awkward position), noise, and chemical hazards.

This fact is supported by Zakaria et al. (2012) who conducted a study in a manufacturing company in Malaysia and found that the most common causes of workplace accidents are the hazardous nature of works as well as individual factor namely unsafe behaviour. As manufacturing is the most hazardous workplace in Malaysia, occupational safety hazards and the associated risks should be seriously addressed to reduce accidents.

Identifying hazards in the workplace is the main element of occupational safety and health management. Section 15, Occupational Safety and Health Act (OSHA) 1994 stipulated that an employer must ensure, so far as is practicable, the safety, health and welfare at work of all his employees; including to make arrangements for ensuring safety and health of the workers in terms of hazards in connection with their works (DOSH, 2006).

Despite the employer's responsibility in conducting hazard identification, risk assessment and risk control, it is proposed that the employees should also have the knowledge on work-related hazards as well as the associated risks' control. This fact is in line with Bahn (2012) who stated that proactive identification of hazards in the workplace fortifies all occupational health and safety practices.

Managers, as well as employees, need to identify hazards the associated risks to assure their safety at the workplace. Furthermore, Zhang et al. (2011) believed that research on identification and control of direct, initial hazard and risk anticipation is important to prevent accidents. Moreover, Zhang et al. affirmed that comprehending of hazards at workplaces could reduce the chances of accidents.

Despite the empirical evidence on the influence of safety knowledge and safety attitude towards safety behaviour, research determining the relationship between these variables within the Malaysia setting is hard to be found. Furthermore, there are limited resources of practical module fostering safety behaviour among workers in increasing their knowledge and attitude towards workplace hazards and risks.

Therefore, this paper aims to propose a design and development research –DDR (Richey & Klein, 2014) which an intervention module is suggested to be developed for increasing the safety

knowledge-attitude-behaviour of manufacturing workers in Malaysia.

The contents of the intervention module should focus more on the knowledge of hazard identification and ways to control the associated risk in order to prevent accidents. On the other hand, the module should be designed to promote the right attitude towards risks so that safety behaviour of manufacturing workers is increased and cultivated.

## 2 LITERATURE REVIEW

### Statistics of Workplace Accident in Malaysia

When the Occupational Safety and Health Act 1994 (OSHA 1994) was firstly enacted, the rate of the industrial accident in Malaysia was as high as 18 per 1000 workers (Maimunah Aminuddin,2013). Subsequently, it has declined to 11/1000 workers in 1999 and continued to decrease in recent years.

However, the total accident cases show an increasing trend again in the recent five years based on statistics reported by the Social Security Organisation (SOCSO 2011, 2013, 2014, 2015 and 2016). According to the annual report of Department of Occupational Safety and Health (DOSH) Malaysia, total workplace accident cases in Malaysia have started to bounce upward since 2015 whereas the total fatalities continue to increase since 2012 (DOSH, 2017). Figure 1 illustrated the total fatality accident cases reported to DOSH from 2010 until 2016.

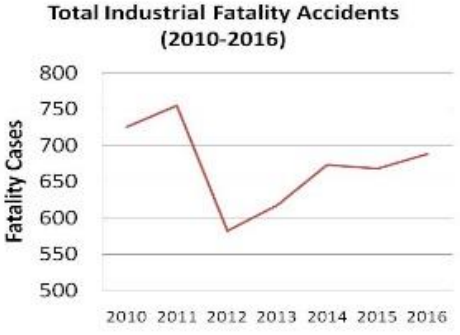


Figure 1: Total Industrial Fatality Accident (DOSH, 2017)

Hui-Nee (2014) has conducted a review on industrial accident in Malaysia. The review stated that the rate seemed to become plateau since the year 2009. From 2009, the total reported work-related accident started to increase gradually until 2013 (SOCSO,2010-2014). According to sectors of industry, manufacturing contributes to the highest of total workplace accidents.

Based on the reported statistics, the increasing numbers of accidents and fatalities provide adequate evidence for the present study to conclude that industrial accidents are a big issue for this country. Therefore, the significant cause of accidents, precisely safety behaviour; must be seriously addressed, and prompt interventions to reduce the number of accidents need to be taken by the authority.

