

RPS

GOVERNORS  
RISK MANAGEMENT & CORPORATE GOVERNANCE



# BowTieXP Risk Analysis Methodology and Software

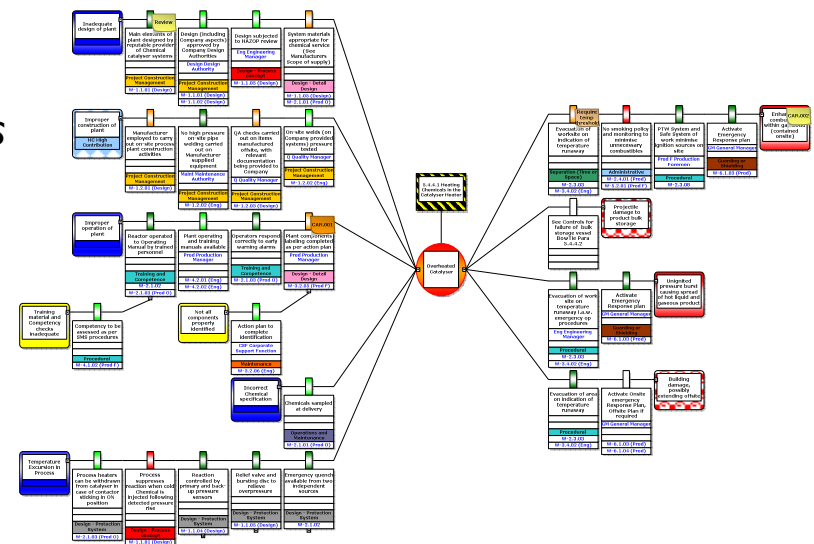
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# What is a BowTie?

## ● Risk analysis in detail – in a simple-to-understand format

- BowTie diagrams are a time-sequence model of risks - assessment, analysis and treatment
- Originated in process industries in Australia in 1979
- First made popular in oil & gas by Shell - 1980s
- Now also highly respected in aviation, mining and anywhere there is a potential for major losses
- It is a time-sequence model of controlling risks, similar to a Fault Tree on the left of a central loss of control event, and an Event Tree at right.
- Accepted and often expected by regulators for managing major accident events
- Used by CASA, ASA (Australia), ICAO, some major airlines, helicopter companies, RAAF, etc.

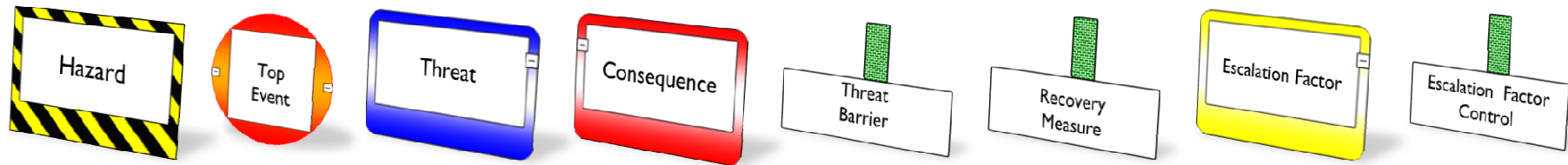


# BowTies are one of many tools

IEC DIS 31010 Table A1- Selection of tools for Risk Assessment					
Tools & Techniques	RISK ASSESSMENT PROCESS				
	SA = strongly applicable		A = applicable		NA = Not Applicable
	RISK IDENTIFICATION	RISK ANALYSIS			RISK EVALUATION
CONSEQUENCE		LIKELIHOOD	LEVEL OF RISK		
Failure mode and effect analysis (IEC 60812)	SA	NA	NA	NA	NA
Failure mode, effect and criticality analysis (IEC 60812)	SA	SA	SA	SA	SA
Fault tree analysis (IEC 61025)	NA	A	A	A	A
Hazard and operability studies (HAZOP) (IEC 61882)	SA	SA	NA	NA	SA
Reliability centred maintenance (IEC 60300-3-11)	SA	SA	SA	SA	SA
Markov analysis (IEC 61665)	A	NA	SA	NA	NA
Human reliability analysis	SA	SA	SA	SA	A
Preliminary hazard analysis	SA	NA	NA	NA	NA
Event tree analysis	NA	SA	SA	A	NA
Brainstorming	SA	NA	NA	NA	NA
Structured or Semi-Structured Interviews	SA	NA	NA	NA	NA
Delphi Techniques	SA	NA	NA	NA	NA
Checklists	SA	NA	NA	NA	NA
Consequence/Likelihood Matrix	SA	SA	SA	SA	A
LOPA	SA	NA	NA	NA	NA
SWIFT	SA	SA	SA	SA	SA
Decision Tree	NA	SA	SA	A	A
Bow Tie Analysis	NA	A	SA	SA	A
Monte Carlo	NA	SA	SA	SA	SA
Root Cause Analysis	A	NA	SA	SA	NA
HACCP	SA	SA	NA	NA	SA
Environmental Risk Assessment	SA	SA	SA	SA	SA
Scenario Analysis	SA	SA	A	A	A
Budsiness Impact Analysis	A	SA	A	A	A
Cause & Consequence Analysis	A	SA	NA	A	A
Cause and effect analysis	SA	SA	NA	NA	NA
Sneak Circuit Analysis	A	NA	NA	NA	NA
Bayesian Analysis	NA	NA	SA	NA	SA

Bowties can adapt very well to a range of risk types and requirements, but don't replace all methods.

