Welcome to the HKARMS Risk Management and Safety Seminar on

Managing Workplace Health and Safety – Systematic Approach vs Innovative Approach

by

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CFIOSH, MCIOB, F.PFM, FSOE

17 April 2014, 7:00 pm to 8:30 pm

City University of Hong Kong

Co-Organisers:

HKARMS 香港風險管理與安全協會 Hong Kong Association of Risk Management and Safety

Department of Systems Engineering and Engineering Management
City University of Hong Kong

Supporting Organisations:

HKIE The Hong Kong Institution of Engineers Safety Specialist Committee

香港核學會 Hong Kong Nuclear Society

職安健聯會 FOSHA Hong Kong

香港職業安全衛生協會 Hong Kong Occupational Safety and Health Association

Society of Registered Safety Officers SRS

HKIUS 香港管綫專業學會 Hong Kong Institute of Utility Specialists

CCPDC 社建 Community & Construction Professionals' Development Centre

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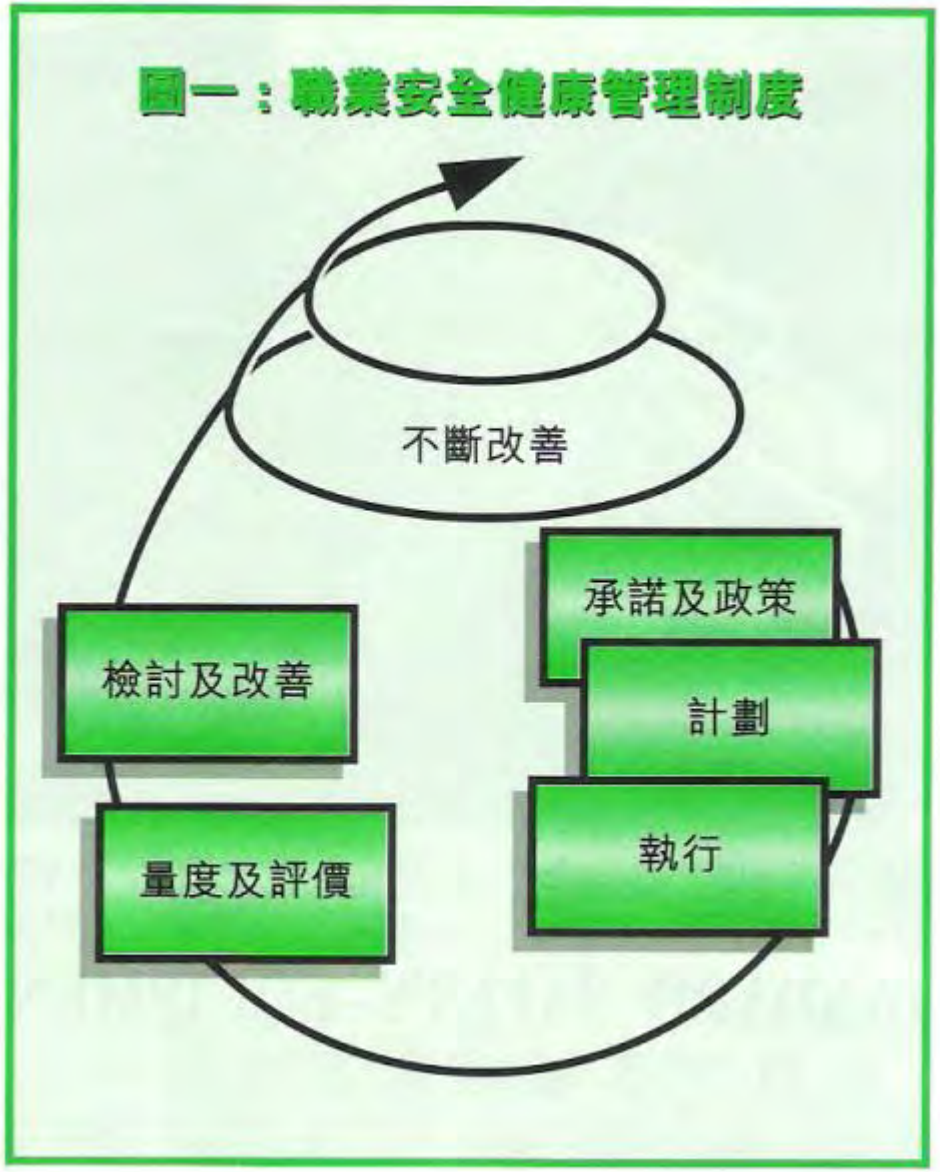
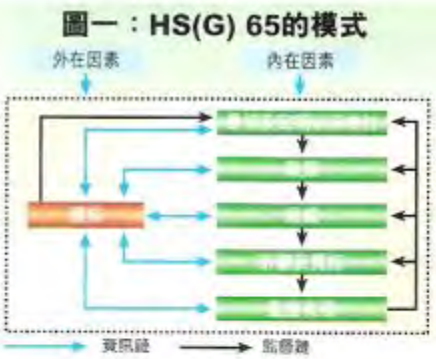
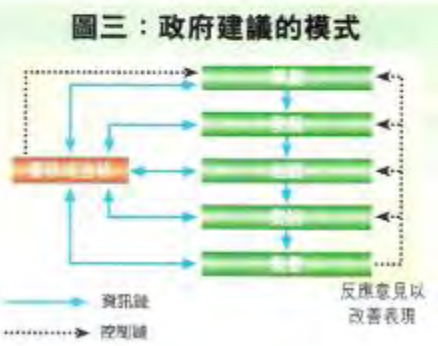
Safety Management - Systematic Approach

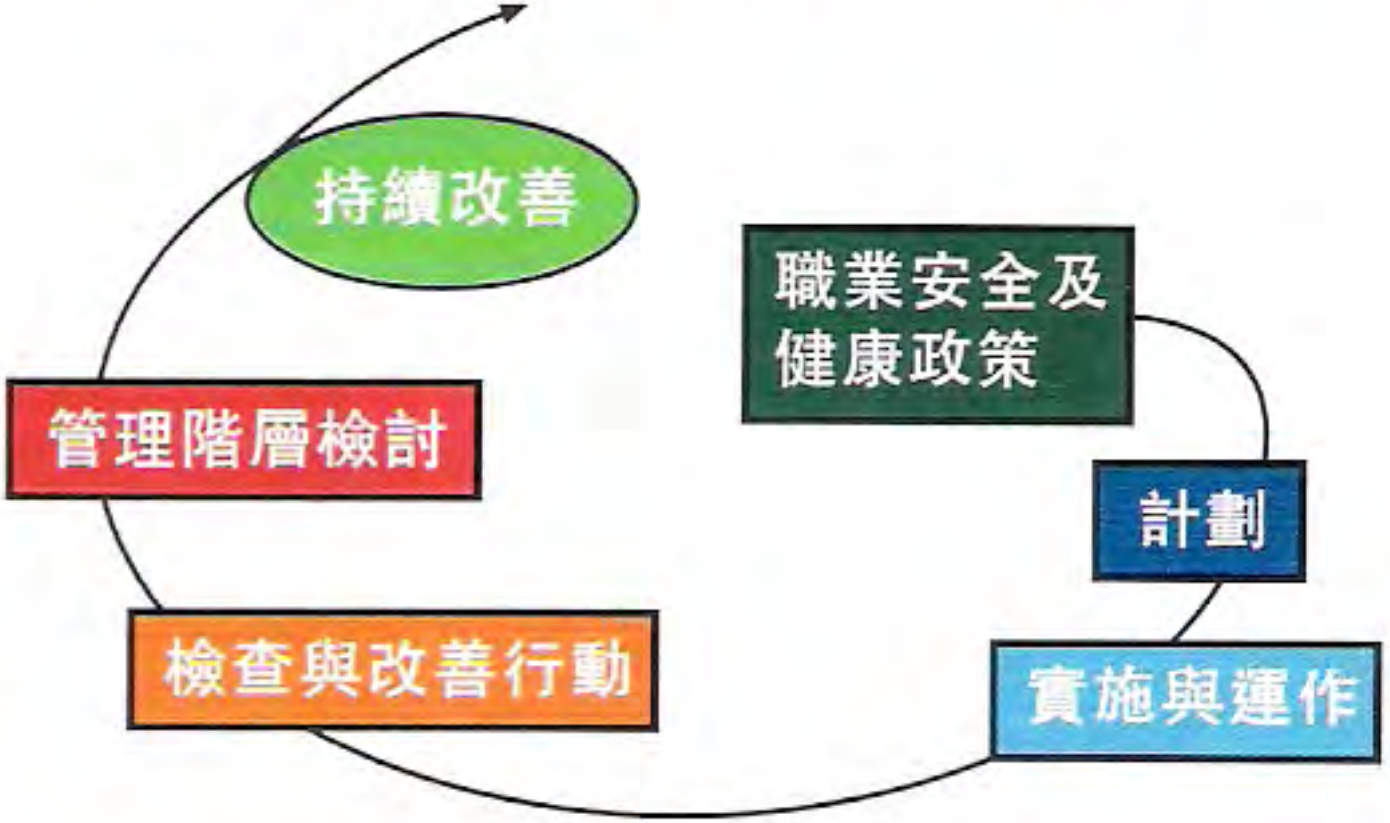




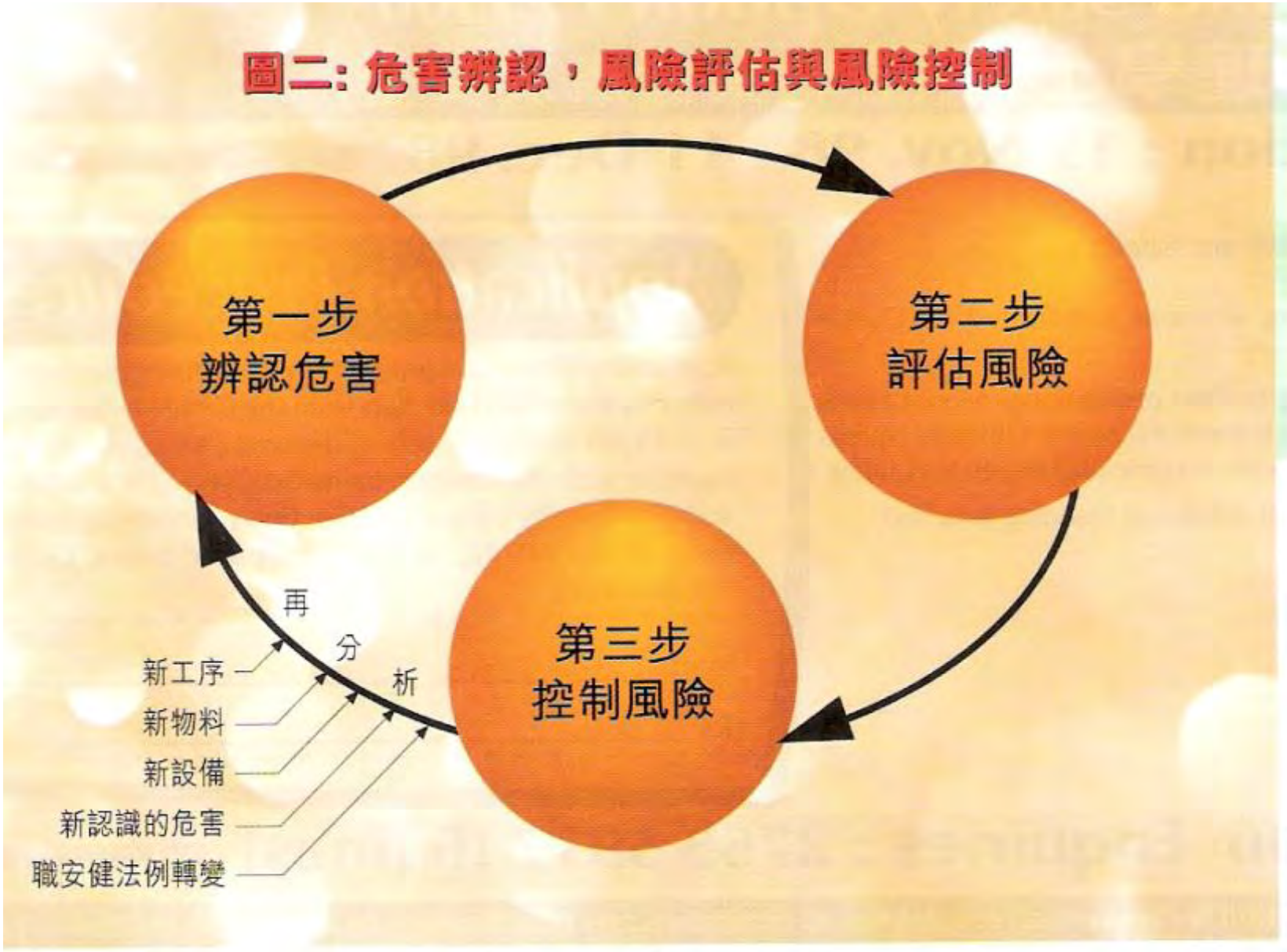


Safety Management - Systematic Approach

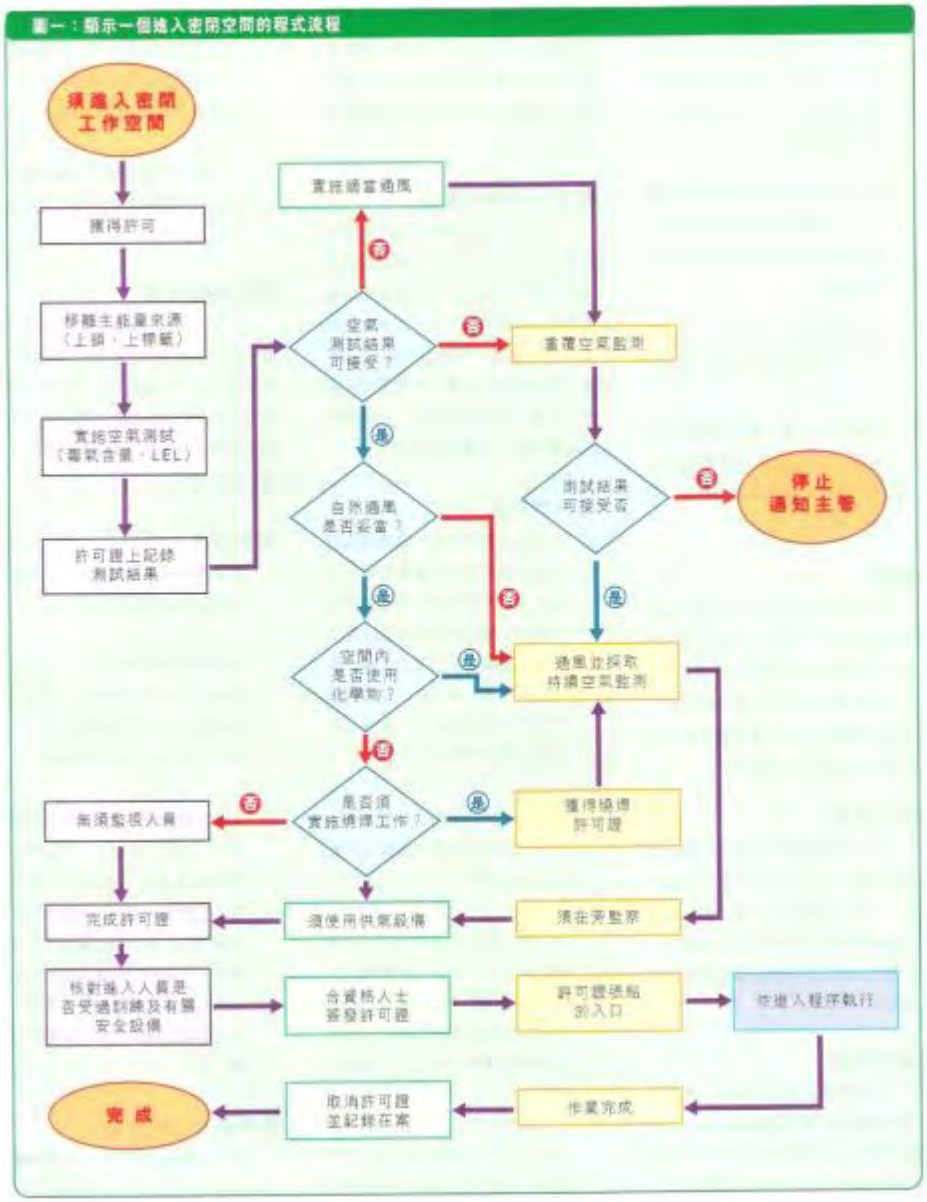
圖一：成功的安全健康管理的要素



Risk Management - Systematic Approach



Confined Space Risk Management - Systematic Approach



Safety Management - Systematic Approach

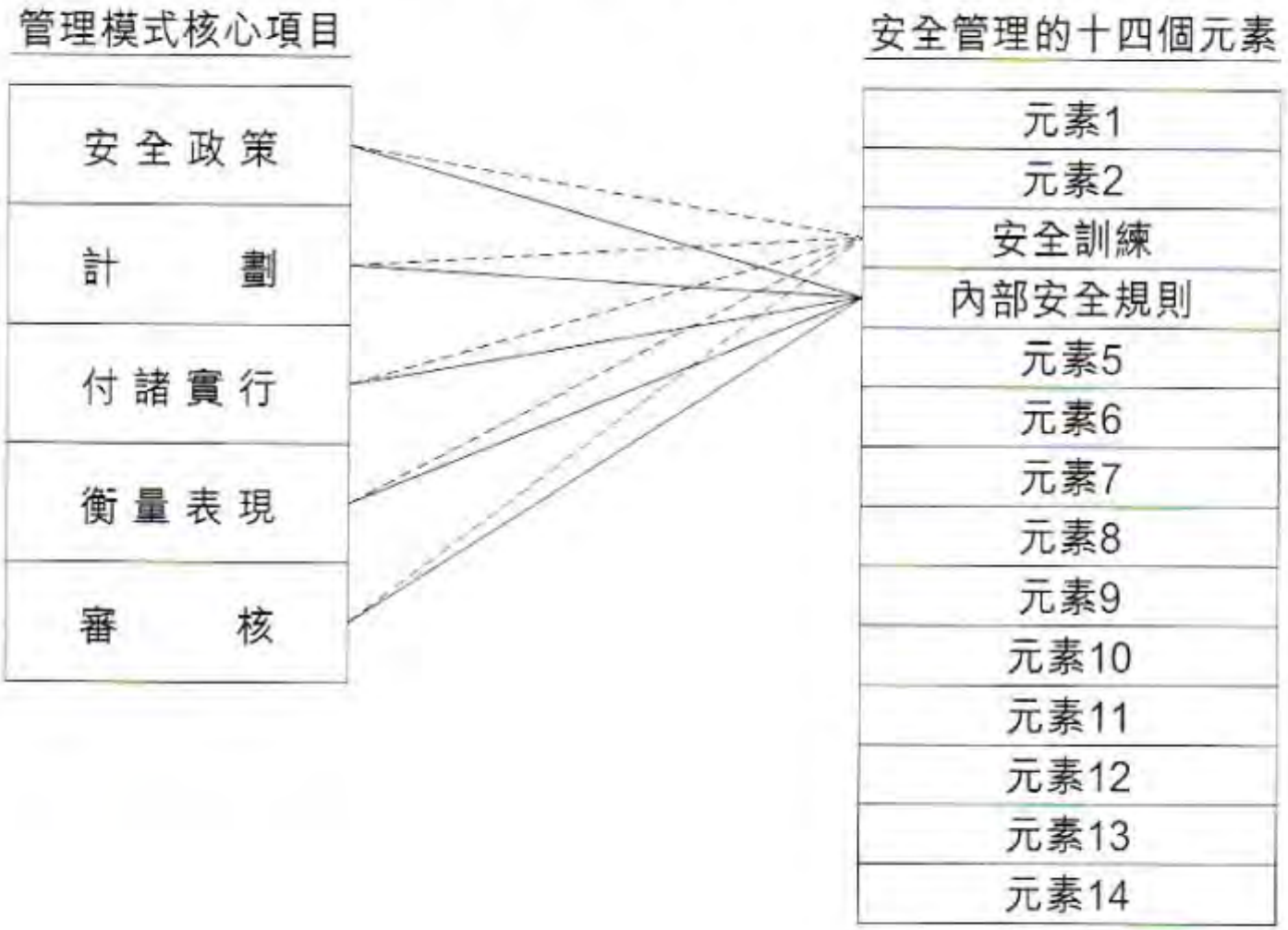
圖二：有安全元素但不連系

Safety Management - Systematic Approach

圖三：基本安全管理制度

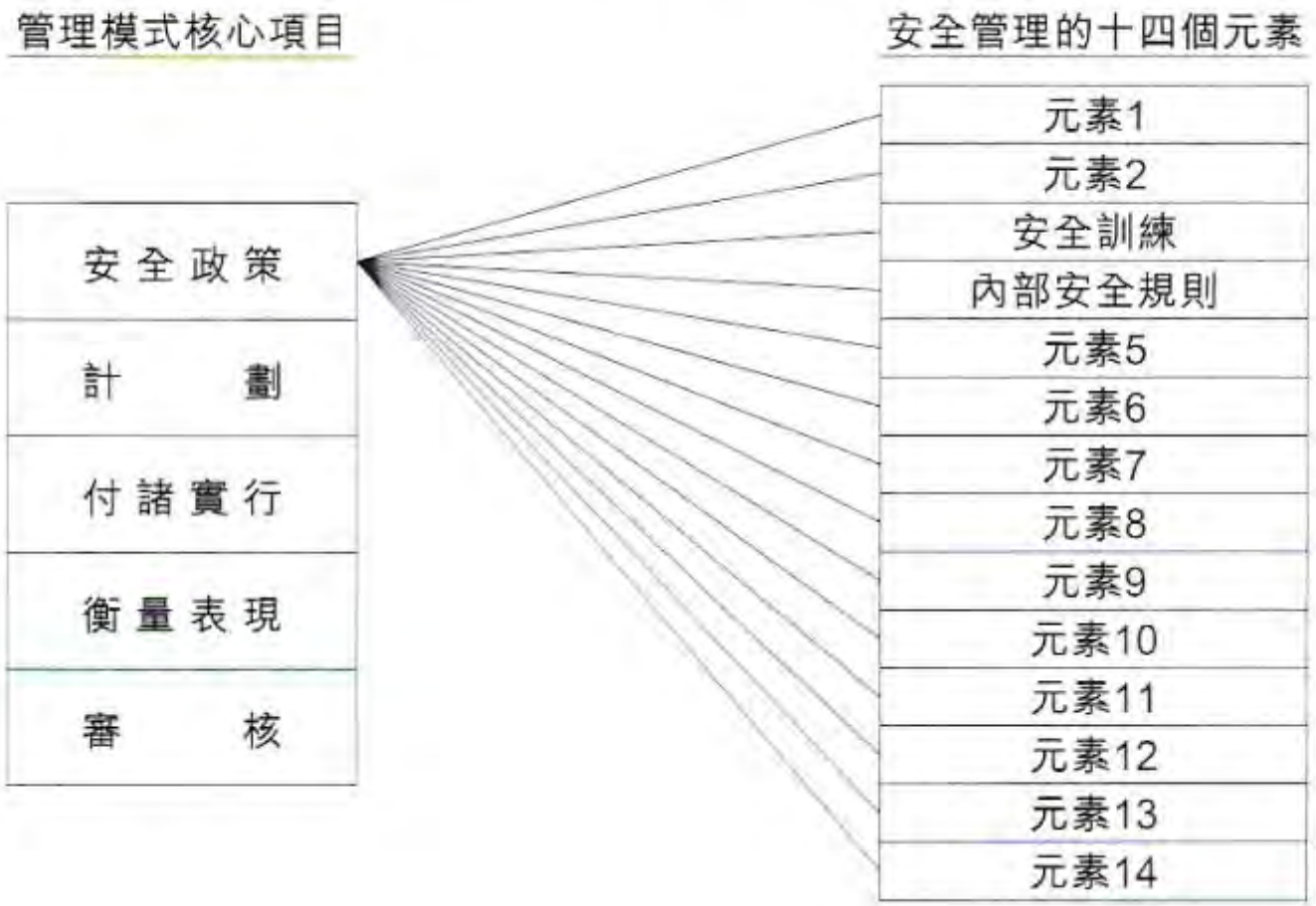
Safety Management - Mixed Approach

圖四：「橫切」方法



Safety Management - Systematic Approach

圖五：「垂直切」方法



Systematic Approach via Vertical Thinking

The Scientific Method

Focus

Observe

Hypothesize

Experiment

Evaluate

Systematic Approach via Vertical Thinking

The Scientific Method
is expressed from the outside in,
trying to understand existing things,
and put them in a tidy box.

Example of Systematic Safety Problem Solving Technique: Job Safety Analysis (JSA)

Job Safety Analysis Worksheet

Latitude:_____ Longitude:_____

Location: Supervisor: Date: Time:

Job Discription: Vacuum Truck Service Call Page 1 of 1

Gas Control Emergency Phone Numbers: 1-888-829-2251 or 956-712-6645 / 6646

Basic Job Steps	Potential Hazards	Potential Hands & Finger Hazards	Safety Recommendations
1. Pre-Trip	1. Job Delays 2. Breakdowns	n/a	1. Check truck and equipment to make sure everything is OK
2. Getting in and out of truck or trailer	1. Slips, trips and falls	n/a	1. Secure grip and foot hold to prevent accidents/injuries
3. Driving to and from location	1. Weather Conditions 2. Road Conditions	n/a	1. Adjust speed 2. Drive defensively
4. Check in with Company man	1. Possible chemical hazards or production operation changes	n/a	1. Visualize area to be worked on before moving truck.
5. Driving truck onto location	1. Running over equipment, cars hoses, pallets, people	n/a	1. Walk through area beforehand 2. Blow horn before backing up 3. Get help when backing into tight spaces or around corners
6. Rigging up	1. Slips 2. Falls 3. Strained backs	n/a n/a n/a	1. Check for wet areas (oil/water) 2. Turn on work lights @ night 3. Get help if needed, proper lifting skills
7. Loading or unloading	1. Oil base mud spills 2. Environmental contamination	n/a n/a	1. Check that all valves are closed and hoses tightened 2. Check levels of tanks before pumping
8. Rigging down	1. Oil base mud spills 2. Environmental contamination	n/a n/a	1. Check that all valves are closed (close valve on truck last) 2. Check levels on tanks for overfilling
9. Check out with Company man	1. Company man must know what is going on to prevent accdts	n/a n/a	1. Drive safely on way out

Safety Equipment Required

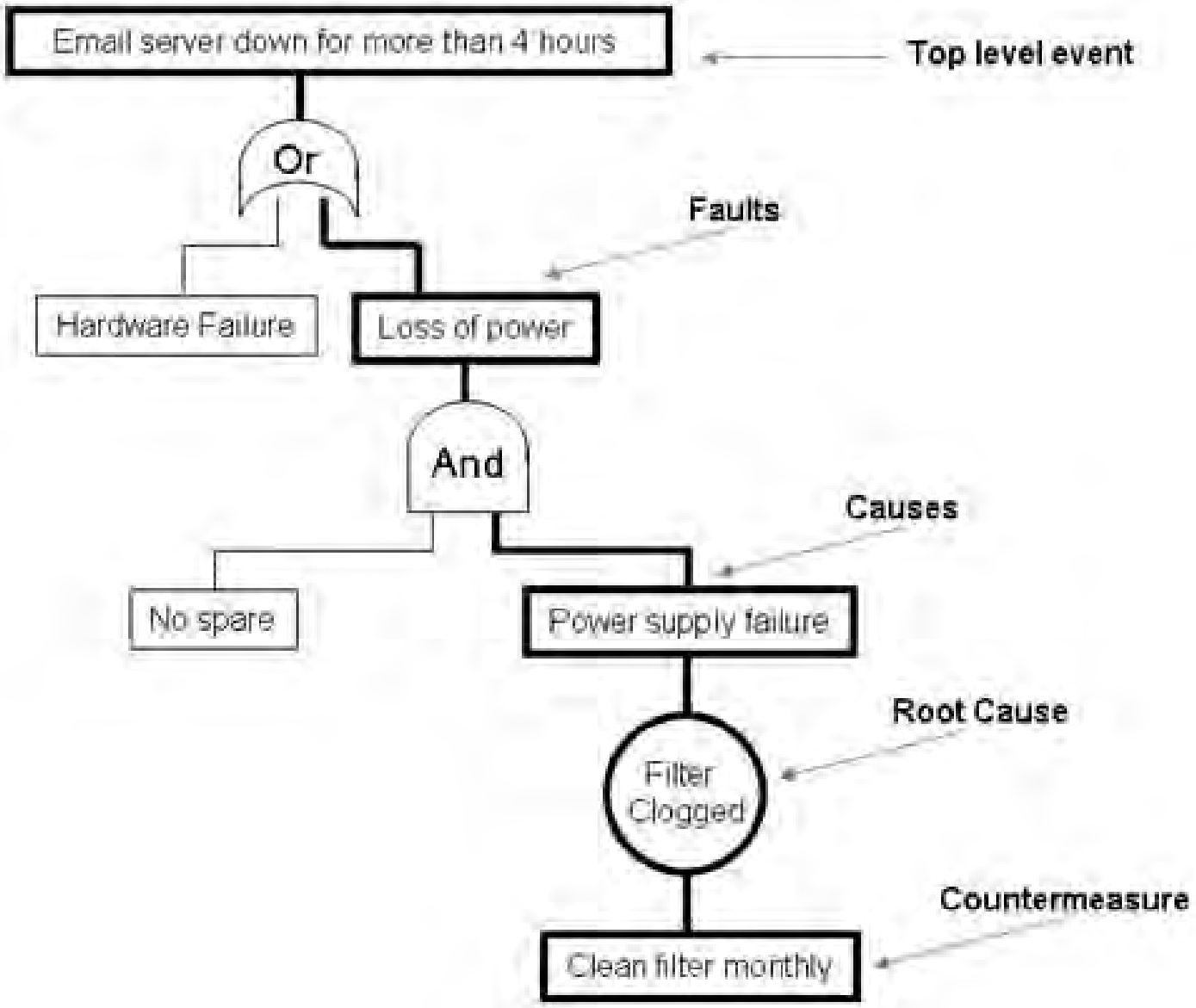
___ JSC Review	___ Safety triangles	___ Safety Belt/Harness	___ Nomex Coveralls
_x_ Work Gloves	___ Goggles/Face Shield	___ LO/TO	_x_ Cotton Clothing
_x_ Hard Hat	___ Chemical gloves	___ Ear Plugs	___ Bunny suit
_x_ Safety Glasses	_x_ Steel Toe boots	___ Respirator	

