safety science

some past and recent research areas

including construction

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content

red thread of presentation

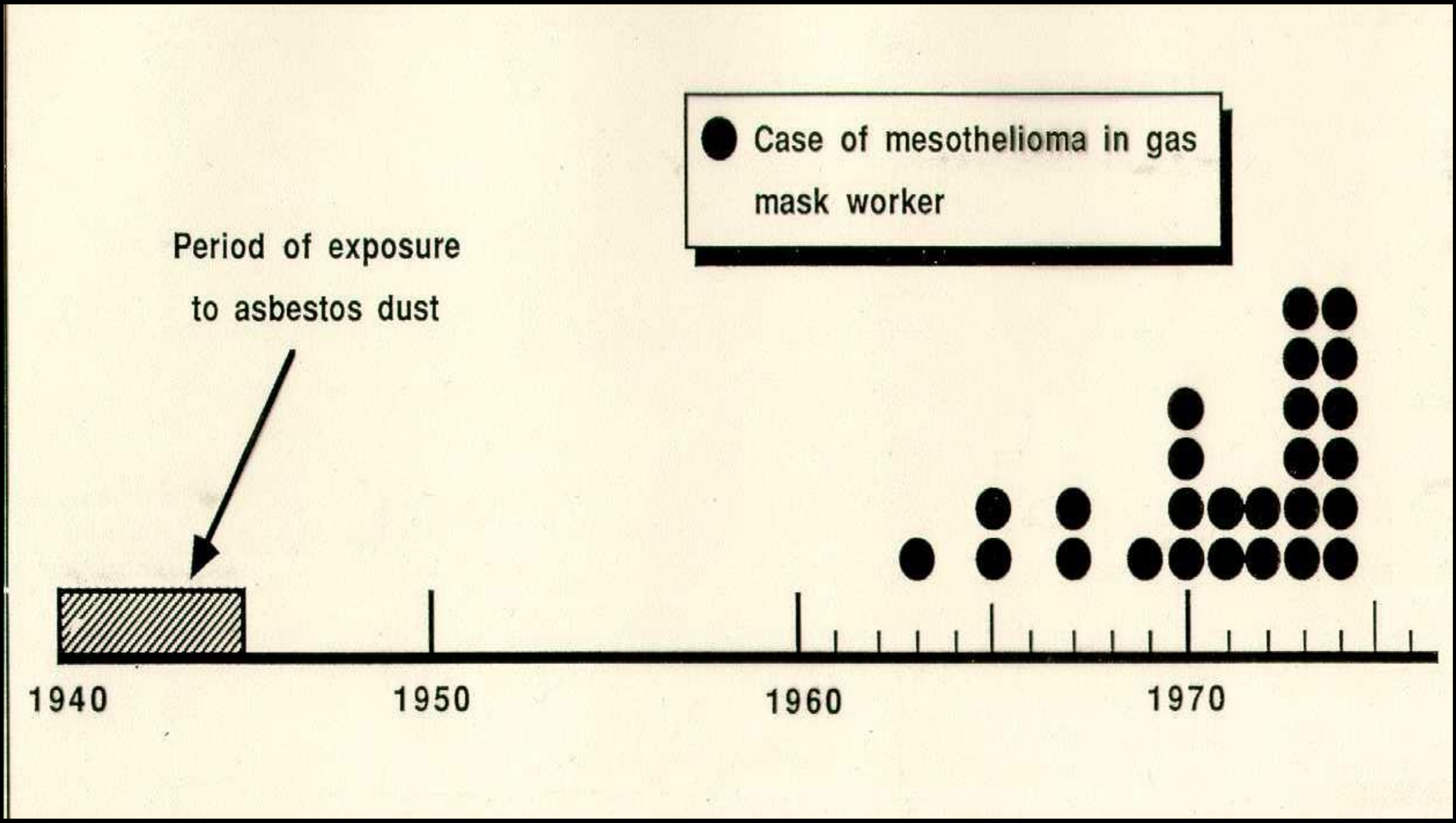
- from mechanism to risk assessment
- from hazard to culture
- from human factor to socio-technique
- from technology push, cost reduction to diasters
- from risk assessment to design
- from management to accidents
- from rule following to critical reflection

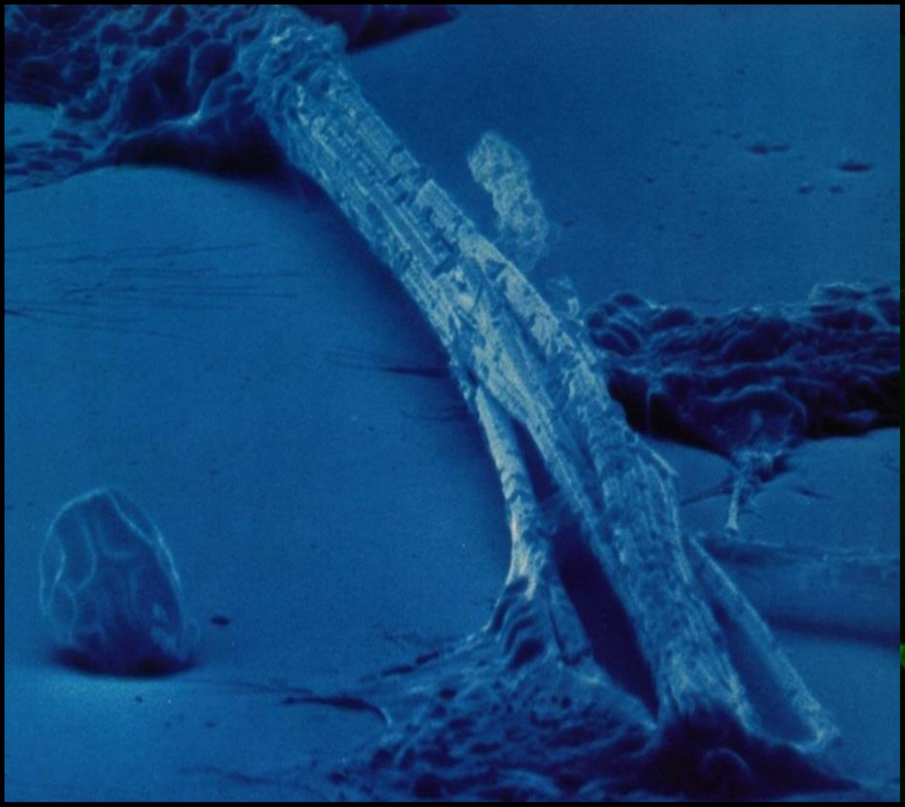
1 introduction

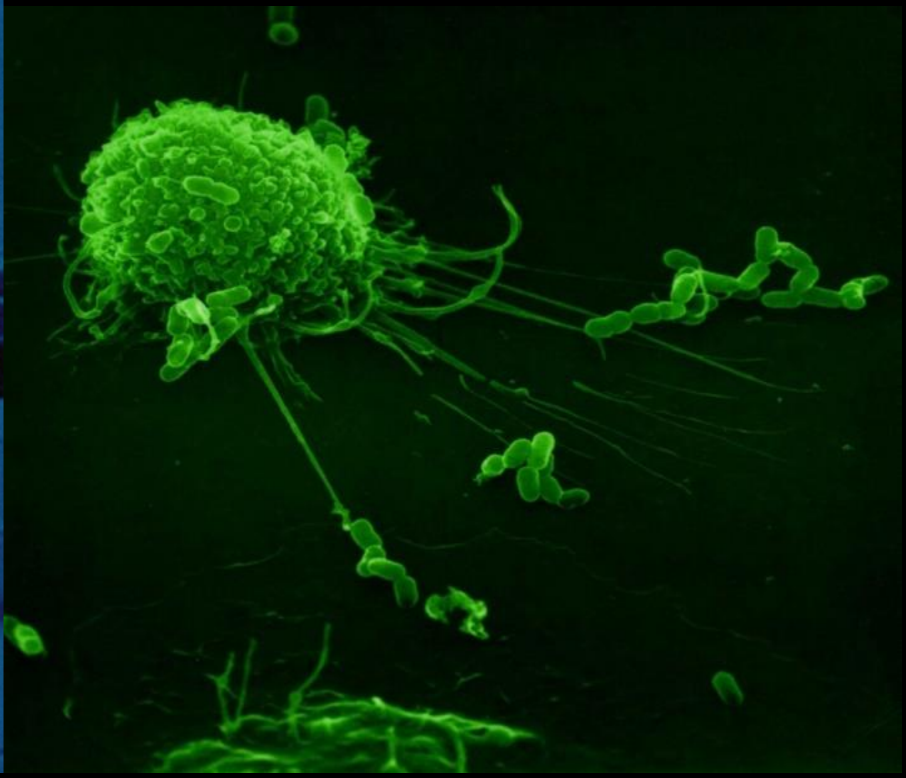
Raphael School of Athens 16th century

2 asbestos

latency period & mechanism







2 asbestos

occupation and mesothelioma

Industry	risk/100 workers	risk ratio	n
insulation industry	4.7	328	59
ship building, maintenance	1.2	83	196
refinery	0.3	24	12
train/tram building	0.2	15	10
stone, glass, cement	0.1	9	23
construction	0.07	5	102
chemical industry	0.06	4	13
all other industries	0.01	1	254

Burdorf A Dahhan M Swuste P (2003). Annals of Occupational Hygiene 47:485-92

3 steel works

we are here to produce

we work like this for years
without too much trouble

we do not need procedures,
because we are experienced

everybody is responsible for
his own safety

this is a very dangerous plant

victims are always to blame

accidents will always happen

Swuste P Hale A Guldenmund F (2002). Changes in a steel works learning from failures and partial successes. in System Safety challenges and pitfalls of intervention Pergamon Adam

