Yvonne Toft

Human Factors in Healthcare Forum, 6 June 2017

BE WHAT YOU WANT TO BE

Socio-technical Systems Safety in Health Care: We need a new lens and practice paradigm!

Yvonne Toft, CQUniversity, Australia

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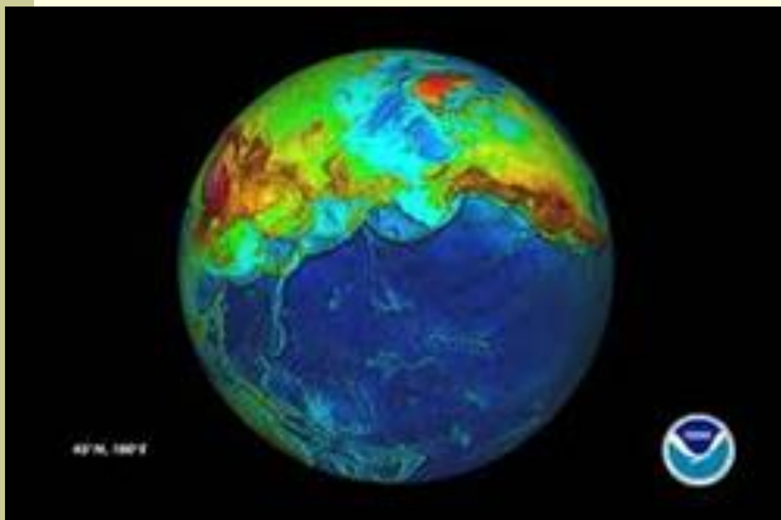
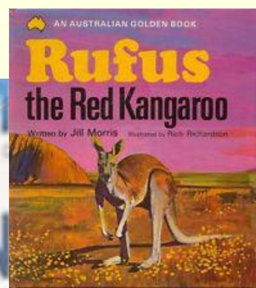
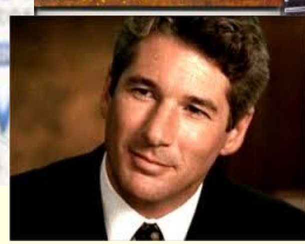
1st Career – Student nurse to RN

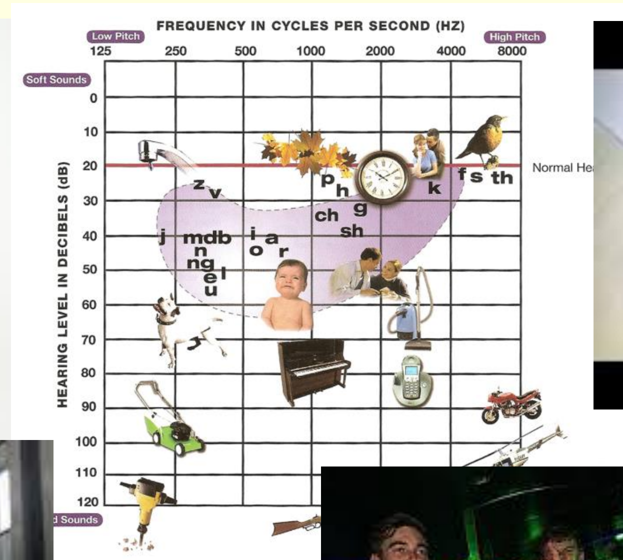
2nd Career – The world is my oyster!

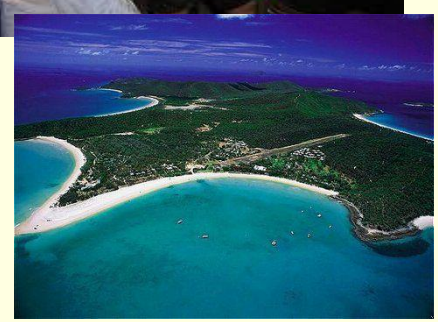






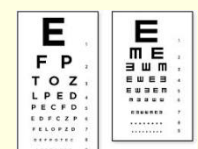
3rd Career – Industrial Nurse -> Rehabilitation Unit Manager



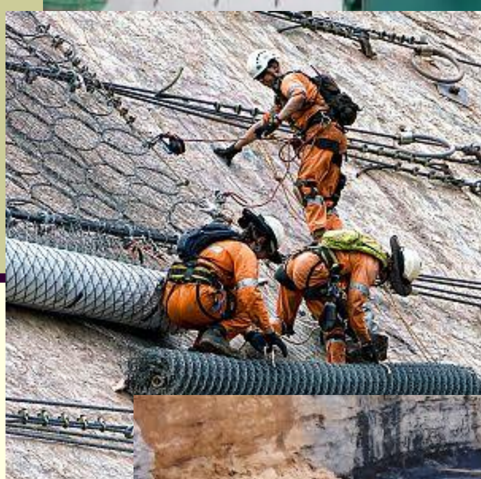


-> Remote Area Nurse (Mining)

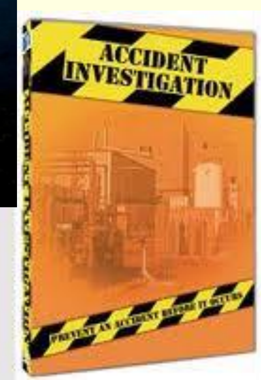
Curtin
University of Technology

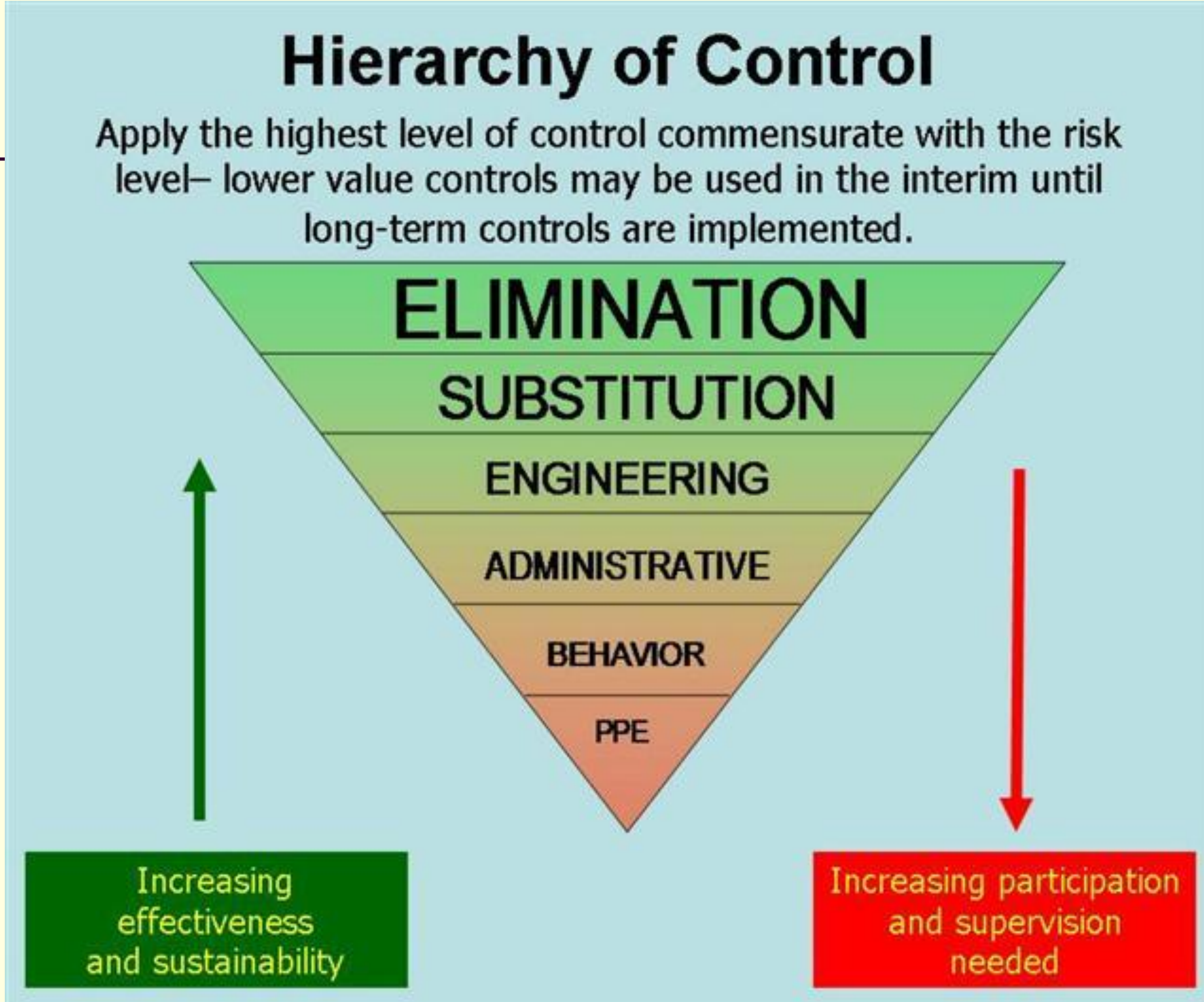


4th Career – Safety Adviser -> Accident Investigator -> Analysis of equipment design



Why?
Why?
Why?




Hierarchy of Control
Apply the highest level of control commensurate with the risk level– lower value controls may be used in the interim until long-term controls are implemented.
ELIMINATION
SUBSTITUTION
ENGINEERING
ADMINISTRATIVE
BEHAVIOR
PPE
Increasing effectiveness and sustainability
Increasing participation and supervision needed

5th Career - Academic

Realisation that not everybody 'gets' it!!!

International Ergonomics Association

Australasian Association for Engineering Education

ENGINEERS AUSTRALIA

NOHSC National Occupational Health & Safety Commission

HFESA Human Factors & Ergonomics Society of Australia inc.