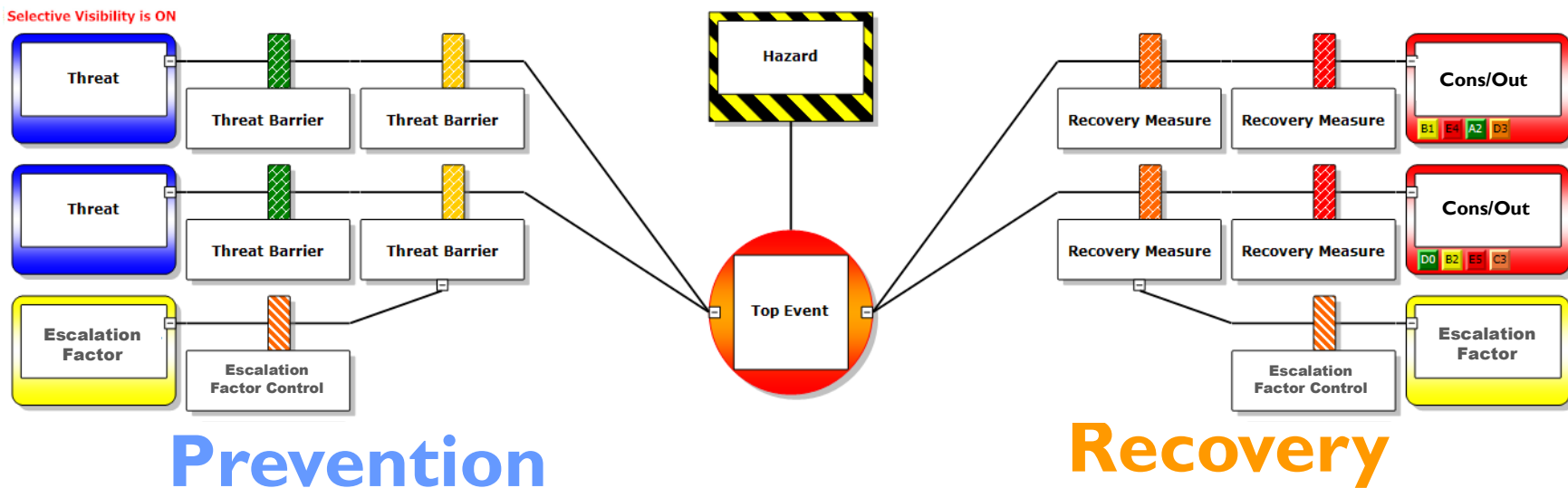
# BowTieXP analysis in 8 steps



**Before**

**After**

Selective Visibility is ON



# Effective risk communication

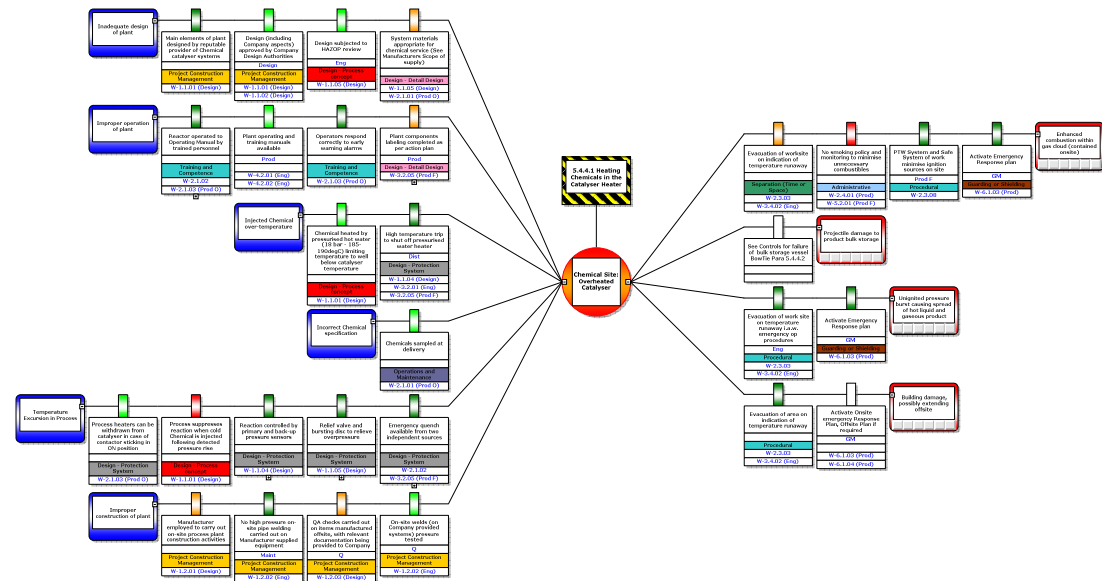


Which hazard register is going to engage your staff and contractors?

