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IDENTIFICATION AND ANALYSIS OF ACCIDENT CAUSES USING HUMAN FACTORS ANALYSIS AND CLASSIFICATION SYSTEM APPROACH IN PT X

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Abstract-*The research's purpose is to reveal most intense human factor to cause accidents within PT X January to July 2012 period by using Human Factors Analysis and Classification System. Result was created by accumulating the accident hierarchy frequency from the Body Injured Incident Data record of six months along with the Injured Body Parts Map data to find out which part could be harmed on what level. Then from the summarized contents , human factors of accident would be extracted using Human Factors Analysis and Classification System (HFACS) approach, dividing each accident into specific category. To see which factor caused what, the accident hierarchy and the factors will be correlated to form a new variable, reveals what kind of causes that appears the most and brought what type accident in result. That step will then completed by adding injured parts to the the one got found. The result overview pointed at revelation of Skill-Based Error and Physical Environment as the dominant of factors that lead to Medical Treatment accidents during the period. The result then would be a consideration to develop accident prevention program with focus on those two.*

Keywords; Safety,Human Factors Analysis and Classification System, Accident.
Category:Human Resources Management, Safety and Health Management

Introduction

Safety is now growing up as trending issue all over the business world shown by increasing eagerness of enterprises to acquire such certification. PT X as representative of state-owned enterprise is now redefining its safety system within the internals since renewed vision statement declared.Safety is now growing up as trending issue all over the business world shown by increasing eagerness of enterprises to acquire such certification. PT X as representative of state-owned enterprise is now redefining its safety system within the internals.

Accident roots to several factors as its causes and ends up yet triggered by various things. Within so many variables, the basic factors of accident are the environment, method, and the human where this research zoomed in the human factor. The resarch is going to define detailed human factor that responsible for most accident based on Human Factors Analysis and Classification System. Correlation within accident hierarchy, body parts injured and human factor as the cause would altogether form a variable of term that consist of those three in contents, revealing the connection between them and may work as suggestion of what to be fixed.

Methodology

Preliminary Study

The early study mostly done through discussing the company safety and health system first with the HSE Director in the central office. The discussion later clarify of what should be done next in the research and also what should not, lead to topic picking. The discussion also conclude the recommendation of what should be done so then it could be useful for the company as well.

Figure1.Accident Hierarchy Pyramid in PT X

Data Gathering

Data collected include primary and secondary data, which taken from different sources. Secondary data documents such as body injured data,map and chronological record was taken from PT X Health and Safety Directorate through request. Body Injured Incident data contains summarized version of the accidents within January-July 2012 period as material to be analyzed, come along the Body Injured Map which contains detailed information of which part harmed from what and how severe it was. The hierarchy described as:

The terms are :

- Fatality (FAT),
- Days Away From Work Cases (DAFWC)
- Restricted Work Desk Cases (RWDC)
- Medical Treatment Cases (MTC)

- First Aid Cases (FAC)

The period taken was one cycle of periodical start and end of an safety record in PT X. Several datas also gathered from company-owned website with permission as provision of support. Since the body injured incident data were about lack of details, then it gathered from people worked on those cases.

As for the primary datas were gathered from discussion with the investigator team representative, more on the how was the accident solved and sort of chronological explanation out of historical records.

Data Processing

Body Injury Incident data that contains numerous accidents from January to June 2012 will be first in place to be considerated in the process. Each of those 57 accidents labelled with accident hierarchy that represents how big the accident was. The accumulation of frequencycoming from each title then will be ranked as in Pareto to see which stands on the peak of occurence, where Medical Treatment Case and First Aid Case came in similar percentage , 36.70 %chance of occurence

throughout the six months period.Later this will change as soon as First Aid Case no longer considerated for it gave almost no impact or disturbance to productivity. Same way goes for the Body Injured Map, where each category of injured parts ranked all over as shown in figure 2 below :