Central Queensland University

DOCTRINA PERPETUA

QUT Science and Technology

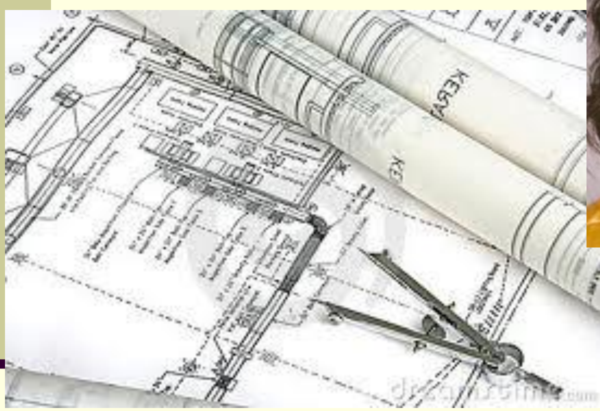
S.I.A. Safety Institute of Australia Ltd

ICOH

"AD MELIOREM LABORANTIUM VALETUDINEM"

FOUNDED 1906

& 6th Career …Human Factors Engineer



No longer working in Health Care but rather, a pilot of complex socio-technical systems design …

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Why?

1. In 2000-01, 8% ($4.0 billion) of total allocated health expenditure was spent on persons who experienced injuries – 6.5% ($3.2 billion) related to non-work related injuries (in the home, recreation etc)

2. The annual cost of accidents on Australian roads totals $17 billion dollars a year representing 2.3% of GDP!

3. In 2005-06, the cost of work-related injuries and illness was estimated as $57.5 billion dollars or 5.9% of GDP

Citations: 1. Australian Institute of Health and Welfare (2004), AIHW Disease Expenditure Database, October 2004. Cited in ABS (2006) *Injury in Australia: A Snapshot, 2004-05, Australian Bureau of Statistics, Canberra*

2. SIPP (2004), *The Draft National Injury Prevention Plan: 2004 Onwards,* Strategic Injury Prevention Partnership Canberra. Cited in ABS (2006) *Injury in Australia: A Snapshot, 2004-05, Australian Bureau of Statistics, Canberra*

3. Safe Work Australia, 2009, The cost of work related injury & illness for Australian Employers, Workers and the Community www.safeworkaustralia.gov.au.

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ACCIDENTS AND WORK RELATED DISEASES AT EPIDEMIC PROPORTIONS

4. **The 2004-05 NHS indicated that:**
   - **18% of the population (3.6 million persons) had sustained a recent injury (in the previous four weeks).**
   - **Of all employed persons aged 15 years and over, 7% had received an injury while working for income in the four weeks prior to interview**

TOTAL ANNUAL COST OF ACCIDENTAL TRAUMA AND DISEASE CIRCA: $77.7 BILLION OR circa 7.8% of GDP

There is a significant cost to our Health Care system when our workers are exposed to injury and disease!

Citation: *Connelly L. & Supangan R. (2006), The economic costs of road traffic crashes: Australia, states and territories,* Accident Analysis & Prevention, Vol 38, Issue 6, November 2001, PP1087-1093, Elsevier

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What about our patients?

Runciman and Moller (2001) estimated that iatrogenic injury in Australia results in **direct medical costs of over $2 billion per year** and that the total lifetime cost of such preventable injury may be twice that amount. They also note that there is a heavy toll in human costs on both those who are harmed and those who care for them. Furthermore, medical misadventure consumes over half the amount spent on compensation and insurance by State Treasury Departments.

Citation: Runciman, W., & Moller, J. (2001). Iatrogenic injury in Australia. Canberra: Commonwealth Department of Health and Aged Care

Why????

Table 10: Data on adverse events in health care from several countries

	Study	Study focus (date ofadmissions)	Number of hospital admissions	Number of adverse events	Adverse event rate (%)
1	United States (Harvard Medical Practice Study)	Acute care hospitals (1984)	30 195	1 133	3.8
2	United States (Utah–Colorado study)	Acute care hospitals (1992)	14 565	475	3.2
3	United States (Utah–Colorado study)[a]	Acute care hospitals (1992)	14 565	787	5.4
4	Australia (Quality in Australian Health Care Study)	Acute care hospitals (1992)	14 179	2 353	16.6
5	Australia (Quality in Australian Health Care Study)[b]	Acute care hospitals (1992)	14 179	1 499	10.6
6	United Kingdom	Acute care hospitals (1999–2000)	1 014	119	11.7
7	Denmark	Acute care hospitals (1998)	1 097	176	9.0

Source: World Health Organization, Executive Board 109th session, provisional agenda item 3.4, 5 December 2001, EB 109/9.

a Revised using the same methodology as the Quality in Australian Health Care Study (harmonising the four methodological discrepancies between the two studies).
b Revised using the same methodology as Utah–Colorado Study (harmonising the four methodological discrepancies between the two studies).
Studies 3 and 5 present the most directly comparable data for the Utah–Colorado and Quality in Australian Health Care studies.

A major cause we are told: Human error!

I propose that

- If we want to prevent human error we need to take a systems safety approach
- human factors is a **design science** and is transdisciplinary
- we will have many more opportunities to address human error across our system by tweaking the design of equipment and systems rather than by tweaking the design of people and their behaviour!
- human factors in health care is REALLY about the design of complex socio-technical systems of which humans are an integral part!

What is Human Factors?

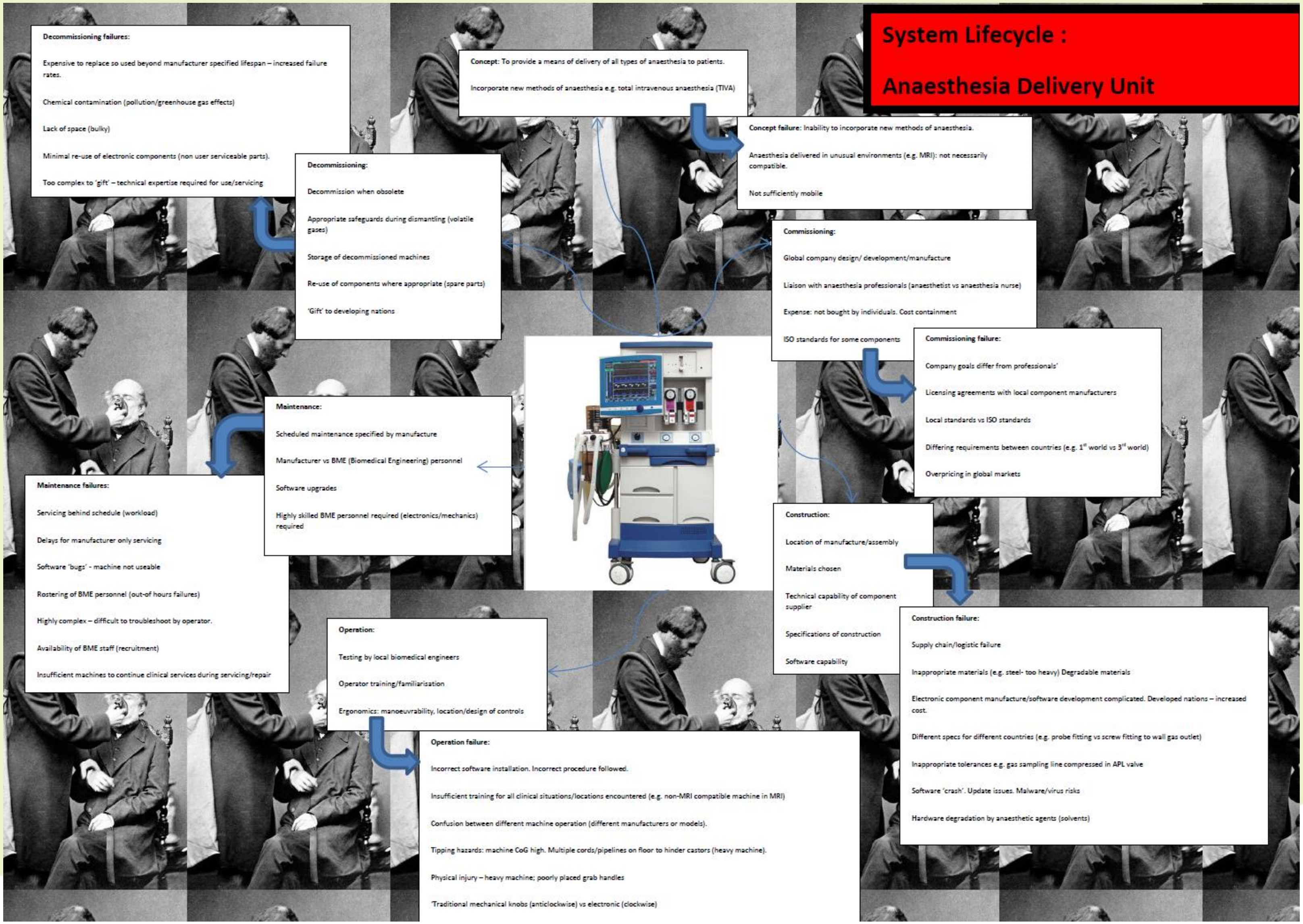
Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to ***design in order to optimize human well-being and overall system performance****.*

Practitioners of ergonomics and ergonomists contribute to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people.

http://www.iea.cc/whats/index.html

Design cues influence people performance …

Human Factors applies to design across the system lifecycle …



Maintenance:

Scheduled maintenance specified by manufacture

Manufacturer vs BME (Biomedical Engineering) personnel

Software upgrades

Highly skilled BME personnel required (electronics/mechanics) required

Maintenance failures:

Servicing behind schedule (workload)

Delays for manufacturer only servicing

Software 'bugs' - machine not useable

Rostering of BME personnel (out-of hours failures)

Highly complex – difficult to troubleshoot by operator.

Availability of BME staff (recruitment)

Insufficient machines to continue clinical services during servicing/repair

Construction:

Location of manufacture/assemb

Materials chosen

Technical capability of compone supplier

Specifications of construction

Software capability

Operation:

Testing by local biomedical engineers

Operator training/familiarisation

Ergonomics: manoeuvrability, location/design of controls

Operation failure:

Incorrect software installation. Incorrect procedure followed.

