

TOTAL PETROCHEMICALS

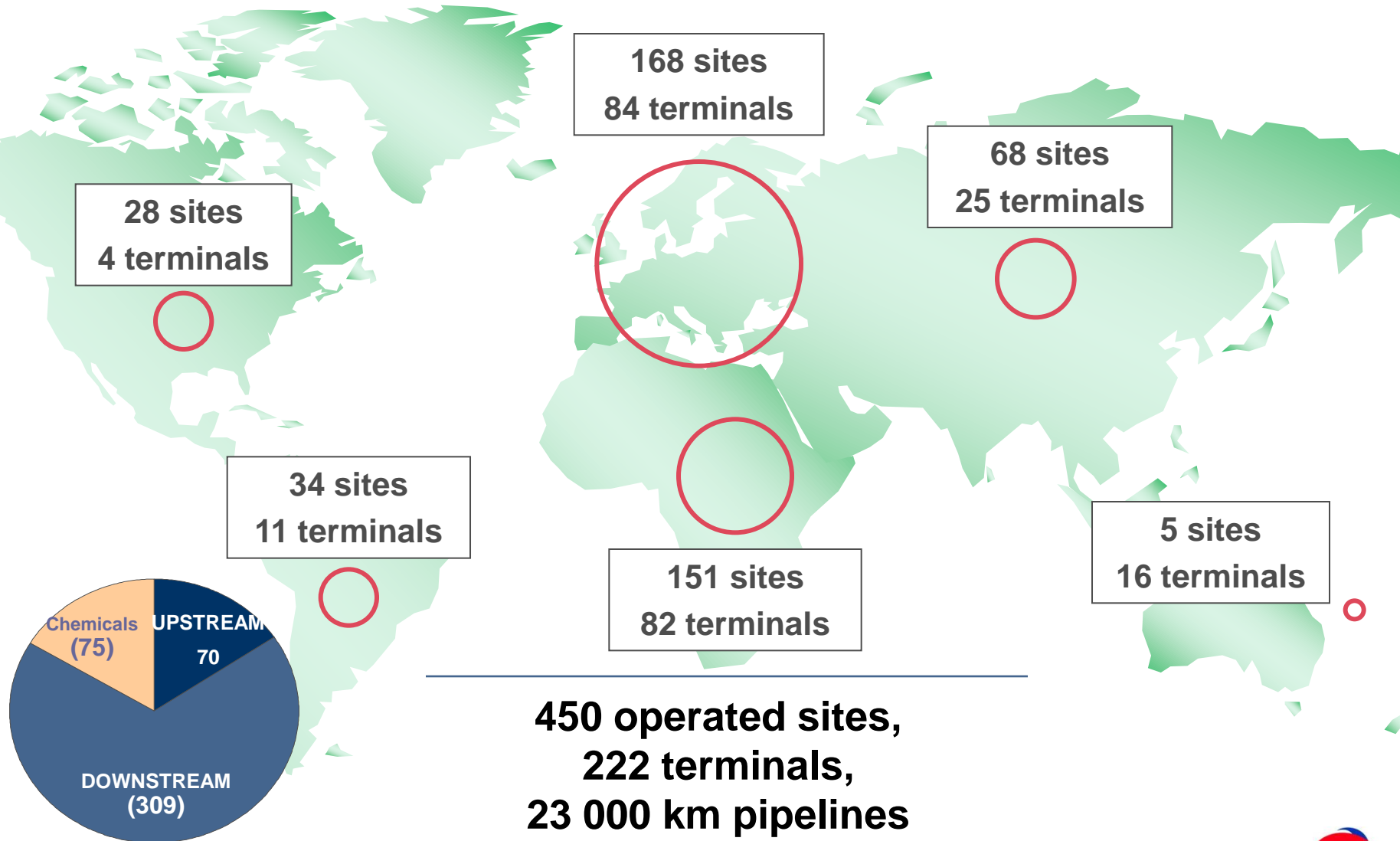
From Incident Reporting to Rule Based Management

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Marcus Evans 3d Annual Behavioral Safety Management, Amsterdam, May 17th 2011



TOTAL : hundreds of high risk installations worldwide



Several approaches exist in our industry

- ▶ **“Hearts & Minds”**

- ▶ **“Grab them by their balls and their throats, and their hearts and minds will follow”**

For all : “Safety first” = also “survival first” ...
(the duty of every business)

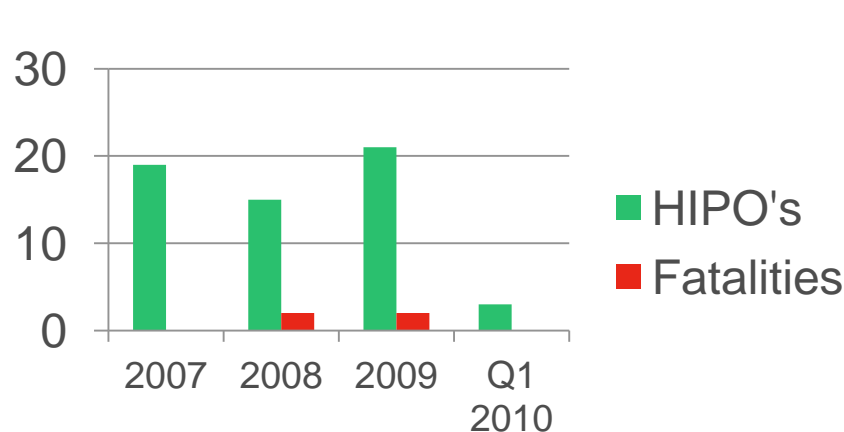


Value of Incident Investigation

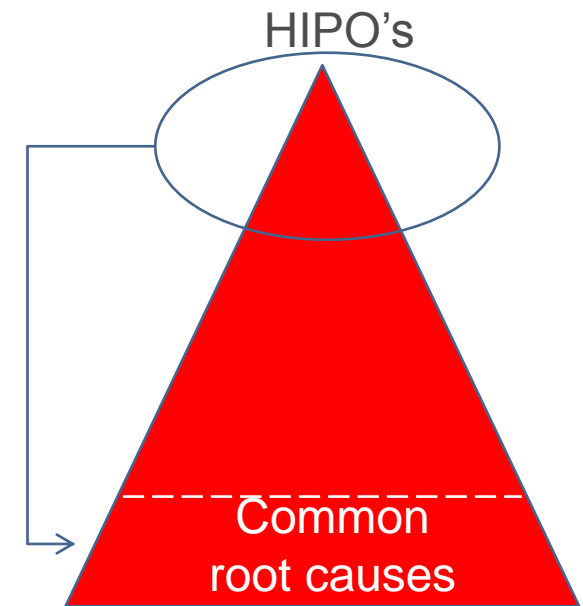
- ▶ It is 100 x easier to learn from an accident / incident than from normal situations.
- ▶ Therefore, accidents / incidents must be seen and nurtured as a high value object (diamond) : in order to extract it's full learning potential.
- ▶ Opportunity for the involved site to transform their problem into something positive for Total Petrochemicals (“REX” = “return of experience”).
- ▶ Incident reports are centralised, translated and distributed to all sites.
- ▶ Strong focus on High Potential (HIPO's) : often Process Safety