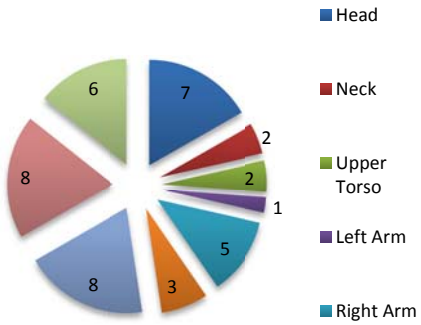
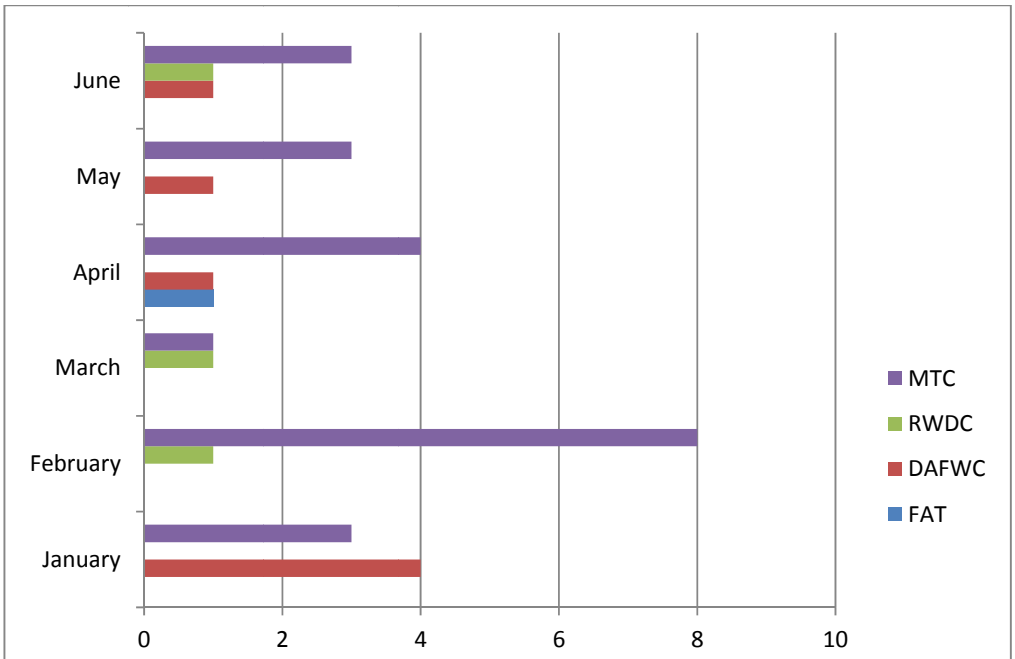


Figure 2 Injured Body Parts Pie Chart

Body Injured data data will be used to determine the most affected body part as the new variabe of accident comes up later. until a new variable of Human Factors Analysis and Classification System and Accident Hierarchy generated. Next, Human Factors Analysis and Classification System used to classify each of accidents as in the Body Injured Incident Date without First Aid Case as in prior statement.



	January	February	March	April	May	June
MTC	3	8	1	4	3	3
RWDC	0	1	1	0	0	1
DAFWC	4	0	0	1	1	1
FAT	0	0	0	1	0	0

As shown by figure 3 ,from 33 accidents to be classified, 22 of them are Medical Treatment cases, holding percentage of 66.67% out of total composition. With more than a half out of all, Medical Treatment Case then stataed as the dominant accident type within the period.

Accident Analysis and Classification

In this stage, what should be done is to categorize each incident using Human Factors Analysis and Classification System as the basis. What to be done is to find the main causal factor that provoke those misfortune events by following the line of HFACS's four major aspects of organizational influences, unsafe supervision, precondition of unsafe acts, and the unsafe acts itself (Shappell,2000) each on different levels where:

Level1 (Unsafe Acts)

Any direct actions that carry possibilities to provoke error and lead to accident that consist of errors :

- Skill-Based Error
- Perceptual Error
- Decision Error

And violations:

- Routine Violation
- Exceptional Violation

Level 2 (Precondition for Unsafe Acts)

Refers to prior condition before the Unsafe Acts take place that consist of Environmental factors:

- Physical Environment
- Technological Environment

Condition of operators:

- Adverse mental state,
- Adverse physiological state,
- And physical/mental limitations
- Personnel Factors

Personnel factors:

- Crew Resource Management
- Personnel factors.

