Safety and Security Integration

World Institute for Nuclear Security

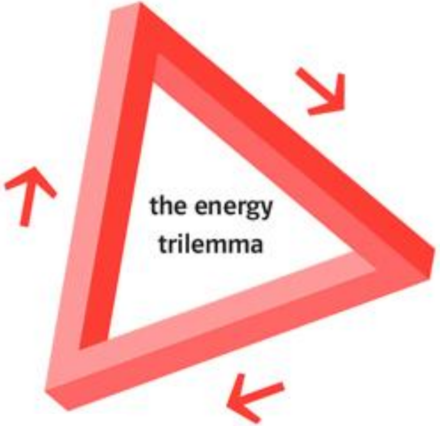
Andrew Knight, Rolls-Royce SMR Safety Division

5 March 2019

"For a system to be safe, it also has to be secure."

Can Safety methods be applied to Security to achieve the Holy Grail?

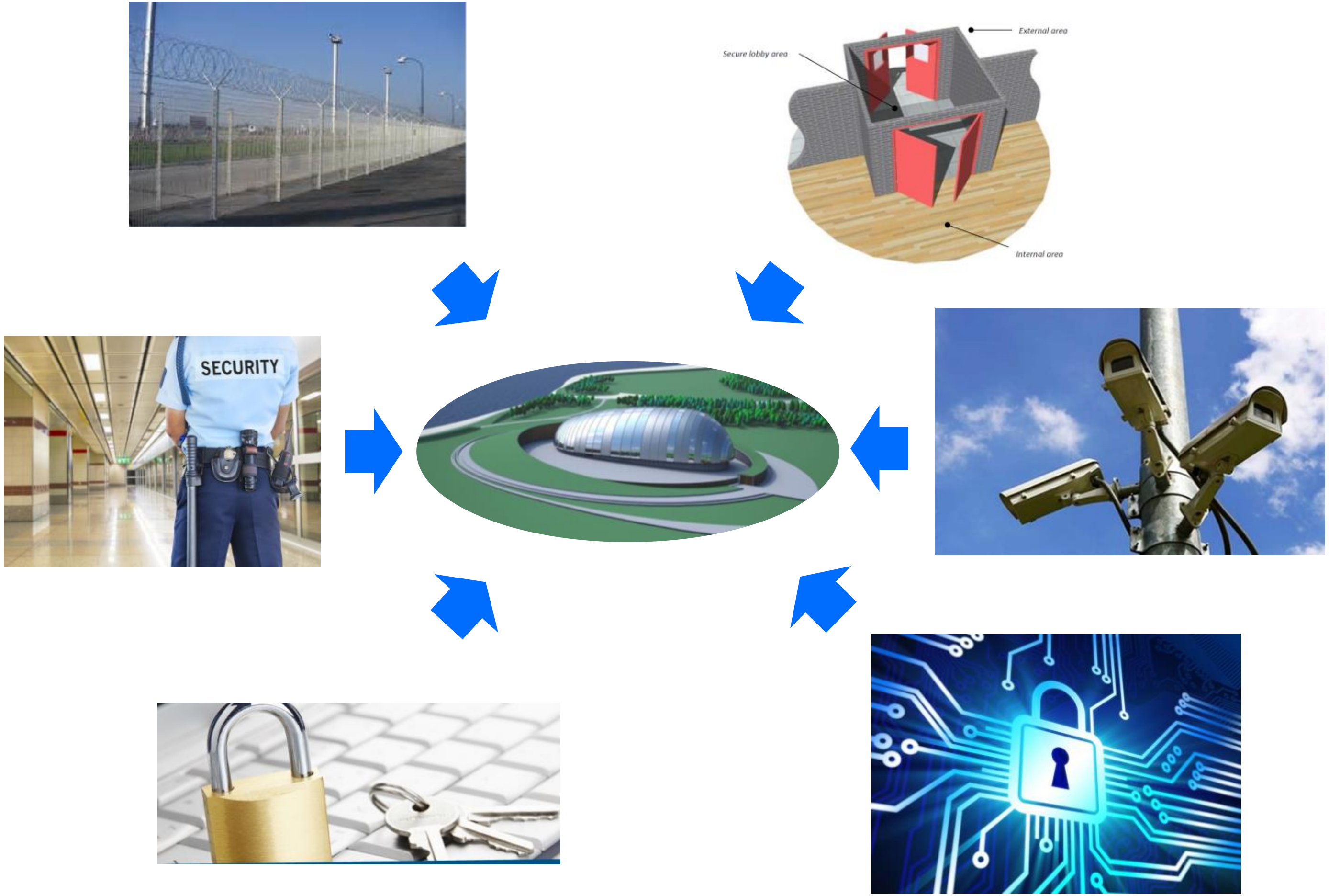
Cost



Reliability

Environment

The fundamental issue is that of “Unlimited Wants”

