

# STRATEGY TO DISSEMINATE OCCUPATIONAL SAFETY AND HEALTH INFORMATION TO FORESTRY WORKERS: THE FELLING SAFETY GAME

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**YOVI EY & YAMADA Y. 2015. Strategy to disseminate occupational safety and health information to forestry workers: The Felling Safety Game.** Participatory occupational safety and health (OSH) protection is an effective strategy to produce safe and healthy forestry work operation. Commitment and active participation of participants are among the key success of participatory OSH. However, most Indonesian forestry workers are ignorant of participatory OSH protection due to insufficient knowledge of potential hazard identification and risk control, working techniques and procedures, and management of work organisation. This research was aimed at developing an OSH learning instrument called The Felling Safety Game which is expected to be applicable to forestry workers globally. A prototype of the game was designed for felling supervisors working in Indonesian long rotation plantation forests applying manual/motor–manual forest operation system. Supervisors were chosen as the main target of this game considering the fact that they retained control and authority on worker groups. The contents of the game were chosen based on direct observation of felling operations and in-depth interviews with key informants. Pre- and post-tests conducted during the game trial showed that the respondents' knowledge of OSH protection significantly increased, indicating an effective application of learning instruments in a broader scale.

Keywords: OSH protection, participatory, safety education, forest operation, felling supervisor

## INTRODUCTION

Manual or motor–manual methods dominate activities of forestry works in Indonesia (Yovi 2009, Yamada et al. 2013). Such activities require rigorous physical workload (Yovi et al. 2006) and are considered dangerous with high accident risks (Wang et al. 2003). Occupational safety and health (OSH) protection in forestry works is thus paramount.

OSH protection efforts can be done through both administrative and technical approaches. In Indonesia, the administrative approach has been done through the publishing of various regulations, for example Regulation of the Minister of Manpower, Transmigration and Cooperative of Indonesian Republic Number 1 Year 1978 on Occupational Safety and Health in Felling and Log Transportation. However, these regulations are generally not well enforced in the field, and as a result, up till this day there are many felling practices which do not comply with these regulations. The technical approach can be done through implementing standard operating procedures (SOP). This approach

requires active involvement of workers and this is referred to as participatory OSH (Knave & Ennals 2001). Participatory OSH protection is considered as an effective strategy for the safety and health of workers. In participatory OSH, workers are given opportunity to fully participate in OSH management through effective social dialogues or OSH arrangement bargaining (ILO 2011).

Although participatory OSH is very important in OSH protection, its implementation has not been fully applicable in the forestry sector in Indonesia. Insufficient basic knowledge of OSH among workers is probably responsible for the recent condition (Gardner et al. 1999, Thelin 2002, Champoux & Brun 2003, Yovi 2009, Yovi et al. 2012, Yamada et al. 2013). Insufficient knowledge and information finally lead to inhibition of the behavioural changing process (Yovi et al. 2012), which in turn will result in incompetent workers and in the end put workers at risk of severe work accidents and health disorders because they are negligent of the

risks, uninformed of self-protection activities and have a tendency for manifesting risk acceptance (Gardner et al. 1999, Axley 2008).

To date, training is considered as a major approach in implementing OSH protection programme in Indonesia. Despite the fact that training has been successfully used as a behavioural mechanism to enhance attitudes (Grau et al. 2002) and skill in the work place, training does not guarantee success of behavioral change (Grau et al. 2002) and decline of accident rates (Bell & Grushecky 2006). It should be noted that dissemination of OSH-related information through training programme requires considerable cost and time, which burden workers since they are mostly self-employed. Therefore, a proper strategy to disseminate OSH information is required. This study, therefore, was aimed at proposing a strategy to disseminate OSH information to forestry workers using safety game.

Games for educational purposes have been widely known. A game may relieve boredom in the learning process (Harris 1968) and is capable of introducing the element of fun that results in suitable learning environment (Charlton et al. 2005). Furthermore, Charlton et al. (2005) mentioned that educational games showed positive impact on improving the performance of students with learning disabilities. A game must fulfil the following requirements: (1) accommodate the framework of safe place, safe person and safe system (Makin & Winder 2008), (2) ensure that all participants are involved in the learning process (Knaue & Ennals 2001) and (3) is enjoyable and interesting (Charlton et al. 2005). Furthermore, the game should be simple, inexpensive and involve a more personal association through the approach that leads to increased safety behaviour and safety culture (Lund & Aarø 2004) in view of worker characteristics, i.e. having simple mind set and limited financial aspect (Champoux & Brun 2003).