*This?*

HAZARDOUS EVENT	POTENTIAL CONSEQUENCES	EXISTING SAFEGUARDS	No.	RECOMMENDATIONS/COMMENTS
Release from local relief vents	Potential for natural gas to encounter process equipment and/or flame sources.	(Will a liquid spill valve be installed on the local tank vents?)	10	Bounded by Scenario #0
<b>CARGO SYSTEMS - LNG CARRIER (04/07/2004)</b>				
Takeover of LNG Carrier	Potential for vapor cloud to drift towards onshore population. Possible use of LNG carrier to collide with/impact shore infrastructure.		11	Addressed in Security Vulnerability Assessment
<b>MARINE SYSTEMS - BALLAST CONTROL (04/07/2004)</b>				
Ballast system malfunction	Potential for sudden listing conditions (5 degrees or greater), possibly causing tender failures and oversteers or more moderate line. Potential for disconnection of one or more loading arms resulting in consequences detailed in #4 above.	Automatic tension system. Weather vaneing capabilities. Flow control valve on caissons. Spill will be limited due to ESD. Manual override from loading master and in #4 above.	12	Correlates to Scenario #4
Vent system failure (i.e. undersized)	Collapse of ballast tank or void tank with possible distortion of sphere foundation. No immediate significant consequences.		13	
<b>MARINE SYSTEMS - BILGE (04/07/2004)</b>				
Down-flooding of void space	Potential to increase boil off gas (BOG) rate with no significant consequences.	Non return valves installed to prevent down-flooding.	14	
<b>UTILITY SYSTEMS (04/07/2004)</b>				
Complete blackout (long term)	Potential loss of thruster capability with subsequent loss of heading control. Stratification of stored LNG due to loss of recirculation (long term event).	Auto-start emergency generator. Redundant buses and power supply. ESD system. LPS.	15	Emergency generators do not supply enough power to run the thrusters.
Fire in the engine room FSRU	Potential loss of all generators including the inert gas generator. Loss of all generators results in the thruster system with subsequent loss of heading control.	Auto-start emergency generator not located in the engine room. Fire suppression system. Emergency procedures. Ability to use the fire water system from the standby tugs and LNG carrier if alongside.	16	All primary generators would have to be lost to lose thruster capabilities. Emergency generators do not supply enough power to run the thrusters.
Fire in the engine room LNG carrier	Potential to suspend loading operations with no significant consequences to FSRU.	Fire suppression system. Emergency procedures. Fire water system from the standby tugs and FSRU. Ability to use tugs to separate LNG Carrier from FSRU if necessary.	17	
LNG leak from storage tank and failure of inert gas system	Potential for fire on FSRU and possible escalation if LNG carrier is along side.	Fire suppression system. Fire water system from the standby tugs and LNG carrier. Ability to use tugs to separate LNG Carrier from FSRU if necessary.	18	Correlates to Scenario #1, #0
<b>PIPELINE SYSTEMS (04/07/2004)</b>				

*or This?*



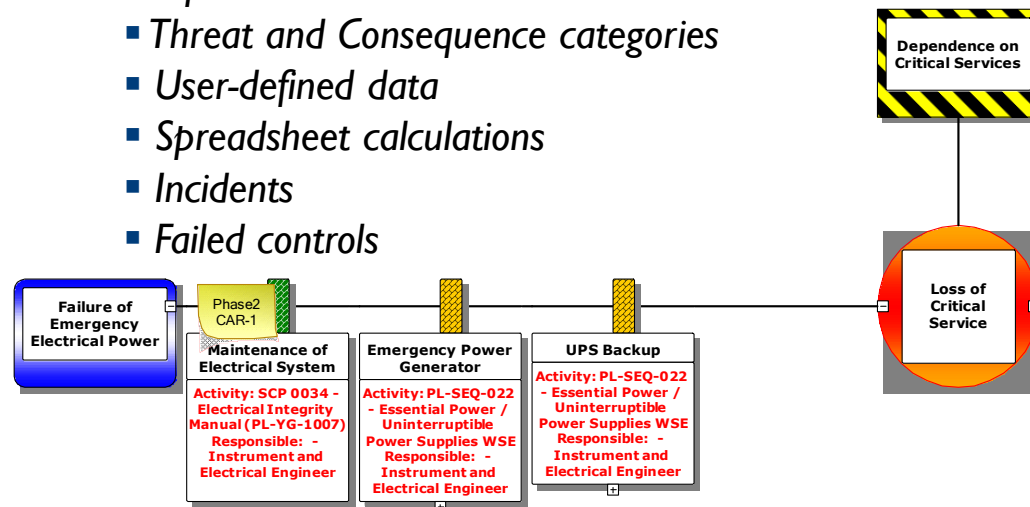
BowTieXP diagrams - for

Risk analysis workshops | Training | Audits | Safety cases | Regulator reviews | Executive presentations | Risk communication | Incident analysis | Quantitative models