High Potential Incidents : strong focus

- HIPO's : under slightly different circumstances, these incidents could have been category 4 or 5 incidents (~multiple fatalities)
 - Difference with cat. 4/5 is ...**just luck**



TOTAL
Petrochemicals



HIPO problem

Why didn't we see these coming ?

LPG derailment by push & pull without break connection between 2 locomotives



Unadapted tractor for heavy load on unbroken wagon, almost damage to hydrocarbon pipes



Collapse of new storm basin during first test, damage to hydrogen line with leak and site evacuation



Why wasn't this prevented ?

5 ton benzene spill by rupture of bellow after visual misalignment (15mm)



Crane without support shoe on unstable ground : disaster just avoided



Worker died while moving persons lift from cabin using cabin arm as counterweight

Do we continue mastering the basics of our profession ?

500 kg propylene cloud during 1 hour
after contractor removed valve on
reactor body under pressure



2 operators died and 6
got burnt by explosion
of superheater during
startup



2 workers wounded by explosion of sulphuric acid
tank in which hydrogen had formed by adding water

Common findings

as produced by actual Incident Investigation system

Root causes for human error :

Lack of Competency

Procedure not followed

Procedure incomplete

Which people ?

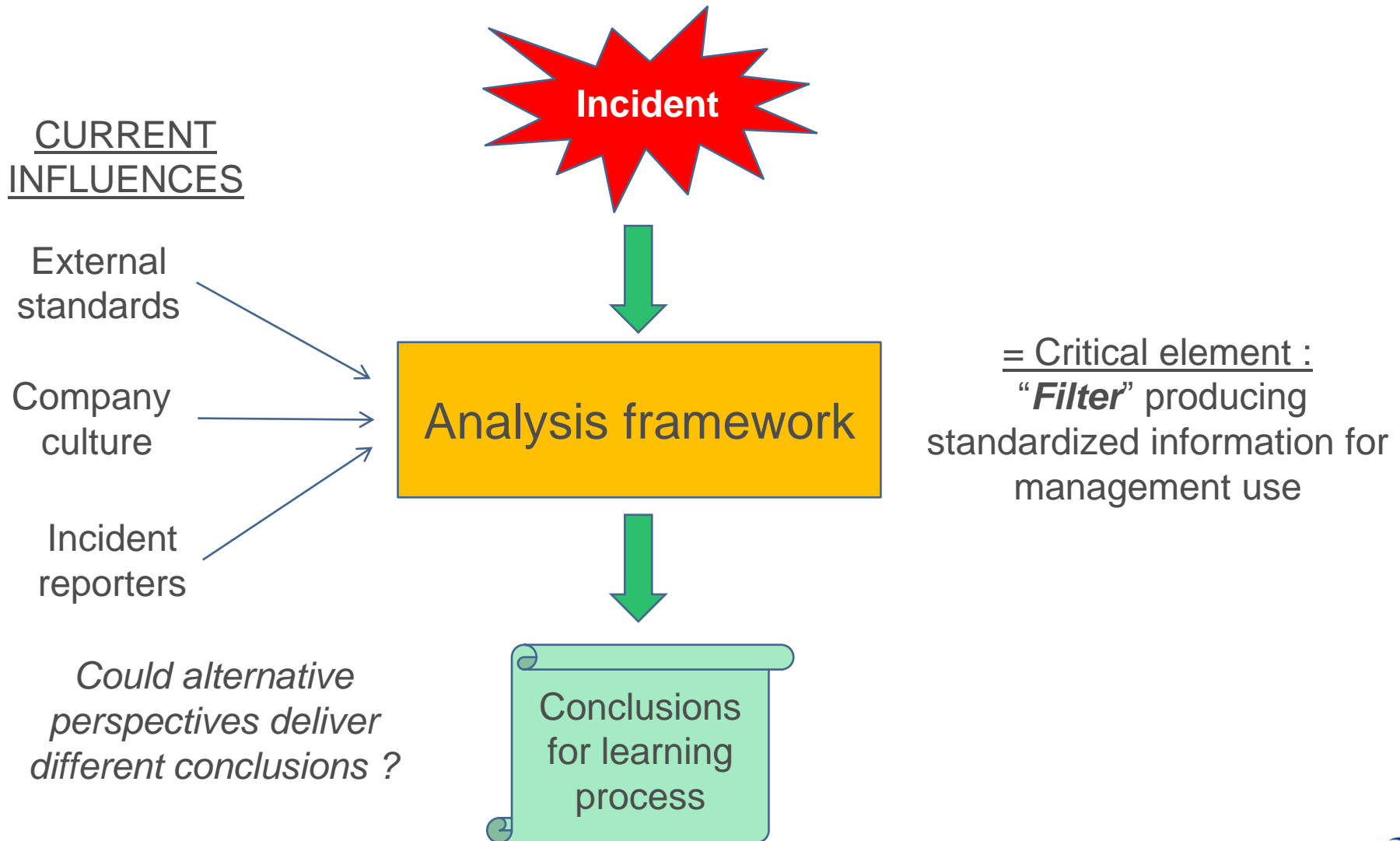
Often contractors

Sometimes maintenance

Seldom production

Never the management

Could we be misled by our Incident Investigation?



