Debunking the ‘Injury Pyramid’
Geneva - 2013

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...or 30 minutes to challenge 80 years of “safety theory” thinking

Time is limited... so let’s get STARTED!
Who The Heck Is This Guy?

• Loaded & Fixed Railway Cars
• Union Safety Representative
• One of the First Government of Alberta OH&S Officers (Enforcement)

Who The Heck Is This Guy?

• Largest Employers in Canada – 16,000 to 36,000 employees
• Educator, Author, Consultant
• Husband, Father, Grandfather, Brother, Son & Professional Musician
“Everything in health & safety is connected!”

Just Some Rules Before We Start

• Avoid Absolutes At...
  Almost ALL Costs 😊

• Exception – Are Exceptions
  — Nothing more – nothing less

• Agreement Is Not Required
  — Consideration of Ideas Is Desired
Safety Basically Is...

1. Find the **RISK** for **Harmful Energy** following a path to humans/things
2. Control those **RISKS** Through Risk Management components:
   a. Probability
   b. Severity
   c. Exposure

3. Ensure the Controls are working through Observation & Inspection
4. When things go wrong investigate and improve the situation to prevent recurrence
5. Repeat as necessary
Risk means...

The FOUR Most Important Words In Safety Management are...

1. **RISK**
2. **Probability**
3. **Severity**
4. **Exposure**

They Work Together and are Forever Linked!
RISK = P x S x E

Probability
Severity
Exposure

“Performing Safely...

is the performance of work or play
without taking
unnecessary risks.”
Probability

• A measure of the expectation that an event will produce a given outcome
• The higher the probability the more certain we are that we will experience the given outcome IF WE ARE EXPOSED TO THE EVENT
• Can Be Expressed as a Percentage or Ratio
  – 5:1 Chance
  – 50% Chance
• Probability is DIFFERENT than Exposure

Probability

• There is a 100% chance you will burn your unprotected hand when you touch molten steel
• There is a relatively small chance you will ever receive money from any of the current Lotteries ($1.00 - $Millions)
• Neither of these statements discusses the RISK of the events...just the probability of outcomes should the exposure happen
Probability Statement

Severity

• Usually Expressed by “How Bad/Good Could the Outcome Be”?  
• Usually Considered Negative in Most Risk Matrix  
• Legal/Moral/Financial Consequence  
• Remember That There are Two Sides to This Coin!  
  – Save Time  
  – Less Hassle  
  – More Comfortable  
  – Injury  
  – Damage

<table>
<thead>
<tr>
<th>Toxicity data</th>
<th>Result</th>
<th>Species</th>
<th>Dose</th>
<th>Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>hydrogen sulphide</td>
<td>LD50 Intraperitoneal</td>
<td>Rat</td>
<td>2300 ug/kg</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>LD50 Intravenous</td>
<td>Rat</td>
<td>270 ug/kg</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>LC50 Inhalation</td>
<td>Rat</td>
<td>820 mg/m3</td>
<td>3 hours</td>
</tr>
<tr>
<td></td>
<td>Vapor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LC50 Inhalation</td>
<td>Vapor</td>
<td>700 mg/m3</td>
<td>4 hours</td>
</tr>
<tr>
<td></td>
<td>LC50 Inhalation</td>
<td>Vapor</td>
<td>470 mg/m3</td>
<td>6 hours</td>
</tr>
<tr>
<td></td>
<td>LC50 Inhalation</td>
<td>Gas</td>
<td>712 ppm</td>
<td>1 hours</td>
</tr>
<tr>
<td></td>
<td>LC50 Inhalation</td>
<td>Mouse</td>
<td>634 ppm</td>
<td>1 hours</td>
</tr>
<tr>
<td></td>
<td>LC50 Inhalation</td>
<td>Gas</td>
<td>444 ppm</td>
<td>4 hours</td>
</tr>
<tr>
<td>IDLH</td>
<td>: 100 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic effects on humans</td>
<td>: May cause damage to the following organs: lungs, upper respiratory tract, eyes, central nervous system (CNS)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Other toxic effects on humans | : No specific information regarding the other toxic effects of this material to humans.
Exposure

• Calculation of how much, many and/or how long the situation exists
• Can be expressed as a % of time or number of the workforce
• Can be expressed as a dose (ppm, mg/m3, dba, etc.)
• Exposure is NOT “Probability” – it is the amount of Exposure TO the Probability in question

In a nutshell we need to manage...

Hazard Anticipation, Identification, Evaluation & Control
In our sincere attempt to “Make Our Lives Safe” We have tended to...
Giving Meaning To Things We Don’t Understand

- A Flaming Chariots
- Earth is Flat
- Colds are caused by being cold
- Moon is made of Cheese
- There was a time some of us believed in Santa...

