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Human Factors: A Personal Perspective

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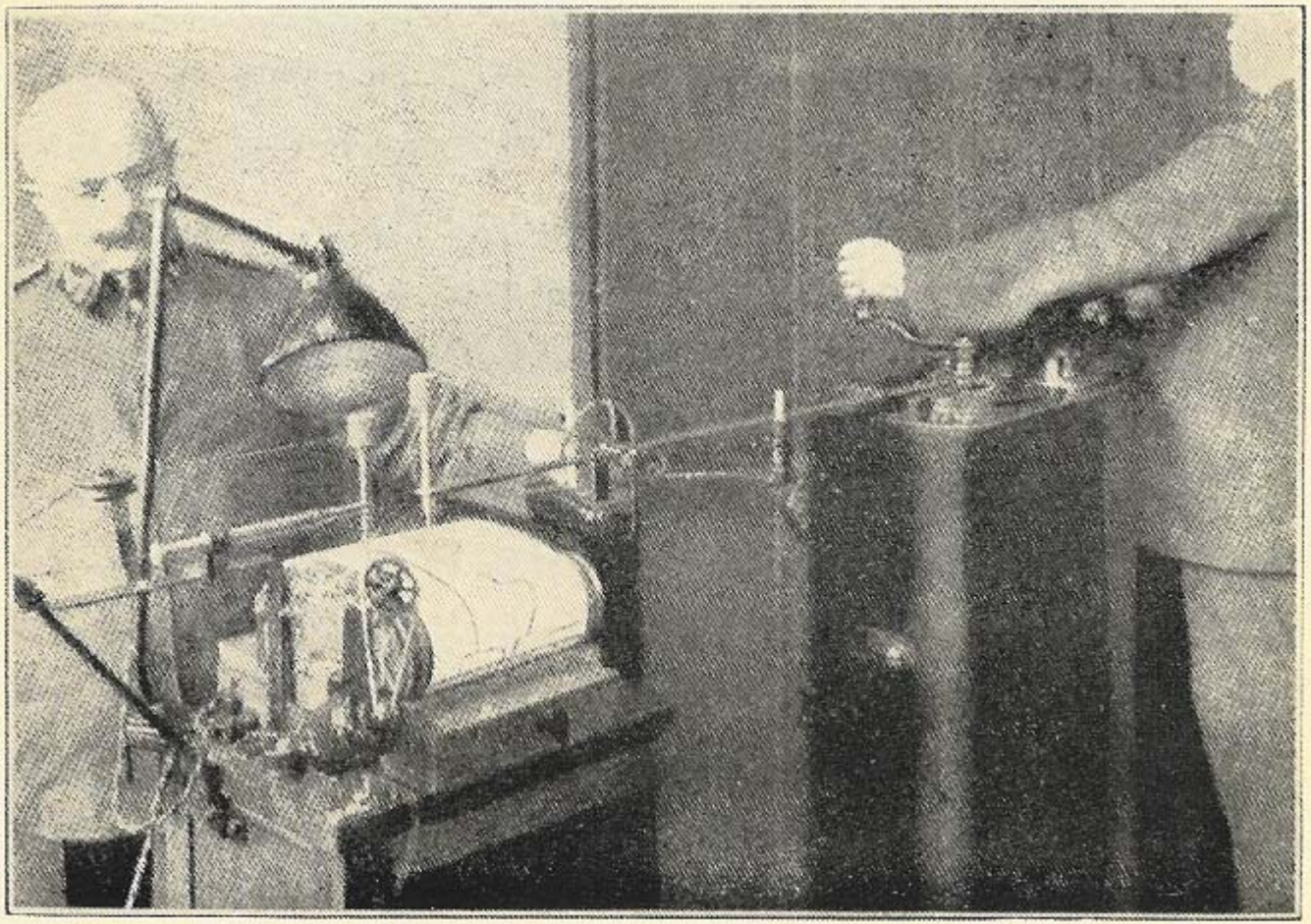
Some personal milestones

- 1962-64: Cockpit ergonomics (military aviation)
- 1964-74: Motion sickness, disorientation (transport systems, NASA)
- 1974-84: Error, absent-mindedness (cognitive psychology of everyday life)
- 1984-94: Safety, error management (various hazardous industries)
- 1994-06: Cultural & organizational issues (mostly patient safety)

Human Factors (HF)

- Term originated in WW2 in response to the ‘people problems’ faced by military aviation.
- HF extended beyond aviation to cover a wide range of hazardous technologies.
- HF is about understanding and enhancing human performance in the workplace—especially in complex systems.

