

Safety Protocols for Construction Workers in Hebei Jintao Security Equipment Technology Co.

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Abstract—The construction industry has an accident rate higher than the average of all industries due to the industry's poor performance in occupational safety and health. Hebei Jintao Security Equipment Technology Co. (Hebei Jintao) is a construction firm located in Hebei province of China. In 2018, Hebei Jintao suffered the loss of a construction worker due to falling from a ladder. The company has since then focused on increasing the safety of its employees. This study focuses on the level of implementation of the safety protocols of the company to determine the current state of safety for targeted improvement. To determine the level of implementation a questionnaire was adapted and modified from K. Sai Dines , while data from supervisors and foremen were gathered using an interview. The data was then analyzed using a 4-point Likert Scale. Data showed that the level of implementation for safety protocols that concerned the 5 most common causes of accidents in the construction in Hebei Jintao ranged from high to very high. It could be concluded that the managers of Hebei Jintao view expenditure as one of the major difficulties in the implementation of safety protocols in the worksite. Alongside this, obsolete equipment, safety awareness of workers, and the unavailability of a proper garbage disposal schedule are the other difficulties that the managers of Hebei Jintao face.

Index Items—Hebei Jintao, safety protocols, construction workers, protective equipment

I. INTRODUCTION

The International Labor Office [1] reports that 2.3 million workers succumb to work-related accidents or diseases every year. This represents over 6000 deaths every single day with construction being a major cause of death and disabilities. The International Labor Office claims that through their findings in their latest statistical data, the construction industry has a disproportionately high rate of recorded accidents.

OSHA [2] has released standards and guidelines intending to reduce constructed related deaths and injuries. OSHA released 5 hazards that workers in construction face which are: falls, trench collapse, scaffold collapse, electric shock and arc flash/arc blast, and failure to use proper personal protective equipment.

Yun Feng [3] found that In China, five of the world's most fatal work safety accidents in the past 2001-2010 where construction-related

Hebei Jintao Security Equipment Technology Co. is a construction company that focuses on structural development. Founded in 2011, Hebei Jintao is located in Shijiazhuang, the capital city of Hebei Province in the north of China. In 2018, Hebei Jintao has suffered a loss of a construction worker due to falling from a ladder and having a bad fall. The company has suffered numerous setbacks after the death of its worker. The company has since had to pay a penalty of approximately 220 thousand RMB and suffered a great loss in its reputation. Hebei Jintao had fewer contracts due to the accident. Since then, Hebei Jintao has focused more resources in occupational health and safety of its workers. In their projects in 2019, Hebei Jintao has allotted 3.5% of its total budget for occupational health and safety .5% higher than the standard 3%. This budget includes insurance premiums for the workers, medical expenses, compensation payments, equipment repair and replacement.

The study aims to determine the level of implementation of the safety protocols of construction workers of Hebei Jintao Security Equipment Technology Co as well as the problems encountered by the supervisors/foremen of Hebei Jintao Security Equipment Technology Co.

II. METHODOLOGY

This research utilized a descriptive-quantitative method to determine the level of implementation of safety protocols for Hebei Jintao Security Equipment Technology Co. This method was used to determine the level of implementation of safety protocols from both the managers and construction workers of Hebei Jintao. The safety protocols focused on concerns the 5 most common causes of accidents in the construction industry which are namely: falls, trench collapse, scaffold collapse, electrical-related accidents, and personal protective equipment-related accidents.

Slovin's formula was used to determine the sample size for the study. the questionnaire and interview were used as the primary sources of data gathering. The questionnaire used in the study was adapted and modified from K. Sai Dinesh. The questionnaire was used for the construction workers while the interview was made for the managers/engineers. The questionnaire contains 32 questions adapted from the hazards presented by OSHA and based on K. Sai Dinesh [4]. The last 4 questions come from K. Sai Dinesh which asks questions based on

management cooperation. The answers were measured using a 4-point Likert scale. There are 17 main interview questions and 3 optional interview questions depending on the answers.

The 4-point Likert Scale and its interpretation were used to interpret the results of the data to be gathered. Table I shows the statistical range and interpretation used.