Level 3 (Unsafe Supervision),

Refers to chain of command supervised worker and consist of:

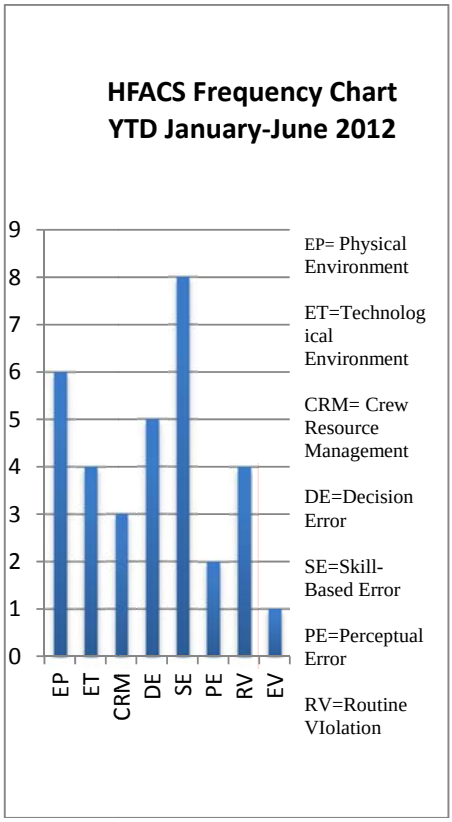
- Inadequate Supervision
- Planned Inappropriate Operation
- Failed to Correc Problems
- Supervisory Violation

Level 4 (Organizational Influences)

A factor caused by surrounding, and daily habit that defined in detailes as:

- Resource Management
- Organizational Climate
- Operational Process

The classification was accomplished by following the decision tree of each Human Factors Analysis and Classification System categories along with discussion.



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The results are then ranked as these:

1. Skill-Based Error factor (SE) with eight incidents,
2. Physical Environment factor (EP) with six incidents,
3. Decision Error factor (DE) with five incidents
4. Technological Environment factor (ET) with four incidents,
5. Routine Violations factor (RV) with four accidents,
6. Crew Resource Management factor (CRM) with three accidents,
7. Perceptual Error factor (PE) with two accidents and,
8. Exceptional Violation (EV) with one accident

From sequential sort above , it is shown that Skill-Based Error comes up as dominant cause that responsible for most accidents within January-June 2012 period. EP and ET share the same number of incident occurrence, then it shall be considered which one is responsible for greater loss. ET-caused accidents are consisting of two MTC and two DAFWC, where DAFWC surely a class of accident with greater loss, while Routine Violations (RV) consist of four cases of MTC. Based of accumulated lost consideration, ET shall be placed first to RV.

With accident hierarchy and human causes come to surface, next is to find the correlation between the causes and accident type. The correlation meant to show the reciprocity relation between human factor and the accident type. The relationship between those two meant to describe how a specific human factors gave impact to performance, hence provoke a certain type of accident. Since type of accident represents the level of injury, then it can be also said as to find specific cause that bear potention for certain level of injury. The data then merged to create a new variable that consist of human factor cause and the level of injury.

Then, by take a look at the number Human Factors Analysis and Classification System-categorized accidents such as in the matrix,the most common Human Factors Analysis and Classification System -categorized accidents are sorted in sequence as shown in the table:

Table 1 HFACS Factors-Accident Hierarchy Correlation

HFACS		Accident Hierarchy			
		FAT	DAFWC	RWDC	MTC
OI	RM				
	OC				
	OP				
PUA	EP				●●●●●●
	ET		●●		●●
	MC				
	PC				
	L				
	CRM		●●	●	
US	IS				
	PIO				
	FCP				
	SV				
UA	DE	●	●●		●●
	SE		●	●●	●●●●●
	PE				●●
	RV				●●●●
	EV				●

Then, the sequential order comes up as:

1. MTC-EP with six cases,or 27.27% out of all MTC, and
2. MTC-SE with five cases, 22.72% out of all MTC

The most two in the list are MTC-EP and MTC-SE. The result goes connected to the prior analysis where SE (27.27%) and EP (22.72%) happened to be the most frequent factors to cause an accident, the only difference is that in this stage those come out in reversed sequence. The result related to a situation in support of a causal relationship that stated low morale and negative work attitudes are associated with attentional deficits and skill-based errors (Edkins & Pollock, 1997) and are significantly predictive of future errors (Van der Flier & Schoonman ,1988).

From the result then it is revealed that MTC is type of accident with highest occurrence for January-June 2012 in PT X with SE and EP as the main causal factors of common happened accident within January-June 2012 period in PT X.

As shown in table 1, both Skill-Based Error factor and Physical Environment factor are contained within Unsafe Acts category, then it described that unsafe acts take great part as the direct cause of accident. As defined by Heinrich whereas unsafe act and unsafe conditions are the central factor and also the basic causation factor to remedy in order to prevent incidents easily by lifting it out of the line

The, from the prior data, it is shown that the affected body parts from accidents caused by physical environment and skill failure which ended in medical treatment. Almost all of the body parts were victimized from the accidents with right hand, right fingers, and left leg at most.