Nothing new under the sun
(Berlin, 1919)



Apparatus for Practice and Recording Practice in Street Car Operation

Expanding concerns over 60 years

- Sensory-motor performance (knobs & dials—traditional ergonomics)
- Cognitive factors (slips, lapses, mistakes)
- Social factors (team issues, violations)
- Organizational issues (‘upstream’ factors, culture)
- System at large (external influences: political, economic, etc.)

Estimates of human error
(as a per cent of all failures)

Jet transport	65-85
Air traffic control	90
Maritime vessels	80-85
Chemical industry	80-90
Nuclear power plants (US)	70
Road transportation	85

Human performance problems dominate the risks in hazardous industries.

Three models of error

- Person model
- Legal model
- System model

Each has its own ‘theory’ of error. Each directs a particular type of remedy.

The person model

- Sees errors as the product of wayward mental processes: forgetfulness, inattention, distraction, carelessness, etc.
- Remedial measures directed primarily at the ‘sharp end’ error-maker: naming, blaming, shaming, retraining, fear appeals, writing another procedure, etc.
- BUT this isolates errors from their context and has little or no remedial value.

The legal model

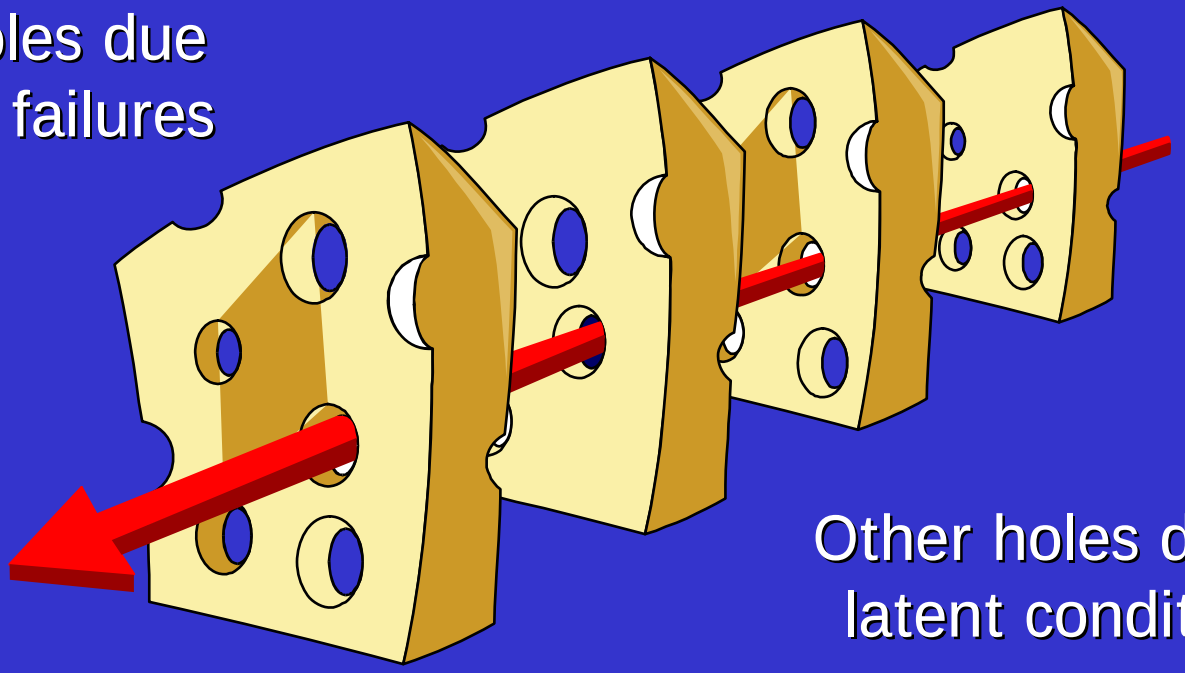
- Responsible professionals should not make errors (duty of care).
- Such errors are rare but sufficient to cause adverse events.
- Errors with bad consequences are negligent or even reckless and deserve deterrent sanctions.
- BUT errors are frequent and mostly without bad consequences. Rarely sufficient alone. Though sometimes necessary to complete an accident-in-waiting.

The system model

- Fallibility is part of the human condition.
- Adverse events are the product of latent pathogens within the system.
- ‘Sharp-enders’ are more likely to be the inheritors than the instigators.
- Remedial efforts directed at improving defences and removing error traps.

