

A Review on Accident Pyramid and its Empirical Interpretation in Oil & Gas Industry (Upstream)

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Abstract- Accident prevention is the key in effective Health, Safety and Environmental management system of any Organization. Understanding the pattern of accidents and ratios helps in preventing major accidents. The older theories on accident prevention have influenced the safety professionals to design accident prevention programs. However, over a period of time, rapid growth in industrial activities are challenging the theories. Hazards are different for different industries and hence resultant safety risks are not uniform. A need arisen to further review and interpret the accident patterns. This paper focused on reviewing and highlighting the gaps in interpretation of accident triangles with respect to Oil and Gas (upstream). How the Oil and Gas is interpreting the accident occurrence and evolving with preventive measures.

Index Terms- Accidents, Accident Triangle, Oil & Gas (Upstream), accident prevention, Process Safety Incidents.

I. INTRODUCTION

An accident may be defined as an unexpected and unplanned occurrence, which may or may not involve injury. The possibility of an accident occurring is present in every sphere of human life.

Accident triangle prescribed by Bird (1969) and Tye and Pearson (1974/75) on accident ratios were in practices. It has provided a support to safety professions to draw a road map in preventing accidents. Bird's work was based in turn on earlier work by Herbert William Heinrich in the 1920, published and republished from 1932 to 1959 in his book *Industrial Accident Prevention: A Scientific Approach*.

Three principles based on the accident triangle are:

There are consistently greater number of less serious events than more serious ones.

Many near misses could have become events with more serious consequences.

All the events (not just those causing injuries) represent failures in control, so are potential learning opportunities.

It is evident from various accident prevention theories that accidents do not happen always according to predefined sequences and scenarios. Rather, they – almost always – fail in complex ways and there is a variety of root causes leading each time to the accident. For that reason it is not possible for a prescriptive regulatory framework to address all relevant risks. It is necessary to use the principles of risk assessment and safety management to review and control the risks on a case-by-case basis.

II. HEINRICH ACCIDENT PYRAMID

Herbert William Heinrich (1886- June 22, 1962) was an [American](#) industrial safety pioneer from the 1930s. He was an Assistant Superintendent of the Engineering and Inspection Division of Travelers Insurance Company when he published his book *Industrial Accident Prevention, A Scientific Approach* in 1931. One empirical finding from his 1931 book became known as [Heinrich's Law](#): that in a workplace, for every accident that causes a major injury, there are 29 accidents that cause minor injuries and 300 accidents that cause no injuries. Because many accidents share common root causes, addressing more commonplace accidents that cause no injuries can prevent accidents that cause injuries.

Heinrich's work is claimed as the basis for the theory of [Behavior-based safety](#) by some experts of this field, which holds that as many as 95 percent of all workplace accidents are caused by unsafe acts. Heinrich came to this conclusion after reviewing thousands of accident reports completed by supervisors, who generally blamed workers for causing accidents without conducting detailed investigations into the root causes.

While Heinrich's figure that 88 percent of all workplace accidents and injuries/illnesses are caused by "man-failure" is perhaps his most oft-cited conclusion, his book actually encouraged employers to control hazards, not merely focus on worker behaviors. "No matter how strongly the statistical records emphasize personal faults or how imperatively the need for educational activity is shown, no safety procedure is complete or satisfactory that does not provide for the . . . correction or elimination of . . . physical hazards,"

This theory came to be accepted as the norm for occupational safety for many years, and continues to have a major influence on the ways in which executives and leaders think about it. However, modern methods of examining the causes of accidents prove that the safety pyramid is not a valid tool for injury prevention.

III. ACCIDENT PYRAMIDS AND SAFETY CULTURE

Organizations have realized that work place injuries are no more tolerable. However, focus was on reacting for accidents and its corrective actions. A need has arisen to understand the root causes of accidents learn lessons from the past incident and establish a sustainable safety culture. There are four types of safety cultures practiced to achieve "Zero Accidents" at work Place.

- Reactive Culture
- Dependent Culture

- Independent Culture
- Interdependent culture

For all the above stages to progress, the pattern of accidents, the pyramid structure became vital for emulating accident prevention program.

