

Risktec Solutions

risk management and assessment for business

Practical HSE Risk Management: An Introduction to the Bowtie Method

Presentation to the International Conference for Achieving Health & Safety Best Practice in
Construction, Dubai, UAE, 26th- 27th February 2007
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Purpose of presentation

- Introduce bow-tie method
- Describe its practical uses and benefits
- Outline an example bow-tie
- Provide some tips for successful use

History of bow-tie method

- Exact origins of bow-tie methodology are hazy – believed to originate from ICI in the late 1970's?
- Royal Dutch/Shell Group first major company to integrate bow-ties fully into business practices
- Use of bow-ties now widely spread between companies, industries, countries and from industry to regulator, e.g.:
 - Abu Dhabi National Oil Company (ADNOC)
 - UK Health and Safety Executive
 - French Government
 - Australian State Regulator
 - Land Transport Safety Authority of New Zealand
 - International standards (e.g. ISO 17776:2000)
 - International Association of Drilling Contractors (IADC)

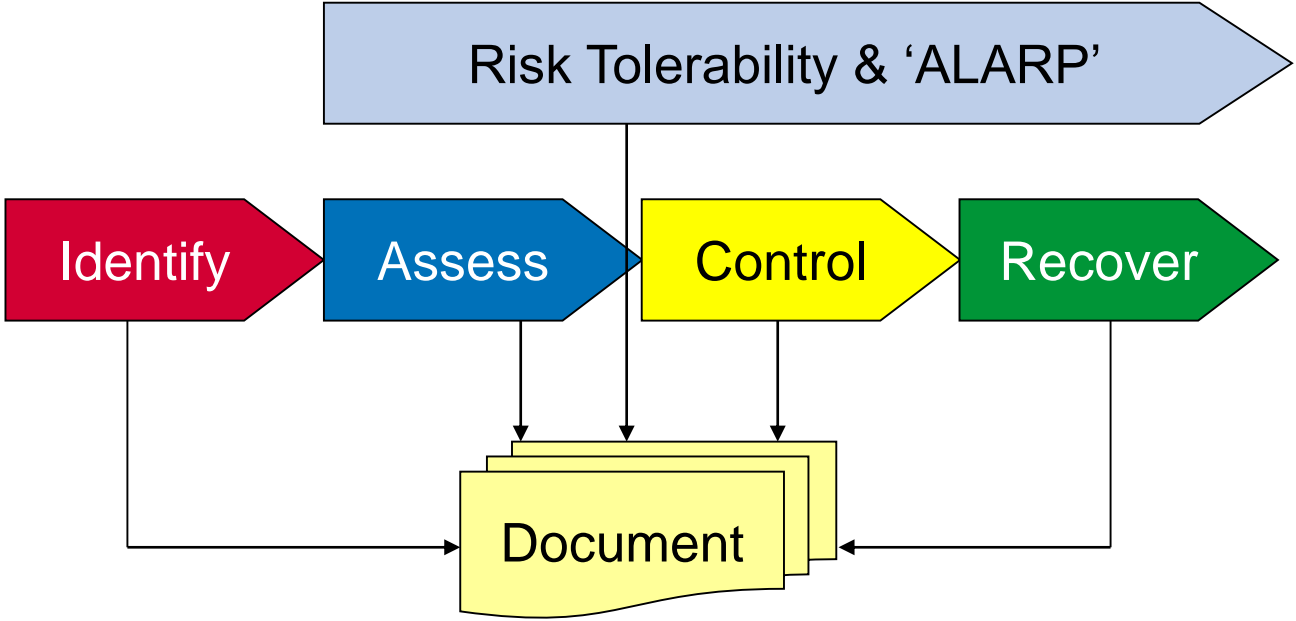
Risk evaluation & management



HSE Management System

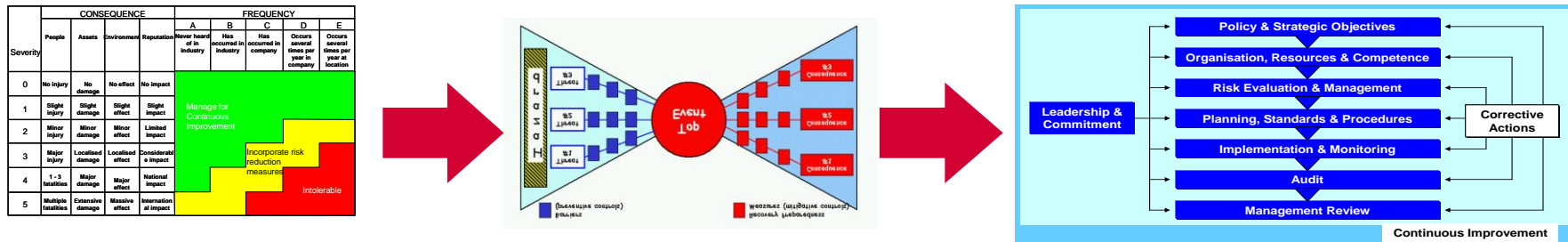
An HSE-MS is a structured set of controls for managing HSE risk in a business

Basic risk evaluation & management model



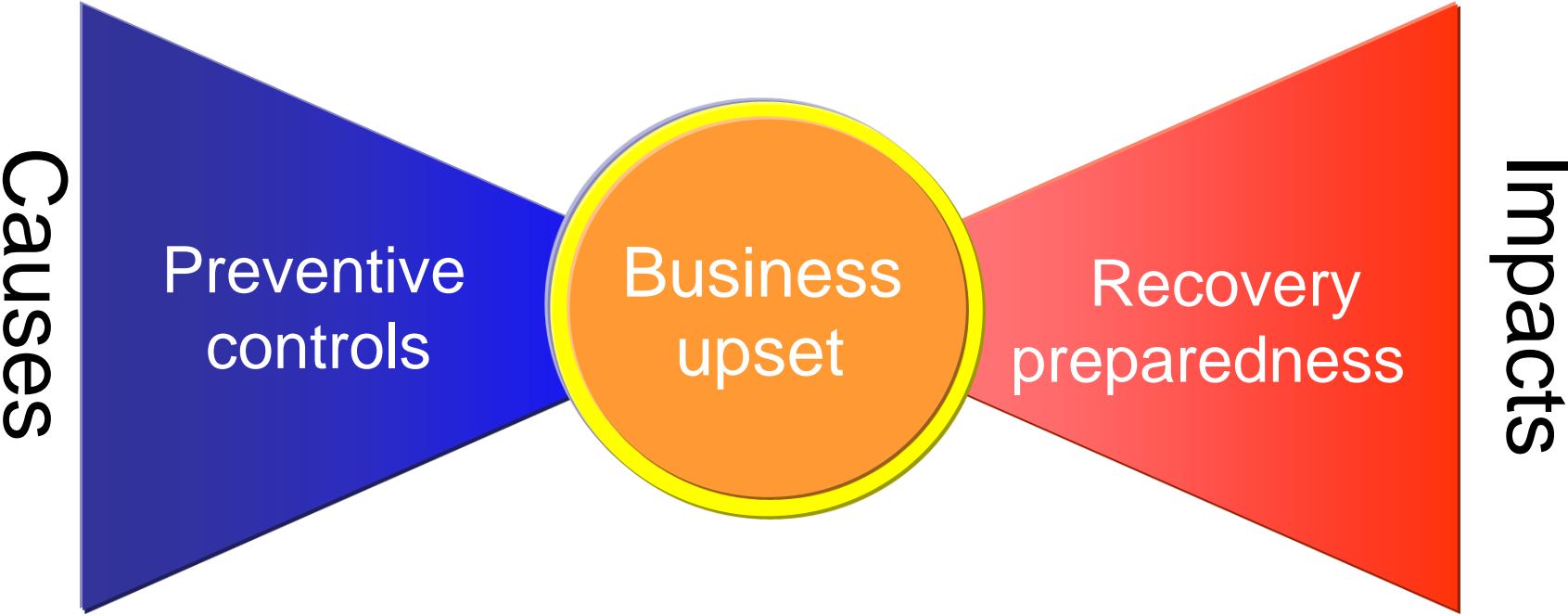
Link with HSE-MS

- Unlike traditional risk evaluation tools, the bow-tie method makes the link between risk controls and the HSE-MS:

