Prioritizing Workplace Risks – A Cost Benefit Approach

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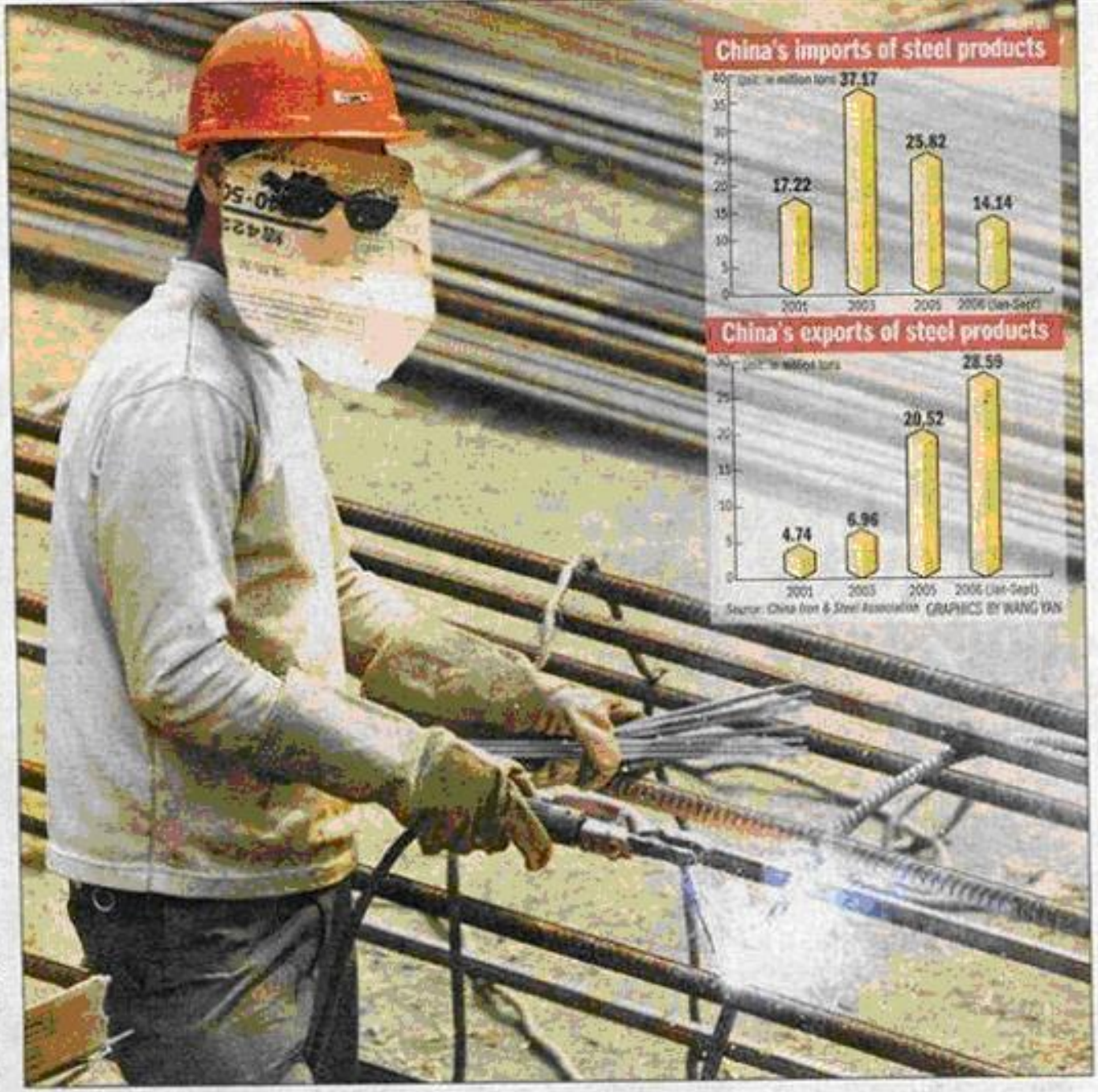


A worker welds at a construction site in Nanjing, the capital of East China's Jiangsu Province.