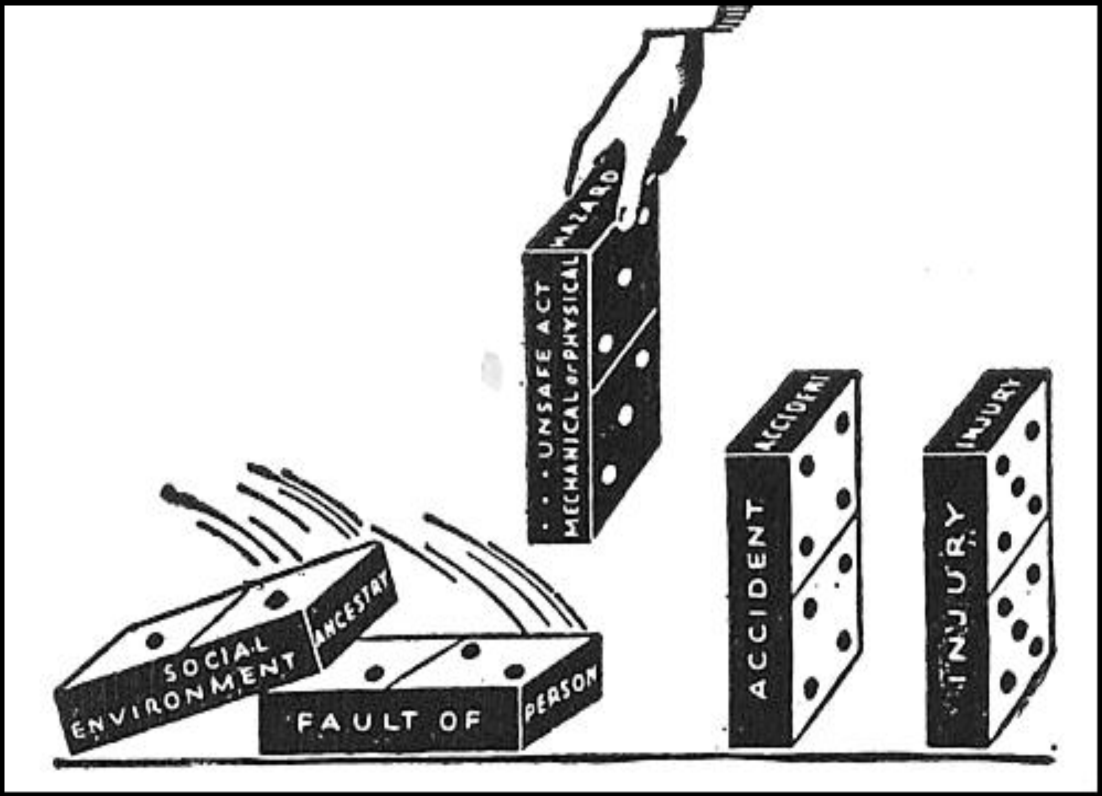
4 theories - models - metaphors

Heinrichs' metaphors statistical correlations

1927 costs:	1 : 4	(direct : indirect)
1928 causes:	88 : 10 : 2	(human : technical : God)
1929 mechanism:	1 : 29 : 300	(serious : minor : no harm)

1931 management: training, selection, safety technique

1941 sequence, dominos:



Heinrich W (1927). The "incidental" cost of accidents. National safety News 17(2):18-20
Heinrich W (1928). The origin of accidents. National safety News 18(1):9-13
Heinrich W (1929). The foundation of major injury. National Safety News 19(1):9-11, 59
Heinrich W (1931). Industrial accident prevention, a scientific approach
Heinrich W (1941). Industrial accident prevention, a scientific approach 2nd edition

4 modern times 1933

Heijermans (Nl) 1905. Job, working hours, crowded workplaces
Eastman (US) 19010. Dangerous machines, repeated accidents
Home Office (UK) 1911. High workload, industrial fatique
DeBlois (US) 1926. One learns from risks, hazard ≡ energy
Vernon (UK) 1936. External causes of accidents

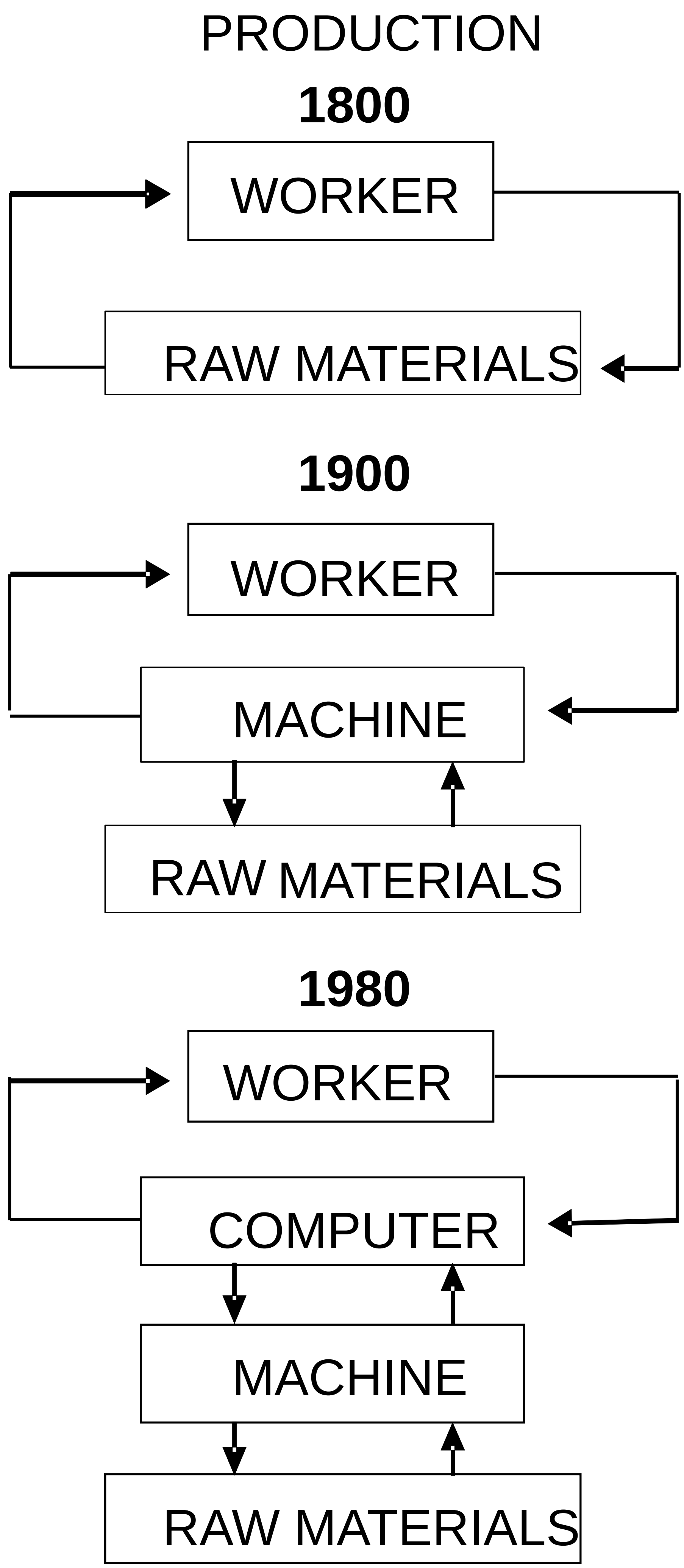
4 theories - models - metaphors

complexity of men-machine systems

direct feedback

energy source

logic aid



4 theories - models - metaphors

automation

4 theories - models - metaphors

Aberfan Barry Turner 1978

- rigid risk perception and a strong believe in the organisation;
- focus on underground hazards;
- minimalizing unexpected dangers;
- organisational exclusivity; signals not coming from members, are not taken seriously;
- information, communication problems between departments.

Turner B (1978). Man Made Disasters. Wickeham, London

4 theories - models - metaphors

accident definition

An accident is the result of a complex series of events, related to energy transfer, failing barriers, and control systems, causing faults, errors, unsafe acts, and unsafe conditions and changes in process and organisational conditions.

Johnson W (1970). New Approaches to safety in industry

Bhopal 1984

Tjernobyl 1986

Challenger 1986

Zeebrugge 1987

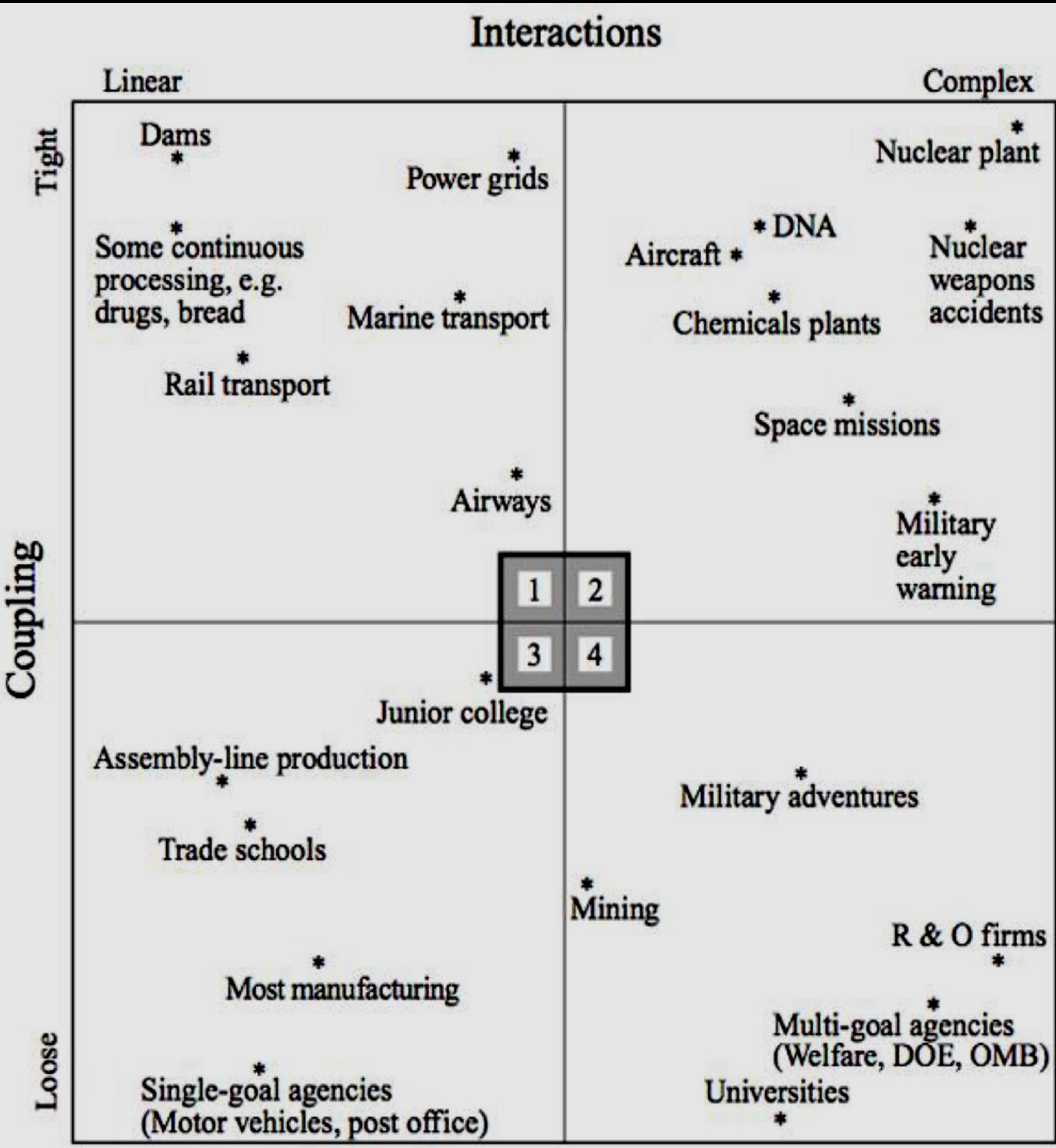
Piper Alpha 1988

Exxon Valdez 1989

Le Coze J (2013). New models for new times, an anti-dualist move. Safety Science 59:200-218

4 theories - models - metaphors

normal accidents



Perrow C (1984). Normal accidents, living with high-risk technologies. BasicBooks, US so you want to understand an aircraft carrier? Well, just imagine that it's a busy day, and you shrink San Francisco Airport to only one short runway and one ramp and gate. Make planes take off and land at the same time, at half the present time interval, rock the runway from side to side, and require that everyone who leaves in the morning returns that same day. Make sure the equipment is so close to the edge of the envelope that it's fragile. Then turn off the radar to avoid detection, impose strict controls on radios, fuel the aircraft in place with their engines running, put an enemy in the air, and scatter live bombs and rockets around. Now wet the whole thing down with salt water and oil, and man it with 20-year-olds, half of whom have never seen an airplane close-up. Oh, and by the way, try not to kill anyone. Senior officer, Air Division

Rochlin G La Porte T Roberts K (1987). The self-designing high reliability organisation: aircraft carrier flight operation at sea. Naval War College Review 40:76-90

4 theories - models - metaphors

people make accidents

organisations cause them

Safety is an dynamic property obtained by the systemic articulation of hazards, environmental, organisational and individual dimensions in high-tech-high-hazard sectors.