Insufficient training for all clinical situations/locations encountered (e.g. non-MRI compatible machine in MRI)

Confusion between different machine operation (different manufacturers or models).

Tipping hazards: machine CoG high. Multiple cords/pipelines on floor to hinder castors (heavy machine).

Physical injury – heavy machine; poorly placed grab handles

'Traditional mechanical knobs (anticlockwise) vs electronic (clockwise)

… otherwise we end up here!

Design brief: Affordable level crossings i.e. redesign passive level crossings to reduce train-vehicle collisions …

Wullems (circa 2012)

When questioned about his design assumptions …

*"**my first assumption had to be that people would use the crossing properly otherwise how would I be able to assign a risk score … "***

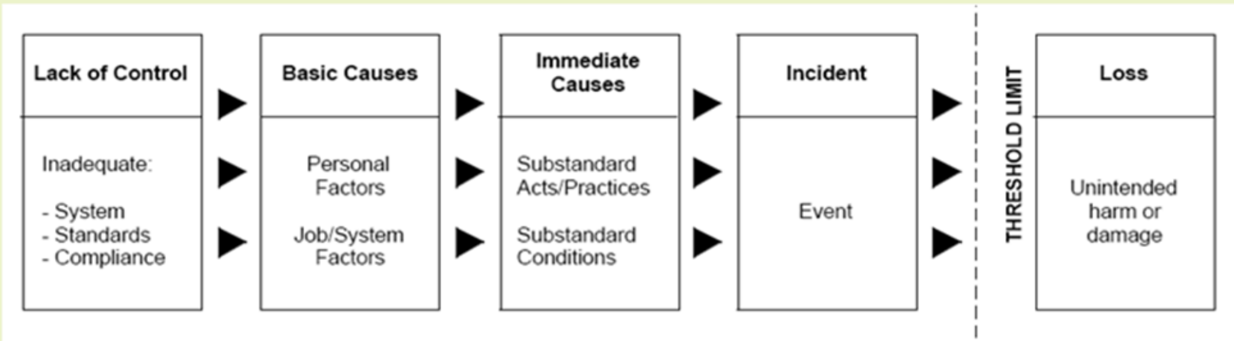
Now….. Human Factors Engineer at European Space Agency!

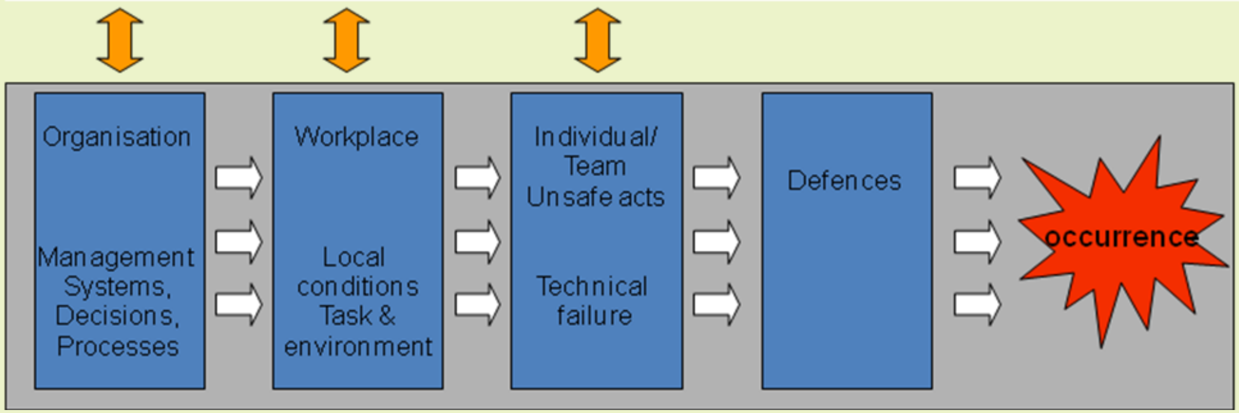
Investigation of human error is only as useful as the lens we wear while investigating …

Even unsophisticated HOLISTIC models can begin to illustrate the complexity that underpins human error across the system lifecycle and helps us identify the genesis of the errors in our systems

However, if we complete investigations with a linear lens …

1950 – Bird & Germain – Loss Causation Model





1990 – Reason – Model of Organisational Accidents

… and rely on error classifications …

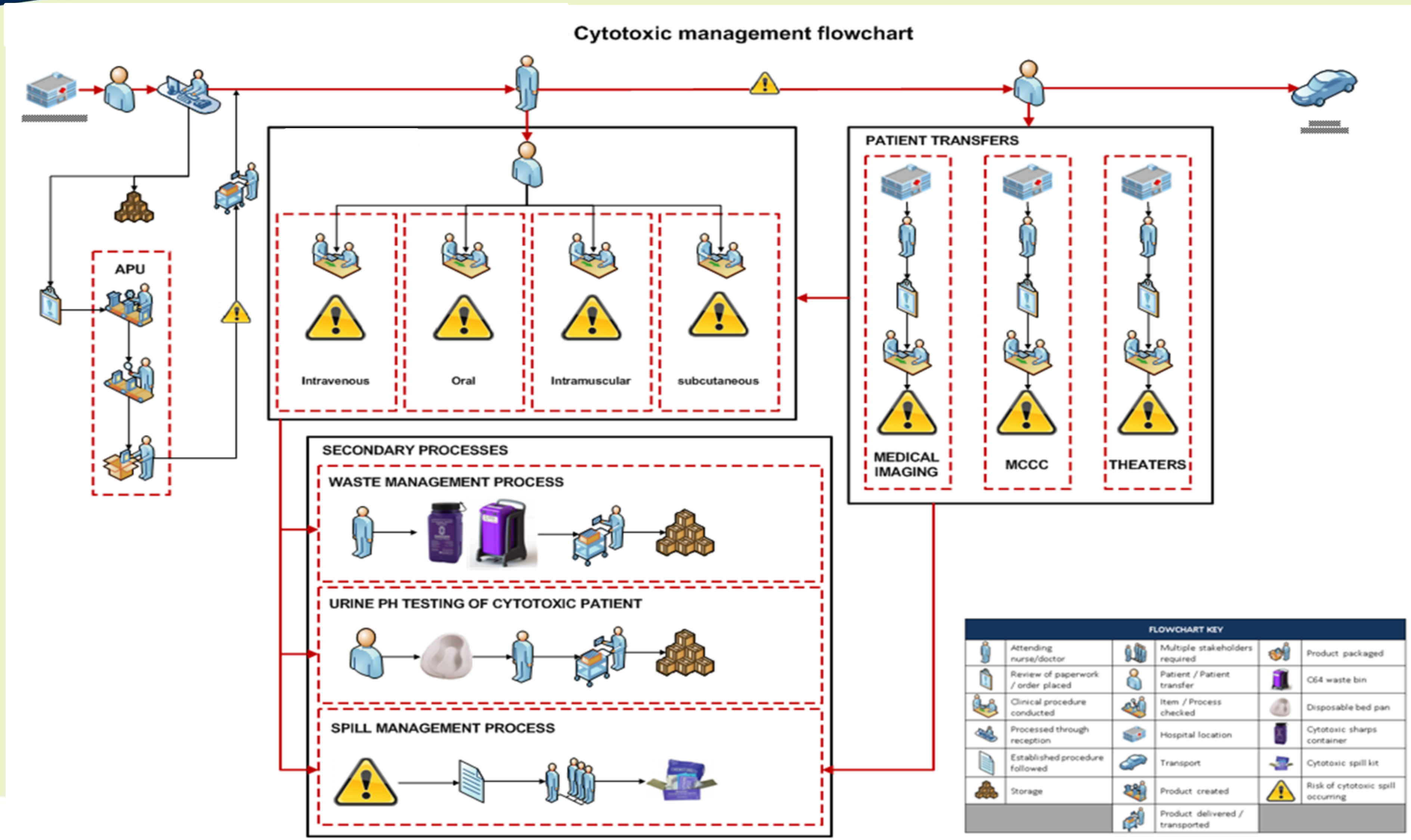
2: Number of adverse events (AEs) associated with each of the human error categories, and proportion of these AEs leading to permanent disability (including death) and with high preventability. Values are number (%) of AEs

Category	Frequency	Permanent disability	High peventability
Complication of, or failure in, the technical performance of an indicated procedure/operation	1017 (34.6%)	144 (14.2%)	504 (49.6%)
Failure to synthesise, decide and/or act on available information*	465 (15.8%)	114 (24.5%)	355 (76.3%)
Failure to request or arrange investigation, procedure or consultation*	346 (11.8%)	111 (32.1%)	293 (84.7%)
Lack of care or attention, failure to attend*	320 (10.9%)	83 (25.9%)	250 (78.1%)
Misapplication of, or failure to apply, a rule; or use of a bad or inadequate rule*	258 (8.8%)	66 (25.6%)	233 (90.3%)
Violation of a protocol or rule*	140 (4.8%)	39 (27.9%)	111 (79.3%)
Unable to code	92 (3.1%)	16 (17.4%)	49 (53.3%)
Other	83 (2.8%)	24 (28.9%)	64 (77.1%)
Acting on insufficient information*	53 (1.8%)	14 (26.4%)	43 (81.1%)
Slips and lapses; errors due to "absentmindedness" in activities in which the operator is skilled*	46 (1.6%)	8 (17.4%)	42 (91.3%)
Failure to continue established management*	43 (1.5%)	7 (16.3%)	37 (86.0%)
Lack of knowledge	33 (1.1%)	10 (30.3%)	33 (100.0%)
Electively practising outside area of expertise	30 (1.0%)	13 (43.3%)	24 (80.0%)
Questionable practice ethics	14 (0.5%)	8 (57.1%)	13 (92.9%)
Total	2940 (100%)†	657 (22.3%)	2051 (69.8%)