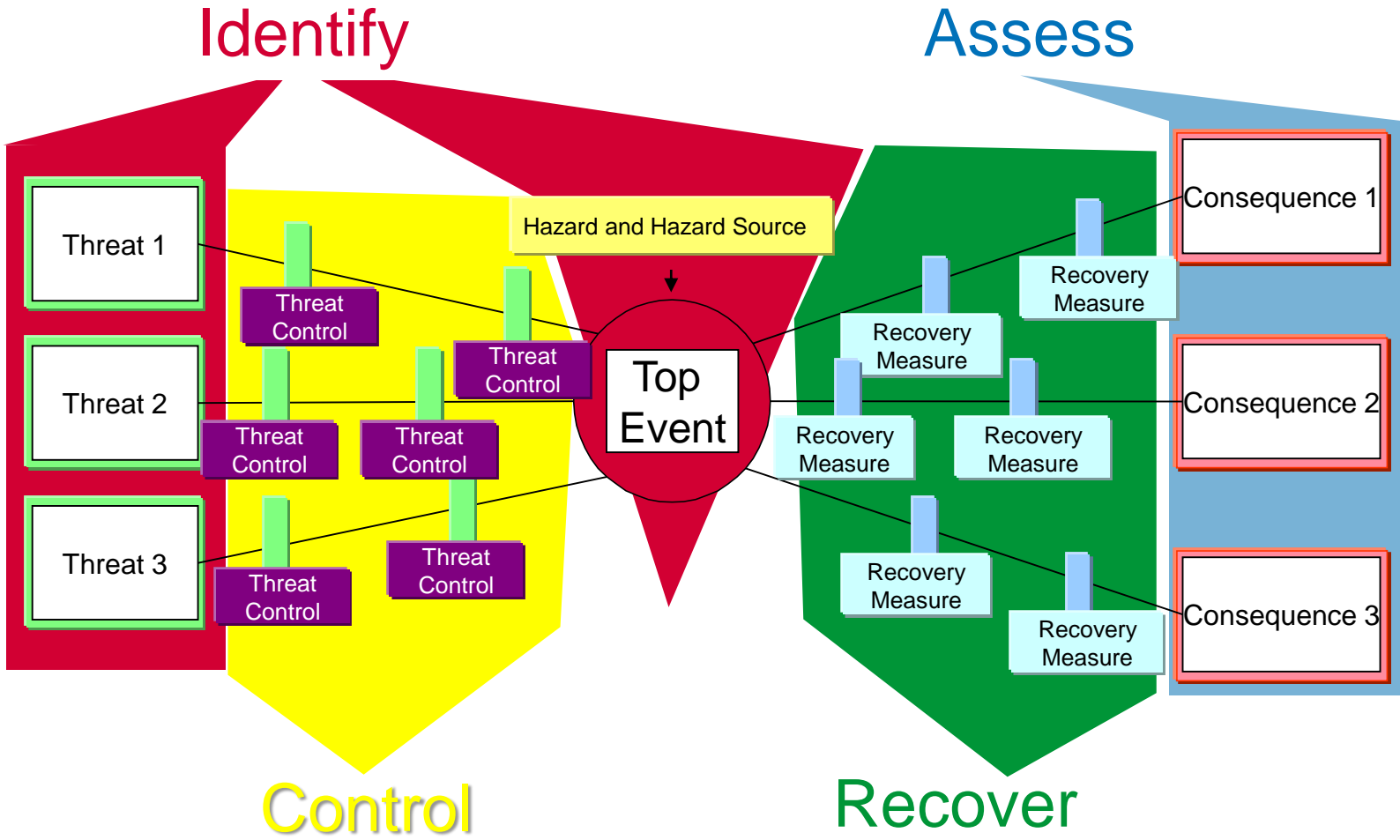


- Links are made via HSE-critical roles and responsibilities, HSE critical procedures, HSE critical equipment and systems, etc. identified on the bow-tie diagram

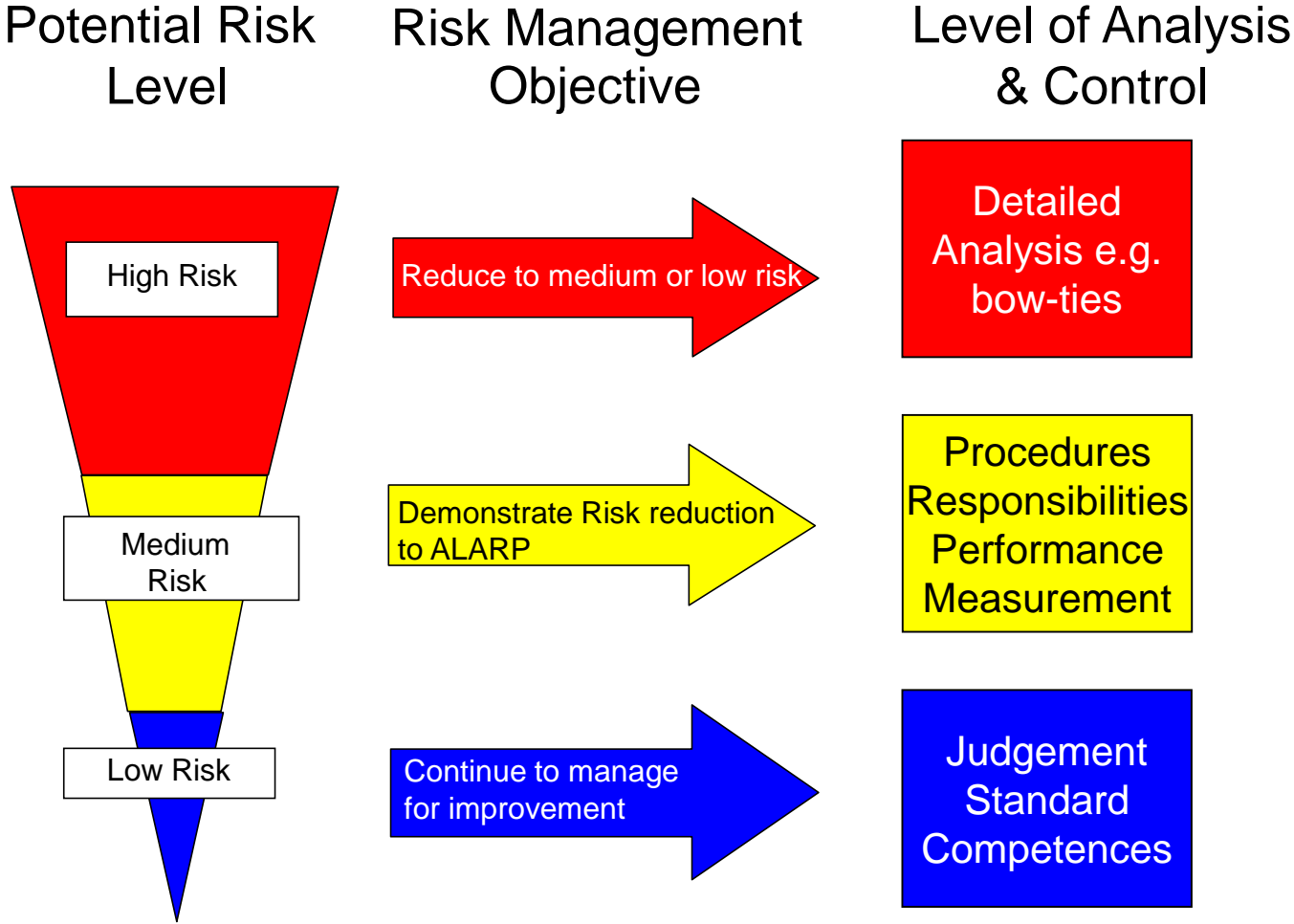
Bow-tie diagram



Bowtie diagram



Typical application of bow-tie method



But method is equally applicable to routine risks as major risks

Practical uses

Logical structured approach

What are our major risks? Do we have any gaps in risk control?

Communication

How do we engage non-risk specialists?

Formal demonstration

Can we really demonstrate control of our risks?

Specific risks

Are these risks properly understood and controlled?

Critical roles

Do our people know what is expected of them?

Competencies

Are competence and control requirements aligned?

Procedures

Are they complete and effective?

