Risk Assessment – A Useful Tool

Jim La Porte, CSP, CHMM


Winners of the:
JOB SAFETY AWARD

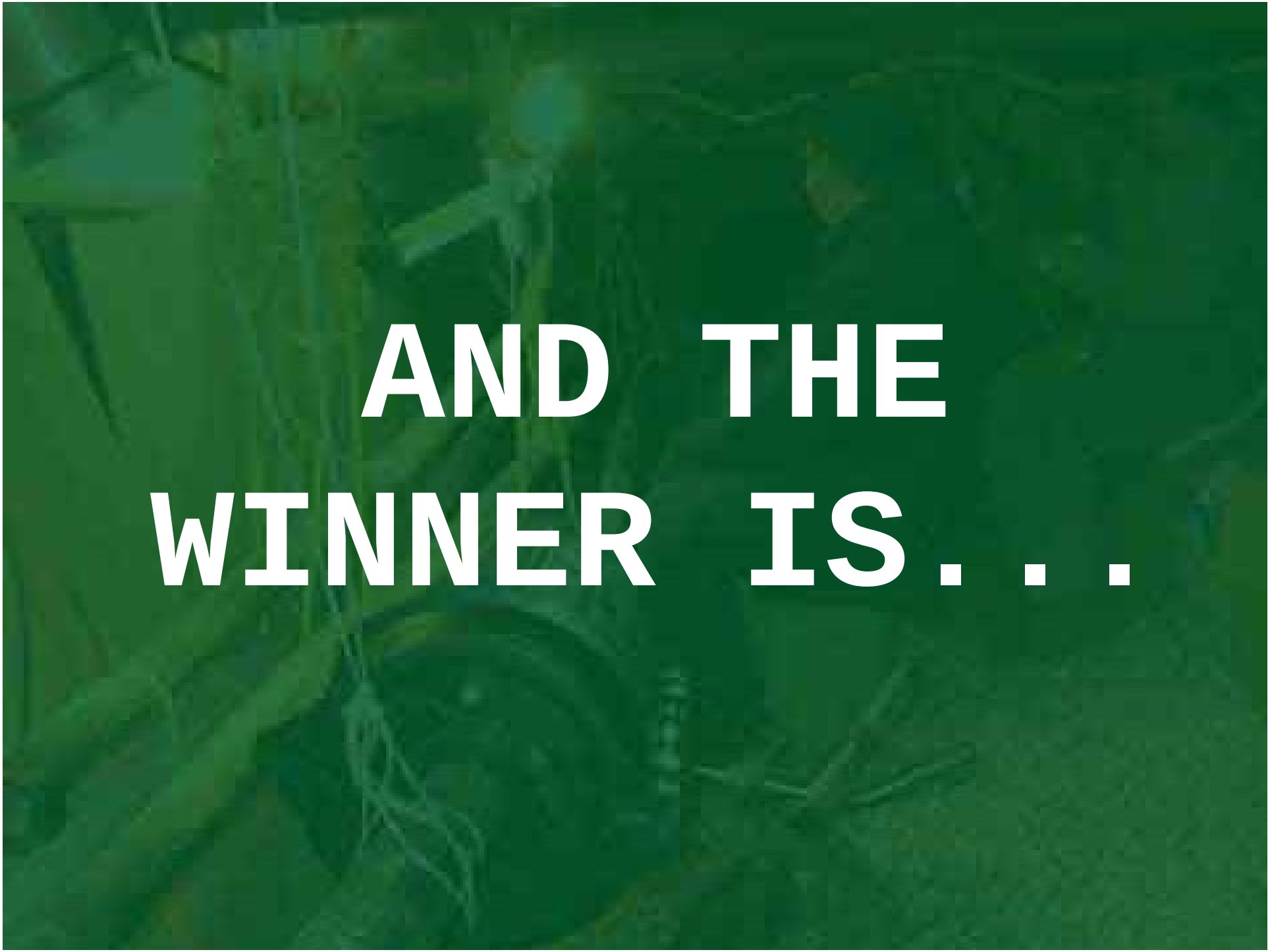

5º PLACE


4º PLACE


TOYOTA
KOMATSU
PATRIA 50

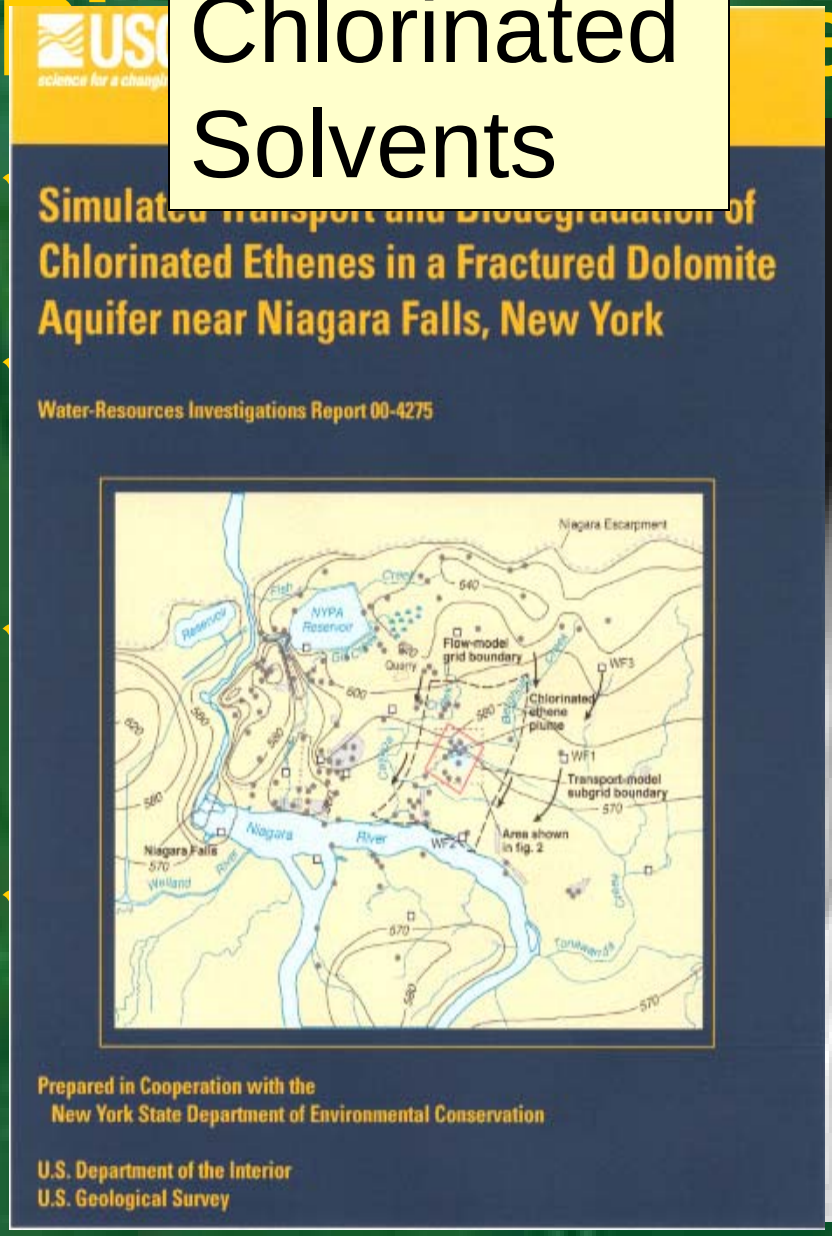

3º PLACE


2º PLACE


AND THE
WINNER IS...

Chlorinated Solvents

Asbestos



Health, Safety & Environmental (HSE) professionals are always doing some sort of risk assessment whether it be inspecting a hazardous waste storage area or observing the safe practices of an employee in the field.