“Filter” elements in the Incident Investigation process (1)

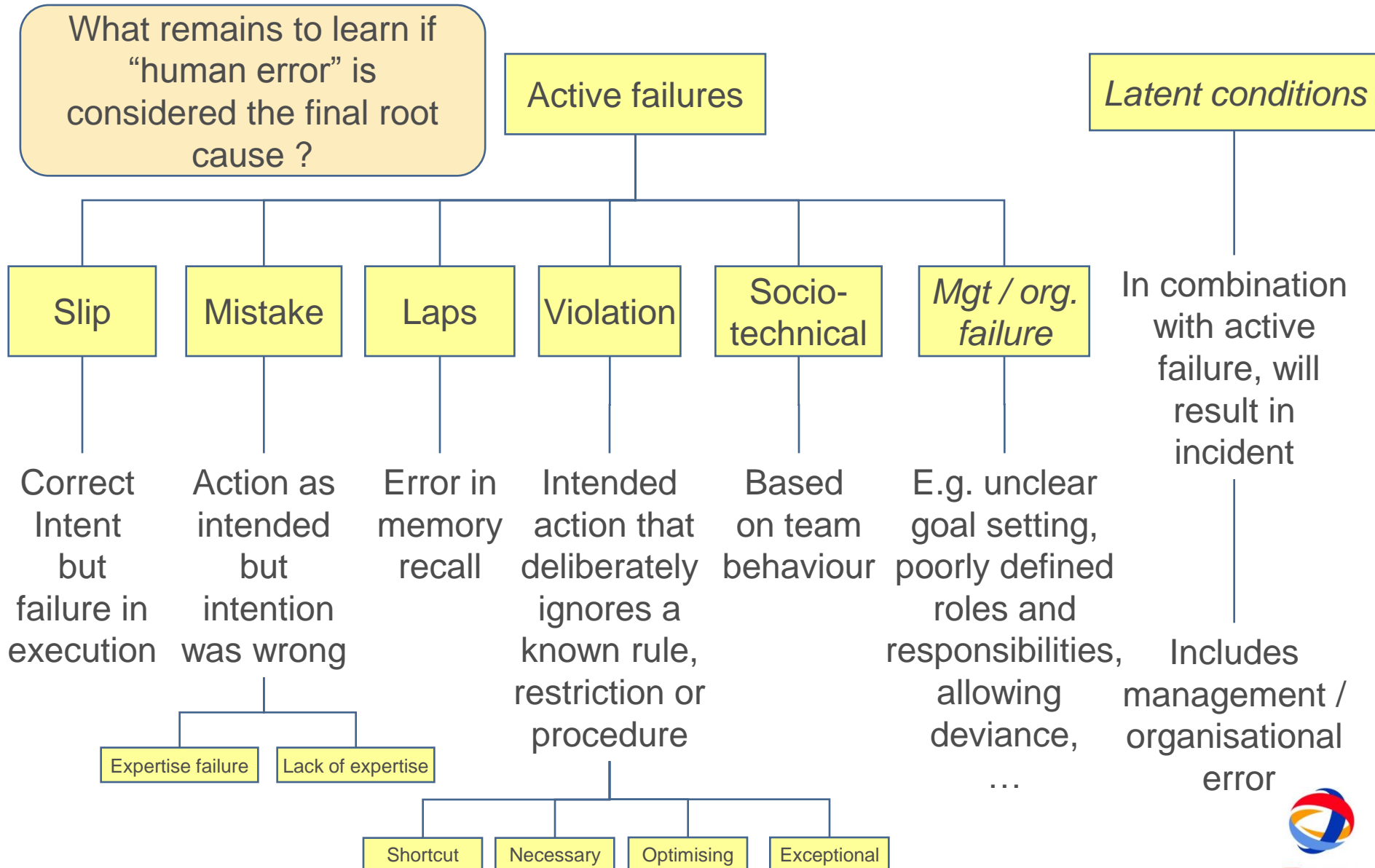
► *Relevant segmentation of root causes :*

- produces pre-determined root causes ‘by construction’, based on current perception of what the problems might be
- contains whatever our company culture is anticipating ...

(Example “Human error typology”)

Human Error typology in the Process Industry :

Classification according to CCPS



“Filter” elements in the Incident Investigation process (2)

► *Relevant segmentation of root causes :*

- produces pre-determined root causes ‘by construction’, based on current perception of what the problems might be
- contains whatever our company culture is anticipating ...

► *The reporter perspective :*

- personal involvement and feeling of accountability in the incident will certainly impact the analysis outcome (human factors...)

(ref. ICSI : “LE RETOUR D’EXPÉRIENCE : ANALYSE BIBLIOGRAPHIQUE DES FACTEURS SOCIO-CULTURELS DE RÉUSSITE”)

(example supervision failures)

Aviation Industry example : unsafe supervision failure modes *explicitely standardised and tracked*

What would remain if the supervisor himself could choose between these and “other cause” ?

Unsafe supervision

Inadequate supervision

- Failed to provide guidance
- Failed to provide operational doctrine
- Failed to provide oversight
- Failed to provide training
- Failed to track qualifications
- Failed to track performance

Planned inappropriate operations

- Failed to provide correct data
- Failed to provide adequate brief time
- Improper manning
- Mission not in accordance with regulations
- Provided inadequate opportunity for crew rest

Failed to correct a known problem

- Failed to correct document in error
- Failed to identify an at-risk aviator
- Failed to initiate corrective action
- Failed to report unsafe tendencies

Supervisory violations

- Authorised unnecessary hazard
- Failed to enforce rules and regulations
- Authorised unqualified crew for flight

from Shappell & Wiegmann, 2001

Incident Investigation Paradox

1.

- Up to 80% of all incidents are related to human error
- Up to 80% of all human error is related to organizational matters

2.

- Up to 80% of all incidents are related to worker's behavior
- Worker's behavior is overwhelmingly influenced by their management

► So :

- ***Why are organizational matters not the primary criterion of the incident investigation ?***

State-of-the-Art external reference : the ASMC

Abnormal Situation Management® Consortium



- R&D consortium of 15 companies and universities
 - Initially co-funded by US Govt (NIST) +\$16M for first 4 years
 - Jointly invested +50M\$ over 15 years
 - Creating knowledge, tools and products designed to **prevent, detect and mitigate abnormal situations** that affect process safety in the control operations environment
- Charter
 - Stage 1 (1994-1998) : Research
 - Stage 2 (1999-2001) : Prototyping
 - Stage 3 (2002-2004) : Development
 - Stage 4 (2005-2008) : Deployment
- Deliverables
 - Technology, prototypes, guidelines, best practices, metrics, application knowledge, workshops, products



www.asmconsortium.com

ASMC's view on the operator : a concept shift



Operator = unavoidable source of errors and losses

- ▶ Human errors are at the origin of most incidents
- ▶ Performance objective = avoid depending on human intervention for safety, reliability, ...
- ▶ Technology = a tool to reduce the exposure of the process to human intervention and errors from operators
- ▶ Operator error = caused by not following procedures and / or lack of competency

Operator = unique source of safety and reliability

- ▶ Unique human contribution = *manage abnormal situations* (anticipate, detect, respond)
- ▶ Performance objective = maximize the operator's impact on his process, by all means
- ▶ Technology is a tool to boost the *Human Reliability* of the operator
- ▶ Operator error = failure of operational and technical *management* to adapt work to human characteristics of operator

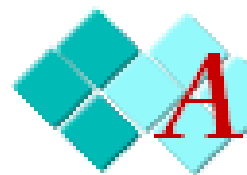
How does the ASMC boost the operator's structural ability to control the process under all circumstances ?