JSA Performed to Protect the Undersigned Employees:

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

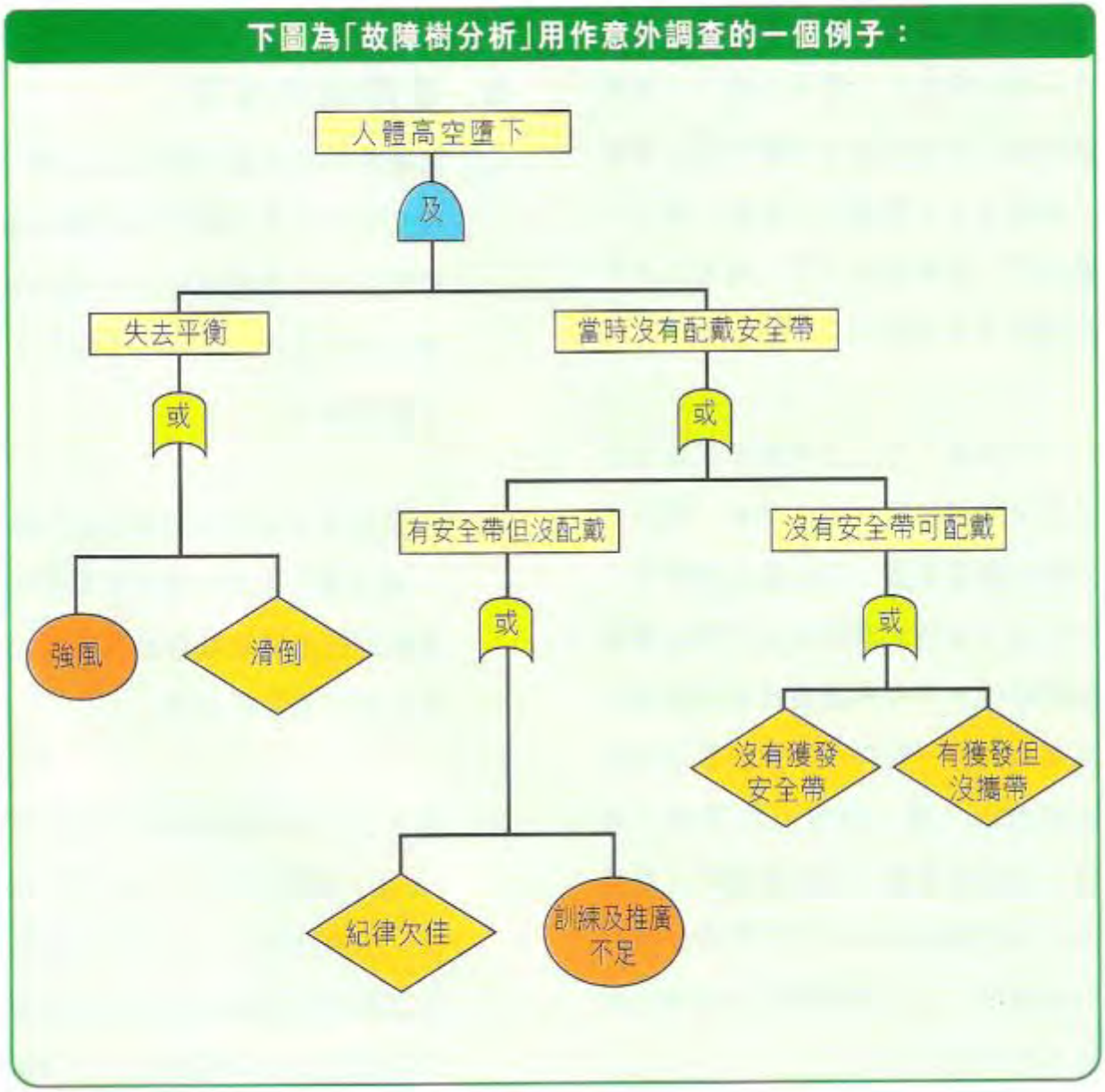
JSA Up Graded After Job was Completed? Yes:_____ No:_____

Example of Systematic Product Failure Investigation Technique: Fault Tree Analysis



Example of Systematic Accident Investigation Technique: Fault Tree Analysis

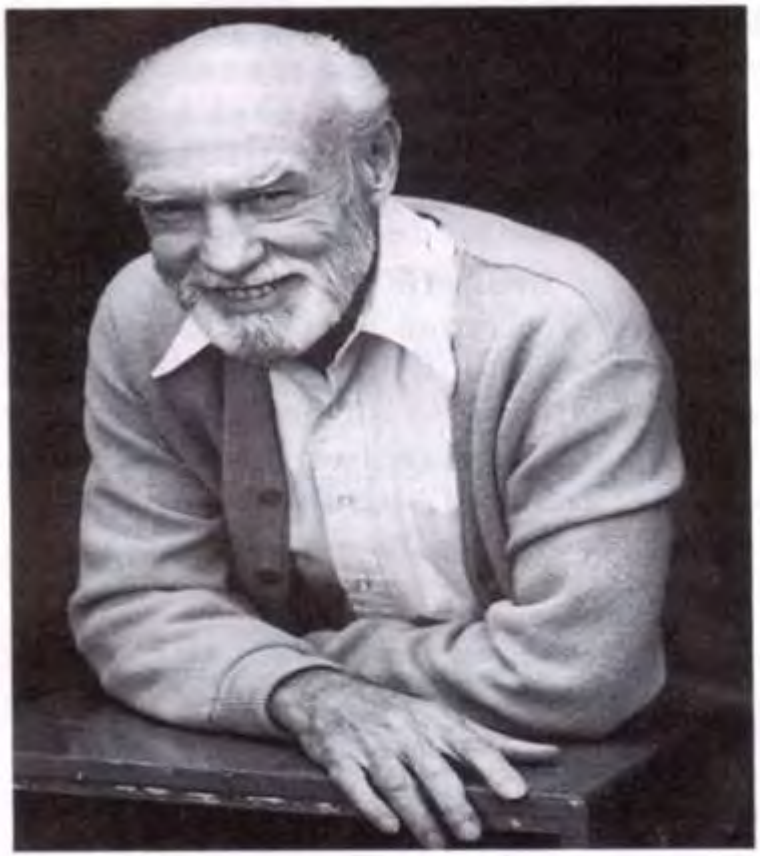
Example of Systematic Accident Investigation Technique: Fault Tree Analysis



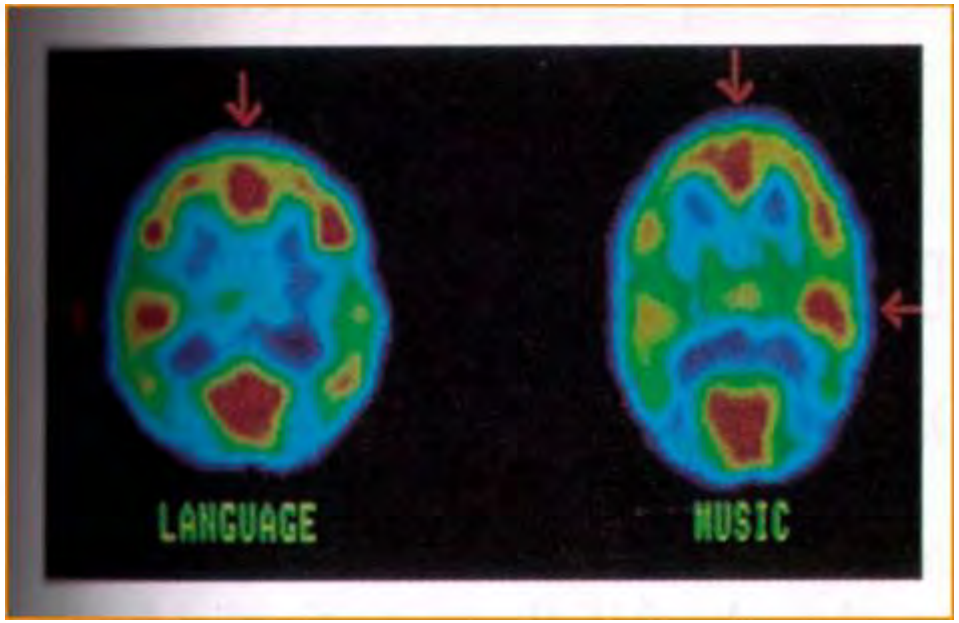
Innovative Approach via Horizontal Thinking

The Creative Method
is expressed from the inside out,
trying to make new things, and
forget there ever was a box.

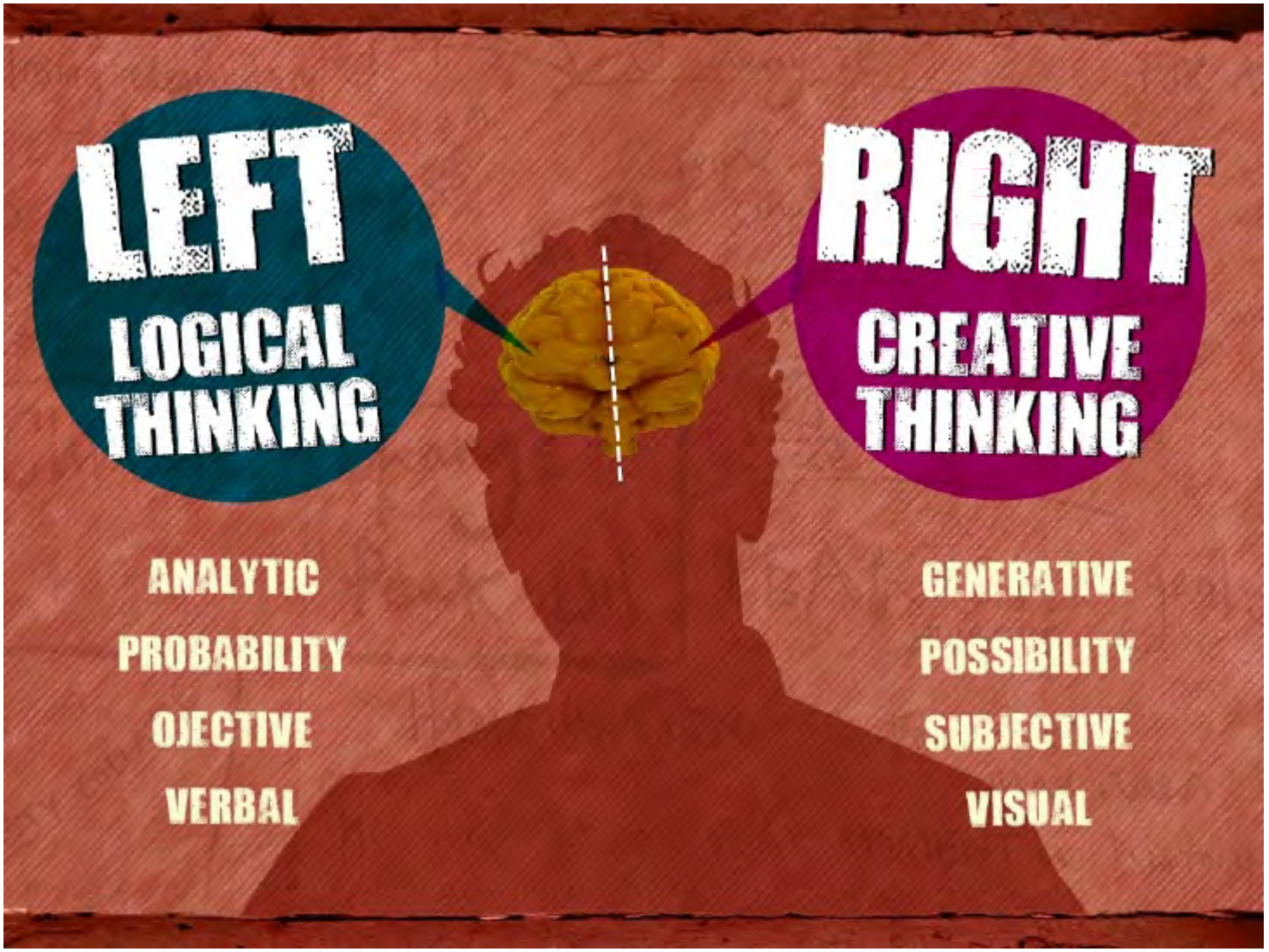
Left vs Right Brain



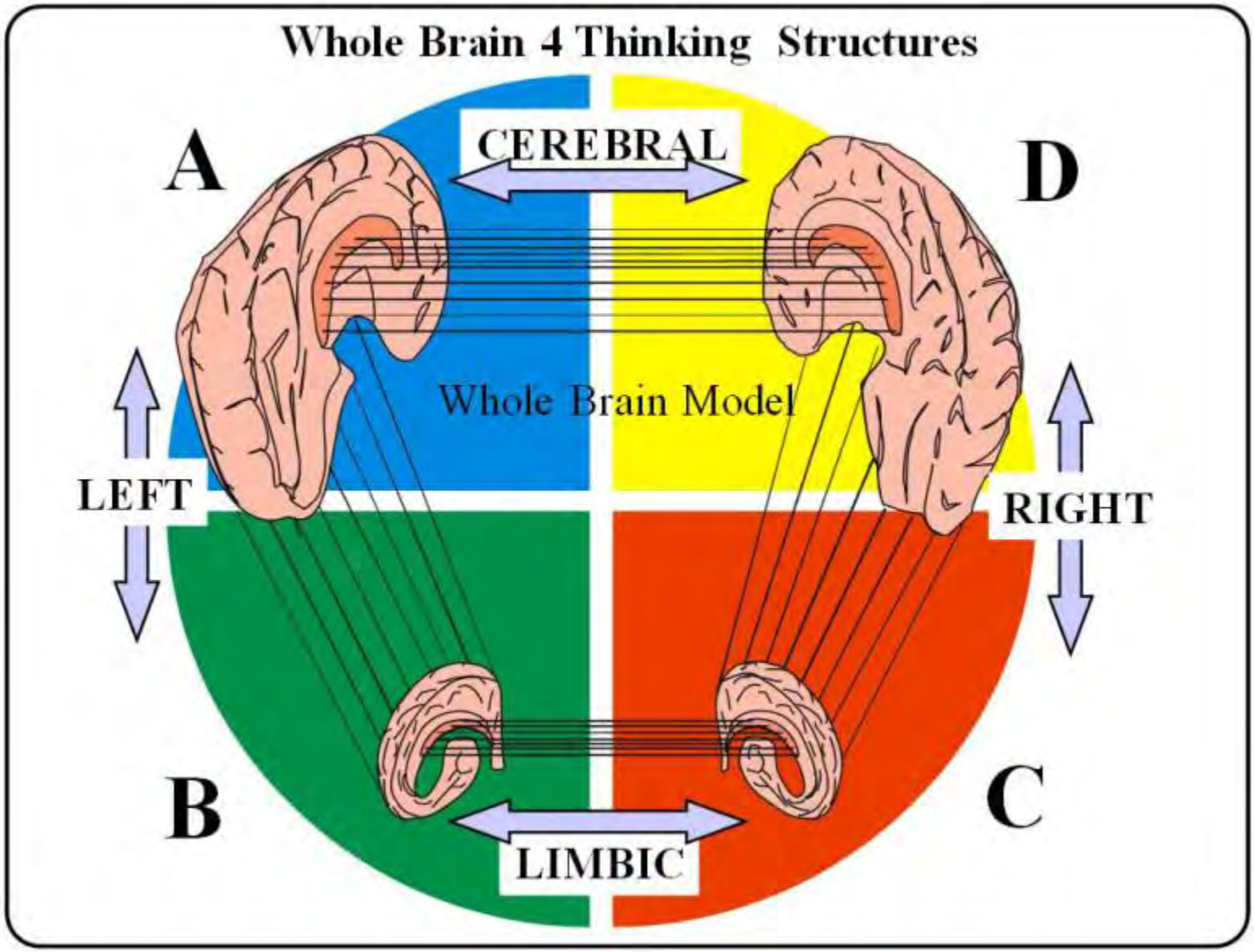
Roger Sperry (1913–1994) For his pioneering research using split-brain patients to investigate the relationship between brain and behavior, Sperry received the 1981 Nobel Prize in Physiology or Medicine.



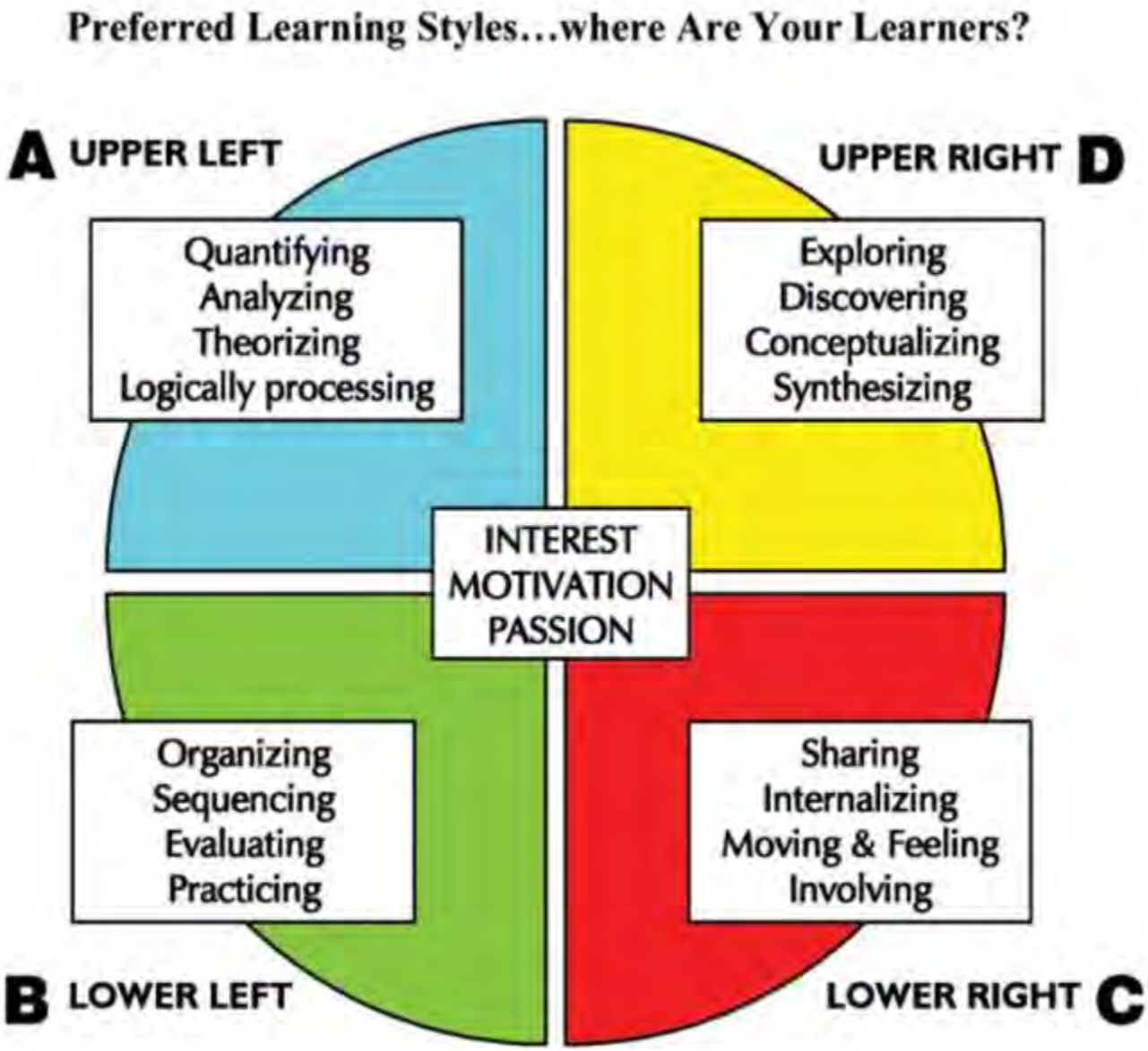
Vertical and Horizontal Thinking Can & Should Co-Exist



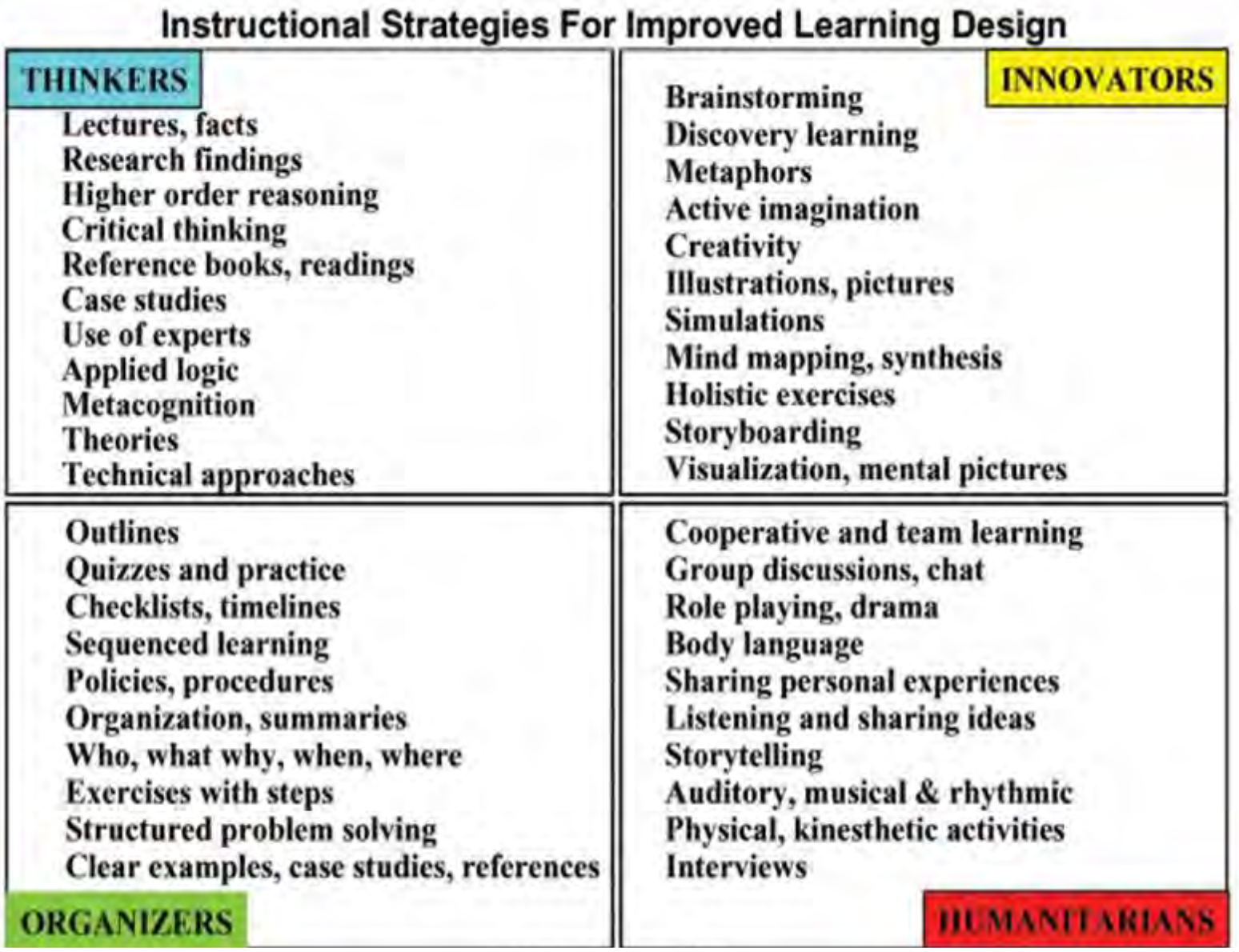
Left vs Right Brain



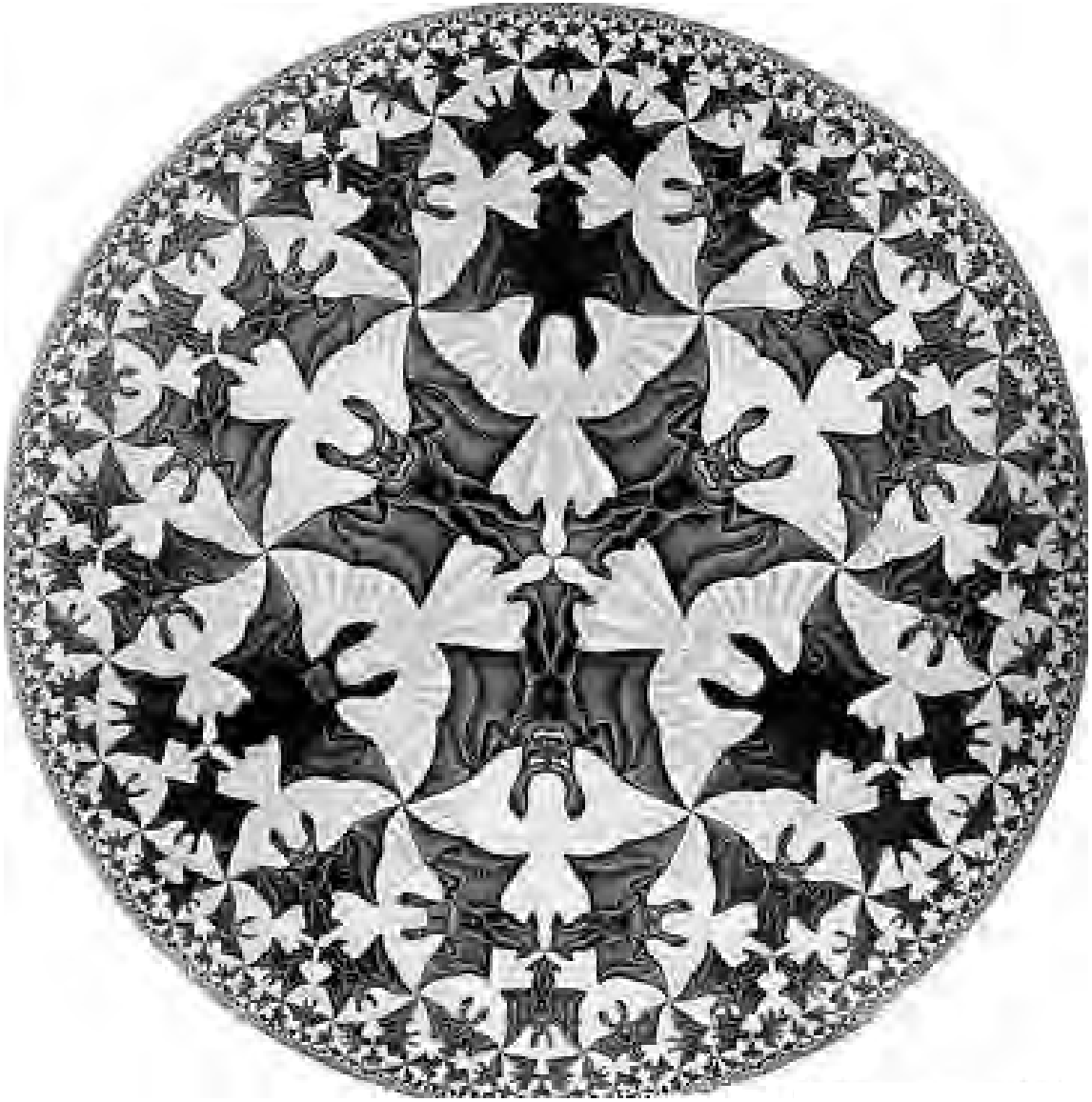
Left vs Right Brain



Left vs Right Brain

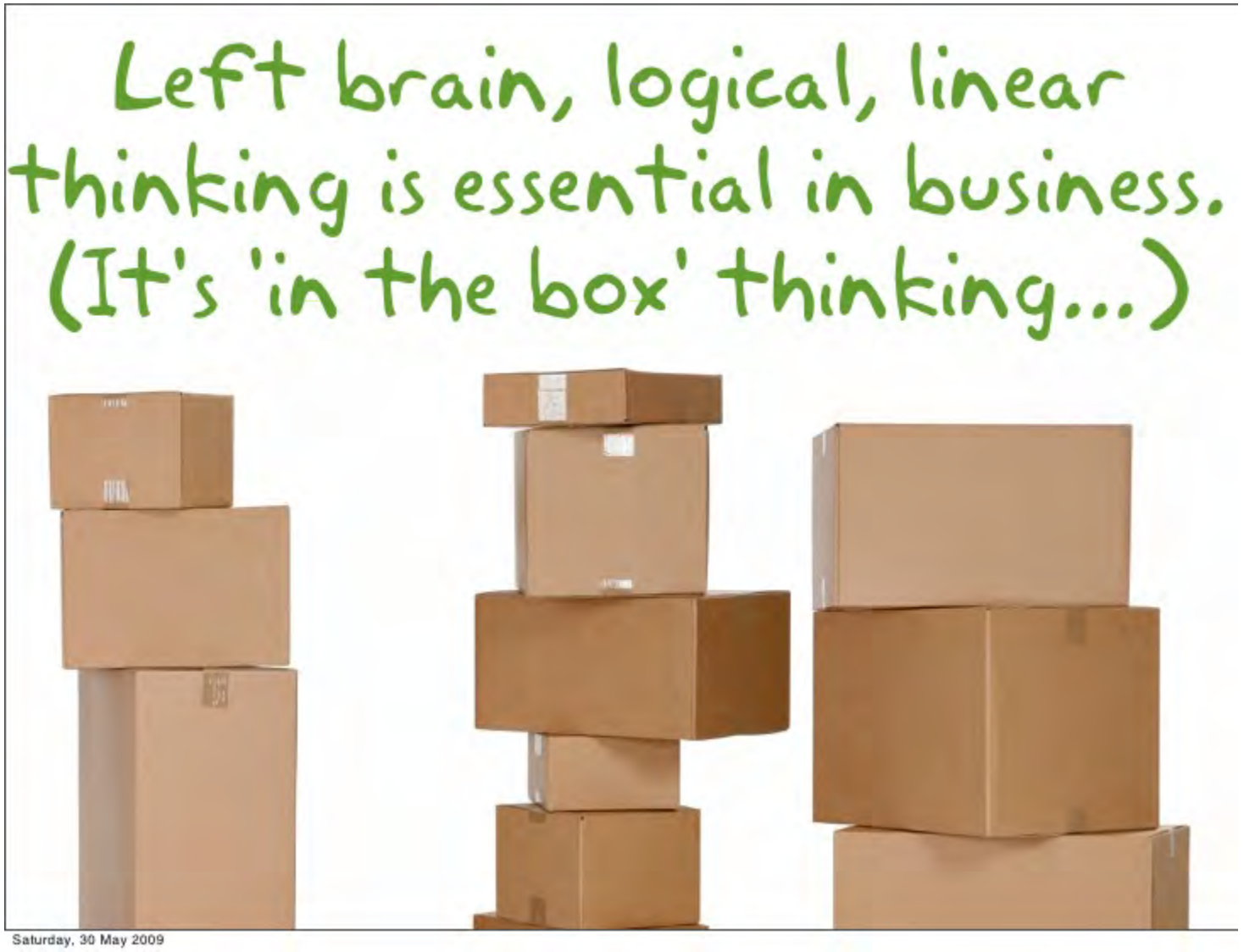


What can you see?

