

# System Safety for the O&G Industry

What will it take?

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By the way, regarding shear rams:  
They do work sometimes...

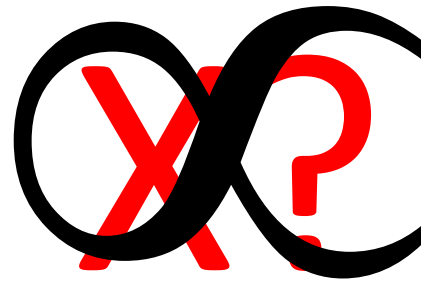


# Behavior Safety::Process Safety

Concepts that may have outlived their usefulness

Lesson learned from BP Texas City ?

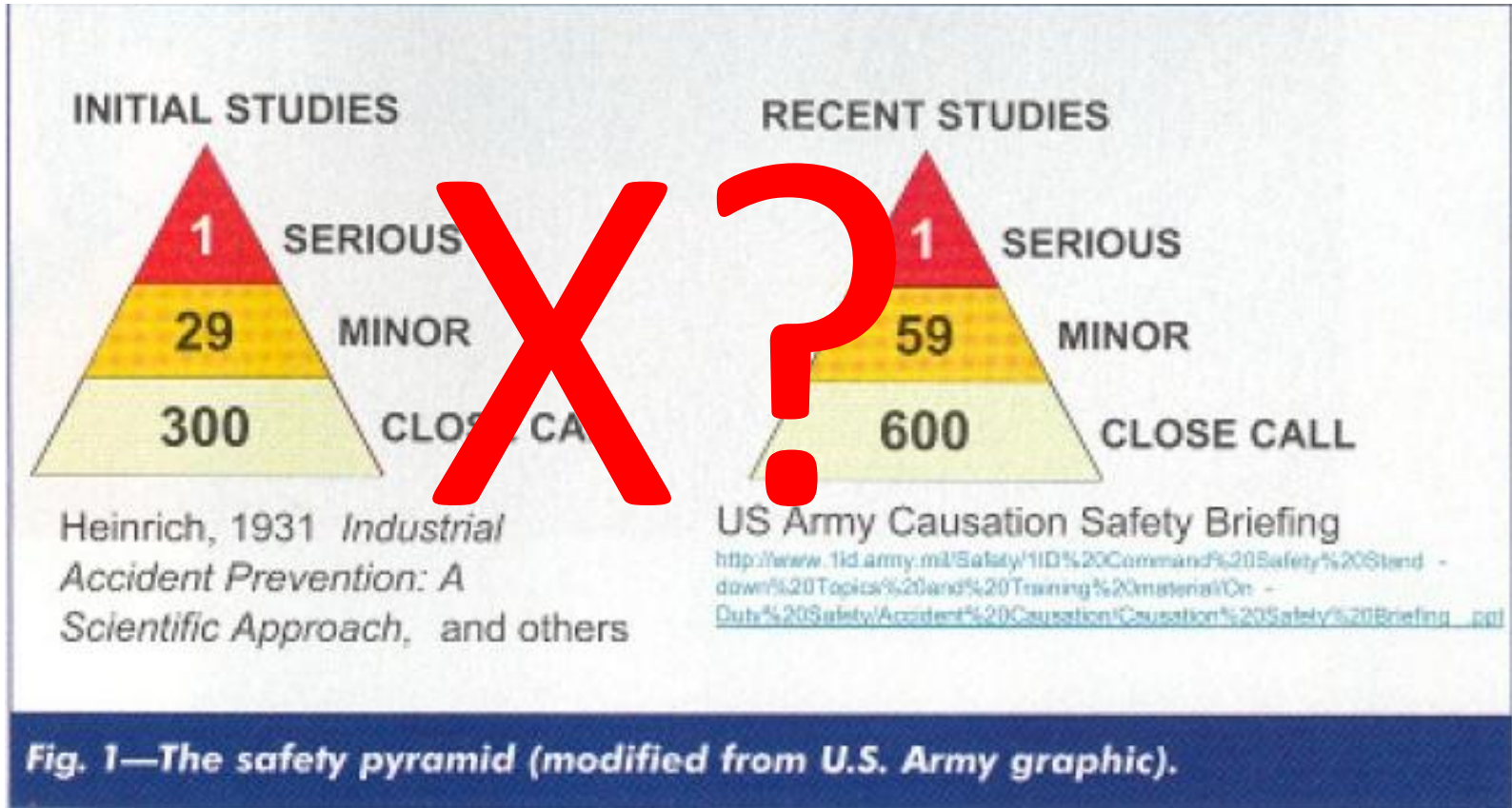
## Slips, trips, falls



## Process incidents

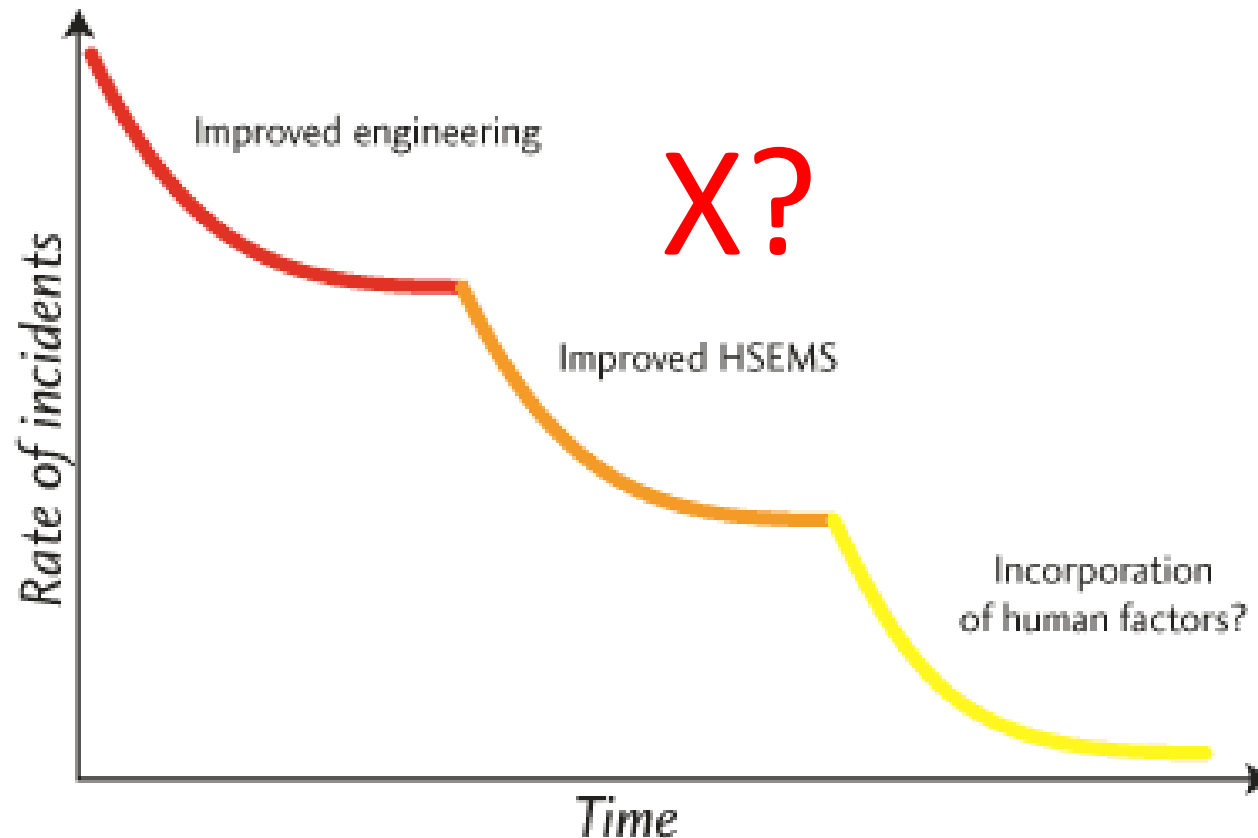
# Safety Pyramid

Concepts that have outlived their usefulness



# Another well entrenched concept that needs to be disposed of?

Concepts that may have outlived their usefulness



# Confusion between occupational safety and system safety

Personal safety focuses on

- Changing individual behavior
- Controlling injuries to employees on the job

Process (system) safety focuses on

- Design of system in which behavior occurs
- Preventing major losses

## Result: Managing to the wrong feedback

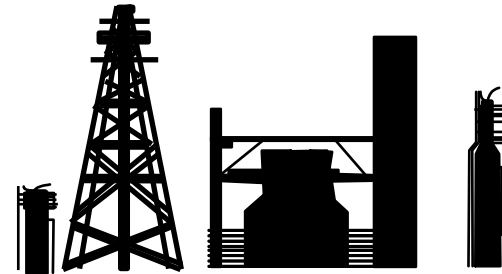
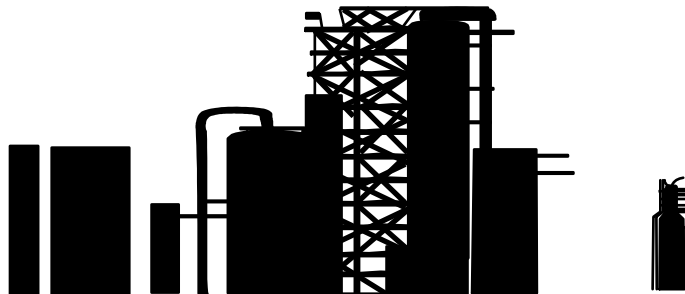
Example: Using “days off from work” as a measure of system safety between occupational safety and system safety

# Caution: In O&G Industry Process Safety = **X?** System Safety

## What is PSM?

Comprehensive, Systematic Management Approach  
that Integrates:

- Engineering Controls & Technologies
- Safe Work Practices
- Training
- Management Practices