## MATERIALS AND METHOD

A series of work was carried out. It started with (1) problem mapping of OSH protection and formulation of OSH issues and (2) the safety game designing including trial result analysis. The observed respondents were felling

supervisors, and chainsaw operators and forestry university students.

## The formulation of OSH issues

The problem-mapping endeavour of OSH protection in felling was carried out through several field observations in Java Island, Indonesia. The study was conducted in 2009 in four forest districts, namely, Madiun (East Java Province), Cianjur, Ciamis and Bogor (all three are located in West Java Province). All districts applied the motor–manual forest operation system and dealt with long rotation plantation forests, and relationship-oriented culture was embedded in most of the frontline worker groups.

We focused this research on felling by using chainsaw. This activity was chosen considering that chainsaw is the most common machine used in tree harvesting operations in most countries (Yamada et al. 2013). However, chainsaw is well-known as the cause of most fatalities in forest-work accidents (Thelin 2002). On the other hand, chainsaw is a very effective felling tool with working productivity of up to 2.08 m<sup>3</sup> hour<sup>-1</sup> (Yovi et al. 2006).

The findings were then evaluated based on OSH guidelines and standard felling techniques adopted from various research results, international guidelines and national regulations. Assessment was done qualitatively by ranking: very good (if respondents' knowledge was > 80% of the standard knowledge), good (if respondents fulfilled only 60–80% of the standard knowledge), poor (if respondents only fulfilled 40–60% of the standard knowledge), very poor (if respondents only fulfilled 20–40% of the standard knowledge), and extremely poor (if respondents only fulfilled < 20% of the standard knowledge). The standard of the evaluation was referred from the following international guidelines and national regulations:

- (1) International Labour Organization Code of Practice Occupational Health and Safety at Forest Work, 1998.
- (2) Indonesian Republic Act Number 1 of 1970 on Occupational Safety.
- (3) Indonesian Republic Act Number 13 Year 2003 on Manpower.
- (4) Regulation of the Minister of Manpower,

Transmigration and Cooperative of Indonesian Republic Number 1 Year 1978 on Occupational Safety and Health in Felling and Log Transportation.

- (5) Indonesian Government Regulation Number 50 Year 2012 on the Application of OSH Management System.

The output of the evaluation was selected checkpoints in which felling practices should be given improvement priority, i.e. the points where the safety game content was emphasised.

### **Design and trial of the safety game**

The safety game was developed between March and June 2012. The prototype of the game ‘The Felling Safety Game: Supervisor’ was intended for felling supervisors because their managerial skill is required to ensure the accomplishment of OSH protection activities in the field. The first prototype was tested twice on forestry university students and felling supervisors. The first trial was conducted on 84 third year forestry students in September 2012. No OSH guideline book for felling was provided during the game. The second trial was conducted in November 2012 on 30 felling supervisors from 24 forest districts on Java Island with well prepared OSH guideline book for felling. In both trials, the safety game was played for 1.5 hours (effective), i.e. equivalent to one game cycle. The game was played by five players in each group, four players playing the role of felling supervisors and one player playing the role of the OSH agency. The OSH agency acted as the referee who was not only responsible for managing transactions but also responsible for leading discussions that possibly expanded during the game. The OSH for felling guideline book that was composed in accordance with the game content was used as reference during the game. The guideline enables player groups to thoroughly discuss a topic of interest, thus their knowledge will develop and finally they will be capable of avoiding accidents in actual work situations (Reilly et al. 1995). Therefore, all players were expected to obtain correct and appropriate OSH information.

The effectiveness of the game in disseminating OSH knowledge in tree-felling was assessed based on pre- and post-test comparisons. Respondents

were pre-tested before being involved in the safety game. The test consisted of 64 questions derived from 24 main issues that had been formulated (Table 1). The test was in the form of an essay test which used questions with standard solutions (1–10 scale). The change of knowledge level in the tests was analysed using t-test. Validity and reliability tests were carried out on the data used in the process of analysis. In addition, all respondents were asked to provide their opinion on the effectiveness of the safety game as an instrument of learning (1–10 satisfaction scale). Later, some improvements on ‘The Felling Safety Game’: Supervisor’ were made based on the trial results.