Concerns about Risk Assessments

- ✓They are not communicated effe
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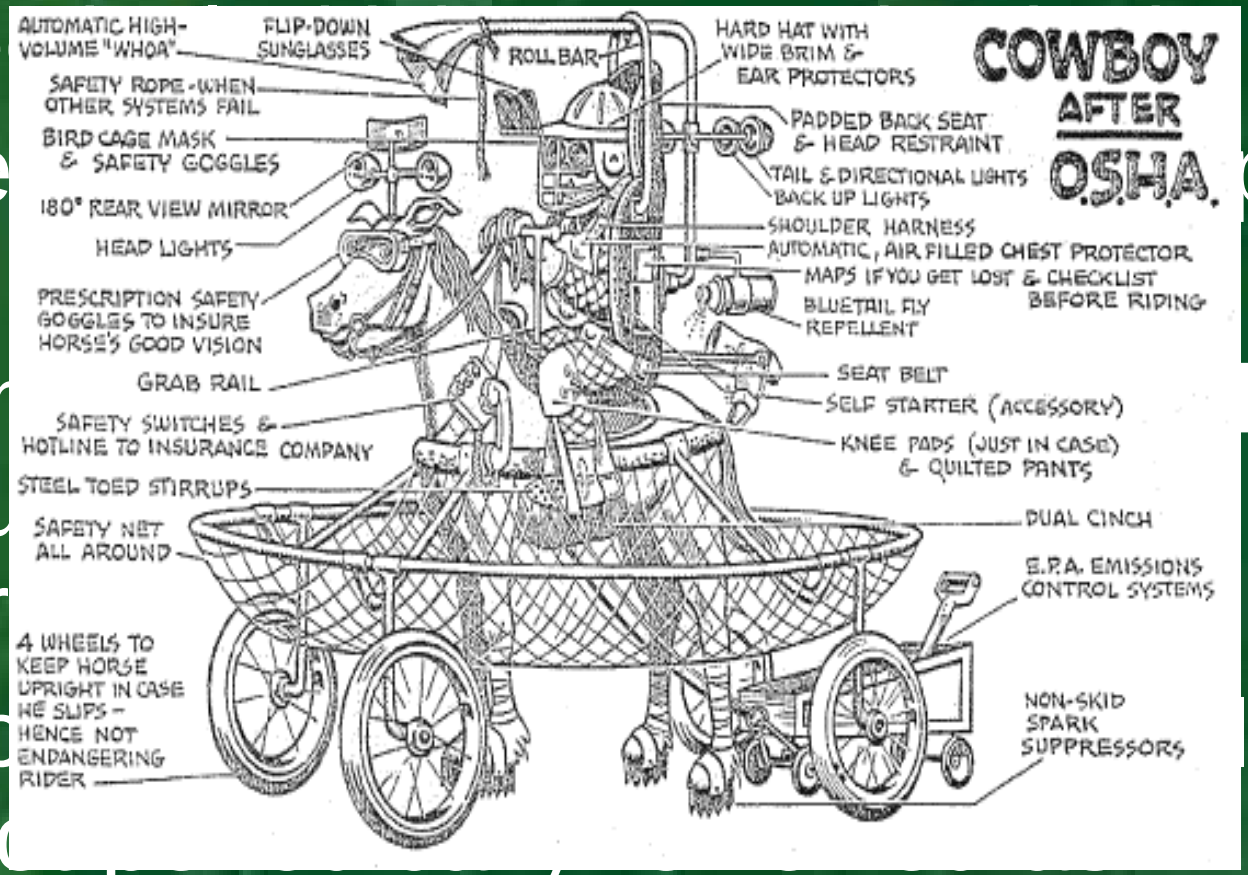
- ✓Onc leted is n conditions change or warrant.
- ✓Supported by management?

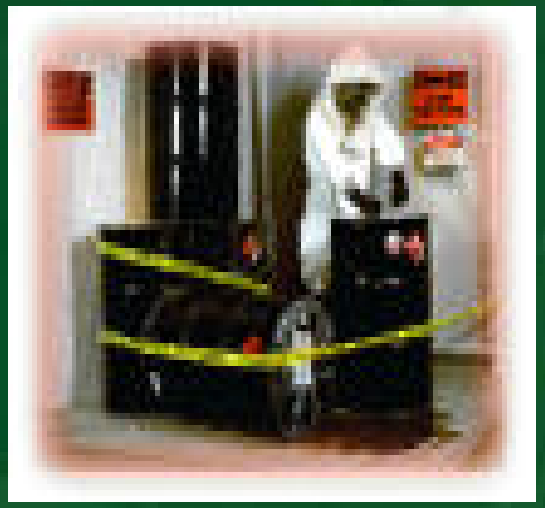


Practical Applications - Safety

- ✓ Accident investigations
- ✓ Employee complaints
- ✓ Equipment, machinery or process assessments
- ✓ Emergency response activities
- ✓ Safety auditing
- ✓ Safety observations

Practical Applications - Environmental

- ✓ Ground water contamination
- ✓ Air emissions
- ✓ Water discharges
- ✓ Property/land assessments



- ✓ Waste treatment solutions
- ✓ Environmental impacts

How Risk Manifests Its Self In Practical Terms

We all know what happened in this case!