TABLE I. STATISTICAL RANGES AND INTERPRETATION

Scale	Statistical Range	Description	Interpretation
4	3.26-4.00	Always	The level of implementation is very high. Protocols are present at all times.
3	2.51-3.25	Often	The level of implementation is high. Protocols are present most of the time.
2	1.76-2.50	Seldom	The level of implementation is low. Protocols are not often present.
1	1.00-1.75	Never	The level of implementation is very low. Protocols are rarely or never present.

III. RESULTS

The tables below show an overview of the findings obtained. The analysis was done by getting the weighted arithmetic mean and cross-referencing it to Table I for interpretation.

A. Fall Safety

TABLE II. FALL SAFETY PROTOCOLS IMPLEMENTATION

Indicators	Weighted Mean	Interpretation
Aerial lifts or elevated platforms are available.	3.39	The level of implementation is very high.
Guardrail systems with toeboards and warning lines are available.	3.33	The level of implementation is very high.
Safety Net System is available.	2.52	The level of implementation is high.
Overall Average Weighted Mean	2.99	The level of implementation is high.

Being one of the major causes of occupational accidents in China according to the Safety and Health in Construction Convention on 1988 (no. 167) fall protection safety protocols are a priority for any construction company. Table II shows that the implementation of the fall protection safety protocols in Hebei Jintao, according to the construction workers, is high. This high level of implementation states that protocols are present and implemented most of the time. This leaves room for improvement since the company is

looking to implement these safety protocols all the time. It can be seen from Table II that the overall average weighted mean declined due to the score in the availability of a safety net system. According to the workers, safety net systems are only used when working in proximity of major roads, as well as having the safety net system used as a form of debris protection rather than that of a human one. The highest level of implementation is under the availability of aerial lifts or elevated platforms. These mechanical platforms that provide safe access to most inaccessible areas due to height are readily available for use by the workers.

B. Trench Collapse

TABLE III. TRENCH COLLAPSE SAFETY PROTOCOLS IMPLEMENTATION

Indicators	Weighted Mean	Interpretation
Ladders, stairway, exits, ramp for trenches are available.	2.92	The level of implementation is high.
Floor holes are covered	2.7	The level of implementation is high.
The protective system for trenches 20 feet deep or greater is available.	2.69	The level of implementation is high.
Entering an unprotected trench is prohibited.	2.5	The level of implementation is low.
Trenches are inspected before and after any hazard-increasing event such as a rainstorm	2.36	The level of implementation is low.
Overall Average Weighted Mean	2.63	The level of implementation is high.

Trench collapse is one of the five most common causes of construction work-related injuries. From the data gathered it can be seen that the level of implementation for the safety protocols regarding trench collapse protection is high with an overall average weighted mean of 2.63, meaning that it is implemented most of the time. The lowest score of 2.36 was obtained by trenches being inspected before and after any hazard-increasing events. These hazard-increasing events include rainstorms which are the most common cause of trench damage or instability. According to the Hebei Jintao, it lacks the competent manpower to be able to check the occurrence of hazard-increasing events. It does not have dedicated personnel that handles the checking of projections regarding hazard-increasing events. The highest score of 2.92 was obtained by the availability of ladders, stairways, exits, and ramps for trenches. This shows a high implementation with room for improvement, this is due to the number of equipment available. According to Hebei Jintao's workers, the number of ladders, stairways, and ramps is limited. An increase in the number of pieces of equipment would result in a higher level of implementation. Overall major

improvements can be made regarding scaffold collapse protection in Hebei Jintao with the lowest score being in the low level of implementation and the highest only being in the high level of implementation without a protocol being implemented at the very high level.

C. Scaffold Collapse

TABLE IV. SCAFFOLD COLLAPSE SAFETY PROTOCOLS IMPLEMENTATION

Indicators	Weighted Mean	Interpretation
A competent person supervises the creation, dismantling, alteration of the scaffold.	3.65	The level of implementation is very high.
Scaffolds are equipped with guardrails, mid-rails, and toeboards.	3.61	The level of implementation is very high.
Scaffolds are erected on solid ground	3.38	The level of implementation is very high.
Lifelines for height work are available	3.29	The level of implementation is very high.
Damaged accessories such as braces, brackets, trusses, screw legs, or ladders are replaced.	3.2	The level of implementation is high.
Unstable objects (barrels, boxes, concrete blocks) are not used to hold the scaffold	3.15	The level of implementation is high.
Scaffolds carry its weight times four the maximum intended load without settling or displacement	3.05	The level of implementation is high.
Safety belts are available.	3.0	The level of implementation is high.
Overall Average Weighted Mean	3.29	The level of implementation is very high.