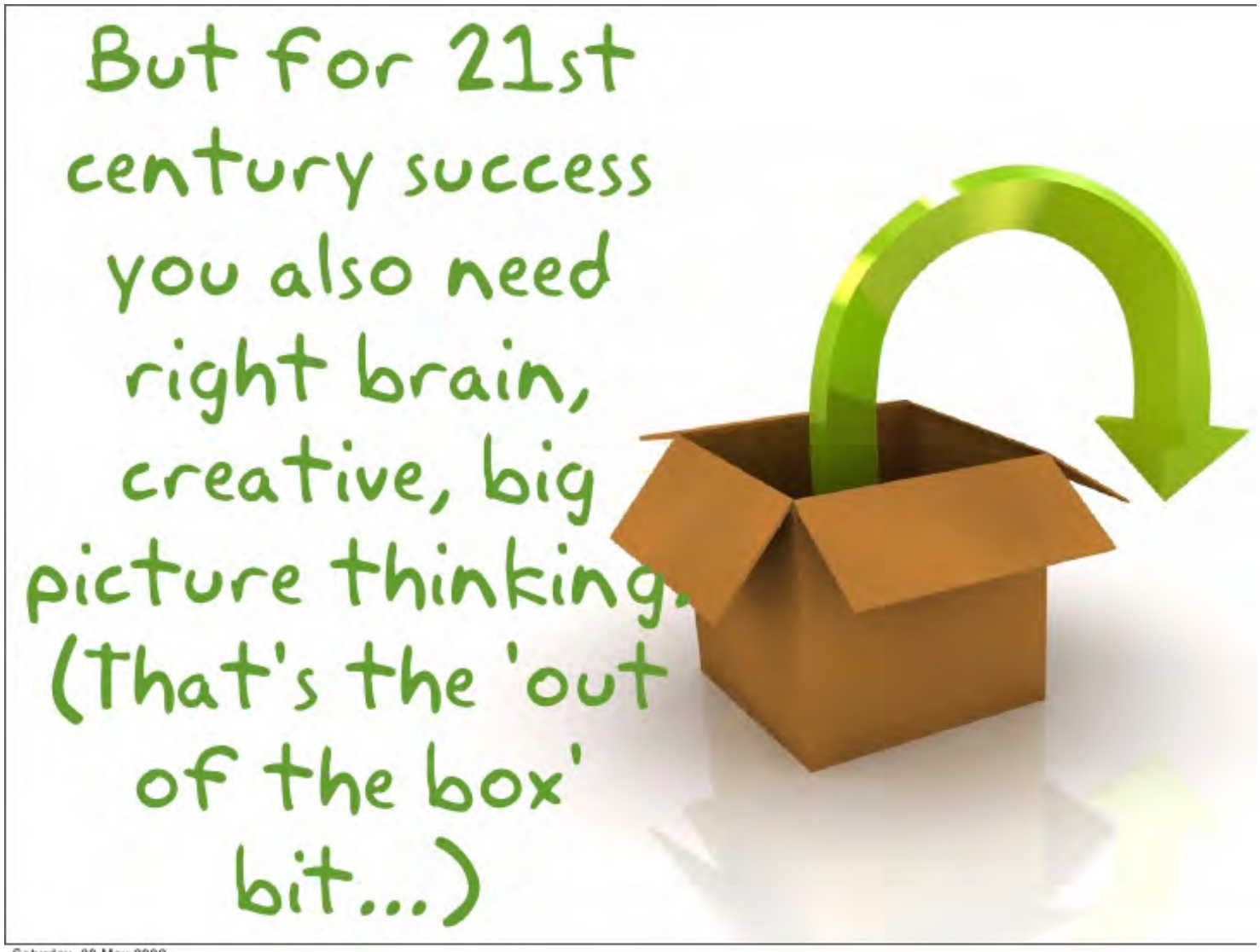


Which Word is this?

Horizontal vs Vertical Thinking



Horizontal vs Vertical Thinking



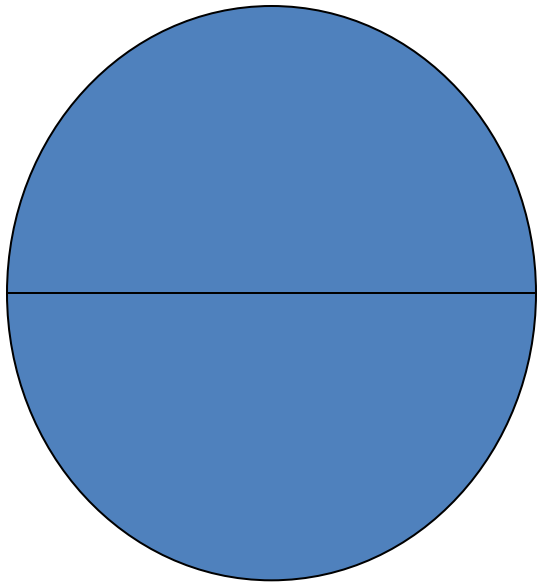
Systematic Approach via Vertical Thinking

"Never, ever, think outside the box."

Horizontal vs Vertical Thinking

Cutting a Birthday Cake

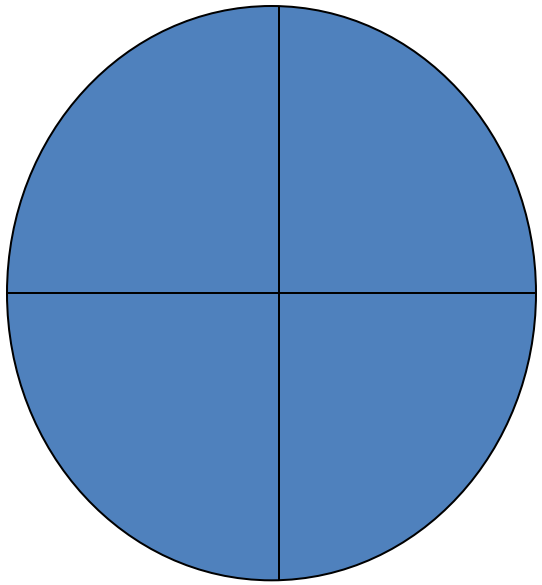
- If 1 cut can split a birthday cake into at most two equal halves



Horizontal vs Vertical Thinking

Cutting a Birthday Cake

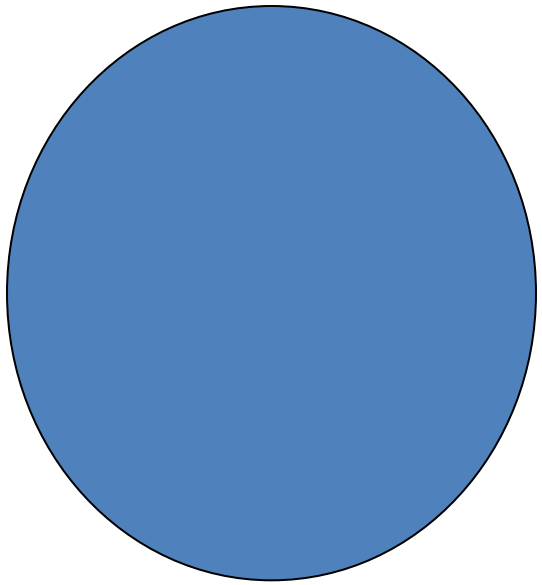
- 2 cuts into at most 4 equal halves



Horizontal vs Vertical Thinking

Cutting a Birthday Cake

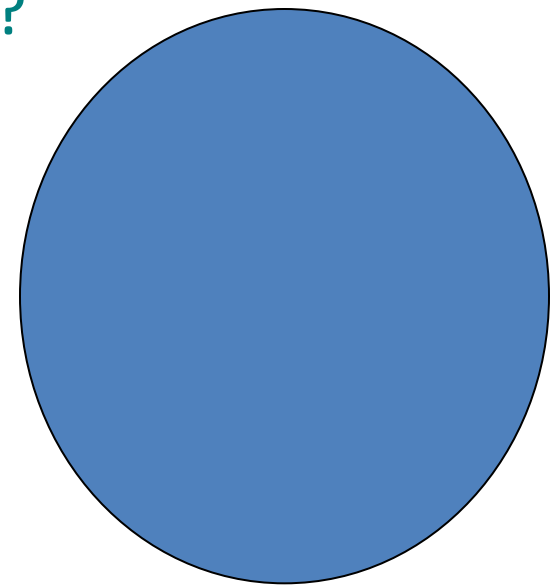
- What is the maximum no. of equal pieces can be cut by 3 cuts?



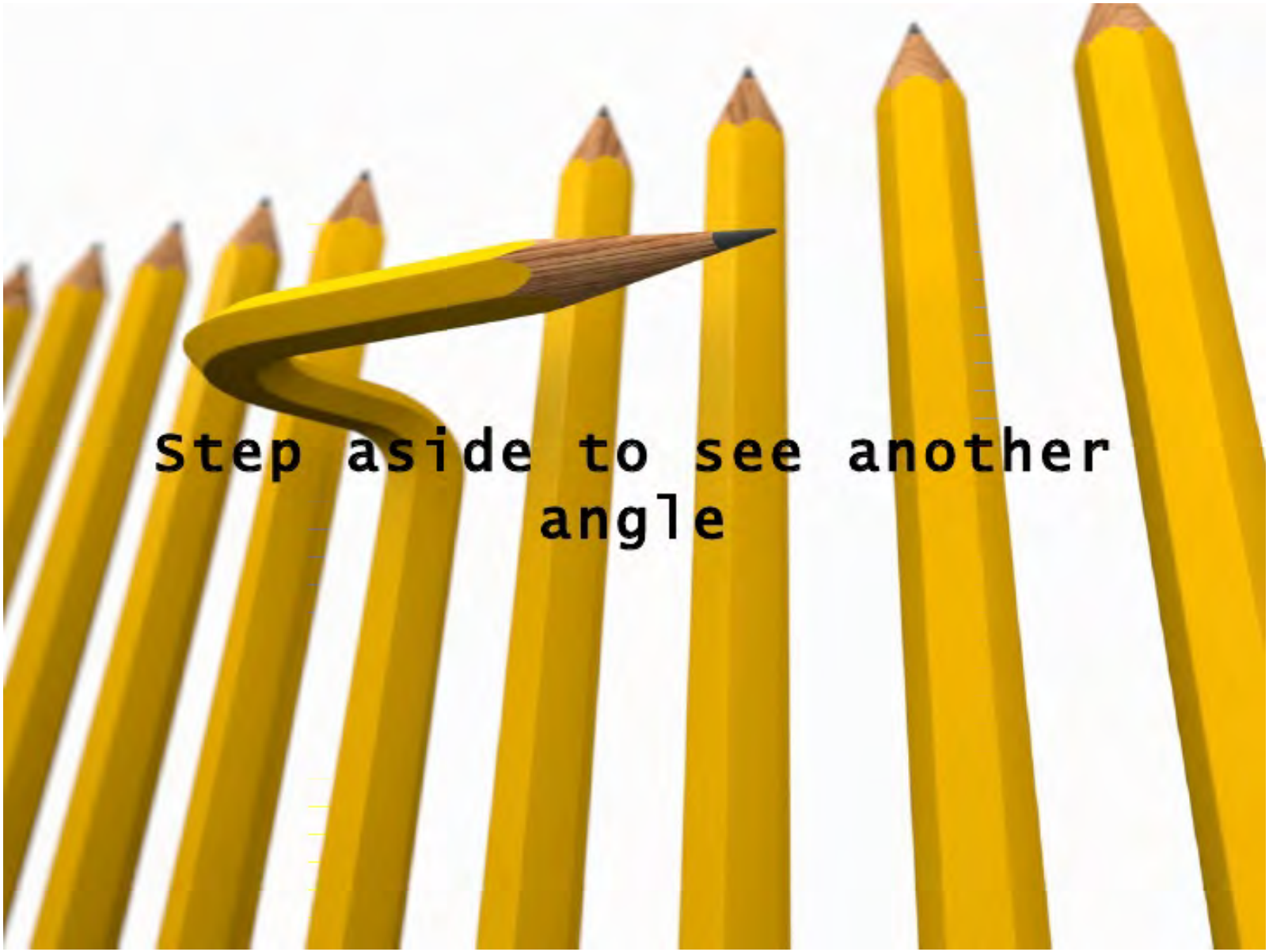
Horizontal vs Vertical Thinking

Cutting a Birthday Cake

- 1 cut gives 2 slices
- 2 cuts give 4 slices
- 3 cuts give 8 slices
- How about 4 cuts?

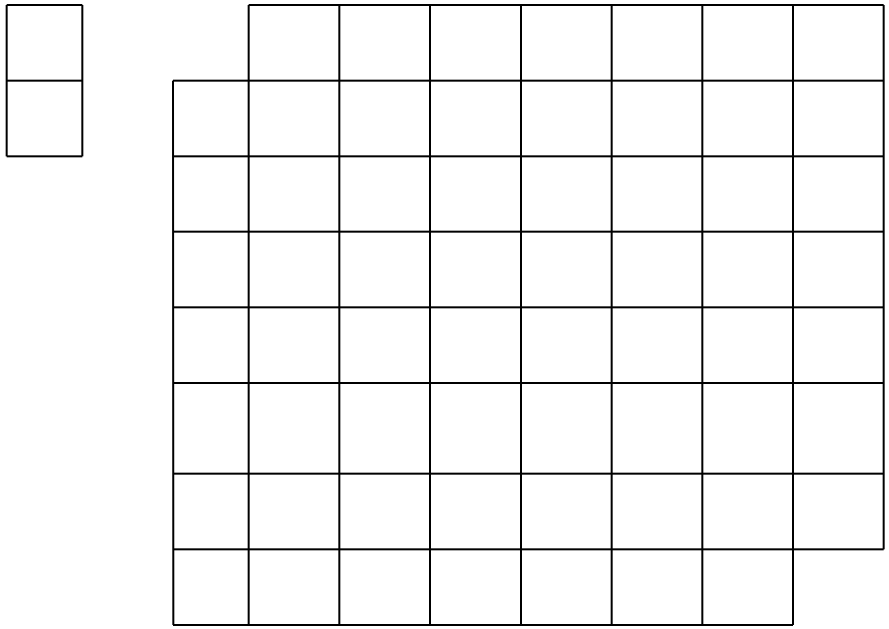


Innovative approach via Horizontal Thinking



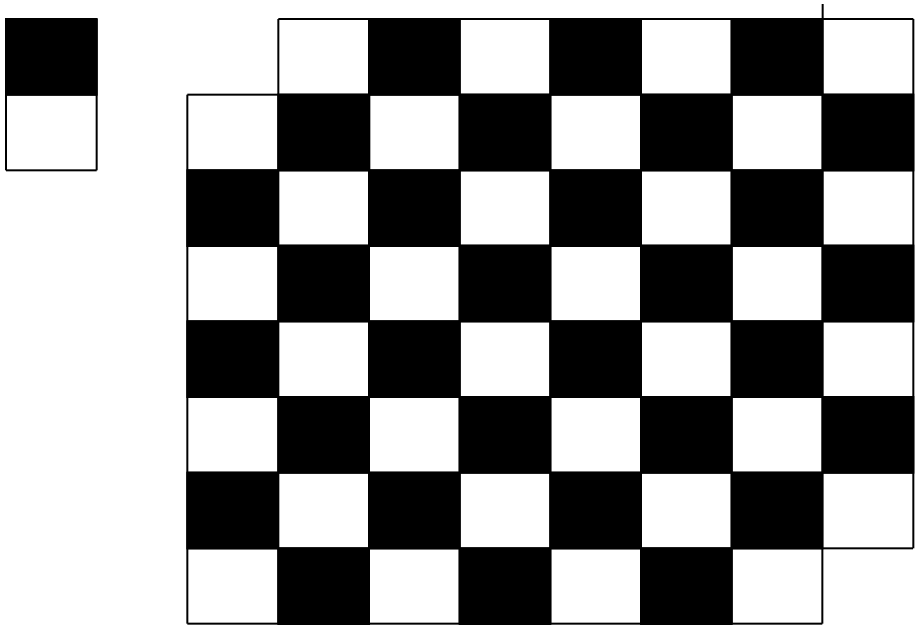
Horizontal vs Vertical Thinking

- A Mathematical problem
  - If the opposite corner pieces of a 8x8 board are cut off, can the rest 62 (= 64 minus 2) pieces of the board be covered by 31 dominos, each domino being of the size of two pieces?
    - 31

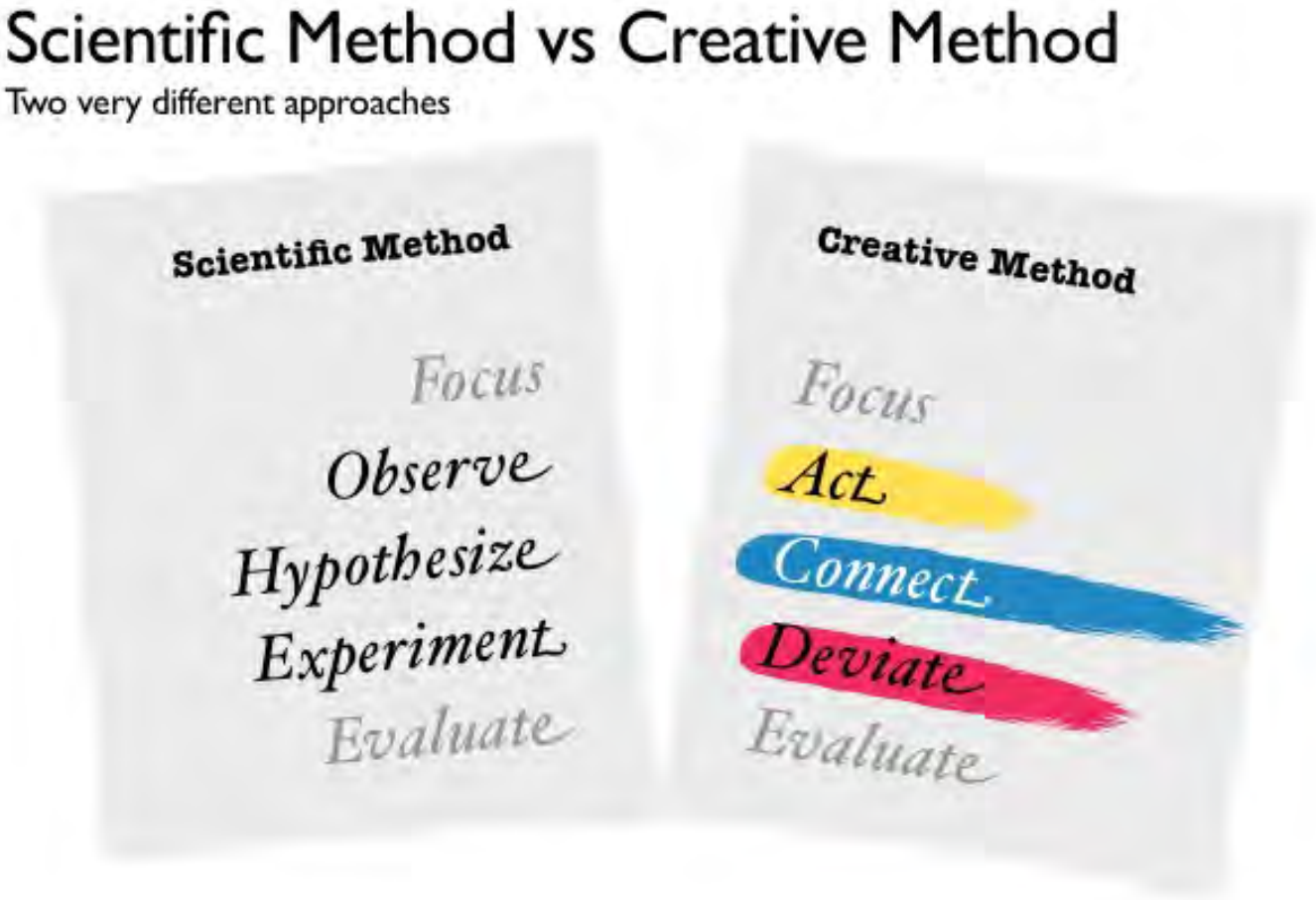


Horizontal vs Vertical Thinking

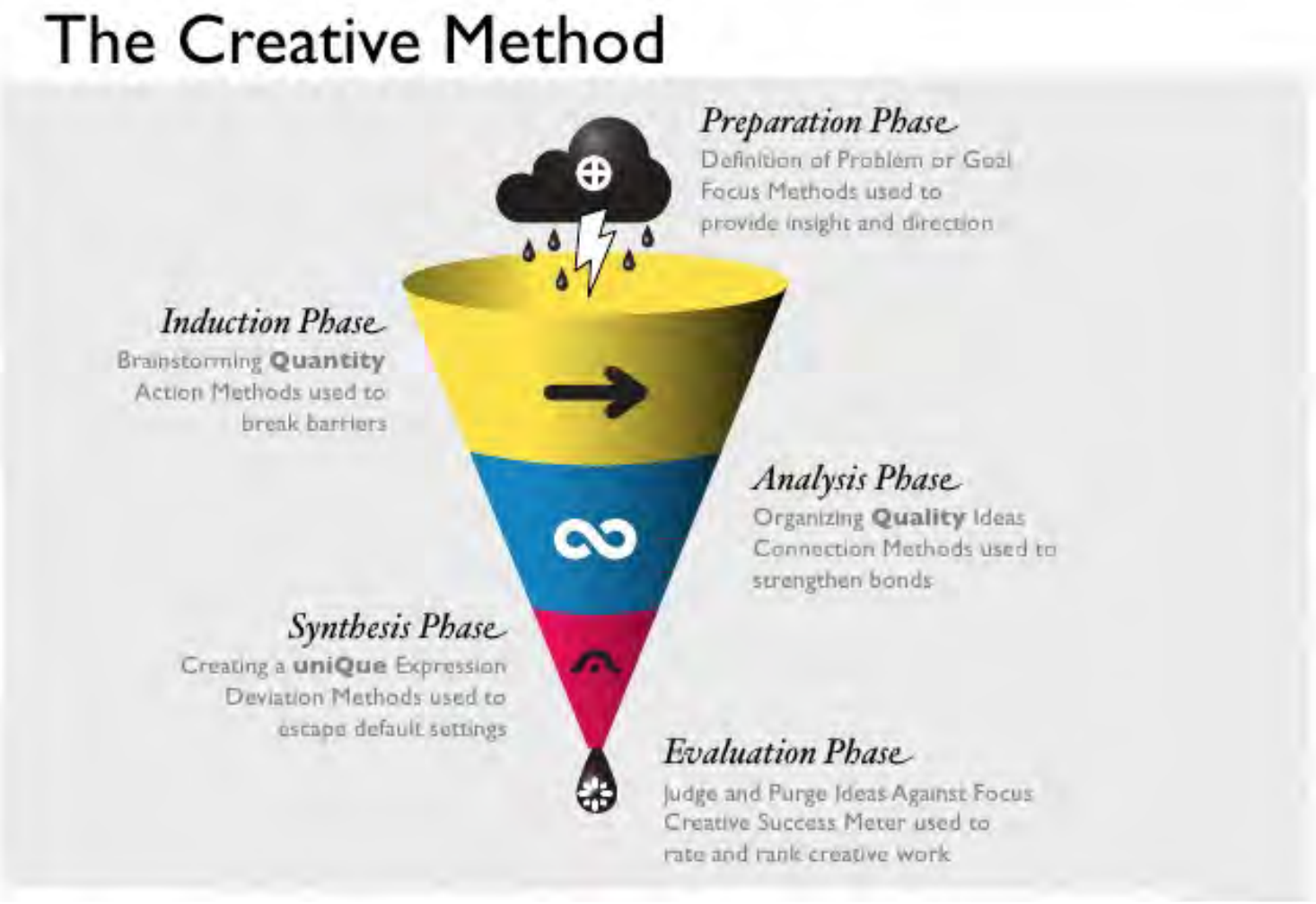
- Solution (Mutilated Chessboard)
  - Think of a chess board with black & white interstices
  - Now 2 blacks are missing, so now there are 32 whites but only 30 blacks - yet each domino covers a black & a white!