FILE PHOTO

Risk Perception and Assessment

- Human perceptions of risk are notoriously inaccurate
- Employees are willing to take the "wrong" chances
- EHS professionals are also prone to misjudge risk

Choose between:

A. A sure gain of $240
B. A 25% chance of winning $1,000 and a 75% chance of winning nothing

Choose between:

A. A sure loss of $760
B. A 75% chance of losing $1,000 and a 25% chance of losing nothing

Table 1. Ordering of perceived risk for 30 activities and technologies (*22*). The ordering is based on the geometric mean risk ratings within each group. Rank 1 represents the most risky activity or technology.

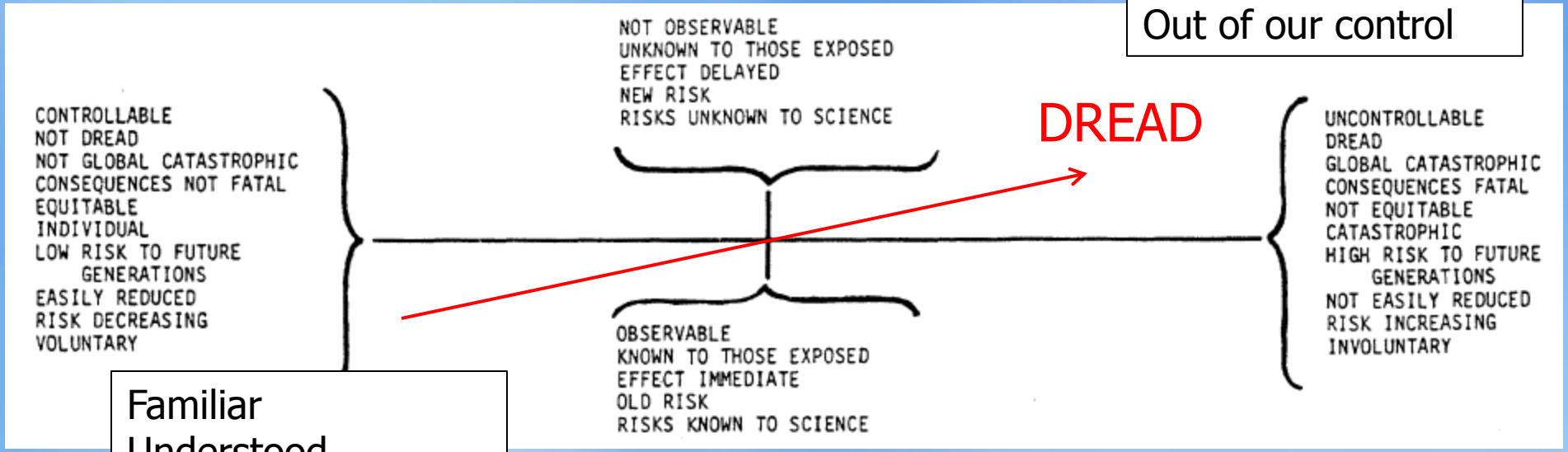
Activity or technology	League of Women Voters	College students	Active club members	Experts
Nuclear power	1	1	8	20
Motor vehicles	2	5	3	1
Handguns	3	2	1	4
Smoking	4	3	4	2
Motorcycles	5	6	2	6
Alcoholic beverages	6	7	5	3
General (private) aviation	7	15	11	12
Police work	8	8	7	17
Pesticides	9	4	15	8
Surgery	10	11	9	5
Fire fighting	11	10	6	18
Large construction	12	14	13	13
Hunting	13	18	10	23
Spray cans	14	13	23	26
Mountain climbing	15	22	12	29
Bicycles	16	24	14	15
Commercial aviation	17	16	18	16
Electric power (non-nuclear)	18	19	19	9
Swimming	19	30	17	10
Contraceptives	20	9	22	11
Skiing	21	25	16	30
X-rays	22	17	24	7
High school and college football	23	26	21	27
Railroads	24	23	29	19
Food preservatives	25	12	28	14
Food coloring	26	20	30	21
Power mowers	27	28	25	28
Prescription antibiotics	28	21	26	24
Home appliances	29	27	27	22
Vaccinations	30	29	29	25

Perceptions of Risk

Reference: Slovic P, 1987. "Perceptions of Risk", Science. 236 (4799): 280-285.