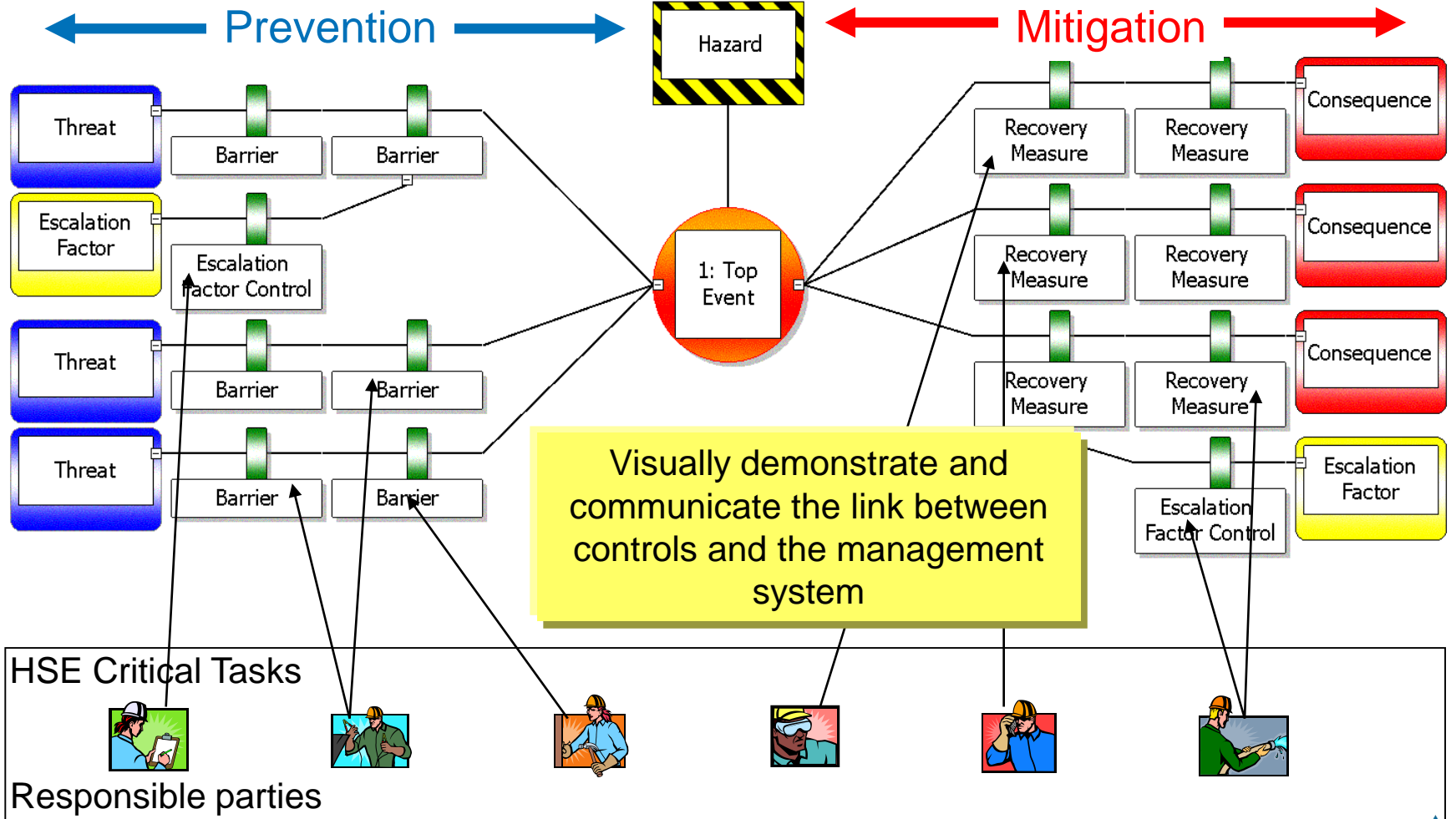
Auditing

How can we focus audits on what really matters?

Critical systems and performance standards

What are they?

Link between bow-ties & HSE-critical tasks



HSE-critical task catalogue

Client/Project Name		Senior Supervisor	
Task 01.01	Making live and Closing of Hot Work Permits	Ensure that all permits are signed out 'made live' and closed by the Authorised Person	Permit register Records of Hot Works Safety Meetings
Task 01.02	Ensure that Hot Work is in compliance with permit conditions	Ensure that permit is in compliance with MSN 102L and work is undertaken in safe manor	Permit register Walk round check/inspection of works Pre-job briefing sign off Safety meeting actions Daily records
Task 02.04	Ensuring that lifting gear is tagged and colour coded	Ensure that lifting gear is coded as per procedure MSN 205L Ensure competence of certifying contractor	Audit and Inspection Sign off from certifying company.
	Confirm portable electrical equipment is fit for purpose and in possession of integrity certification	Ensure that external electrical equipment is tested on a 3 month cycle and internal equipment is tested on a 6 month cycle as per MSN 23L.	Visual check Audit of Portable appliances

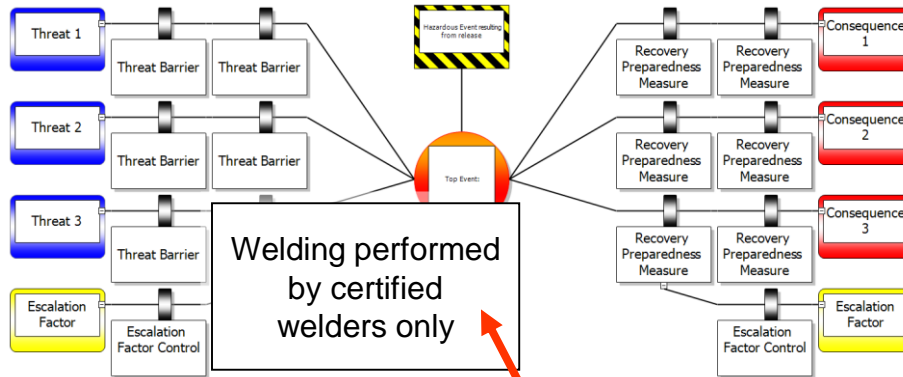
HSE-Critical Role

HSE-Critical task

HSE-critical procedure

Verification

Link between bow-ties and competence



Verify that competence and control requirements are aligned

Job Title: **Lead Production Operator (OPF)** JG: 7

Building Block	Skill Element	A	K	S	M	Building Block	Skill Element	A	K	S	M
Process System Description	Describe purpose of system					Equipment Operation Description	Describe purpose of equipment				
	Provide sketch of product flow						Identify pressures, temperatures, flow rates				
	Identify process parameters						Equipment Readings	Take readings			
Equipment Identification	Identify subsurface completion equipment					Analyse readings					
	Identify surface equipment					Report anomalies					
	Identify facilities equipment					Equipment Availability Optimisation	Execute maintenance				
Identify safety systems					Control running hours						
Facilities (and Wells) Configuration	Identify line-up						Analyse equipment failure				
	Identify availability of production system					Rotating Equipment	Describe different rotating equipment				
	Take levels of production tanks						Perform rotating equipment maintenance				
Calculate tank capacity					Analyse and correct machinery faults						
Production Flow Regulation	Identify production capacity					Maintain equipment history					
	Select well production					Test emergency equipment					
	Produce wells and facilities					Monitor rotating equipment					
Product Delivery Commitments	Communicate with marketing					Static Equipment	Describe different static equipment				
	Plan production						Perform static equipment cleaning and maintenance				
	Produce at required rate						Maintain equipment history				
Failure Analysis	Apply condition monitoring techniques					Monitor static equipment condition					
	Analyse faults					Failure Analysis	Apply condition monitoring techniques				
	Troubleshooting						Analyse faults				
Produce at required rate					Troubleshooting						

Typical Competence Assurance System Job Profile

Accountability pack for each HSE-critical role

Accountability Sheet					
Role/Post :		Maintenance Supervisor			
Identified Safety Critical Role (Document OD-SA-03-46):		Yes, Level 1 and 2			
HSE Critical Task Specification Sheet					
Task Ref	Task Title	Input / Procedures		Task Verification	
BON-06.01.03	<i>Maintain, test and inspect cargo and crude export pumps, meters and protection systems</i>	<ul style="list-style-type: none"> • OPRM-2003-0304 : POPM Volume 4 - Oil Storage Handling and Ballast • OPRM-2003-0305 : POPM Volume 5 : Oil Metering and Export • OPRM-2005-0057 : Maintenance and Inspection Management System Manual 		Maintenance plan, maintenance records, test results checked and verified by Operations Supervisor	
BON-06.01.08	<i>Maintain, test and inspect the inert gas system</i>	<ul style="list-style-type: none"> • OPRM-2003-0319 : POPM Volume 19 - Inert Gas 		Maintenance Records. Reviewed by Ops Supervisor.	
Etc...					
Safety Critical Role Competencies (Document OD-SA-03-46)					
Competence Requirements	Prerequisites for Assessment	Assessment Format (Standard)	Assessor / Verifier	Re-Asses. Frequency	Maintenance of Competence
Skill at Validating PTW	Computer Based Training to Signatory standard	Computer Based Assessment	PTW Coordinator / Line Verifier	-	Maintained through ongoing daily activities and annual staff appraisal whilst in position
Skill at Supervising HSE	On the job exposure while completing OIM portfolio	Area Supervisor Competence Assessment Manual	Installation Manager / Line Verifier	-	Maintained through ongoing daily activities and annual staff appraisal whilst in position
Knowledge of the Nigerian Legislation (Mineral Oils (Safety) Regulations	Training Course	Demonstration of knowledge	Line Assessor / Line Verifier	-	Maintained through ongoing daily activities and annual staff appraisal whilst in position
Etc...					
I understand and accept the HSE Critical Tasks and Safety Critical Role Competencies assigned to me.					
Name		Signature			
Position		Date			