- ▶ By focusing on following 7 areas in solution development, from conceptual research to effective deployment
 1. Understanding ASM - Focuses on issues that can lead to a better understanding of current incident causes providing insight to reduce future abnormal situations and to prepare operations teams accordingly
 2. Management Structure & Policy - Focuses on the impact of management structure and policy on the ability of the operations team to prevent and respond appropriately to abnormal situations
 3. Training & Skill Development - Focuses on the impact of training and skill development, in anticipating and coping with abnormal situations
 4. Communications - Focuses on communications issues among plant personnel with or without the use of information technology under normal, abnormal and emergency situations
 5. Procedural Operations - Focuses on all aspects of procedures used to accomplish critical operations at an industrial site, particularly startup/shutdown
 6. Control Building & Operations Environment - Focuses on the impact of the control building environments on effective operations
 7. Process Monitoring Control & Support - Focuses on process monitoring, control and support applications for effective operations. It includes such aspects as alarm management and early event detection.

Detailed 2008 survey on public and shared member incidents revealed a key insight :

ASM Key Message

- Current incident reporting approaches do **NOT** **effectively capture the influence of human reliability** on process safety or abnormal situation management performance

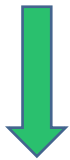


ASM Typical Practice Today

- Current incident reporting systems have evolved within the safety departments
- Outcome metrics tend to emphasize personnel safety and impact on injuries and lost work days
- Causal metrics tend to focus on equipment reliability
- Operations interested in capturing production related events are evolving separate reporting systems,
 - Often with separate causal factors