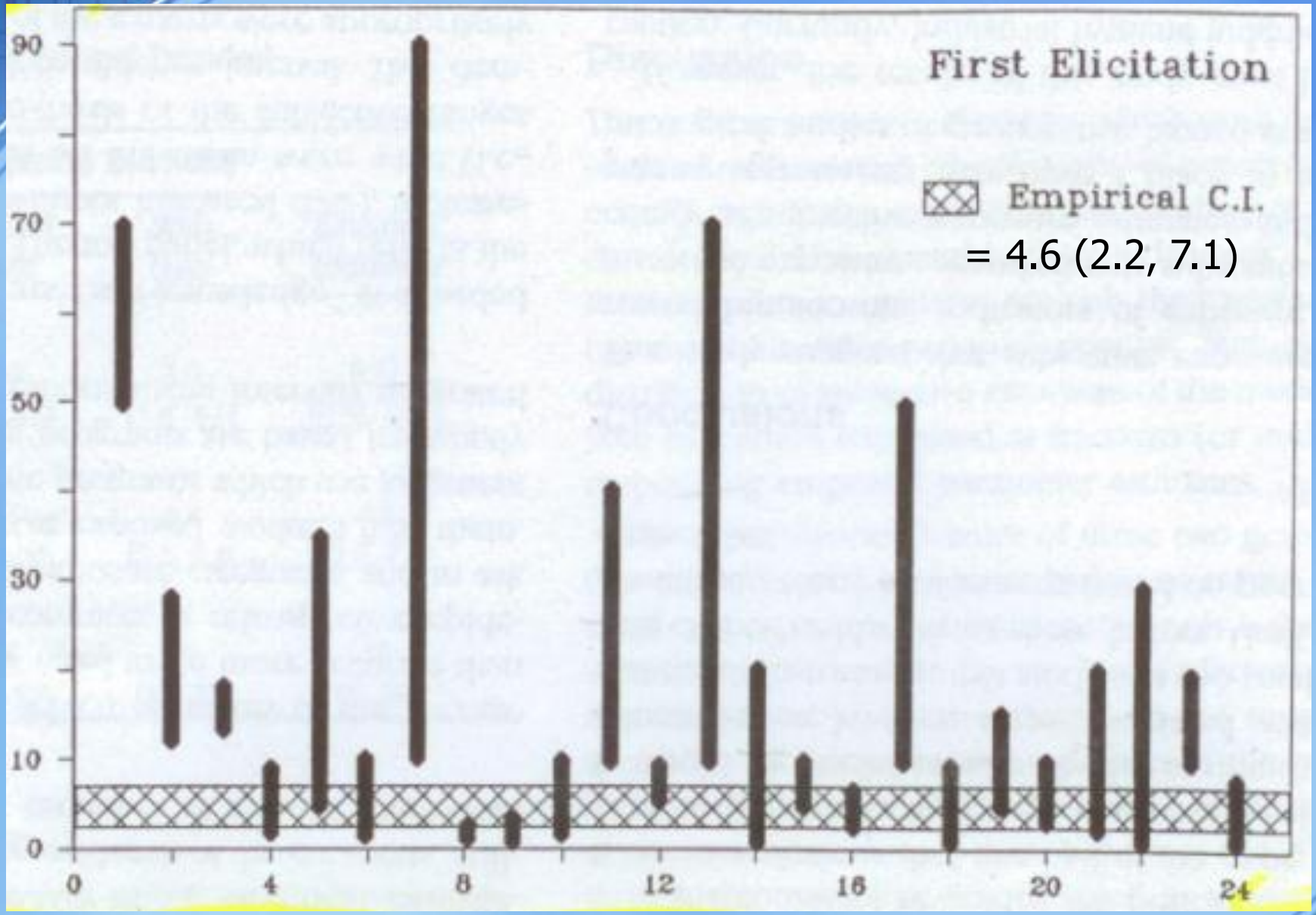
Perceptions of Risk

Unfamiliar
Not understood
Out of our control

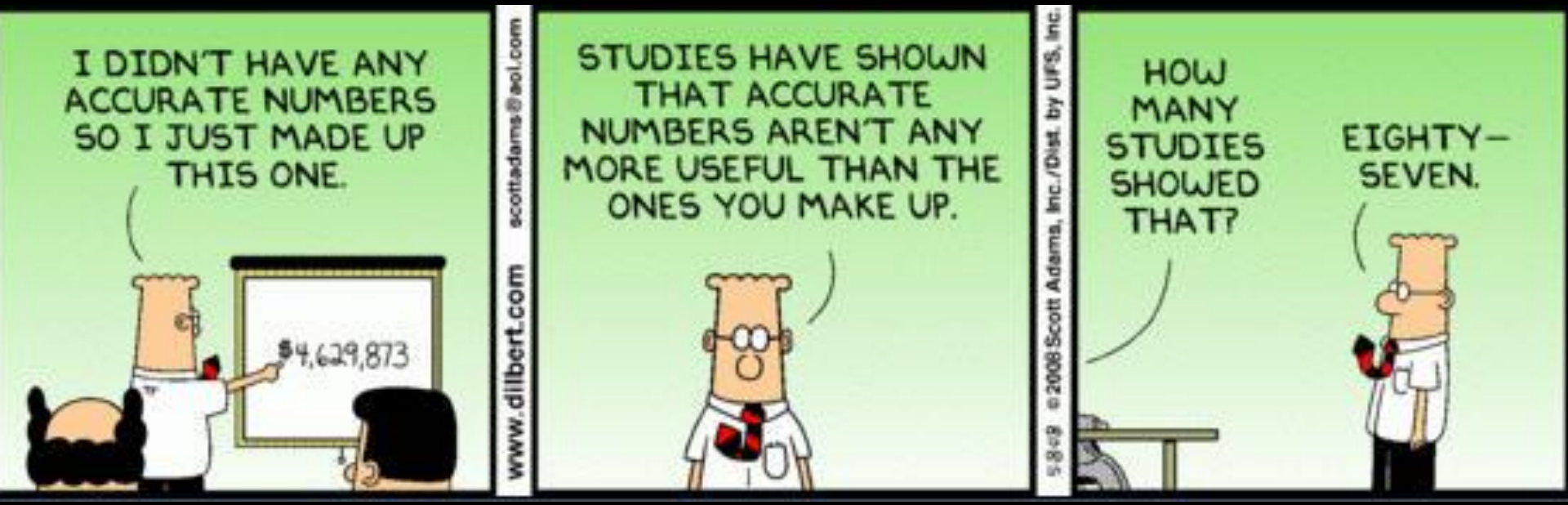


Familiar
Understood
Under our control

Reference: Slovic P, 1987. "Perceptions of Risk", Science. 236 (4799): 280-285.



Source: Hawkins and Evans, Appl. Ind. Hyg. 4: 61-68, 1989


I DIDN'T HAVE ANY ACCURATE NUMBERS SO I JUST MADE UP THIS ONE.
$4,629,873
www.dilbert.com scottadams@aol.com
STUDIES HAVE SHOWN THAT ACCURATE NUMBERS AREN'T ANY MORE USEFUL THAN THE ONES YOU MAKE UP.
5-8 ©2008 Scott Adams, Inc./Dist. by UFS, Inc.
HOW MANY STUDIES SHOWED THAT?
EIGHTY-SEVEN.

Risk Assessment Matrix

Probability of Occurrence of Harm	Severity of Harm			
	Catastrophic (4)	Serious (3)	Moderate (2)	Minor (1)
High (4)	High (16)	High (12)	Medium (8)	Low (4)
Medium (3)	High (12)	High (9)	Medium (6)	Low (3)
Low (2)	Medium (8)	Medium (6)	Low (4)	Negligible (2)
Remote (1)	Low (4)	Low (3)	Negligible (2)	Negligible (1)

Courtesy of AMT - The Association for Manufacturing Technology

From ANSI B11-TR3 Note: Modified version of matrix

High Risk	Moderate Risk	Low Risk	Negligible

Common Problems with Risk Rankings and Risk Matrices

- Too little differentiation
- May assign identical ratings to very different risks
- Different users may obtain different ratings
- Don’t reflect relative risk
- Resources may be misallocated if risks are not weighted properly