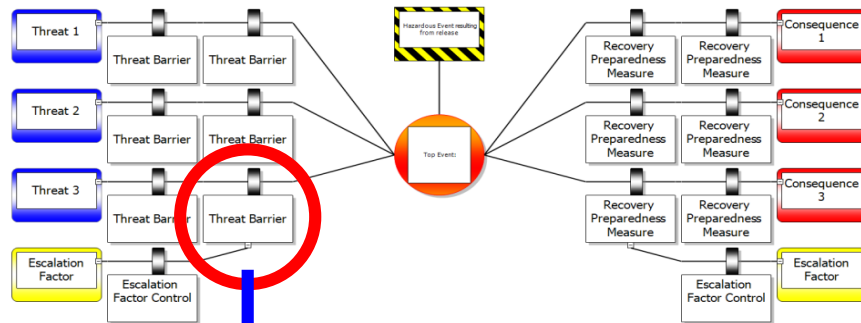
HSE-critical role

HSE-critical tasks, procedures & verification

HSE-critical competencies

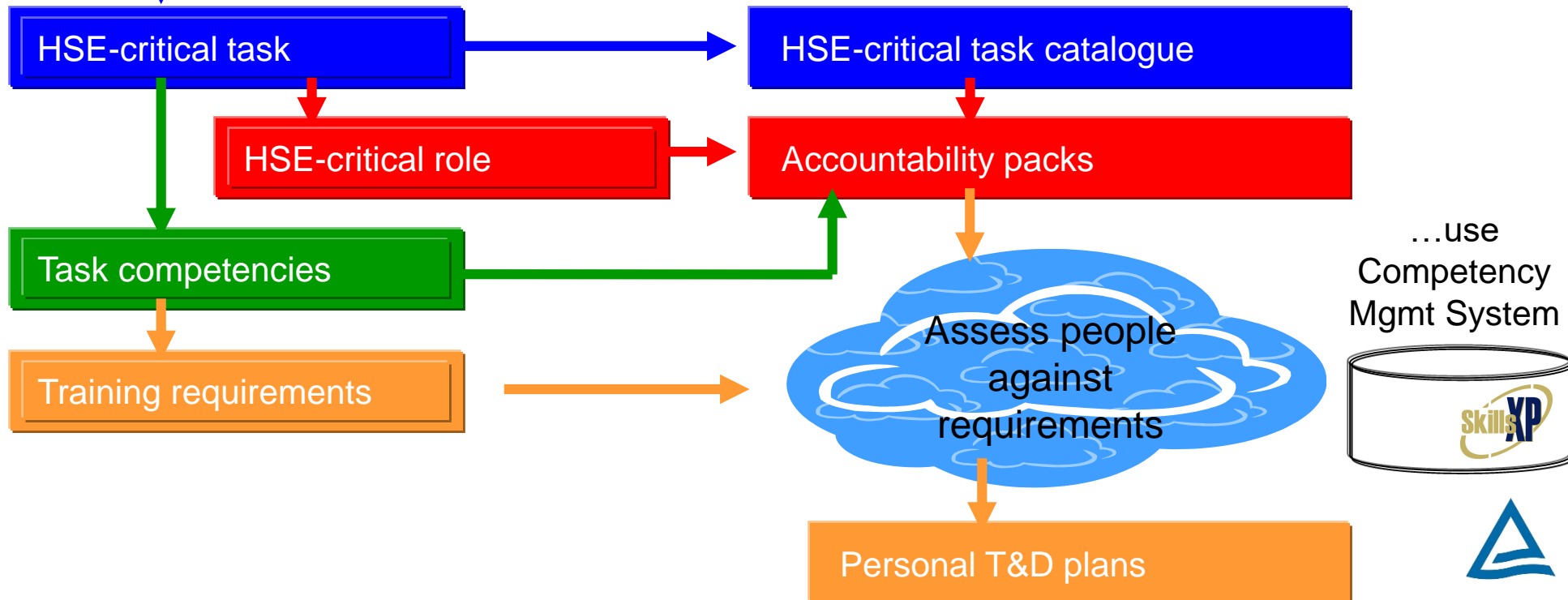
Sign-off

Link between bow-ties and training & development



Competent people provide resilience against major risks

...to ensure each risk control works...



Competency management system

CompetencyXP [Show Matrix]

File Add Records Security Maintenance Reporting Course Planning Tools Window About... Help

Select a Matrix

Matrix from definition
Dynamic matrix from role
Role: F04tab04

Expiry date: 27/2/2006

Core role certifications: Filled: 250 23.91 % 75,000.00
 Expired: 10 0.68 % 2,520.00
 Missing: 1,114 76.09 %

Legend:
■ Met
■ Expired
■ Planned date before selected expiry
■ Planned, in future

Name	Age	H2S Training	JSA	NR06 EPI	OVI	Rigging and Slinging	Scaffolding	STOP Method Safety Management	HUET	Survival	ISM Instruction	Planned To Visit	SEMS
CORREA DE LIMA, EVERTON	F04tab04									12/7/2007	11/23/2008		
CORREA GUEDES, WESLEY	F04tab04								10/14/2007	5/14/2007			
CORREA DOS SANTOS, LUIZ ANTONIO	F04tab04			12/31/9999	12/31/9999			12/31/9999		6/24/2006		12/31/9999	
COITINHODE OLIVEIRA, RITA DE CASSA	F04tab04					8/23/2007		12/31/9999	10/29/2007	10/27/2008			
CRUZ DO NASCIMENTO, MARCOS	F04tab04		12/31/9999		12/31/9999	12/31/9999		12/31/9999	8/25/2006	7/5/2006		12/31/9999	
DA CDS TA MONTEIRO, RONALDO	F04tab04					8/5/2007			4/7/2006	8/28/2007			
DA CUNHA SILVA, FABIANO	F04tab04					12/31/9999	12/31/9999			12/12/2007	1/6/2008	12/31/9999	
DA CUNHA SILVA, FABIO	F04tab04					12/31/9999			4/17/2006	2/7/2007	12/31/9999		
DA FIORA, JOSE LAELIO	F04tab04				12/31/9999	7/22/2007			10/22/2005	3/31/2006	11/18/2010		
DA SILVA CORREIA, ADILDO	F04tab04									12/9/2007	12/8/2010		
DA SILVA CORREIA, CARLOS	F04tab04							12/31/9999	2/2/2007	2/15/2006			
DA SILVA CORREIA, JOSE PAULO	F04tab04								4/28/2007	6/11/2006			
DA SILVA CORTEZ, JOAO MARCIO	F04tab04	12/31/9999	12/31/9999			12/31/9999		2/13/2005	5/14/2006	11/25/2006		12/31/9999	
DA SILVA ESTEVAO, ANSELMO	F04tab04					11/11/2007			11/12/2006	2/22/2006			
DA SILVA OLIVEIRA, JOSE EDUARDO	F04tab04	12/31/9999	12/31/9999			12/31/9999			10/11/2005	1/21/2006	2/2/2006		
DE ALENCAR SANTOS DA SILVA, HUMBERTO	F04tab04								12/21/2007	3/18/2007			
DE ALMEIDA COIMBRA, PAULO CESAR	F04tab04					12/31/9999		12/31/9999	11/18/2007	8/27/2006			
DE ALMEIDA RANSEL, MARCELO	F04tab04	12/31/9999	12/31/9999			12/31/9999		12/31/9999	2/23/2007	9/15/2009			
DE JESUS, DANIEL LUCIANO	F04tab04					12/31/9999			10/13/2007	10/13/2008			
DE LEMOS CASADO, SIDNEI	F04tab04									3/29/2009			
DE OLIVEIRA FREITAS, JIMSON ROGERS	F04tab04									2/15/2006			
DE OLIVEIRA TALUNA, CLAUDIO	F04tab04									8/26/2007			
DE PAULA DA SILVA, PAULO SENEZ	F04tab04	12/31/9999	12/31/9999					12/31/9999	1/19/2007	1/21/2008			
DE SA SANTOS, ALEXANDER	F04tab04								12/5/2007	8/4/2008			
DE SENNA, ADILTON CATAIBO	F04tab04		12/31/9999				12/31/9999		8/18/2006	4/4/2008			
DE SOUZA GALDAS, ROGERIO	F04tab04							12/31/9999	10/14/2007	2/25/2007		12/31/9999	
DE SOUZA MELO, PAULO ADRIANO	F04tab04					8/5/2007			4/26/2006	6/18/2006			
DE SOUZA PEREIRA, CRISTIANO	F04tab04							4/13/2005	12/3/2006	4/29/2007			
DE SOUZA PESSANHA, REGINA MARCIA	F04tab04								11/26/2006	12/1/2010			
DE SOUZA SILVA, JOAO BATISTA	F04tab04			12/31/9999	12/31/9999				12/12/2007	7/22/2007		12/31/9999	
DE SOUZA TAVARES, CARLOS AUGUSTO	F04tab04									12/15/2006			
DIAS GULDES, ROSSON	F04tab04									7/22/2009			
DOS ANJOS, WAGNER JORGE	F04tab04								10/14/2007	10/13/2008			
DOS REIS CORREIA, FERNANDO ANTONIO	F04tab04								10/7/2007	10/3/2009			
DOS SANTOS ARAUJO DA SILVA, ANDERSON	F04tab04					3/23/2007			8/18/2006	8/20/2008			
DOS SANTOS, JOSUE LUIZ	F04tab04		12/31/9999			12/31/9999		9/24/2005		9/21/2006			
DOW, WILLIAM MICHAEL	F04tab04					8/5/2007			4/7/2006	7/29/2009			
DUARTE DA SILVA, EDUARDO	F04tab04									1/10/2009			
FARIA MACIADO, MARCELO ANTONIO	F04tab04								3/24/2006	2/29/2009			
FELIX DA SILVA, FRANCISCO CARLOS	F04tab04			12/31/9999		12/31/9999		12/31/9999		5/23/2007			
FERREIRA BARBOSA, ELY CARLOS	F04tab04					12/31/9999			4/23/2006	12/9/2007			