# And...

There are 14 Elements in the Process Safety Management regulation:

- 1) Process Technology
- 2) Process Hazards Analysis
- 3) Operating Procedures and Safe Work Practices
- 4) Management of Change - Technology
- 5) Personnel Training and Performance
- 6) Contractor Safety and Performance
- 7) Management of Change - Personnel
- 8) Incident Investigation and Communication
- 9) Emergency Planning and Response
- 10) Auditing
- 11) Quality Assurance
- 12) Mechanical Integrity
- 13) Pre-Startup Safety Reviews
- 14) Management of "Subtle" Changes



# But, PSM is not:

- **Exceptions**

- Hydrocarbon fuels used solely for workplace consumption as a fuel
- Flammable liquids stored in atmospheric storage tanks
- Retail facilities
- Oil & gas drilling or servicing operations
- Normally unoccupied remote facilities

Perhaps...

this has changed under  
new rules? It has for  
some companies.

# Process Safety in the Oil Industry



## 1 The need for process safety KPIs

### 1.1 Introduction

Across the global oil & gas industry, considerable effort has been focused on the prevention of major incidents. The International Association of Oil & Gas Producers (OGP) has previously published *Asset Integrity – the key to managing major incident risks* (OGP Report No. 415, December 2008<sup>1</sup>) which provides advice on how to implement an asset integrity management system for new and existing upstream assets. It also includes preliminary guidance on 'monitoring and review', including how to establish lagging and leading Key Performance Indicators (KPIs) to strengthen risk controls (barriers) in order to prevent

this reason, this document is focused on KPIs to prevent such releases; however, much of the guidance can be applied to other aspects of process safety and asset integrity.

In response to a number of major incidents such as the disasters in 2005 at the US Texas City Refinery and the UK Buncefield oil terminal, the downstream oil industry has been developing improved process safety KPIs. Recommendations provided by organisations such as the UK Health & Safety Executive (UK HSE)<sup>2</sup>, the US Chemical Safety and Hazard Investigation Board (US CSB)<sup>3</sup> and the Independent 'Baker' Panel<sup>4</sup> reinforced

**DEFINITION** **Process safety**  
Process safety is a disciplined framework for managing the integrity of operating systems and processes handling hazardous substances. It is achieved by applying good design principles, engineering, and operating and maintenance practices. It deals with the prevention and control of events that have the potential to release hazardous materials and energy. Such incidents can result in toxic exposures, fires or explosions, and could ultimately result in serious incidents including fatalities, injuries, property damage, lost production or environmental damage.