The 'Swiss cheese' model of accident causation

Some holes due to active failures



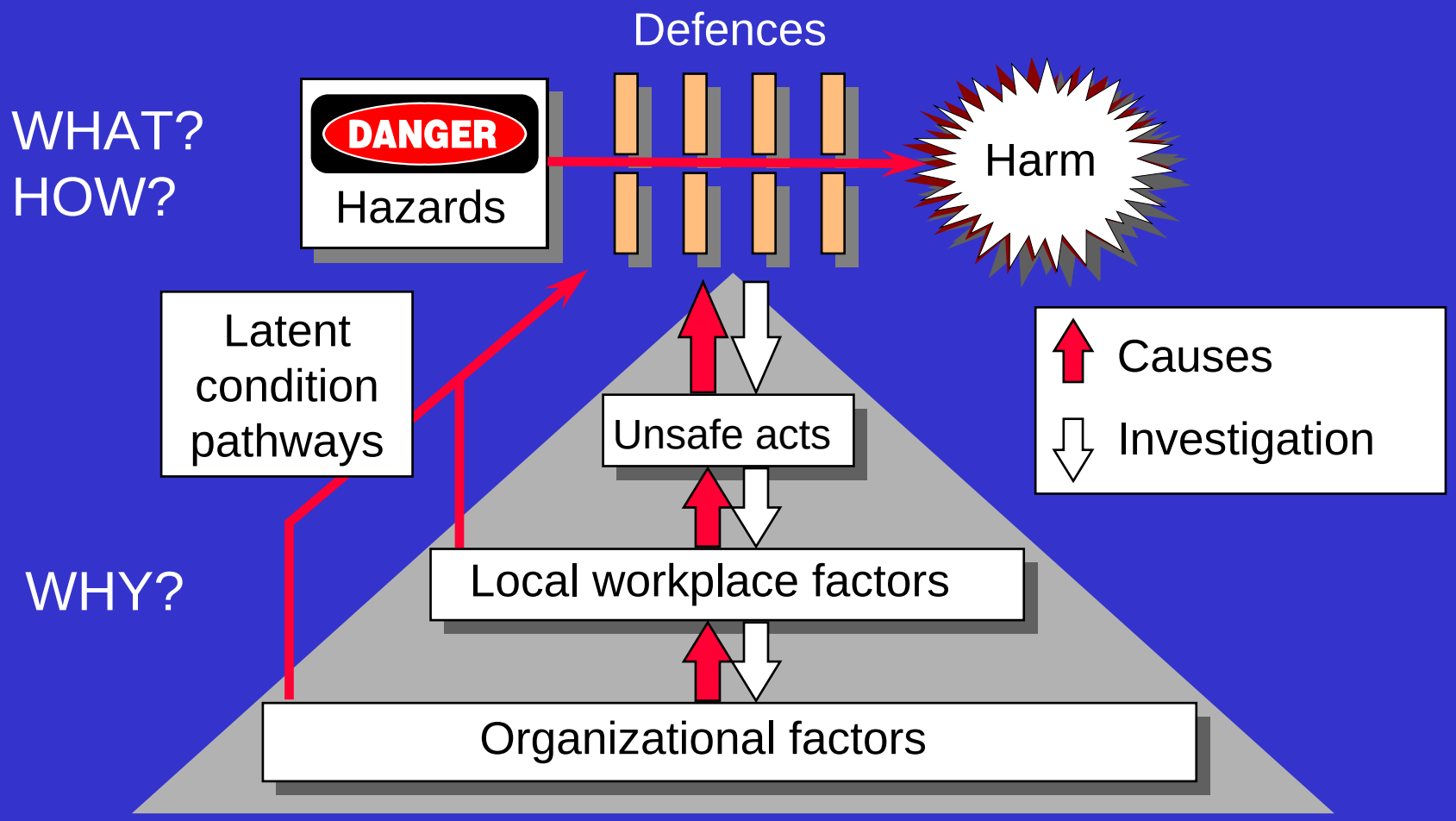
Hazards

Harm

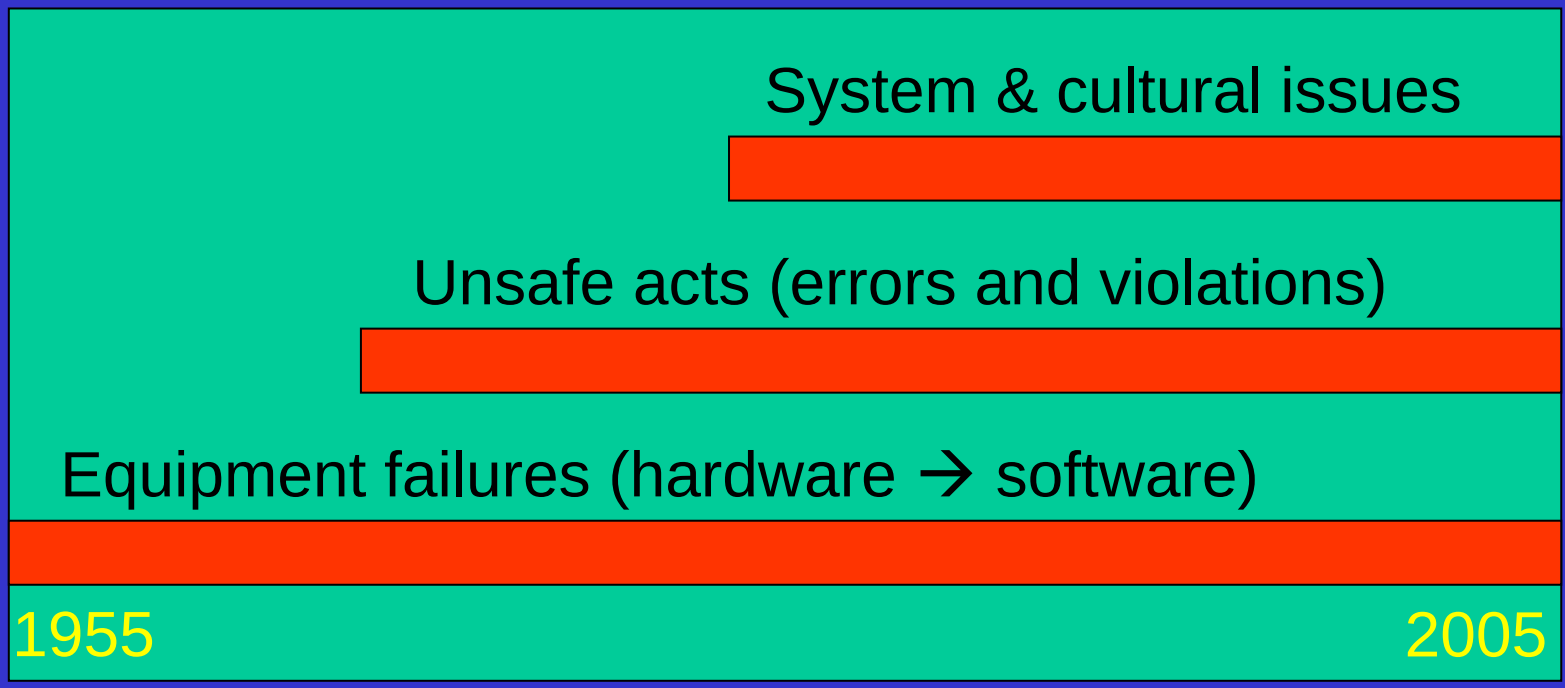
Other holes due to latent conditions

Successive layers of defences, barriers, & safeguards

A system perspective on adverse events



Shifting focus of safety concern across industries



1960s	1970s	1980s	1990s	2000s
Metal fatigue	Flixborough	Chernobyl	Paddington	Linate
Aberfan	Seveso	Zeebrugge	Long Island	Überlingen
Ibrox	Tenerife	Bhopal	Alabama	*Columbia*
	TMI	*Piper Alpha*	*Estonia*	
	Mt Erebus	Dryden	Eschede	