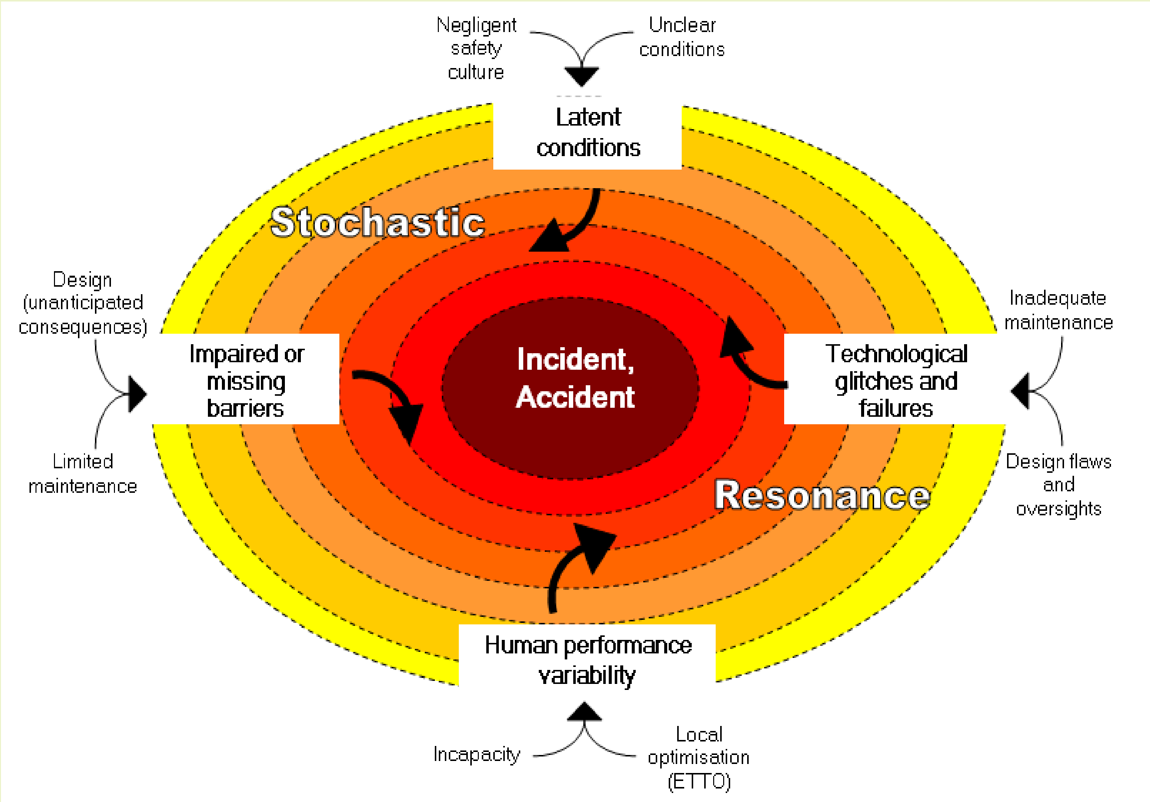
* Failure of cognitive function.

† Total is greater than number of AEs (2351) as the categories were not mutually exclusive.

We fail to really learn about the true complexity …

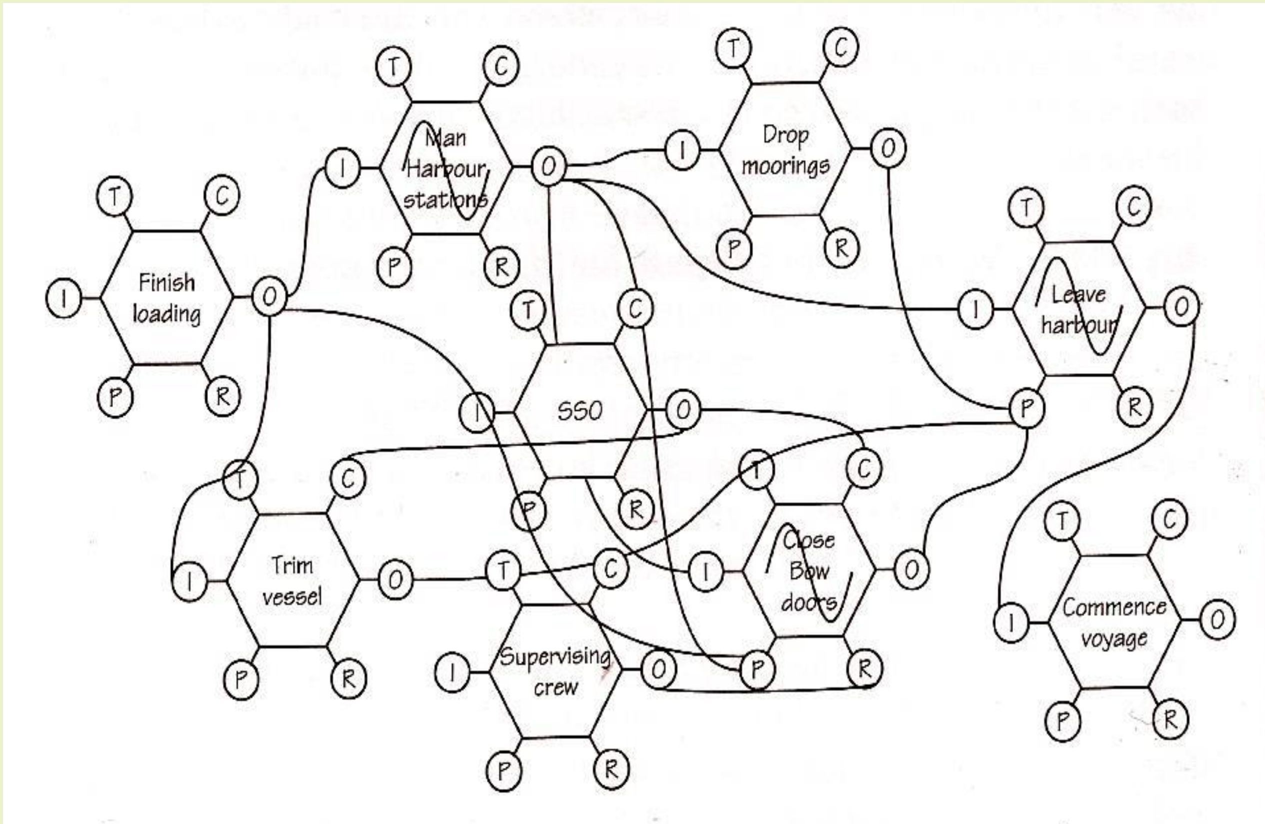


Some theorists have tried to capture the nature of complex socio-technical systems ….



2004 – Hollnagel – Functional Resonance Accident Model - FRAM

… and complex accident modelling, but when it comes to using these, they either get lost in translation or end up like this ….



Hollnagel: Functional Resonance Accident Method

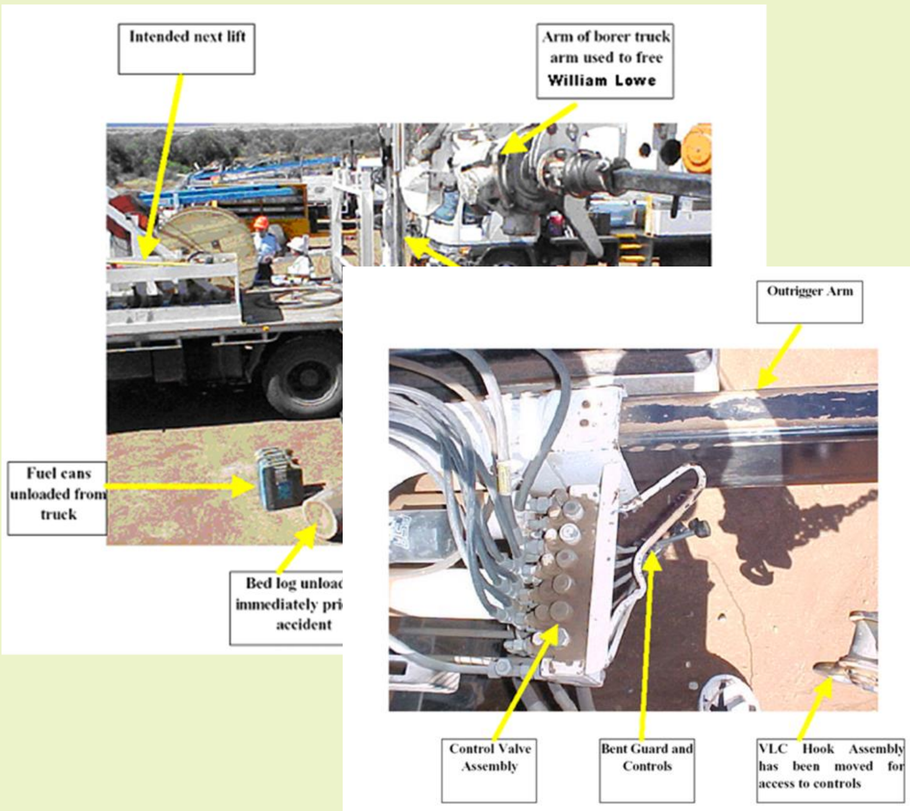
However, even our most enlightened safety minds fall into our design induced traps …

(we tried to knock Erik Hollnagel off his feet with this design!!!!)

There are so many questions still to ask!

… sometimes the most obvious questions are the best place to start, yet still they remain unanswered with any evidence base…

Why do functionally and technically robust designs fail?



We can't always influence design but our investigations MUST create the evidence base for issues at the interface!