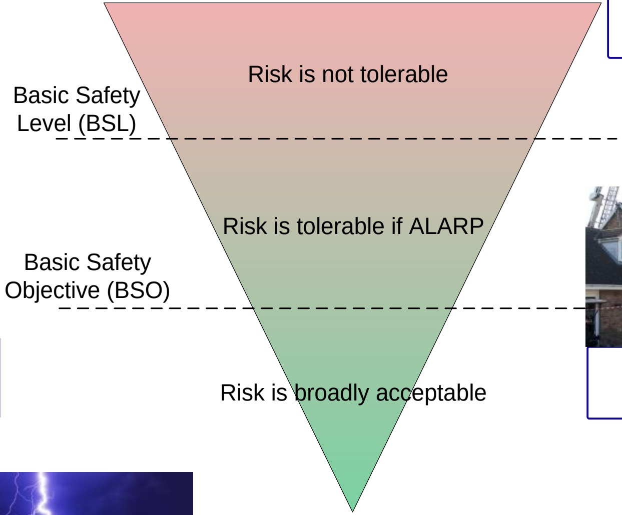


Defining Acceptable Risk

1E-03/yr
Working in a mine

1E-02/yr
Solo rock climbing, 5hrs/wk

1E-04/yr
UK road traffic accident

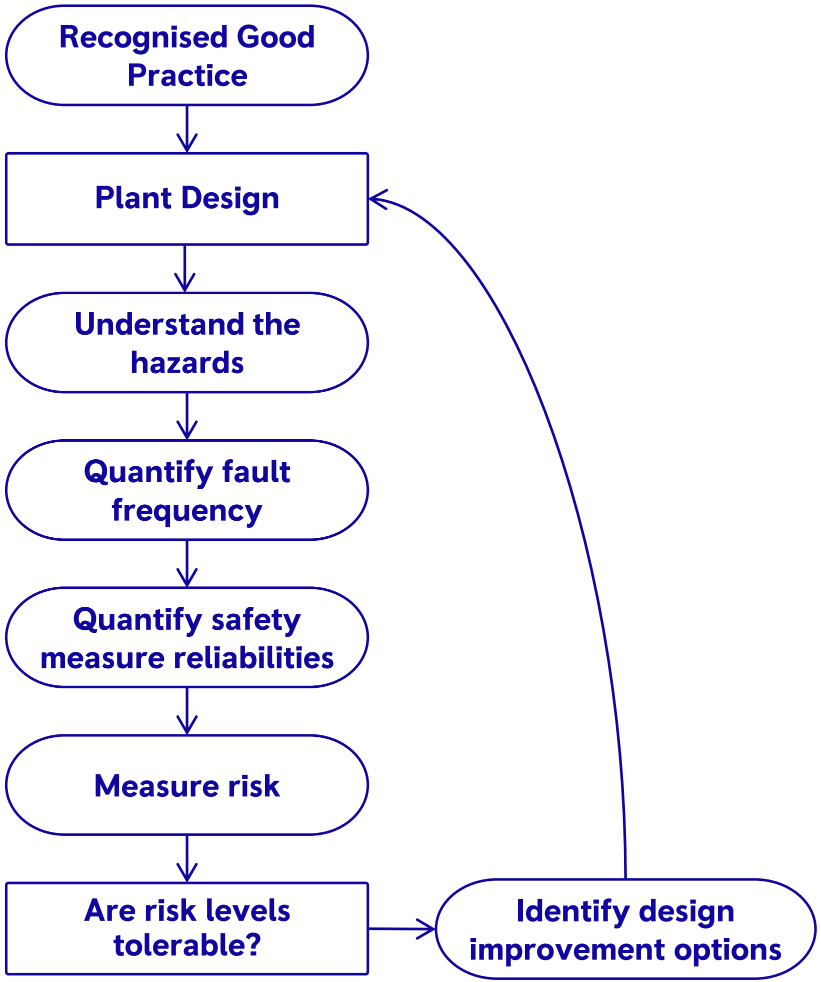


1E-05/yr
UK factory worker

1E-06/yr
UK house fire

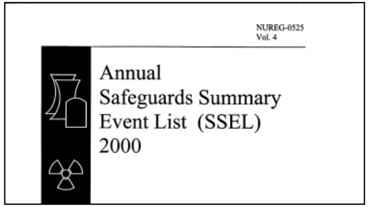
1E-07/yr
Lightning

Measuring Risk



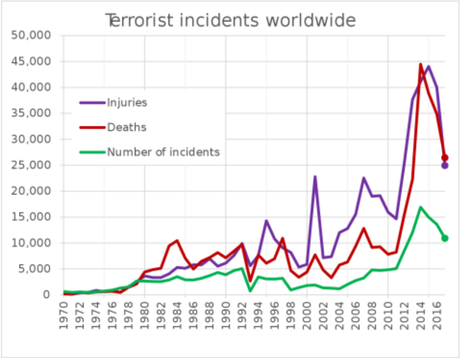
Understanding the Threat

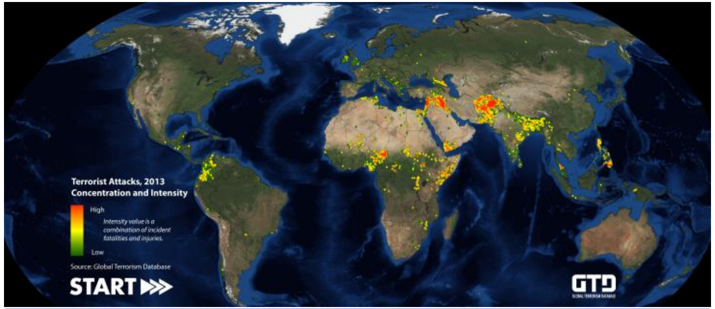
Recognised Good Practice
↓
Plant Design
↓
Understand the hazards
↓
Quantify fault frequency
↓
Quantify safety measure reliabilities
↓
Measure risk



US NRC SSEL

Malicious Acts Database





Global Terrorism Database

Open Source

Nature of threats

Typical size and capability of threats

Equipment used

Target types favoured by terrorists

Trends and patterns

Frequency Calculation

Equipment Failure

vs

Intelligent Threat

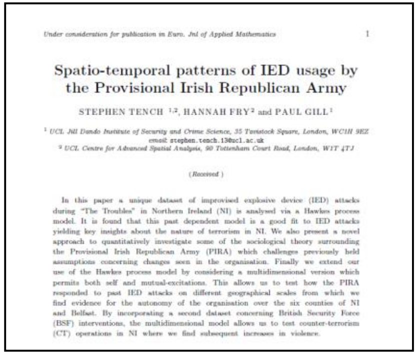
Recognised Good Practice
↓
Plant Design
↓
Understand the hazards
↓
Quantify fault frequency
↓
Quantify safety measure reliabilities
↓
Measure risk

Standard equipment failure equations not appropriate for intelligent threat

↓

Patterns and trends should not be ignored; however, and can be used as the basis for risk estimation

↓



Under consideration for publication in Euro. Jnl of Applied Mathematics 1

Spatio-temporal patterns of IED usage by the Provisional Irish Republican Army