## **RESULTS AND DISCUSSION**

### **Formulation of OSH issues**

Most felling supervisors and chainsaw operators were found to have poor basic knowledge of OSH, mainly with regard to work-related health disorders (including heat stroke) and work accidents. These were indicated by the fact that most of them were incapable of distinguishing between occupational accidents and health disorders caused by work. There were evidences of poor knowledge on working places definition, the reasons why OSH protection was important, the benefits of implementing OSH and risk management. Risk management is a new concept to respondents. As a result, they consider OSH protection as a cost centre (Hasle & Limborg 2006) despite the fact that safety management increases the economic–financial performance (Muñiz et al. 2009).

Most of the workers did not comprehend the concept of risk and hazard. The knowledge of both groups of respondents on the scope of their duty and responsibilities in OSH protection activities was extremely poor. Supervisors tended to consider their responsibility in OSH protection effort limited to providing personal protective equipment (safety helmets, safety shoes and gloves) and giving stipend when accidents occurred. Most of them also declared that providing SOP was not one of their main responsibilities. Musculoskeletal disorders, the most common health problems in felling activity, which might cause chronic pain (Niu 2010) were regarded as minor health problems.

**Table 1** The 24 safety issues and their contents in felling operation that need to be addressed, knowledge level and distribution among the eight categories of cards of The Felling Safety Game

No.	Safety issue	Content	Knowledge level	Distribution of each topic in each category of the cards*							
1	Occupational disease	Definition	Poor	1	2	3	4	5	6	7	8
2	Risk	Definition	Poor			1					
3	Sources of hazard	Definition	Poor			1					
4	Working place	Definition	Poor			1					
5	Occupational accident	Definition; classification of accidents	Poor			1					
6	The reasons why OSH protection is important	Safety and health as human right; economics impact of OSH protection; law compliance	Poor	1	1						
7	The benefits of implementing OSH	Advantages for workers; increase work productivity; advantages for employer; good work relationship; competitive advantages; positive image for company	Poor	1	1						
8	Risk management	Hazard identification; risk evaluation; monitoring/audit	Poor	1	1			1	1		
9	Felling hung-up tree	Safe-treatment of hang-up trees	Poor	1			1	1	1		
10	Felling technique	Conventional cut: felling notch and felling cut; the importance of hinge	Poor	1	1		1	1	1		
11	Chainsaw maintenance	The importance of regular (daily and periodic) maintenance; tasks that should be carried out	Poor		1	1	2		1		
12	Escape route and emergency procedure	The importance of evacuation route; determining evacuation route; emergency procedure	Poor				1	1	1	1	1
13	Other important things	Nutrition; workload; communications; the importance of commitment on OSH protection; rewards and penalties	Poor	5							
14	Kind of occupational diseases	Hearing impairment; respiratory system disorders; nerve system disorders; msds; heat stroke	Poor			2	2		2		
15	Heat stroke	What is heat stroke; symptom of heat stroke; first aid for heat stroke; discomfort index	Poor	2	2	1				1	1
16	Safety features on chainsaw	Safety features of chainsaw	Poor		2		2	2	2		
17	Working in uphill side	The importance of good planning; stand on the uphill side of the log; cross-cutting on sloping ground; warning	Poor			2	2		2	2	2
18	Operating chainsaw	Pre-start checks; cutting techniques; safe operating techniques	Very poor			7				3	3
19	Felling preparation	Tree base clearing for secure footing; evacuation route; persons allowed to be in work area	Very poor			4	2		2	4	3

(continued)

Table 1 (continued)