# Why is the BowTie a useful risk tool?

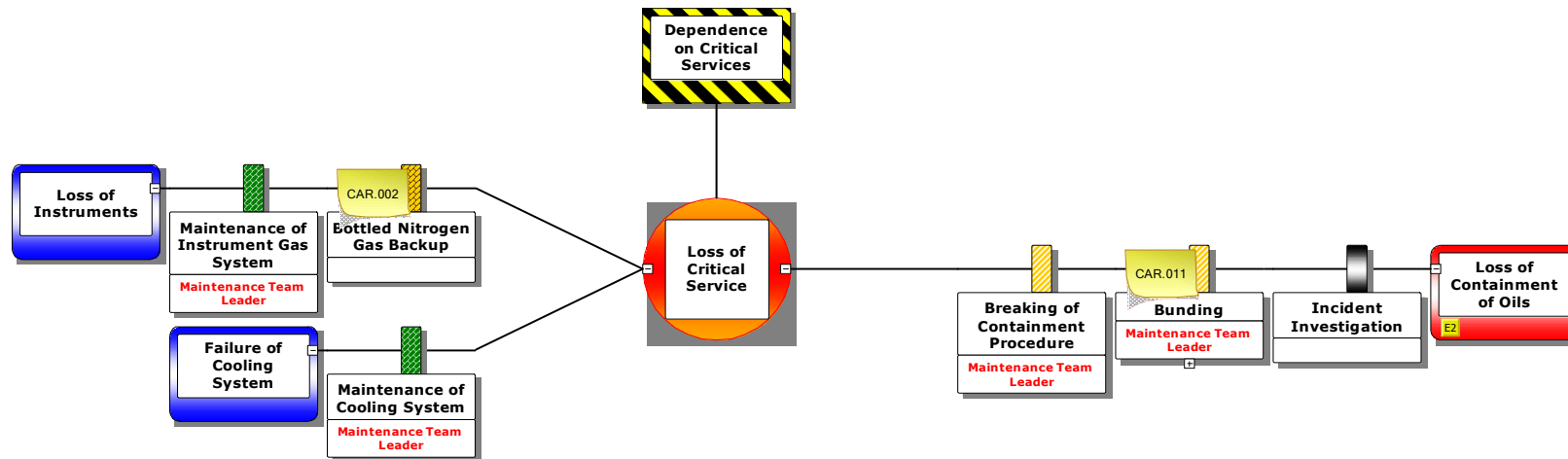
## 99% Pure Risk Management

- First designed for the analysis of risk rather than the detailed quantitative assessment of risk
- Now able to add quantitative modeling in BowTieXL
- Accepts, displays and reports:
  - Control types
  - Effectiveness
  - Control System
  - Criticality
  - Accountability
  - Management systems
  - Documents
  - General Failure Types (BRFs)
  - Corrective actions
  - Inherent and residual risk assessment
  - Top event risk assessment
  - Threat and Consequence categories
  - User-defined data
  - Spreadsheet calculations
  - Incidents
  - Failed controls



# Benefits of BowTieXP

- **Demonstrates the routes to incidents**
  - *Linking the hazards and the Consequences through a series of event lines maps the routes to undesirable Consequences*
- **Logical structured approach**
  - *Sequentially considers all aspects of risk management, cause to Consequence*



# Benefits of BowTieXP



## Early capture of loss of control

- Our primary focus is concentrate on the Top Event rather than the Consequence.
- This offers a more cost-effective allocation of resources than by going directly to the Consequences
- It identifies preventive and recovery control pathways
- It is directly compatible with the Reason Model, with a better understanding of the defences in a system