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(*Received*)

In this paper a unique dataset of improvised explosive device (IED) attacks during "The Troubles" in Northern Ireland (NI) is analysed via a Hawkes process model. It is found that this past dependent model is a good fit to IED attacks yielding key insights about the nature of terrorism in NI. We also present a novel approach to quantitatively investigate some of the sociological theory surrounding the Provisional Irish Republican Army (PIRA) which challenges previously held assumptions concerning changes seen in the organisation. Finally we extend our use of the Hawkes process model by considering a multidimensional version which permits both self and mutual-excitations. This allows us to test how the PIRA responded to past IED attacks on different geographical scales from which we find evidence for the autonomy of the organisation over the six counties of NI and Belfast. By incorporating a second dataset concerning British Security Force (BSF) interventions, the multidimensional model allows us to test counter-terrorism (CT) operations in NI where we find subsequent increases in violence.

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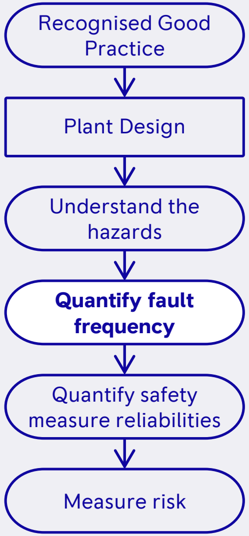
PREDPOL®

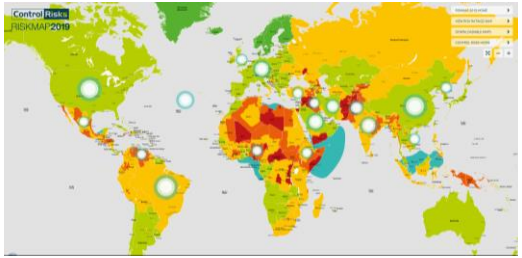
$$\frac{\partial A}{\partial t} = B + \frac{\eta D}{4}\nabla^2 A - \omega A + \theta\omega\delta$$