(AHRAE, ANSI, etc..)

How is risk defined?

Does eating too many Big Mac's cause obesity? What is the risk if I eat a Big Mac a day? What is the risk to the customer and the company?


Could you imagine this today?

Risk is defined many different ways

Risk descended into English from the Italian rischio. It refers to possible damage or negative consequences due to unpredictable circumstances.

WEATHER RISK

By Bob Dischel

More hedgers would come into the weather derivatives market if a more reliable pricing method was available. Well here is one

At last: a model for weather risk

Many potential hedgers are not entering the weather derivatives market because they don't know how to price the instruments and the market isn't transparent enough. After all, who could find comfort in an opaque over-the-counter market that can be seen only through a keyhole, and where an ask price can be two or three times the bid price?

Hedgers want eyeglasses to correct this distorted vision, and will come to the market as soon as they understand pricing – provided they also see value. To spot value, however, they need fair pricing technologies, and these are not widely available.

The decision by the Chicago Mercantile Exchange to seek approval to trade futures and options indexed to temperatures (see page 5) may bring daylight to a market that keeps end-users in the dark. Exchange trading in futures based on eight US cities will enhance price discovery at those sites, and can provide opportunities to offset risk through correlation and diversity. But hedgers are also interested in hundreds of other sites.

These potential hedgers, who number in the tens of thousands, are unable to evaluate prices at the sites that interest them without the aid of pricing models. Because of this limited price transparency they cannot yet recognise the market's ability to meet their risk management needs. The goal of this article is to set out a straightforward procedure to price weather derivatives, specifically temperature derivatives – to offer a model that can be constructed by any weather market player with knowledge of quantitative techniques.

In addition to price, an important product of our model is the 'expected return profile' which is an intrinsic feature of most value-at-risk (VAR) management programs, although they may be known by different names. The VAR of a portfolio is the worst loss expected to be suffered over a given period of time with a given probability.

In two earlier articles (Dischel, *Energy & Power Risk Management*, October 1998; Dischel, *Applied Derivatives Trading*, November 1998) a mean-reverting two-parameter model of temperature and temperature changes was presented. A two-parameter model was proposed, based on the belief that the distributions of temperature and its day-to-day changes are different – the two distributions evolve differently over time. This piece describes the implementation of that model in more detail.

We look into the past to see the future. We will assume that the time series of temperatures observed at a site over a meagre few decades is one possible sequence from the distribution that also governs the future. The observed sequence will be used to define the distribution from which the sequence was drawn. The distribution we are looking for is not represented well by the accumulated values on which derivative contracts are paid – there are too few data points and the meteorological sequence is masked. Therefore, the history of daily weather values, rather than a seasonal collection of values, such as the history of degree-days over a contract term, will be used.

We want to estimate the level and variability of future seasons – the principal attributes that we need to be able to price derivatives.

A two-parameter model that will do this is:

$$dT = \left[\alpha\Theta(t) + \beta T(t)\right]dt + \gamma dm_1 + \delta dm_2$$

As before, T is the temperature that varies over time, t. The parameter Θ is the time-varying daily temperature averaged over many years for each date. This average reflects the inevitable march of the meteorological seasons that lag the solar cycle. Θ is the gravitational nucleus to which the simulated temperature reverts in the absence of randomness. Gamma (γ) and delta (Δ) do not relate to delta hedging and are constant coefficients in this equation.

This first equation is written a little differently here than it was in the earlier articles. The standard deviations of the historical distributions and the Wiener processes, dz_1 and dz_2, have been replaced by the actual distributions, dm_1 and dm_2. Note that we have moved away from the notion that the model imposes a normal or some other distribution. We make no assumption about the shape of the distributions – rather we will bootstrap the future distribution from the actual history of temperatures.