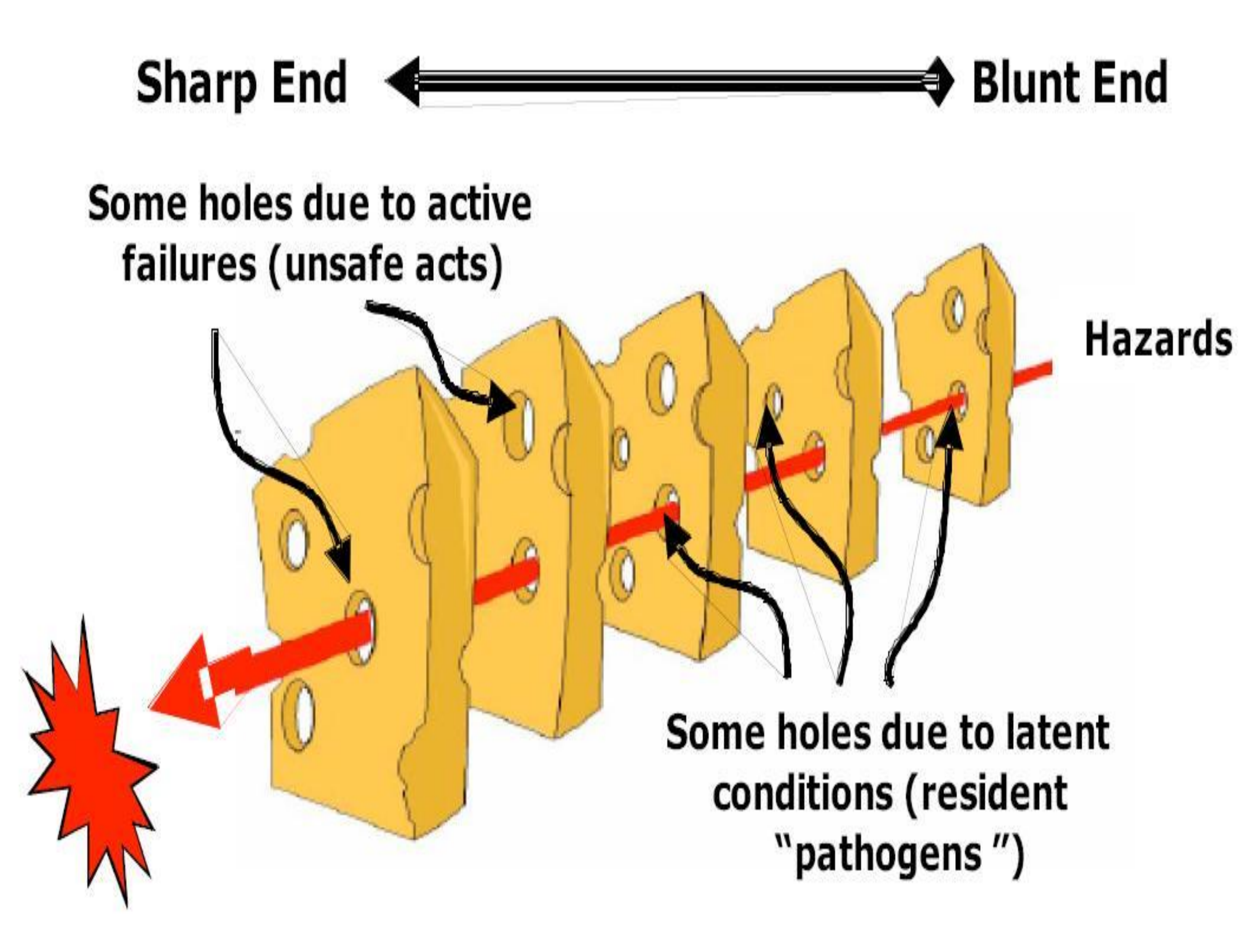
This property is obtained through the on-going interaction of in/external actors with technology, mediated by structures and power.

Balancing conflicting goals defined as trade-offs quandaries is at the heart of the vision of safety. The power of safety departments is one of the elements of the quality of these trade-offs.

Wagenaar W (1998). People make accidents but organisations cause them. In: Feyer A Williamson A. Occupational injury, risk, prevention and intervention, p. 121-128. Taylor & Francis, London