Hawkes Process approach to modelling the distribution of crime and terrorism

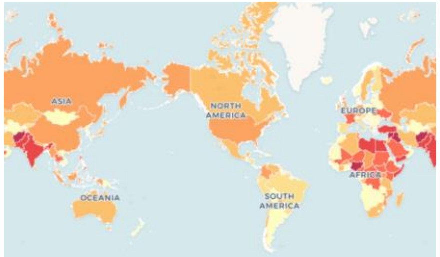
Risk Landscape

Predictive Systems





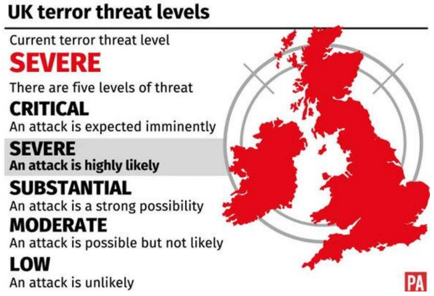
Control Risks



Global Terrorism Index, Institute for Economics and Peace

National Threat Levels

Threat and Risk Intelligence Service, ANVIL



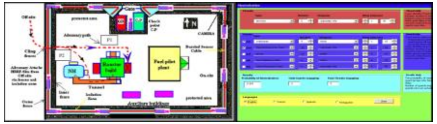
Security Measure Reliability

Calculating security measure effectiveness to neutralise a threat

- Recognised Good Practice
- Plant Design
- Understand the hazards
- Quantify fault frequency
- **Quantify safety measure reliabilities**
- Measure risk

Security Measure failure probability estimation approaches

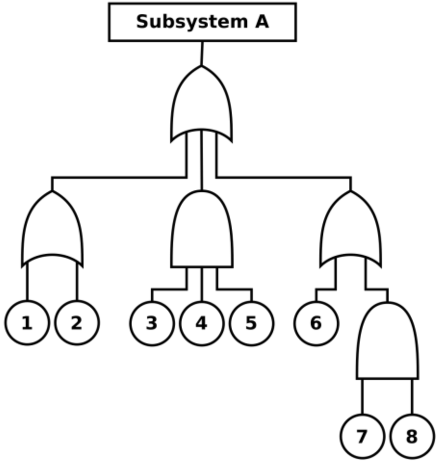
Simulation Software



Systematic Analysis of Vulnerability to Intrusion (SAVI)