Ever-widening search for the 'upstream' factors

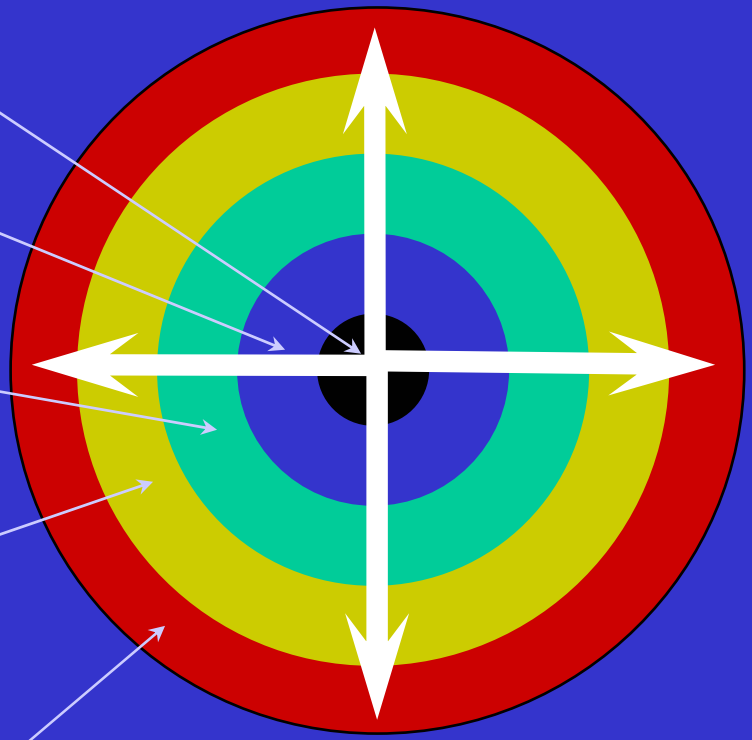
Individuals

Workplace

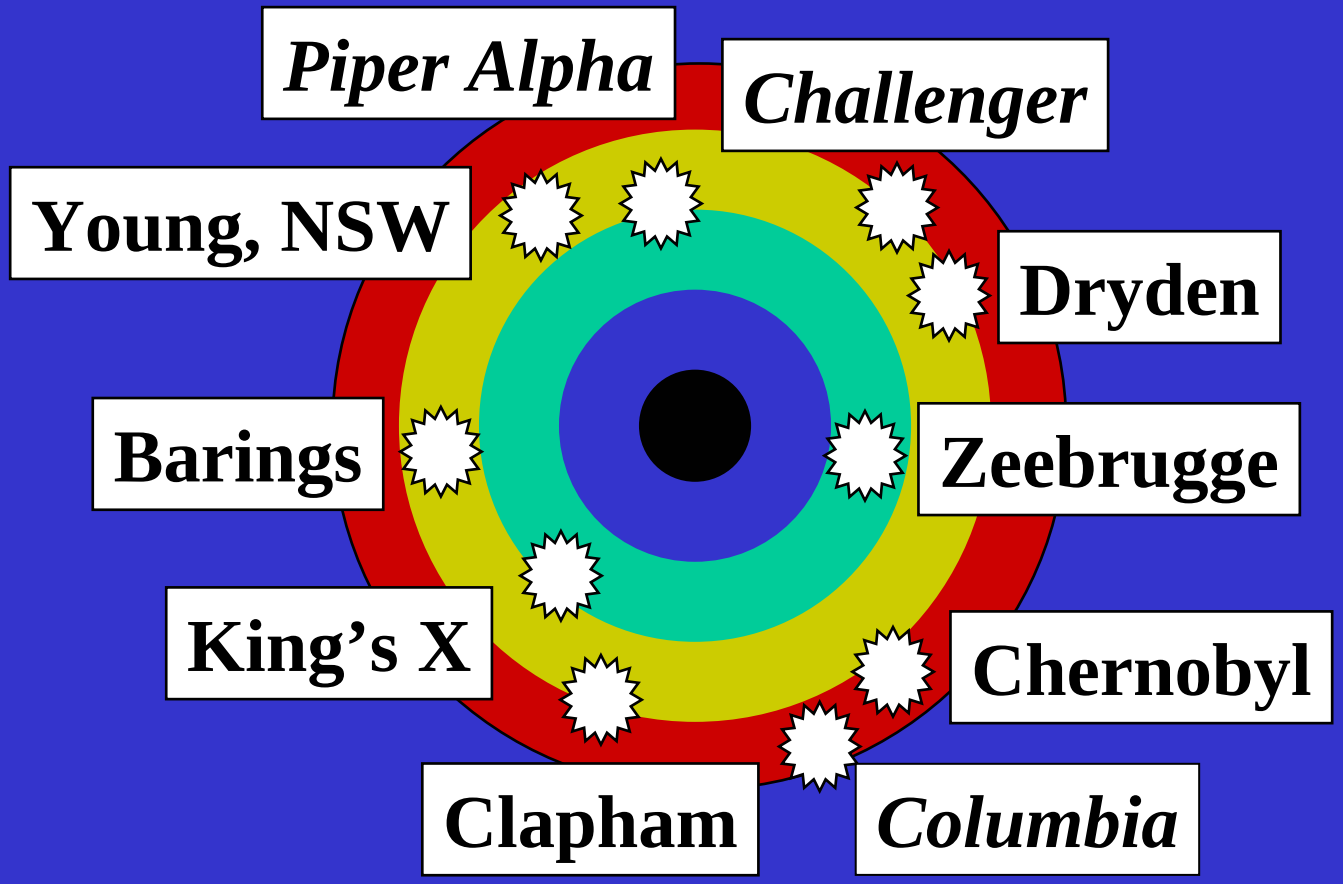
Organisation

Regulators

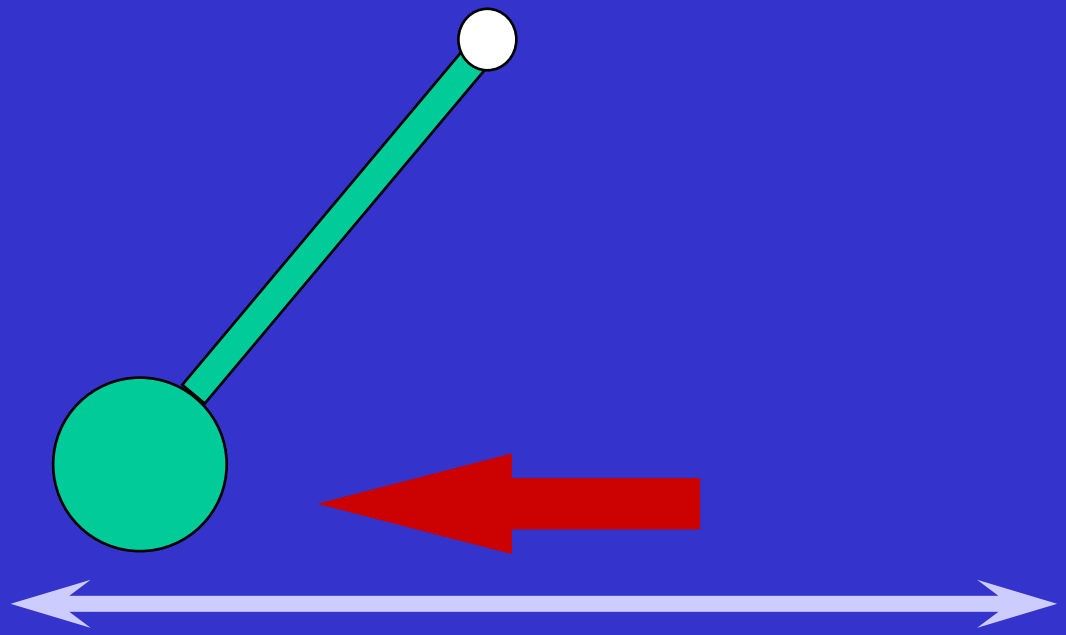
Society at large



Echoed in many hazardous domains



But has the pendulum swung too far?



Collective responsibility

Individual responsibility

Mr Justice Moshansky on the Dryden F-28 crash

Had the system operated effectively, each of the (causal) factors might have been identified and corrected before it took on significance . . . *this accident was the result of a failure of the air transportation system as a whole.*

Academician Valeri Legasov on the Chernobyl disaster

After being at Chernobyl, I drew the unequivocal conclusion that the Chernobyl accident was . . . *the summit of all the incorrect running of the economy which had been going on in our country for many years.*

(pre-suicide tapes, 1988)

CAIB Report (Ch. 5)

‘The causal roots of the accident can be traced, in part, to the turbulent post-Cold War policy environment in which NASA functioned during most of the years between the destruction of *Challenger* and the loss of *Columbia*.’