4 theories - models - metaphors

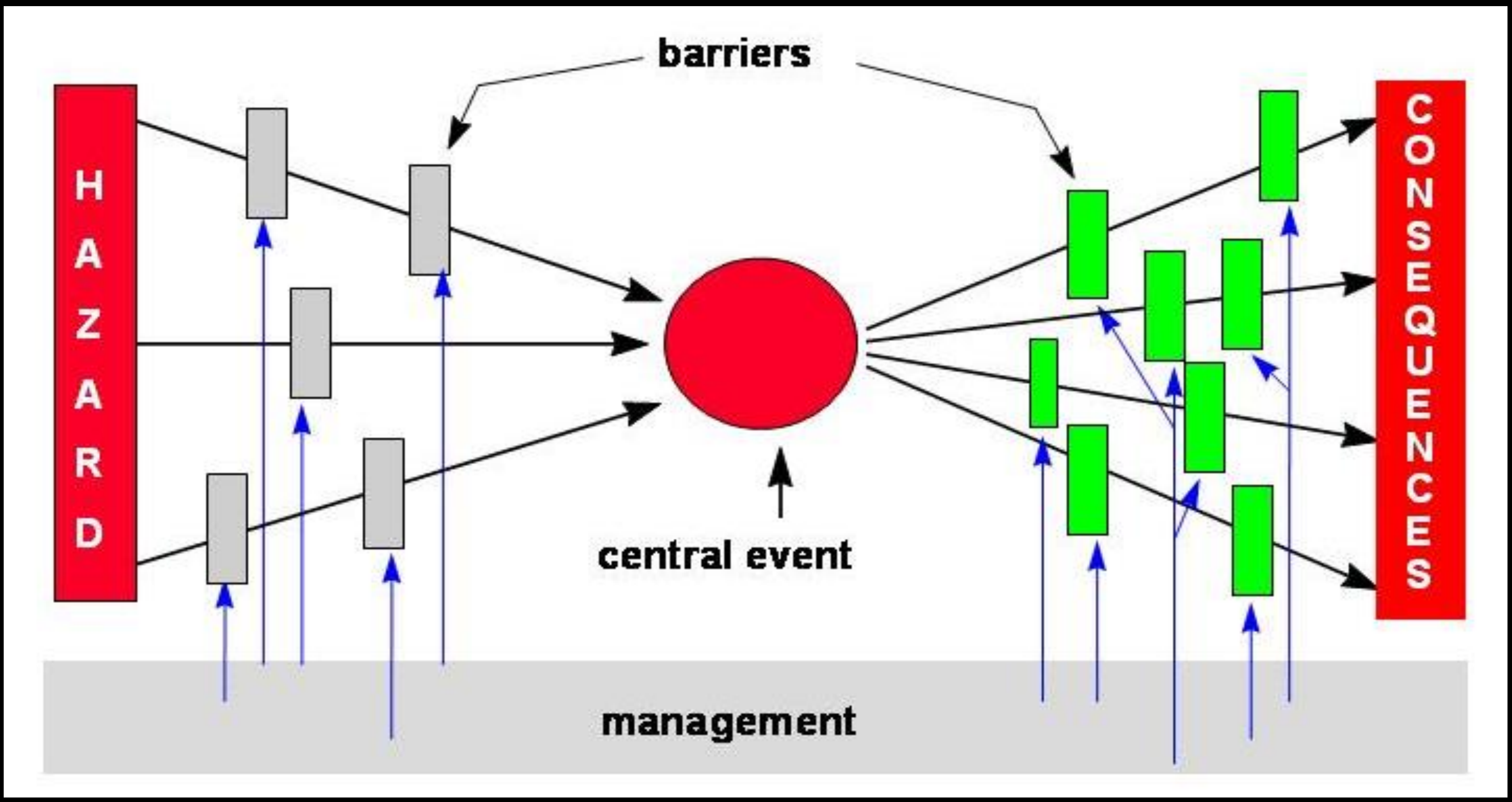
Swiss cheese

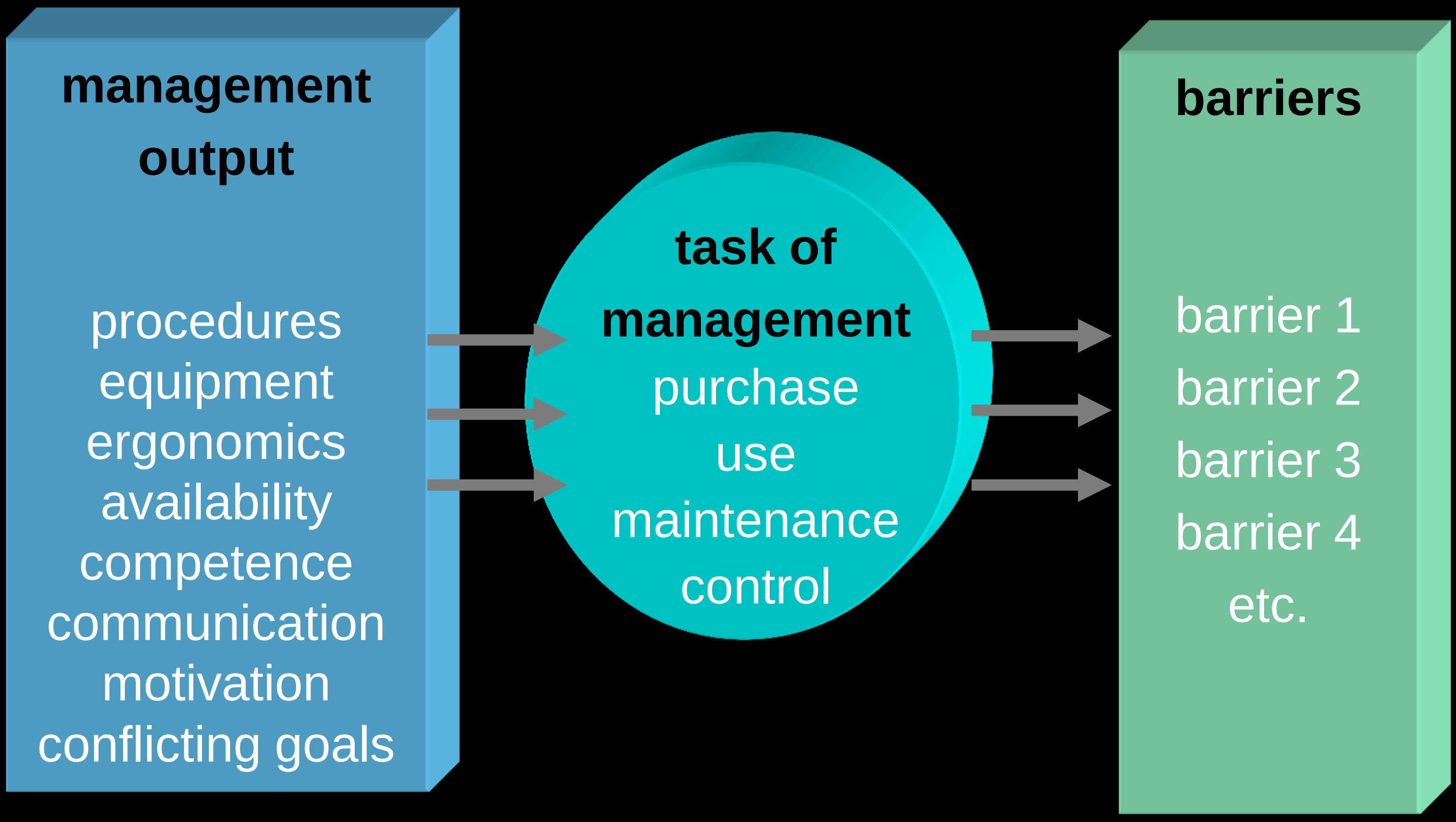


Reason J (1997). Managing the risk of organisational accidents. Ashgate, Aldershot Hampshire

4 theories - models - metaphors

process & occupational safety - bowtie

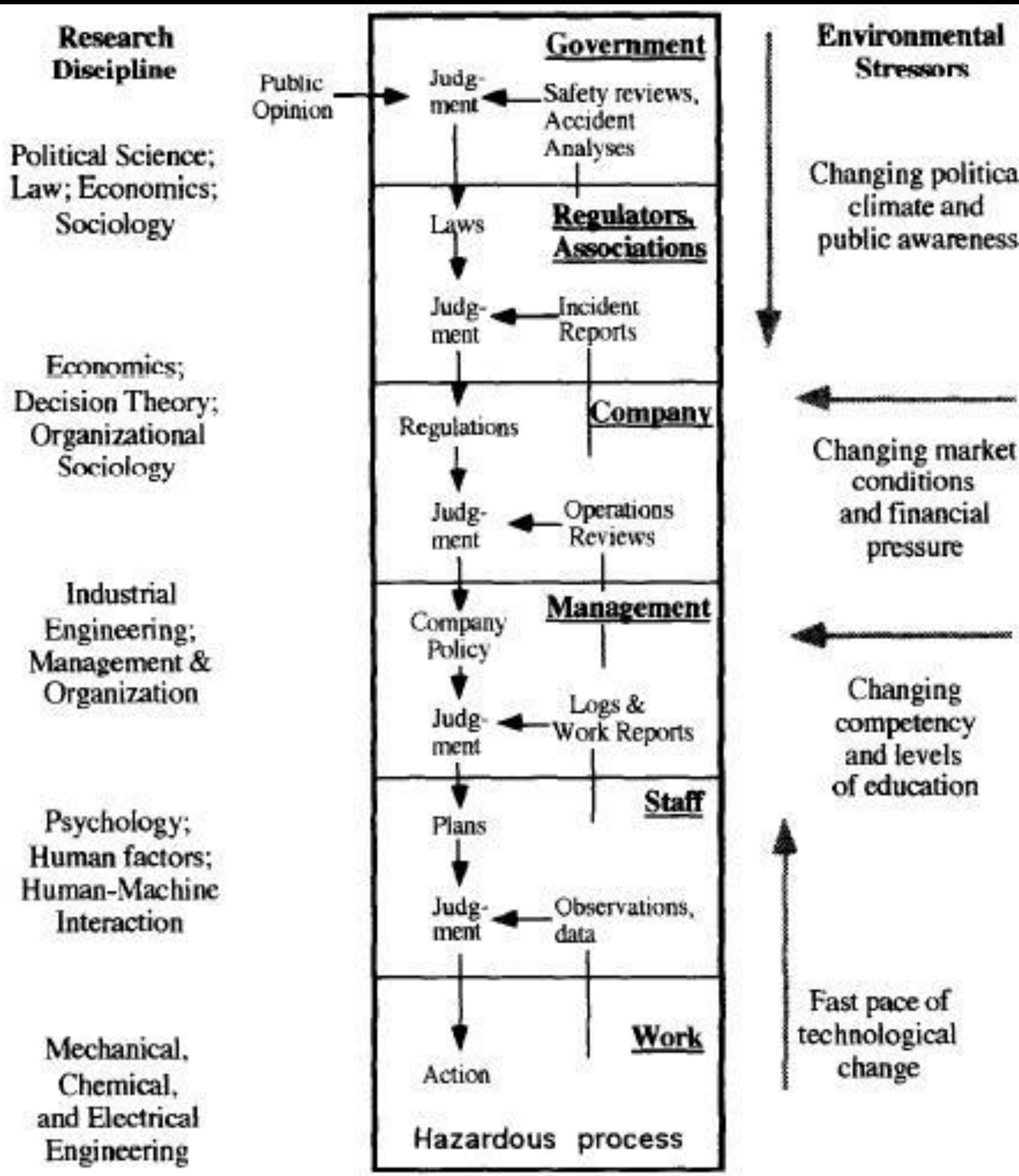




Visser K (1998). Developments in HSE Management in Oil & Gas Exploration, Production
Guldenmund F Hale A Goossens L Betten J Duijn N (2006). Audit technique quality safety barrier management. Journal of Hazardous Materials 130(3)

4 theories - models - metaphors

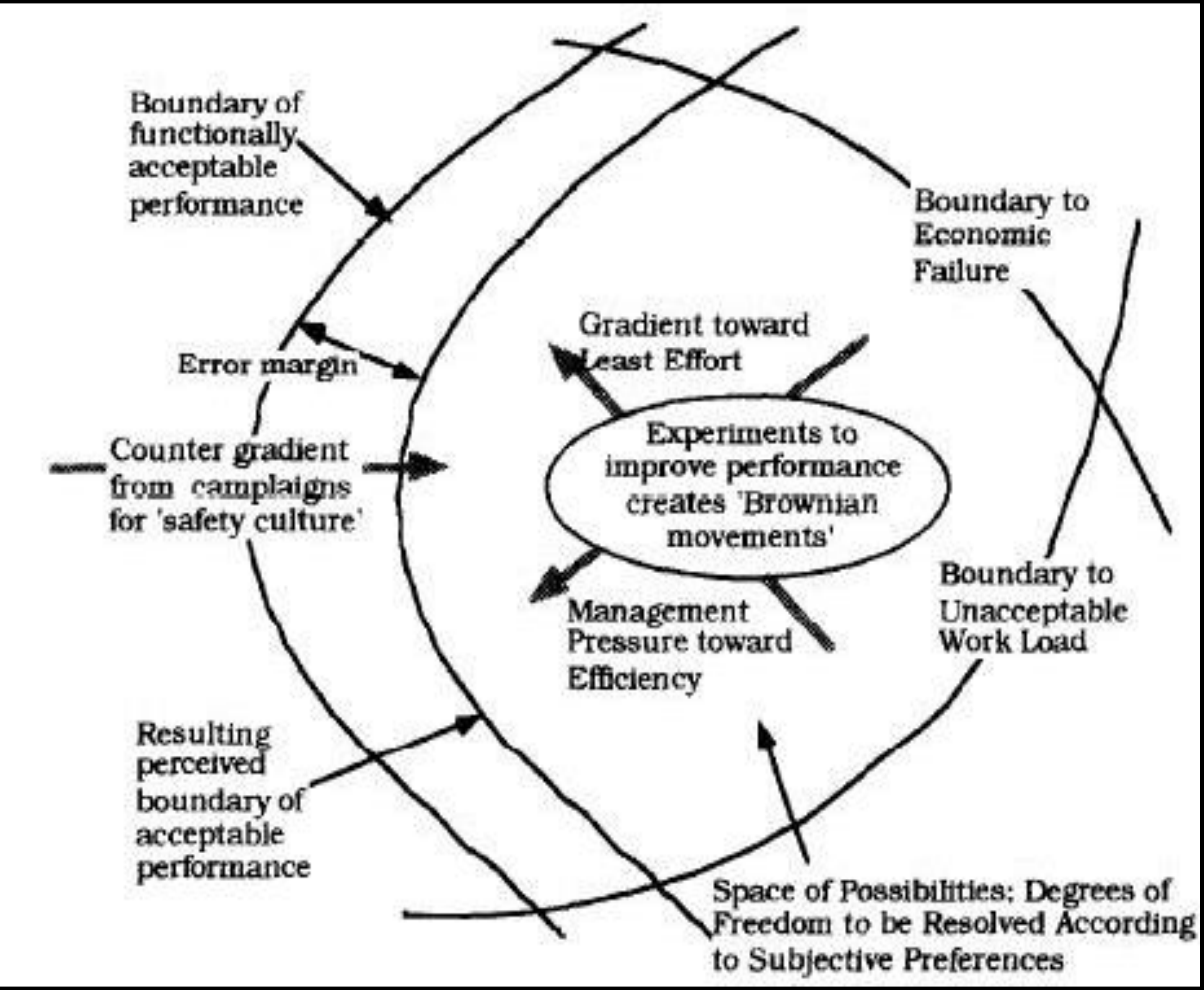
Rasmussen drift to danger



Rasmussen (1997). Risk management in a dynamic society. Safety Science 27(2-3):183-213

4 theories - models - metaphors

Rasmussen drift to danger



Rasmussen (1997). Risk management in a dynamic society. Safety Science 27(2-3):183-213