Vertical vs Horizontal Thinking

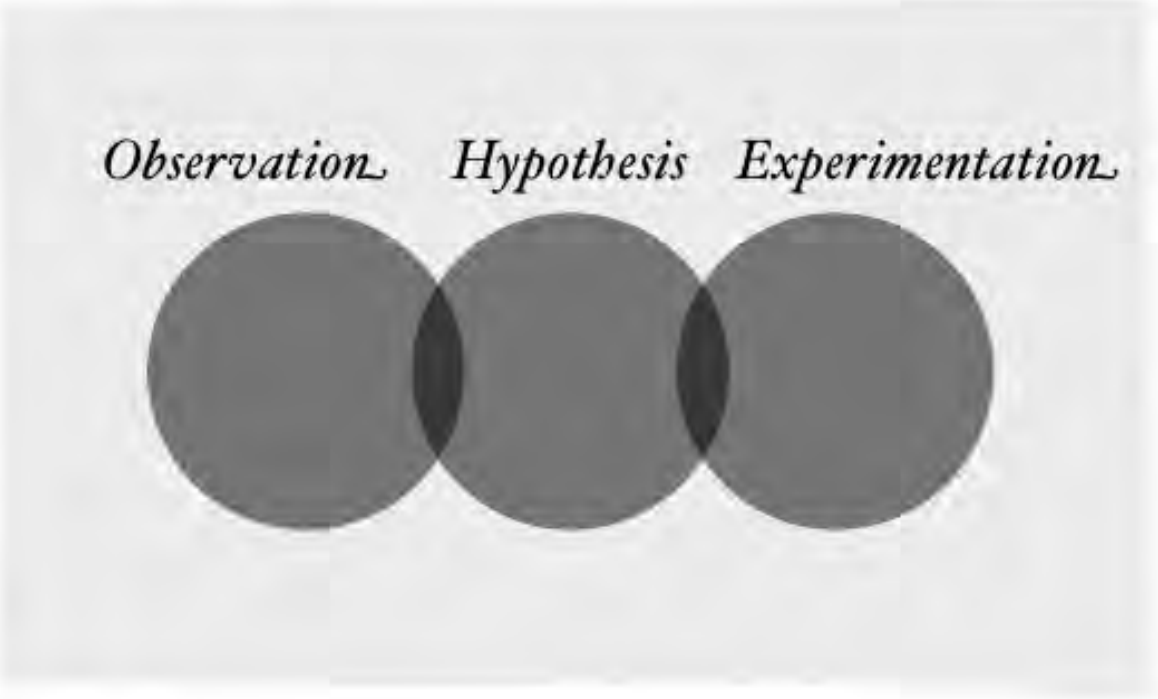


Innovative approach via Horizontal Thinking



Innovative approach via Horizontal Thinking

Elements of Science



Innovative approach via Horizontal Thinking

Elements of Creativity

Innovative approach via Horizontal Thinking

Innovative approach via Horizontal Thinking

Innovative approach via Horizontal Thinking

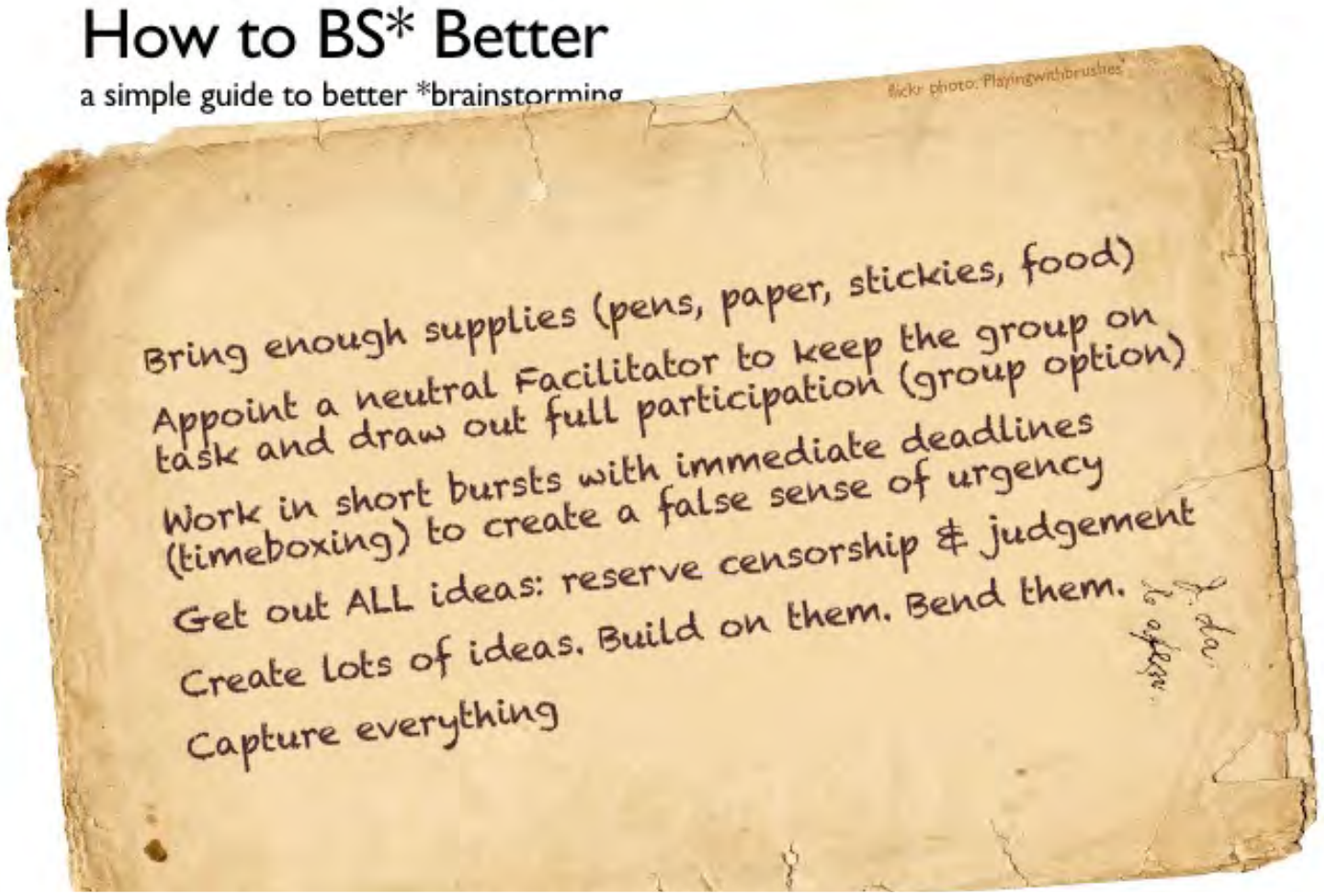
Brainstorming

- Brainstorming
  - Developed by Alexander F. Osborn (1888-1966)
    - Form a group of 6-8 members
    - Group presented with a problem
    - Group asked to identify as many potential solutions as possible
    - Sometimes Group members given a 1-page summary of the problem as least 2 days before the session

Brainstorming

- Four rules of brainstorming
  - Criticism prohibited – Judgment of ideas withheld until all ideas have been generated
  - "freewheeling" welcome – The wilder & further the idea the better.
  - Quantity wanted – The greater the number of ideas, the greater the likelihood of an outstanding solution
  - Combination & improvement sought – In addition to contributing ideas of their own, members are encouraged to suggest how the ideas of others can be improved, or how two or more ideas can be combined into still another idea

Brainstorming



Brainstorming

Example of Brainstorming

PROBLEM: Concorde's airframe needs to be streamlined like a bullet to allow it to fly at supersonic speeds, to reduce drag and improved aerodynamic efficiency. This means that unlike other passenger jets, she needs a very long pointed nose which must also be a streamlined shape for supersonic flight. Concorde lands and takes-off with a very high angle of attack, this is due to the way that the delta wing produces lift at low speeds. At these high angles of attack, a fixed streamlined nose would completely obscure the runway, on landing the available view to the pilot would be only about 5 degrees.

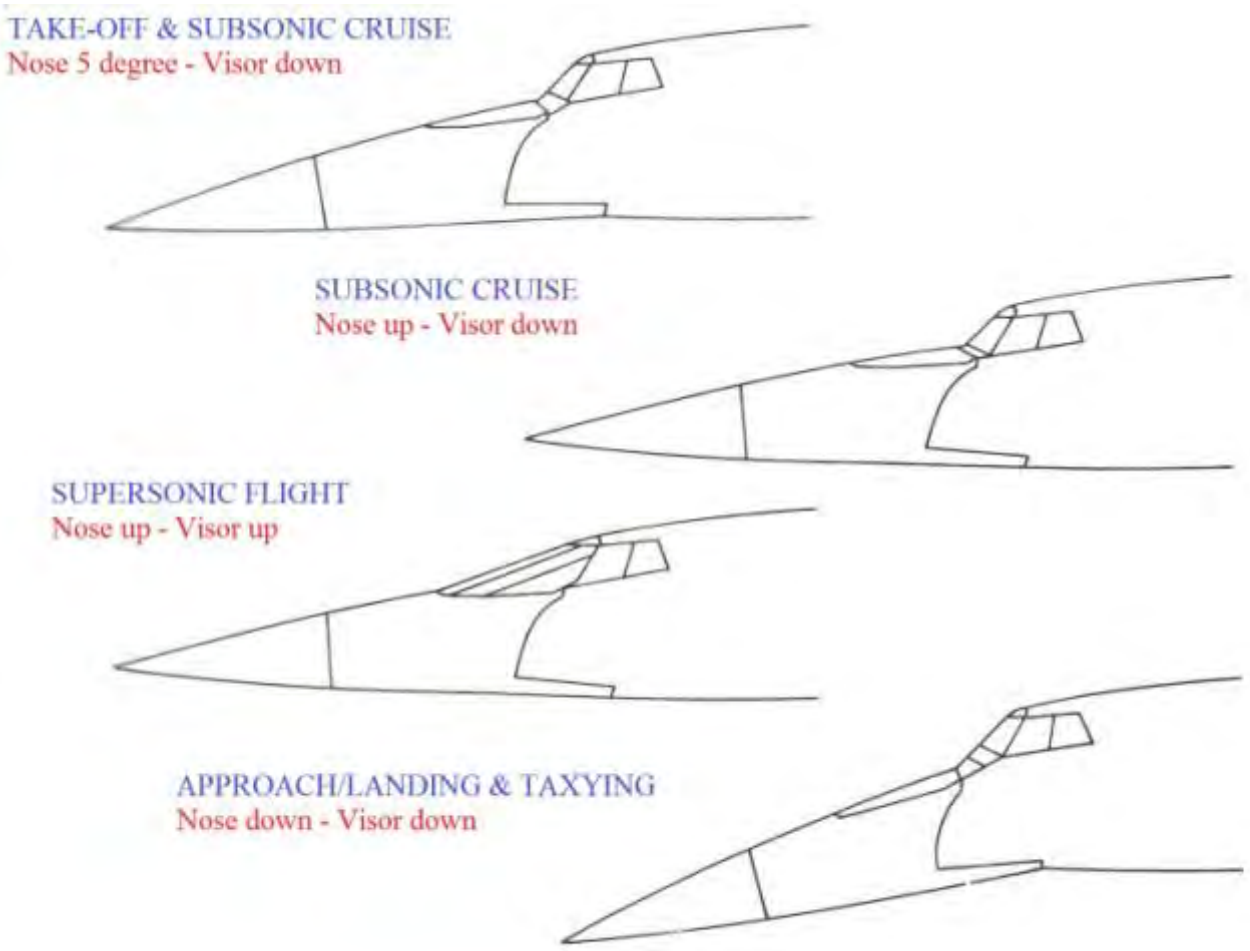
- What would you recommend to overcome this problem?

Brainstorming

- Concorde in Flight

Brainstorming

- Solution: Drooping the Nose & Visor Options



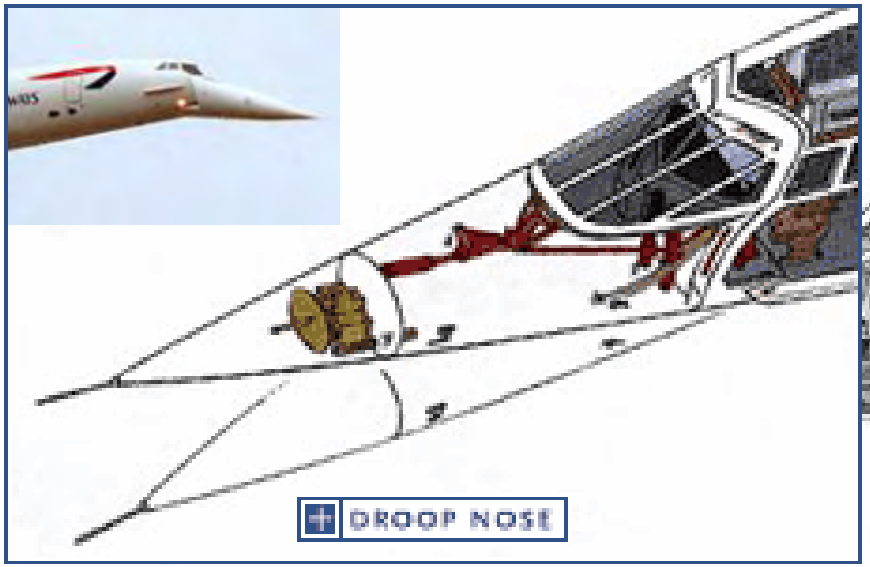
DROOP NOSE & VISOR OPTIONS

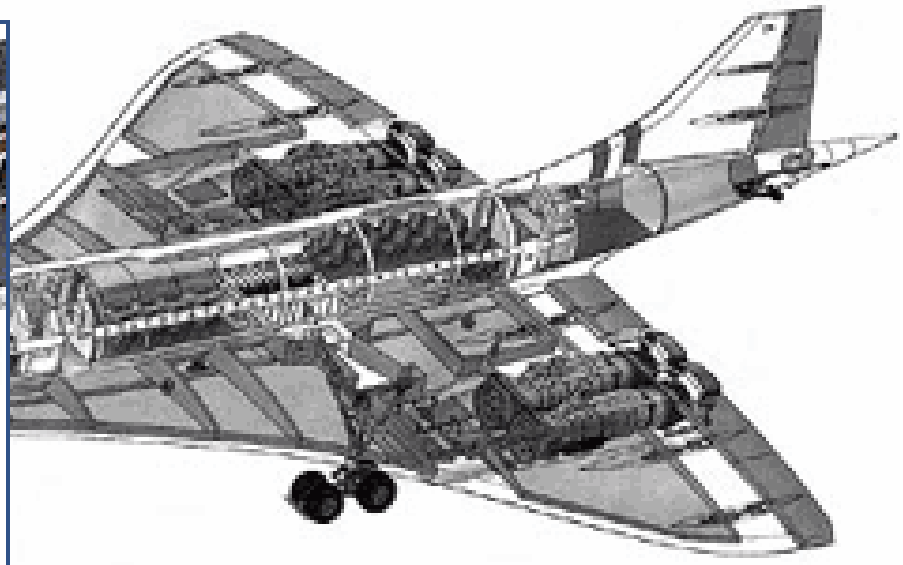
Brainstorming

- Solution: Drooping the Nose & Visor Options

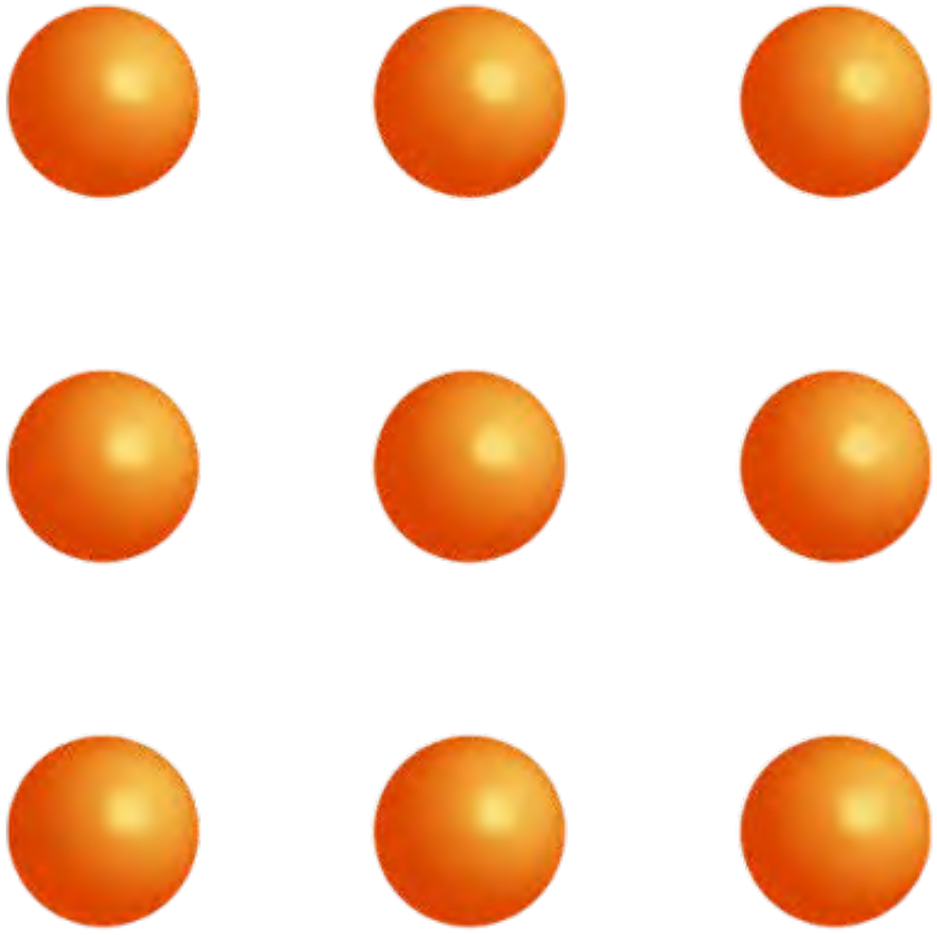
Brainstorming

- Droop the nose for better vision of the runway during takeoff and landing



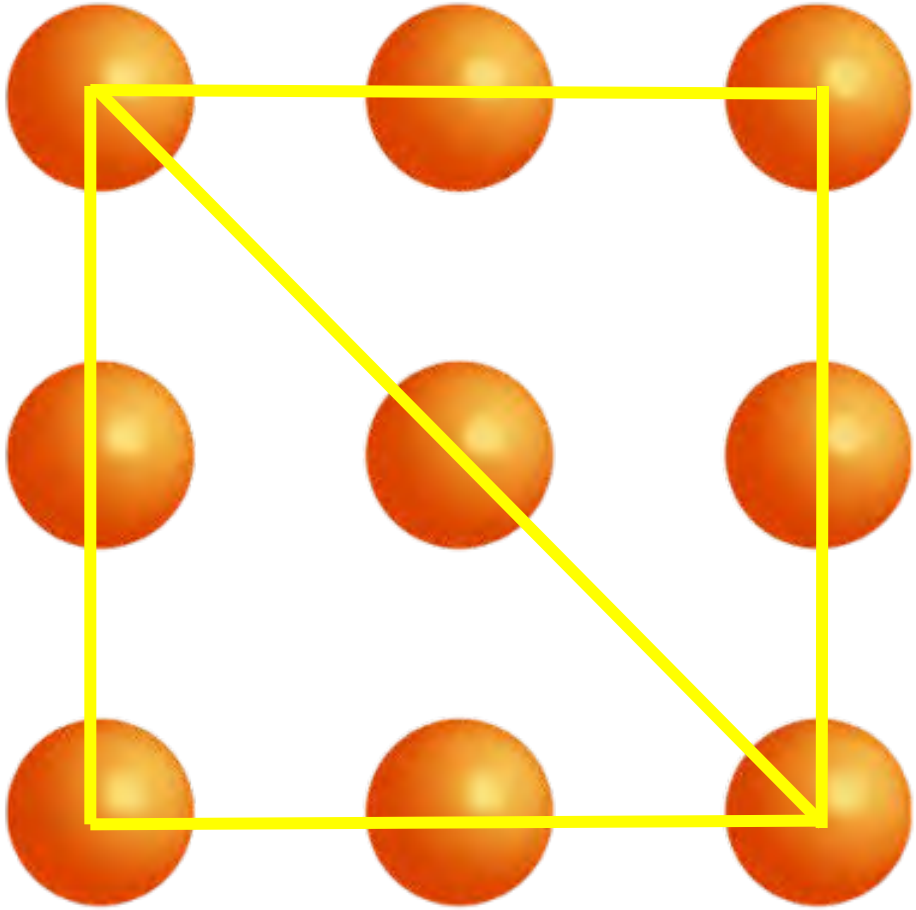


The nine dots problem (Maier, 1931)



Link them together in 1 continuous set of lines using the minimum no. of lines

Beginner’s 5-line solution



flickr photo: Playingwithbrushes

9 dots puzzle

Deviation Exercise

- Connect all dots in 4 strokes or less without lifting your pencil.
- Now can you do it in 3 strokes?
- How about 1?

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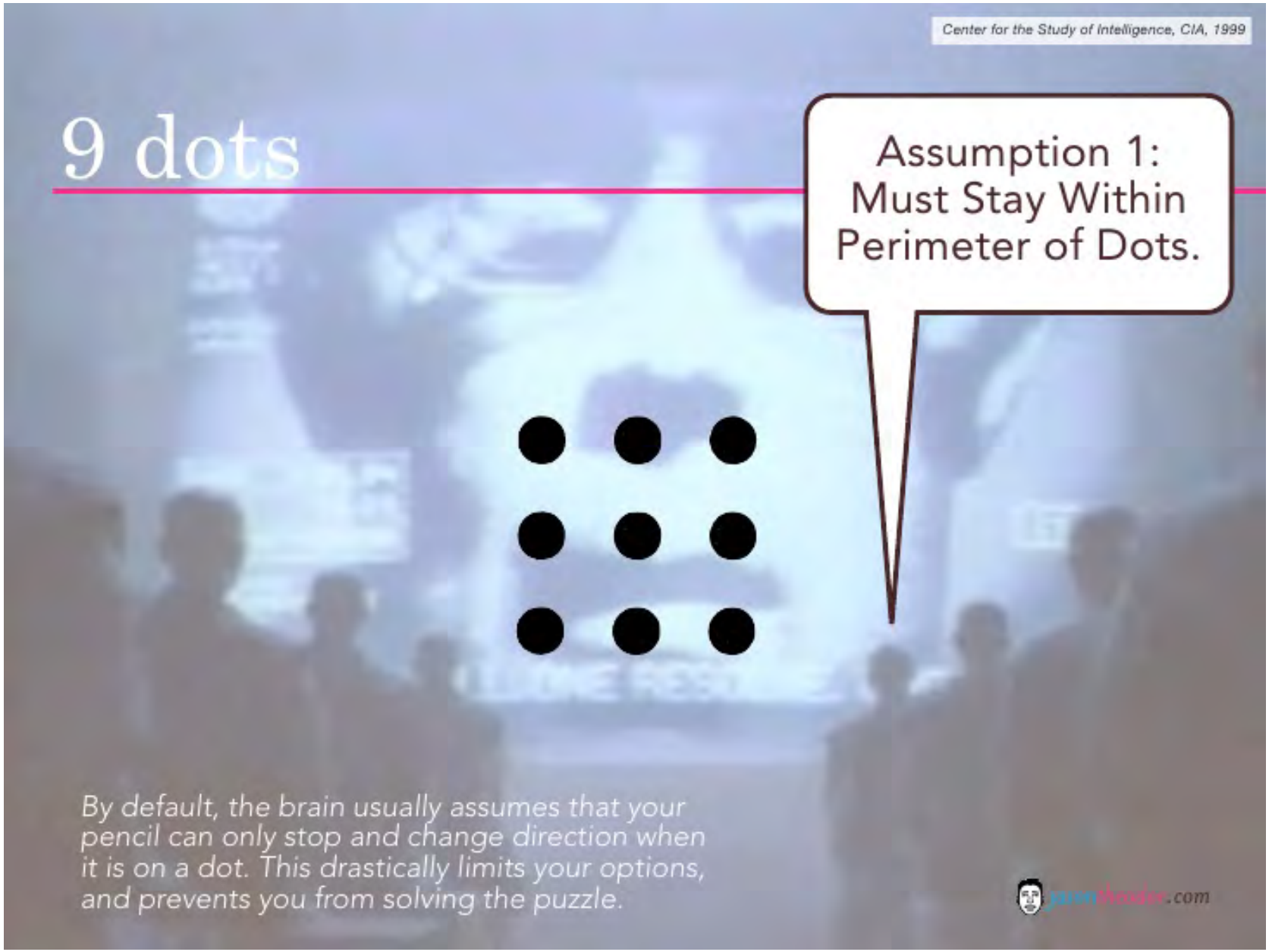
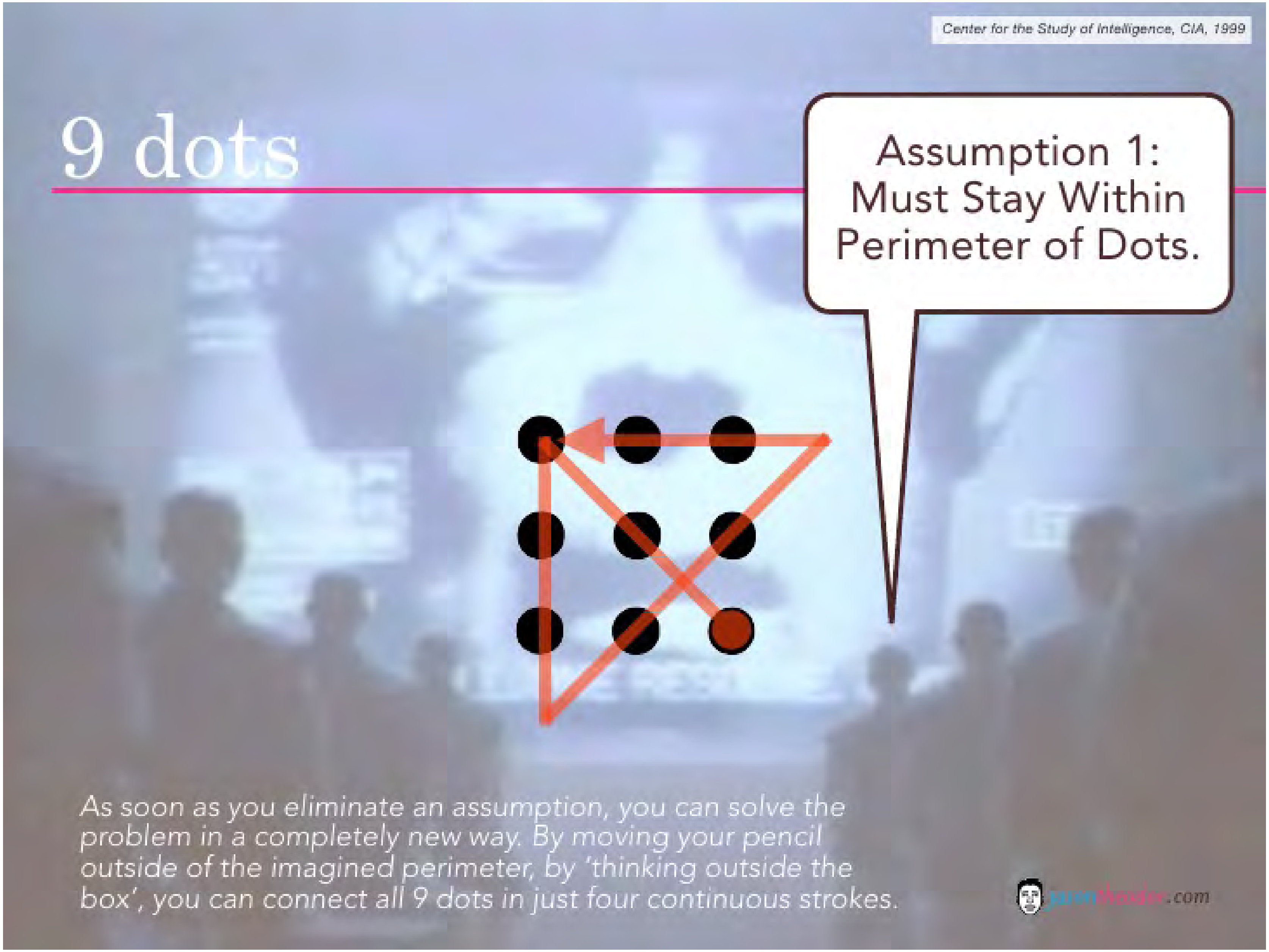

Center for the Study of Intelligence, CIA, 1999
9 dots
Assumption 1:
Must Stay Within
Perimeter of Dots.
By default, the brain usually assumes that your pencil can only stop and change direction when it is on a dot. This drastically limits your options, and prevents you from solving the puzzle.
.com



Center for the Study of Intelligence, CIA, 1999
9 dots
Assumption 1: Must Stay Within Perimeter of Dots.
As soon as you eliminate an assumption, you can solve the problem in a completely new way. By moving your pencil outside of the imagined perimeter, by 'thinking outside the box', you can connect all 9 dots in just four continuous strokes.

Center for the Study of Intelligence, CIA, 1999

9 dots

Assumption 2:
Must go through centre of dots.