### Relationship between Safety Knowledge, Safety Attitude and Safety Behaviour

A work from Zohar (1980) proposed that safety knowledge in terms of the perceived level of risk at work could influence an individual's behaviour towards safety. On the other hand, Mearns and Flin (1995) stated that safety knowledge of how individuals perceive hazards, how they perceive the control of those hazards and how individuals share and communicate information about hazards. In terms of workplace accident prevention, previous scholars have distinguished that there is a relationship between safety knowledge and safety behaviour (Vinodkumar & Bhasi, 2010; Murphy, 2008; Champbell et al., 2003; Griffin & Neal, 2000; Neal et al., 2000).

In detail, Griffin and Neal (2000) conducted two researches separately studying the effect of safety climate on safety behaviour. The studies were conducted on manufacturing and mining organisations, where Study 1 consisted of 1,403 employees of several manufacturing and mining organisations located in Australia. The results indicated that safety knowledge partially mediates the relationship between safety climate (represented by variables namely "management values", "safety inspections", "personnel training & safety communication") and safety compliance behaviour.

Meanwhile, Study 2 consisted of 381 employees in several Australian manufacturing organisations, and the results revealed that safety knowledge partially mediates the relationship between safety climate and safety compliance behaviour as well as safety participation behaviour. Besides, the study also revealed that safety knowledge in terms of understanding the way to perform the job safely and skill to comply with safety procedures could reduce workplace accidents.

Additionally, Kao et al. (2019) determined that workers' safety knowledge has predicted safety behaviour in the power industry in the southern US. Moreover, it is also revealed that workers' safety attitude directly influenced safety behaviour. Besides Kao et al., other work of literature also found that attitude could influence one's behaviour as well as reaction (Haynes et al., 2011).

Moreover, previous scholars have also proposed that oneself belief, attitude and ethics attitude, and personal responsibility are the internal factors which could influence human behaviour (Jatinder Pal Singh,2016; Rahman,2016). Moreover, attitude, alongside with environmental concern, intention, cognition, awareness and knowledge are socio-psychological factors which have been found to influence the environmental behaviour of people (Mei et al.,2017).

In occupational safety and health area, unwillingness to follow SOP and wear PPE is counted as the forms of safety attitude issues among workers that lead to poor safety performance (De Silva & De Silva,2015). Research from Muhammad Safizal Abdullah et al. (2016) which was conducted in a manufacturing service industry in Northern Malaysia involving 196 workers revealed that safety behaviour was significantly influenced by the employee's safety attitude and subjective norms. Subsequently, Bavani Sugumaran et al. (2017) conducted a

study among manufacturing workers in Perak, Malaysia.

Based on the data collected among 383 respondents, the results determined that safety attitude have a significant positive relationship with compliance safety behaviour (CSB), besides "management support and safety rules & procedures". Moreover, regression analysis result indicated that safety attitude had the most decisive influence on CSB based on β-value (0.482).

In addition, negative safety attitude is also found to be the cause of unsafe act among the workers, besides lack of safety knowledge and skills as well as the unconducive working environment (Gharibi et al.,2016; Stranks 2007). Besides, a work from Clarke (2006) investigated and determined the influence of work environment, job communication and safety attitude on accidents as well as unsafe behaviour in an automobile manufacturing plant in the UK.

Perceptions of work-safety environment had important effects as a significant predictor of both accidents and safety behaviour. A work of Zafir Khan Mohamed Makhbul and Maran Kaliannan (2019) has also proposed a framework that safety attitude among workers could influence safety behaviour in terms of safety compliance and safety participation.

Based on the review of these works of literature, it could be specified that safety knowledge could influence safety behaviour. Besides, it is also proven that safety attitude could also give impact on safety behaviour at the workplace.

**Safety Intervention and Safety Behaviour**

Safety intervention programmes could improve workers' safety behaviour. Thus, Mohammad and Hadikusumo (2017) advocated that recent safety management should be tailored to increase behavioural safety performance. Thus, safety interventions for nowadays should aim to change unsafe acts into safety behaviour.

For this purpose, Mohammad et al. proposed a multi-level integrated safety intervention model, which is divided into three levels, namely "management safety intervention", "technical safety intervention" and "human safety intervention". For "human safety intervention", the items include behavioural based safety (BBS), safety training, safety induction, safety campaign, safety monitoring, workplace inspections and also hazard/risk assessment. Moreover, this research hypothesised that human safety intervention could change human competence and knowledge; together with attitude and safety behaviour.