5th generation technology
2nd generation managers

Colombia 2003

Texas City 2005

Buncefield 2005

AF 447 2009

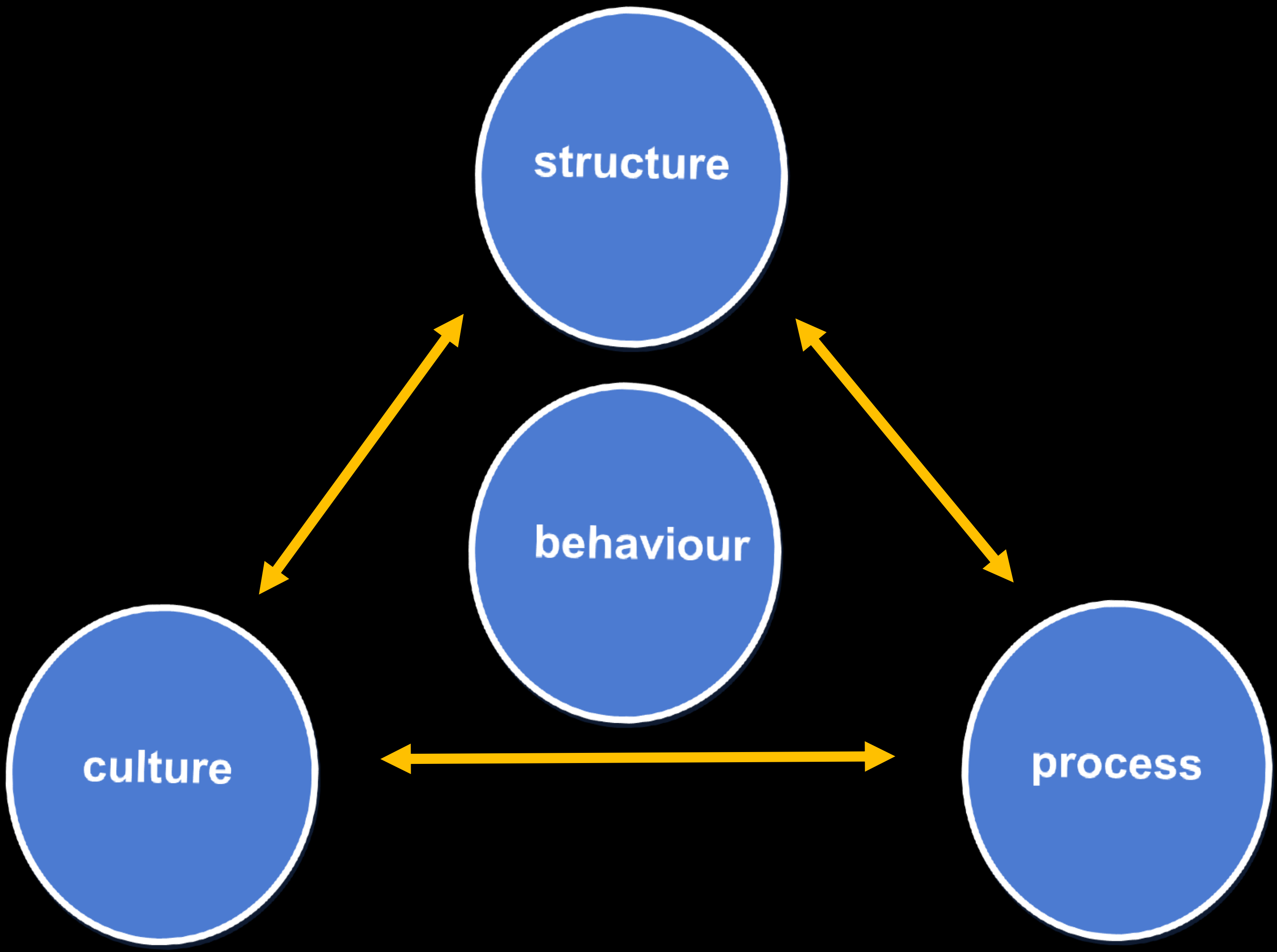
Deepwater Horizon 2010

Fukushima 2011

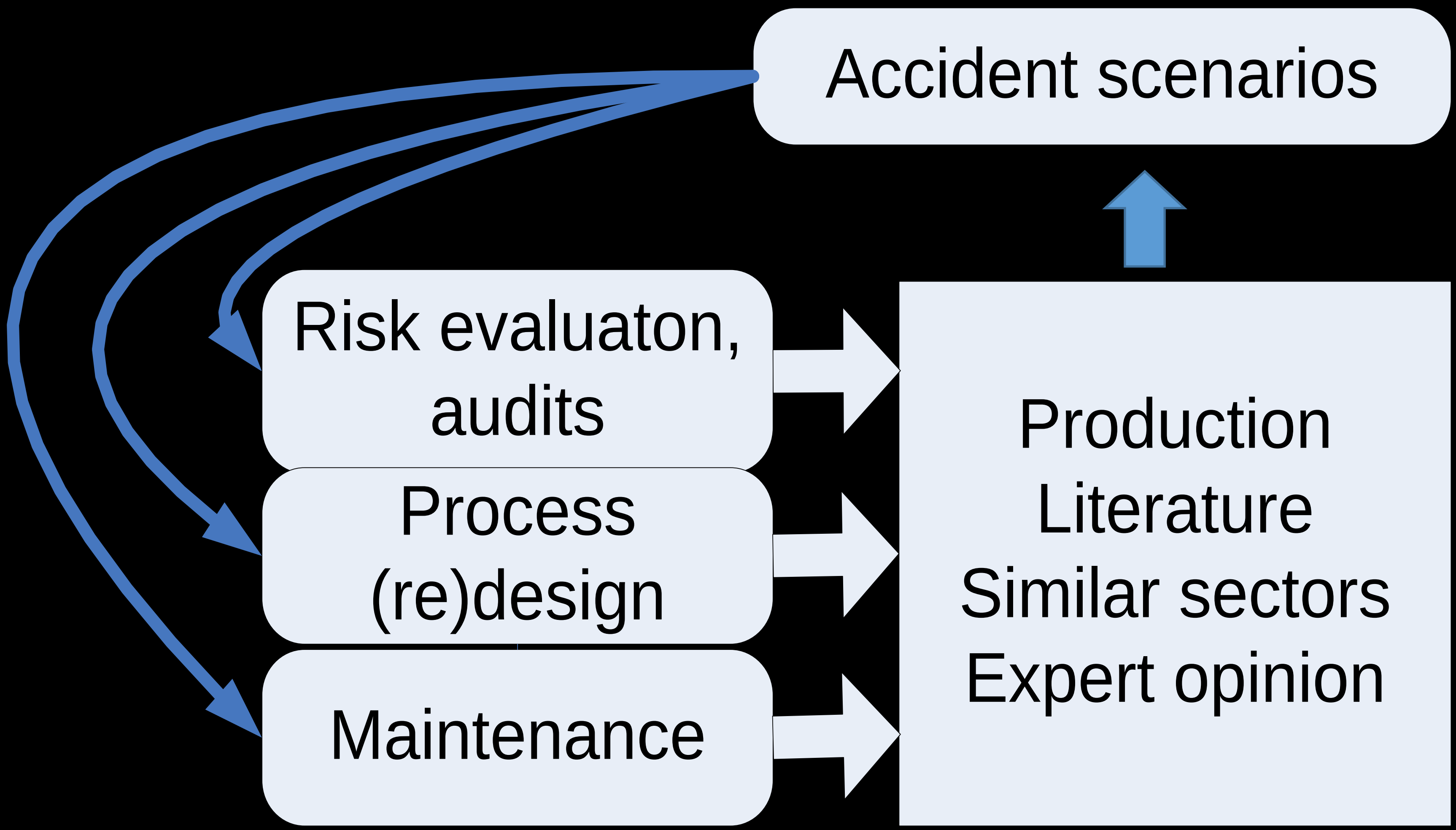
Le Coze J (2013). New models for new times, an anti-dualist move. Safety Science 59:200-218