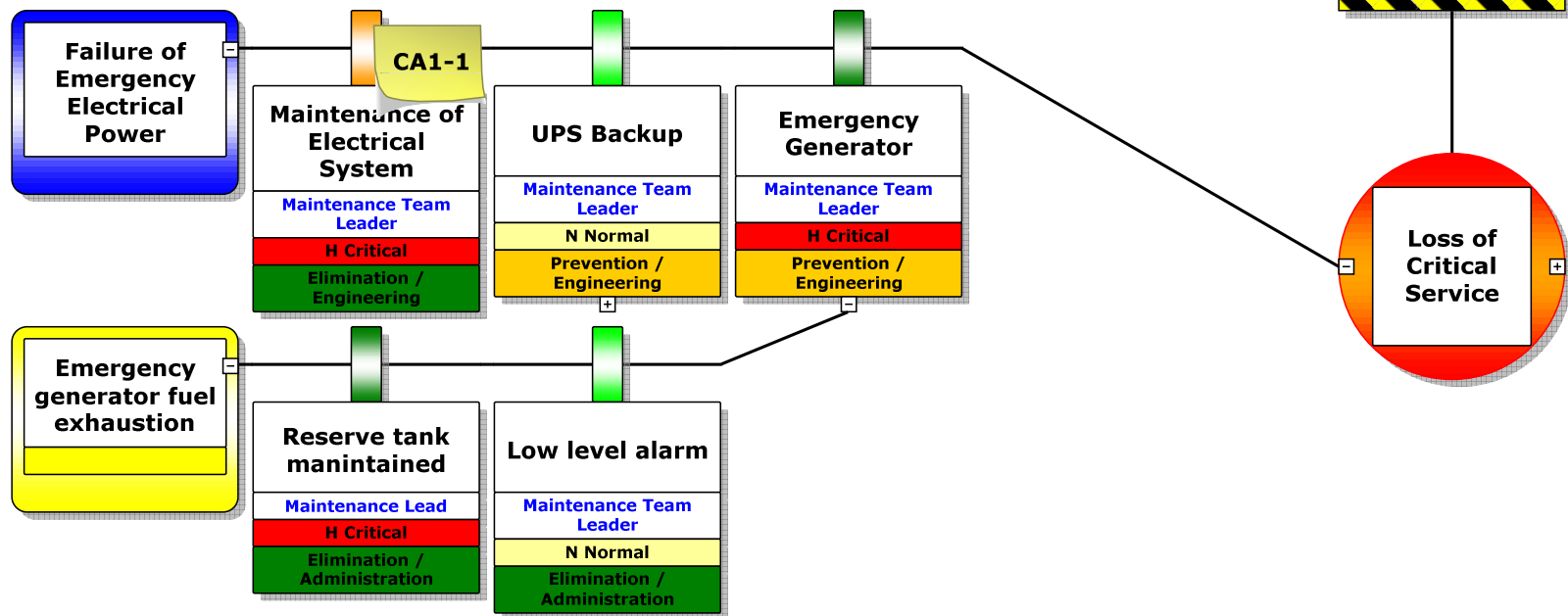


# Benefits of BowTieXP



## Demonstrates how controls fail and are maintained

- Allows examination of the routes by which the controls can fail
- Aids identification of the critical components that prevent these failures



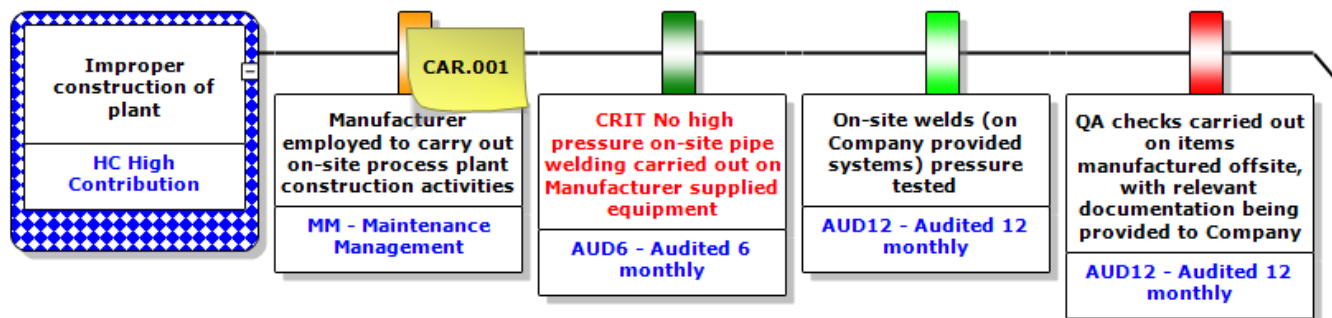
# Benefits of BowTieXP

## Clear communication

- Visually illustrating the hazard, its causes, Consequences, controls and how controls fail
- A 'picture paints a thousand words' – BowTies can be readily understood at all personnel levels