Besides, Es-Haghi and Parvin Sepehr (2017) conducted an intervention study to investigate the efficacy of managerial interventions based on Deming's model in reducing the rate of unsafe behaviours. The results showed the interventions were influential in decreasing unsafe behaviours (31%, P=0.006) among workers. The training module consists of occupational safety and health topics which mainly focus on identification of hazards and their implications towards safety and health, ergonomic, work-related accidents and diseases, fire safety, machine guarding, and the importance of personal protective equipment (PPE).

Furthermore, occupational safety and health (OSH) information intervention research was held by Syed Ismail et al., (2018). The research applied a quasi-experimental design conducted on the selected students from the health sciences program in Universiti Putra Malaysia. In the research, OSH related information was incorporated into a mobile application, and the respondents were requested to utilise the apps for two weeks.

The results indicated that respondents' safety knowledge, attitude, and practice had significantly increased as compared to before the intervention was conducted. Liu, Yang and Li (2016) similarly carried out a prospective experimental analysis involving three groups (behaviour intervention, education intervention, and control group).

The research was carried out in the maternity department of two hospitals. During their postnatal treatment, both intervention groups (behaviour & education) obtained a folded booklet on child passenger safety, a height chart, and a structured safety education. However, each of the behaviour intervention group members had been given an additional free child seat (CS) complete with the technical discharge installation instructions.

On the other hand, the control group members were only provided with a pamphlet without information pertaining to child passenger safety, a height chart, or given any education session about infant care. The results found a significant difference between the use of CSS for the three groups regarding the pre and post-intervention. However, the behaviour intervention group shows a significant increase in "drivers wearing seat belts" as compared to other groups. The research concluded that insufficient knowledge besides poor safety attitude made a significant contribution to the low usage of CSS among parents.

Based on these works of literature, it could be summarised that safety interventions are found to cause improvement in workers' safety knowledge, attitude as well as behaviour. Therefore, intervention modules which could increase workers' safety knowledge and attitude, specifically on workplace hazards are proposed by this paper to be developed for the manufacturing sector in Malaysia. Such modules are expected to improve safety behaviour among manufacturing workers.

For example, continuous training interventions focused on educating employees on the management of workplace hazards are recommended to improve understanding of a safe working culture as these factors can affect human attitude and behaviour towards minimising workplace accidents. (Sivaprakash & Sakthivel,2011). Furthermore, Koo et al. (2012) have also recommended the development of behaviour-based safety (BBS) interventions in an organisation to transform the unsafe act among young workers into safety behaviour.

For such intervention programmes, the module should be a person-based (knowledge and education) and behaviour-based (training and change of behaviour) module. Moreover, Koo et al. proposed quasi-experimental research with the non-equivalent control group as the research design to measure the effectiveness of the module.

**Design and Develop Research (DDR)**

According to Richey, Klein and Nelson (2004), the vague purposes of DDR are including the production of knowledge, understanding, and prediction. Furthermore, DDR is also regarded as a process to develop new methods, techniques and tools based on the analysis of specific needs. (Richey & Klein, 2007).

As proposed by Reeves (2020), DDR is divided into which is categorised into two dimensions. First, "commitment to theory construction and explanation", and second is "solving local problems". In the scope of research methodology, DDR combines pragmatic design and traditional research methods to answer research questions specifically.

Furthermore, Richey and Klein summarised that DDR is divided into two clusters, namely "product and tool research" and "model research". The advantage of the design-based research is that it allows the improvement of practices through systematic yet flexible methodology throughout the design, development and implementation of the product (Wang & Hannafin, 2005). Moreover, this type of research design is found appropriate in fulfilling the gap between academic research and real-world problems.

Richey & Klien (2007) state that using the DDR approach is very systematic, which involves the process of design and development and evaluation where it is based on empirical research. Several scholars affirmed that DDR approach is suitable for developing measurement tool, product, and process. For example, Hevner et al. (2004) and Ellis and Levy (2008) pointed out that the DDR approach can be used as a guideline to produce new instruments in solving the problem, to design and development of the new model in each field of study or to develop a method and new process in implementation model or existing equipment. In addition, it has also been clearly stated that DDR approach is not a product, but it is closely linked to research that is carried out to solve the problem, research that is carried out based on the literature and empirical study or research that is carried out to contribute to the body of knowledge.