*The **CIA** briefs agents with a book called **Psychology of Intelligence Analysis** by **Richards J. Heuer, Jr.** which discusses this puzzle and the assumptions we make.*

JasonShoaf.com

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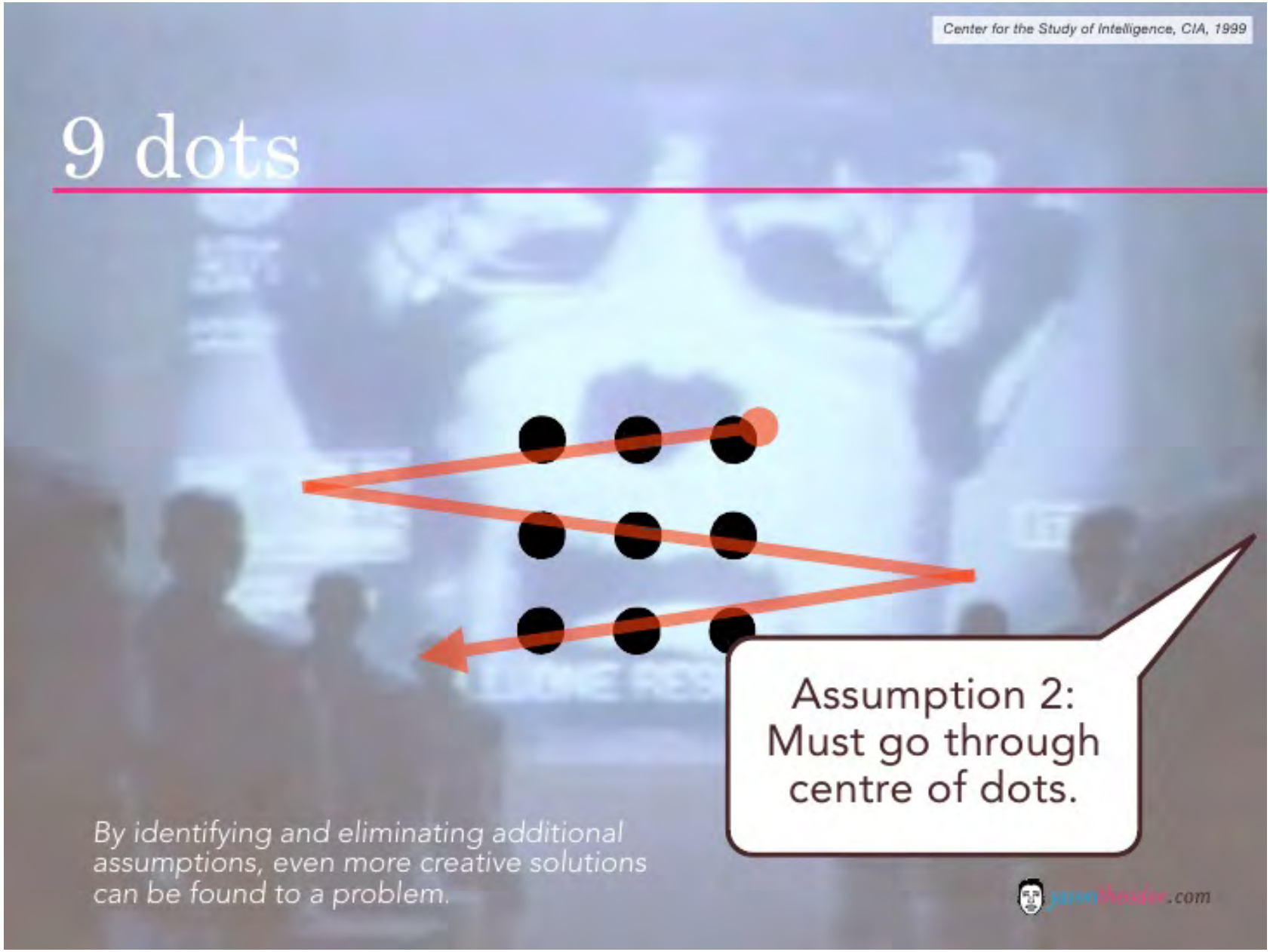
Center for the Study of Intelligence, CIA, 1999
9 dots
Assumption 2:
Must go through
centre of dots.
By identifying and eliminating additional assumptions, even more creative solutions can be found to a problem.
.com

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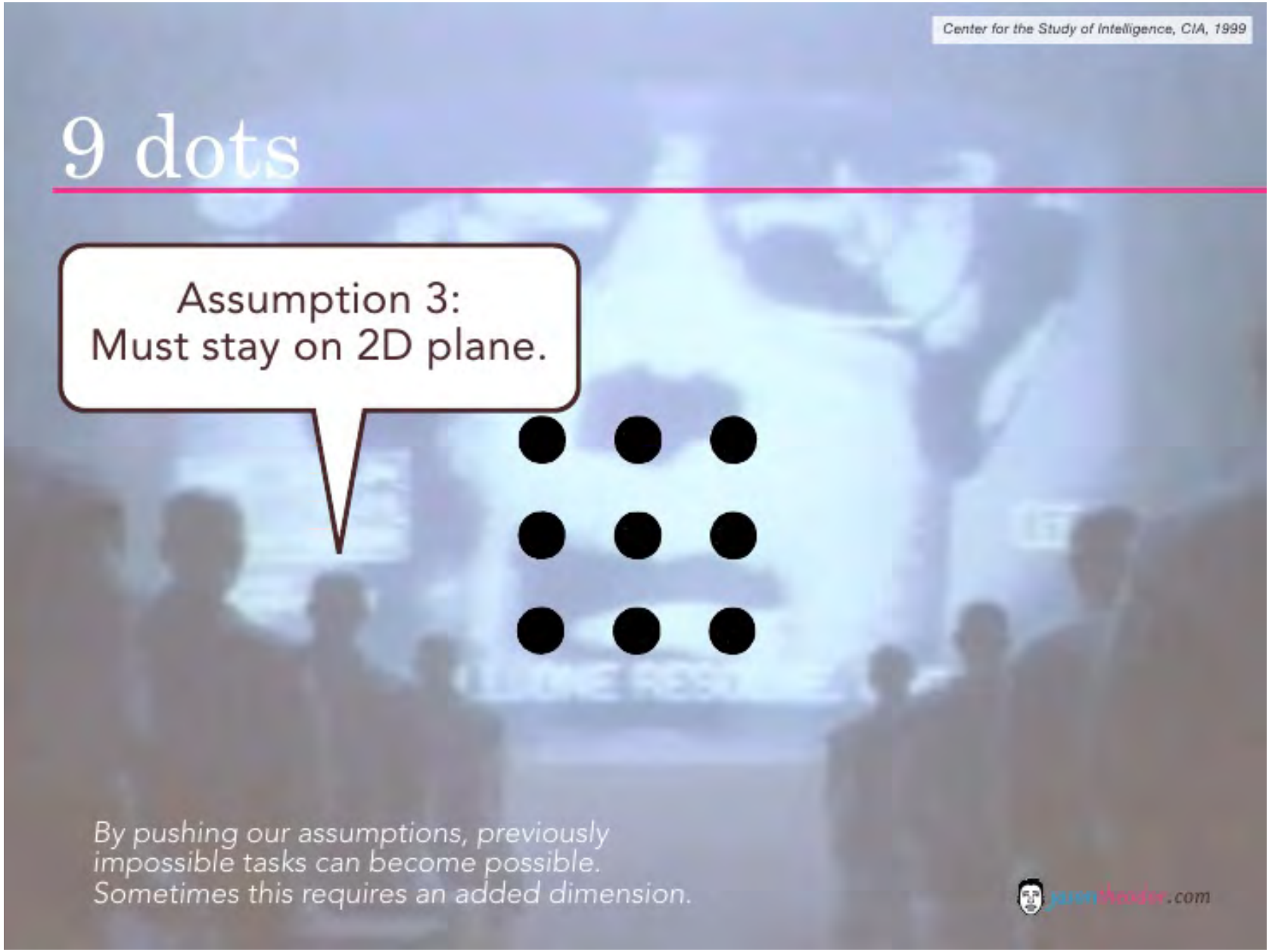
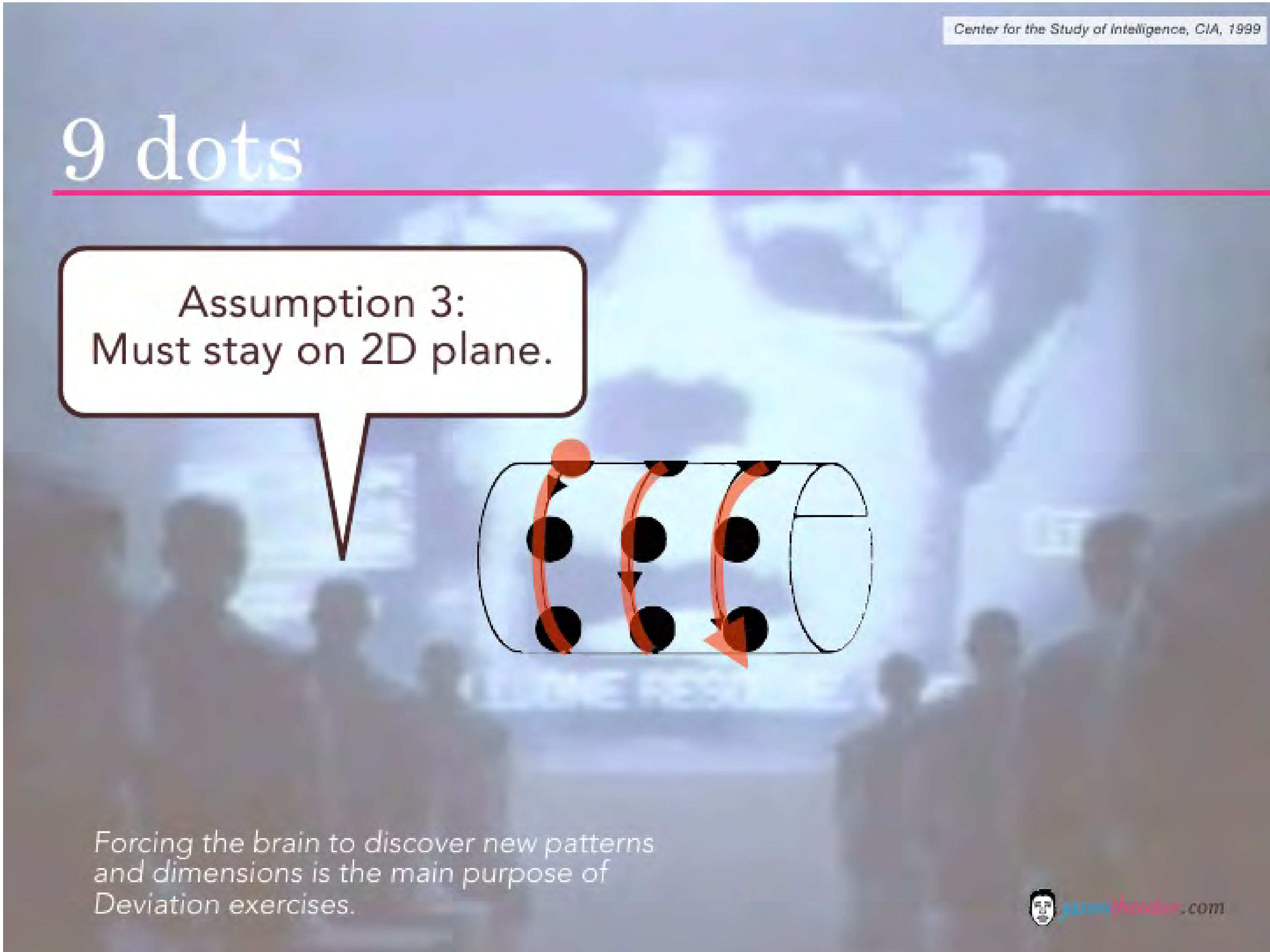
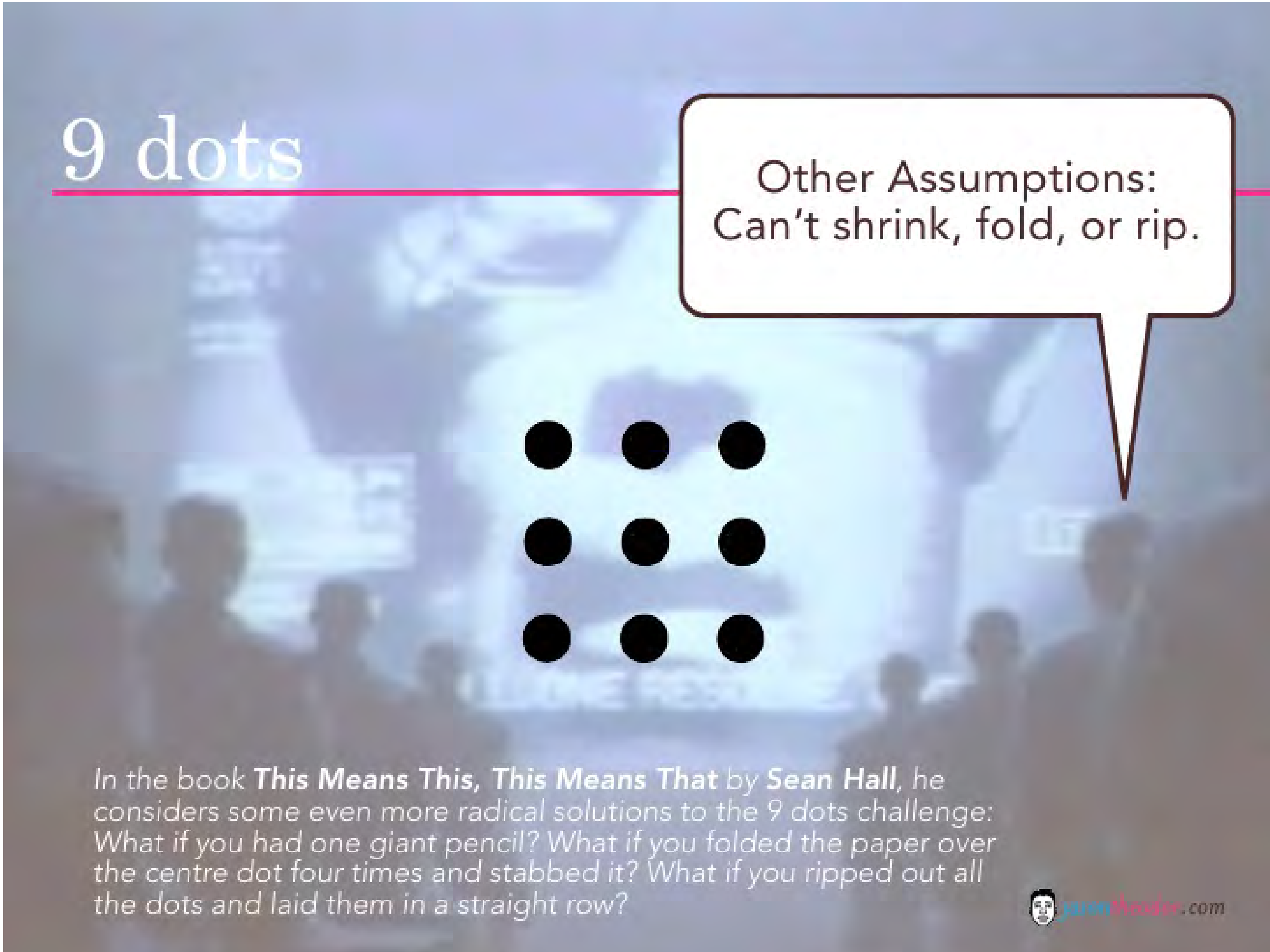
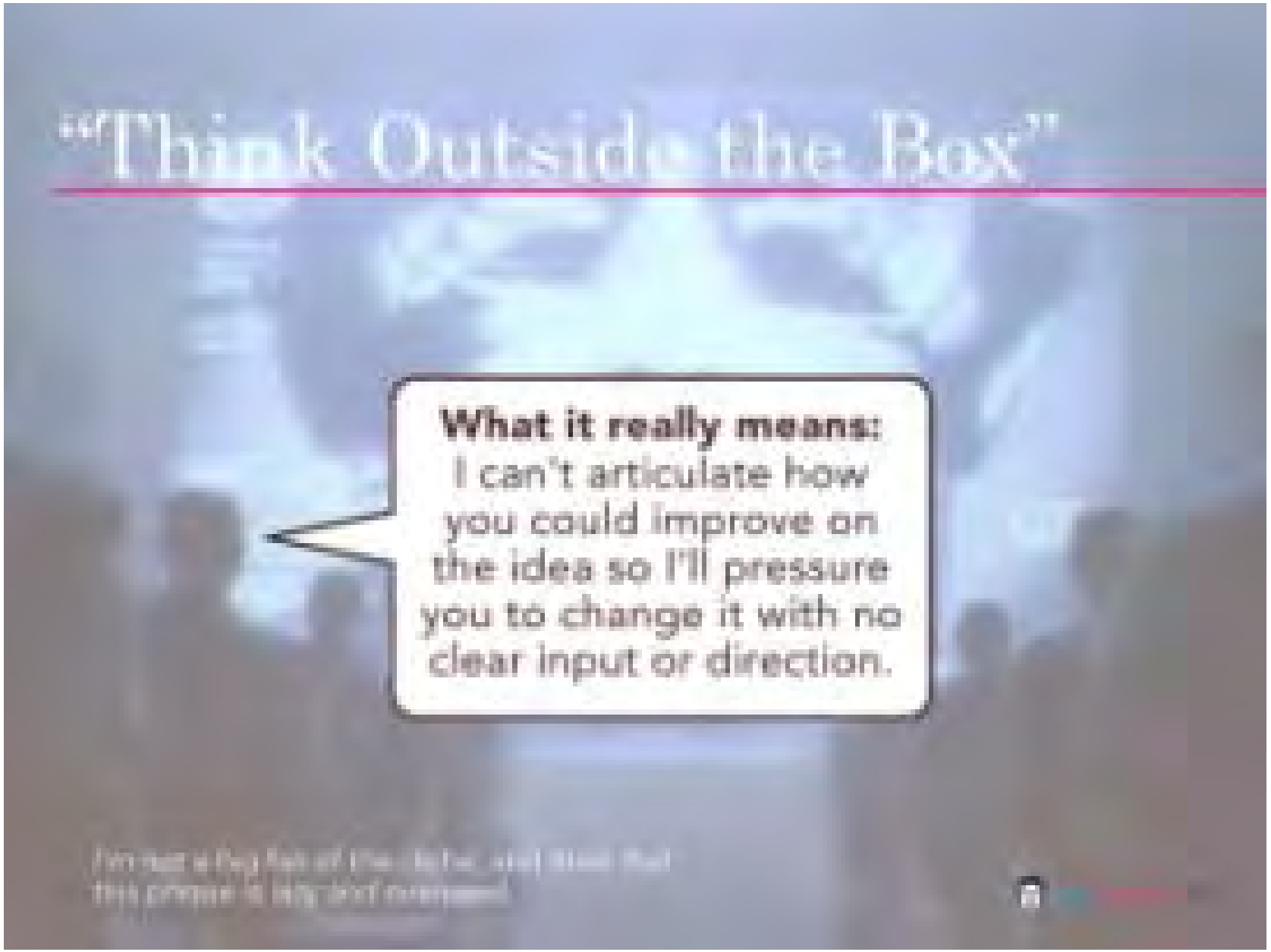

Center for the Study of Intelligence, CIA, 1999
9 dots
Assumption 3:
Must stay on 2D plane.
By pushing our assumptions, previously
impossible tasks can become possible.
Sometimes this requires an added dimension.
.com

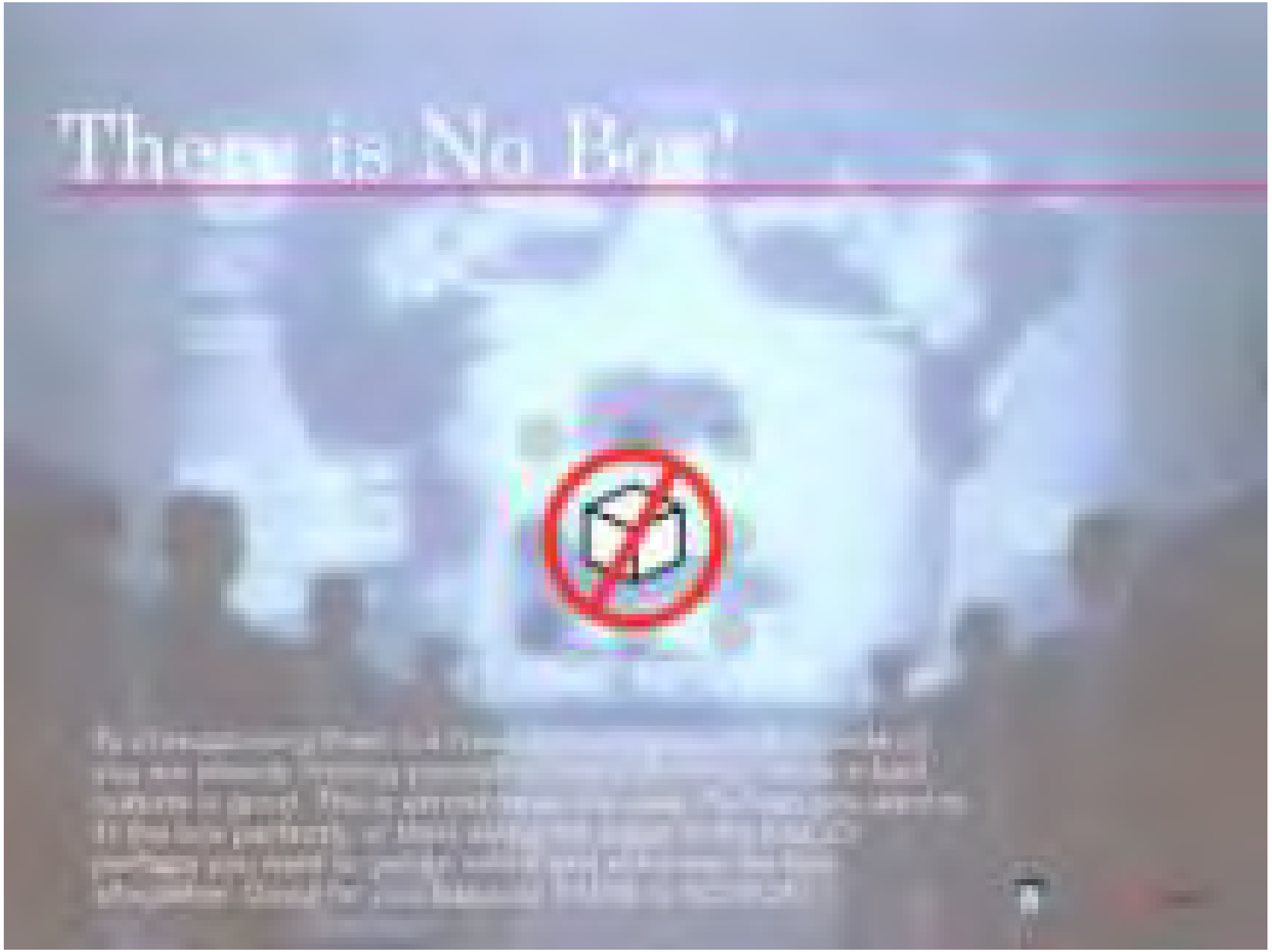

Center for the Study of Intelligence, CIA, 1999
9 dots
Assumption 3:
Must stay on 2D plane.
Forcing the brain to discover new patterns and dimensions is the main purpose of Deviation exercises.
.com


9 dots
Other Assumptions:
Can't shrink, fold, or rip.
In the book **This Means This, This Means That** by **Sean Hall**, he considers some even more radical solutions to the 9 dots challenge: What if you had one giant pencil? What if you folded the paper over the centre dot four times and stabbed it? What if you ripped out all the dots and laid them in a straight row?

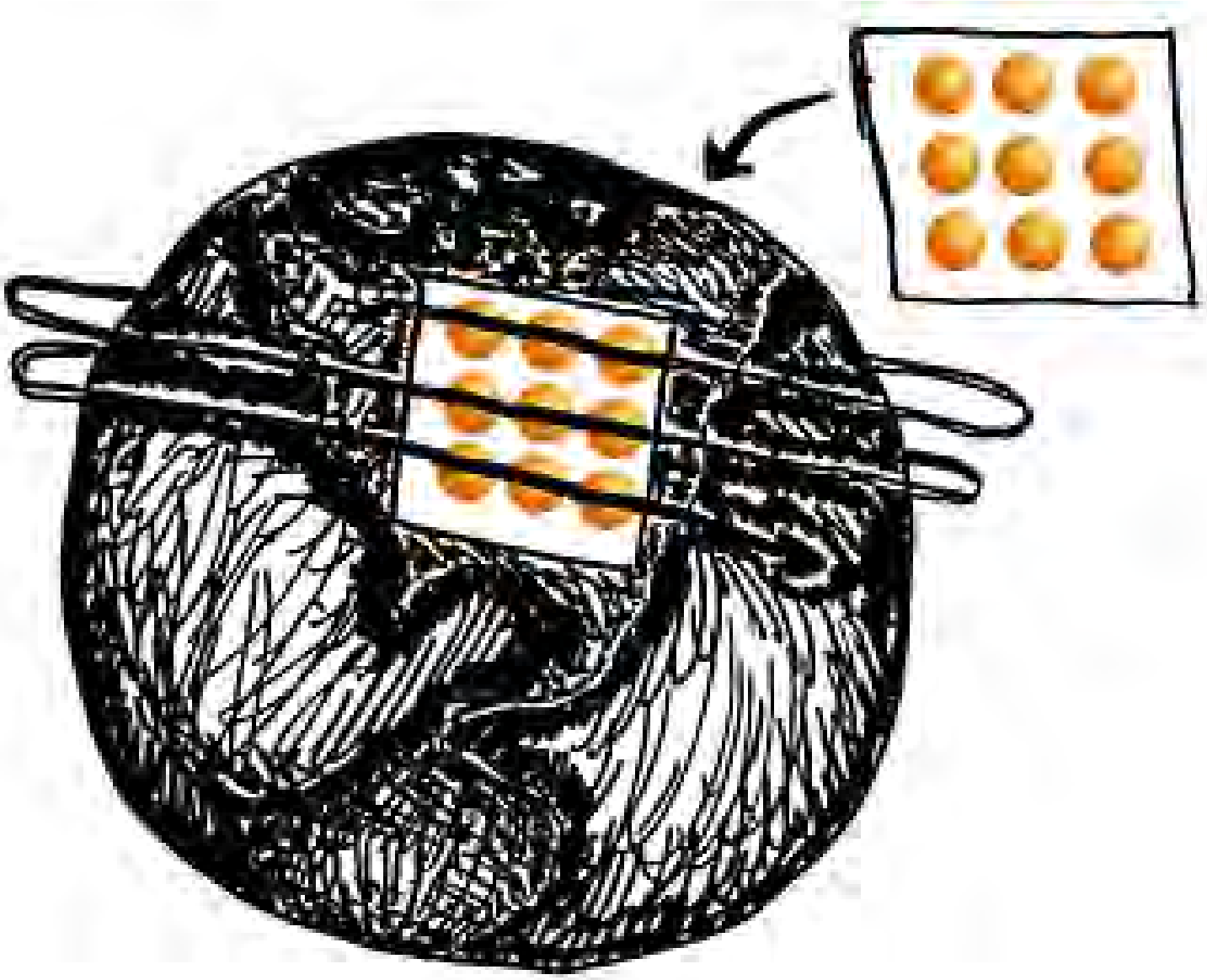
Think Outside the Box



There is No Box

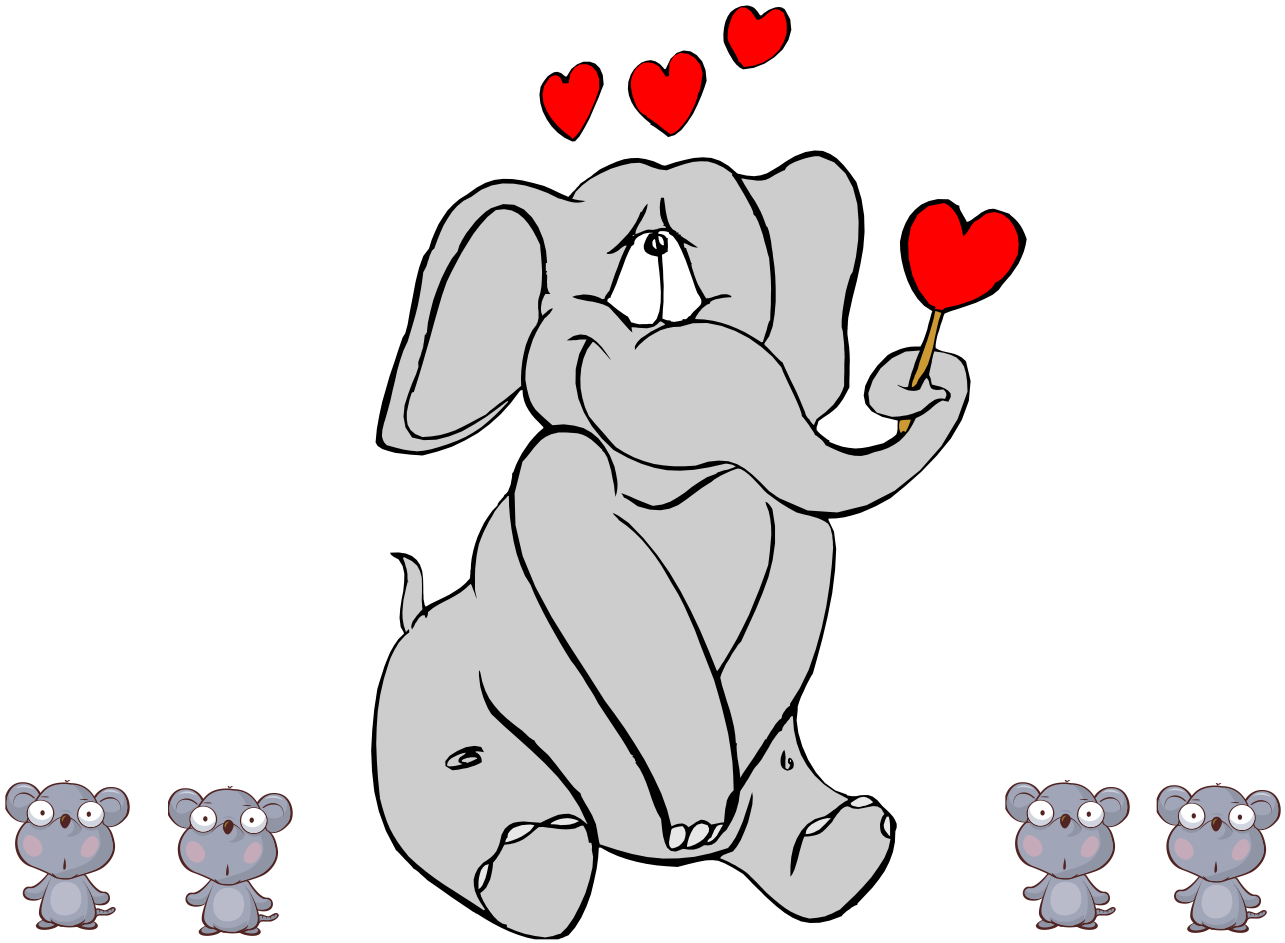


Geographer's 1-line solution



What to Look for in an Inspection in general

- 4 Mice and 1 Elephant



What to Look for in an Inspection in general

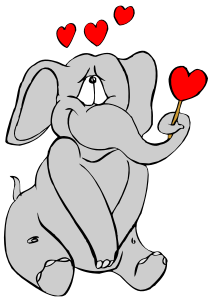
- 4 Mice and 1 Elephant

M - Man

M - Machine

M - Material

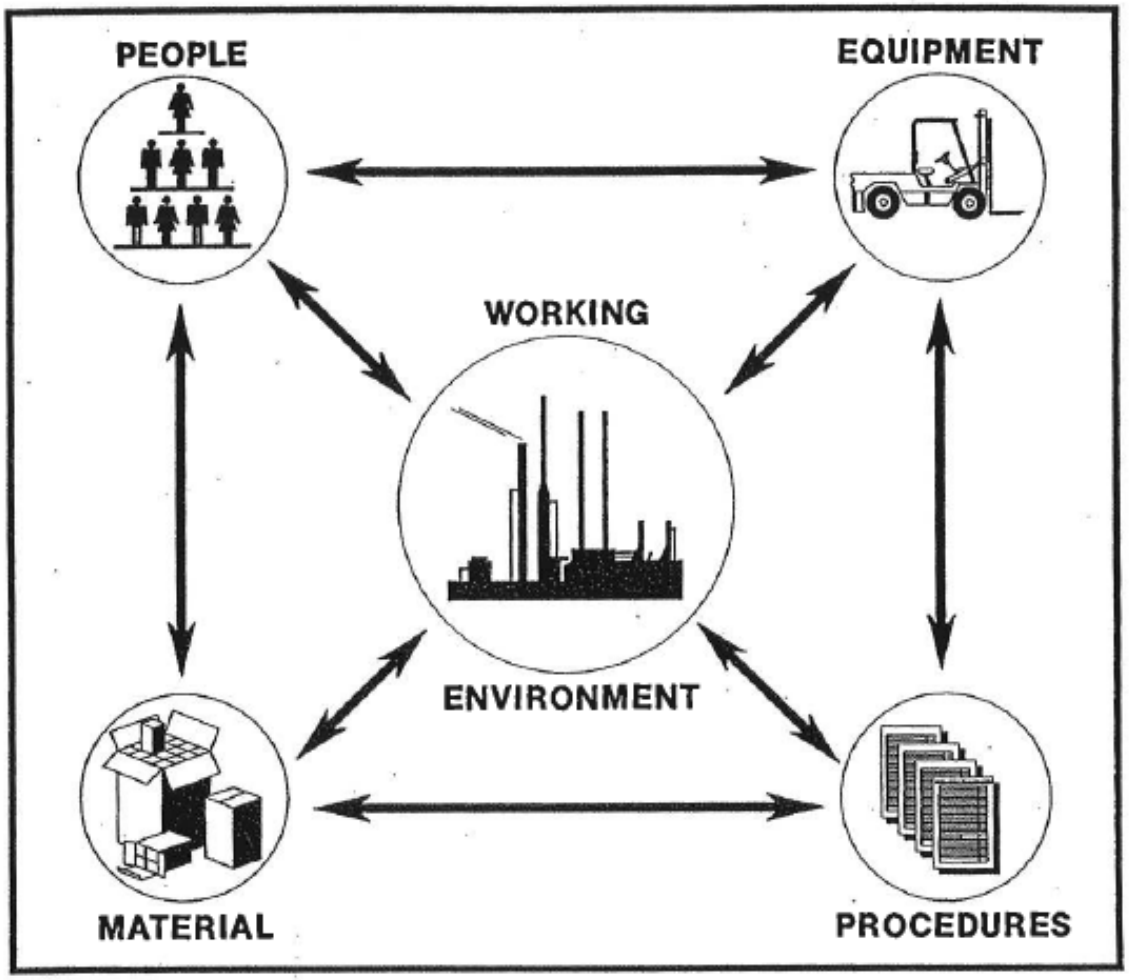
M - Method



E - Environment

What to Look for in an Accident Investigation

- These 5 elements of a Production Model, which can be converted into an Accident Investigation Model



The five elements that must interact for successful business operations.