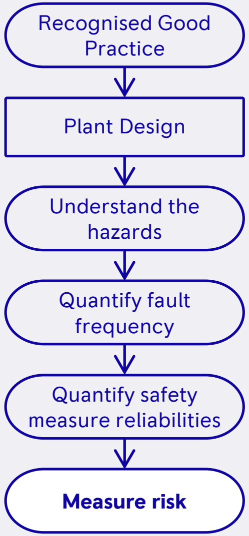
AVERT Physical Security

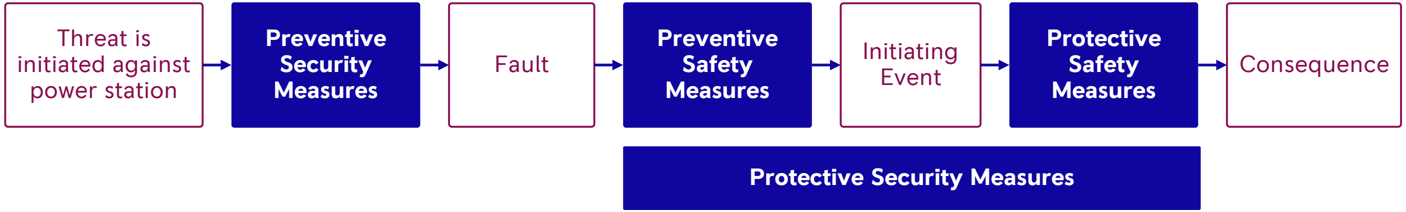
Fault Tree Analysis

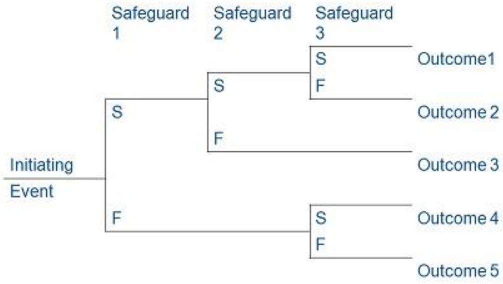


Operating Record	Expert Judgement	Physical Testing	Human Reliability Analysis

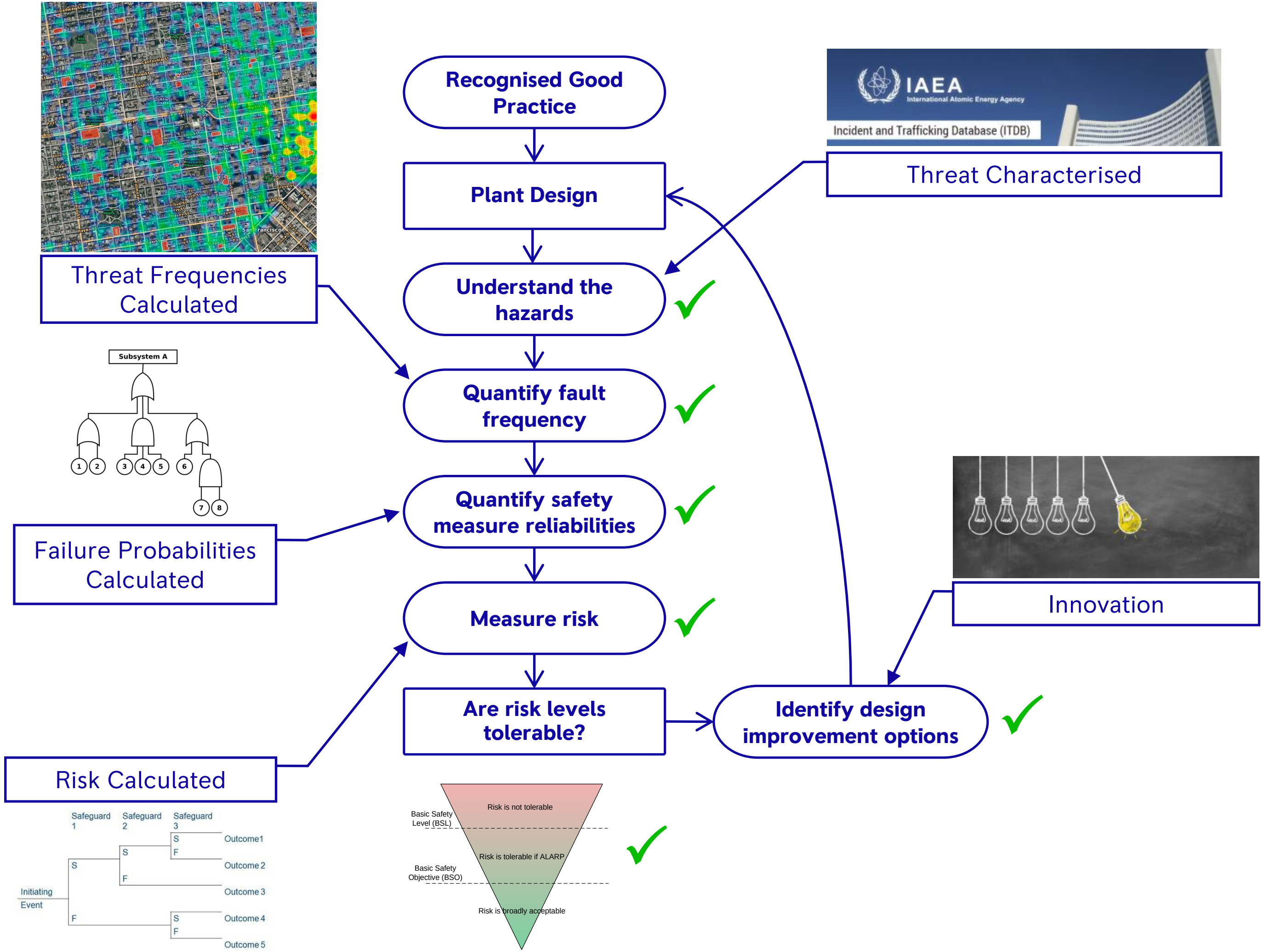
Risk Model


Recognised Good Practice
Plant Design
Understand the hazards
Quantify fault frequency
Quantify safety measure reliabilities
Measure risk


Threat is initiated against power station
Preventive Security Measures
Fault
Preventive Safety Measures
Initiating Event
Protective Safety Measures
Consequence
Protective Security Measures


Safeguard 1
Safeguard 2
Safeguard 3
Initiating Event
S
F
S
F
S
F
S
F
Outcome1
Outcome 2
Outcome 3
Outcome 4
Outcome 5

Drawing together information around this framework to optimise for security



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