Show report Export

Sample training matrix



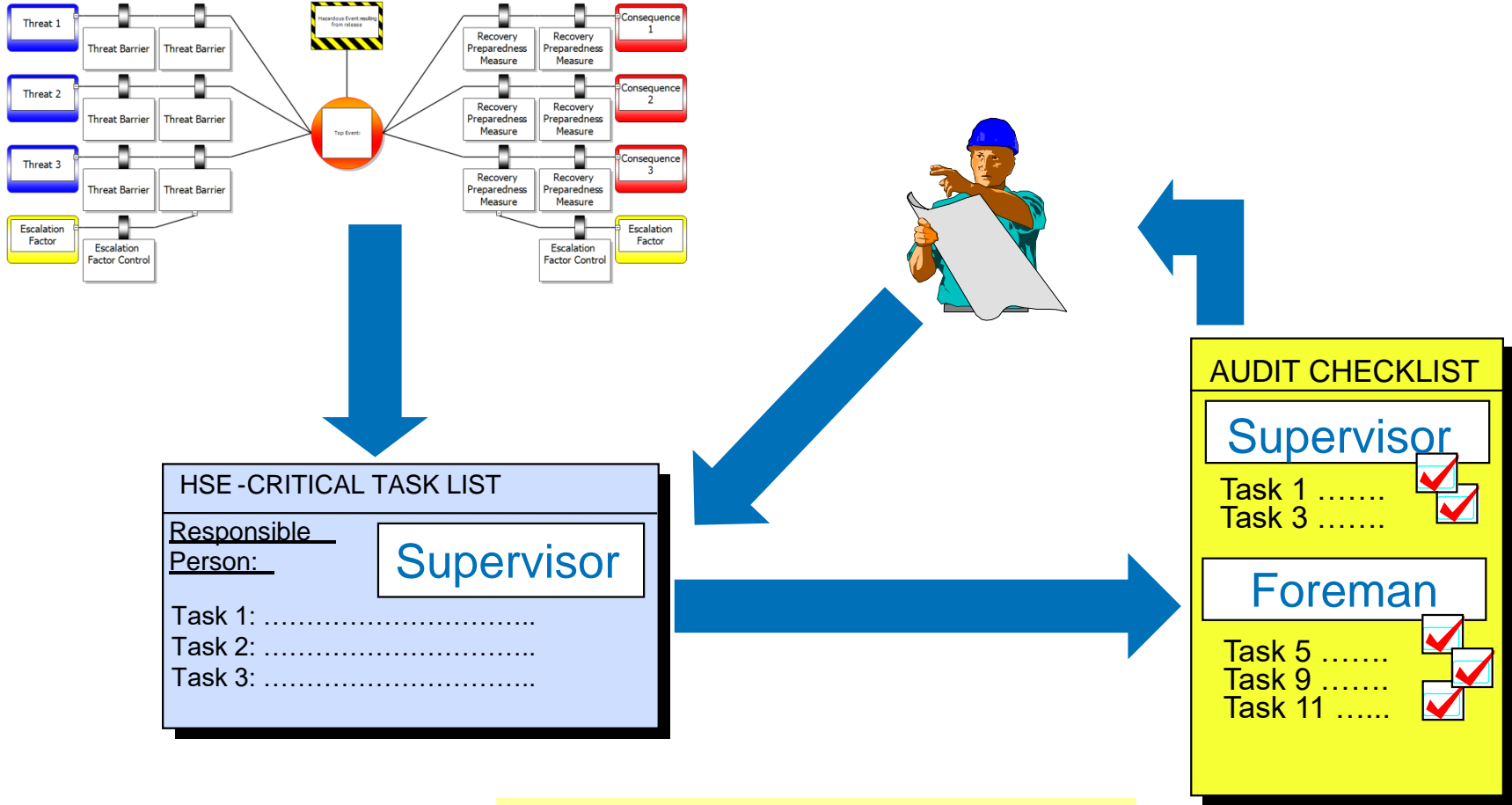
- Personnel information
- Training management
- Competency management
- Document management
- Reporting

Link between bow-ties and procedures

Task	Responsible Person/Task Description	Inputs/Documents	Verification
ABC-22.05	Area Supervisor – Maintain Safety Signage	Ensure safety related signs are maintained up-to -date and in good order - escape routes - exit signs - fire equipment signs - life saving appliance signs	- Inspection and Audit
ABC-12.03	HSE – Manager – Management of Hazardous Materials	Ensure correct storage and handling of hazardous materials in accordance with the requirements identified in the MSDS - secure storage - segregation of incompatible chemicals - use of PPE - appropriate means of transport- inventory management	- HSE audit - area inspections - manifests - non compliance reports
ABC-06.03	Site foreman – Weekly area Inspections of process facilities	Carry out weekly inspections of all site areas: - housekeeping - general condition - general condition - condition of - availability of	- Inspection checklist - Non compliance reports - Non compliance reports

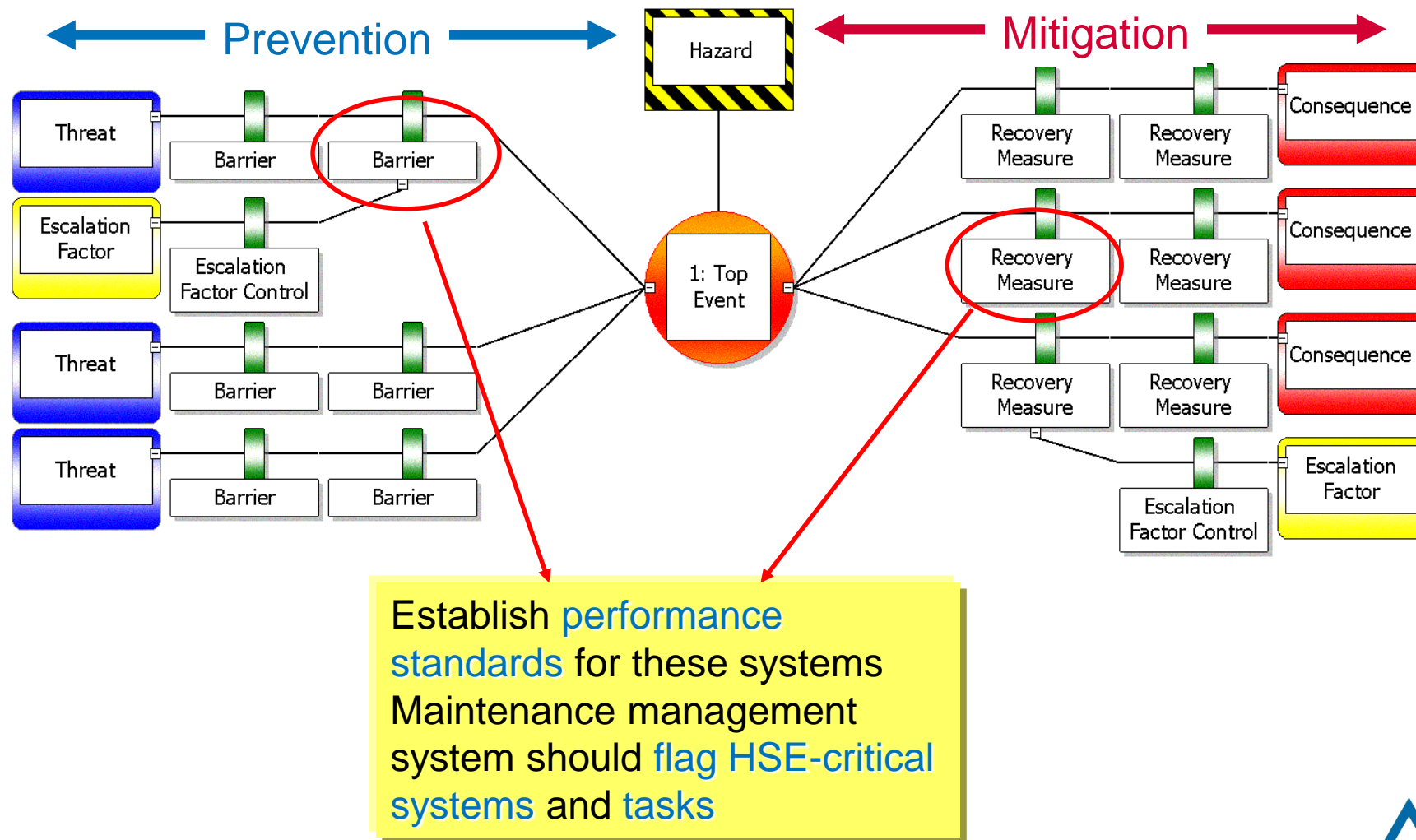
Verify procedures for conducting HSE-critical tasks are complete and effective