Now it is stated that the accident cases within PT X January-June 2012 period are commonly come to exist as the impact of skill failure of worker while working and also as the result from the external disturbance of any physical environment around workplace that could interact with workers that end up gave injury mostly to right hand, right fingers, and left leg.

Analysis and Discussion

General Analysis

According to PT X new vision which is to be a world class energy it is necessary for the company to improve performance through a development of safety system which is more human-centered.

As company of petroleum industry, PT X worker often come in contact with hazardous situation and injury experience which reduced the rate of productivity. The company was willing to improve productivity and implement CEO's instruction as soon as it can. Health and Safety Directorate then put a development of a human-centered program where the solution expected to last for a long period, reducing cost of annual program development and improve productivity.

Human Factors Analysis and Classification System was taken to help classifying the human factors of accident that exist. The company believed that human was the roots of all problems appeared, so that's why they picked the system.

The revelation of human factors causes and its impact is great value of provision to develop a more-effective worker development program such as training to prevent future accidents as Safety rule infringements are notusually acts of deliberate risk taking, but shortcuts designed to make work more efficient,quicker, or easier (Reason et al., 1994, in A. Ian Glendon, S.G.C.E.F.M., 2006). Knowing of which human factor truly existed will help to develop specifically-aimed training.Safety ,human resource management, and productivity are in integrated system where one could affect another, a leveraging action to one aspect may uplift the rest two.

A proper prevebtion program will lead to an improvement of safety climate, and safety climate could increase productivity through worker's feeling of security. Besides, a reduction of accident would be a good record for the company itself and make it closer to the vision.

Conclusion

From the analysis then it is revealed that PT X HSE Performance YTD June 2012 with 33 considered accidents is mostly originated by unsafe acts of the worker as the direct cause. The accident hierarchy-HFACS matrix put SE and EP as the representative of unsafe acts and precondition of unsafe acts to surface as the main causes of accidents in PT X Year To Date June 2012.

According to H.W Heinrich,unsafe acts happened because of improper attitude, lack of knowledge, physical unsuitability, and improper mechanical or improper environment condition. Improper

enviroment condition as an element of unsafe acts may refers to physical environment as the second accident cause after SE in PT X HSE Performance YTD June 2012.

SE and EP as most frequent accident causes do not stand without correltion, since both of them are having reciprocal effects to one another. This effect means that one cause might be a possible trigger for another cause, such as seen in the HFACS full chart where precondition of unsafe acts just about one level above of unsafe acts. This close relations depict a strong bond between , explain that when one come to surface it also might happen to another. SE and EP are pair of unseparable causes.

As for the injury given, there's no standard of inJury level for certain cause. Even in this researc MTC occurs as most caused by SE and EP, another level of injury caused by those two also appear. MTC is the lowest level injury, so then the frequency of occurence is quite high as seen. The lower the ijury level, the higher the frequency., especially in a well-trained worker environment.Another level of injury caused by SE and EP are exist with uncertainty. However, the pattern of injury level still cannot be described by this research since it requires data of several periods to decide.

Recommendation

The recommendation is adapt H.W Heinrich three E's method to eliminate unsafe conditions and acts.

- Engineering,

In order to eliminate the hazard it is obvious to design the tools to be as suitable and as safe as possible according to what it might be used. It might referred as to make the work environment more suitable for the man ,prevent further risk.

- Education, this points briefly defined ways to improve employee's certain skill according to safety includes training for worker to assure worker's skill in the field and reduce skill error. Apllied by developing a long lasting training and coaching method with focus on the primary cause of the accident. Sustainable training will able to cut cost and time to develop a new one each year.

- Enforcement, approaching worker and management to ensure that all internal & external rules, regulations, and standard of operation is followed by both sides.The enforcement can be done by both sides of supervisor and worker through direct commun ication.

Therefore, for the foreseeable future, this approach must operate in parallel with the need to address the effects and reasons for entrenched opposition to positive OHS activities that result in multiple injustices in OHS,including those affecting many vulnerable groups or other form of voice (Peterson & Mayhew, 2005)

Further Research

For the further research, it is necessary to gather more data such as deep interview with victim or eye witness to provide detailed explanations and take a look if it was happened as in historical record, since some people might have different point of view. Since the causes revealed only for a period, it might not suitable to another time period. Data of several years HSE performance record are required to create more general yet accurate result.

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