Same as What to Look for in Accident Investigation

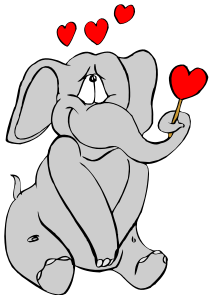
- 4 Mice and 1 Elephant


M - Man ( )


M - Machine ( )


M - Material ( )


M - Method ( )


E - Environment ( )

Safety Management - Mixed Approach

Basically the 4M+1E is an Ergonomic Model

- Heinrich's Domino Model (1959): a 1M +1E Man-Environment Unsafe Act-Unsafe Condition Model
- McDonald's Ergonomic Model (1976): a 2M+1E Man-Machine-Environment Model
- Wigglesworth (1972) had proposed a 3M+1E Man-Machine-Method-Environment Model emphasizing Operator-Machine-Process-Physical/Behavioural Environment
- JUSE (Union of Japan Scientists & Engineers) IN 1950'S after learning from Deming & Juran proposed a 4M+1E Man-Machine-Material-Method-Environment QCC (Quality Control Circle)

4M+1E in General Duties (OSHO s. 6 or FIUO s. 6A)

- General Duties Requirements (s. 6A of Factories & Industrial Undertakings Ordinance & s. 6 of Occupational Safety and Health Ordinance):-
  - Man: Provision of Safety Information, Instruction, Training & Supervision of all persons employed
  - Machine: Provision & Maintenance of Safe Plant
  - Material: Safe use, handling, storage & transport of Articles & Substances
  - Method: Provision & maintenance of Safe Systems of Work
  - Environment: Provision & maintenance of Safe Working Environment, including Safe Access & Egress

4M+1E in Confined Space Risk Assessment

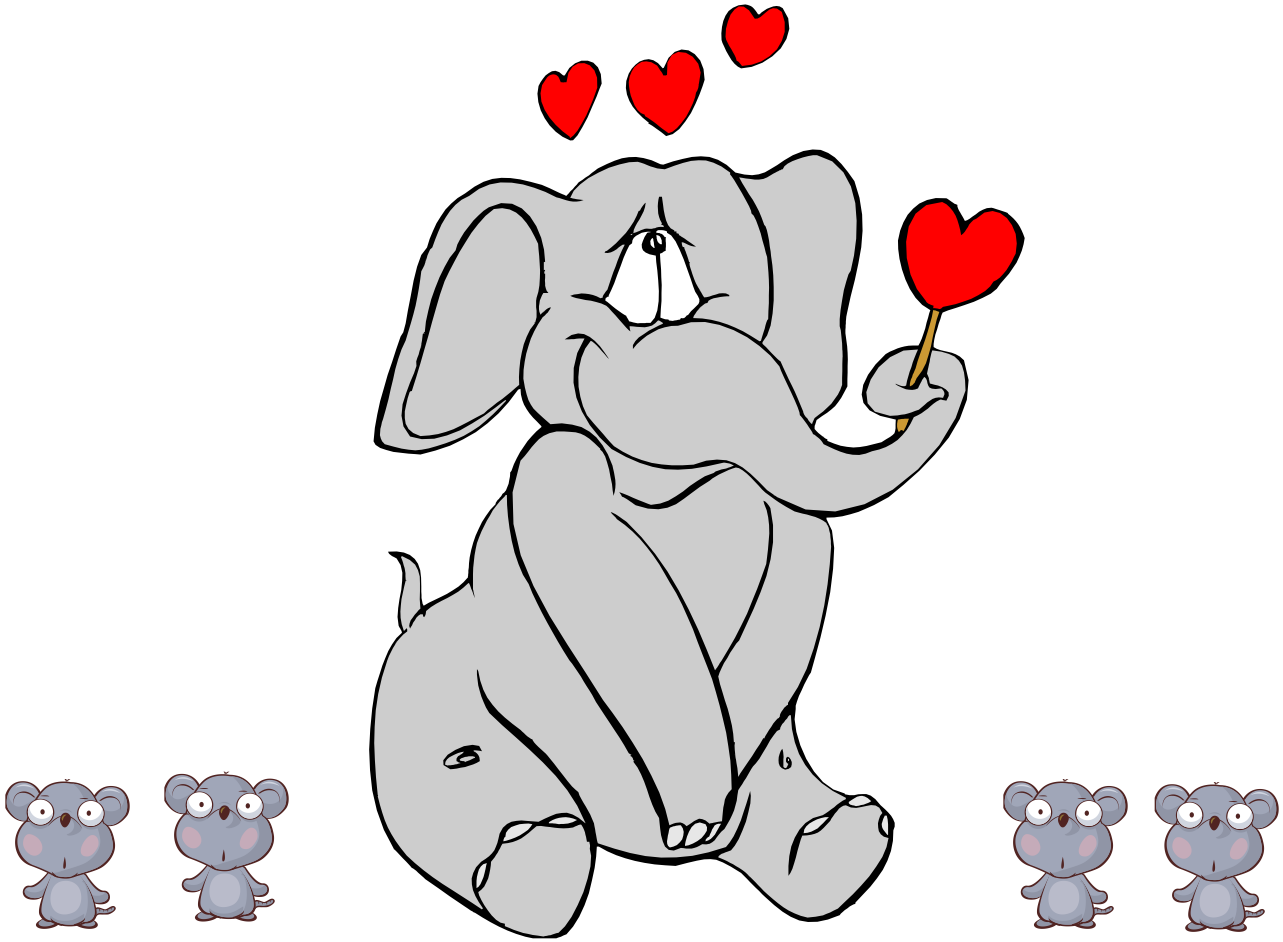
- Confined Space Risk Assessment (s. 5(2)(a) of Factories & Industrial Undertakings (Confined Spaces) Regulation):-
  - Man: Possibility of Loss of Consciousness of a Certified Worker arising from an Increase in Body Temperature
  - Machine: Plant to be used in Work Activities
  - Material: Materials to be used in Work Activities
  - Method: Work Method to be Used
  - Environment: Presence or Possibility of Ingress of Hazardous Gas, Vapour, Dust or Fume or There is any deficiency in Oxygen; Possibility of Sludge or Other Deposits liable to give off Hazardous Gas or Fume; Possibility of Fire or Explosion

4M+1E in MHO (OSHR)

- Manual Handling Operations Risk Assessment (s. 27(1)(c) & Schedule 3 of Occupational Safety and Health Regulations):-
  - Man: Individual Capability
  - Machine: Mechanical Aids
  - Material: The Loads
  - Method: The Tasks
  - Environment: The Working Environment

What to Look for in an Accident Investigation

- Became 4 Wives and 1 Husband



What to Look for in an Accident Investigation

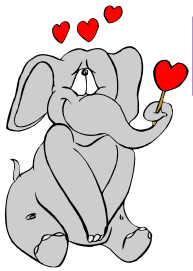
4 Wives and 1 Husband

W - Who (Man)

W - Which (Machine)

W - What (Material)

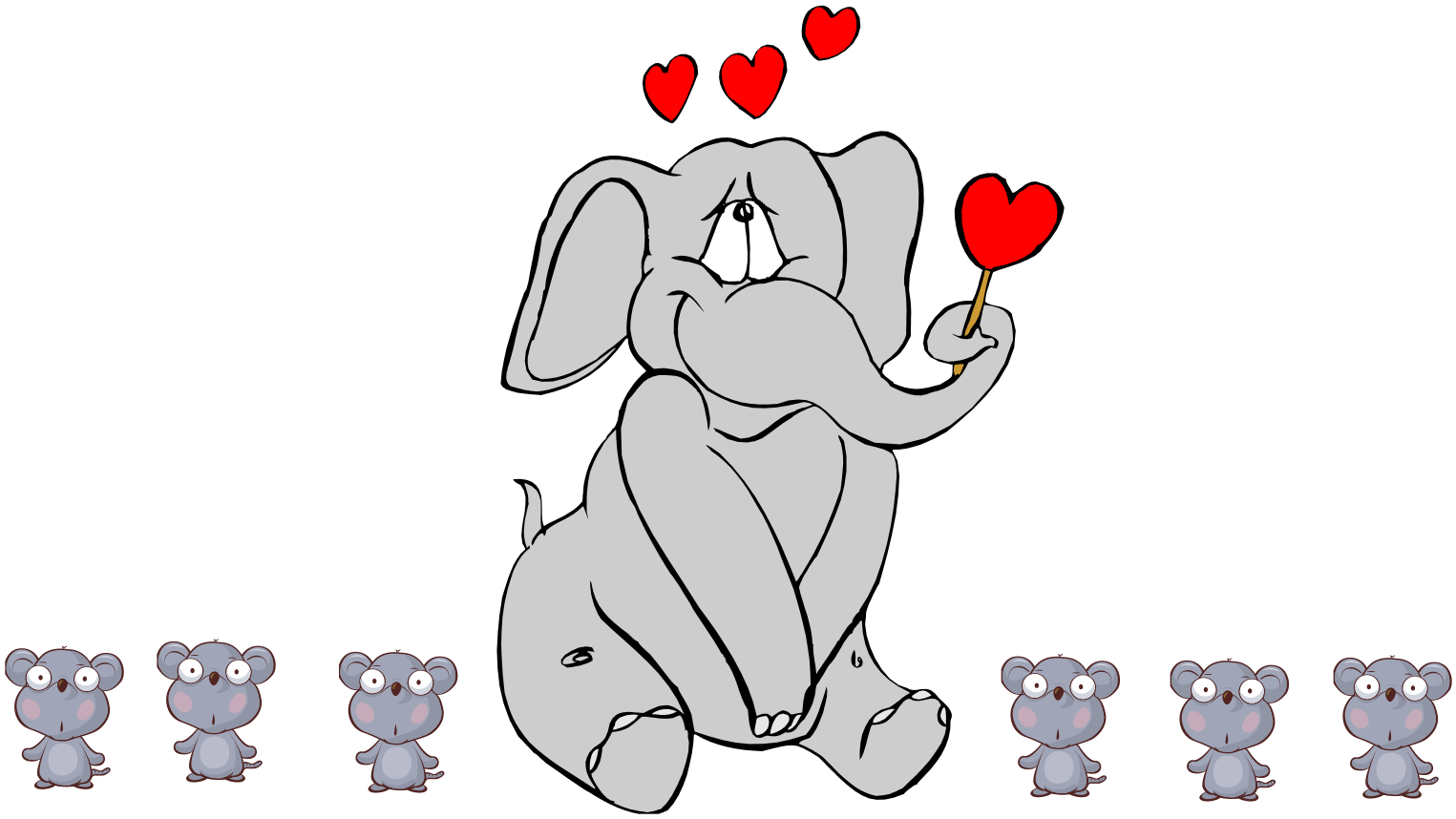
W - Where (Environment)



H - How (Method)

What to Look for in an Accident Investigation

- Gets 2 more Mice (or Wives) to become 1E+6M (or 1H+6W)



What to Look for in an Accident Investigation

6 Wives and 1 Husband

H - How (Method)

W - Who (Man)

W - Which (Machine)

W - What (Material)

W - Where (Environment)

W - When (Moment)

W - Why (Motive)

Effective Risk Management

- Convert the 1H + 6W into 7 Procedural P's in the Planning stage of a SMS

Effective Risk Management

- 7 Procedural P's in the Planning stage of a SMS

How - Process

Who - Person

Which - Plant

What - Production materials

Where - Place

When - Period

Why - Purpose

Effective Risk Management

- 7 Procedural P's in the "Planning" stage of a SMS

A	-	Process
K	-	Person
Q	-	Plant
J	-	Production materials
10	-	Place
9	-	Period
8	-	Purpose

Effective Risk Management

- Add 6 Management P's to become 13P's:
  - 7 - Policy
  - 6 - Parties involved
  - 5 - Planning
  - 4 - Program implementation
  - 3 - Performance monitoring
  - 2 - Periodic audit / review

Effective Risk Management

- Elements of a 13-P Safety Management System

Policy

Parties Involved

Planning (Plan & Procedure Compilation)

Program Implementation

Performance Monitoring

Periodic Auditing / Review

Plans & Procedures:-
People
Plant
Production materials
Process
Place
Purpose
Period

Example

- A Mathematical problem
  - In a soccer tournament, there are 16 teams. Each team must play at least once (one match). In any match, the team that loses will be out.
    - As the organizer, you have to estimate the minimum no. of matches to be held so as to book adequate venues. What is this no?

Standard Solution

  - Every 2 teams need 1 match
- so 16 teams need 8 matches
- these 8 teams need 4 matches
- these 4 teams need 2 matches
- the final 2 teams need 1 match
- total is 8+4+2+1 = 15 matches
  - But what if the no. of teams is increased to 20 teams at the start?

3-Line Solution

Horizontal (Creative) Thinking for Any No. of Teams

- Think from the FIRST PRINCIPLE, or the BASICS first!
  - 1 team, 0 match
  - 2 teams, 1 match
  - 3 teams, 2 matches …
  - So N teams, N-1 matches will result in a winner
  - Now add 1 more team to become N+1 teams, this new team competes with this winner to come up with a new winner, hence 1 more match needed, hence totally 1+(N-1)=N matches

1-Line Solution

Horizontal (Creative) Thinking for Any No. of Teams

- Think of solving not by deduction, but by ELIMINATION (evicting failure modes)
- To get a winner, how many teams need to be evicted?
- 1 eviction per match, hence 20 teams need 19 matches to evict 19 teams
- Sometimes need to think in the opposite direction
- Think the Opposite

Horizontal Thinking: Think the Opposite ( )

Example

How can we multiply 2 numbers just by adding, subtracting, doubling and halving only, without using a multiplication table?

Standard Solution

Get all multiples by doubling and / or adding only:

x2 Add the no. twice

x3 Add the 1- to 2-times

x4 Double the 2-times

x5 Add the 1- to 4-times or 2- to 3-times

x6 Add the 1- to 5; 2- to 4-; or double 3-times

X7 Add the 1- to 6-; 2- to 5-; or 3- to 4-times

X8 Add the 1- to 7-; 2- to 6-; 3- to 5- or double 4-times

x9 Add the 1- to 8-; 2- to 7-; 3- to 6-; or 4- to 5-times

Layout on the multiplication result

Then add them to give the answer

3-Line Solution

Russian Peasant's Method for 12,345 x 6,789 (=83,810,205)

Halving the no. on the left, then doubling the no. on the right. Repeat it until the no. on the left reaches 1.

12,345	6,789
6,172	13,578
3,086	27,156
1,543	54,312
771	108,624
385	217,248
192	434,496
96	868,992
48	1,737,984
24	3,475,968
12	6,951,936
6	13,903,872
3	27,807,744
1	55,615,488

3-Line Solution

Russian Peasant's Method for 12,345 x 6,789 (=83,810,205)

Then cross out those lines whose no. on the left is an even no. & add the right-hand column

12,345	6,789
~~6,172~~	~~13,578~~
~~3,086~~	~~27,156~~
1,543	54,312
771	108,624
385	217,248
~~192~~	~~434,496~~
~~96~~	~~868,992~~
~~48~~	~~1,737,984~~
~~24~~	~~3,475,968~~
~~12~~	~~6,951,936~~
~~6~~	~~13,903,872~~
3	27,807,744
1	55,615,488
Adding gives	83,810,205

3-Line Solution

Russian Peasant's Method for 12,345 x 6,789 (=83,810,205)

How about if we put 6,789 on the left and 12,345 on the right?

6,789	12,345
3,394	24,690
1,697	49,380
848	98,760
424	197,520
212	395,040
106	790,080
53	1,580,160
26	3,160,320
13	6,320,640
6	12,641,280
3	25,282,560
1	50,565,120

3-Line Solution

Russian Peasant's Method for 12,345 x 6,789 (=83,810,205)

Same result 83,810,205

6,789	12,345
~~3,394~~	~~24,690~~
1,697	49,380
~~848~~	~~98,760~~
~~424~~	~~197,520~~
~~212~~	~~395,040~~
~~106~~	~~790,080~~
53	1,580,160
~~26~~	~~3,160,320~~
13	6,320,640
~~6~~	~~12,641,280~~
3	25,282,560
1	50,565,120
Adding gives	83,810,205

1-Line Solution

Swiss Trachtenberg Method (derived from India's Veda System) for 12,345 x 6,789 (=83,810,205)

For x6 : Start with the unit digit, Add 5 to it if it is odd, then add half of the value of the number to the right ignoring any decimals (in this case the number to the right is 0). Then repeat the above step up to the final digit on the left. E.g. 12,345 x 6 = 74,070

Step 1: Unit digit is 5, since 5 is odd, adding 5 gives 10, and adding half of the value of the number to the right is adding 0 which gives a final of 10, i.e. '0

Step 2: Tens digit is 4, no need to add 5 as 4 is even, adding half of 5 (ignoring decimals) is to add 2, giving 6 and adding the 1 carried forward from Step 1 gives 7

Step 3: Hundreds digit is 3, adding 5 for 3 being odd gives 8, adding half of 4 gives 10, i.e. '0

Step 4: Thousands digit is 2, no need to add 5 as 2 is even, adding half of 3 gives 3, and adding the 1 carried forward from Step 3 gives 4

Step 5: Ten Thousands digit is 1, adding 5 for 1 being odd gives 6, adding half of 2 gives 7

Step 6: No more digit, so this step only gives half of the value of the number to the right which is half of 1, giving 0 which can be ignored

So the answer is 74,070

1-Line Solution

Swiss Trachtenberg Method (derived from India's Veda System) for 12,345 x 6,789 (=83,810,205)

For x7 : Start with the unit digit, Double it, Add 5 to the doubled amount if the unit digit is odd, then add half of the value of the number to the right ignoring any decimals (in this case the number to the right is 0). Then repeat the above step up to the final digit on the left. E.g. 12,345x7=86,415

Step 1: Unit digit is 5, doubling gives 10, since 5 is odd, adding 5 gives 15, and adding half of the value of the number to the right is adding 0 which gives a final of 15, i.e. '5

Step 2: Tens digit is 4, doubling gives 8, no need to add 5 as 4 is even, adding half of 5 (ignoring decimals) is to add 2, giving 10 and adding the 1 carried forward from Step 1 gives 11, i.e. '1

Step 3: Hundreds digit is 3, doubling gives 6, adding 5 for 3 being odd gives 11, adding half of 4 gives 13, and adding the 1 carried forward from Step 2 gives 14, i.e. '4

Step 4: Thousands digit is 2, doubling gives 4, no need to add 5 as 2 is even, adding half of 3 gives 5, and adding the 1 carried forward from Step 3 gives 6

Step 5: Ten Thousands digit is 1, doubling gives 2, adding 5 for 1 being odd gives 7, adding half of 2 gives 8

Step 6: No more digit, so this step only gives half of the value of the number to the right which is half of 1, giving 0 which can be ignored

So the answer is 86,415

1-Line Solution

Swiss Trachtenberg Method (derived from India's Veda System) for 12,345 x 6,789 (=83,810,205)

For x8: Subtract the unit digit from 10, Double the difference, then add the value of the number to the right (in this case the number to the right is 0). Then repeat the above step, except subtracting the digit from 9 instead of 10, up to the final digit on the left. Subtract two from the leftmost answer. E.g. 12,345x8=98,760

Step 1: Unit digit is 5, subtracting it from 10 gives 5, doubling gives 10, and adding the value of the number to the right is adding 0 which gives a final of 10, i.e. '0

Step 2: Tens digit is 4, subtracting it from 9 gives 5, doubling gives 10, adding value of the no. to the right is to add 5, giving 15, adding the 1 carried forward from Step 1 gives 16, i.e. '6

Step 3: Hundreds digit is 3, subtracting it from 9 gives 6, doubling gives 12, adding 4 gives 16, and adding the 1 carried forward from Step 2 gives 17, i.e. '7

Step 4: Thousands digit is 2, subtracting it from 9 gives 7, doubling gives 14, adding 3 gives 17, and adding the 1 carried forward from Step 3 gives 18, i.e. '8

Step 5: Ten Thousands digit is 1, subtracting it from 9 gives 8, doubling gives 16, adding 2 gives 18, and adding the 1 carried forward from Step 4 gives 19, i.e. '9

Step 6: No more digit, so adding 1 gives 1, and adding the 1 carried forward from Step 5 gives 2. Subtracting 2 gives 0 which can be ignored.

So the answer is 98,760

1-Line Solution

Swiss Trachtenberg Method (derived from India's Veda System) for 12,345 x 6,789 (=83,810,205)

For x9: Subtract the unit digit from 10, add the value of the number to the right (in this case the number to the right is 0). Then, repeat the above step, except subtracting the digit from 9 instead of 10, up to the final digit on the left. Subtract one from the leftmost answer. E.g. 12,345x9=111,105

Step 1: Unit digit is 5, subtracting it from 10 gives 5, adding the value of the number to the right is adding 0 which gives a final of 10, i.e. 5

Step 2: Tens digit is 4, subtracting it from 9 gives 5, adding value of the no. to the right is to add 5, giving 10, i.e. '0

Step 3: Hundreds digit is 3, subtracting it from 9 gives 6, adding 4 gives 10, and adding the 1 carried forward from Step 2 gives 11, i.e. '1

Step 4: Thousands digit is 2, subtracting it from 9 gives 7, adding 3 gives 10, and adding the 1 carried forward from Step 3 gives 11, i.e. '1

Step 5: Ten Thousands digit is 1, subtracting it from 9 gives 8, adding 2 gives 10, and adding the 1 carried forward from Step 4 gives 11, i.e. '1

Step 6: No more digit, so adding 1 gives 1, and adding the 1 carried forward from Step 5 gives 2. Subtracting 1 gives 1

So the answer is 111,105

1-Line Solution

1-Line Solution: Swiss Trachtenberg Method (derived from India's Veda System) for 12,345 x 6,789 (=83,810,205)

Listing and adding them gives:

	12,345
x	6,789
	111,105
	987,600
	8,641,500
	74,070,000
Adding gives	83,810,205

1-Line Solution

Swiss Trachtenberg Method (derived from India's Veda System) for 12,345 x 6,789 (=83,810,205)

The other way will also do. x1 gives the same no. x2 just doubles the no. 6,789x2=13,578.

For x3: Subtract the unit digit from 10, Double the difference, Add 5 to the doubled amount if the unit digit is odd, then add half of the value of the number to the right ignoring any decimals (in this case the number to the right is 0). Then, repeat the above step, except subtracting the digit from 9 instead of 10, up to the final digit on the left. Subtract two from the leftmost answer. E.g. 6,789x3=20,367

Step 1: Unit digit is 9, subtracting it from 10 gives 1, doubling gives 2, since 9 is an odd no., adding 5 gives 7, and adding half of the value of the number to the right is adding 0 which gives 7

Step 2: Tens digit is 8, subtracting it from 9 gives 1, doubling gives 2, no need to add 5 as 8 is even, adding half of the value of the no. to the right is to add 4, giving 6

Step 3: Hundreds digit is 7, subtracting it from 9 gives 2, doubling gives 4, adding 5 gives 9, and adding half of the value of the no. to the right is to add 4, giving 13, i.e. '3

Step 4: Thousands digit is 6, subtracting it from 9 gives 3, doubling gives 6, no need to add 5 as 6 is even, adding half of the value of the no. to the right is to add 3, giving 9, and adding the 1 carried forward from Step 3 gives 10, i.e. '0

Step 5: No more digit, so adding half of the no. to the right gives 3, and adding the 1 carried forward from Step 5 gives 4. Subtracting 2 gives 2

So the answer is 20,367

1-Line Solution

Swiss Trachtenberg Method (derived from India's Veda System) for 12,345 x 6,789 (=83,810,205)

For x4: Subtract the unit digit from 10, Add 5 to the doubled amount if the unit digit is odd, then add half of the value of the number to the right ignoring any decimals (in this case the number to the right is 0). Then, repeat the above step, except subtracting the tens digit from 9 instead of 10, up to the final digit on the left. Subtract one from the leftmost answer. E.g. 6,789x4=27,156

Step 1: Unit digit is 9, subtracting it from 10 gives 1, since 9 is an odd no., adding 5 gives 6, and adding half of the value of the number to the right is adding 0 which gives 6

Step 2: Tens digit is 8, subtracting it from 9 gives 1, no need to add 5 as 8 is even, adding half of the value of the no. to the right is to add 4, giving 5

Step 3: Hundreds digit is 7, subtracting it from 9 gives 2, adding 5 gives 7, and adding half of the value of the no. to the right is to add 4, giving 11, i.e. '1

Step 4: Thousands digit is 6, subtracting it from 9 gives 3, no need to add 5 as 6 is even, adding half of the value of the no. to the right is to add 3, giving 6, and adding the 1 carried forward from Step 3 gives 7

Step 5: No more digit, so adding half of the no. to the right gives 3. Subtracting 1 gives 2

So the answer is 27,156

1-Line Solution

Swiss Trachtenberg Method (derived from India's Veda System) for 12,345 x 6,789 (=83,810,205)

For x5: The answer is equal to 5 if the unit digit is odd, and is 0 if the unit digit is even, then add half of the value of the number to the right ignoring any decimals (in this case the number to the right is 0). Repeat the above step up to the final digit on the left. E.g. 6,789x5=33,945

Step 1: Unit digit is 9, which is odd, so the answer is 5, and adding half of the value of the number to the right is adding 0 which gives 5

Step 2: Tens digit is 8, which is even, so the answer is 0, and adding half of the value of the no. to the right is to add 4, giving 4

Step 3: Hundreds digit is 7, which is odd, so the answer is 5, and adding half of the value of the no. to the right is to add 4, giving 9

Step 4: Thousands digit is 6, which is even, so the answer is 0, and adding half of the value of the no. to the right is to add 3, giving 3

Step 5: No more digit, so adding half of the no. to the right gives 3

So the answer is 33,945

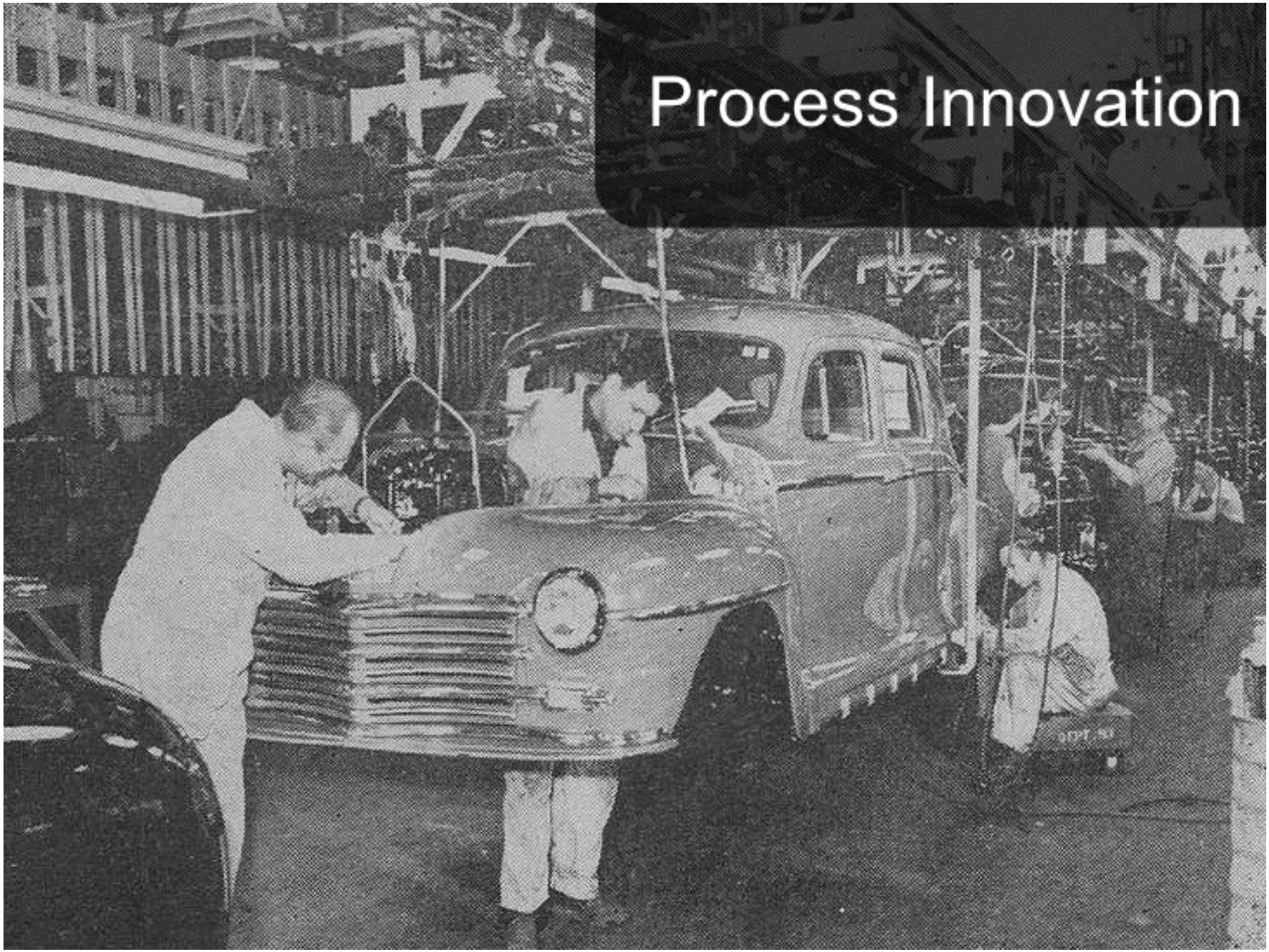
1-Line Solution

Swiss Trachtenberg Method (derived from India's Veda System) for 12,345 x 6,789 (=83,810,205)

Listing and adding them gives:

	6,789
x	12,345
	33,945
	271,560
	2,036,700
	13,578,000
	67,890,000
Adding gives	83,810,205

Process Innovation



Brainstorming

What's the hazard?