No.	Safety issue	Content	Knowledge level	Distribution of each topic in each category of the cards*						
20	Unsafe human acts	Wearing personal protective clothing and equipment; applying proper working techniques; proper working posture; team work and communications	Very poor	2	2	5			3	4
21	Aid-tool	The importance of using aid-tools; aid-tools that should be available; the use of cant hook/breaking bar	Very poor	4	4		2	1	2	2
22	Parts of body to be protected and personal protective equipment	Parts of body to be protected; personal protective clothing and equipment normally appropriate	Very poor	3	5		3	3	3	
23	Knowledge on the scope of duty and responsibilities in OSH protection activities	OSH information dissemination; caring safety of all team member; using and maintenance of personal protective equipments; reporting dangerous situation; first aid	Extremely poor			9			6	6
24	Unsafe working condition	Hazards (unwanted felling direction; dead branches and twigs; over-large logs; poisonous animal and plant; uneven/muddy/slippery forest floor; roots/rocks/other obstacles; sharp tree stumps left behind from undergrowth-clearing activities; high temperature and humidity; rain & strong winds; sun exposure; noise; vibration; gas emission)	Extremely poor	4	4	1	6	4	6	

\*1 = knowledge, 2 = question, 3 = information, 4 = OSH action, 5 = audit, 6 = incident, 7 = good work, 8 = careless; OSH = occupational safety and health

In the area of felling techniques, chainsaw operators did not have proper felling skills. Cutting with a chainsaw above shoulder height was common, especially when facing hung-up tree cases. Another common technique in taking down hung-up trees was directly felling the holding tree. Field observations showed that chainsaw operators tended to perform careless chainsaw operations such as performing cross-cutting without considering the areas under compression and tension, not switching off the chainsaw when placing it on the ground, leaving the chainsaw on when moving to a fresh tree and filling up the fuel tank while smoking. These actions were clearly violations of safe operating practices.

Observations revealed careless practices while working in uphill sides. Although most

supervisors and chainsaw operators agreed that tree-felling was an exhausting job due to the heavy workload (Yovi et al. 2006), they considered felling of small-diameter trees (20–30 cm) with a large-type chainsaw and long blade as the best practice. In most sites, felling, cross-cutting and de-branching were carried out using 90-cm chainsaw blade, with gross weight ranging from 12 to 13 kg. They had poor knowledge on aid tools during felling. There were no cant hook seen in any of the felling sites even though cant hooks could assist in moving logs and bringing down hung-up trees. The respondents were unable to explain the shape and functions of a cant hook.

Their knowledge of maintenance issues was very poor. They considered regular chainsaw maintenance as an over-rated task. Unsuitable

spare-part use was very common and they saw nothing wrong with it. It was common to find chainsaws with very minimum safety devices. For example, the front handle guard, an important safety feature of the chainsaw to protect the left hand of chainsaw operators in kick back situations, was considered a hindrance and was deliberately removed. They ignored the fact that removing the hand guard would deactivate the chain brake.

In addition, workers' knowledge of the types of personal protective clothing and equipment was very poor. Only helmets and shoes were used regularly. However, shoes used were those with soles lacking grips and were made of thin plastic. The shoe design was clearly unsuitable for felling activities. They mentioned at least six reasons: (1) they felt awkward when wearing the clothing and equipment, (2) inconvenience due to inappropriate design, (3) they did not own any, (4) the equipment was broken and substitute was unaffordable and (5) it was not mandatory to use the clothing and safety equipment; in all observation sites, felling supervisor still allowed chainsaw operators to work although they were not wearing personal protection equipment and (6) workers considered that they were not at such risk.

Workers' knowledge of escape routes was lacking. None of the workers gave the same explanation on SOP in emergency situations. In addition, it was obvious that clearing the base of a tree from obstacles was frequently ignored. The most frequent excuse for this negligence was 'not being ordered to'. Furthermore, the presence of persons that were not related to tree-felling in the work area was also ignored by chainsaw operators and felling supervisors.

Several dangerous work behaviours were recorded: (1) not wearing personal protective clothing and equipment, (2) working using improper techniques, (3) practising bad work organisation, (4) removing chainsaw safety devices or modifying chainsaws illegally, (5) having improper working postures such as performing one-hand operations, (6) having bad work coordination and ineffective communication (effective communication is indispensable for OSH protection, Blair 2004), and the most common was (7) ignoring fatigue that could occur rapidly due to a combination

of physical workload and heat stress (Yoopat et al. 2002). Most of the chainsaw operators were paid based on total number of logs cut. They continued working even though they were exhausted in order to reach higher production targets even though they understood that fatigue might result in loss of control. These are very dangerous conducts because these situations increase the level of risk (Gardner et al. 1999, Wang et al. 2003, Niu 2010).