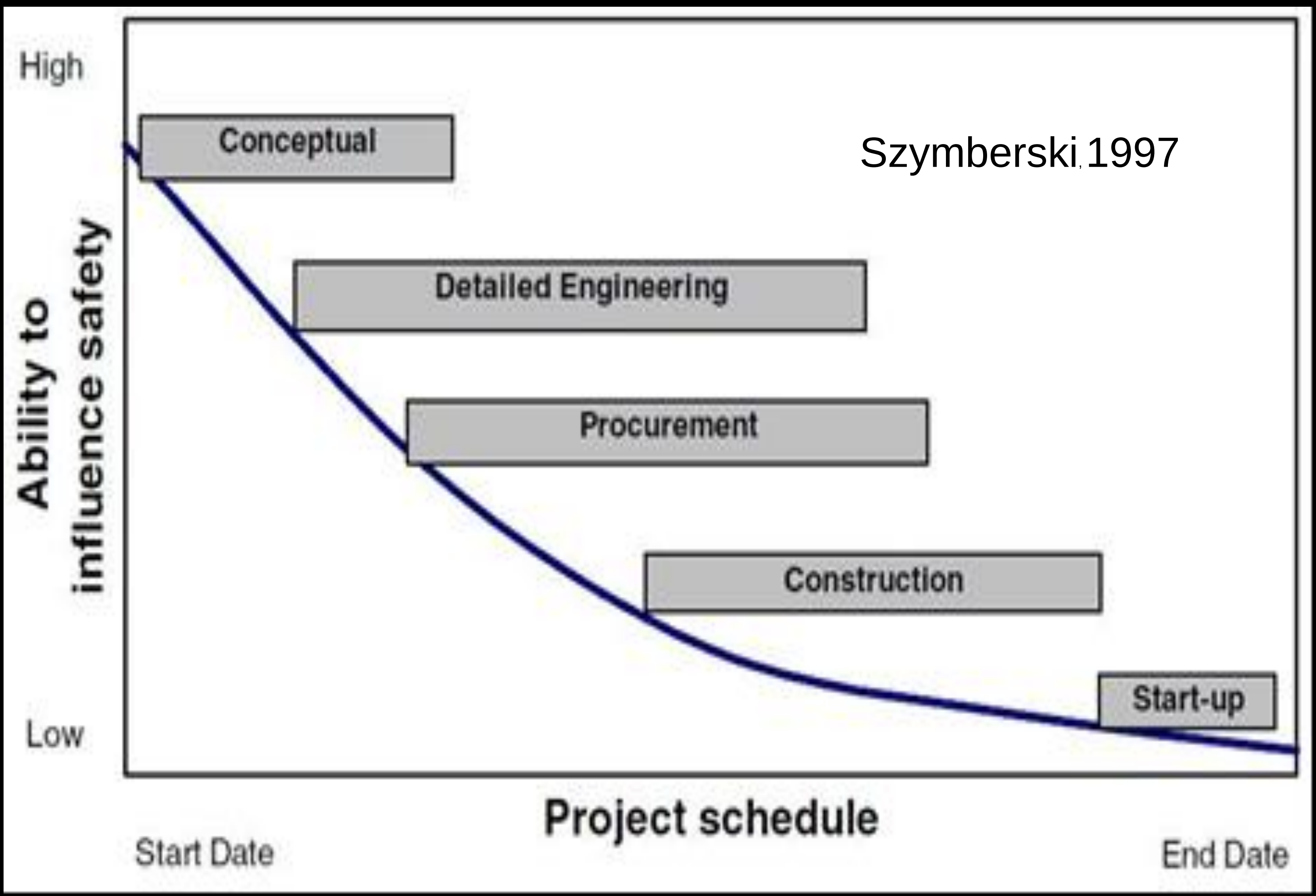
5 management

5 management

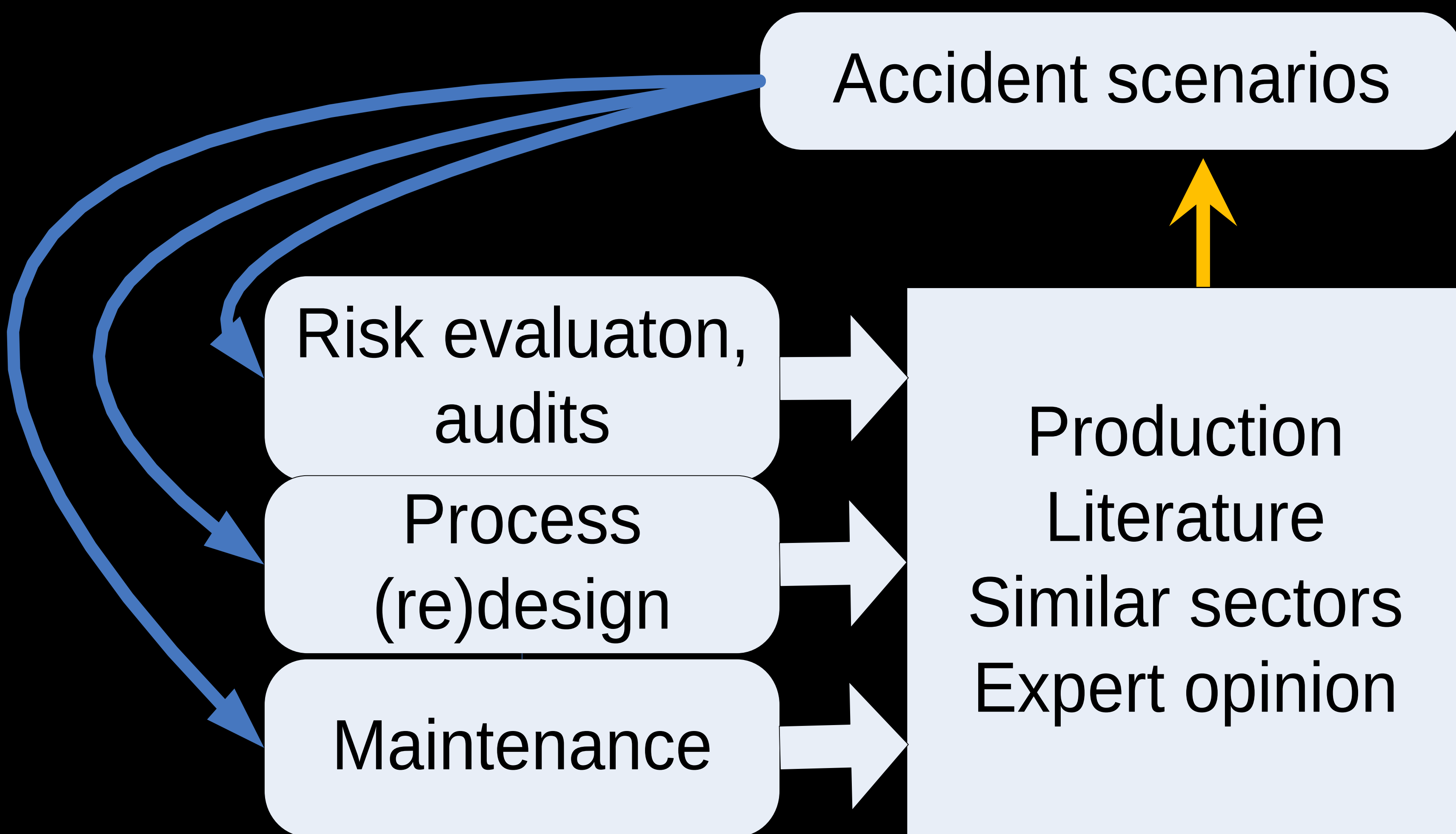


5 management and design

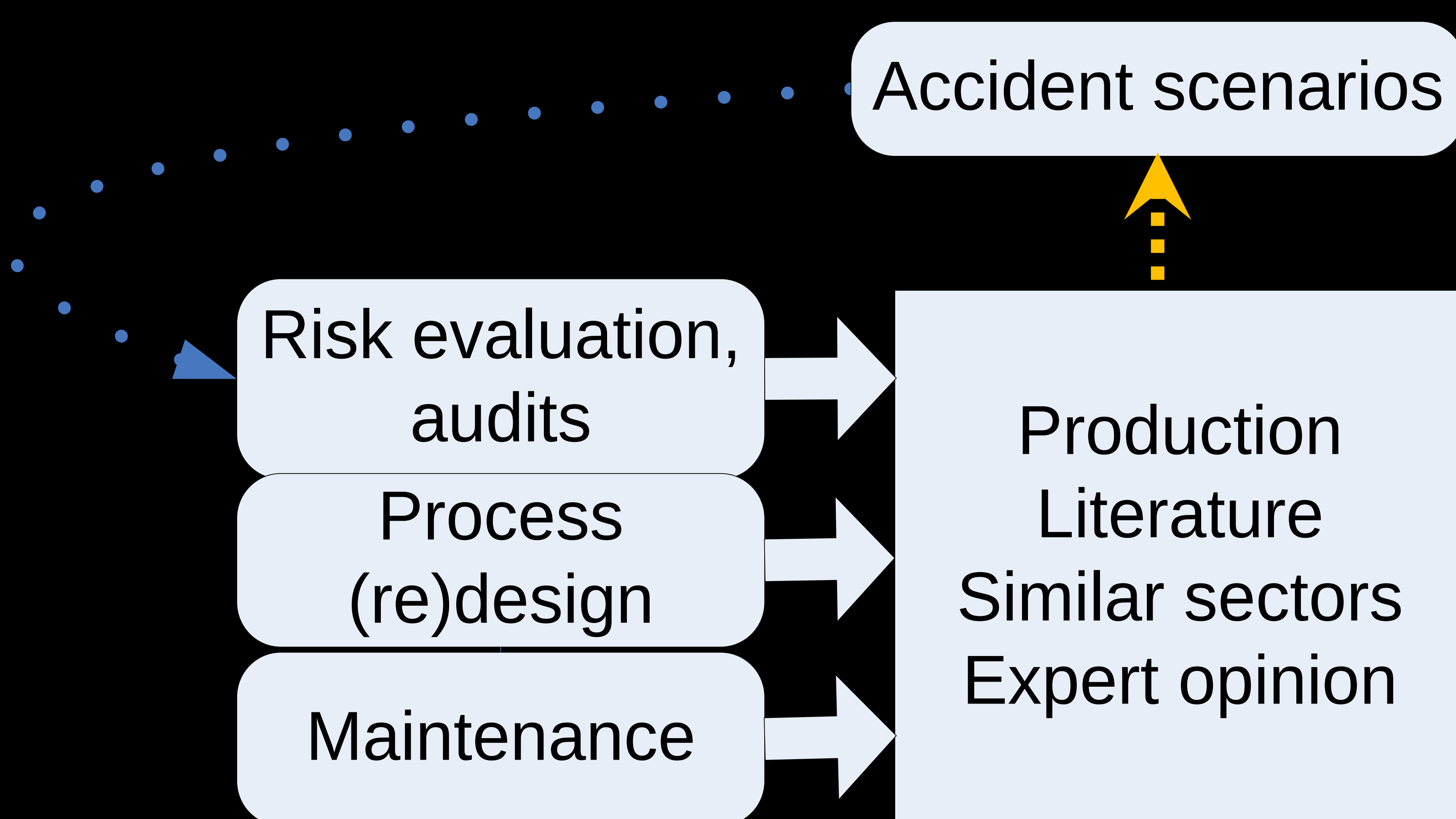




5 ideal feedback



actual feedback



6 construction is ‘organic’

Ford Madox Brown 1852-1865

Fernand Léger 1950

6 construction shocks and vibrations

Swuste P Drimmelen D van Burdorf A (1997). Pneumatic chippers design analysis and solution generation Safety Science 27:85-98