The model used in this article is a descendant of the above equation. This one-parameter temperature model yields very acceptable, fair values. If, for now, we include only the randomness of day-to-day temperature changes, the model, in finite difference form, can be reduced to:

$$\hat{T}_{n+1} = \alpha\Theta_{n+1} + \beta\hat{T}_n + \delta\Delta T_{\varepsilon(n)+1}$$ The circumflex on $\hat{T}$ signifies that it is the simulated or projected temperature. The subscript n indicates a point in time, say today, and n+1 indicates the next period, say tomorrow. The random selection of forward temperature change is ΔT. We solve for α, β and δ, imposing α+ β=1, and δ≤1.

Viewing an example might be helpful.

The Hot Air Gas Company is a fictional company located near the US-Canadian border. Winters are cold and gas sales for heating rise as tempera-

Figure 1

Hot Air Gas Company
Gas demand vs. outdoor temperature

Risk:

The computation of risk. Risk is a threat that exploits some vulnerability that could cause harm to an asset. The risk algorithm computes the risk as a function of the assets, threats, and vulnerabilities. One instance of a risk within a system is represented by the formula (Asset * Threat * Vulnerability). Total risk for a network equates to the sum of all the risk instances.

securityresponse.symantec.com/avcenter/refa.html

Risk:

A study to determine risks posed by the site if no cleanup action was taken and what cleanup levels need to be established to be protective of human health and the environment. There are two types of risk assessments. Human health risk assessment looks at the risks to humans from contamination at the site and an ecological risk assessment looks at the risks to ecosystems, such as plants, fish, and animals, from contamination at the site.

www.state.ak.us/dec/dspar/csites/glossary.htm

Risk:

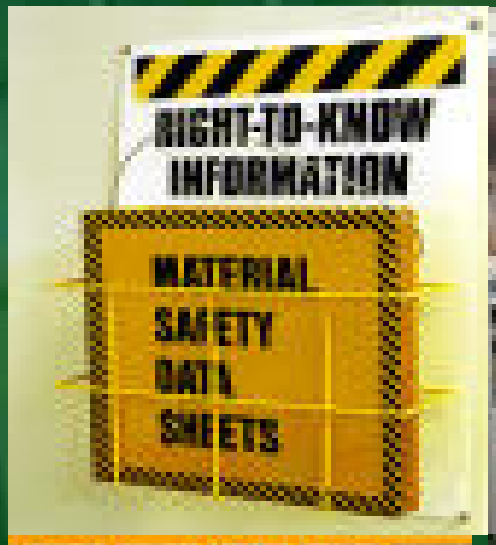
Qualitative and quantitative evaluation of the risk posed to human health and/or the environment by the actual or potential presence and/or use of specific pollutants

www.deq.state.mt.us/pcd/awm/haz/RCRA/RCRA_Glossary.asp

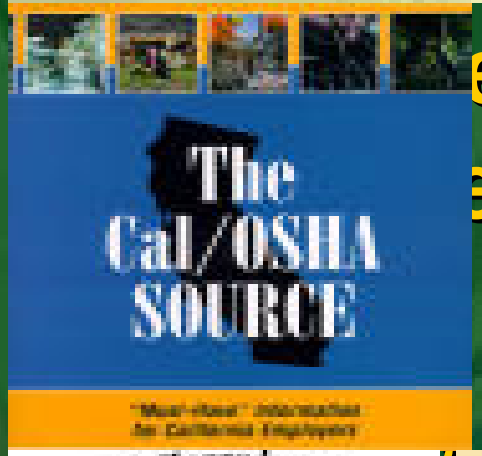
Risk Assessment Objectives

Remember that the goal of a risk assessment to ultimately to anticipate and reduce or eliminate the likelihood of injury, property loss or impact on the environment. My experience has been that the earlier in the process a risk assessment of any type is employed the better. The practical application ranges from a person first getting into a car and putting on a seatbelt to the clean up of a superfund site.

OSHA even refers to the theory of risk assessment in the Michigan Occupational Safety & Health Act by requiring that each employer “furnish to each employee employment and a place of employment that is free from recognized hazards that are causing or likely to cause death or serious physical harm to the employee”.