Theatre Suite	Emergency Call bells (push button) located in all theatres, each bedspace in recovery, preadmission and in toilets. All bells linked to central unit, which alerts staff via audible alarm, and LED display units, located in each theatre and in several other locations throughout the theatre suite, which give the location of the alarm.	Call button obscured by other equipment in theatre. Inadvertent activation by equipment pushed against call button Button located next to light switch in bathrooms – poor location choice
Installation Company	3rd party installs buttons, wiring and LED panels. Software to align activated button with location on LED panel. Some locations given abbreviation.	Dissimilar mental model between installer and purchaser. Incorrect wiring Software programming mistakes Unclear/ambiguous location abbreviations chosen
Maintenance Dept.	System function checked weekly. Problems rectified by electrician	Forget to check system Delays in fixing problems due to workload. Equipment to fix system presents hazard to normal ward traffic (e.g. ladders in corridor to fix ceiling mounted LED panel) Inadvertent failure from maintenance on separate co-located equipment (e.g.wiring loom-wrong wire cut).

What drivers influence design outcomes?

Table Error! No text of specified style in document.:**1 Comparative Analysis of Viewpoints**

Matter of interest	**Factor 1 Pragmatist**	**Factor 2 Democrat**	**Factor 3 Traditionalist**	**Factor 4 Strategist**
Motivation	Safety	User acceptance	Safety	Cost-benefit
Approach	Practical & socio-technically realistic	Democratic & socially responsible	Functionalist & technically rational	Calculated & socio-technically astute
Priority	System wellbeing	Human system	Sound engineering	Business
End-user role	Valued subject matter expert	Gatekeeper to project success	Recipient of support	Necessary inconvenience
Human Factors professionals	Design partner	Ensure human factors are addressed	Not mentioned	Value is experience dependent
System focus	Overall system – Systems have humans	Usable system – user solution not an engineer's	Cutting edge – humans use systems	Anticipates future trends – has main user needs
Productivity	Increases when safety is assured	Increases when technology incorporates end-user preferences	Increases through a competitive advantage	Increases by strategic and astute action
Safety	Paramount for business success	No risk, no gain	Paramount – No go if it is unsafe	A concern, but not the primary focus
Learning support	Reduced when design matches end-user needs	Hands-on essential. Online training offers no real benefit	Full end-user training required	Inadequately trained user will delay project implementation
Technical support	Reduced when design matches end-user needs	Not a primary focus	Necessary to support end-user	Essential during implementation
Key to success	Involve end users	Satisfy end users	Sound engineering	Involve end users astutely

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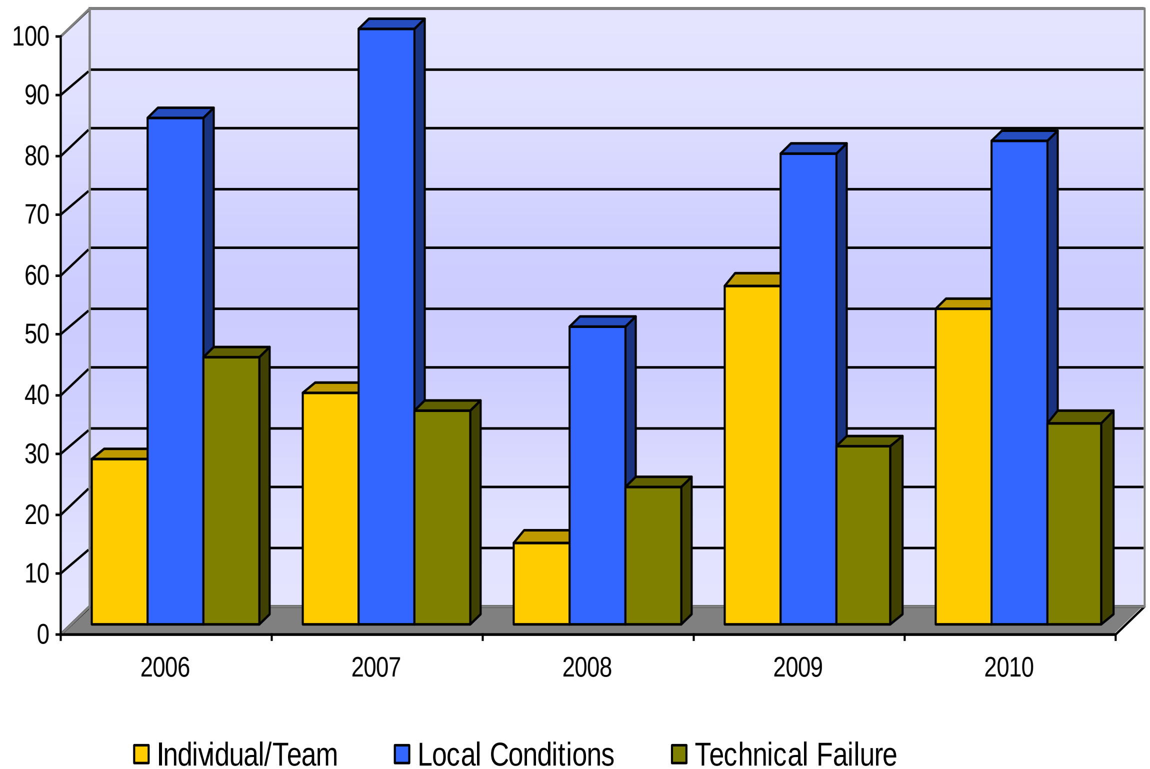
We need high fidelity investigations!!

Rubbish in = Rubbish out!

… shallow investigations in relationship to human error / system and equipment interface issues become even less useful when we try to base our learning on data like this ….

Is this 'really' reflective of what is happening in modern day complex socio-technical system?



If we want to learn about the genesis of human error ….

We need to find ways to visualise the complex reality of our environment in a way that enables us to start to see relationship between people and other elements of the system … NOT shadow box with data!!!