**Related Theories**

The human factor model introduced by Ferrell described a linkage of accident causation with the attitude and behaviour of employees at the workplace (Heinrich et al., 1980). The human factor model comprised three major components that would lead an employee to commit errors.

The components are overload, inappropriate response, and inappropriate activity. Based on the model, poor attitude and lack of awareness regarding accident prevention at workplace may lead the employees to ignore the elimination of the potential hazards, and thus, over a period of time, the human error would happen which could cause an accident to occur. Petersen (2003), based on Ferrell's human factor model, had concluded that workers would decide to commit unsafe acts due to the pressure from peer or superior on productivity, his/her mental situation and perceived of low accident risks in their workplaces.

Besides Ferrell's human factor model, Theory of Planned Behaviour (TPB), introduced by Icek Ajzen 31 years ago has become one of the most frequently cited and influential models for human behaviour in terms of social (Ajzen,2011). Ajzen forwarded three key variables, namely "attitude toward behaviour", "subjective norms" and "perceived behavioural control", that become a decisive factor which would directly influence the intention to commit actual behaviour.

According to the influence of such three behaviours, the intention will influence the behaviour. "Attitude towards behaviour" refers to the positive or negative assessment of individual self-performance of the behaviour to be performed. Whilst, "subjective norms" is the individual's perception on the influence or pressure received from the significant parties (e.g. parents, families, communities, schools, employer, peers) toward a behaviour to be committed. Furthermore, "perceived behavioural control" is defined as the extent to which an individual feels he can perform the behaviour or the individual's perception of how easy or difficult for him/her to perform the behaviour.

TPB has been successfully applied in previous studies for predicting the performance of health-related behaviour (Conner & Armitage, 1998; Godin et al., 1992; De Wit et al., 2005; Godin et al., 2001). Despite safety behaviour has been revealed to be closely related to health behaviour of a person, the influence of the TPB on safety behaviour has received little attention (Goetsch,2005; Rundmo & Hale, 2003). A work from Xu et al. (2018) applied TPB to explain factors influencing unsafe behaviour. The research was conducted by establishing the relationship between attitude, subjective norms and perceived behavioural control, and intention towards safety behaviour.

The results found a direct relationship between attitude, subjective norms and perceived behavioural control in terms of safety, and intention towards safety behaviour. It was also found that the attitudinal ambience (i.e., wearing PPE could lengthen the work process, feeling unsafe at the worksite) mediates the relationship between the independent variables and intention towards safety behaviour. The research has also emphasised on the application of psychological theories to develop the leading factors towards safety behaviour. The research also proposed a more effective and human-oriented safety intervention should be designed and implemented to prevent safety violations behaviour.

Similarly, a multi-method exploratory research was conducted by Goh and Sa'don (2015), following the theory of planned behavior (TPB) to model the cognitive factors affecting the unsafe behavior of scaffolders.A cross-sectional study using questionnaire was conducted to 40 migrant workers from Bangladesh, India, and China, aiming to explore the cognitive factors influencing the unsafe behaviour of not anchoring a safety harness while working at height using scaffoldings. Based on the multiple regression results, "subjective norms" and "attitude" were the variables which significantly influenced the behaviour of the scaffolders. Moreover, based on a neural analysis performed, "subjective norms" gives 42% impact and

"attitude" incur 36% impact on scaffolders' unsafe behaviour. Meanwhile, "perceived behavioural control" gives only 22% impact on safety behaviour of the scaffolders.

In addition to those theories and model, this study proposes to apply the most popular model related to behaviour-based safety (BBS) which is the model of Antecedent – Behaviour-Consequence (ABC Theory) for its underpinning theory. "Antecedent" refers to a source or a condition triggers to cause an action of a person. "Behaviour" is defined as what people do or in a simple word is an "action" while "Consequences" is a result of the behaviour or action taken (Miltenberger 2008; Reid & Parsons, 2007).