RIGHT-TO-KNOW
INFORMATION
MATERIAL
SAFETY
DATA
SHEETS


Research


The
Cal/OSHA
SOURCE


Environmental
Protection
Agency


A S
S E


Academy of Certified Hazardous Materials Managers
ACHMM

CAUSES OF SLIP-AND-FALLS

UNSA
UNCLE
FLOO
SURFA

ROPRIATE
TWEAR

INSUFFI
TRAIN

Data Available Through Various Sources; OSHA, EPA, BLS, ASSE, ACHMM, Trade Associations, Company Information, Manufacturer, etc…

- *National Floor Safety Institute*

Lets Look At The Practical Side Of Risk Assessment By Looking At Two Models In **Theory** and In Practice:

- ✓ A risk assessment on an industrial robot.
- ✓ A risk assessment of a manufacturing facility for ISO 14001.

SP
ISO 14001
Certified

Risk Assessment Process

- ✓ Hazard identification and recognition.
- ✓ Evaluation of the risk (i.e. ranking the risks by frequency, severity and probability).
- ✓ Eliminating or minimizing the risk.
- ✓ Risk communication.

The process of completing a risk assessment on an industrial robot follows the ANSI standard R15.06. In a condensed version it entails:

1. Gathering information about the robot itself such as operating and maintenance information.

2. Assembling a group of affected employees to identify what types of tasks are performed on the robot during both routine and non routine operations and the frequency of the task.(identifcatiion of Tasks)

The process should include for a piece of machinery, equipment or process:

- ✓ Persons who operate, maintain or otherwise interact with the machinery, equipment or process
- ✓ Engineering or design personnel
- ✓ Machinery, equipment or process manufacturer's)

One must consider QC and Maint/Service functions that might be involved even if infrequent.

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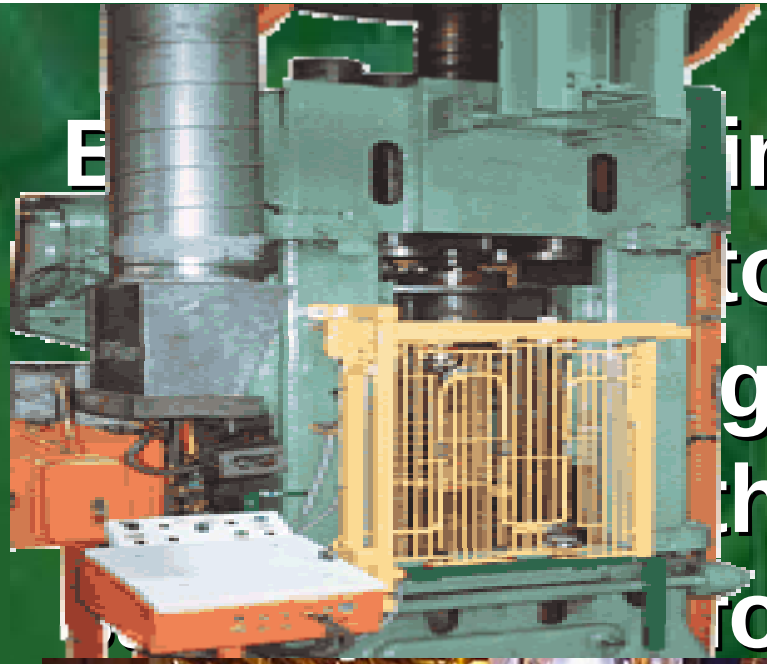

Risk Assessment – Machinery Summary

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Lets look at another risk assessment process with an environmental flavor!

The process of completing a risk assessment an a manufacturing facility to complete the aspects and impacts portion of ISO 14001 certification is like the robot risk assessment. The aspects and impacts starts with a group attempting to identify the aspects in the facility such as a bulk storage tank and their impact on the environment such as air, land, water. The next step is to quantify the risk.

frequency categorization	
Category	**Description**
1	Not expected to occur during the facility lifetime (50 yrs)
2	Expected to occur several times within the facility lifetime
3	Expected to occur more than once in a year
4	Expected to occur more than once in a month

consequence categorization	
Category	**Public Consequences**
0	No injury or health effects
1	Minor injury or health effects
2	Moderate injury or health effects
3	Death or severe health effects