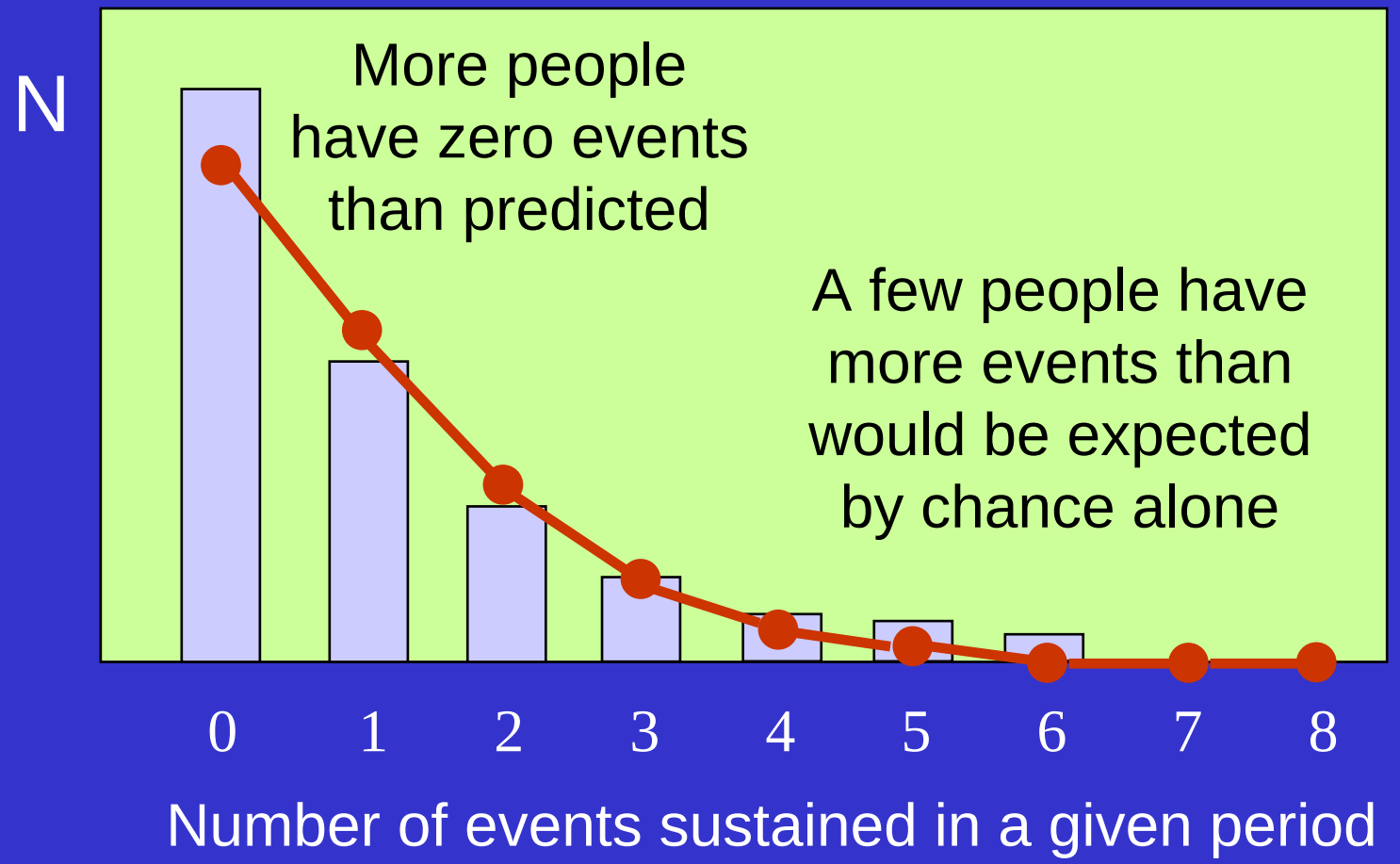
Remote factors: some concerns

- They have little causal specificity.
- They are outside the control of system managers, and mostly intractable.
- Their impact is shared by many systems.
- The more exhaustive the inquiry, the more likely it is to identify remote factors.
- Their presence does not discriminate between normal states and accidents; only more proximal factors do that.

Revisiting Poisson

- Poisson counted number of kicks received by cavalrymen over a given period.
- Developed a model for determining the chance probability of a low frequency/high opportunity event among people sharing equal exposure to hazard.
- How many people would one expect to have 0, 1, 2, 3, 4, 5, etc. events over a given period when there is no known reason why one person should have more than any other?