IV. ACCIDENT DATA MANAGEMENT IN OIL & GAS INDUSTRY

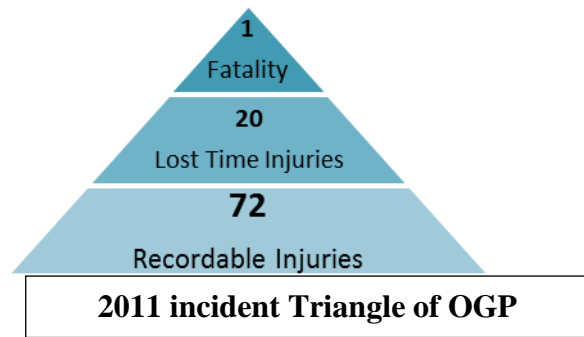
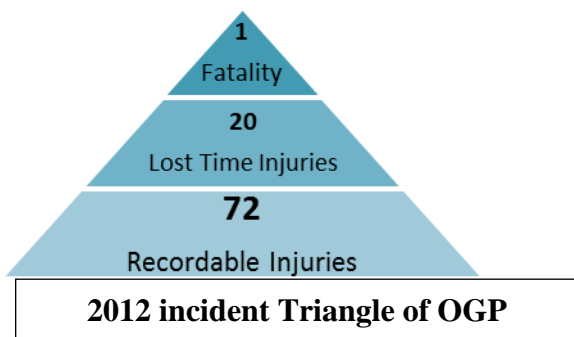
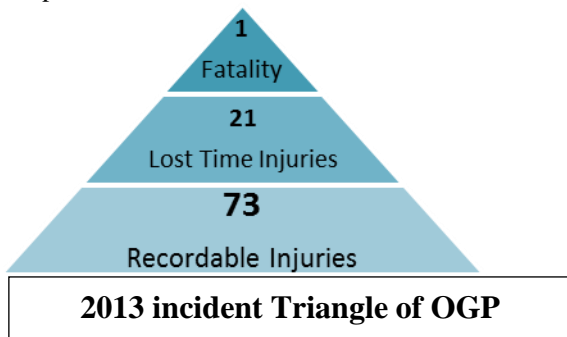
Learning lessons from accidents is vital in order to avoid accidents in the future. Knowledge of past accidents serves as important input to risk assessment with respect to hazard identification, consequence evaluation, decision support, and identification of high risk areas.

40-years' experience of worldwide offshore accident history is systemized and stored in DNV GL's Worldwide Offshore Accident Databank - WOAD.

Technical information about approximately 3700 offshore units including mobile drilling unit's location and operation mode at any time is available. This helps the Oil & Gas industry for developing their accident prevention program.

Data on a number of parameters such as name, type and operation mode of the unit involved in the accident, date, geographical location, chain of events, causes and consequences, and evacuation details are available.

International Association of Oil & Gas Producers (OGP) has been collecting the safety incident data since 1985. It is having largest data base of safety performance in E&P Industry. About fifty member Organization of Oil and Gas participate in annual benchmarking process which focuses on accidents and injuries in the sector. The accident pyramids resulted from these comparative studies are different from the Heinrich theory.



These incident triangles of OGP pertinent to three consecutive years helped the Oil & Gas Industry to further design accident prevention programs. It also released Life saving rules (OGP Life saving rules, OGP report no 459) intended for Oil & Gas Industries. It is interpreted that 67% of fatal accidents would have been reduced by implementing life saving rules. These are rules consists of icons with simple text providing simple communication on prevention of accidents. These life saving rules are prepared based on accident data and pyramids in Oil and Gas Industry. There is an increase in work hours by 2% and decrease in fatalities.

V. SUMMERY AND CONCLUSION

Heinrich's Accident pyramid helped the industry to look ahead for prevention of accidents. It has brought an insight to understand the sequence of serious accident occurring and accordingly the Organizations have proactively designed their accident prevention programs. However, rapid and diversified industrial activities, many hazards increased and accordingly the risk of serious accidents increased. The research on post Heinrich proposal suggested to revalidation of the theory and Organization to relook into their specific hazards and risk controls to prevent serious injuries at work place.

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Siva Prasad Penkey has several papers on work place safety improvements presented during national and International Conferences. He has carried out work place research on “Participation approach improves work place Health and Safety”. Presented a paper in American Congress of Govt. Industrial Hygiene, World Congress held in Anhem, California in the year 2005. He was also active member as Head, Occupational Health and Safety of ASSE Chapter Kuwait. He carried out more than

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