Category	Employee Safety Consequences
0	No injury or occupational safety effect
1	Minor injury or minor occupational illness
2	Moderate injury or occupational illness
3	Death or severe occupational illness

Category	Environmental Consequences negative impact on the environment
0	no significant environmental impact
1	$1000 -$10,000 natural resource replacement value
2	$10000 -$100,000 natural resource replacement value
3	greater than $100,000 natural resource replacement value

Category	Environmental Consequences in terms of regulatory/legal impact (fines/fees/reporting/operating costs) *
0	no regulatory/legal obligation
1	low *
2	medium**
3	high***

* low =	small area or few environmental media impacted - little regulatory/legal involvement expected
** medium =	moderate area or several environmental media impacted - regulatory/legal involvement and oversight expected
***high =	large area or groundwater impacted OR off-site contamination - regulatory/legal enforcement expected

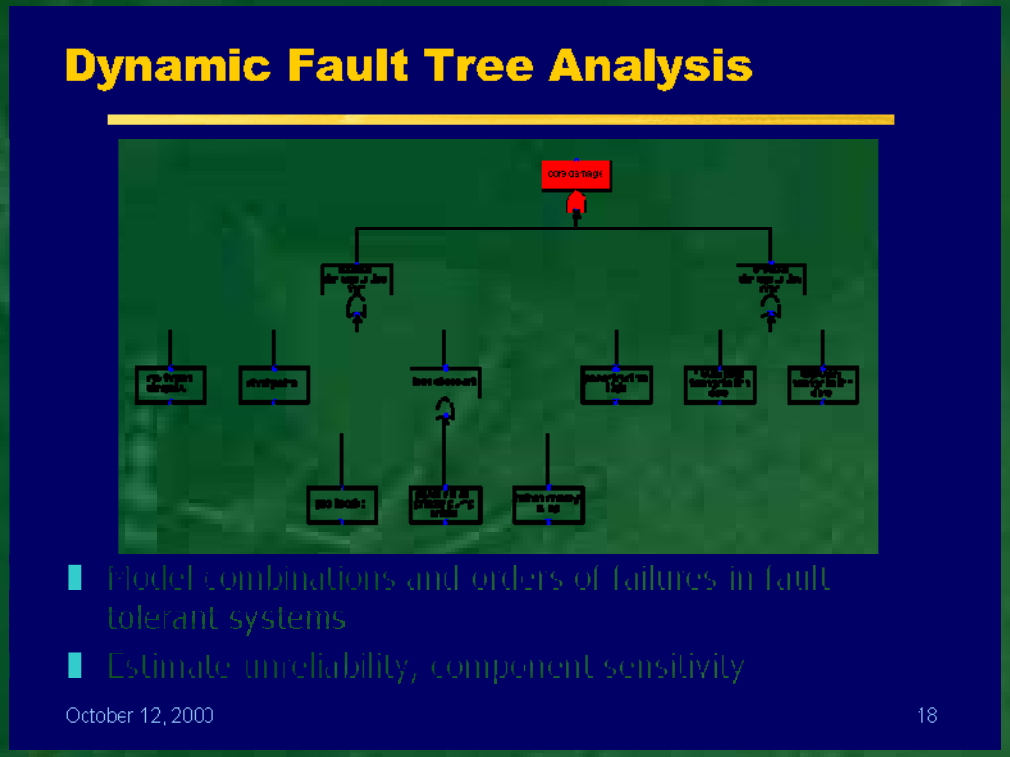
1	Shut down with no impact to customer
2	Shut down the Tier I customer
3	Shut down the assembly plant

Area	Aspects
Autowax	Autowax
Process Chemical Storage	Bulk Storage - Wax
On-Line	Foam pour
On-Line	Mold opening & demold
Chemical Unloading	Tanker (TDI)
Chemical Unloading	Tanker (TDI)
Chemical Unloading	Tanker (TDI)
On-Line	Mold opening & demold
Foamer	TDI Surge Skid
Foamer	Pour head
Foamer	Pour head
Foamer	Pour head
Chemical Transfer	TDI
Chemical Transfer	TDI