Scaffold collapse protection protocols are highly related to fall protection which is the most common cause of construction worksite accidents worldwide. The data gathered shows that in Hebei Jintao the availability of safety belts is the lowest scoring safety protocol with a high level of implementation. This is related to the lacking equipment available to the workers especially when additional workers are hired to complete jobs that are close to the deadline. The highest scoring safety protocol with a very high level of implementation is having a competent person supervise the creation, alteration, and dismantling of the scaffolds. This is due to the dedicated manager in charge of overseeing the process. Overall, safety protocols regarding scaffold collapse protection has a very high level of implementation with little improvement needed to areas where there is a high level of implementation, especially regarding equipment maintenance and repair.

D. Electrical Safety

TABLE V. ELECTRICAL SAFETY PROTOCOLS IMPLEMENTATION

Indicators	Weighted Mean	Interpretation
Power is shut off when working on energized electrical circuits.	3.2	The level of implementation is high.
Damaged or worn electrical cords are replaced.	2.86	The level of implementation is high.
Extension cords have grounding prongs.	2.85	The level of implementation is high.
Multiple plug adapters are not used.	2.66	The level of implementation is high.
Electric tools are maintained and checked.	2.61	The level of implementation is high.
Overall Average Weighted Mean	2.84	The level of implementation is high.

Safety protocols regarding electrical protection in Hebei Jintao garnered an overall average weighted mean of 2.84 with a high level of implementation where not one safety protocol got a result of very high. The lowest scoring protocol is concerning the maintenance and checking of electrical tools. Hebei Jintao as a company, checks electrical tools every month as well as during incidents, according to the workers these checks are done mostly on time. The highest scoring protocol with a weighted mean of 3.2 is the shutting off the power when working on electrical circuits with a high level of implementation. This high-level implementation shows that there are still instances where power is not turned off when working with electrical circuits. According to the interviews with the managers, which is discussed in detail below, a major safety issue within the company is the lack of safety awareness of the workers. This lack of safety awareness leads the workers to act haphazardly in following the safety protocols of the company. Overall, a high-level of implementation regarding electrical protection was gathered with all protocols staying within this range. This means that all protocols can be improved into having a very high level of implementation.

E. Personal Protective Equipment

TABLE VI. PERSONAL PROTECTIVE EQUIPMENT SAFETY PROTOCOLS IMPLEMENTATION

Indicators	Weighted Mean	Interpretation
The right glove (heavy-duty, welding gloves, insulated gloves) for the job is used.	3.58	The level of implementation is very high.
Hard hats are replaced after a heavy blow or electrical shock.	3.56	The level of implementation is very high.
Safety jackets for workers are available	3.53	The level of implementation is very high.

Hard hats are inspected for dents, cracks, deterioration.	3.49	The level of implementation is very high.
Safety-toed boots are used when working with heavy equipment.	3.24	The level of implementation is high.
Gloves fit snugly	3.21	The level of implementation is high.
Boots have slip-resistant and puncture-resistant soles.	2.65	The level of implementation is high.
Overall Average Weighted Mean	3.32	The level of implementation is very high.

Safety protocols regarding Personal Protective Equipment (PPE) talk mostly about specifications and availability of equipment. The lowest scoring protocol is about the specification of boots used in the company. While the safety protocol states that boots must have slip-resistant and puncture-resistant soles, the managers answered that although the company provides these specifications for boots, the workers sometimes forget and even disregard the use of the equipment, especially when left on their own. This result again points to the lack of safety awareness of the workers of the company. The highest scoring protocol is the specifications regarding the gloves that the workers use. The workers use specific gloves for specific jobs without fail and have a very high level of implementation. Overall PPE safety protocols have a very high level of implementation due to the equipment provided by the company with room for improvement concerning the safety awareness of the workers.