For example, in a classroom, the teacher asked a student to come forward and solve several complicated mathematical questions. The student then solved the questions and finally got applause from all the other students in the classroom. In this situation, the teacher had triggered an antecedent to the behaviour of the selected student. Subsequently, getting applause from all of his/her friends was the positive impact related to his/her behaviour which was to solve a complicated series of mathematical questions.

This positive impact refers to "consequences". Incongruent with the ABC Theory, Mousavi et al. (2017) conducted a review on the antecedents of safety performance (safety behaviour and occupational accidents) and summarised that the antecedents of safety behaviour could be categorised into four dimensions which are working environment hazards (i.e.,– physical, chemical), task characteristics, workers characteristics (i.e., unsafe behaviour, safety knowledge), and organisational factors – (i.e., safety policy, communication).

**Summary of Literature Review**

To summarise, previous studies proved that workplace accidents are mainly caused by unsafe acts of workers who work in hazardous working conditions. Previous scholars also revealed that safety behaviour is influenced by safety knowledge regarding the risks that exist due to hazards found in the workplaces. Furthermore, workers' attitude towards safety is also found by previous researches, has influenced safety behaviour.

On the other hand, Nasab et al. (2009) also advocated that the management of an organisation should design and implement interventions specifically on managing workplace's hazards which could increase safety knowledge, attitude and behaviours. This is also similar to Clarke (2006), who suggested that safety interventions need to focus on how the workers could personally recognise the immediate working safety conditions and furthermore improve the safety procedures.

Intervention programmes focusing on managing workplace hazards are found to have the most direct influence on safety behaviour as well as workplace accidents. Therefore, this paper proposed the designing and developing an intervention module specifically to increase safety knowledge-attitude-behaviour among manufacturing workers in order to reduce workplace accident cases.

## 3 METHODOLOGY

**Research Design**

This research proposes a systematic research design involving the process of designing, developing and evaluating a specific purpose module renowned as "design and develop research (DDR)" (Richey & Klien, 2007). The research will consist of three phases, namely Phase 1, Phase 2 and Phase 3. The DDR phases are summarised in Table 1.

**Table 1**
Design and Development Research (DDR)

| Phase | Details | Methodology |
|---|---|---|
| Phase 1 (Analysis) | Analysis of Need | Literature review |
| | | Cross-sectional study |
| Phase 2 (Design & Develop) | Design the Module | Nominal Group Technique |
| | Develop the Module | Adaptation of Existing |
| Phase 3 (Implementation & Evaluation) | Implementation of Module | Quasi-Experimental with a control group |
| | Evaluation of Module | Pre and Post Test analysis |

**Phase 1 (Analysis)**

In the first phase, an analysis of need is proposed to determine the necessity of developing a specific intervention module. The need will be determined by measuring the workers' level of knowledge related to hazards identification and risk control as well as their attitude towards risks associated with the identified hazards. In addition, the level of safety behaviour among the workers will also be distinguished. The research instrument for measuring the variables is proposed to be adapted from previous researches (i.e., Vinodkumar & Bhasi, 2010; Griffin & Neal,2000; Sawhney, 2016; Subhash et al., 2016) and to be modified to suit the research context.

For the purpose of data analyses, descriptive analysis (i.e. mean and standard deviation) will be used to determine the level of safety knowledge-attitude-behaviour. Whilst, inferential analyses namely correlation and regression analysis, will be used to determine the relationship between safety knowledge, safety attitude and safety behaviour. The process of Phase 1 is summarised in Table 2.

**Table 2**
Phase 1: Analysis of Need

| Objective | Research Design | Research Instrument | Data Analysis | Population and Sample |
|---|---|---|---|---|
| a) to examine the level of safety knowledge-attitude-behaviour among manufacturing workers | Cross-sectional study | A self-administered questionnaire adapted from previous researches. Five Likert scale | Descriptive (mean and standard deviation) | Manufacturing production workers proportionate random sampling |
| b) to determine the relationship between safety knowledge, safety attitude and safety behaviour among manufacturing workers | Quantitative study | | Correlation and Regression | Sample size determined from Krejie and Morgan (1970) |

**Phase 2 (The Module Design & Development)**

The second phase (Phase 2) is the stage were the intervention module is supposed to be designed as well as developed. The contents of the module shall consist of elements that instil safety knowledge related to hazards identification and risks control among the workers in the manufacturing sectors. The contents of the module will also be designed to foster safety attitude, together with safety behaviour among manufacturing workers.