#	Topic Area	Observation	Adverse Event	Probability of Adverse Result	Severity of Injury or Violation	Current Risk Score	Risk Level
1	Confined Spaces	Air monitors that are out of calibration were used prior to confined space tank entries.	Asphyxiation	Remote	Catastrophic	4	Low
2	Fire Protection	There are no automatic fire protection systems in areas where flammable chemicals are used.	Explosion	Remote	Catastrophic	4	Low
3	Housekeeping	Angle iron behind tanks are a hazard for a contusion or cut.	Contusion or cut	Low	Moderate	4	Low
4	Slip, Trip, and Fall Prevention	There is no guardrail on the top of tank 210, which also has a sloped top.	Fatal fall	Remote	Catastrophic	4	Low
5	Toxic and Hazardous Substances	Material Safety Data Sheets are not available for many chemicals in use on site.	Inadvertent mixing or exposure	Remote	Catastrophic	4	Low

Risk Assessment Matrix

			Probability of Adverse Event this Year				
			1	2	3	4	5
			< 1 in 1,000	1 in 100	1 in 10	1 to 10 events	> 10 events
Severity of Adverse Event		**Weight**	**0.01**	**0.1**	**1**	**10**	**100**
1	Minor injury	**0.01**	0.0001	0.001	0.01	0.1	1
2	Possible lost time injury	**0.1**	0.001	0.01	0.1	1	10
3	Serious - amputation, disability, etc.	**1**	0.01	0.1	1	10	100
4	Fatality	**10**	0.1	1	10	100	1000
5	10 or more fatalities	**100**	1	10	100	1000	10000

AIHA Exposure Ratings

Rating*	Description	Values
0	Trivial	< 0.01 x OEL
1	Highly controlled	0.01 to 0.1 x OEL
2	Well controlled	0.1 to 0.5 x OEL
3	Controlled	0.5 to 1 x OEL
4	Poorly controlled	>1 x OEL

OEL = Occupational Exposure Limit

*Ratings based on "A Strategy for Assessing and Managing Occupational Exposures", 2006, 3rd edition. American Industrial Hygiene Association, Farifax, VA. (trivial category added)

			Expected frequency/number of adverse outcomes				
			1	2	3	4	5
			0.01	0.1	1	10	> 100
Severity of Adverse Event		**Weight**	**0.01**	**0.1**	**1**	**10**	**100**
1	Minor injury/irritation	**0.01**	0.0001	0.001	0.01	0.1	1
2	Temporary disability	**0.1**	0.001	0.01	0.1	1	10
3	Permanent disability	**1**	0.01	0.1	1	10	100
4	Fatality	**10**	0.1	1	10	100	1000
5	10 or more fatalities	**100**	1	10	100	1000	10000

		0.1 x OEL	1 x OEL	10 x OEL
N exposed x freq of exposure		**1**	**2**	**3**
1,000 exposure events/yr	**1**	0.01	0.1	1
10,000 exposure events/yr	**2**	0.1	1	10
100,000 exposure events/year	**3**	1	10	100

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5	Toxic and Hazardous Substances	Material Safety Data Sheets are not available for many chemicals in use on site.	Inadvertent mixing or exposure	Remote	Catastrophic	4	Low

#	Topic Area	Observation	Adverse Event	Frequency of Adverse Result	Severity of Injury or Violation	Current Risk Score	Risk Level
1	Confined Spaces	Air monitors that are out of calibration were used prior to confined space tank entries.	Asphyxiation	1	4	0.1	Moderate
2	Fire Protection	There are no automatic fire protection systems in areas where flammable chemicals are used.	Explosion	1	5	1.0	High
3	Housekeeping	Angle iron behind tanks are a hazard for a contusion or cut.	Contusion or cut	2	2	0.01	Low
4	Slip, Trip, and Fall Prevention	There is no guardrail on the top of tank 210, which also has a sloped top.	Fatal fall	2	4	1.0	High
5	Toxic and Hazardous Substances	Material Safety Data Sheets are not available for many chemicals in use on site.	Inadvertent mixing or exposure	1	4	0.1	Moderate

What's still missing?