## Auditable trail

- The diagrams and critical task lists provide a framework for auditing

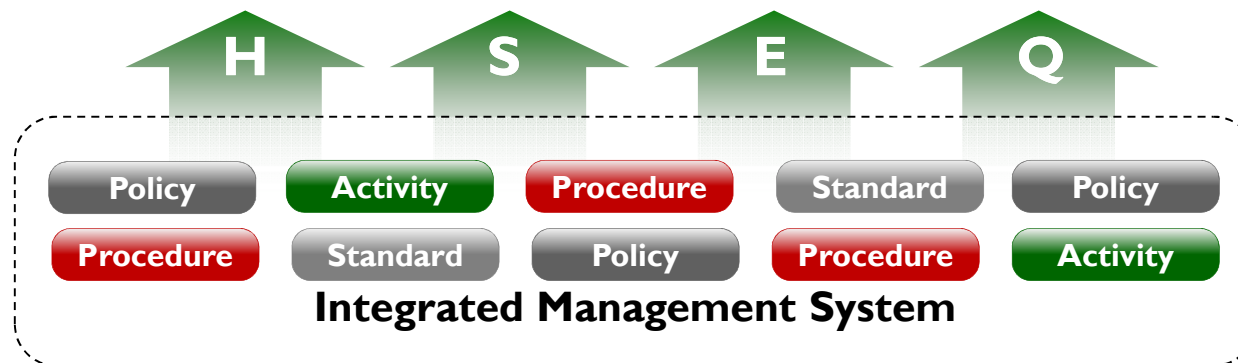
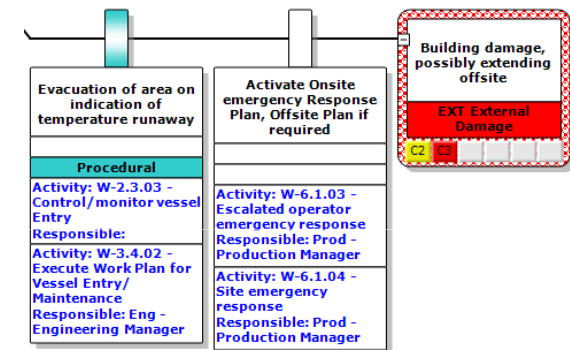


# Benefits of BowTieXP



## Fit for purpose management system

- *Linking the elements of the organisation's management system to specific controls, for ongoing risk management*
- *Used to identify the outcome of any changes that might take place in the management systems*



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# Benefits of BowTieXP



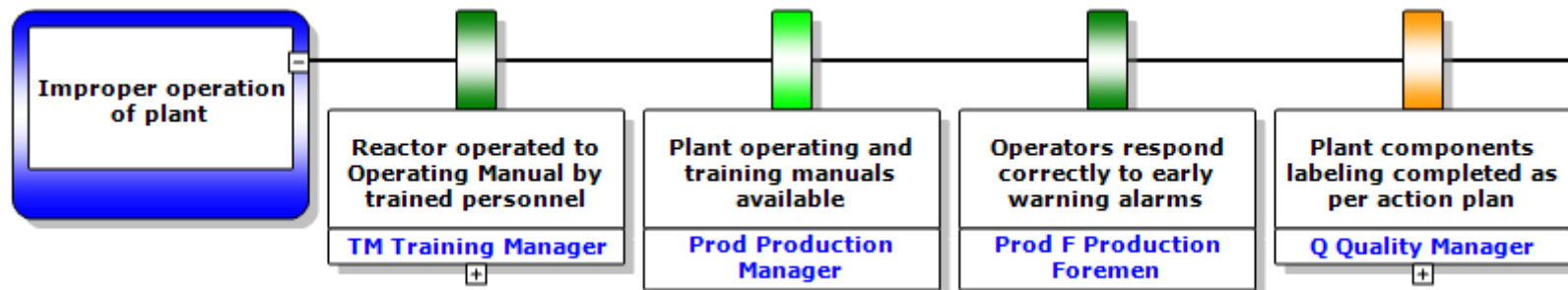
## Workforce involvement

- *All levels can see where their risk-critical controls are used*
- *BowTie workshops stimulate communication between key stakeholders*



## Ownership

- *Effective risk management is only possible if people are assigned responsibilities for controls*