ASM Consortium “deep dive” on communication and coordination failures

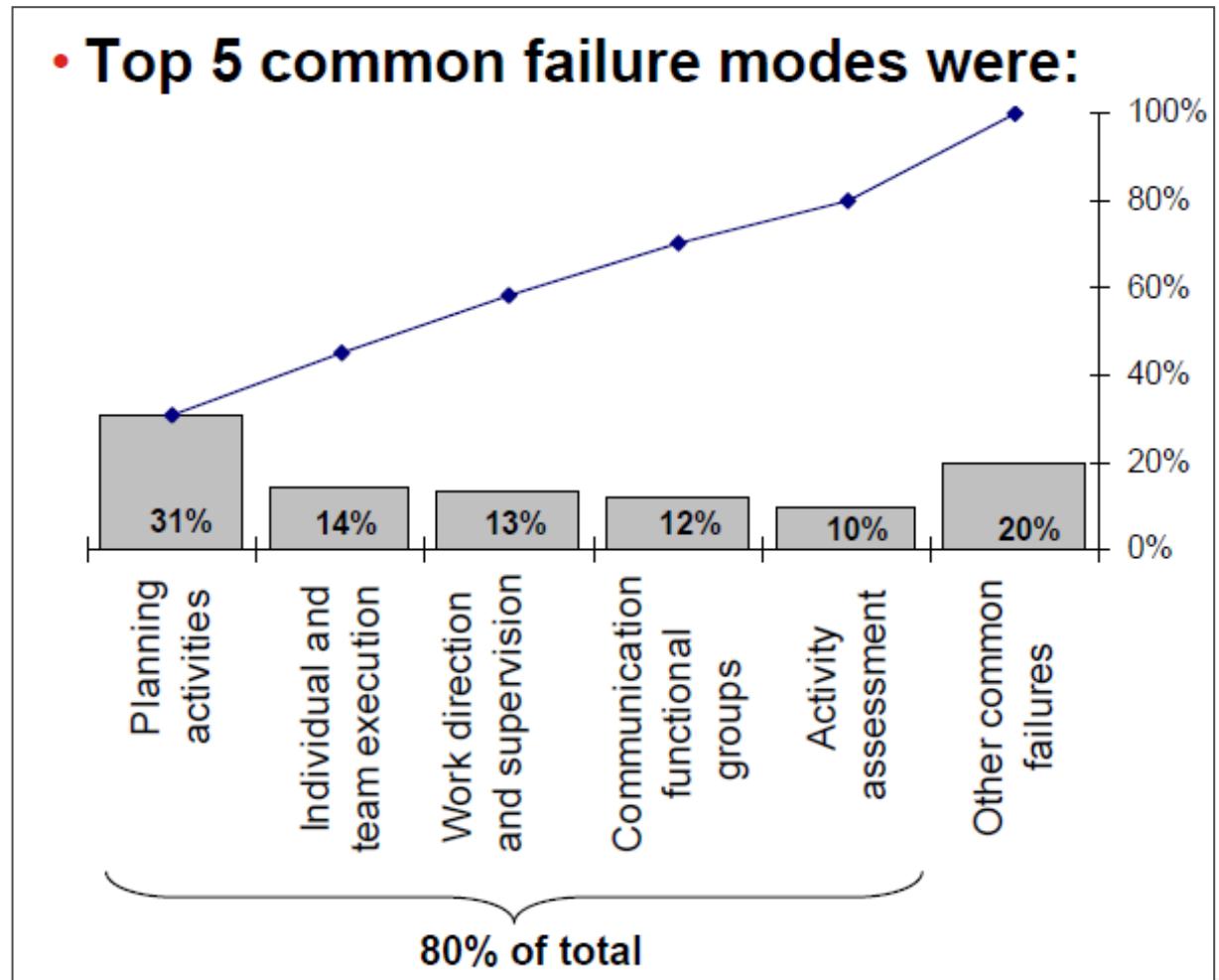
14 selected incidents



207 failures

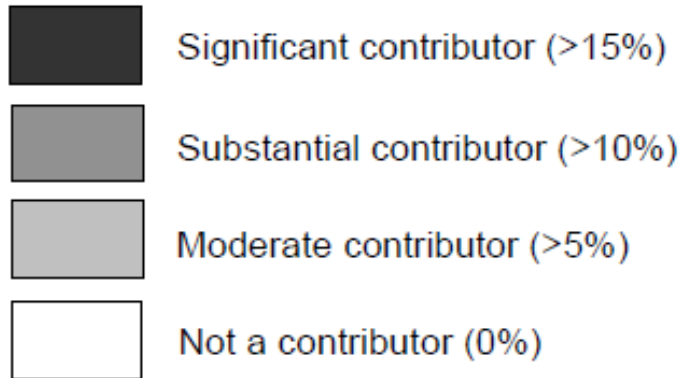


80% = 5 failure modes



“Deep dive” insight

- Common root causes show why failures occurred across incidents



Root Cause	Combined for Top 5	Planning activities	Individual and team execution	Work direction and supervision	Communication between functional groups	Activity assessment
	%	%	%	%	%	%
No SPAC	12.2%	20.4%	8.6%	7.8%		15.2%
Crew teamwork needs improvement	11.1%	7.4%	15.5%	17.6%	6.5%	12.1%
SPAC not followed	8.8%	7.4%	19.0%	7.8%		9.1%
No communication	8.4%	6.5%		5.9%	32.6%	
No supervision	7.4%		12.1%	19.6%		15.2%

SPAC – Standards, Policies, Administrative Controls

Who is in charge of this ?

Management emphasis on Human Error approach in the Aviation Industry

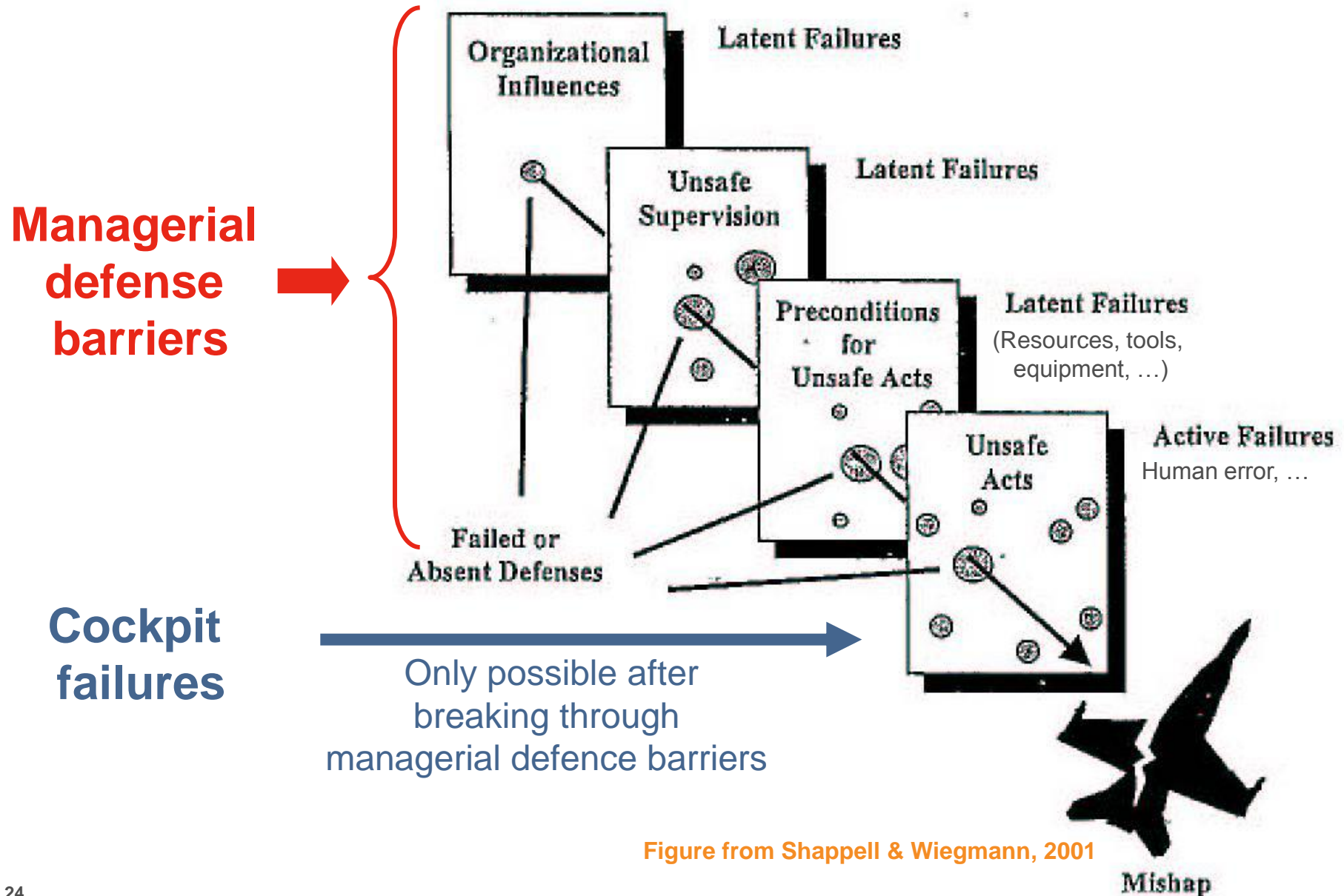


Figure from Shappell & Wiegmann, 2001

The Operational Management as Defense Barrier

► High level mission :

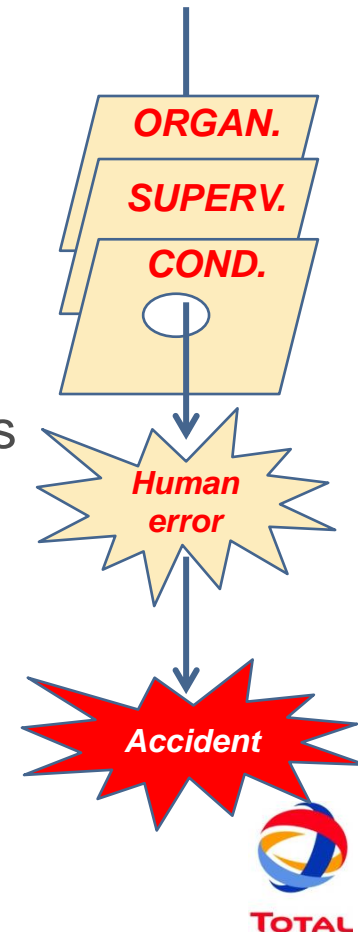
- *Conduct the operations at a high standard of total safety and effectiveness*

