

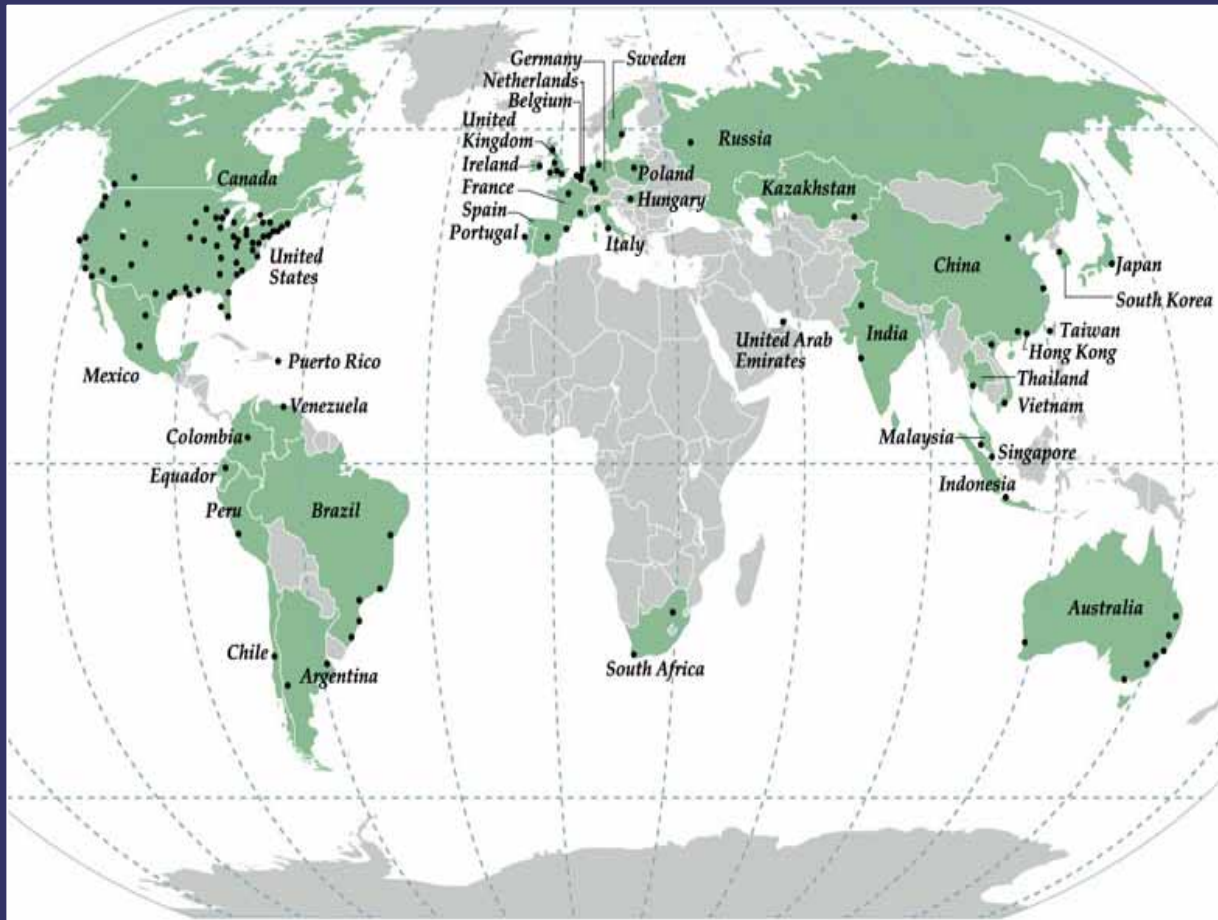


Risk Management for the Offshore Wind Energy Sector: Lessons learnt from the Oil, Gas and Process Industry

Suzanne Knights

Principal Consultant, ERM Manchester

ERM Worldwide



- >3000 people
- All HSE Consultancy
- >100 offices in 40 countries
- Gross revenue \$600 million (07/08)



ERM Services and Clients

Services

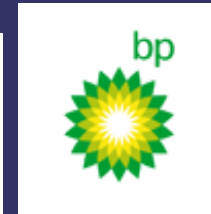
- Risk Assessment
- Risk Management
- Environmental Impact Assessment
- Health and Safety Assessments
- Security Assessment
- Social Issues
- Project Risk Assessment
- Software Development
- Information Solutions
- Management Systems
- Corporate Governance
- Compliance Auditing
- Climate change
- Due Diligence