SAFE-Net Method - STEPS

1. Collect the data – Contributing Factors

2. Convert the data to relationships

<u>Rationale Used</u>

Accident = party

Factor = person

3. Use SNA program/s

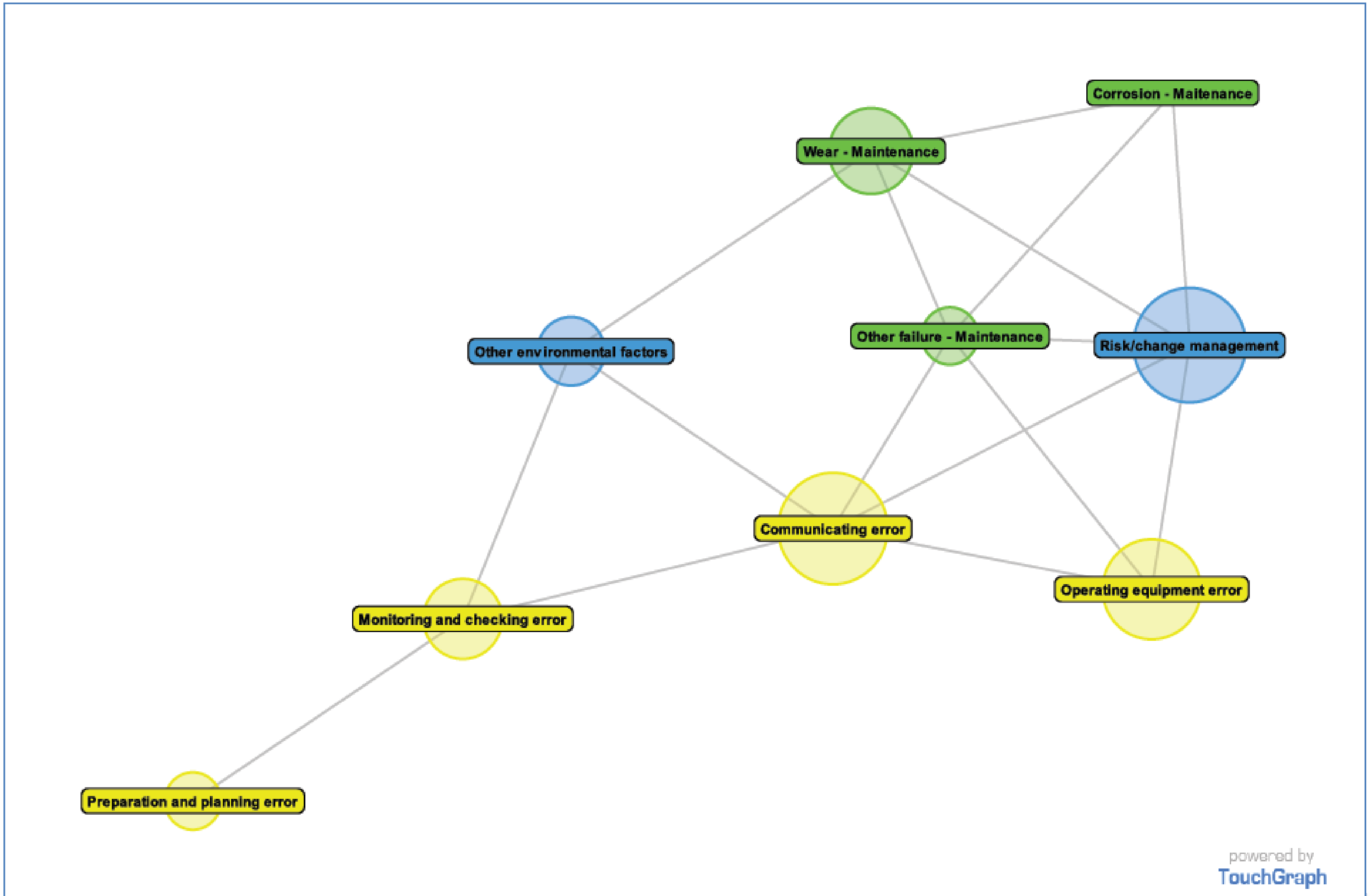
4. Examine and explore resulting model

Centrality Measures using Social Network Analysis

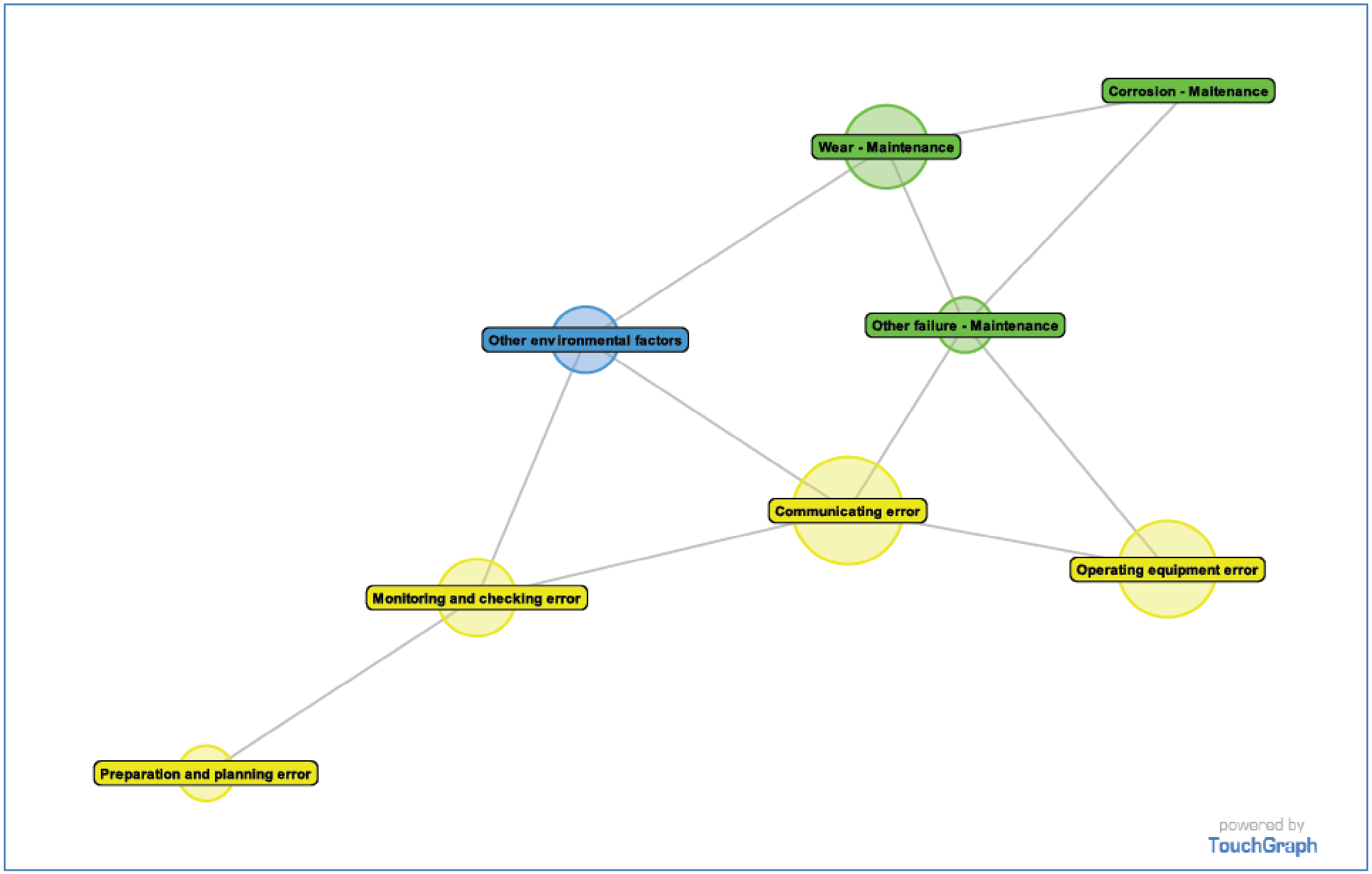
- Betweenness Centrality

- a measure of how much removing a factor would disrupt the connections between one factor and another factor

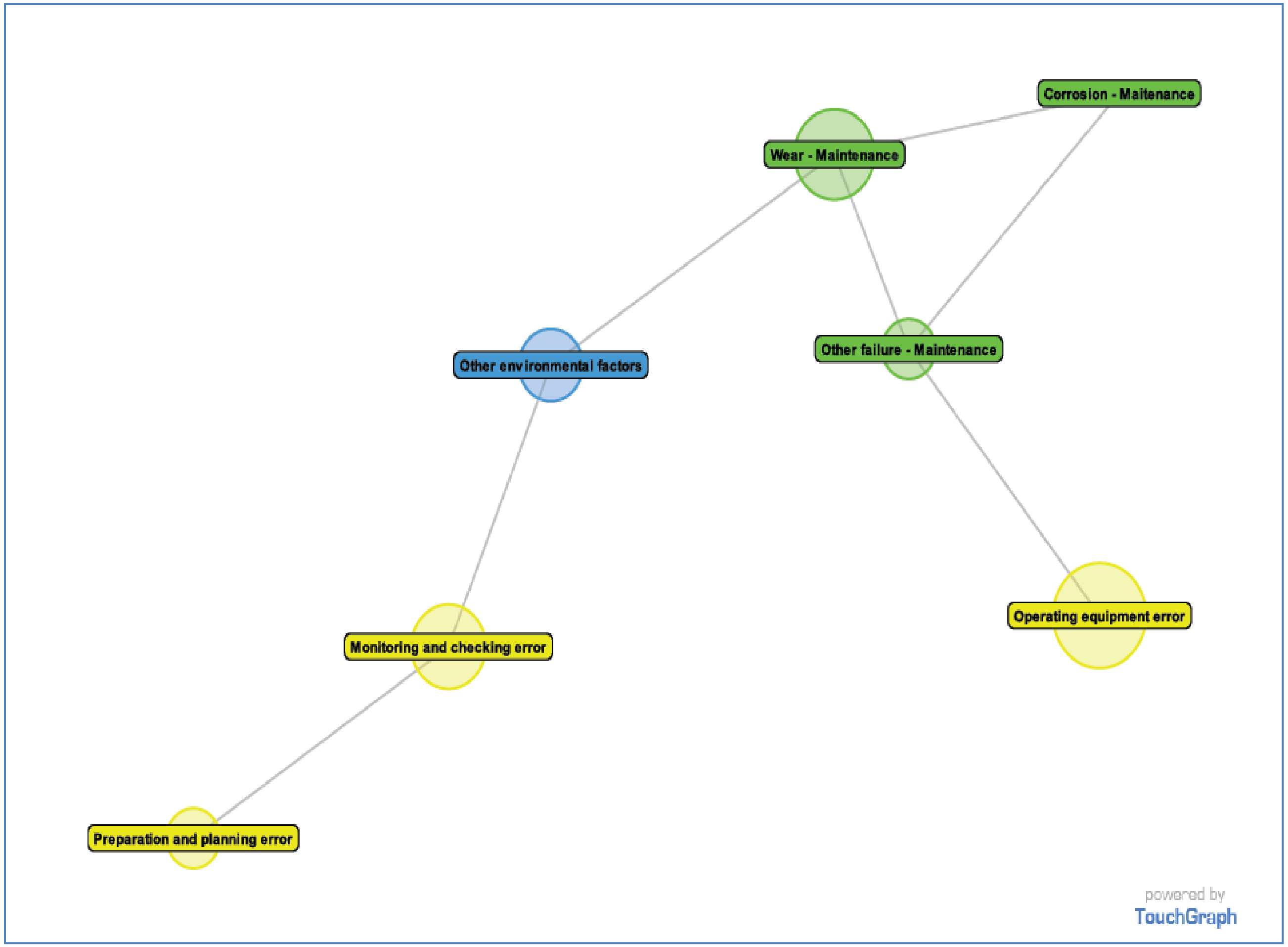
Yard Derailments – Only Top 9 Factors Shown



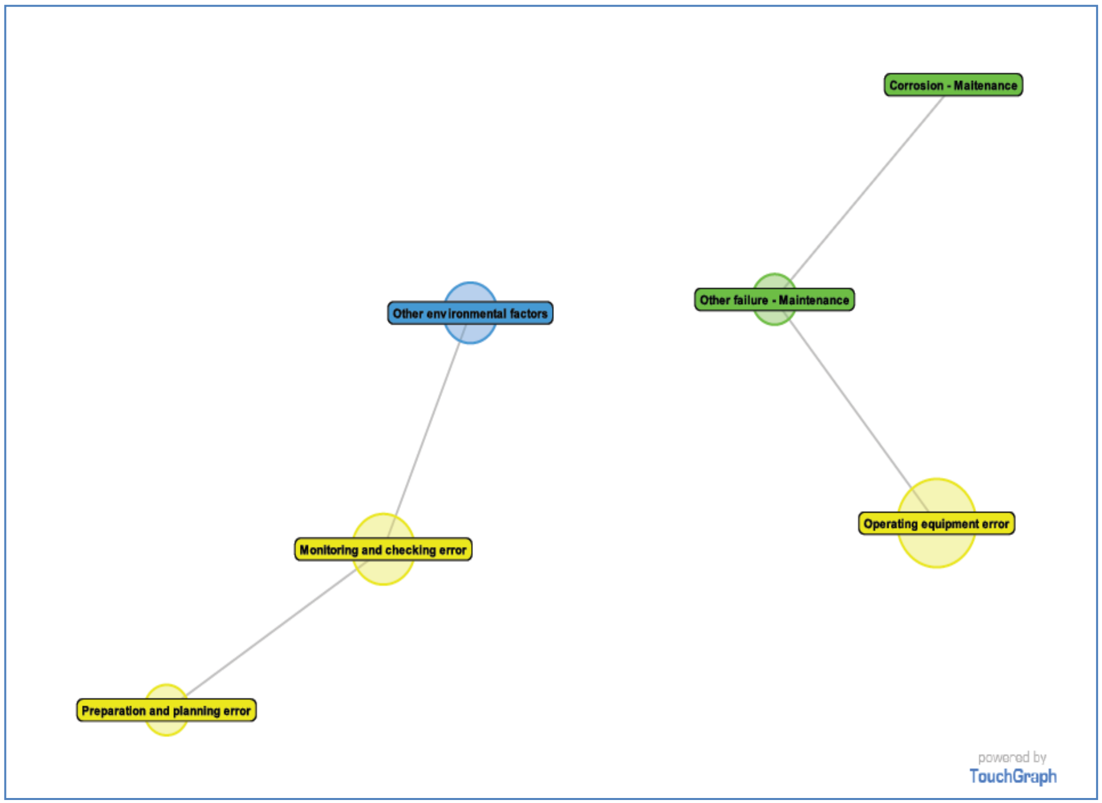
Yard Derailments – Risk/Change Management Factor Removed



Communication Error Factor Removed



Wear Maintenance Factor Removed – Network Broken



SAFE-Net Method - Results

- Accident Model representing the relationship between the contributing factors – the network
- Better representation of the connectiveness of the parts in the socio-technical system under investigation
- Easy understood via visual representations
- Evidence based data (Centrality Measures) to identify where to put safety efforts
- Supports understanding the genesis of human error related design issues!