► All accidents can be prevented by ensuring

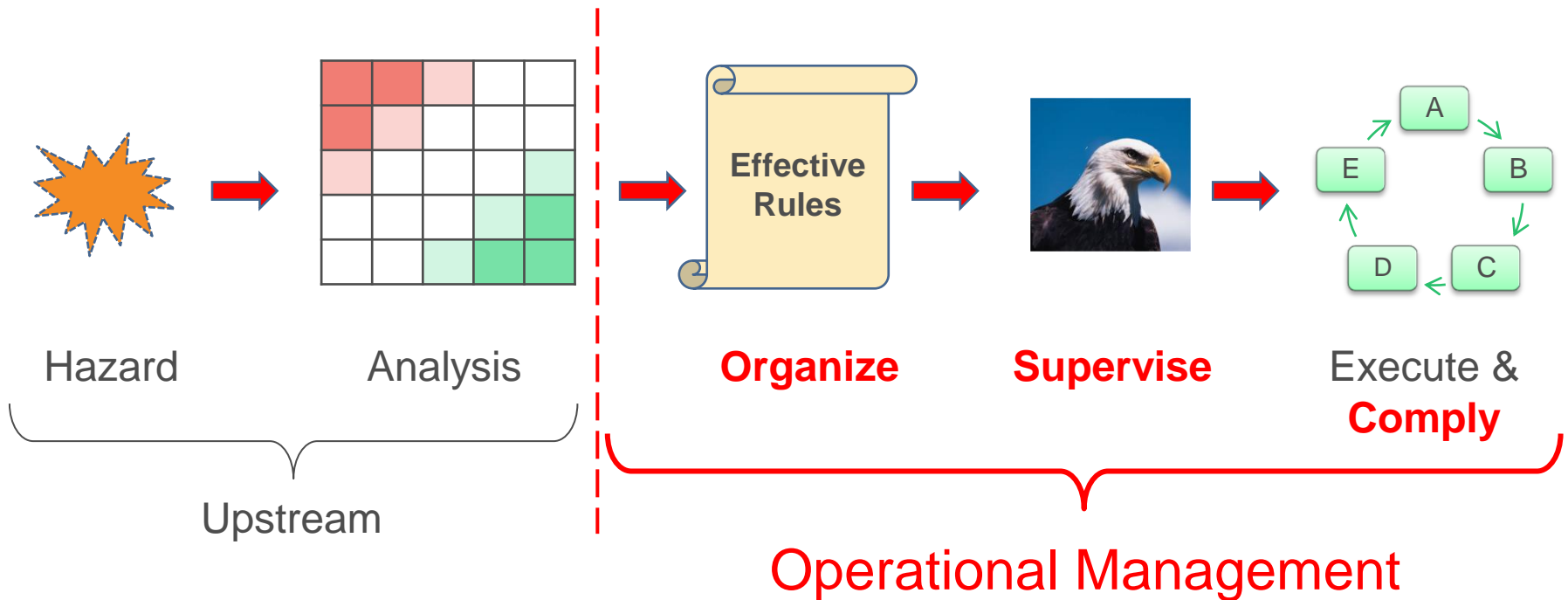
- That every hazard is identified
- That effective organizations (rules) are in place against every hazard
- That the rules are effectively implemented
- That all conditions are adapted to the work requirements

► Also human error ...? YES

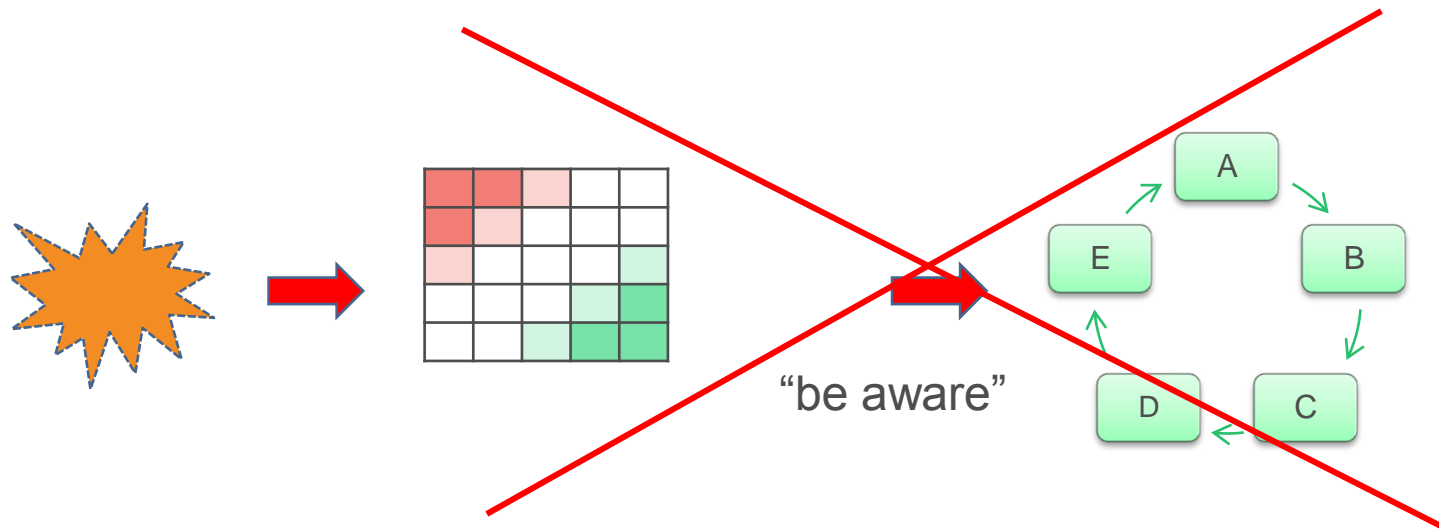
► How about risk and probability considerations ?



Message : Operational Management = *Rule Based* !