The conditions that are in dire need of attention are workers' knowledge on the scope of duty and responsibilities in OSH protection activities and occupational hazard sources which are classified as extremely poor. Workers tend to believe that occupational accidents are God's will, happen naturally by chance and having no patterns in their occurrence. They performed very bad OSH information dissemination, tended to ignore the safety of other team members, had little understanding of the use and maintenance of personal protective equipment, hardly ever reported dangerous situation and had extremely poor knowledge in first aid. Furthermore, they tended to be negligent of the various conditions found at their work place which could potentially become hazard sources. They merely identified trees leaning in unwanted directions, rain, strong winds and venomous animals such as snakes as sources of hazard. They considered dead branches and twigs, over-large logs, poisonous plants, uneven/muddy/slippery forest floors, roots/rocks/other obstacles, sharp tree stumps left behind from undergrowth-clearing activities, high temperatures (up to 32 °C) combined with high humidity (up to 90%, Yovi et al. 2006), sun exposure and emissions–noise–vibrations produced by chainsaws as a normal part of their working conditions although these were potential sources of hazard for them.

### **Designing 'The Felling Safety Game: Supervisor'**

Felling supervisors are one of the key factors in the implementation of OSH protection (Kines et al. 2013). With wider range of authority, a supervisor (line manager), especially in relationship-oriented culture, is potentially capable of being an agent of change by advising workers to avoid practising less safe/healthy works (Hsu & Lee

2012). A supervisor's insufficient knowledge and ineffective enforcement of OSH regulations is, therefore, responsible for poor OSH protection in felling activities (Motamedzade et al. 2003). Furthermore, supervisor's low compliance to safety regulations caused workers to decrease their standard of safety and health at work.

The safety game prototype was aimed as a medium for dissemination of OSH information to felling supervisors or those at the same level. The game, which was designed as a board game would provide them with appropriate knowledge of OSH protection in accordance with characteristics of their duties in felling operations. The game is inexpensive, straightforward and achievable by everyone at any time and any place. It also retains suitable contents for a specific target. It is enjoyable and interesting. In addition, different from conventional training, the dissemination process of OSH information can be repeated many times without additional cost.

Twenty-four topics related to OSH protection on felling operations were identified and used as a basis for determining the safety game contents (Table 1). These topics were printed on cards and classified into eight categories: Knowledge, Question, Information, OSH Action, Inspection, Incident, Good Practice and Careless Practice. The number of the cards for each topic was determined based on the level of knowledge. Safety issues which had 'poor' level of knowledge were raised 1–10 times and those categorised as 'very poor' were raised 11–20 times. Topics in the 'extremely poor' category would have the largest chance of turning up (> 21 times). For example, the topic 'potential hazards in the working place' was raised in these categories: Knowledge (4 times), Question (4 times), Information (1 time), OSH Action (6 times), Inspection (4 times) and Incident (6 times).

The eight categories were used to make the correction of the existing workers' misconceptions easier. For example misconception that OSH protection possibly demands additional expenses means that OSH protection should not be considered as priority, the counter strategy for this misconception is well accommodated in the form of Knowledge, Information and OSH Action cards. Players must pay a certain amount to buy Knowledge or to implement an OSH Action and will receive incentives if he/she spreads

the contents of the Information card to other players. The game also gives an opportunity to players to understand that the cost spent for the three cards is essentially required to prevent higher costs when problems (represented by Question cards) and accident/health problems (represented by Incident cards) occur (Rzepecki 2012) or in the case of an audit/inspection by external parties (represented by Inspection cards). There are also Good Practice and Careless Practice cards which are intended to promote the knowledge improvement process—an important requirement in behaviour change—and to impart positive perception of the effort of OSH protection in felling operation. The concept of information sharing is applied in the game as well. Once they hold Information, Good Practice and Careless Practice cards, players are required to read the card out loud so that the other players acquire the same information too. Rewards given to players are in the form of good-shape OSH trophies to promote the players' sense of pride in their active role in promoting OSH protection by playing the game. On the other hand, penalties/fines are given in the form of bad-shape OSH trophies to enforce the feeling that the results achieved are unsatisfactory.

