

HUMAN FACTORS How to take the first steps...



STEP CHANGE IN SAFETY



“Human rather than technical failures now represent the greatest threat to complex and potentially hazardous systems”

James Reason, 1995



“Making the UK the safest place to work in the worldwide oil and gas industry”

Step Change in Safety vision



Bourbon Dolphin Capsize

“No chain is stronger than its weakest link. Where human beings are involved, experience shows that mistakes are made. That is why it is necessary to have safety systems that detect human error and make sure that it does not lead to accidents.”

The Commission of Inquiry into the loss of the Bourbon Dolphin, NOU Official Norwegian Reports 2008:8.



Space Shuttle Challenger Loss

“The Space Shuttle’s Solid Rocket Booster problem began with the faulty design of its joint and increased as both NASA and contractor management first failed to recognise it as a problem, then failed to fix it and finally treated it as an acceptable flight risk.”

Presidential Commission on the Space Shuttle Challenger Accident. (Photograph courtesy of NASA).



Texas City Refinery Explosion

“The Panel found instances of a lack of operating discipline, tolerance of serious deviations from safe operating practices, and apparent complacency toward serious process safety risks.”

The Report of the BP U.S. Refineries Safety Review Panel, January 2007.



Piper Alpha Disaster

“It was caused by a massive fire, which was not the result of an unpredictable ‘act of God’ but of an accumulation of errors and questionable decisions. Most of them were rooted in the organisation, its structure, procedures, and culture.”

Learning from the Piper Alpha Accident: A Postmortem Analysis of Technical and Organisational Factors, M Elisabeth Paté-Cornell, Risk Analysis Vol.13, Issue 2, April 1993.



Longford Gas Plant Explosion

“A combination of ineffective management procedures, staffing oversights, communication problems, inadequate hazard assessment and training shortfalls combined to result in a major plant upset with consequential tragic loss of life.”

Have Australia’s Major Hazard Industries Learnt from the Longford Disaster? , J Nicol, Institute of Engineers Australia, October 2001.



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Introduction

We're all human. We make mistakes and forget things. Our attention span is limited. We overlook crucial evidence when making decisions. We believe we're cleverer, stronger and faster than we actually are. Evolution has given us brains that flip into "automatic" mode to help us be creative, efficient and adventurous. There are things about us that are impossible to change. Unfortunately, despite our best intentions, these things can end up putting us, and our colleagues at risk.

We try and make the human mind and body do things for which it is not suited. We design plant and equipment that doesn't take account of our human fallibilities. We use procedures, rules and behavioural processes to attempt to mould people's behaviour to fit our expectations. Some of these processes can be very complex and demanding in their own right. Permits can become unwieldy, procedures can become over-complicated. There can be too many rules. Technology can become so clever that human beings struggle to understand it when it goes wrong.

Human factors is about explaining how human behaviour at all levels of an organisation can cause accidents. Investigations from across our industry tell us that human and organisational factors lie at the root of serious incidents. If we can recognise when these factors arise in our activities, we can learn how to manage them and prevent harm to our people.

This publication presents twelve case studies from our industry. They describe the deep-seated human and organisational factors that allowed the incidents to happen. Some are incredible, some predictable. All are true.

Each case study is an opportunity for you and your colleagues to recognise how human factors impact on your work. It gives you a chance to use your expertise in what you do, to prevent human factor incidents from happening. To encourage you further we have provided some examples of how other organisations have tackled human factors issues.

This publication will help you to identify some simple first steps that will help you, your team and your organisation manage human factors. YOU can make a difference.

Now read on and commit to taking the first steps.

the first steps...

for Everyone

I will....

- **Challenge procedures that are difficult to follow**
- **Report any human factors concerns** – *talk to your supervisor about problems you recognise in the case studies.*
- **Take the time to consider how my actions and decisions can affect others now and in the future**
- **Report plant and equipment that is difficult to operate, maintain, inspect and test safely**
- **Encourage others to think about human factors**

for Managing Directors and Management

I will....

- **Appoint a Human Factors Champion** – *someone whose job it is to understand what human factors is about, how it applies to your business and who can help you.*
- **Make a simple plan to tackle human factors issues** – *use this document to help identify where you want to start. Choose one topic and deal with it.*
- **Take the time to listen to the workforce** – *they know best where the problems are. Get their views on the case studies and how they apply to your business.*
- **Give feedback to the workforce** – *tell them what issues you're working on and how you intend to deal with them.*

for Supervisors

I will....