Impacts	Public Consequences	Employee Safety Consequences	Environmental Consequences - Impact on Environment	Environmental Regulatory/ Legal Consequences	Business Interruption Consequences	Consequences Sub-total	Frequency	Total
wax air emission	1	1	1	3	3	9	4	36
air emissions	0	1	0	2	1	4	4	16
air emissions	0	1	0	2	1	4	4	16
air emissions	0	1	0	2	1	4	4	16
spills - air emissions (TDI)	1	2	0	2	3	8	2	16
spills -soil/groundwater impact	0	2	3	3	0	8	2	16
spills -storm water impact	0	2	3	3	0	8	2	16
waste chemicals from mis								

What Other Formal Risk Assessment Protocols Exist

- ✓What If
- ✓Fault Tree Analysis
- ✓HAZOP
- ✓Checklist
- ✓8D
- ✓Six Sigma

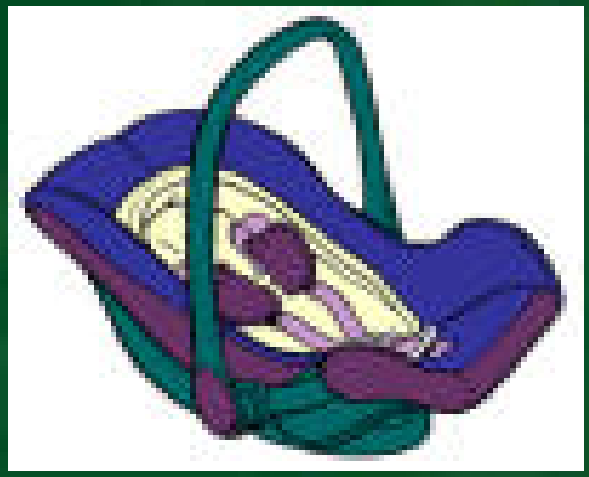


Risk Assessment Information:

Enables decision makers to easily understand and categorize the risk to determine the methods and costs to reduce or eliminate the risk's.

Ultimately, the decisions are left up to Management. How do they respond?

- ✓Take no action
- ✓Modify
- ✓Redesign
- ✓Substitute
- ✓Eliminate

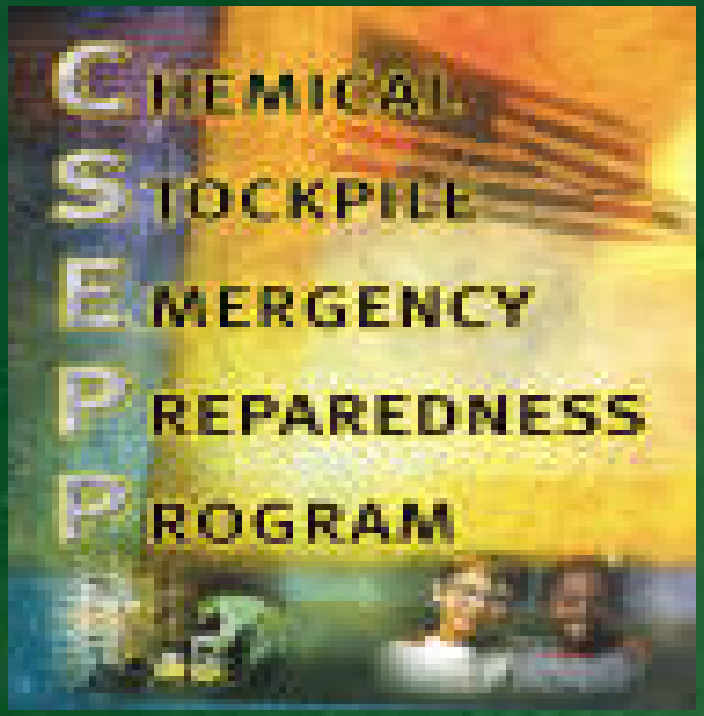


If you asked anyone in your company What is the biggest risk to your companies future?

Quality, stopped production, scrap, etc…

Risk Communications

- ✓Formal Education & Training
- ✓Accident/Incident Alerts
- ✓Meetings
- ✓Manuals
- ✓Warnings Signs
- ✓Observations



Talk About Risk Prevention!

Questions???

and remember

GO BUCKEYES!!!