"Hierarchy of Controls"

Substitution/Elimination

Engineering Controls

Administrative Controls

Personal Protective Equipment

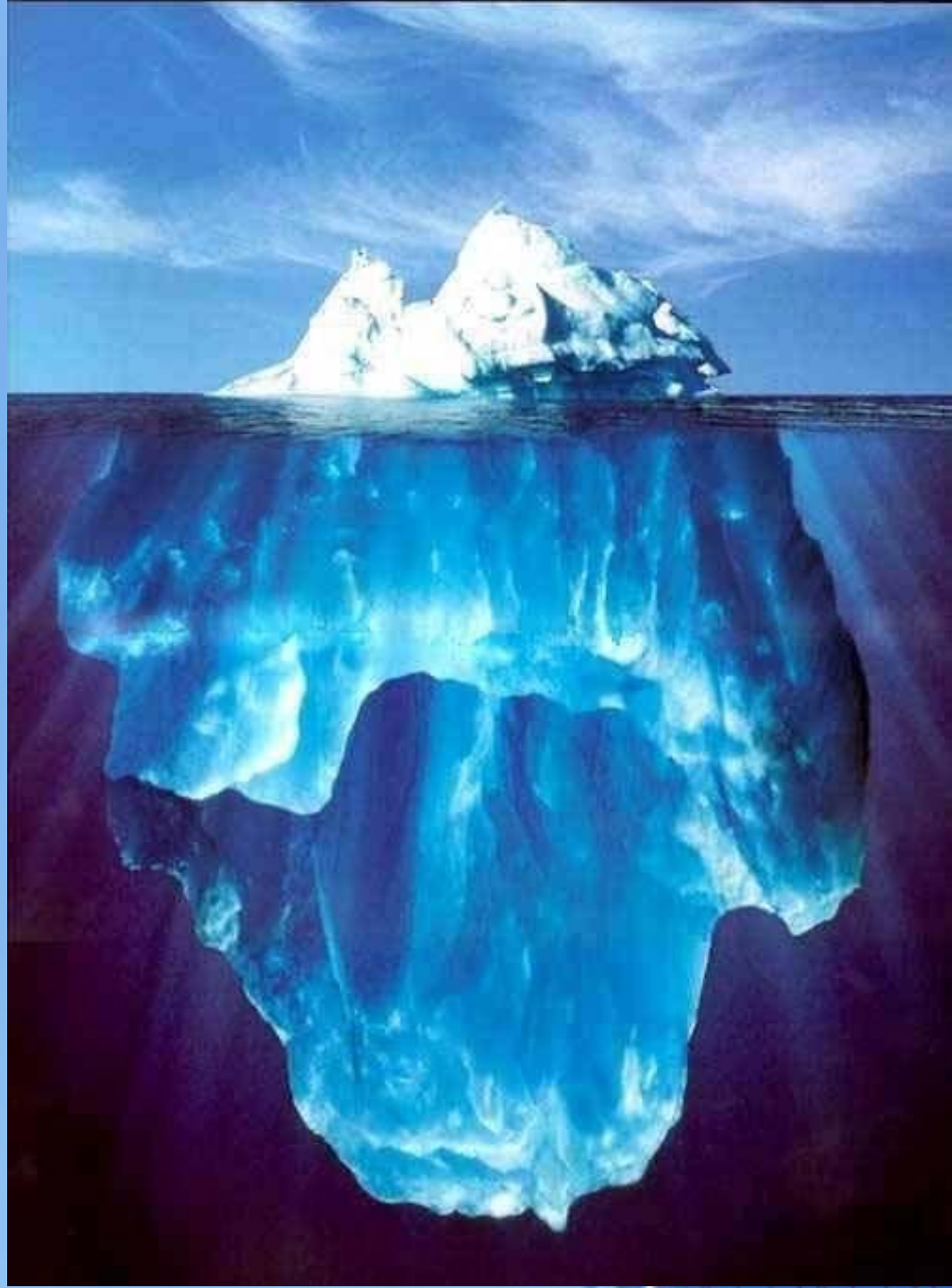
	Proposed Control(s)	Risk Reduction (%)
1	Elimination	100
2	Fail safe engineering	95
3	Engineering	80
4	Administrative/Barriers	50
5	PPE	20