Key Clients

- Exxon
- EON
- Centrica
- BP
- BG
- Shell
- Chevron
- Total
- OMV
- Overall Energy HSE Consultancy (\$87m)



StatoilHydro



Structure of Presentation

- **Regulatory Framework in Other Industries**
- **Comparison of Wind Energy Industry with Others**
- **Approach to Risk Management**
 - Development of Basis of Safety (HSE case)
 - Hazard Identification and Risk Assessment
 - The Bowtie Process
 - Risk Control and Verification

Background

- Increased activity in the sector
- Large investment
- Many new projects planned
- New, emerging technologies
- Associated increase in installation, construction, maintenance activities
- There are risks associated with carrying out these activities in the onshore and offshore environment



Regulatory Framework

- Health & Safety at Work Regulations
- UK Offshore Safety Case Regulations
- PFEER
- UK Pipeline Safety Regulations
- UK Planning Regulations
- CDM
- COMAH

- All Stages of Project Lifecycle
- Integration protocol and standards with other practices



ESTABLISHING THE BASIS OF SAFETY

Regulatory Framework – Wind Industry

- Legislative Position:

- Health and Safety at Work Act 1974
- Application Outside Great Britain Order 2001 (extended application of Health and Safety at Work Act to Offshore Wind farms)
- Others e.g. Noise at Work, CDM, Electricity at Work etc
- The Energy Act 2008

- No formal regulations to demonstrate control of major risks
- ...this may change

What is the Basis of Safety?

All about demonstrating how the hazards and risks related to work activities are managed.



In particular the **Major Accident Hazards**.

Example Major Accidents



Major Hazards in the Wind Sector

- **No hydrocarbon/ chemical risk but risks due to:**

- Jack-up stability
- Working at height
- Evacuation from tower platform in the event of fire
- Electrocutation
- Heavy lifts
- Dropped/swung loads
- Search & Rescue
- Impacts on sub-sea pipelines
- Diving
- Also some public safety issues (ship collision, light aircraft, etc)



What are the Risks?

	Risk	Risk Ranking	Project Phase
B	Contract bankability	1	Development
O	Warranty non-performance	2	Operation
N	Offtaker default	3	Operation
E	Engineering risks	4	Construction
F	Physical hazard (caused by man or nature)	5	Construction
J	Natural hazards	6	Operation
G	Offtaker contract failure	7	Construction
H	Catastrophic design failure	8	Construction
A	Permitting / Planning delays	9	Development
C	CER bankability	10	Development
M	Wind volatility	11	Operation
I	Process Interruption	12	Operation
P	Legal liability	13	Operation
L	Physical hazard (caused by third party)	14	Operation
T	CER insolvency risk	15	Operation
D	Contractor non-performance	16	Construction
Q	CER Regulatory Risk	18	Operation
K	Design / Engineering Risk	19	Operation
R	CER political risk	20	Operation
S	CER performance risk	21	Operation
U	Long term CER marketability	22	Operation

Risk Ranking	Risk Letter	Head Line Risk	Details of Risk	Expected Loss (US\$)
1	B	Contract bankability	Risk of being unable to secure bankable offtaker / fuel supply contracts.	10,465,953
2	O	Warranty non-performance	Risk of the warranty provider failing to meet contractual obligations.	9,235,476
3	N	Offtaker default	Risk of the electricity offtaker defaulting on contractual obligations under PPA.	8,739,566
4	E	Engineering risks	Risk of physical loss or damage to property caused by technical / engineering hazards (e.g. defective design, faulty parts and / or workmanship).	8,086,700
5	F	Physical hazard (caused by man or nature)	Risk of physical loss or damage to property caused by man made and / or natural hazards / catastrophes (e.g. fire, lighting, explosion, earthquake, flood, windstorm).	7,740,908
6	J	Natural hazards	Risk of physical loss and / or damage to the plant and / or machinery breakdown caused by natural hazards / catastrophes (e.g. fire, lighting, explosion, windstorm, flooding)	6,992,974
7	G	Offtaker contract failure	Risk that power offtakers withdraw from contract subsequent to financial closure.	6,779,618
8	H	Catastrophic design failure	Risk of complete mechanical or control failure during	6,678,678

— UNEP “Risk Assessment for a 100.5 MW Wind Farm in Jilin Province, China”

A Basis of Safety

*A document that **demonstrates** that **risks** to the environment, workforce and general public are effectively **controlled** and that emergency plans are in place to manage major accidents*



Why Develop a Basis for Safety?