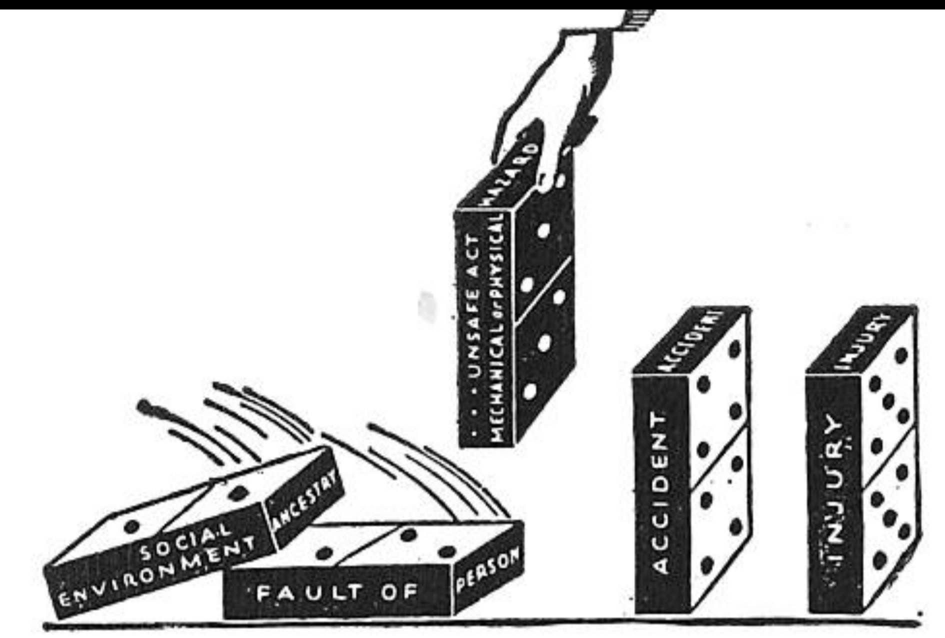
6 construction accident process

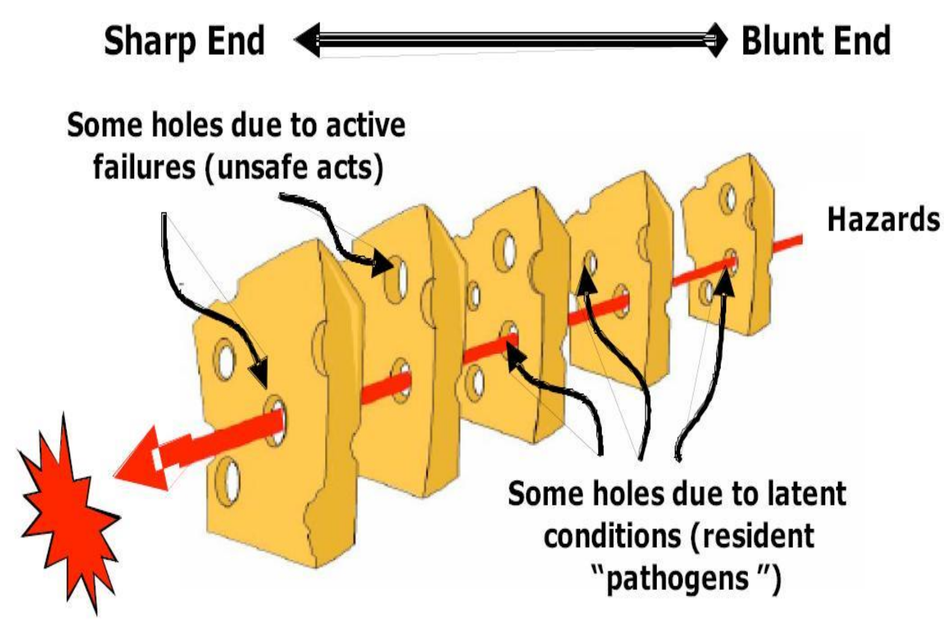
direct and latent factors in construction

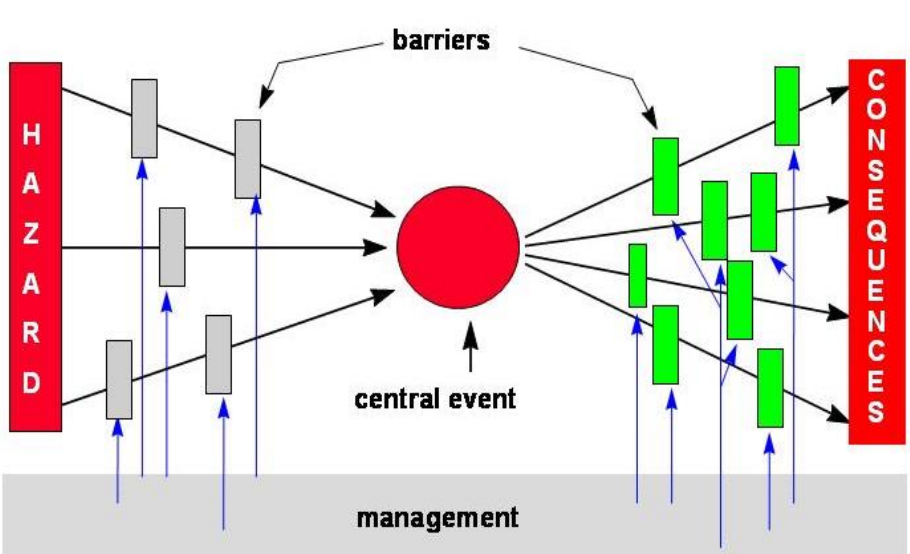
direct factors	latent factors
disturbances in materials	safety-production conflict (time)
disturbances in process	production bonuses
inadequate monitoring	not familiar with scenarios
prime focus on human factor	indifference to safety
inadequate accident analysis	no link to safety policies
labour, low level of education	distant from mother company
language	not adequate safety managem.
macho behaviour	relation design – unsafety
	low safety knowledge architects
	separation design – execution

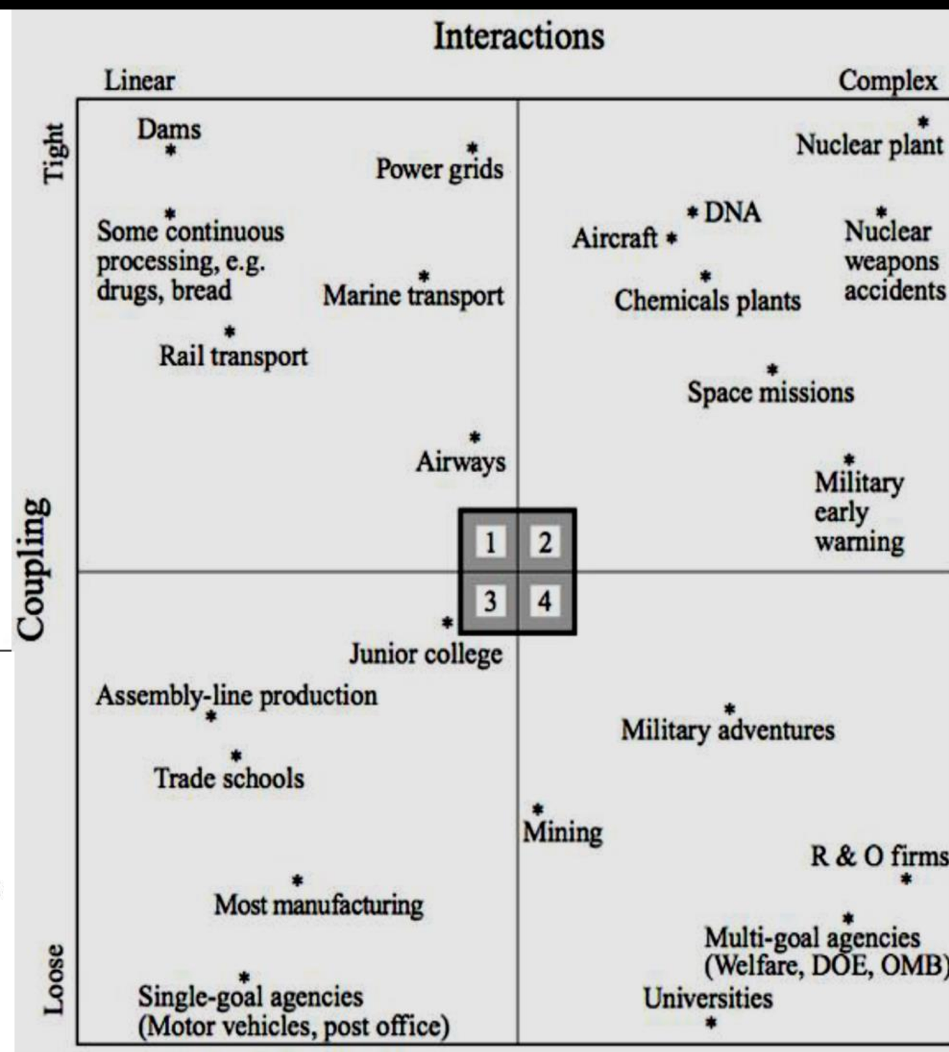
Swuste P Frijters A Guldenmund F (2012). Is it possible to influence safety in the building sector. Safety Science 50:1333-1343

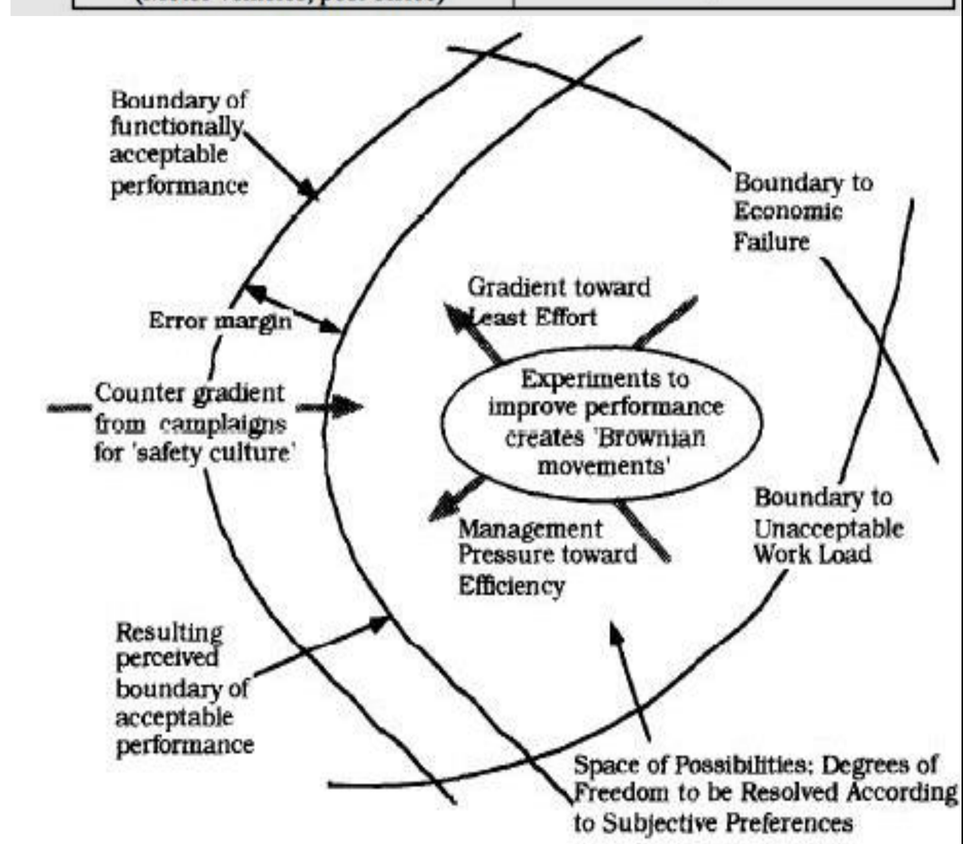
7 are accidents predictable?