**Asset integrity**  
Asset integrity is related to the

# Swiss Cheese KPIs = Process Safety?

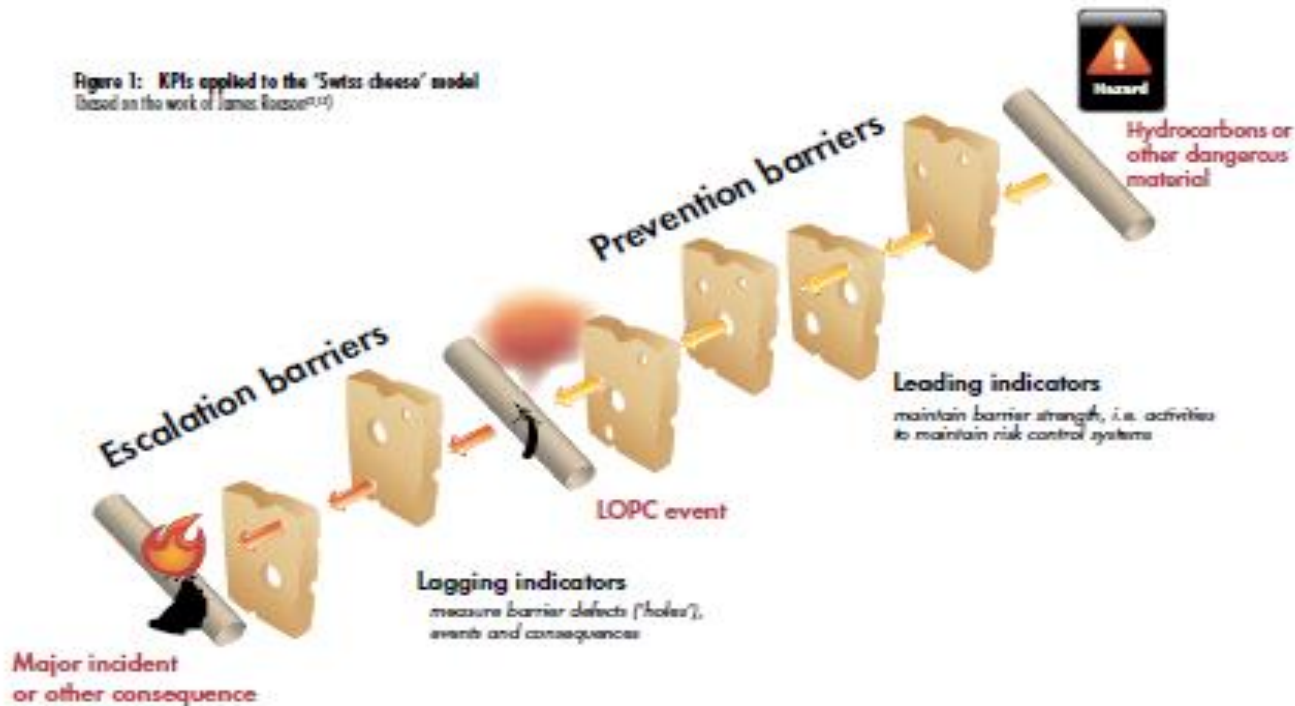
In Figure 1 using the 'Swiss cheese model' (after James Reason, 1990<sup>12</sup> and 1997<sup>13</sup>). The same principles underpin other similar approaches such as the 'bow tie' model or 'layers of protection analysis' (LOPA).

Hazards are contained by multiple protective 'barriers' or 'risk control systems'. The barriers – represented here by individual 'slices of Swiss

cheese' – which is the predominant cause of major process safety incidents in our industry. Barriers can have weaknesses, depicted as 'holes' in the Swiss cheese. The alignment of holes in the