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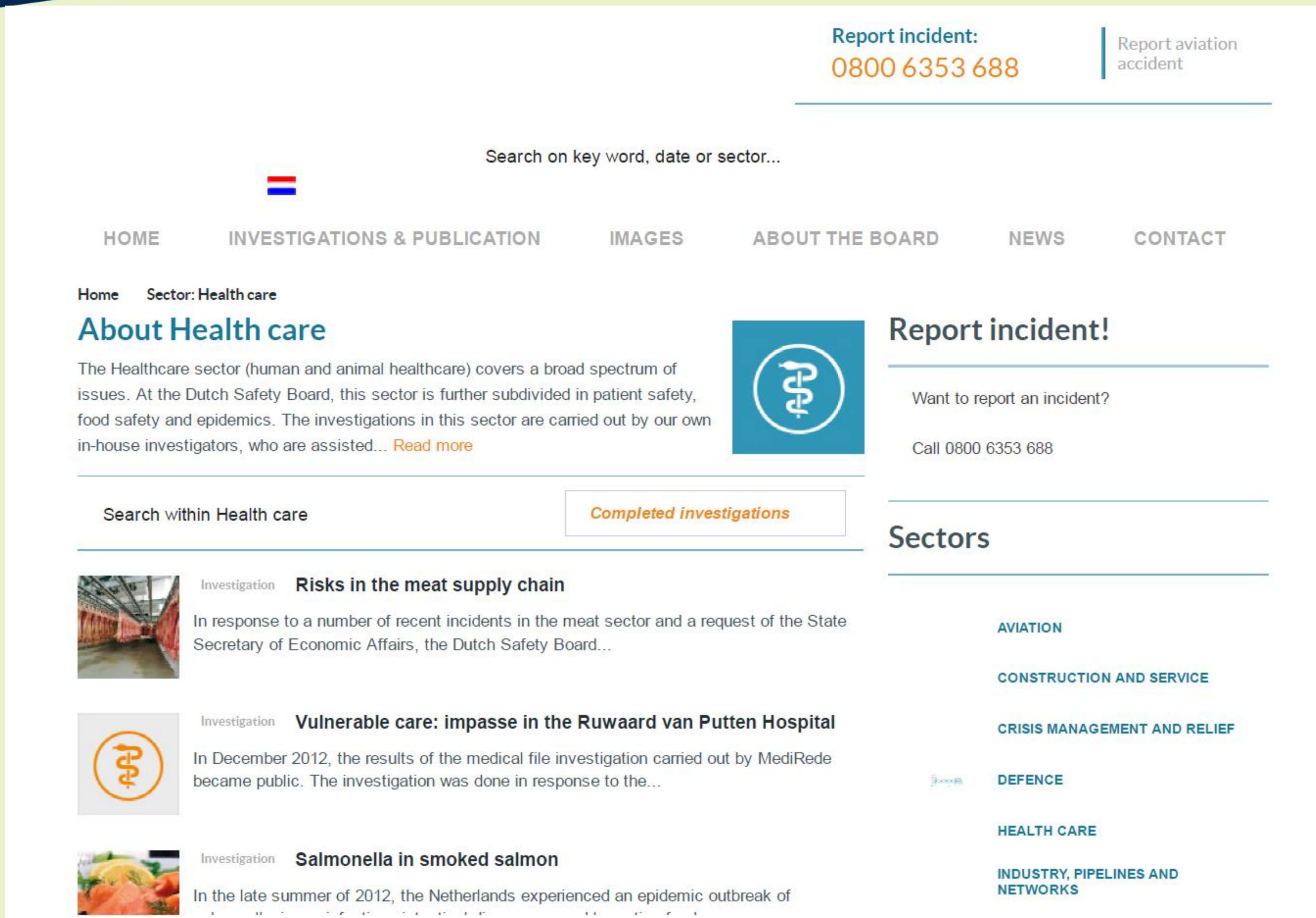
We need ‘just’ & ‘independent’ investigations and analysis centred on learning!


Report incident:
0800 6353 688

Report aviation accident

Search on key word, date or sector...

HOME INVESTIGATIONS & PUBLICATION IMAGES ABOUT THE BOARD NEWS CONTACT

Home Sector: Health care

About Health care

The Healthcare sector (human and animal healthcare) covers a broad spectrum of issues. At the Dutch Safety Board, this sector is further subdivided in patient safety, food safety and epidemics. The investigations in this sector are carried out by our own in-house investigators, who are assisted... Read more

Search within Health care

Completed investigations

Investigation **Risks in the meat supply chain**

In response to a number of recent incidents in the meat sector and a request of the State Secretary of Economic Affairs, the Dutch Safety Board...

Investigation **Vulnerable care: impasse in the Ruwaard van Putten Hospital**

In December 2012, the results of the medical file investigation carried out by MediRede became public. The investigation was done in response to the...