#	Topic Area	Current Risk Score	Recommended Action(s)	Effectiveness of Proposed Controls	Risk Reduction
1	Confined Spaces	0.1	Ensure air monitoring with a calibrated gas meter prior to all entries.	4	0.05
2	Fire Protection	1.0	Install a foam fire protection system in the tank area.	3	0.80
3	Housekeeping	0.01	Cut off or protect protruding angle iron.	1	0.01
4	Slip, Trip, and Fall Prevention	1.0	Install automatic tank level detection and prohibit access to the top of the tank	1	1.0
5	Toxic and Hazardous Substances	0.1	Ensure prompt procurement of an accurate MSDS for all chemicals.	4	0.05

Slip, Trip, and Fall Prevention	1.0	Use fall protection to tie off on top of the tank	4	0.50
	1.0	Provide a guardrail on top of the tank	3	0.8
	1.0	Install automatic tank level detetion and prohibit access to the top of the tank	1	1.00

Topic Area	Raw (Uncontrolled) Risk Score	Primary Control Strategy	Residual (Current) Risk Score
Ergonomics	100	Admin	50
Motor Vehicle / Fleet Safety	10	None	10.0
Bloodborne Pathogens	10	Admin	5.0
Lockout/tagout	10	Admin	5.0
Fire Protection and Life Safety	10	Engineer	2.0
Electrical	1.00	Admin	0.50
Powered Industrial Trucks	1.00	Admin	0.50
Slip, Trip, and Falls	1.00	Admin	0.50
Hazard Communication	1.00	Admin	0.50
Machine Guarding	1.00	Engineer	0.20
Industrial Hygiene	1.00	Engineer	0.20