- **Corporate** requirement
- Maybe a **legal requirement** to prepare a HSE case
- To give Management Committee and Joint Venture partners the **confidence** that major risks are being managed
- To demonstrate that an effective **Safety Management System** (SMS) is in place that continually identifies, assesses, eliminates and/or manages risk to as low as reasonably practicable.



Structure of the HSE Case Document :

Part 1 : Introduction and Executive Summary

Overview of the scope, purpose, content of the HSE case. Summary of major accident hazards and risk levels.

Part 2 : Description of Facilities

Provides an overview of the facilities and activities that may be hazard sources

Part 3 : Description of HSEQ Management

Describes the arrangements in place at site level for effectively managing HSEQ (e.g. PTW, auditing etc)

Part 4 : Formal Safety Assessment (FSA)

Identifies major hazards and assesses risks – *KEY PART OF THE HSE CASE*

Part 5 : Emergency Response

Provides an overview of the emergency response arrangements

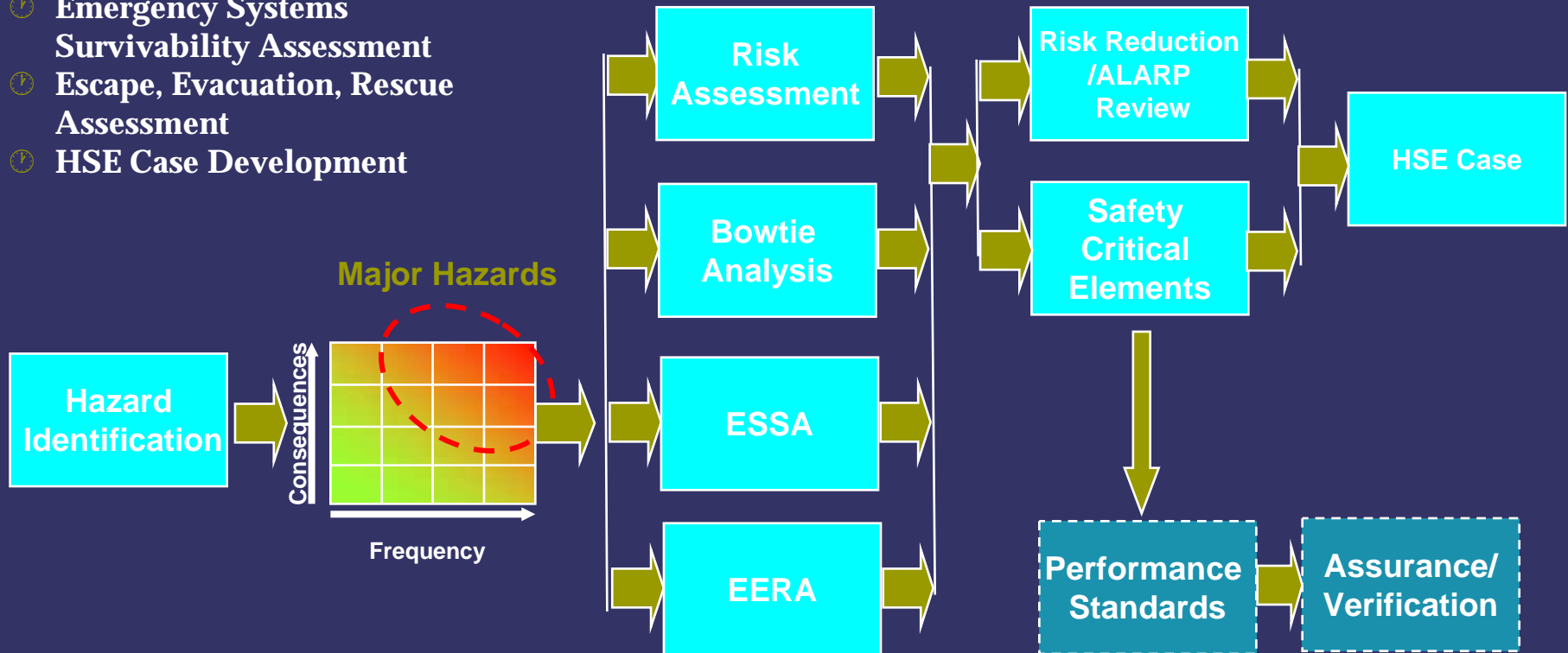
Part 6 : Improvement Action Plan

Areas for potential improvement and risk reduction

Formal Safety Assessment

ERM has extensive Formal Safety Assessment Experience :