Thus, the contents are proposed to be adapted from Japan Zero Accident module named "Kiken Yochi (KY)". KY or "Hazard Prediction" is a practice of small group discussions between leaders and employees on hazards related to works that will help employees to identify types of accidents that may occur due to the hazards. Lastly, action plans for accident prevention would be mutually determined (Ji, 2014).

The practice of KY will result in the increase of workers' awareness of hazards that exist in their working environment and furthermore improve their problem-solving capabilities towards workplace safety issues (Chen & Jin,2012). Consequently, practising KY will benefit the organisation by reducing human errors and improving safety behaviour performances (JICOSH, 2013). Moreover, Noor Afifah et al. (2017) found that KY is able to impose a positive effect in reducing accident across different cultures, including Malaysia.

Therefore, contents of the modules should apply the basic principle of KY with some modifications which will enable it to be easily adapted to local working culture. Basically, the module is proposed to consist of five main chapters which are Chapter 1: Identifying the critical hazards/ at-risk behaviour, Chapter 2: Evaluating the consequences, Chapter 3: Determining the control measures, Chapter 4: Implementing the control / safe behaviour, and Chapter 5: Maintaining the safety behaviour.

The procedures of the second phase are as per summarised in Table 3.

**Table 3**
Phase 2: Design & Development

| Objective | Research Methodology | Research Instrument | Data Analysis | Sample |
|---|---|---|---|---|
| a) to distinguish the appropriate contents of the module | Nominal Group Technique | A self-administered questionnaire which is specifically developed and used for obtaining the experts' consensus on the usability and validity of the module's contents | Descriptive analysis (mean and standard deviation) will be used to determine experts' consensus | 15 of OSH experts (Nurahimah Mohd Yusoff & Muhammad Nidzam Yaakob, 2016) |
| b) to evaluate the reliability, validity and usability of the developed module | Perry and Linsley (2006) | | | |

**Phase 3 (Evaluation)**

For the implementation (testing) and evaluation of the intervention module, this paper proposed a quasi-experimental research (with a control group) design for the third phase of the research. The design seems to be the most suitable as this research will be conducted within the manufacturing setting where the researcher owns less control of the implementation of the intervention (Campbell & Stanley,1963).

Before the intervention, observations of safety behaviour and unsafe behaviour for each sample will be conducted as "pre-test" to determine the baseline of safety behaviour among the experiment group and control group samples. The level of safety behaviour among the samples will be determined using Safety Behaviour Index (Chen & Tian, 2012). Subsequently, an intervention programme using the module developed in the second phase of the research will be imposed on the experimental group within three (3) months. After the intervention would take place, the observations of safe and unsafe behaviour will be repeated on the experiment as well as the control group. The second observation would be considered as the "post-test". For sampling method, this paper proposes that the production workers from statistically high accident manufacturing companies are included both in the experimental and controlled group. Furthermore, the sample size will be determined using two proportion formula (Lwanga and Lemeshow,1991). The summary of the research's Phase 3 procedures is depicted in Table 4.

**Table 4**
Phase 3: Implementation and Evaluation

| Objective | Research Methodology | Research Instrument | Data Analysis | Sampling and Sample Size |
|---|---|---|---|---|
| a) to implement the prototype intervention module for safety knowledge-attitude-behaviour<br>b) to examine the efficacy of the developed intervention module in increasing safety knowledge-attitude-behaviour among the manufacturing workers | Quasi-experiment with a control group with pre-test and post-test | Safety Behaviour Index (Chen & Tian, 2012)<br>SI=100[N2/(N1+N2)]%,<br>N2: observed times of safety behaviour;<br>N1: observed times of unsafe behaviour;<br>N1+N2: total times of observed behaviour. | Descriptive analysis (mean and standard deviation)<br>Inferential analyses (i.e. T-test and ANOVA ) | For sample size calculation, two proportion formula;<br>$n = \{ Z_{1-\alpha/2}\sqrt{2P(1-P)} + Z_{\beta}\sqrt{P_1(1-P_1) + P_2(1-P_2)}\}^2/(P_1-P_2)^2$<br>(Lwanga and Lemeshow,1991)<br>n = sample size<br>$Z_{1-\alpha/2}$ = Z statistic for level of confidence interval on 95% = 1.96<br>$Z_{\beta}$ = Z statistic for 80% power = 0.842<br>$P_1$ = Prevalence rate for safety behaviour for experimental group of behaviour-based safety intervention.<br>$P_2$ = Prevalence rate for safety compliance behaviour for a control group of behaviour-based safety intervention. |