Brainstorming

Any way to prevent this?

Example: Cutter Injury Prevention

Standard Solution: Wear Cut-resistant Glove (Man-solution, usually Uncomfortable)

Example: Cutter Injury Prevention

3-Line Solution: Transverse Cutting Method

Comox Valley Regional District

PARK VOLUNTEER SAFETY GUIDELINES

General park development and maintenance activities	SAFETY GUIDELINES
POTENTIAL INJURIES: Bruises, cuts, scrapes, insect bites, dog bites, slip and fall, muscle pull, back injury, abrasions, soreness, dust in eyes, crushed toes, repetitive strain, blistering, wild animal attack	❑ Inspect work sites for hazards before entering and beginning work. ❑ Do not take unnecessary risks. ❑ Keep tools in good condition at all times. ❑ Inspect tools for defects before each use – do not use tools that are in poor condition or are missing safety guards. ❑ Use tools only for tasks intended use. ❑ Never cut towards yourself. ❑ Never work alone when working from a ladder, near electrical lines or when using motorized equipment. ❑ Let someone know where you will be working and when you expect to return. ❑ Wear clothing and footwear appropriate to the job. For example, wear a hard hat when working under low branches or where there may be falling objects.

Assessing hazard trees	SAFETY GUIDELINES
POTENTIAL INJURIES: Severe injury, trip and fall, death	Only a certified wildlife/danger tree assessor may declare any dead, dying or damaged tree to be safe to work under or around. ❑ Inspect work site for hazardous trees before entering and beginning work. ❑ Wear a hardhat and sturdy footwear, assess trees for obvious hazards such as lean, fruiting bodies and dead limbs or tops. ❑ Stay clear of overhead hazards, and stay out of treed areas in strong wind conditions. ❑ Create a safety zone 1.5 tree lengths away from dead trees/snags with temporary flagging to keep all volunteers out of this hazardous area until the tree or hazardous part is removed or a certified assessor has declared it safe. ❑ Where possible adjust trail to avoid danger trees. ❑ All tree hazards are to be removed by an experienced faller only.

Carrying materials	SAFETY GUIDELINES
POTENTIAL INJURIES: Muscle pull, back injury, abrasions, soreness	❑ Store materials at waist height whenever possible. ❑ Get help when the materials are more than you can handle. ❑ Wear gloves. ❑ Place your feet shoulder length apart. ❑ Stand close to the load to be lifted and keep the load close to your body. ❑ Use the strength of your leg and arm muscles to slowly lift the load smoothly. ❑ Lift with legs not back! ❑ Pivot on your feet moving your whole body and keeping your back straight – do not twist at waist. ❑ Push rather than pull a load. ❑ Avoid heavy lifting immediately after bending or kneeling- stretch first.

Eastern School District

Hand Tools (General)
Safe Work Practices and Procedures
SWPP-020
Page 1 of 1

Health and Safety Hazards

- Chemical hazards; dust.
- Physical hazards; noise and lighting.
- Ergonomic hazards; force, repetitive movements and posture.
- Machine hazards; moving parts, sharp blades and pinch points.
- Energy hazards; gravity.
- Work practice hazards; following established safe work practices and procedures, and general housekeeping practices.

Safe Work Practices

- ✓ Read and follow the manufacturer's instructions and warning labels.
- ✓ Know how to safely use hand tools and identify when they need repair.
- ✓ Wear **personal protective equipment** such as safety footwear, safety glasses, etc that are appropriate for the hazards to which you may be exposed to when doing the required task.
- ✓ Select the right tool for the job; do not substitute.
- ✓ Ensure there is adequate lighting in the work area.
- ✓ Always concentrate on what you are doing.
- ✓ Use good quality hand tools.
- ✓ Maintain tools in good working condition. Keep them clean and dry, and store them properly after each use.
- ✓ Inspect tools for defects before use. Replace or repair defective tools.
- ✓ Ensure that the handle fits tightly into the head of the tool.
- ✓ Always pull on a wrench or pliers.
- ✓ Replace cracked or broken handles on files, hammers or screwdrivers.
- ✓ Replace worn jaws on wrenches, pipe tools and pliers.
- ✓ Keep cutting tools sharp and cover the sharp edges with a suitable covering to protect the tool and to prevent injuries from unintended contact.
- ✓ Keep the work environment clean and tidy.

- × Do not use any broken or unsafe equipment, attach a warning tag, take it out-of-service and advise your supervisor.
- × Do not use hand tools for jobs they are not intended to do.
- × Do not apply excessive force or pressure on tools.
- × Do not cut towards yourself when using a cutting tool.
- × Do not wear bulky gloves when using hand tools.
- × Do not throw tools. Hand them, handle first, directly to another worker.
- × Do not carry tools in a way that interferes with using both hands on a ladder or while climbing on a structure.
- × Do not carry a sharp tool in your pocket.

Approved By: Directors of Facilities, and Policy and Facilities Planning
Date Approved: March 1, 2012
Date of Amendments:

Example: Cutter Injury Prevention

1-Line Solution: Retractable Cutter Blade Guard

Example: Dog Bite Injury Prevention

How to Prevent Dog Bite Injury?

Example: Dog Bite Injury Prevention

Standard Solution: Wear Protective Glove

Example: Dog Bite Injury Prevention

3-Line Solution: Dog Baton

經過狗身邊時，步行要慢，側身向着牠，並把防護裝備放置在你和狗之間，作為保護。

使用防護裝備作為你和狗的有效阻隔物。

Dog Baton Long & Short

- The "DOG BATON" is a solid nylon rod.
- There will be no breaking of this Baton!
- A dog will bite the first thing he comes to!
- A protection device can only be effective if it is out at all times!
- This Dog Bite Stick/Baton can be used to keep a dog at bay, move brush, open gates and protect your employees.

#213 Long Dog Baton (2.5ft.)
#212 Short Dog Baton (2ft.)

Dog Bite Stick Long & Short

- The Dog Bite Stick is made of SCH #40 PVC
- This Dog Bite Stick can be used to keep a dog at bay, move brush, open gates and protect your employees.
- A dog will bite the first thing he comes.
- A protection device can only be effective if it is out at all times.
- Great for all field employees!

#106 Long Dog Bite Stick (2.5ft.)
#107 Short Dog Bite Stick (2ft.)

Example: Dog Bite Injury Prevention

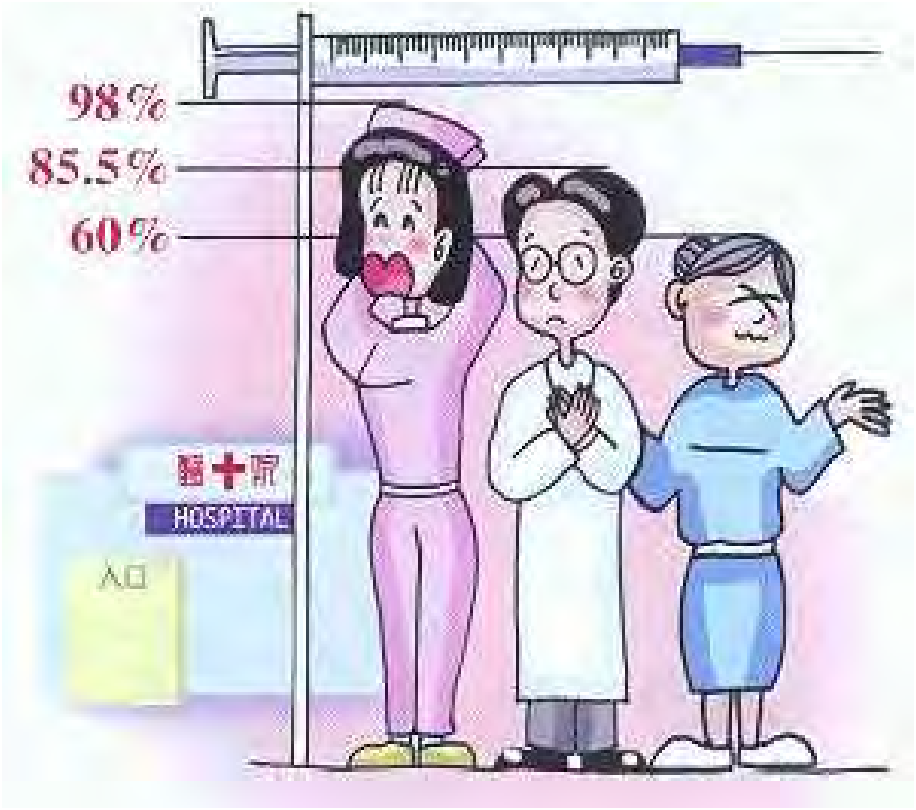
1-Line Solution: Dog Repeller

聲波槍最可怕的就是觀衆席上任何人都可以用，包括寵狗場。存心開玩笑的觀衆也可以引起大混亂，就因爲目前已有很多在民間。一些郵差就是配備了此物對付惡狗，在電器店用廿五鎊就可以買到。此物是放射超聲波，人難不見，但動物可聽見而很不舒服，咬郵差的惡狗則會跑開。

英國郵政部門在自然福特成功地實驗過了之後向美國訂購了一千件，每件價值十八鎊，在十五呎內有效，分發給郵差。澳洲的郵差亦有了此物。馬兒耳朵塞了棉花也感是使之聽不見觀衆叫喊，却阻不了超聲波。

Brainstorming

Needstick injury of Health Care Workers



Brainstorming

How to prevent or reduce needstick injury?

Example: Needlestick Injury Prevention

Standard Solution: Don't Recap, Use Sharp Box. If not practicable, Recap with 1 Hand

Recapping:

The "one-hand" technique

Step 1

Place the cap on a flat surface,
then remove your hand from the cap.

Step 2

With one hand, hold the syringe and
use the needle to "scoop up" the cap.

Step 3

When the cap covers the needle completely,
use the other

Example: Needlestick Injury Prevention

3-Line Solution: Needleless Injector

Example: Needlestick Injury Prevention

1-Line Solution: Retractable Needle Guard

Other Food for Thought:

The BOX (Plant): Must fire extinguishers be cylindrical. Why?

Can't they have other shapes

So we have:

Product Information

Product: The Revolutionary F2000

Type: 6-litre high-performance IMPREX extinguisher

Application: Conference rooms, Seminar rooms, Hotels, Banks, Fashion houses, Restaurants, Galleries, Stately homes etc.

Features:

- Revolutionary design
- Award winning design
- Suited to architectural design
- Can contain first aid kit
- A world-first
- EN3 approved

Benefits:

- Phenomenal performance
- Minimum space requirements
- Better performance than twice the size
- Environmentally friendly IMPREX
- Knockdown performance of powder, applied like foam
- Enhances the surroundings

Technical Data

Model	Capacity	Type	Weight of charged extinguisher	Extinguishing agent	Volume of extinguishing agent	Working pressure	Discharge Time	Range of jet horizontal	Temperature range	Height mm	Width mm	Depth mm
F2000 – 6 ltr.	6 litre	Stored pressure	12.0kg	IMPREX	6 litre	13 bar	+32 sec.	+4m	-4°C to +60°C	450	447	158

May be subject to technical change

FOAM EXTINGUISHERS are ideal where both A & B class fire risks exist. IMPREX has the knockdown performance of powder and works as foam. It is a very high-performance compound which combines excellent fire fighting properties whilst being totally environmentally friendly. This extinguisher has passed the electrical conductivity test at 35kv.

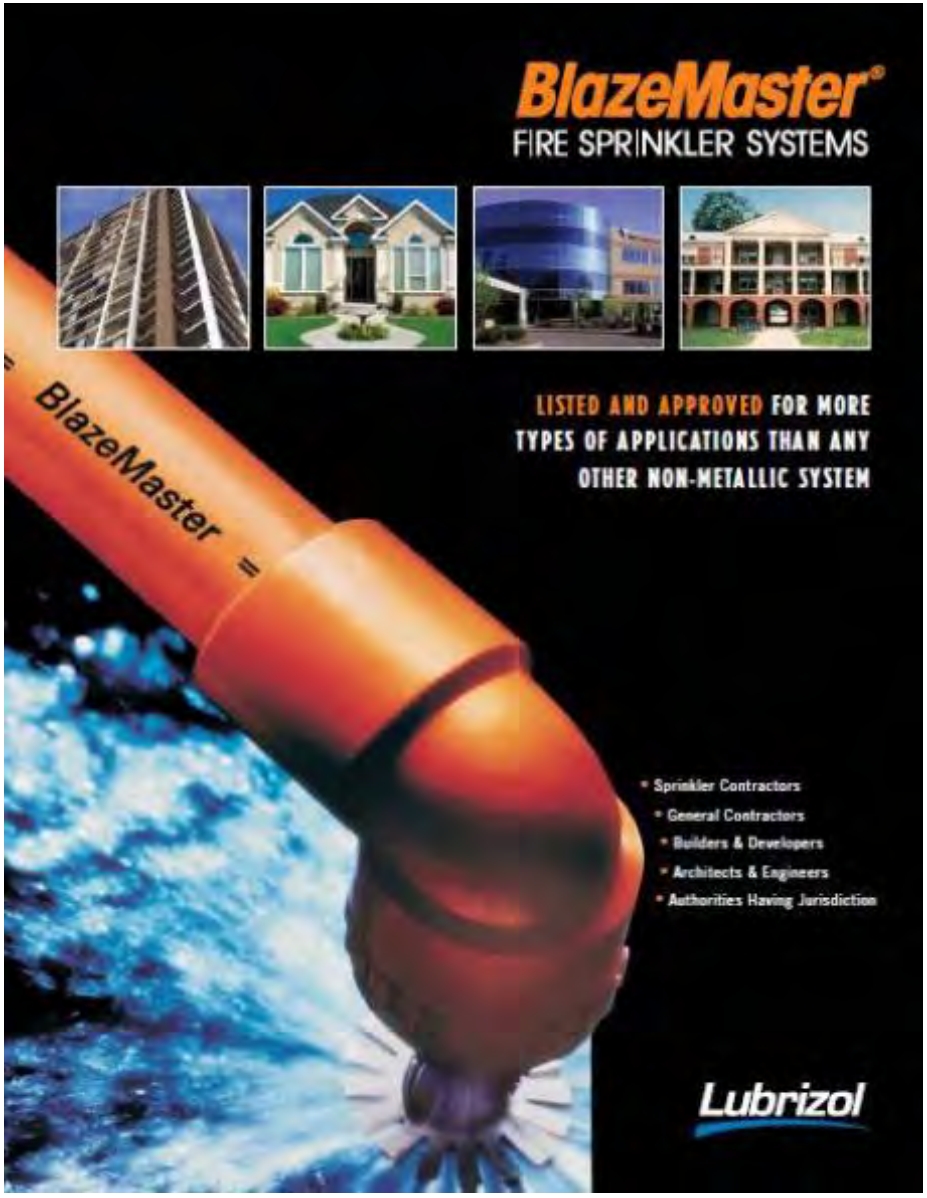
Model				
F2000 – 6 ltr	21 A	183B		

Other Food for Thought:

The BOX (Material): Must Scaffolding materials be made of Bamboo or Metal.

Can't they be Plastic ones? We already have Plastic Water Pipes

And Plastic Fire Sprinkler Pipes!



CPVC Fire Sprinklers

BlazeMaster

When dealing with fire protection, you need a piping system you can depend on. BlazeMaster® CPVC pipe and fittings are designed specifically for fire sprinkler systems and are based on more than 40 years of proven experience. Lubrizol, the worldwide leader in CPVC innovation, takes fire sprinkler systems to a level of superior performance that exceeds your expectations.

BlazeMaster fire sprinkler systems are the most advanced, Listed and approved non-metallic piping system available on the market today. And there's no comparison between CPVC pipe and metal pipe. CPVC systems offer more advantages than metal systems making all other pipes obsolete.

Check the facts:

- Certified by NSF International for potable water safety under all water conditions
- Elimination of scaling and corrosion for lasting performance, even in salt air environments
- Natural immunity to Microbiologically Influenced Corrosion (MIC)
- Superior flow characteristics offer better hydraulic design over metal systems
- Ease of fabrication in the field provides unmatched flexibility
- Minimal tool investment generates increased cost savings
- 50-year life expectancy with a safety factor of two
- CPVC formulation delivers exceptional toughness
- Quality Assurance Program guarantees consistency and reliability

BlazeMaster fire sprinkler systems are backed by an extensive field support organization, which is available for expert technical assistance and can provide you with:

- Proven installation recommendations to maximize efficiency and cost savings
- Expert consultation regarding compliance with local, regional and national codes
- Assistance with architects and engineers on design and specification work

There are numerous advantages to using the BlazeMaster fire sprinkler technology to address your specific needs, including:

Sprinkler Contractors

- **Improved durability:** BlazeMaster CPVC pipe and fitting compounds have been specially formulated using Lubrizol technology for improved durability. It provides many advantages during installation, even at cold temperatures.
- **Cost savings:** Overhead on tools is minimal since pipe can be cut on-site with simple hand tools. A one-step joining system makes installations even quicker, keeping labor to a minimum.

General Contractors

- **Less conflict with other trades:** Contractors installing BlazeMaster systems work easily and quickly around drywallers, framers and other mechanical contractors.
- **Lightweight:** No special rigging or equipment is needed to move BlazeMaster pipe within the building.

Builders and Developers

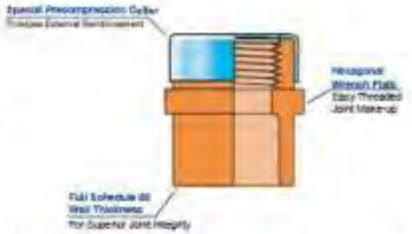
- **Low cost:** Installed costs of a BlazeMaster system are significantly lower and prices are more stable than metal systems.
- **Optimal sized system:** Smooth internal diameters lead to better hydraulic performance than metal systems, which often means pipe can be downsized, lowering material costs.

FlameGuard™ SPECIAL REINFORCED (SR) CPVC FIRE SPRINKLER HEAD ADAPTER FITTINGS

FG-2B-0806

Advanced Patented Technology
Factory Mutual (FMRC) and UL Approved!

Spears® patented special reinforced (SR) plastic female thread design is one of the most significant advancements in the use of CPVC fire sprinkler system threaded fittings. Not just an added ring, this unique precompression design compensates for expansion forces generated from tapered pipe thread joint makeup. Radial stress is no longer a problem in normal installations and easily managed in severe over-tightening situations.



One-Piece Fitting Construction
One-piece fitting design increases reliability and maintains system integrity.

Designed for Sprinkler Heads & Plastic-to-Metal Transitions
Spears® patented SR design and manufacturing process allows direct connection to fire sprinkler heads or threaded metal pipe through one simple adapter. Material thermal expansion/contraction differences are equalized by the restraining collar. You get low-cost, worry-free plastic-to-metal transitions every time.

Corrosion Resistant
SR Adapters are produced from a CPVC thermoplastic compound for superior chemical and corrosion resistance to system fluids.

Full ASTM Schedule 80 Conformance
All SR Sprinkler Head Adapters conform to ASTM F 439 requirements for dimensions and hydrostatic pressure test.

Potable Water Approved
Certified by NSF International, lead-free thermoplastic compounds are safe for use in drinking water systems.

Available in 1/2" through 1-1/4" Thread Sizes
Spears® **FlameGuard**™ SR Sprinkler Head Adapters are available in socket or spigot by SR Thread configurations including Sprinkler Head Tees, 90° Elbows and Female Adapters.

Tested & Approved by Underwriters Laboratories

Spears® **FlameGuard**™ Fire Sprinkler Piping Products are Listed by Underwriters Laboratories for use in: Light Hazard occupancies as defined in the Standard for Installation of Sprinkler Systems, NFPA 13; Residential occupancies as defined in the Standard for Installation of Sprinkler Systems up to Four Stories in height, NFA 13R; Residential occupancies as defined in the Standard for Sprinkler Systems in One and Two Family Dwellings and Mobile Homes, NFPA 13D; and Air Conditioning and Ventilation Systems, NFPA 90A.

PROGRESSIVE PRODUCTS FROM SPEARS® INNOVATION & TECHNOLOGY
Visit our web site: www.spearsmfg.com

Glass-Reinforced Plastic tubular scaffold

Captrad Ltd

Tel: 01695 680010
Fax: 01695 680009
sales@captrad.com

GRP Scaffolding

Captrad have introduced a new scaffolding system to their product range. This includes grp scaffolding tubes and planks. These grp scaffolding products allow customers to erect temporary or semi-permanent structures in those environments where conventional scaffolding materials cannot be used. This includes chemical process plant, the food industry, electrical or radiation hazard areas and those situations where weight saving is critical.

Scaffold tube Specially designed high stiffness, thick walled, Pullwound glass fibre reinforced polyester tube.
Outside diameter: 48.5 mm.
The correct diameter to accept standard steel scaffolding fittings
Laminate construction: high glass content, multiply structural core with tough external composite layer for maximum resistance to in-service damage.

Technical Data GRP behaves very differently from metals in that it has a much lower modulus but the same or higher strength; it is elastic and has no defined yield point. Therefore it is not easy to make direct comparisons with the specification given in the BS and EN standards for steel scaffold tube.

	Units	Property Data
Axial modulus	GPa	35
Axial strength	MPa	> 300
Transverse crush strength	kN	100
Weight	kg/m	1.7

Scaffold plank

A unique pultruded hollow grp box profile with internal stiffening ribs and an integral anti-slip top surface. The plank is designed to match the performance of wood or aluminium scaffold planks. The scaffold plank is highly resistant to corrosive environments, does not chip, spall or create splinters, is lighter than wood or metal planks and is electrically non-conductive.

All these benefits make it an ideal plank for use in those areas where wood or metal planks are not suitable or are limited by regulatory requirements.
The plank has been thoroughly tested and complies with CSA (S269.2M87) and OSHA (1926.451 Section A1)

Other Food for Thought:

Total gas flooding system is both expensive and the gas is not good to health. What's good for fight electrical or flammable liquid fires, e.g. fires in computer rooms or diesel tanks?

The BOX (Material): Since computer systems are electronic equipment, use of water may cause electric shock and is dangerous

Water Mist Suppression System (or Fog System)

HIGH-PRESSURE WATER MIST

FINE WATER SPRAY FIRE-FIGHTING SYSTEMS

The Smarter Way of Fire Fighting

www.fogtec.com

FOGTEC Brandschutz GmbH & Co. KG | Schanzenstraße 19A | 51063 Köln (Cologne) | Germany
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Good for Fires in Office, Museum, Hotel & Hospitals

7.2 Office Buildings and Museums

Typical application examples	Office areas, exhibition areas, foyers, atria, assembly rooms etc.

Description of the risk	Solid fires (Class A), and e.g. paper, furniture, floor and wall coverings
Possible protection targets	Fire control and suppression
Important effects	Fighting the initial fire Cooling the surroundings Limiting the spread of the fire
System layout	Wet system (glass bulb nozzles) The following minimum parameters must be taken into account with the design: – Criteria for nozzle installation (height, protected area) – Total effective area (presumed area of operation according to hazard classification) – Type and flow rate of the nozzle – Minimum pressure at the nozzle
Proof of efficiency	For example according to CEN/TS 14972 or IMO Res. A800 The efficiency corresponds at least to that of a conventional sprinkler system.

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FOGTEC FIRE PROTECTION

7.1 Hotels and Hospitals

Typical application examples	Hotel rooms, bedrooms, foyers, atria, restaurants, bars etc.

Description of the risk	Solid fires (Class A), e.g. beds, furniture, floor and wall coverings
Possible protection targets	Fire control and suppression
Important effects	Fighting the initial fire Cooling the surroundings Limiting the spread of the fire
System layout	Wet system (glass bulb nozzles) The following minimum parameters must be taken into account with the design: - Criteria for nozzle installation (height, protected area) - Total effective area (presumed area of operation according to hazard classification) - Type and flow rate of the nozzle - Minimum pressure at the nozzle
Proof of efficiency	For example according to CEN/TS 14972 or IMO Res. A800 The efficiency corresponds at least to that of a conventional sprinkler system.

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And Good for Gas Turbine & Flammable Liquid Store

7.10 Gas Turbines

Typical application examples	Gas turbines in power stations and industrial plants
	
Description of the risk	Liquid fires (Class B), e.g. lubricants, fuels
Possible protection targets	Fire extinguishing
Important effects	Fighting the initial fire Cooling the surroundings Careful cooling of the turbine outer surfaces Limiting the spread of the fire Extinguishing the fire Prevention of re-ignition
System layout	Deluge system (open nozzle) Activation should be as early as possible. The following minimum parameters must be taken into account in the design: - Criteria for nozzle installation (height, protected area, distance of the nozzle from the object, alignment of the nozzle) - Total effective area - Type and flow rate of the nozzle - Minimum pressure at the nozzle
Proof of efficiency	For example according to FM 5560

7.16 Storage and Production Facilities of Flammable Liquids

Typical application examples	Flammable liquids in production and storage facilities in industrial plants, paint factories etc.
	