- ⌚ Hazard Identification (HAZID)
- ⌚ Quantitative Risk Assessments
- ⌚ Emergency Systems Survivability Assessment
- ⌚ Escape, Evacuation, Rescue Assessment
- ⌚ HSE Case Development

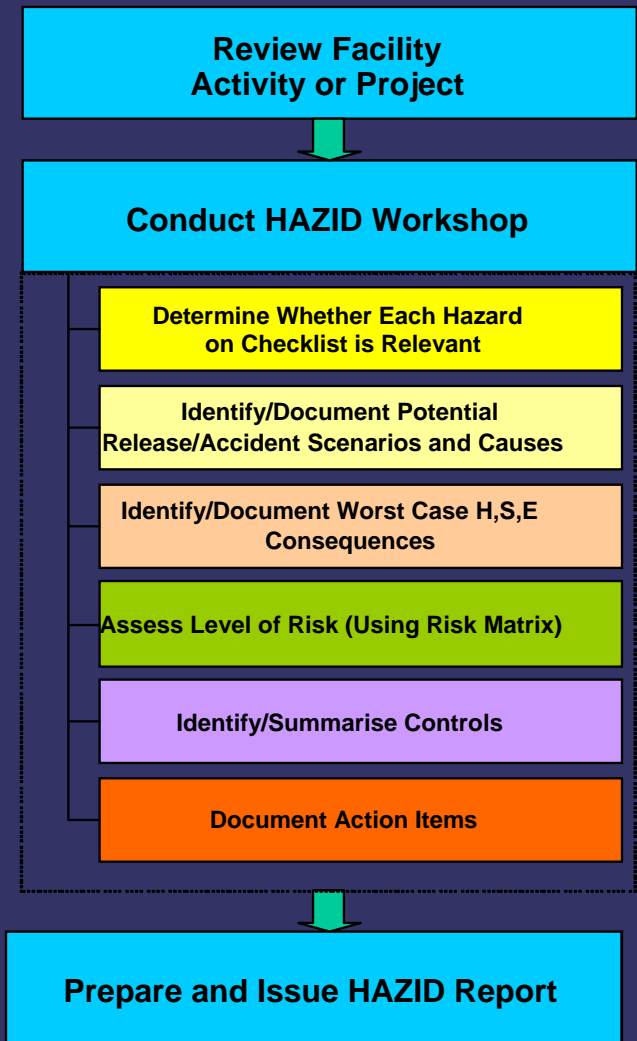


Hazard Identification and Preliminary Risk Assessment

ERM has extensive experience of facilitating Hazard Identification and Risk Ranking exercises and workshops.

Our consultants have worked globally to support a range of clients in the identification of Hazard and Risk

Severity	Consequence				Increasing Probability				
	P	A	E	R	A	B	C	D	E
					Never heard of in the industry	Heard of in the industry	Has happened in Company or more than once/year in industry	Has happened at location or more than once/year in Company	Has happened more than once per year at the location
0	No injury or health	No damage	No effect	No Impact					
1	Slight injury or	Slight damage	Slight effect	Slight Impact					
2	Minor injury or	Minor damage	Minor effect	Minor Impact					
3	Major injury or	Moderate	Moderate effect	Moderate Impact					
4	PTD or up to 3	Major damage	Major effect	Major Impact					
5	More than 3	Extensive	Massive effect	Massive Impact					