For this phase, the effectiveness of the module will be measured by statistical analysis, namely "paired sample t-test" and "independent sample t-test". The developed module will be determined as effective if a significant difference in terms of Safety Behaviour Index is found between the pre-tests and post-tests results of the experimental group. In addition, the developed module will be deemed as effective if a significant difference in terms of safety Behaviour Index between the experimental and controlled group of the post-tests results is found.

## 4 EXPECTED RESULTS

This paper is a proposal of a DDR research. Thus, the data analysis is not being performed. However, it is expected to produce results as per depicted in Table 5.

Table 5 Expected Results of Research

| Phase of DDR | Description |
|---|---|
| Phase 1 (Analysis) | Low or moderate level of safety behaviour<br>There is a significant positive relationship between safety knowledge and safety attitude with safety behaviour<br>Safety knowledge and safety attitude has a significant influence on safety behaviour |
| Phase 2 (Design and Develop) | An intervention module consists of five chapters is designed and developed<br>The chapters are:<br>Chapter 1: Identifying the critical hazards/ at-risk behaviour Chapter 2: Evaluating the consequences<br>Chapter 3: Determining the control measures<br>Chapter 4: Implementing the control / safe behaviour<br>Chapter 5: Maintaining safety behaviour |
| Phase 3 (Implement and Evaluate) | There is a statistically significant difference of SBI between experimental group and control group<br>There is a statistically significant difference between the pre-test results and post-test results of the experimental group. |

## 5 DISCUSSION

Workplace accidents have become a recent problem in industrialisation world (Biggs et al.,2005). Moreover, industrial accident cases in Malaysia has shown the increasing trend since 2009. In recent years, Malaysia has decided to push its economic and industrial development robustly. This scenario has brought in more significant challenges to occupational safety and health area especially to the DOSH as this phenomenon has brought a broader range of hazardous conditions and material which could increase of the industrial accident rates.

Practically, it is opined that the traditional approaches, namely enforcement and engineering control, could not be sufficient to solve workplace accident problems. Nor Azimah Chew Abdullah et al. (2010) advocated that a comprehensive programme that focuses on inculcating safety culture at the workplaces could be the best method to prevent accidents at workplaces. Theoretically, previous researchers have found that safety knowledge and safety attitude could predict safety behaviours among workers.

Furthermore, safety behaviour is found to be the most significant predictor of workplace accidents. Several previous researchers are found to conduct intervention research to increase safety behaviour among workers as it is proven that safety behaviour could reduce accident. This matched with the research framework proposed by Mohamad et al. (2017) where safety intervention at management, technical and personal level could improve safety behaviour at workplaces. Moreover, the research proposed that safety risk identification and analysis is one of the personal level safety intervention elements that could be positively related to safety behaviour.

This paper objective is to propose a DDR research to increase safety KAB among workers in highly accident manufacturing plants in Malaysia by developing a specific intervention module. Additionally, the paper proposes the development of the intervention module, focusing on hazards identification and self-evaluation.

A design and development research (DDR) is proposed by this paper to analyse the need of intervention module, design and develop the specific module, and to implement and evaluate the module. The design of the research (DDR) is proposed due to its rigorous method in developing a specific tool or model in solving a practical problem. Similarly, Norlidah Alias et al. (2013) stated that DDR is a research technique which emphasises on comprehensive research process about any field involving analysis of context and situation.

## CONCLUSION

The result of this study would become the empirical evidence in determining the effectiveness of the developed intervention module. Moreover, this study also will be the preliminary reference for the government in formulating effective strategy, specifically in increasing safety behaviour among manufacturing workers and therefore to decrease industrial accidents within the manufacturing sector. The intervention module could be one of the references for the Department of Occupational Safety and Health in developing module or guideline of safety behaviour practices in Malaysia's manufacturing sectors.

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