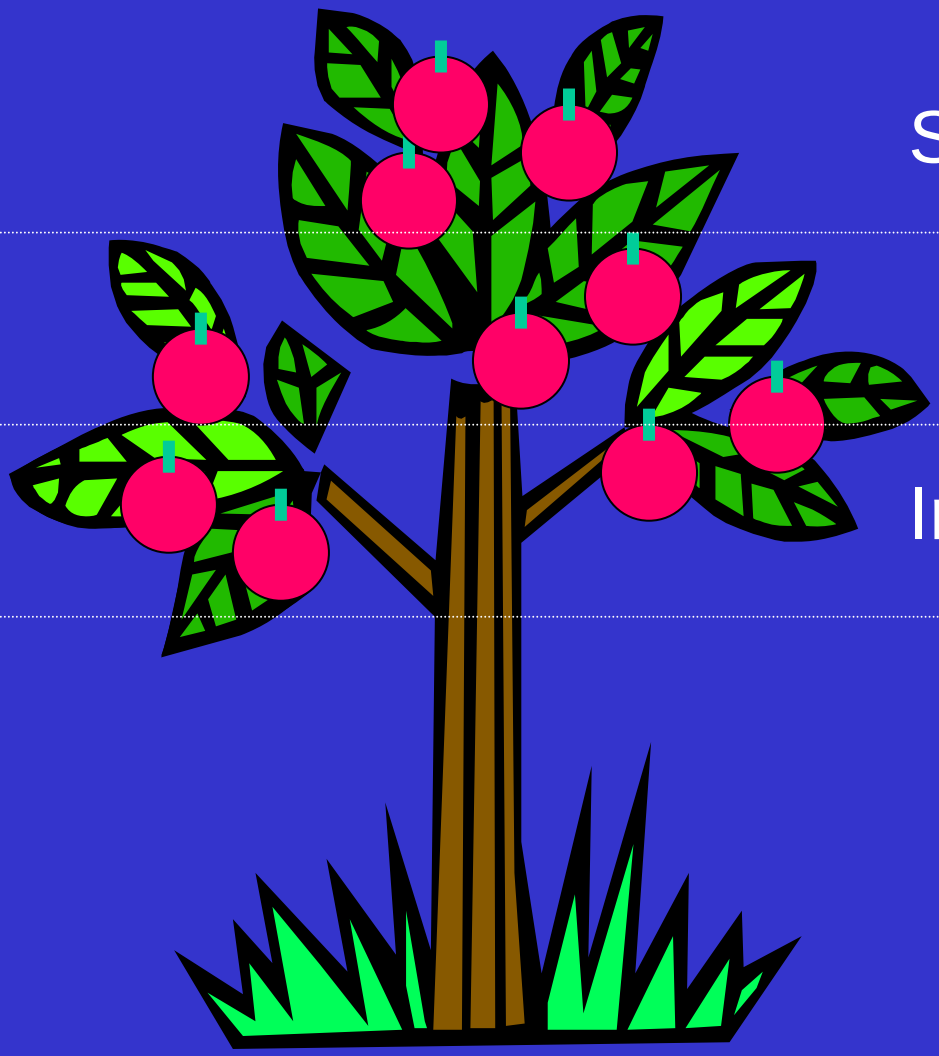
Unequal liability: common finding



Interpreting these data

- Repeated events are associated with particular conditions. Suggests the need for specific retraining.
- Repeated events are not associated with particular conditions:
  - Bunched in a given time period. Suggests influence of local life events. Counselling?
  - Scattered over time. Suggests some enduring problem. Promote to management?

Reaching ever higher for the fruit

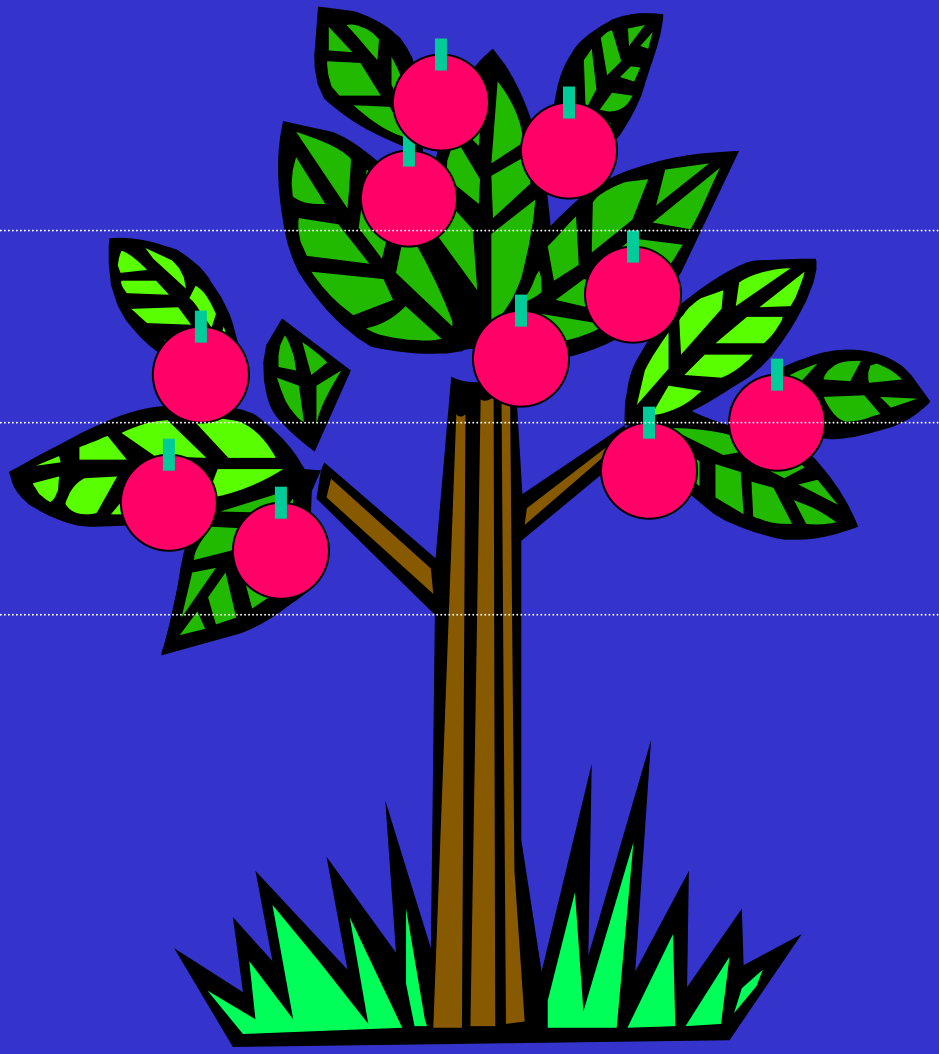


Systemic factors

Social factors

Individual factors

End-of-century grades



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Conclusions

- Widening the search for error-shaping factors has brought great benefits in understanding accidents.
- But maybe we are reaching the point of diminishing returns with regard to prevention.
- Perhaps we should revisit the individual (the heroic as well as the hazardous acts).