Bowtie Assessment

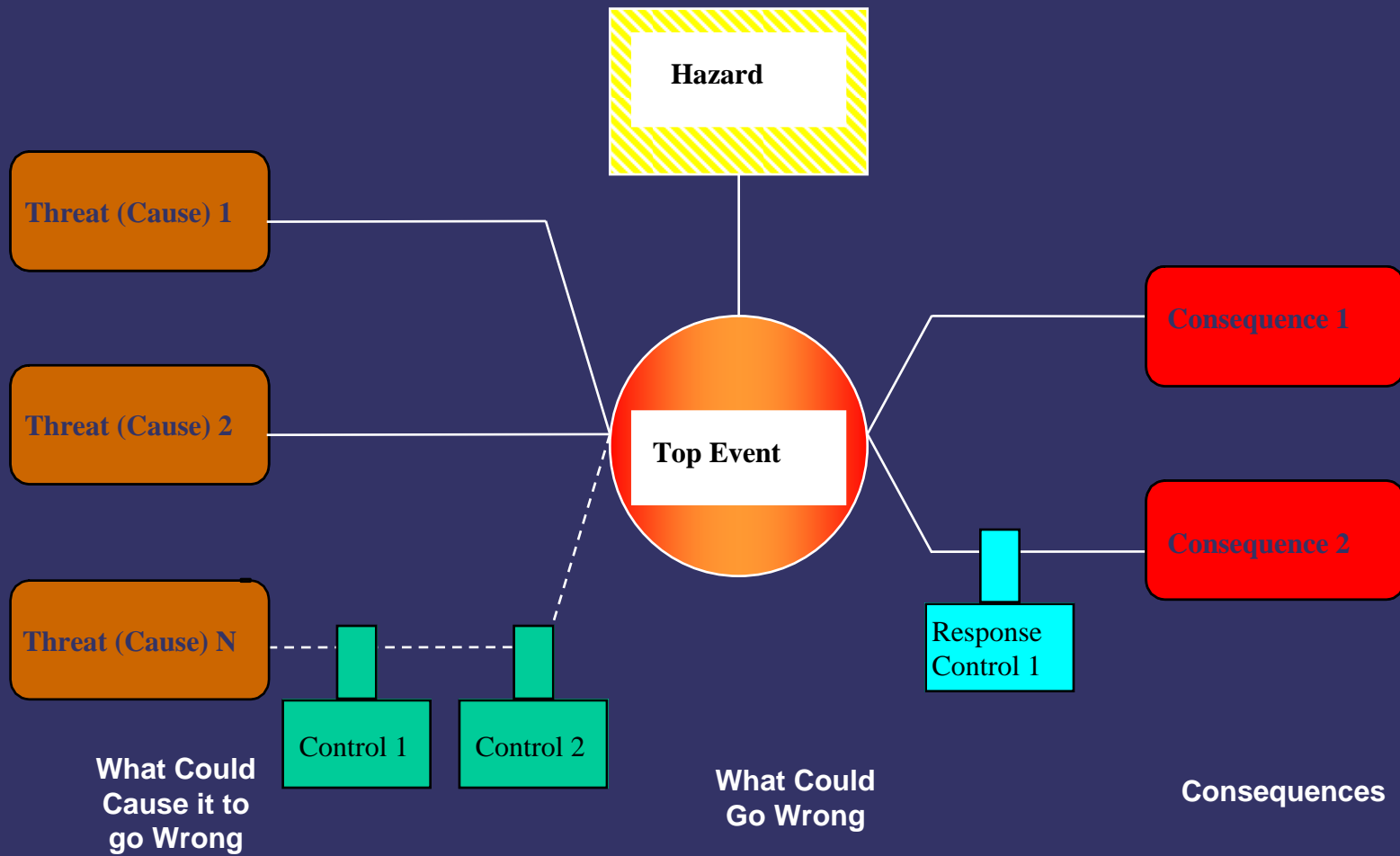
Bowtie Analysis – provides a structured assessment and graphical representation of the relationship between Hazards, Causes, Consequences and Controls.