# Benefits of BowTieXP



## Practical approach

- *Doesn't require technical specialists to build and maintain*



## All risks

- *The technique is ideal for assessment of all types of risks and industries:*

*Aviation, Defence*

*Banking and Finance*

*Oil & Gas and Energy*

*Safety in Design studies*

*Information Technology*

*Business Interruption*

*Project Risks*

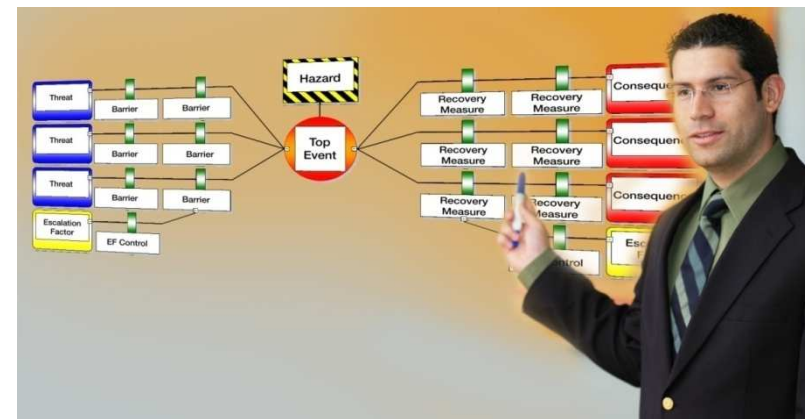
*Security Management*

*Transport*

*Environmental*

*Refining, Chemical, MHF*

*Mining*

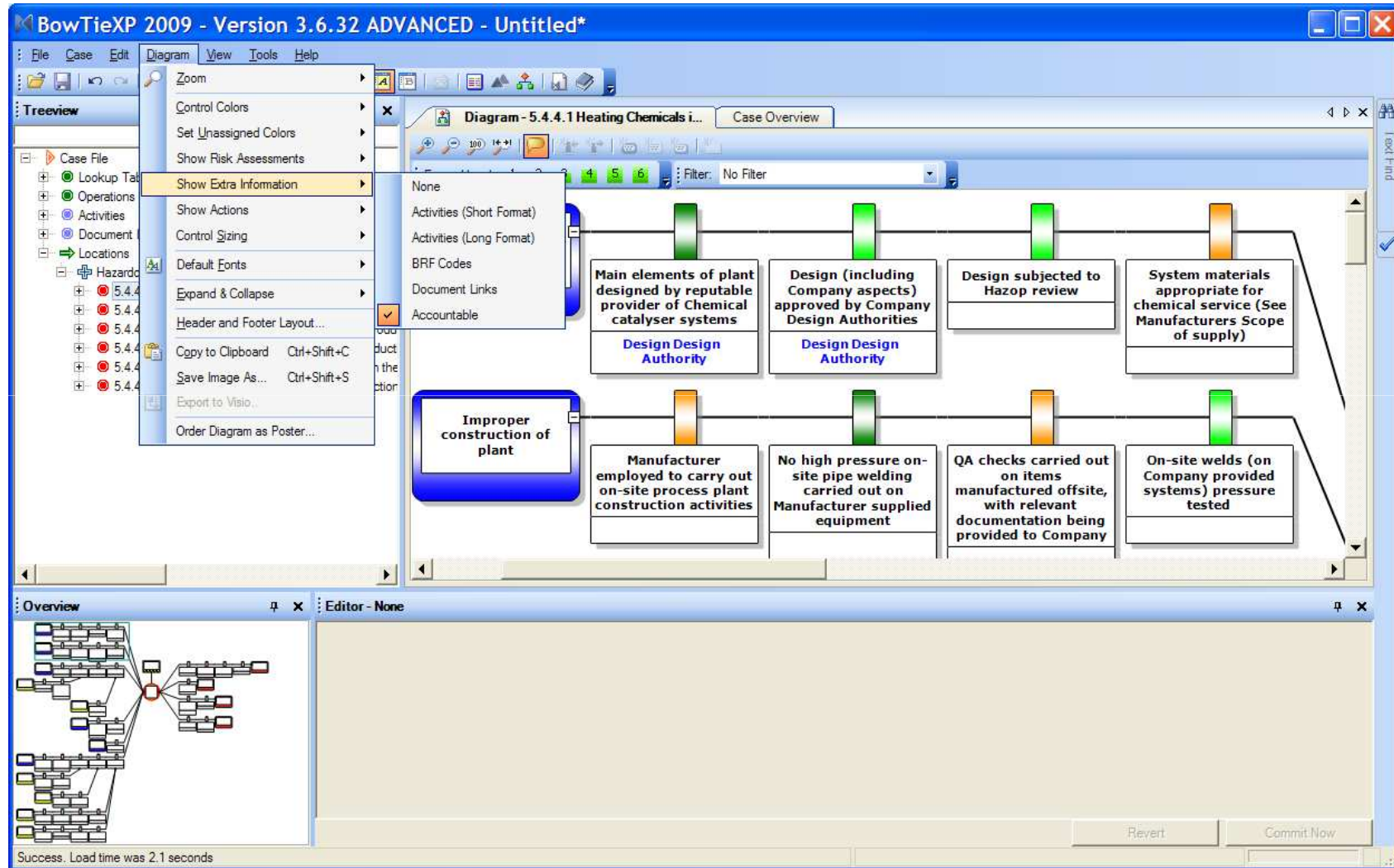


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# Managing Controls is Critical

- 1** What type of effect do they provide?
- 2** How effectively will they work?
- 3** Which are the most critical?
- 4** When do they deliver their effect?
- 5** Who is responsible for them?
- 6** Why do they fail, and how are they maintained?
- 7** How many controls do we need?
- 8** How should we measure performance?
- 9** What documents and management references apply?