Cost/ Benefit Analysis



Terms and Equation

- Return-on-Investment (ROI)
- Benefit/Cost Ratio
- Rate of Return

$$ROI = \frac{Benefits/Time}{Initial\ Investment}$$

ROI = Risk Reduction / Cost

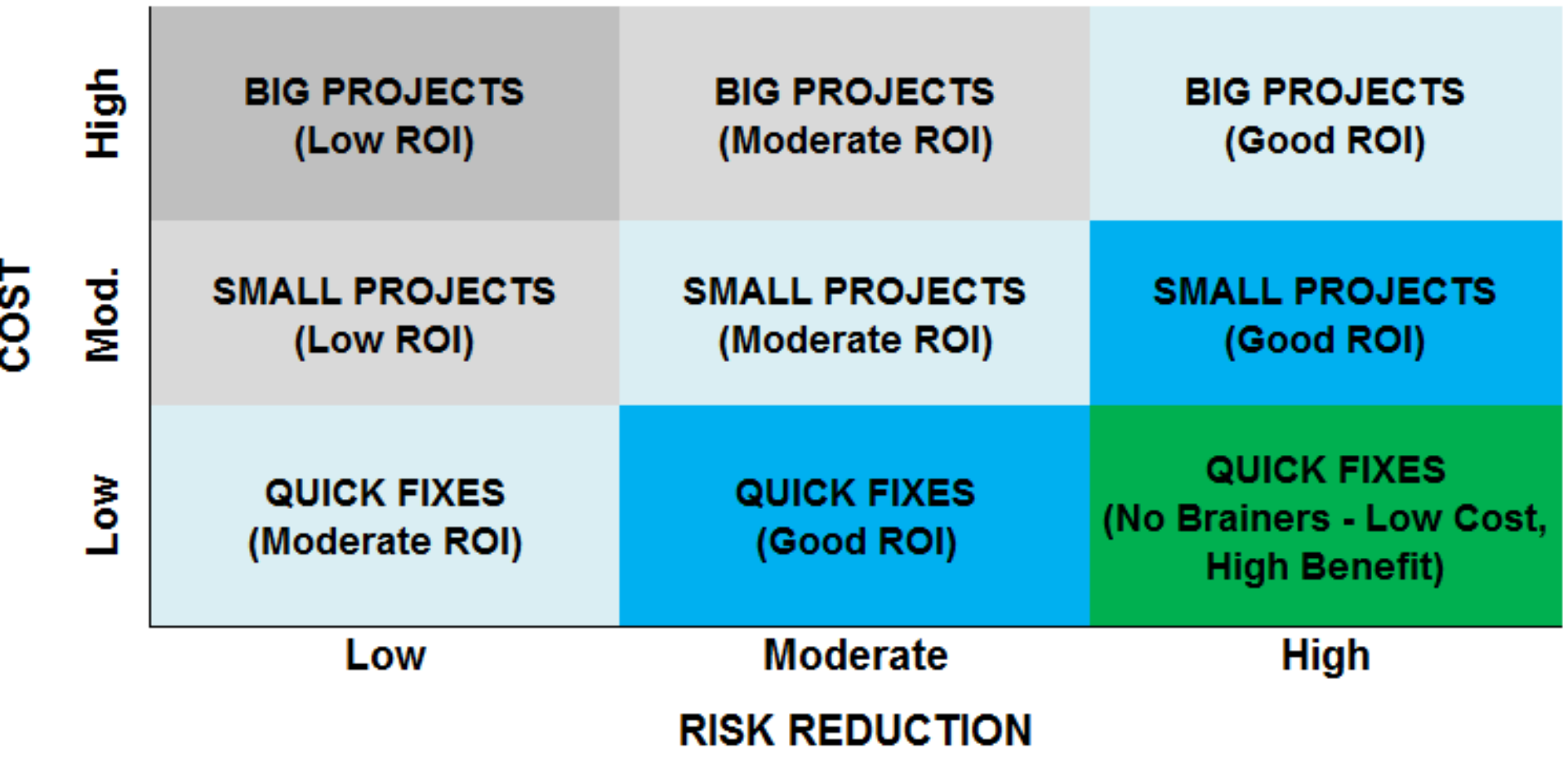
Estimating Costs

- Labor/salary costs
- Capital expenditures
- Expenses
- Worker's compensation
- Business impacts
- Lost productivity
- Property damage
- Fines, Lawsuits, Etc.
- Depreciation
- Etc.

Estimating Benefits

- Reduced risk
- Reduced worker's compensation
- Reduce time away from work
- Avoid injuries, fines, liability, . . .
- Avoid property damage
- Increased productivity
- Improved public image
- Increased sales
- Etc.

#	Topic Area	Current Risk Score	Recommended Action(s)	Effectiveness of Proposed Controls	Risk Reduction	Cost to Implement	ROI
1	Confined Spaces	0.1	Ensure air monitoring with a calibrated gas meter prior to all entries.	4	0.05	$2,000	0.03
2	Fire Protection	1.0	Install a foam fire protection system in the tank area.	3	0.80	$50,000	0.02
3	Housekeeping	0.01	Cut off or protect protruding angle iron.	1	0.01	$100	0.10
4	Slip, Trip, and Fall Prevention	1.0	Install automatic tank level detection and prohibit access to the top of the tank	1	1.0	$5,000	0.20
5	Toxic and Hazardous Substances	0.1	Ensure prompt procurement of an accurate MSDS for all chemicals.	4	0.05	$5,000	0.01


COST
High
Mod.
Low
BIG PROJECTS (Low ROI)
BIG PROJECTS (Moderate ROI)
BIG PROJECTS (Good ROI)
SMALL PROJECTS (Low ROI)
SMALL PROJECTS (Moderate ROI)
SMALL PROJECTS (Good ROI)
QUICK FIXES (Moderate ROI)
QUICK FIXES (Good ROI)
QUICK FIXES (No Brainers - Low Cost, High Benefit)
Low
Moderate
High
RISK REDUCTION

Risk Communication

- Get buy-in beforehand
- Use a participatory process
- Keep communications simple
- Discuss uncertainty
- Don’t belittle or condescend to your audience
- Don’t make promises you can’t keep

YOUR FEEDBACK IS IMPORTANT!

Please remember to complete a session evaluation form.

Collection boxes are located in the back of the room.

Thank you!

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