Link between bow-ties and auditing



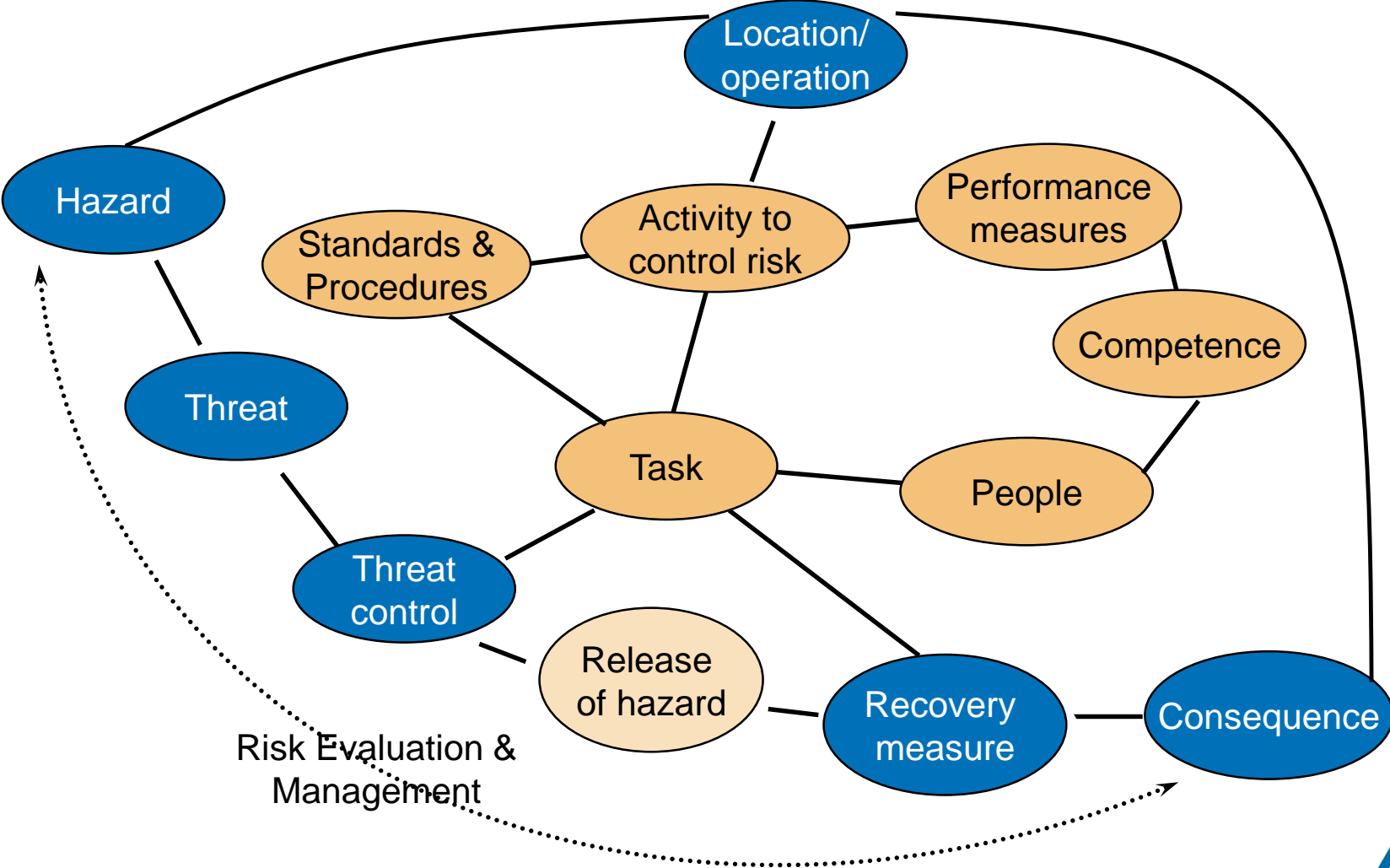
Audits can be focused on what really matters