# User-friendly BowTieXP software



# BowTieXL for spreadsheet functions

The screenshot displays the BowTieXL software interface. The main window shows a spreadsheet with the following data:

Threat Name	Average Effectiveness:
Inadequate design of plant	6.5
Improper construction of plant	5.5
Improper operation of plant	6
Injected Chemical over-temperature	7
Incorrect Chemical specification	8
Temperature Excursion in Process	5.5

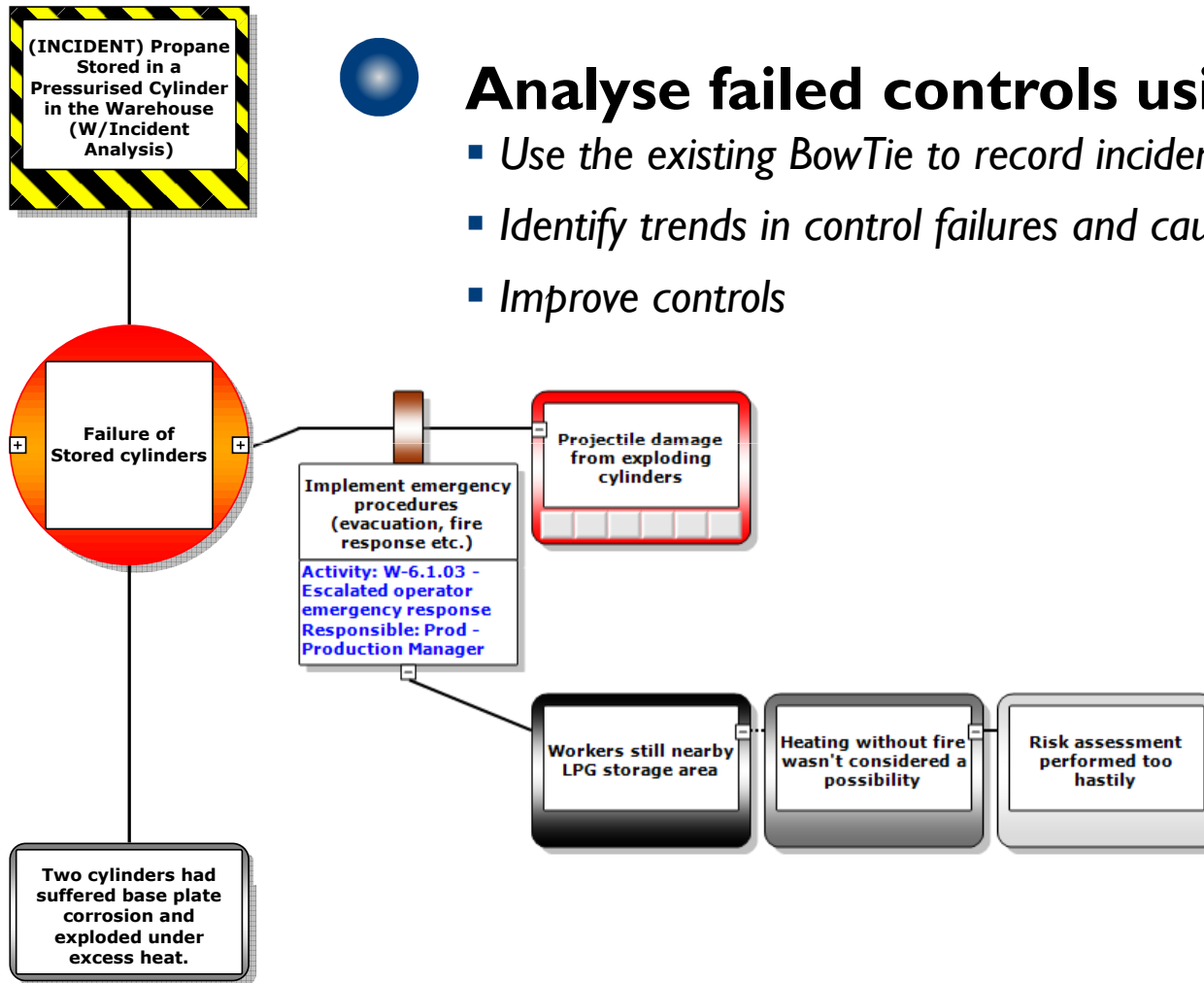
A bar chart is overlaid on the spreadsheet, showing the average effectiveness for each threat. The y-axis ranges from 4 to 9. The x-axis labels are: Improper operation of plant, Injected Chemical over-temperature, Incorrect Chemical specification, and Temperature Excursion in Process.

An 'Editor - Effectiveness' dialog box is open, showing a table for editing user data:

Key	Value
Frequency	6
New Key Name...	New Value...

The dialog box also includes 'Add' and 'Remove' buttons, and a status bar at the bottom with 'Overview' and 'Editor - Effectiveness' tabs.

# Black Bowties for Incident Analysis



## Analyse failed controls using Tripods

- Use the existing BowTie to record incidents
- Identify trends in control failures and causal factors
- Improve controls

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# Further enquiries

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