- **Use the case studies to identify human factors topics under my control and deal with them** – *involve your team in the process.*
- **Ensure human factors topics are discussed during work planning, preparation and execution**
- **Incorporate human factors into my incident investigations** – *don't be content with "human error" or "procedural violation" as a conclusion. Look for the reasons behind the actions.*
- **Take the time to listen and give feedback to my team on human factors topics** - *your team knows best where the problems are. Ask their views on the case studies and how they apply to your workplace. Tell them how you are going to deal with any issues.*

for Safety Representatives

I will....

- **Take human factors concerns to the relevant safety forums**
- **Talk to my constituents about human factors issues and concerns in their areas**

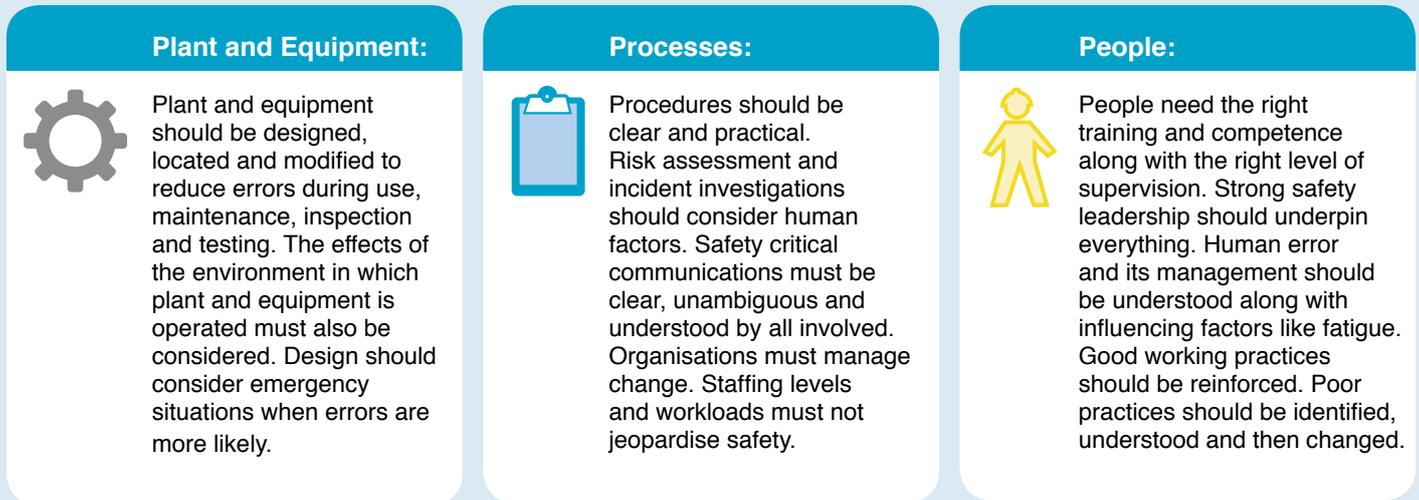
Human Factors in accident prevention

“Human factors refer to environmental, organisational and job factors, and human and individual characteristics, which influence behaviour at work in a way which can affect health and safety”