F. Management

TABLE VII. MANAGEMENT SAFETY PROTOCOLS IMPLEMENTATION

Indicators	Weighted Mean	Interpretation
Regular toolbox talks are conducted	3.94	The level of implementation is very high.
Training on safe material handling procedures are conducted	3.89	The level of implementation is very high.
Training on safety are conducted	3.83	The level of implementation is very high.
First-aid boxes are available	3.81	The level of implementation is very high.
Overall Average Weighted Mean	3.87	The level of implementation is very high.

The safety protocols concerning management, according to Hebei Jintao's workers have the highest level of implementation. Meaning that these protocols are implemented all the time. The highest scoring safety protocol, being regular toolbox talks are conducted, and

the lowest, availability of first-aid boxes, only have a different of .13 in their weighted mean. All protocols in this category fall in the classification of having a very high level of implementation. According to the managers of Hebei Jintao, they must perform these tasks continuously and on time to help promote safety awareness in the workers. Constant reminder they say is one of the keys to preventing injuries in the worksite. This is in line with Abd Latib [5] stating that cooperation between the management and the construction workers is invaluable in setting up a proper risk management system.

Table VIII gives a visual representation of the data gathered from the interviews with Hebei Jintao's supervisors, managers, and foremen. The overall average weighted mean of the perceived implementation is 86.69%. Most answers were the same except for the answer relating to OSH training and meetings regarding OSH, where the answers greatly differed.

TABLE VIII. PERCEIVED LEVEL OF IMPLEMENTATION ON THE MANAGEMENT LEVEL

Questions	Perceived Implementation Mean	Distribution of Answers
Who employs incident investigations in case of accidents?	91.43%	25 - Safety Bureau
Are all incidents documented?	88.56%	25 - Yes
Is there a clear organizational structure in the case of competent personnel and supervisors? Is there a clear structure of accountability?	88.56%	25 - Yes
How often are there meetings on OSH?	88.33%	11 - 1-5 times 10 - 6-10 times
Are there resources available to learn Occupational Safety and Health?	88.08%	25 - Yes
Is there an Occupational Safety and Health policy signed by the top manager?	87.67%	24 - Yes 1 - No
How often are there trainings on OSH?	87.17%	13 - 5 times 10 - 6-10 times 2 - 0 times
Are workers supervised and observed in following safety protocols?	85.52%	25 - Yes
Are all workers trained for emergency response?	84.16%	25 - Yes

Are workers evaluated in following safety protocols?	25 - Yes
Are there internal audits within the company to make sure proper implementation of safety protocols is done?	25 - Yes
Overall Average Weighted Mean	86.69%

Table IX illustrates the open-ended questions and the common answers to these questions by the managers, supervisors, and foremen.

TABLE IX. DIFFICULTIES IN SAFETY PROTOCOL IMPLEMENTATION

Questions	Common Answers
What are the difficulties faced concerning fall protection?	11 – Costs 7 – Non-Standardized Construction 7 – Low safety awareness of workers
What are the difficulties faced concerning trench collapse protection?	14 – Rainstorms 11- Costs
What are the difficulties faced concerning scaffold collapse protection?	25- Aging of equipment
What are the difficulties faced concerning electrical protection?	10 – Aging equipment 8- Electrical Line problems 7 – Mismanagement
What are the difficulties faced concerning Personal Protective Equipment?	15 – Costs 10 – Obsolete Protection Equipment
What are other OSH problems that you might have encountered and have difficulty dealing with?	15 – None 6 – Air Switch Failure 4 – Untreated Garbage

IV. CONCLUSION

Though the level of implementation of Hebei Jintao Security Equipment Technology Corporation is seen to be in the range of high to very high, a few problems were seen from the data gathered. Most problems such as low safety awareness, lack of skilled personnel, obsolete equipment, and unavailability of a garbage disposal can be attributed to the lack of budget. Additional budget or proper expenditure management are two ways that the company can provide solutions to the key issues that they

are facing which may include increased training, simulations, and equipment.

CONFLICT OF INTEREST

This paper belongs to the author's cooperation, and has nothing to do with other people's articles, except for quoting scholars' opinions. Therefore, the authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Hu Bo conducted the research and wrote the whole words of the paper. Yang Qingqing analyzed the data and wrote the table of the paper. Dr. Rhodora A. Ngolob wrote the recommendation of the paper. All authors had approved the final version.

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