To play the game, players need to prepare the safety game board, dice, markers (one marker per player), cards and an OSH guideline book. The safety game ends when all players pass the finish line. The winner is the player with the most good-shape OSH trophies.

### **Trial of The Safety Game**

Respondents in the first trial were university students who already got five chapters of lectures on forest operation. Validity test results of a subjective test indicated that 62 out of 64 questions were valid (significance value of > 0.05). All 62 questions were reliable with Cronbach's alpha value of 0.979 (> 0.8). The paired t-test result showed no significant difference between the pre- and post-tests. The increase was only 6% (from 6.5 to 6.9) at the p-value (0.000) <  $\alpha$  (0.05). Respondents stated that the safety game was quite effective (scoring 6 out of a scale of 1–10), but they also complained about lack of a guideline book. The lack of a guideline book was the reason why they were unable to develop their discussions;

even when there was an indication that OSH disinformation occurred, players were hesitant in answering the same questions in the post-test. In the post-test, 9.52% of the respondents were able to give better answers compared with their pre-test. In contrast, another 5.95% gave worse answers in their post-test. The remaining 84.52% gave similar answers for both the pre- and post-tests.

The second trial was carried out with felling supervisors who played the game using the OSH guideline book as the main reference during discussions. A short OSH explanation (4 hours) was given prior the game. Quite the opposite happened from the previous test conducted on forestry students (who had no OSH guideline book). Good result was indicated on the paired t-test, as the test result significantly increased from an average of 6.2 to 7.7 at p-value  $(0.000) < \alpha (0.05)$ . This was 24% increase of respondent's knowledge. These results suggested a very promising accomplishment of knowledge development considering that the trial of 'The Felling Safety Game: Supervisor' prototype was carried out for only 1.5 hours (one cycle) of play.

Respondents in the second trial claimed that the safety game was very beneficial in increasing their OSH knowledge. Furthermore, the game was considered enjoyable and interesting, thus playing the game was not tiresome. They also said that the availability of the OSH guideline book was very useful in guiding their discussions, providing them with accurate OSH information. All respondents agreed that they were willing to play the game again. They tended to consider that their knowledge would improve the more they play the game. The effectiveness of the safety game in disseminating OSH information was scored 8 (on a scale of 1–10) by the respondents.

Overall, it can be said that the 'The Felling Safety Game: Supervisor' was an effective instrument in disseminating OSH information. It is very accommodating and can be played any time even without the presence of an OSH expert. However, some modifications should be carried out to the game prototype, i.e. using shorter and simple sentences for the safety game cards or using more illustration in the guideline book. Moreover, the basic idea of the game could be effortlessly adopted in other specific forest operations. Nevertheless, depending on the target and type of forest works, improvement is

required to ensure that the game will provide significant impact on OSH protection.

In future, a group of workers may require only a set of the affordable safety game and its benefit can be felt in the long term. Quite the opposite of enrolling in a training/workshop, using the game, workers do not have to spend their effective working hours and pay a large amount of money to gain additional OSH information. Therefore, the game is very advantageous considering that time and cost are the greatest obstacles for workers in improving their knowledge (Champoux & Brun 2003). Due to technical characteristics of forestry workers and the effectiveness of the game in disseminating OSH information, the application of the safety game as an alternative for training deserves thorough consideration.

## CONCLUSIONS

The insufficient knowledge of most forestry workers in Indonesia has caused poor implementation of participatory OSH protection. Limited access to OSH information and the unaffordable cost of training were among the main causes of insufficient knowledge. Therefore, an alternative strategy for disseminating OSH knowledge is paramount. The newly developed learning instrument method named 'The Felling Safety Game: Supervisor' met the requirements. The game is inexpensive, straightforward and achievable by everyone, anytime and anywhere. The game also contains suitable contents for a specific target, and is both enjoyable and interesting. At present, the game is designed to OSH knowledge of felling supervisors involved in manual/motor-manual tree-harvesting systems. The safety game trials significantly increased the knowledge level of respondents and the game was found highly acceptable by felling supervisors as a learning instrument. The basic idea of the game could be effortlessly adopted in other specific forest operations.

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