Description of the risk	Liquid fires (Class B), e.g. flammable liquids, solvents, coatings, paints, process fluids etc.
Possible protection targets	Fire extinguishing
Important effects	Fighting the initial fire Cooling the surroundings Limiting the spread of the fire Extinguishing the fire Prevention of self-ignition and re-ignition
System layout	Deluge system (open nozzle) Activation should be as early as possible. The following minimum parameters must be taken into account in the design: - Criteria for nozzle installation (height, protected area, distance of the nozzle from the object, alignment of the nozzle) - Total effective area - Type and flow rate of the nozzle - Minimum pressure at the nozzle - Use of additives (AFFF)
Proof of efficiency	For example application-related fire tests

Also Good for Fires in Computer Room, Control Room & Transformer Room

7.5 Computer Rooms and Control Rooms

Typical application examples	Control rooms, server rooms, telecommunication switch areas

Description of the risk	Solid fires (class A), e.g. electric cables, electrical devices, switch cabinets
Possible protection targets	Fire control and suppression
Important effects	Fighting the initial fire Cooling the surroundings Limiting the spread of the fire
System layout	Wet or pre-action system (glass bulb nozzles) and deluge system (open nozzle) The deluge system should be activated as early as possible. The following minimum parameters must be taken into account in the design: - Criteria for nozzle installation (height, protected area) - Total effective area (presumed area of operation according to hazard classification) - Type and flow rate of the nozzle - Minimum pressure at the nozzle
Proof of efficiency	For example application-related fire tests or according to IMO A900

7.17 Transformers

Typical application examples	Transformers

Description of the risk	Liquid fires (Class B), e.g. thermal oil
Possible protection targets	Fire extinguishing
Important effects	Fighting the initial fire Cooling the surroundings Limiting the spread of the fire Extinguishing the fire Avoidance of re-ignition
System layout	Deluge system (open nozzle) Activation should be as early as possible. The following minimum parameters must be taken into account in the design: - Criteria for nozzle installation (height, protected area, distance of the nozzle from the object, alignment of the nozzle) - Total effective area - Type and flow rate of the nozzle - Minimum pressure at the nozzle
Proof of efficiency	For example application-related fire tests

Also Good for Kitchen & Deep Fat Fryer Fire

7.7 Industrial Deep Fat Fryers and Industrial Furnaces

Typical application examples	Industrial deep-frying lines
	 
Description of the risk	Fires involving oils and fats Liquid fires (Class F), e.g. frying oils, greases
Possible protection targets	Fire extinguishing
Important effects	Fighting the initial fire Cooling of oil, machine surroundings Limiting the spread of the fire and damage Extinguishing the fire Prevention of re-ignition
System layout	Deluge system (open nozzle) Activation should be as early as possible. The following minimum parameters must be taken into account in the design: - Criteria for nozzle installation (height, protected area, distance of the nozzle from the object, alignment of the nozzle) - Dimension of the extraction hood - Total effective area - Type and flow rate of the nozzle - Minimum pressure at the nozzle
Proof of efficiency	For example application-related fire tests

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7.8 Deep Fat Fryers / Kitchen Areas

Typical application examples	Kitchen deep fat fryers
	
Description of the risk	Fires involving oils and fats (Class F): deep-frying oils and fats
Possible protection targets	Fire extinguishing
Important effects	Fighting the initial fire Cooling of oil, machine surroundings Limiting the spread of the fire Extinguishing the fire Prevention of re-ignition
System layout	Deluge system (open nozzle) and wet system (glass bulb nozzles) for small deep-fat fryers The deluge system should be activated as early as possible. The following minimum parameters must be taken into account in the design: - Criteria for nozzle installation (height, protected area, distance of the nozzle from the object, alignment of the nozzle) - Dimensioning of the extraction hood - Total effective area - Type and flow rate - of the nozzle - Minimum pressure at the nozzle
Proof of efficiency	For example application-related fire tests

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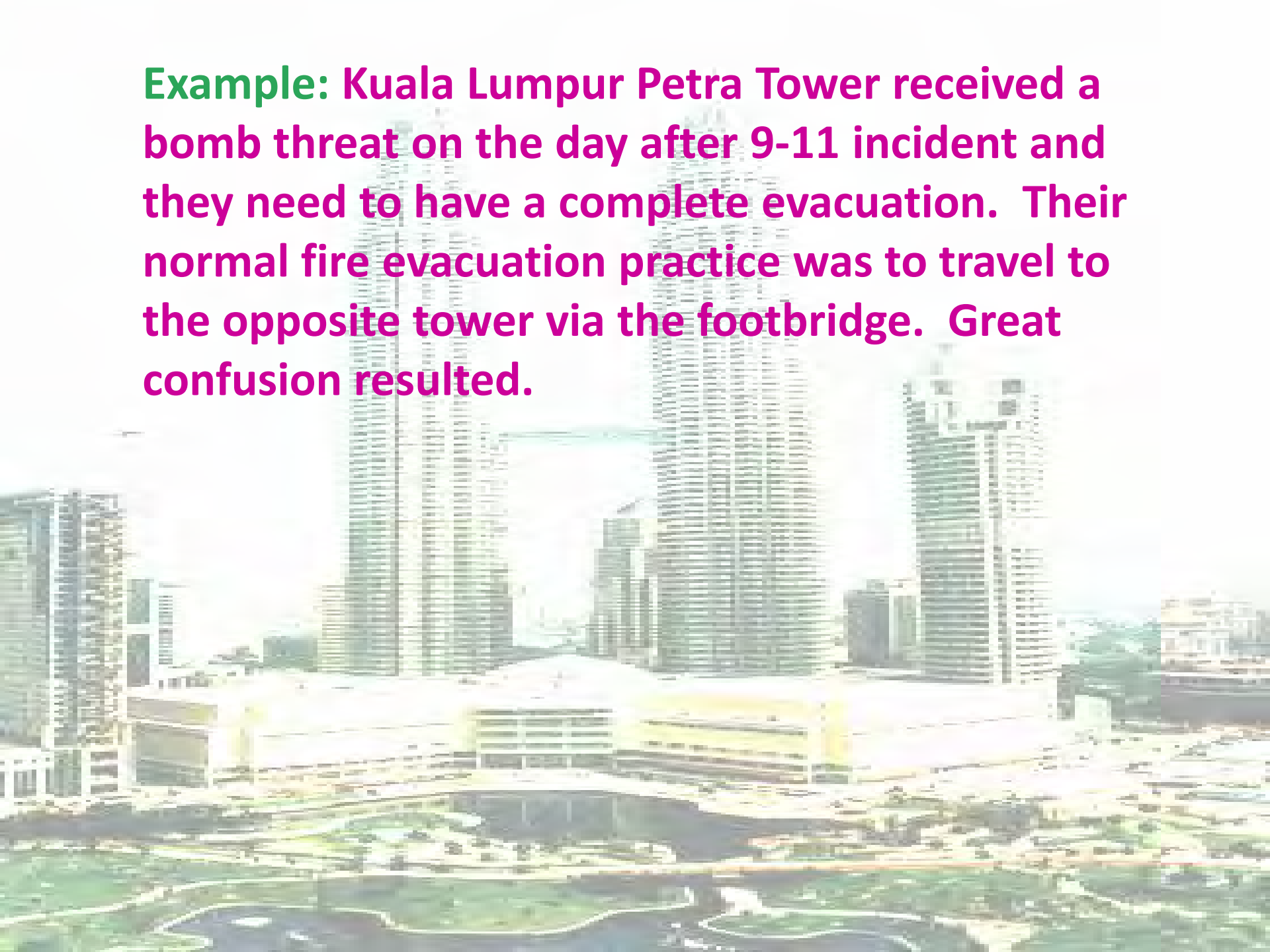


Example: Kuala Lumpur Petra Tower received a bomb threat on the day after 9-11 incident and they need to have a complete evacuation. Their normal fire evacuation practice was to travel to the opposite tower via the footbridge. Great confusion resulted.

What was the BOX? And how did they solve the problem?

The BOX is: Never use Lift for Fire Evacuation!

But, use of Lift for Evacuation is always permitted for hospitals & sanitoriums under the FSD CoP for Minimum FSI&E

CODES OF PRACTICE

FOR

MINIMUM FIRE SERVICE INSTALLATIONS

AND EQUIPMENT

AND

INSPECTION, TESTING AND MAINTENANCE OF

INSTALLATIONS AND EQUIPMENT

April 2012

(xiii) Required for hospitals and sanatoria where:

(a) natural venting of staircase is not provided; and

(b) the aggregate area of openable windows of the rooms/units of the building does not exceed 6.25% of the floor area of those rooms/units, calculated on a floor by floor basis. The number of pressurized staircases to be provided shall be determined by the table stipulated under the definition of pressurization of staircase in Part II provided that the number of pressurized staircases required shall not exceed the total number of staircases required by the Code of Practice for Fire Safety in Buildings.

(xiv) Required for all parts of buildings including staircases, common corridors, toilets and bathrooms.

(xv) When a ventilation/air conditioning control system to a building is provided, it shall stop mechanically induced air movement within a designated fire compartment.

ADDITIONAL REQUIREMENTS

(i) All linings for acoustic and thermal insulation purposes in ductings and concealed locations shall be of Class 1 or 2 Rate of Surface Spread of Flame as per British Standard 476: Part 7 or its international equivalent, or be brought up to that standard by use of an approved fire retardant product.

(ii) All linings for acoustic, thermal insulation and decorative purposes within protected means of escape shall be of Class 1 or 2 Rate of Surface Spread of Flame as per British Standard 476: Part 7 or its international equivalent, or be brought up to that standard by use of an approved fire retardant product.

(iii) Any intended storage or use of dangerous goods as defined in Chapter 295 of the Laws of Hong Kong should be notified to the Director of Fire Services.

(iv) Protection for hospital and sanatorium lifts which are designated for evacuation purpose shall satisfy every condition for a fireman's lift with the exception of the internal floor area of car, and the minimum rated load factors.

4.33 Kitchens (other than kitchens in dome/the premises)

REQUIREMENTS—SYSTEMS/INSTALLATIONS/EQUIPMENT

&

EXTENT FOR:

(i) Kitchens shall normally be required to incorporate the fire protection and life safety systems in the building in which they are located with the addition of any special equipment/requirements as may be required by the Director of Fire Services.

(ii) Portable hand-operated approved appliances are to be provided as required by risk.

4.34 Lift motor rooms

REQUIREMENTS—SYSTEMS/INSTALLATIONS/EQUIPMENT FOR:

(i) Fire detection system.

(ii) Portable hand-operated approved appliance

EXTENT

(i) To be provided in all lift motor rooms where the portion of building is required to be provided with fire detection system.

(ii) As required by occupancy.

4.35 Mechanical plant rooms (Group I)

REQUIREMENTS—SYSTEMS/INSTALLATIONS/EQUIPMENT FOR:

Note: Plant Rooms to exclude open gas fired appliances.

(i) Automatic actuating devices

(ii) Fire detection system

(iii) Gas detection system

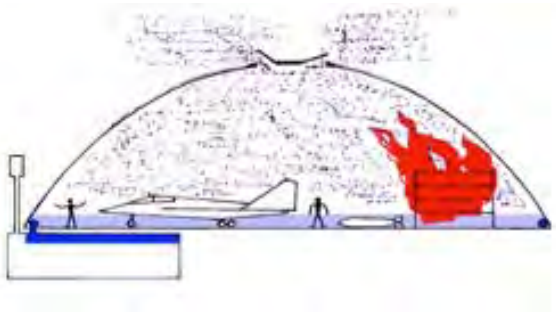
(iv) Gas extraction system

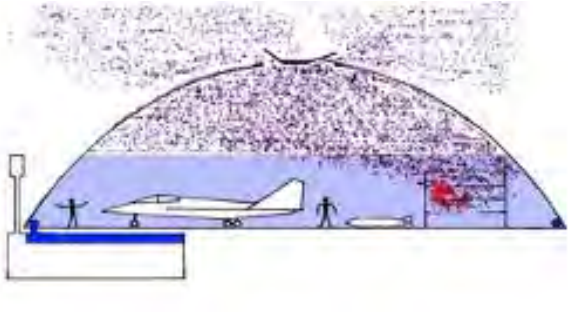
If you are the American Government, how would you protect the damage of the first National Flag against fire?

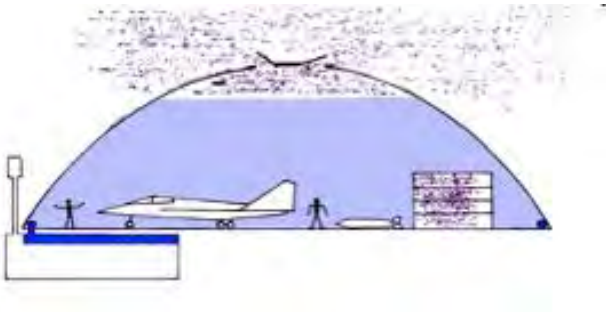
Standard Solution: Fire detection plus Fire Fighting System (such as Smoke Detector plus Sprinklers) … But there will be **WATER DAMAGE!**

3-Line Solution: Fire Detection System plus Total Gas Flooding System. Well, no Water Damage, but the flat may still suffer **FIRE DAMAGE**!

1-Line Solution: Hypoxic System, e.g. FirePASS

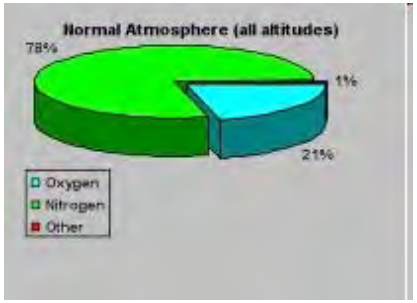


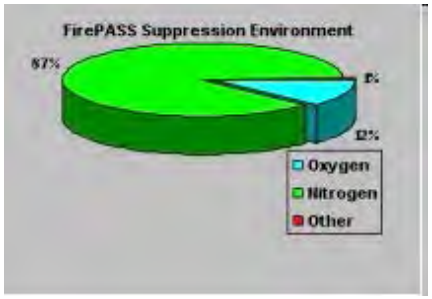


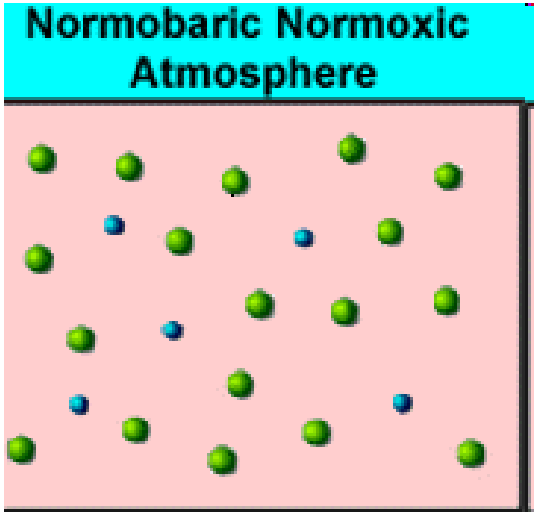


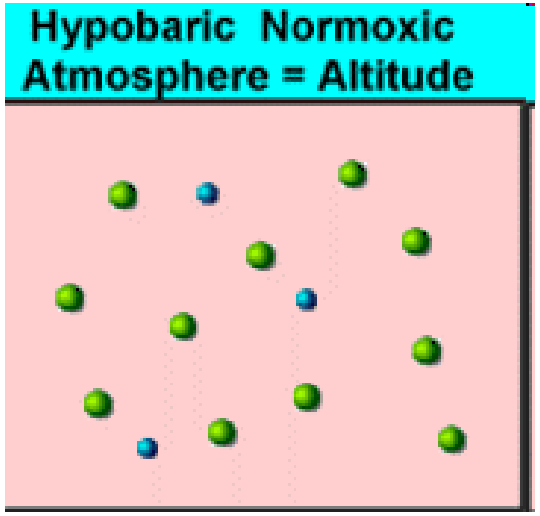
The BOX is: For occupied areas, the Oxygen content must not be lower than 18%, or else one can NEVER survive

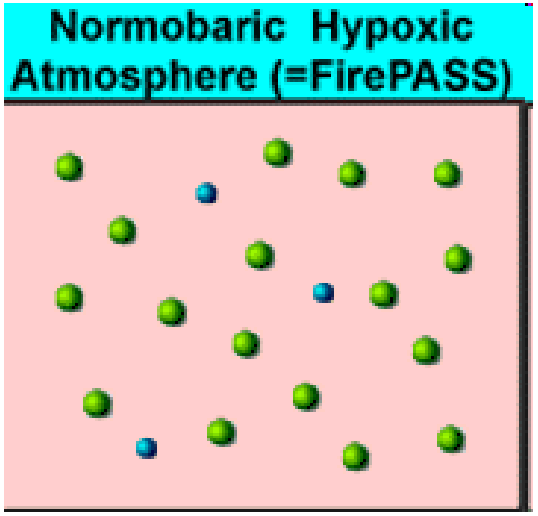
OUT-OF-THE-BOX: This applies only to normobaric condition!

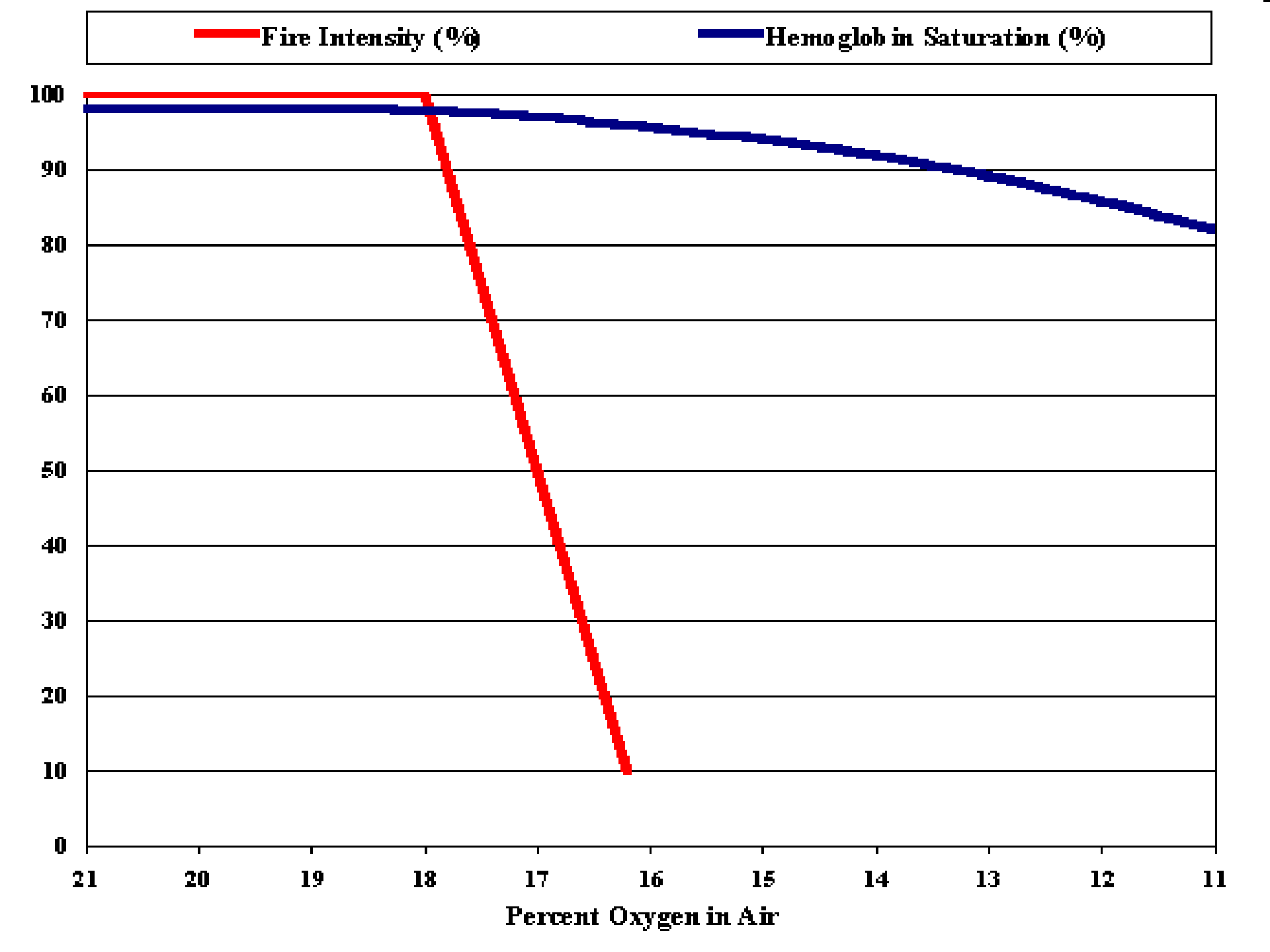






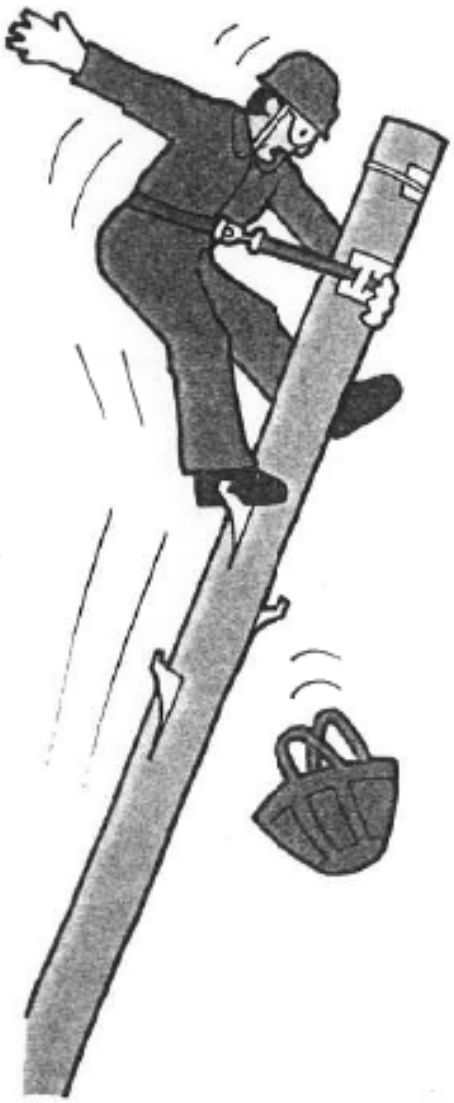





Fire Intensity (%)
Hemoglobin Saturation (%)
100
90
80
70
60
50
40
30
20
10
0
21
20
19
18
17
16
15
14
13
12
11
Percent Oxygen in Air

How to avoid fall from pole accidents?

How to avoid fallen pole accidents?



柱底遭銹蝕 攀上換電纜

工人隨20呎鐵柱塌下重傷

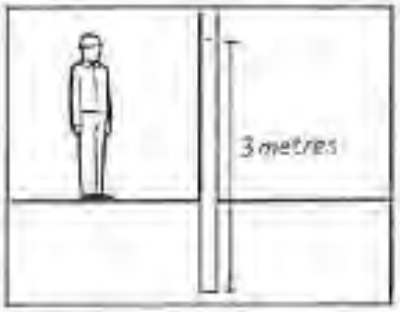
增加供電穩定性工程

振公司指引測試柱身

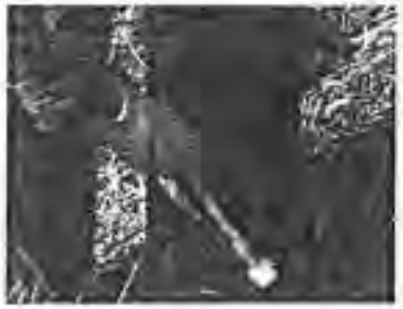
22公斤路牌突塌下 傷女途人臂

Example: Fall from Pole & Fallen Pole

Standard Solution: Pole Belt to prevent fall; Hammer the Pole for Ringing Tone to identify rusted poles before breakage



Use the three metre mark in the manner shown to check that a pole is set at the correct depth. Stamp aside or cut away, any grass or growth at the foot of the pole.



With a one pound hammer tap all round the ground line, making occasional reference taps 30 to 45cm higher up. Listen for a change in tone to the dull or dead note indicating decay. If test indicates decay or you have doubts about conditions below ground, excavate to a spade's depth, clean and hammer test the exposed section.

Decayed wood will offer little resistance to your Probe Pole Test and will not grip the point. Use it to establish the extent of surface decay which may be seen or suspected after the hammer test.

Fig. 6. Pole testing.

Example: Fall from Pole & Fallen Pole

3-Line Solution: Use Cherry Picker to prevent fall; Concrete Plinth to prevent pole collapse

Creative Solution during Brainstorming

BOX: Ladders must have steps on them.

OUT-OF–THE-BOX (PLANT): But aren't there step-less ones?

無級之梯

希臘製造的無級之梯，祇有一支工字鋁，很方便儲放及携帶，摺起來可放入一個三呎半長的袋裡，用梯的人踏上梯上的脚踏，一放脚，彈簧就使脚踏升上下，一踏下時，反扣的齒就鎖住，如此就可以步步高升。要下來可以按掣，左邊下一步就鎖住，然後右邊自鬆，右邊再下一步左邊又自鬆而左邊鎖住。

Creative solution during Brainstorming

BOX: X-Ray Machine should be Pedestal.

Out-OF-THE-BOX (PLANT): But aren't there handheld ones?

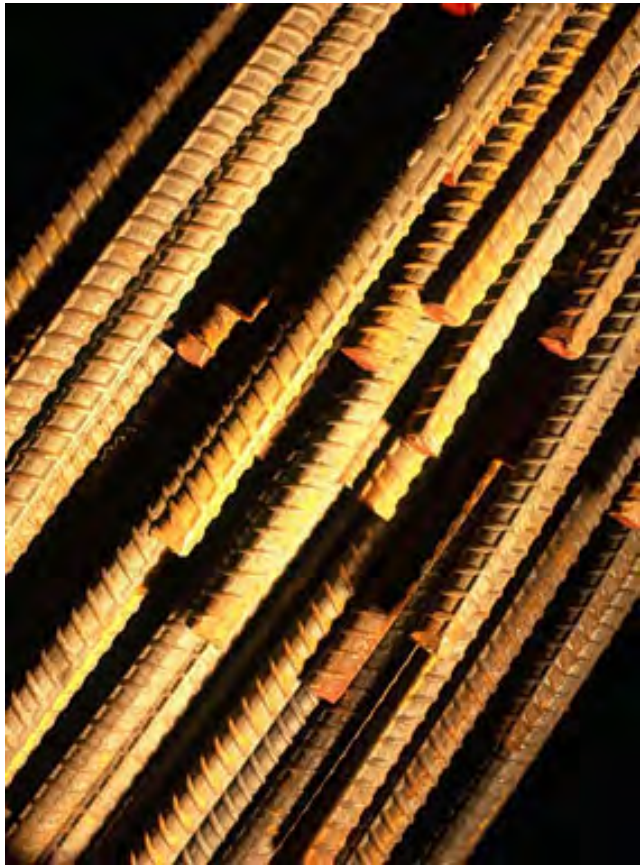
小型手提X光機

這種革命性的使用電池手提X光機不久將可投入服務，移機就人，送到發生意外處、戰場上或無醫院的落後國家使用。它祇重不到四十磅，能放入兵士的野戰背包。乃是梅榮·薛特賓教授及電機工程師法蘭·格蘭素的發明，在圖中所見是正在密迪遜市的威斯康辛州大學示範。這機拍出來的X光片是信用咭大小的，用鐳射碟原理的激光「閱讀」，而所閱的資料還可通過電話傳送，讓醫生能在醫院的電腦上看到照出什麼而判斷及指導最適合的處理病人方法。

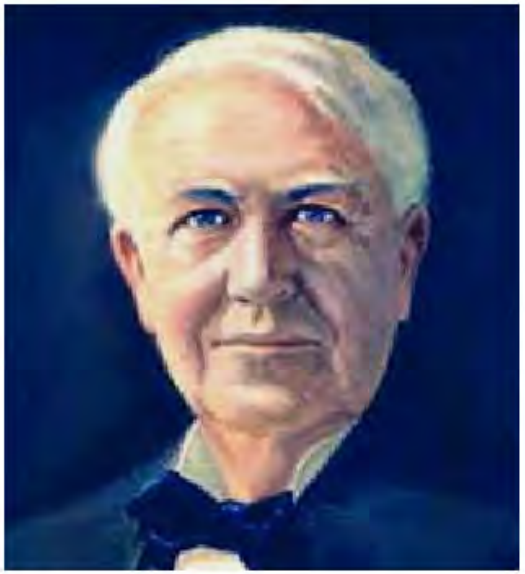
Example: Fall from Pole & Fallen Pole

The **BOX** is: What are we going to protect against, pole snapping or man falling?

1-Line Solution **OUT-OF-THE-BOX (Material)**: Fit Rebar into Pole



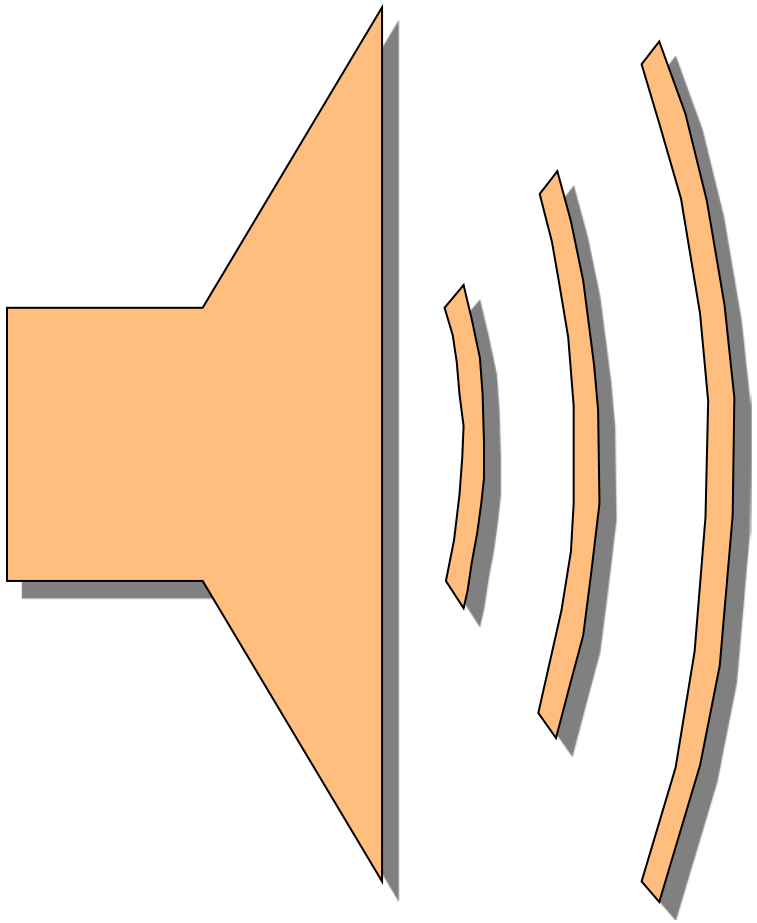
Not Every New Idea will work though. Needs trial and error



Thomas Edison

"I have not failed, I've just found 10,000 ways that won't work".

New Idea or Crazy Idea – Fighting Fire by Sound! Is it possible?



Pentagon's DARPA (Defense Advanced Research Projects Agency) did it

聲音可以滅火　美科學家實驗成功

發生火災相當可怕，一般除了以水滅火外，美國科學家已經成功實驗以「聲音」滅火，由於火勢被分散造成燃燒時間加快，因此初步效果還不錯，未來科學家將進一步實驗，是否將讓聲音滅火的面積可以擴大，保障民眾的生命財產安全。

美國國防部先進研究計劃機構（DARPA）進行的「聲音語滅火」實驗，以兩處揚聲器對著火源發出聲音，由於提高了空氣速度，可讓火源面積逐漸變小，火勢較容易控制，再加上火勢經由聲音干擾並分散成數個起火點，因此讓燃燒速度增快，火災就很快可以獲到撲滅。而且科學家表示，要完全撲滅火勢，不需要製造高分貝噪音也可以達到。

科學家古得曼表示，「我們經由實驗發現，燃燒時的物理現象仍有許多未知的秘密，或許這些實驗結果可以作為研究燃燒的新題材與應用。」

利用聲音滅火的先驅美國國防部先進研究計劃機構並不是第一人，德國科學家魯本斯(Heinrich Rubens)早在十九世紀就曾透過「火」管與控制聲音來影響火勢發展。

美國國防部先進研究計劃機構則表示，實驗證明能從火焰面積擴大，未透過外力聲音幫忙可以暫時在火場中「清出」逃生走道，未來則將進一步實驗是否能擴大滅火的面積。

有趣度：★★★　實用度：★★

28.8.2012

Probably like gunpowder & the compass, this technology originated in old-time China, but is now lost

THE END. THANK YOU