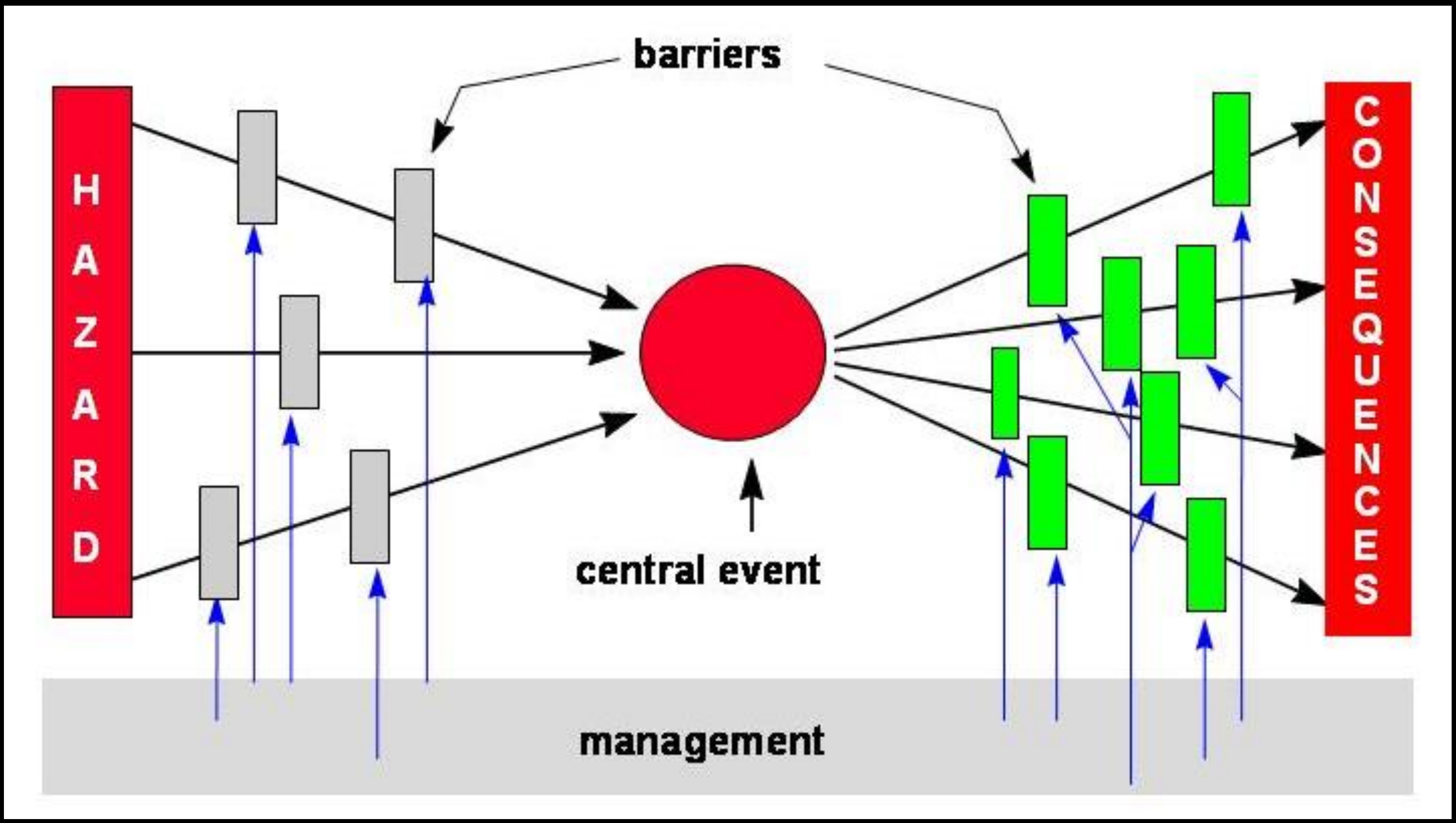






Swuste P Theunissen J Schmitz P Reniers G Blokland P (2016) Process safety indicators Journal of Loss Prevention 40:162-173

7 recent research



1. start with hazards and scenarios, observations, interviews workers & managers, literature, accident reports

2. determine central events, many scenarios, few central events

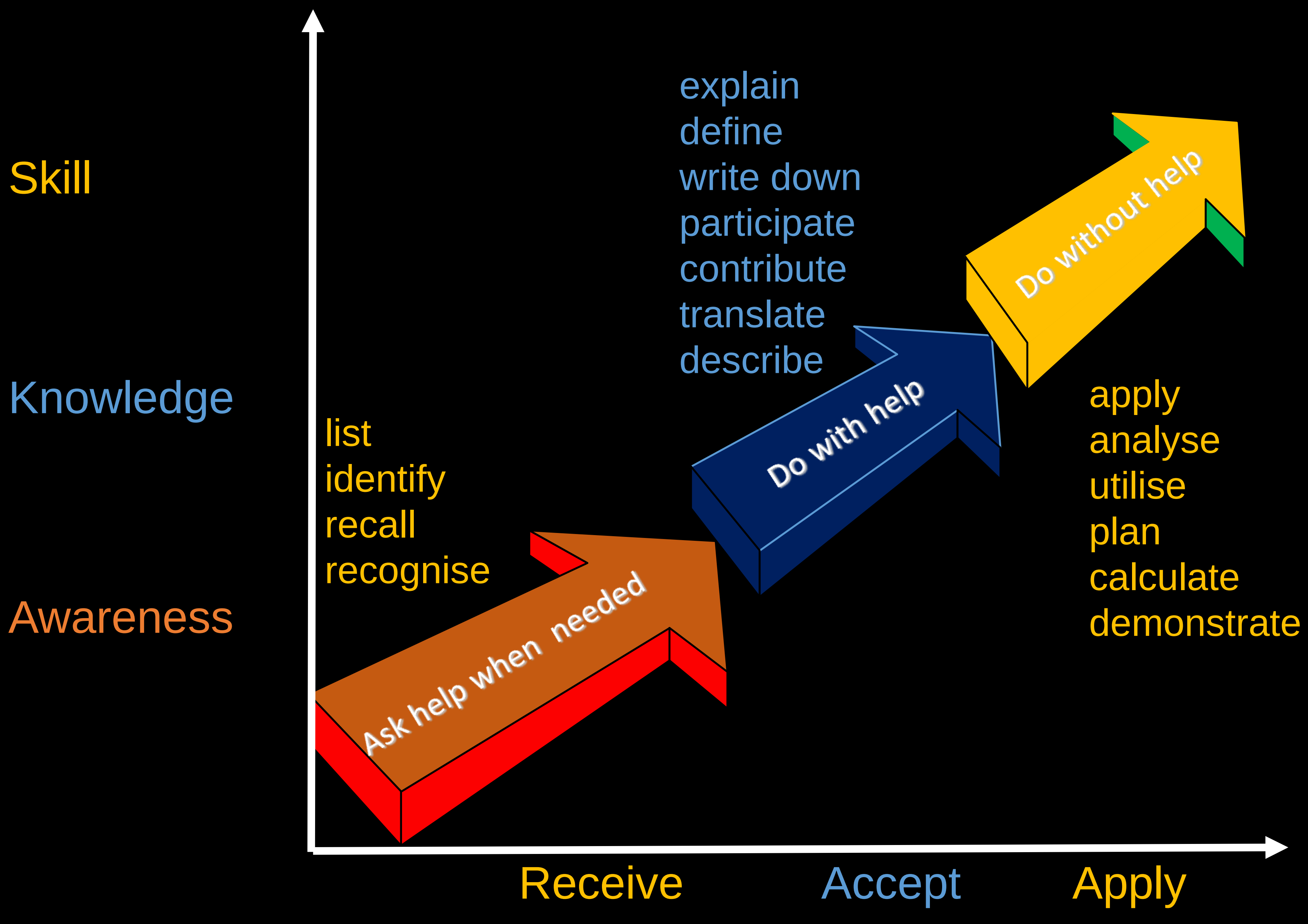
3. which barriers are present to stop, reduce effects of scenarios

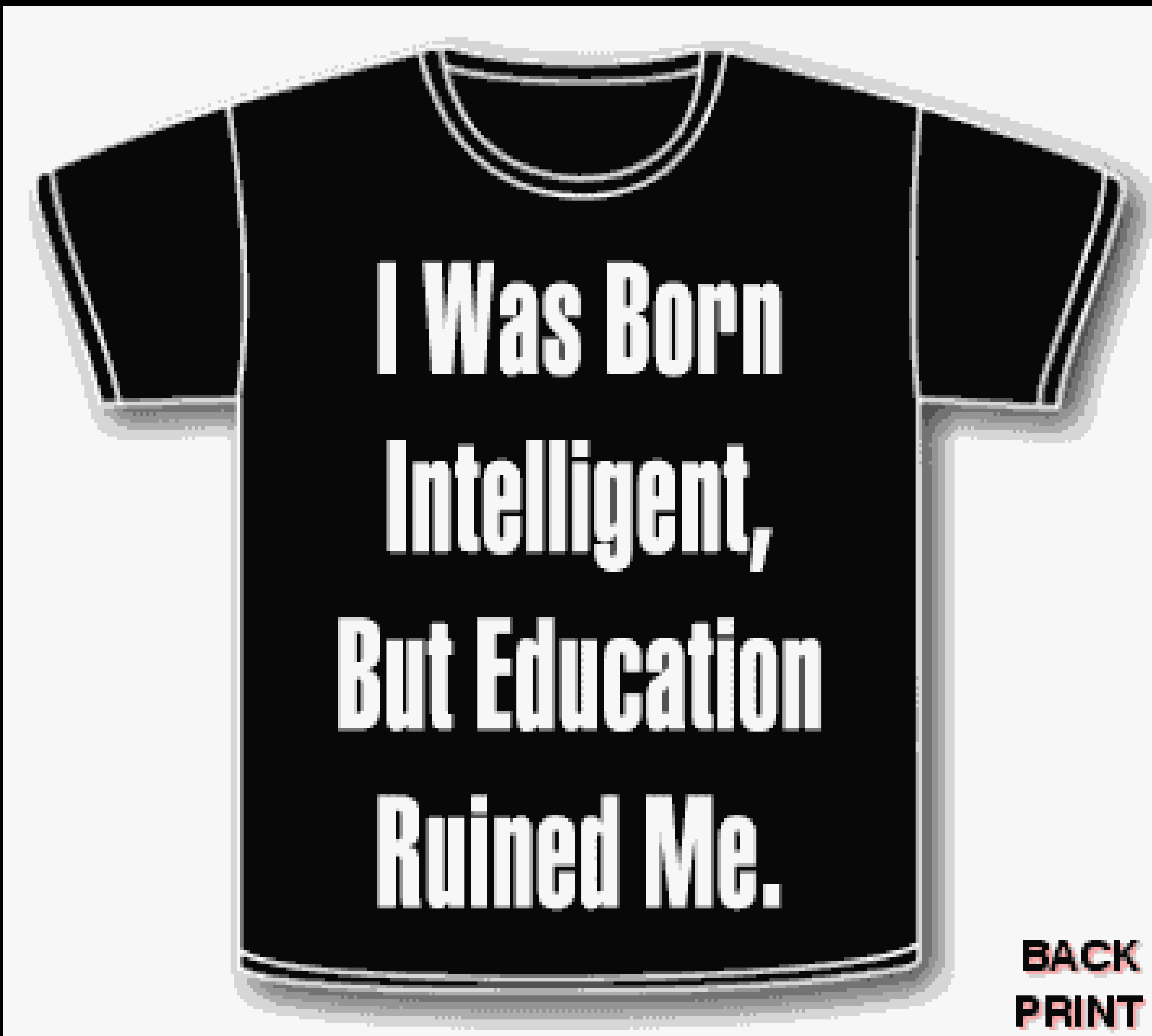
4. how effective are barriers, interviews, accident reports

5. does management control the effectiveness of barriers

8 education

competence levels




I Was Born
Intelligent,
But Education
Ruined Me.
BACK
PRINT

red thread of presentation

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