... and that there is a Ratio Connection with Minor & Major events
Thinking Fast and Slow

Kahneman describes the two different ways the brain forms thoughts:

• System 1: Fast, automatic, frequent, emotional, stereotypical, subconscious
• System 2: Slow, effortful, infrequent, logical, calculating, conscious

“What You See Is All There Is”

So with these things in mind let’s look at this

Debunking of the Pyramid!
The Injury Pyramid
Proposed Premise

1. There are common causes to incidents

2. Serious injury incidents are averted by reducing/avoiding minor/no injury incidents
The Injury Pyramid  
Proposed Logical Premise

3. There’s a randomness to outcomes (ranging from minor to major)

4. The less minor/no injury incidents we have the less major injury incidents we will have in a ratio relationship (many to few).

“Moral – Prevent the Accidents and the injuries will take care of themselves”

Exposure  
Severity  
Probability Is Missing
Historic Accident Ratio Studies

H. W. Heinrich 1931

Frank Bird Jr. 1969

1969 - Modified By P&G

1993 UK Study

The assumption is that if you reduce THESE
That these will be reduced

• Used as a Risk Management Tool it is flawed
• Errors in base data/assumptions lead to errors in the resulting conclusions

A Minor Leads To Major Is Not Valid
Errors in Logic

• It’s not that the Pyramid is totally wrong
• It inappropriately tries to explain a complex subject like RISK
• Severity is NOT a function of repetitions in Exposure
• Let’s look at a simple EXAMPLE…

Juggling

Chainsaws VS. Eggs
Juggling Eggs

• Severity of Dropping an Egg while juggling them is impacted by?
  – Energy exerted (gravity/velocity)
  – Strength of the Egg
  – Qualities of the landing surface (ring)
  – How the Egg lands
  – Many Repetitions would not significantly change the experienced outcome severity!
  – Extreme exceptions are possible
Juggling Chainsaws

Severity of Dropping a Chainsaw while juggling them is impacted by?

– Energy exerted (gravity/velocity)
– Strength of the Chainsaw
– Qualities of the landing
– How the Chainsaw lands
– Many repetitions would not significantly change the experienced severity outcome!
Eggs VS Chainsaws

Reducing Egg Incidents will have NO Logical Impact on Chainsaw Incidents

Worst First

- As Heinrich suggested reducing ALL Juggling Incidents would indeed reduce all injuries (perhaps) but at what cost (Careful of Absolutes)
- Problem - Low payback on investment
- High Payback comes from reducing WORST FIRST!
Risk Analysis

\[ P \times S \times E = Risk \]

**Probability** 100  Severity 100  Exposure 100

0 0 0

Winning a EuroMillions Lottery?

Errors in Logic Explained

- **Probability** does NOT increase with frequency of **Exposure**
- The amount of **Energy** relative to the damaged item/person is the key difference in **major and minor** events (**Severity** of Outcome)
- **Large energy missing the “target” is a MAJOR RISK because of the Potential for a Severe Outcome**
Exception?

• The factors that impact severity are not usually impacted by probability nor exposure
• Note: Repetitive Motion Injuries can be an exception

Attacking Catastrophic Loss

The Solution:
• Find High Energy
• Extreme Outcome Probability
• Logic #101 tells us that:

$$A+B=C \text{ then } C-B=A \text{ and } C-A=B$$
Defining Critical Safe & Unsafe Behaviours

• The Golden Rule Approach
  – Statement of Intent – “We will work at heights safely and legally”

• What are the Golden Rules in your Industry?
Where the Rubber Hits The Road

1. Prioritize the Golden Rules for Local Conditions
2. Identify the Energy/Barriers Situations
3. Identify the Critical Behaviours & Procedures
4. Identify the Activators and Consequences
5. Identify the Measurements & Processes
6. Identify the Management of Change Issues
7. Develop and Implementation the Plan
8. Implement – Measure Activities and Outcomes as Defined
9. Celebrate or Correct

Trailing Indicators

<table>
<thead>
<tr>
<th>Year</th>
<th>Major</th>
<th>Serious</th>
<th>Percentage Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>6</td>
<td>101</td>
<td>-37%</td>
</tr>
<tr>
<td>2006</td>
<td>1</td>
<td>64</td>
<td>-48%</td>
</tr>
<tr>
<td>2007</td>
<td>4</td>
<td>33</td>
<td>-61%</td>
</tr>
<tr>
<td>2008</td>
<td>1</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>
Putting It Together

- **Probability** without **Exposure** = **Zero Risk**
- Low **Probability** does not increase with higher **Exposure**
- **Probability** requires **Exposure** to create a **Risk Event** (incident)
- Without sufficient **Energy** there is little or no **Severity**
- Without significant **Severity** there is little **Risk**

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Alan D. Quilley CRSP

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