Investigation **Salmonella in smoked salmon**

In the late summer of 2012, the Netherlands experienced an epidemic outbreak of

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Sectors

AVIATION

CONSTRUCTION AND SERVICE

CRISIS MANAGEMENT AND RELIEF

DEFENCE

HEALTH CARE

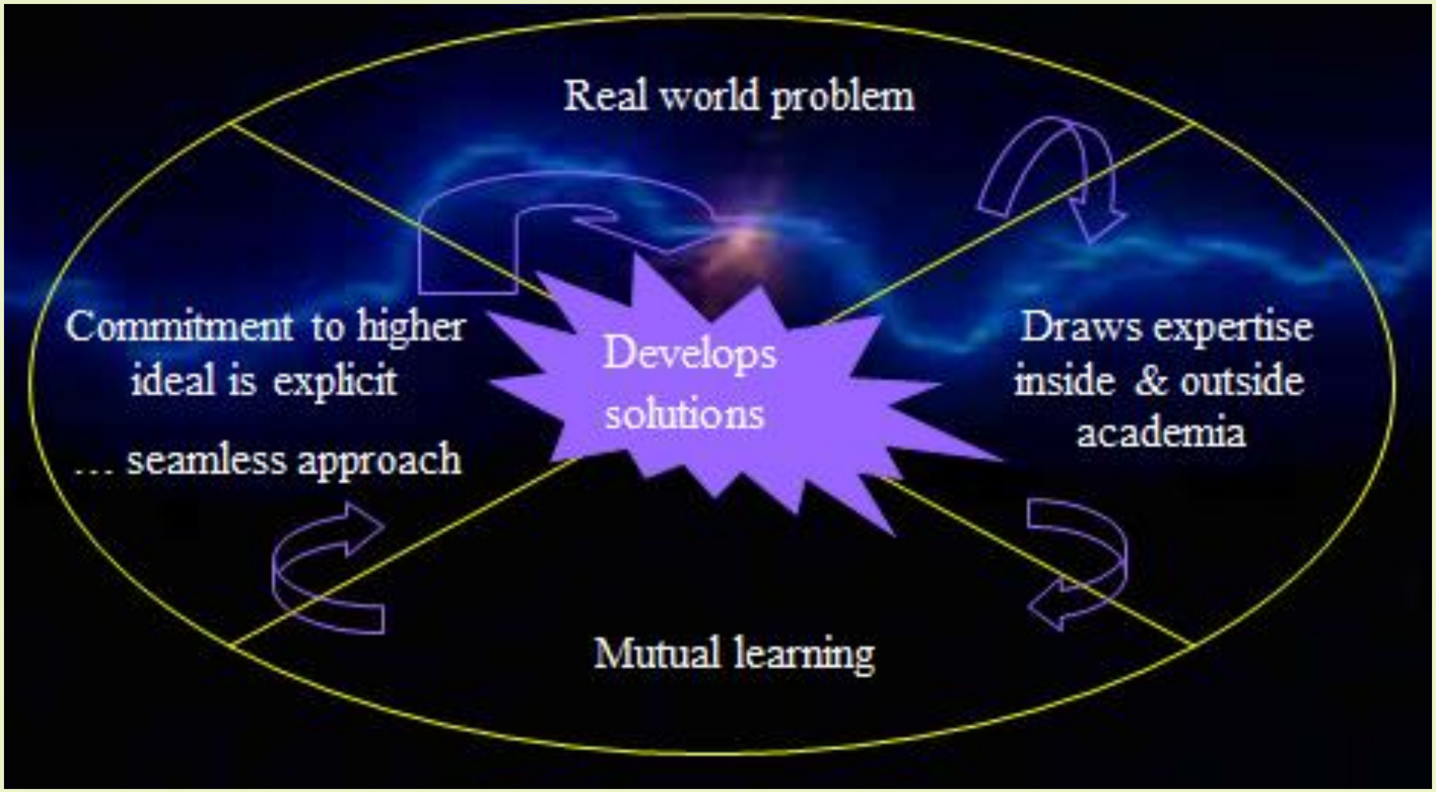
INDUSTRY, PIPELINES AND NETWORKS

Basic risk management maturity chart

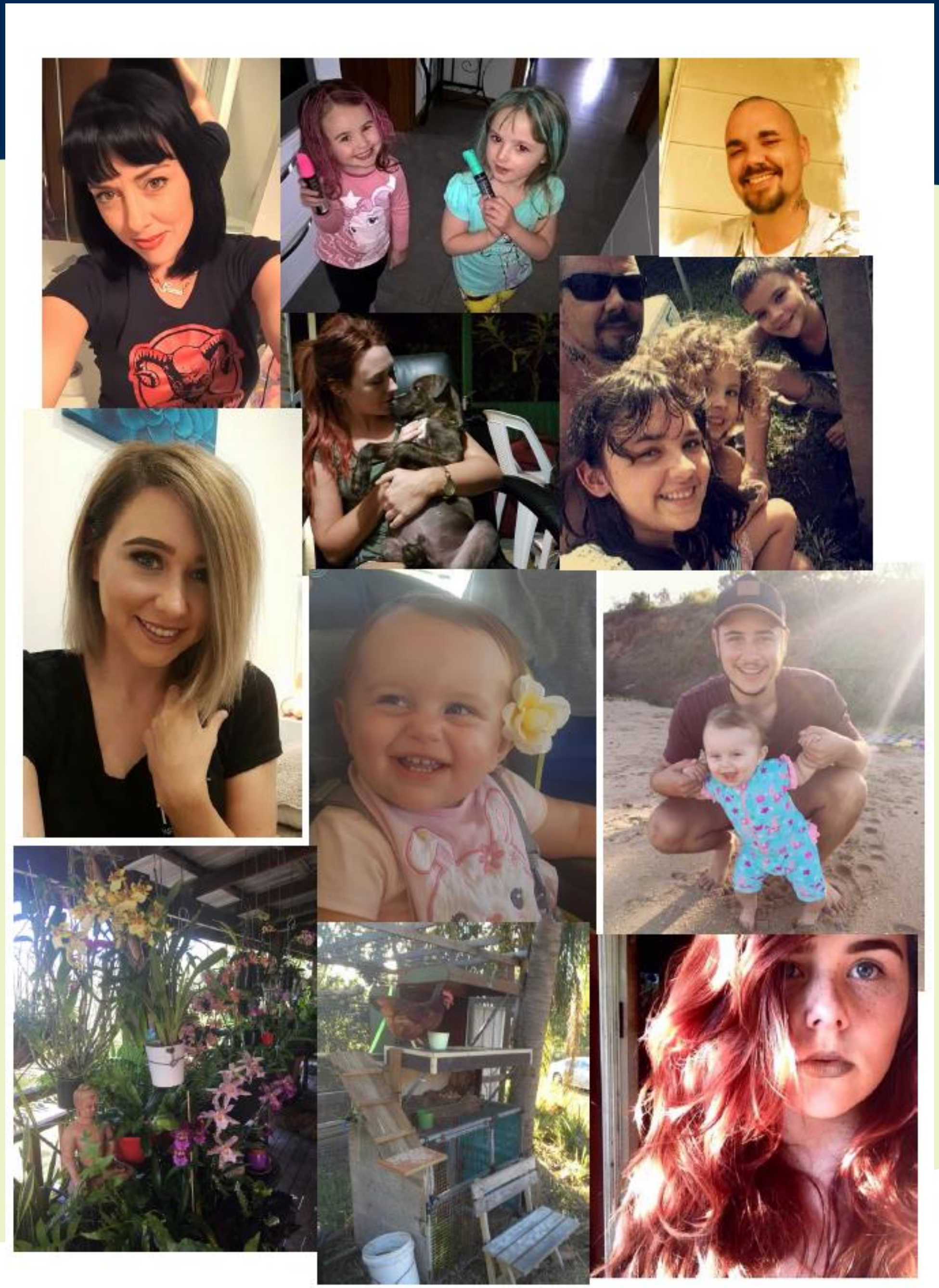
No Care Culture	Blame Culture	Compliance Culture	Ownership Culture	Way of Life
BASIC	REACTIVE	COMPLIANT	PROACTIVE	RESILIENT
Accept that incidents happen	Prevent a similar incident	Prevent incidents before they occur	Tune the systems through ownership	Way we do business
No Risk Assessment	Reactive Risk Assessment	Regular Risk Assessment	Proactive Risk Assessment	Integrated Risk Assessment
Poor Investigation	Limited Investigation	Causal Investigation	Open Causal Investigation	Proactive Investigation
No Auditing	Ad hoc Auditing	Regular Auditing	Targeted Auditing	External Auditing

Complex socio-technical systems investigation and problem solving requires a transdisciplinary approach …

We need transdisciplinary solutions to complex problems …



We need to act now!



Our current Emergency & Safety Sciences offerings … how can we use education & training to make a difference???

VET & BACHELOR DEGREES

- Cert IV in Work Health & Safety
- Cert IV in Paramedical Science
- Cert IV in Rail Safety Investigation
- Diploma of Work Health & Safety
- Diploma of Paramedical Science
- Associate Degree in OHS
- Bachelor of Accident Forensics
- Bachelor of Emergency Service
- Bachelor of Occupational Health & Safety
- Bachelor of Paramedic Science

MASTER & DOCTORAL DEGREES

- Master of Safety Science (Air Safety Investigation)
- Master of Safety Science (Rail Safety Investigation)
- Master of Safety Science (Road Safety Investigation)
- Master of Safety Science (Industrial Accident Investigation)
- Master of Safety Science (Human Factors Engineering)
- Master of Safety Science (Risk Engineering)
- Master of Safety Science (Accident Forensics)
- Master of Safety Science (Emergency Services Safety)
- Master of Advanced Safety Science Practice
- Master of Paramedic Science (Paramedic Practitioner)
- Masters by Research
- PhD & Professional Doctorate

GRADUATE CERTIFICATES & DIPLOMAS

- Graduate Certificate in Emergency & Disaster Management
- Graduate Certificate in Fatigue Risk Management
- Graduate Certificate in Accident Phenomenology
- Graduate Certificate in Advanced Accident Investigation Practice
- Graduate Certificate in Advanced Safety Science Practice
- Graduate Diploma of Accident Investigation
- Graduate Diploma of Occupational Health & Safety
- Graduate Diploma of Paramedic Science (Critical Care)

Master of Safety Science (??????)

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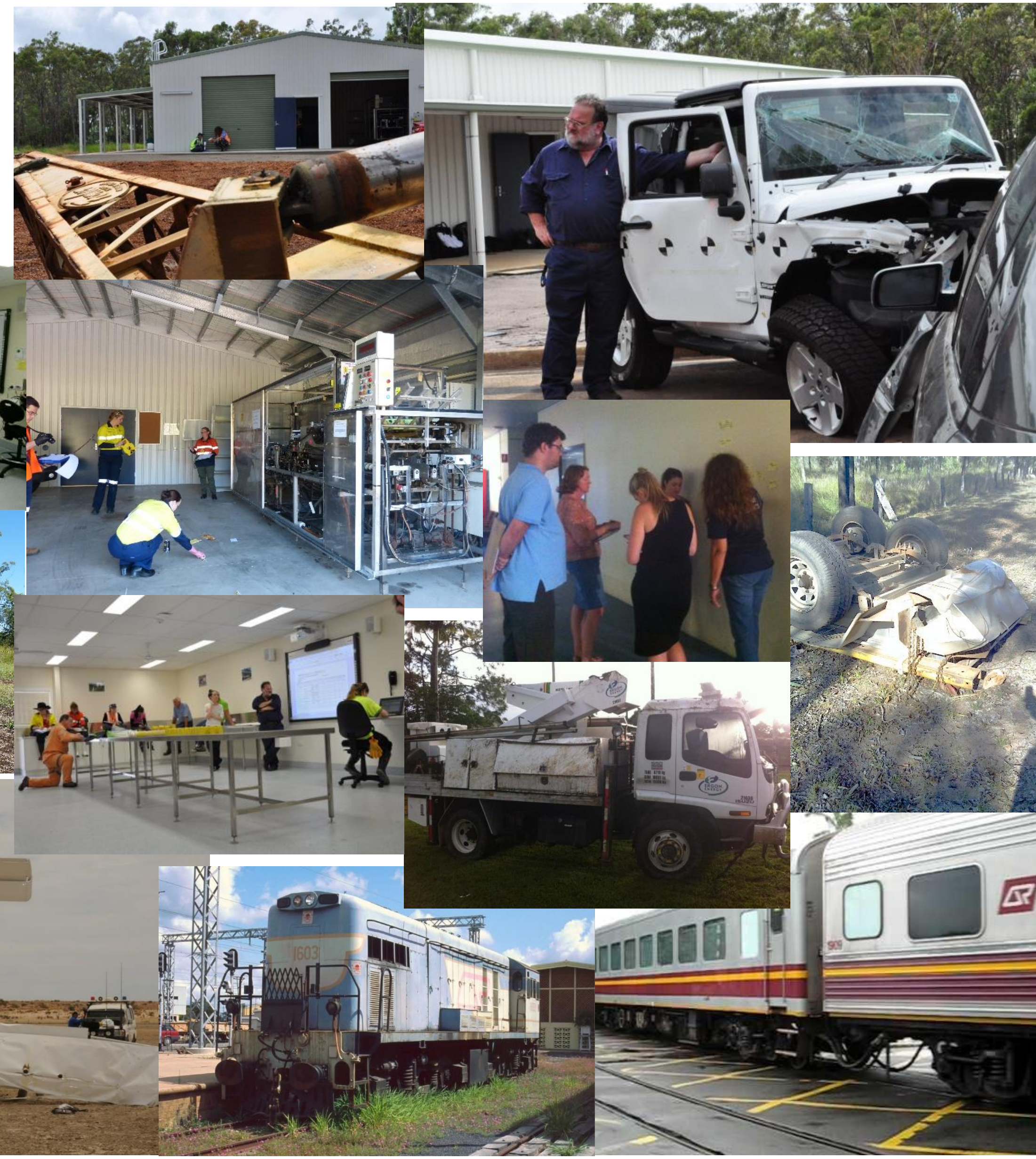
We want to change the world - do you??????



CQU FORENSIC INVESTIGATION TEACHING LABORATORY, BUNDABERG, 2016