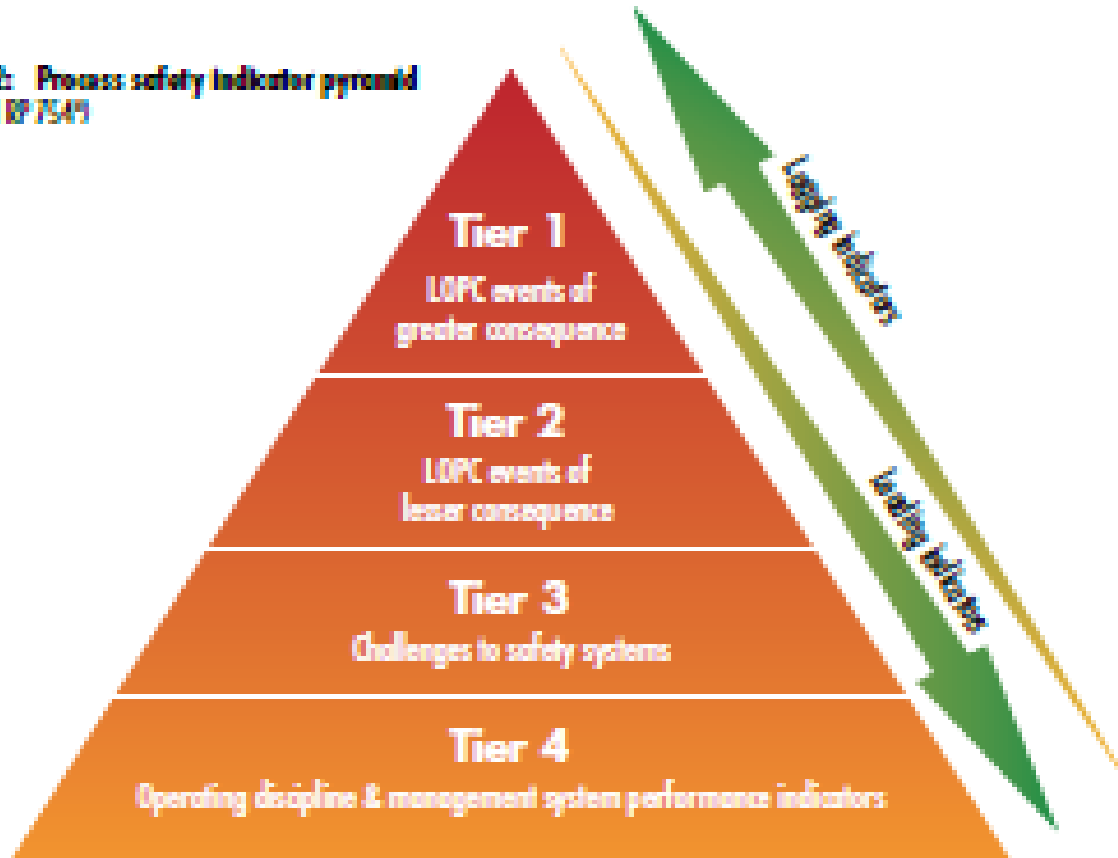
Swiss cheese model, where harm can result from a fire, explosion or other destructive incident.

Figure 1: KPIs applied to the 'Swiss cheese' model  
 (Based on the work of James Reason<sup>12,13</sup>)



# New Triangle?

Figure 2: Process safety indicator pyramid  
(from API RP 754)



eOGP

# API RP 754 – Are we on the same page?

**Table 1 – process safety event definitions, reproduced from API RP 754**

## Tier 1 Indicator Definition and Consequences

A Tier 1 Process Safety Event (PSE) is a loss of primary containment (LOPC) with the greatest consequence. A Tier 1 PSE is an unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g. steam, hot condensate, nitrogen, compressed CO<sub>2</sub> or compressed air), from a process that results in one or more of the consequences listed below:

- An employee, contractor or subcontractor 'days away from work' injury and/or fatality;
- A hospital admission and/or fatality of a third-party
- An officially declared community evacuation or community shelter-in-place
- A fire or explosion resulting in greater than or equal to \$25,000 of direct cost to the Company
- A pressure relief device (PRD) discharge to atmosphere whether directly or via a downstream destructive device that results in one or more of the following four consequences:
  - liquid carryover
  - discharge to a potentially unsafe location
  - an onsite shelter-in-place
  - public protective measures (e.g., road closure)and a PRD discharge quantity greater than the threshold quantities in Appendix B in any one-hour
- A release of material greater than the threshold quantities described in Appendix B in any one-hour period

## Tier 2 Indicator Definition and Consequences

A Tier 2 Process Safety Event (PSE) is an LOPC with lesser consequence. A Tier 2 PSE is an unplanned or uncontrolled release of any material, including non-toxic and non-flammable materials (e.g. steam, hot condensate, nitrogen, compressed CO<sub>2</sub> or compressed air), from a process that results in one or more of the consequences listed below and is not reported in Tier 1:

- An employee, contractor or subcontractor recordable injury;
- A fire or explosion resulting in greater than or equal to \$2,500 of direct cost to the Company;
- A pressure relief device (PRD) discharge to atmosphere whether directly or via a downstream destructive device that results in one or more of the following four consequences:
  - liquid carryover
  - discharge to a potentially unsafe location
  - an onsite shelter-in-place
  - public protective measures (e.g., road closure)and a PRD discharge quantity greater than the threshold quantities in Appendix B in any one-hour period
- A release of material greater than the threshold quantities described in Appendix B in any one-hour period

*Note: Non-toxic and non-flammable materials (e.g., steam, hot water, nitrogen, compressed CO<sub>2</sub>, or compressed air) have no threshold quantities and are only included in this definition as a result of their potential to result in one of the other consequences.*

# Behavioral or Process?



# A nod to "Environmental"?

Perhaps "System Integrity" to include System Safety, Process Safety, HSE?