Without good rules and compliance : “stuck in the matrix”

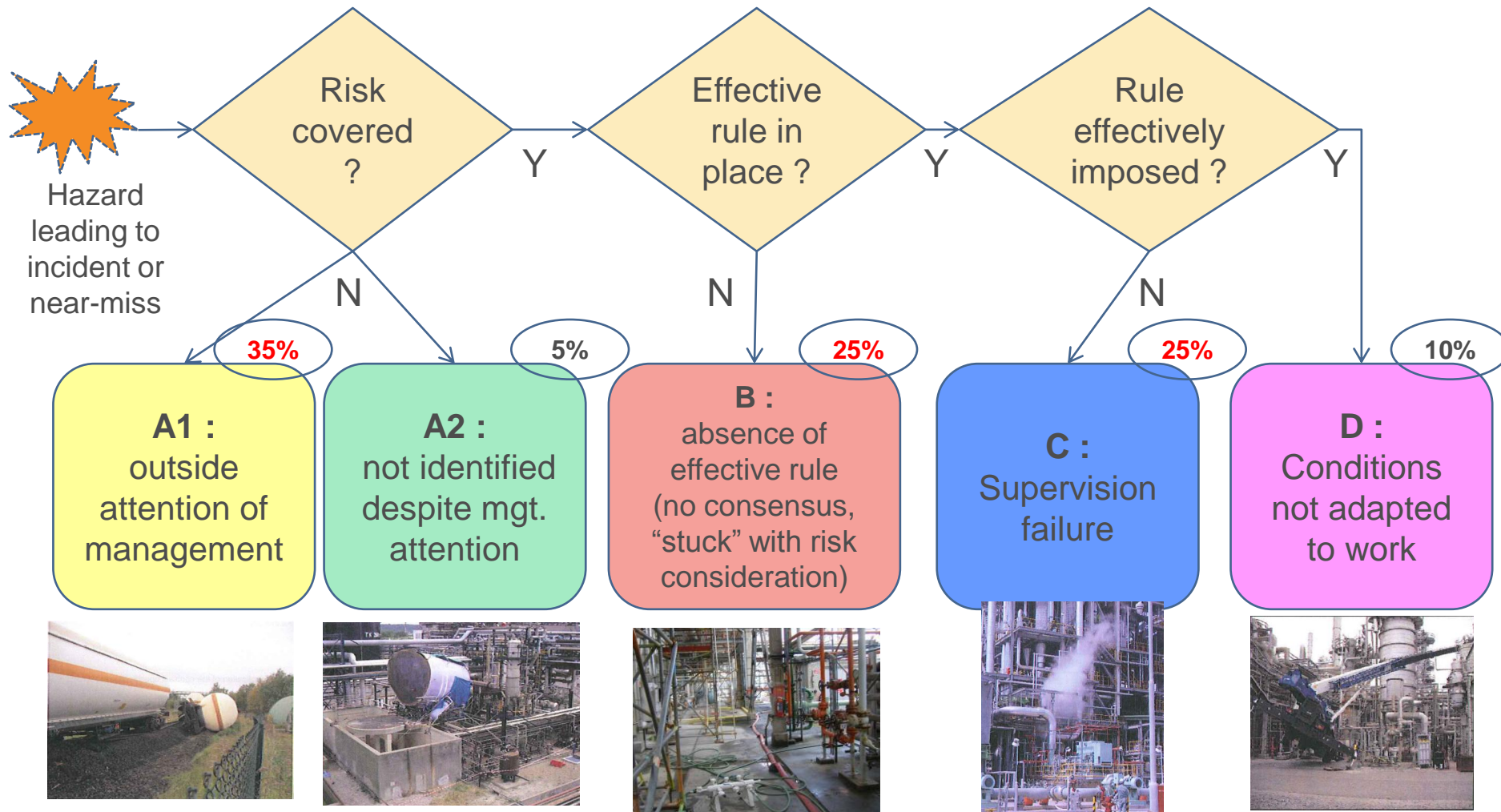


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Operational decisions require guidance with rules, not just *risk considerations and awareness*

- *Should I wear a hard hat on a production site, to reduce the risk of being injured by falling objects, or not?*
- *Is it too hot to work in the normal way, or not?*
- *Am I too fatigued to fly this aircraft, or not?*
- *Should I stop a process now because of the risks involved, or not?*

Effectiveness of Managerial Defense Barriers as criterium for incident investigation



- Advantage : categories identify clearly the corrective action to be taken, by the only resource which has direct impact : the operational management

Observed recent tendencies undermining the excellence of the *human manager*

► Effect of outsourcing and lump sum contracting

- Considered “not core” for the company : human (managerial) reaction = focus on other aspects which have hierarchy attention
- Contractual result = prescribed : human reaction “not my problem any more” (mgt. failure cat. A1)
- After a while : “we are not competent for this, we have no professional experience”

► Risk and probability considerations in operations :

- Message to the young manager = whatever you do, these (the matrix) are the probabilities that incidents happen in your area ... and everyone knows it and agrees
- Degradation of good rules by “add-on” in order to move at lower risk position in matrix
- Human reaction : “ despite the 10^{-4} it happened in my duty : just bad luck”

► Audits focused on administrative ‘management *systems*’