Link between bow-ties and HSE-critical equipment & systems

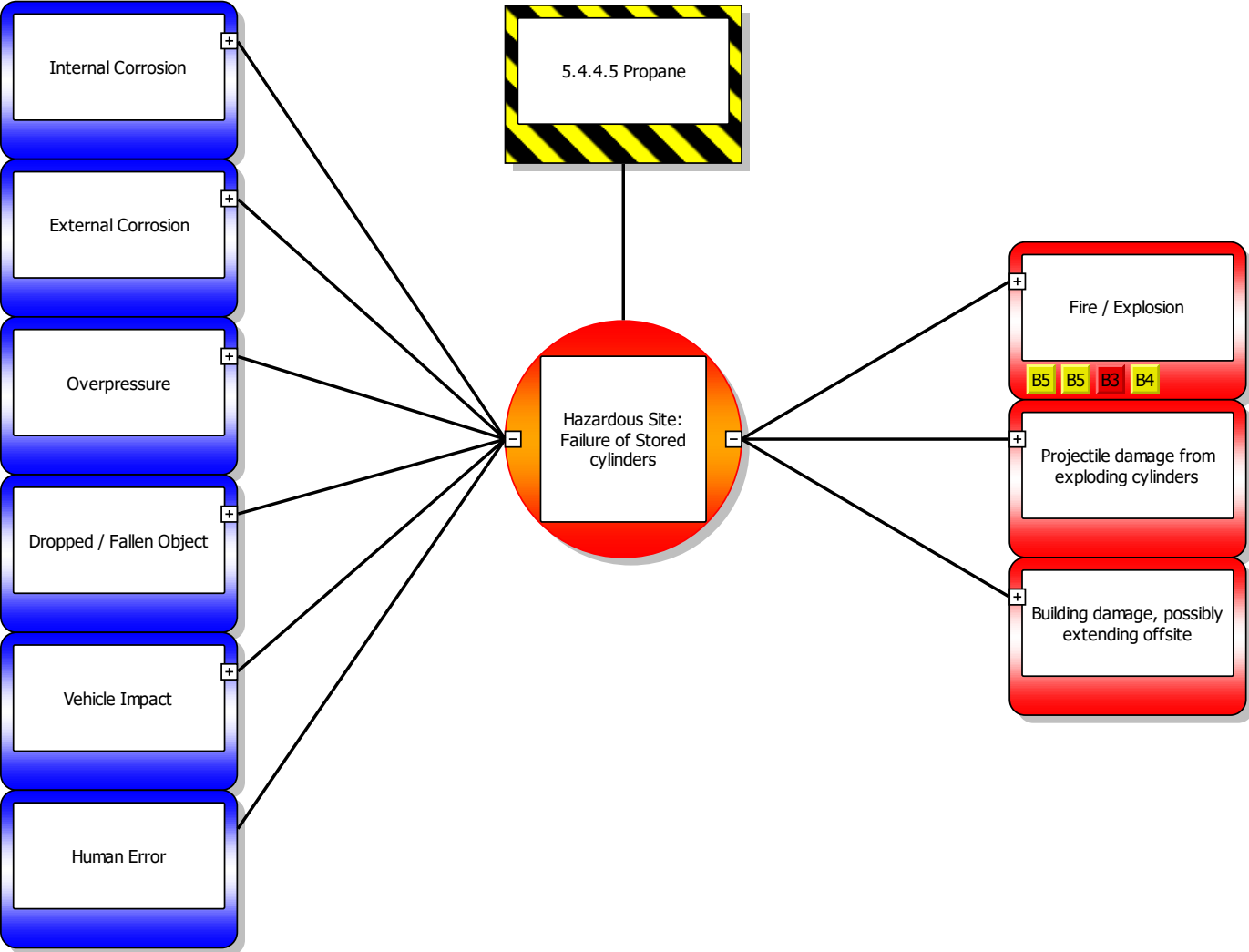


Total hazard control

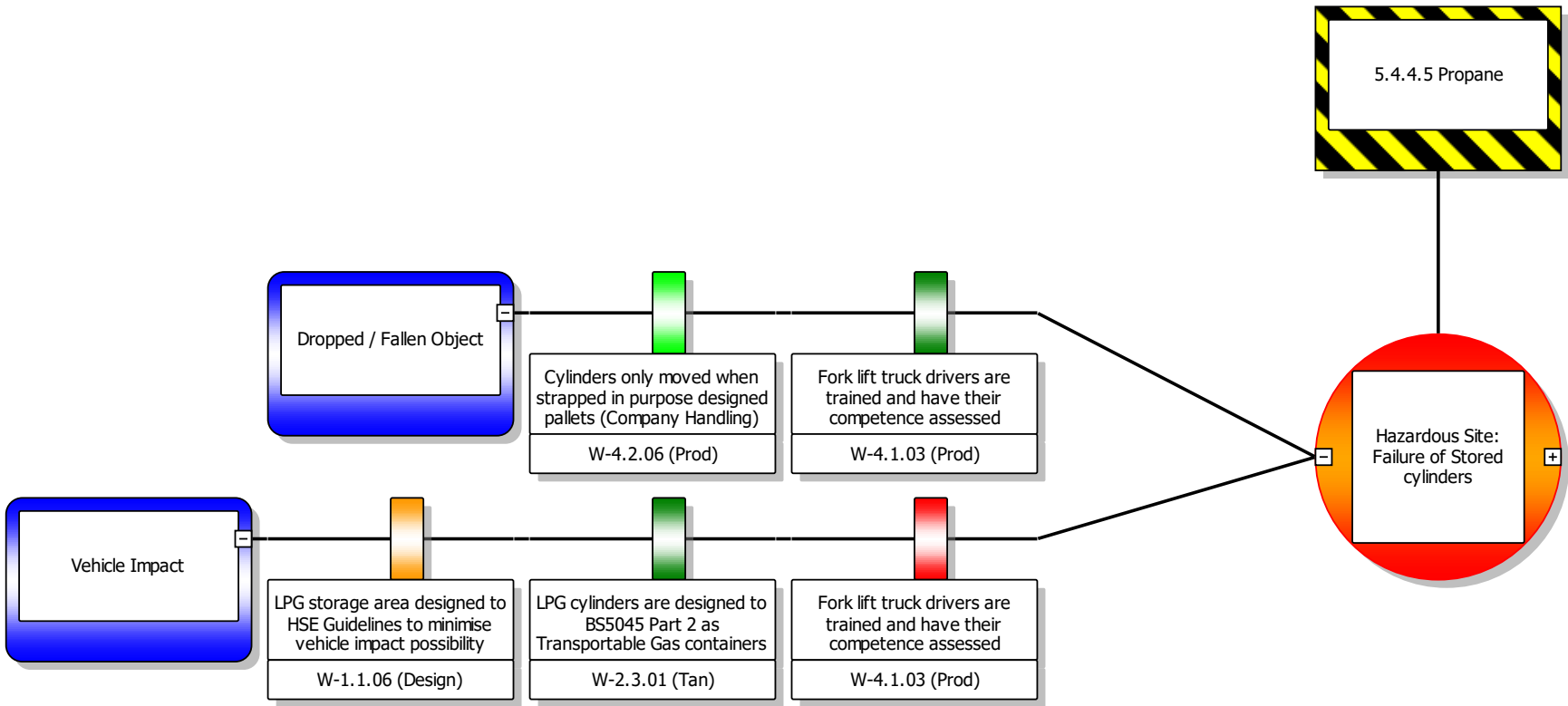
In the end you must have all connections in place for effective hazard control