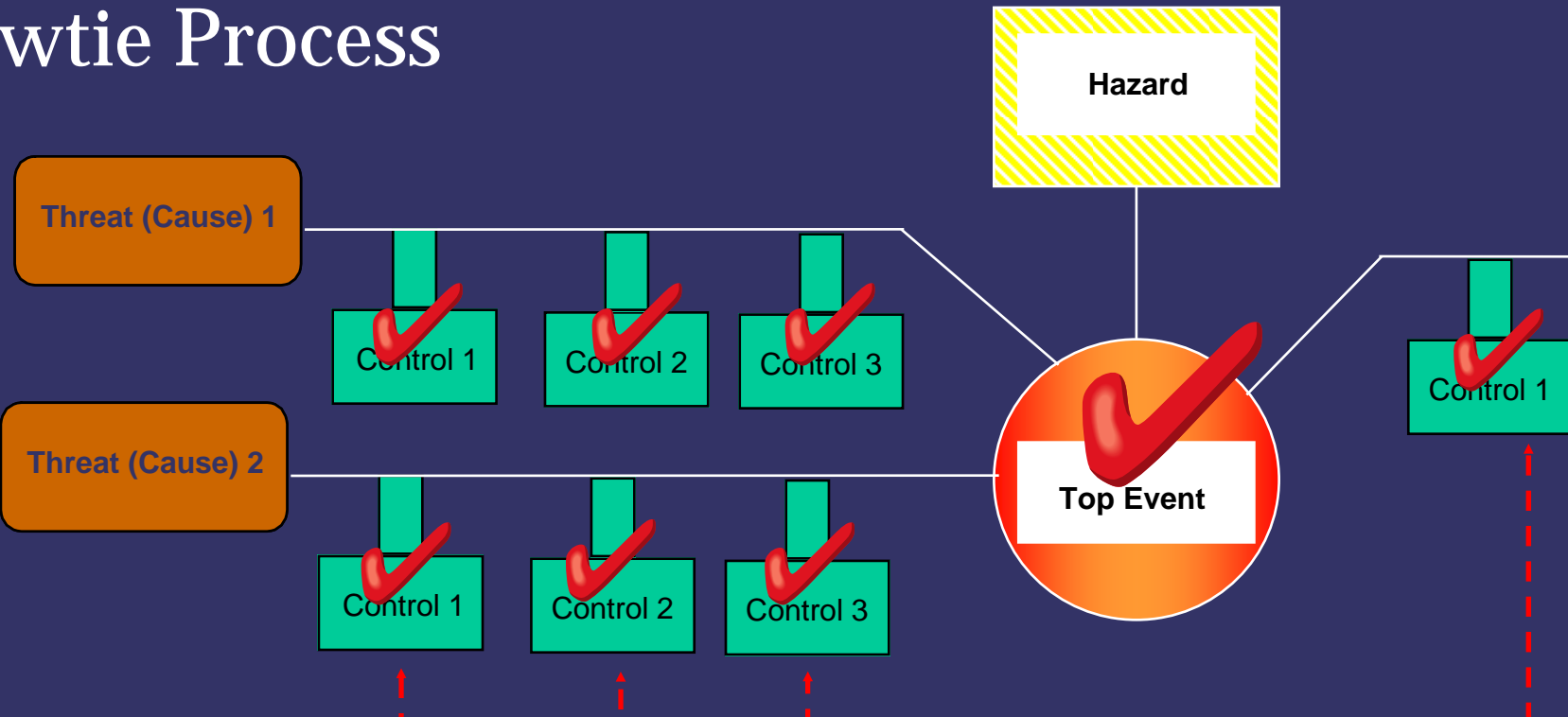
What is a Bowtie Diagram?

- Simple, **graphical means** of illustrating the relationship between:
 - major risk/hazard/undesirable event
 - its causes/threats
 - its consequences
 - the associated prevention and mitigation controls
- Helps **demonstrate** how major risks controlled – key part of a *Safety/HSE Case*
- Qualitative not quantitative

What is a Bowtie Diagram?



Practical Uses and Benefits of the Bowtie Process



Provide assurance that controls are in place

Ref	Task	Who	When	Verified/ Assured
T1				✓
T2				✓
T3				✓
etc				✓

Practical Uses and Benefits of the Bowtie Process

- Easy way of **communicating major hazards** and their controls.
- Major component of the Safety/HSE Case – helps to **demonstrate** how risk are controlled
- Basis for identifying key **Risk Control Systems**
- Can be used as a basis for risk control **auditing** (e.g. audit whether “critical” tasks being carried out)
- Can be used in **gap analysis** – what controls do we have? what should we have?
- Acts as the **backbone** for any Basis of Safety Documentation

Contact Details

- **Enquiries**

- Suzanne.Kinghts@erm.com
- 0161 958 8823
- 11th Floor,
5 Exchange Quay,
Manchester,
M5 3EJ