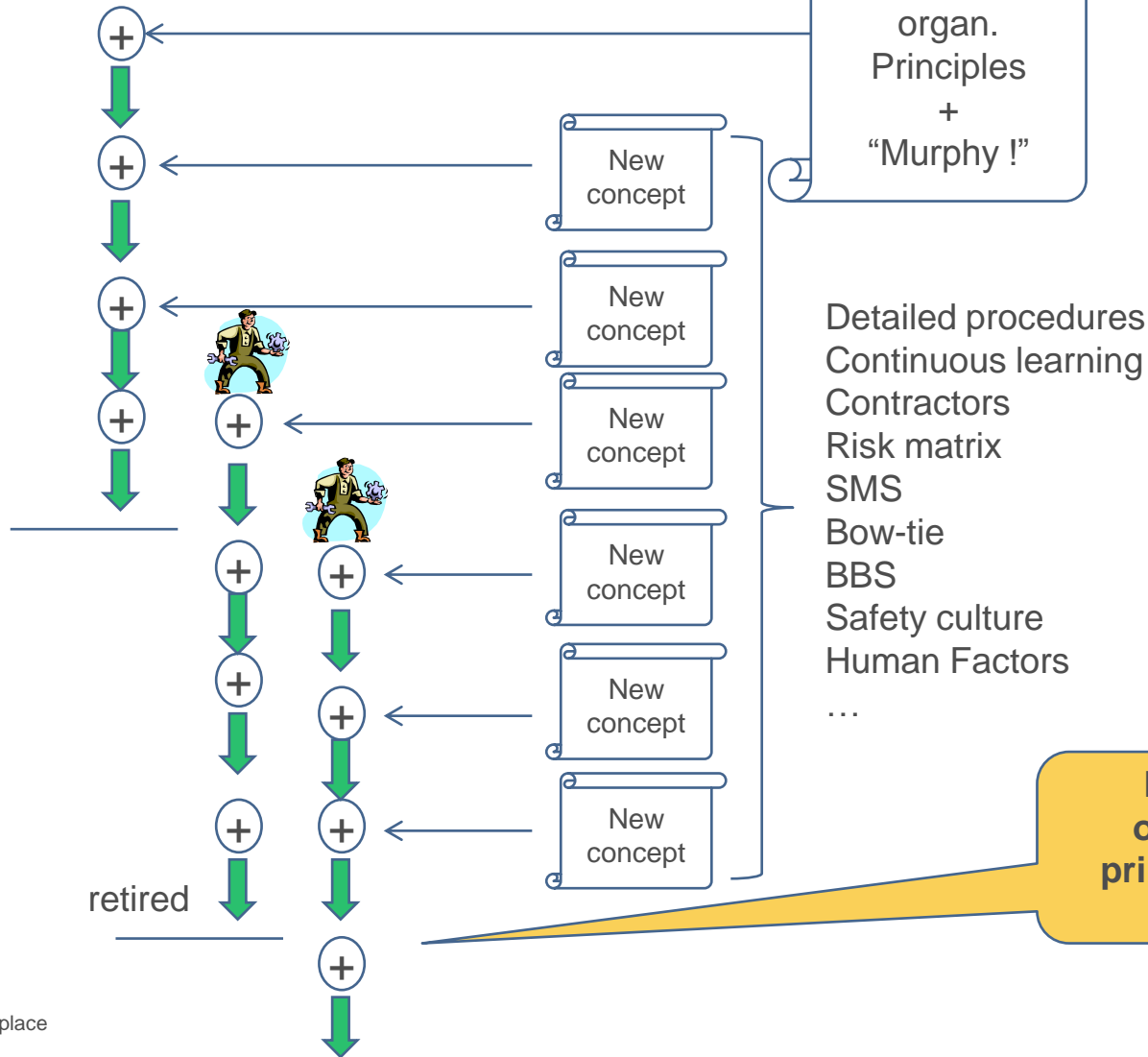
- Instead of detecting field weakness to trace underlying management problem
- General score system leading to “congratulations” may stop the learning and reduce the essential “sense of vulnerability”

Organisation's competency evolution

1950...
1980



hired



Training :
Fundamental
organ.
Principles
+
"Murphy !"

Mtce vs. prod. perimeter
Permit vs. execution
Signature commitment
Single line of command
Written instructions
TAG numbering
Nothing w/o work order
Supervision
Perimeter of accountability
...

Detailed procedures
Continuous learning
Contractors
Risk matrix
SMS
Bow-tie
BBS
Safety culture
Human Factors
...

2000...
2010

retired

**Fundamental
organisational
principles ? Never
heard about**

What are “good rules” for the Process Industry ?

- ▶ Simple to understand
- ▶ Universally applicable
- ▶ Focused on avoiding human error
- ▶ Not necessarily the most efficient way to do things, but their universal application generates *overall predictability of the complex reality and overall efficiency*
 - Cfr. Airplane landing
- ▶ Specifically reinforcing Process Safety (the heart of our profession)
- ▶ “Organizational layers of protection” : not just any rule

Apparent holes in the « organisational Layers of Protection » (°) vs. expectation standard

Organisational Layers of Protection		2007-065 Burns by caustic soda during operator intervention at a pump	2008-026 Worker spread with sulphuric acid	2008-028 Working on a blind while system still in service	2008-059 Worker spread with sulphuric acid	2008-061 Ethylene ship connected to propylene loading arm	2008-065 Isobutane cloud after rupture of nitrogen hose during startup	2008-070 Large benzene spill in pipeway	2008-072 Hot quench oil spread on operator after manometer removal	2009-014 Large fuel oil spill after contractor opened purge	2009-020 Fire during furnace startup
Leadership, Organisation and Accountability	Strict distinction Operations vs. Maintenance / Construction	X	X					X	X		
	Operations = overall coordinator							X			
	Single set of coherent procedures and instructions						X				
	Clear and single line of command			X			X				
Safe Work Procedures, practices and work permits	All non-routine work is based on SWP and permit	X	X						X		
	Special permit required for special works	X	X						X		
	Standard process to authorise deviation	X							X		
Safe work practices	All non-routine work is formally initiated, authorised and registered	X									
	Golden rule of first choice : installation de-energised	X	X		X				X		
	Special works require special coordination (operations - maintenance)				X						
	Changes to the work plan require new autorisation										X
	Individual signature = personal commitment			X							
	Paperwork is complete before the work execution					X					X
	Work execution follows strictly the permit prescriptions		X							X	X
Proper plant & equipment status	Each equipment is in a well defined accountability perimeter	X	X					X			
	Accountability perimeters in the field are indicated and respected							X		X	
	Field equipment is properly TAGged										
	Good housekeeping and cleanness										
	Proper lighting										
Proper communications within operations	Effectif shift transfer : structured and formalised		X	X			X				
	Proper coordination with the day organisation			X							
	Effective communications between operations		X				X				
	Permanent coherence between field and control room						X				
Operational discipline and capability	Operations are conducted within formally defined safe limits										
	Complex operations are conducted with adapted formalism and supervision						X				X
	Operations support tools are effectively used										X
	Operators are aware of the field / process situation			X			X	X			
	Operations are within the operation team's capability										
	Procedural formalism and planning of operations						X				X
	Operator training and performance measurement										

(°) as observed through information in initial incident reports

X = identified failure X = not identified failure

Conclusions

- ▶ **Operational managers are HUMANS too !**
 - Not immune to human errors
 - Subject to Human Factors
 - Needing guidance and clear expectations framework to perform well
- ▶ **Their impact is huge : probably most important improvement tool**
 - Much more direct than “show commitment”
 - Should not be placed in the role of “observers of their department”
- ▶ **Operational Management performance vs. high expectation standard should be part of any Incident Investigation**
- ▶ **Modern concepts like BBS, risk matrix etc.
do NOT replace good organization and RULES
but come on top of it...**