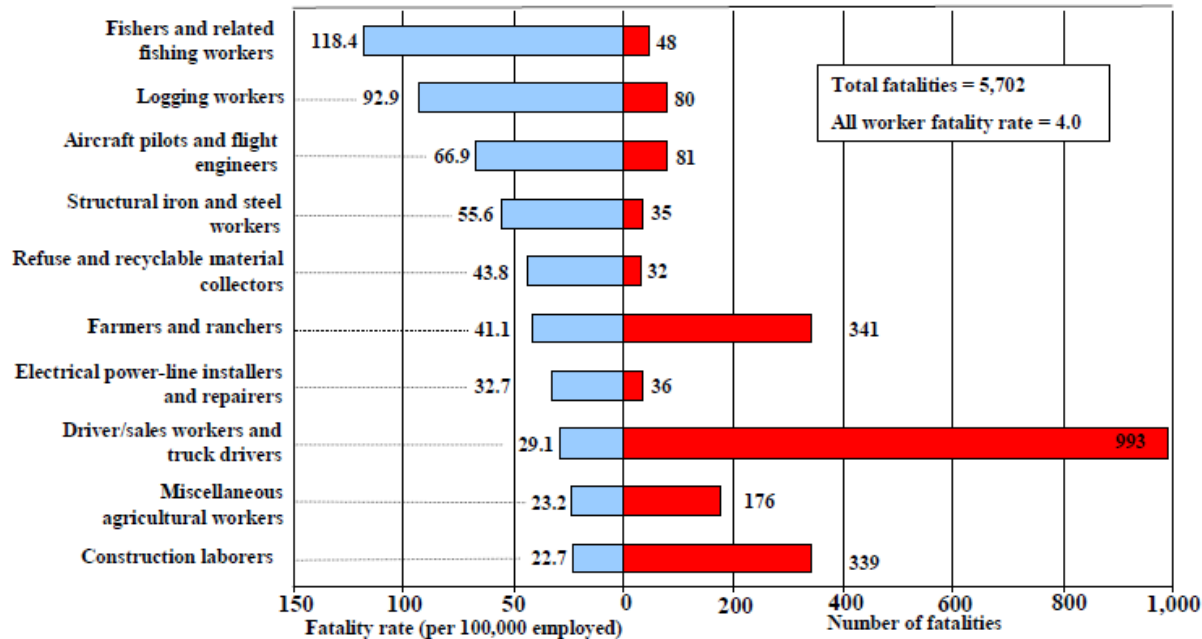


# Behavioral or Process? How about System Integrity?



# Behavioral or Process?

Selected occupations with high fatality rates, 2005






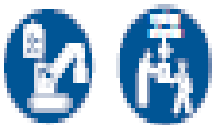


Occupations had to meet predetermined employment and fatality count criteria to be considered for inclusion.  
 Rate = (Fatal work injuries/Employment) x 100,000. Employment data based on the 2005 Current Population Survey (CPS) and Department of Defense (DOD) figures.  
 SOURCE: US Department of Labor, Bureau of Labor Statistics, Current Population Survey, Census of Fatal Occupational Injuries, and US Department of Defense, 2005.

Transportation and material moving occupations accounted for the highest number of fatalities of any major occupational group (1,543 fatalities, up 2 percent from 2004). Fatalities among motor vehicle operators accounted for 71 percent of all fatal work injuries in this

# Life Saving Rules

The OGP Life-Saving Rules can be grouped into four broad categories.

OGP Core Life-Saving Rules		OGP Supplemental Life-Saving Rules
	Personal safety	
	Driving	
	Site safety	
	Control of work	

# Lately (last ~15years) I hear more talk about....

- Risk
  - Recordables
  - Forward looking
  - Lagging, Leading indicators
  - High Potential near misses
  - Symptoms
  - Values
  - PMT – Performance Management
  - PE – Production Excellence
- ...but not much about Process Safety (except in chemicals divisions)
- ...only most recently from SPE, API, OGP

# Conclusion

System Safety/Process  
Safety/System Integrity has made it  
to the agenda. But there is a long  
way to go to implement it in the  
Upstream Oil and Gas Industry