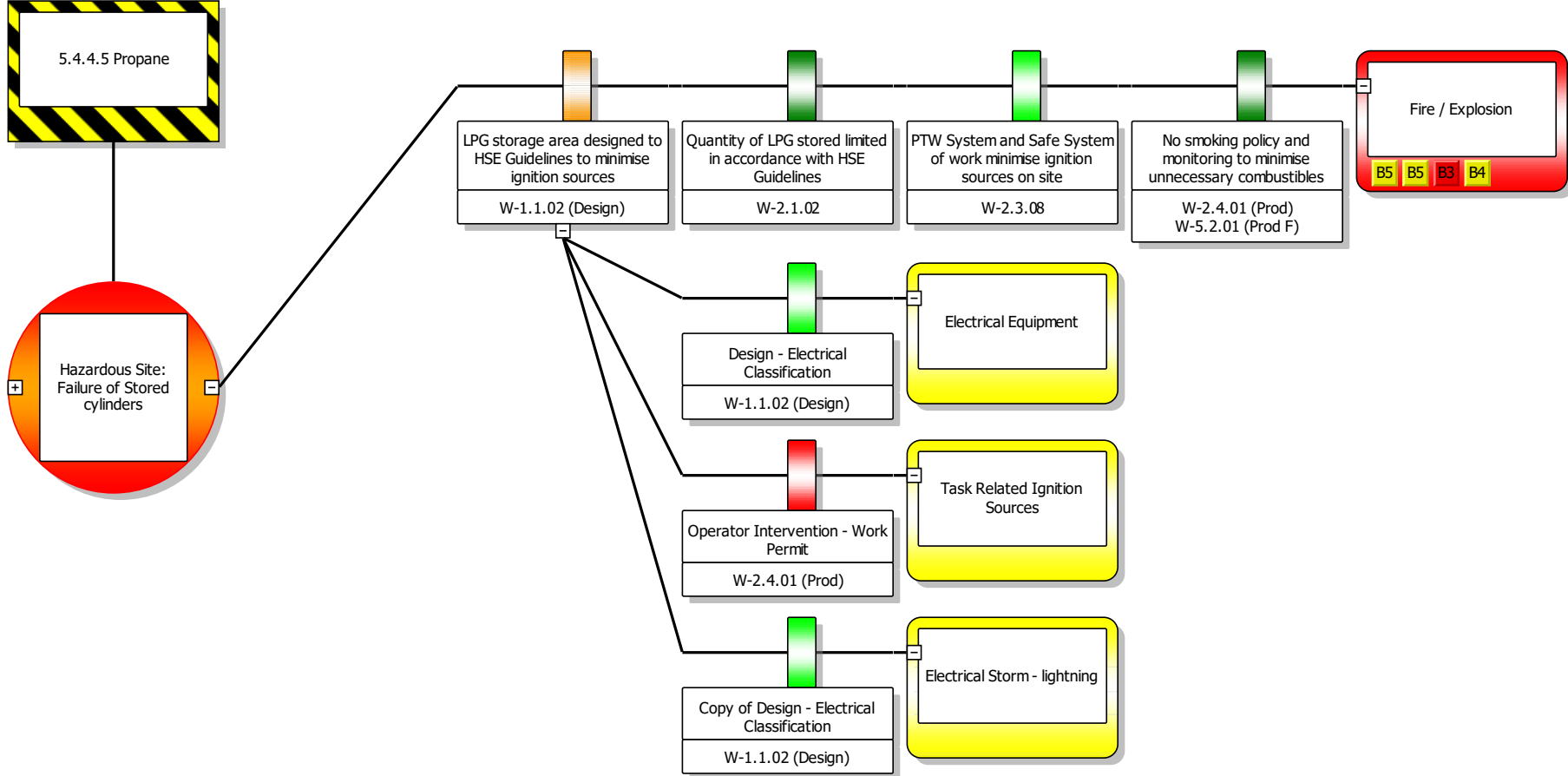
Example bow-tie



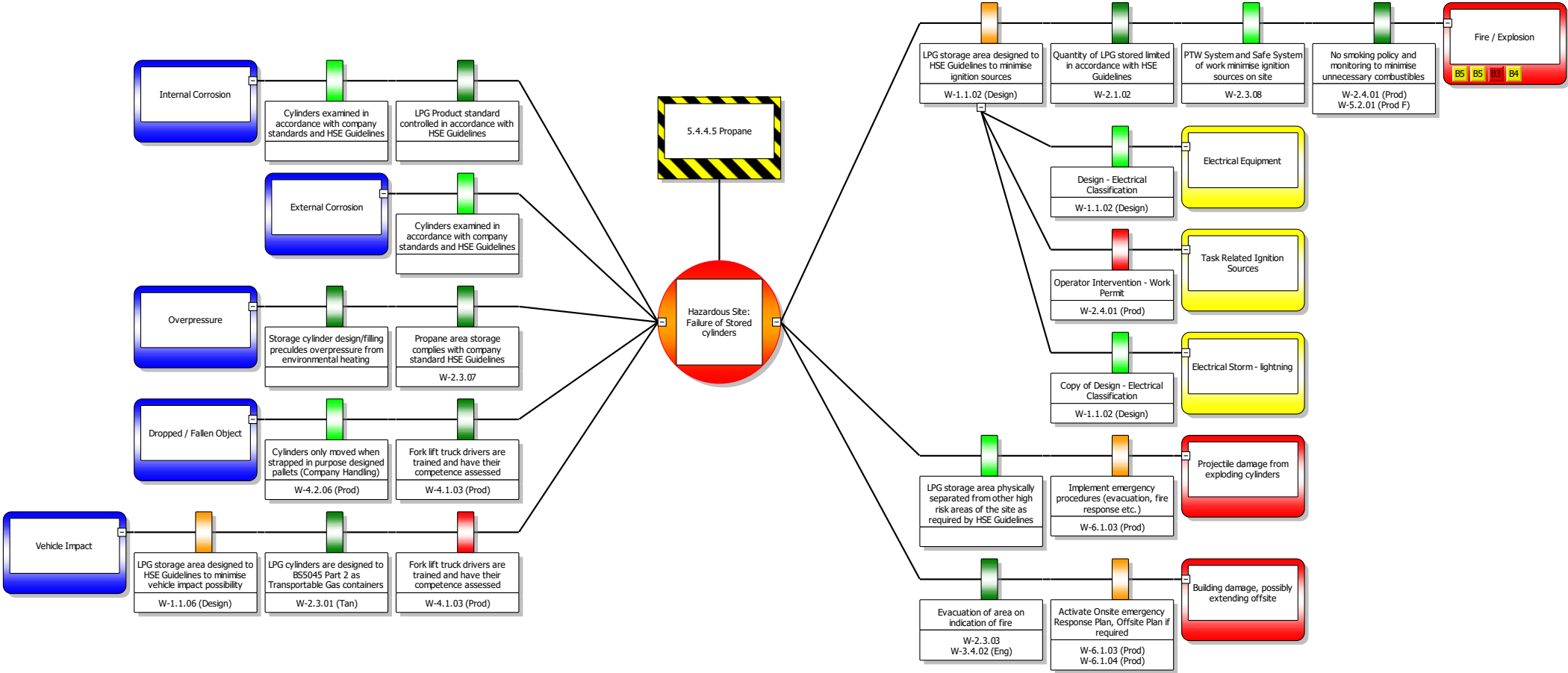
Example bow-tie: threats



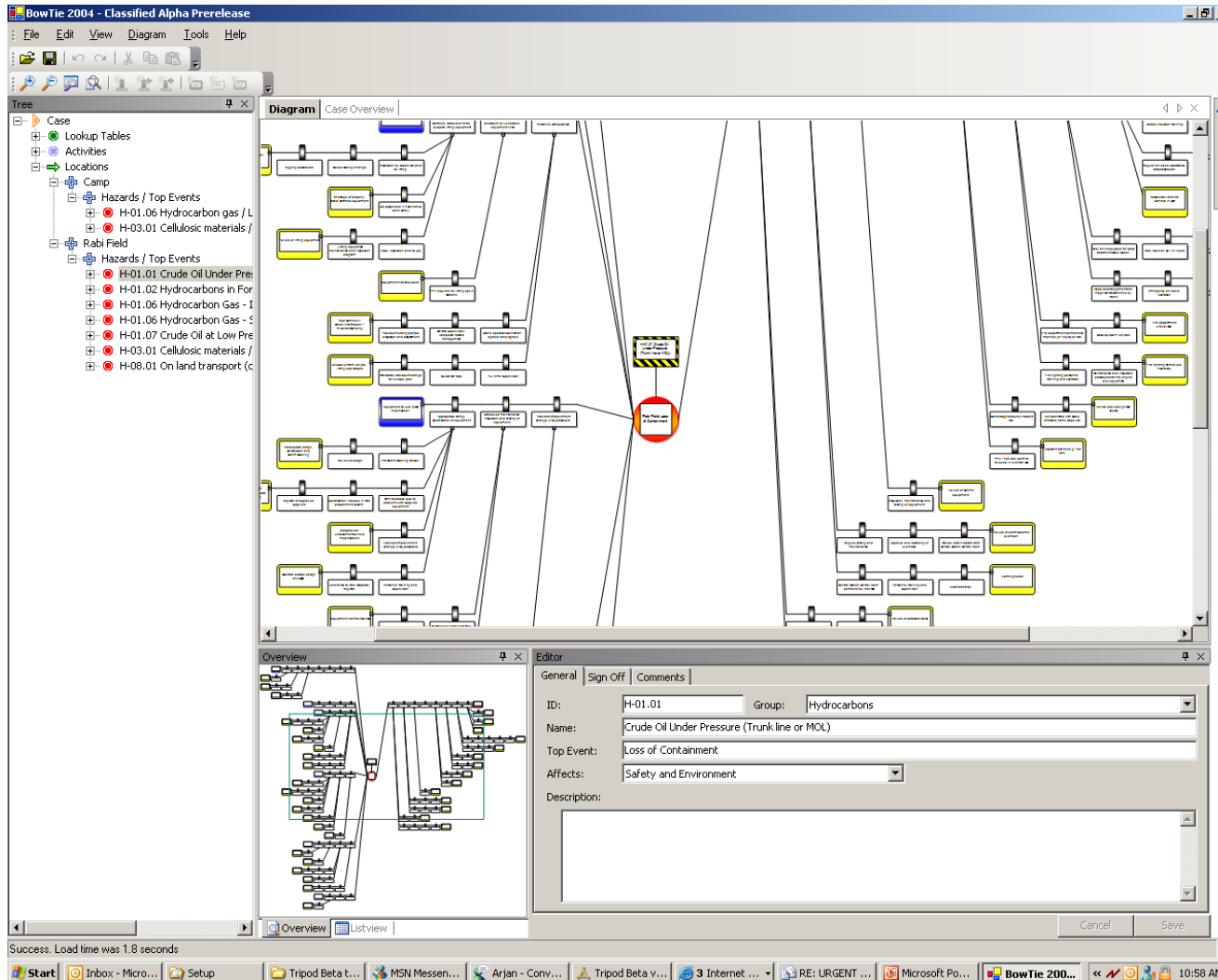
Example bow-tie: consequence



Example bow-tie: complete



Building bow-ties



Software helps but don't get hung up on it!

Benefits are from approach and involving workforce

 BowTieXP

Benefits of bow-tie method

- **Communication** – “a picture paints a thousand words”
- **Ownership** – involves people, gains buy-in, practical approach
- **International application** – overcomes language difficulties
- **All risks** – not just HSE
- **Risk reduction** - identifies where resources should be focussed for risk reduction, i.e. prevention or mitigation

Benefits cont...

- **Fit for Purpose MS** – Links elements of the organisation's MS to specific control
- **Auditable Trail** – the diagrams and critical tasks provide protocol around which auditing by internal depts focuses on what people are actually doing rather than physical systems

Limitations

- Entirely qualitative
- Does not replace other techniques (JSA, method statements, etc.) – is complementary to them
- Depends on experience of personnel and active workforce involvement
- Ensure controls in bowtie are truly independent

But if you want to remove mystique of risk management and obtain insights into your risk controls that are easy to understand and easy to communicate, there is no better method than bow-ties

Tips for success

1. Keep end objective in mind - pitch at the right level
2. Involve the right people
3. Avoid barrier counting
4. Use method to full potential
5. Verify controls and tasks

Summary

- The **Bow-tie Diagram** is a user-friendly, graphical illustration of how hazards are controlled
- Effective risk management is only possible if people are assigned responsibilities for controls via **HSE-Critical Tasks**
- Visible links are made to **HSE-critical systems** and **competencies** and **auditing**
- The total methodology demonstrates not only what controls are in place **today**, but why they will still be there **tomorrow**

Thank you for your attention

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