Health and Safety Executive

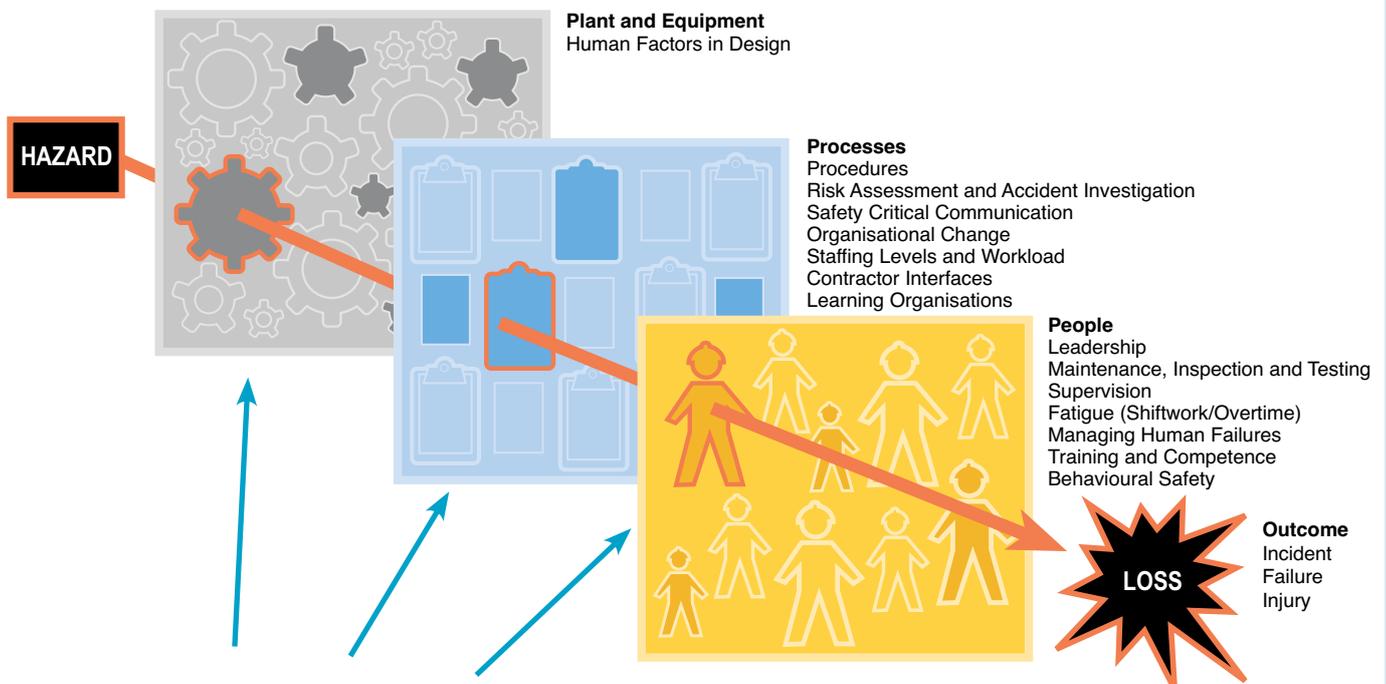


Human Factors covers a huge range of topics, which can be grouped under three key headings:



Human Factors and the barrier model

In our industry the most widely known model of accident causation is the “barrier” or “Swiss Cheese” model. In its simplest terms we have three barriers preventing accidents – Plant and Equipment, Processes and People. The presence of one or more of the barriers will prevent accidents happening. If we have a gap in one or more of the barriers then an accident can occur. The effectiveness of all three barriers can be influenced by a range of “human factors”. If we fail to take account of these human factors then gaps may open up in one or more of the barriers thereby increasing the chances of an accident. To minimise the impact of human factors we should always be looking to eliminate hazards through good engineering, clear and effective processes and procedures, and only then relying on the individual.



Organisational Culture

An organisation’s safety culture is the collective values and attitudes of its people towards safety. It is often described as “the way we do things around here”. Organisational culture influences human performance and human behaviour at work, and whether we judge a behaviour as good or bad. It will have an important influence on the effectiveness of the barriers and their vulnerability to human factors issues. It will also determine an organisation’s approach to learning lessons from past accidents.

Human Factors: introducing the key topics

The UK Health & Safety Executive has identified the human factors issues most closely associated with the Oil and Gas industry. They are:



Plant and Equipment:



Human Factors in Design:

The design of control rooms, alarm systems, plant and equipment can have a huge impact on human performance. The work environment (lighting, thermal comfort, working space, noise and vibration) also impacts human performance in unexpected ways. Designing tasks, equipment, processes and the work environment to suit the user can reduce human error, accidents and ill-health.

Processes:



Procedures:

Procedures include method statements, work instructions, permits to work etc. Incomplete, incorrect, unclear or outdated procedures can lead to short cuts and errors. Procedures should be managed and use a format, style and level of detail appropriate to the user, task and consequences of failure.

Risk Assessment and Incident Investigation:

Risk assessments need to recognise the limits of what humans can and can't do and take into account the impact of job, personal and organisational factors when deciding on control measures. Incident investigations need to dig down to establish the conditions that allowed human failures to occur. The investigation needs to take account of all aspects of human factors that may have contributed to the incident.

Safety Critical Communications:

Frequent and clear two-way communication (spoken and written) is essential for safety in any task. The method of communication, language, timing and content are all important factors in effective communication. Checking understanding is also critical.

Organisational Change:

Organisational change covers a range of issues e.g. staffing levels, use of contractors or outsourcing, combining departments, changes to roles and responsibilities etc. Similar to plant or process change, organisational change can have direct and indirect effects on the control of hazards. Organisational changes need to be planned and assessed.

Staffing Levels and Workload:

Changes in staffing levels and increase/decrease of workload often occurs as part of organisational change. It is important to consider the impact of this change on the control of hazards.

Contractor Interfaces:

Contractors (including suppliers and third parties) face the same human factors issues as their clients. Some of these issues are critical at the client-contractor interface, e.g. communication, supervision, organisational culture, competence.

Learning Organisations

A learning organisation values and encourages learning from its own and other organisations' experiences. Learning is linked to "corporate memory", which must withstand organisational changes. Learning organisations are characterised by "constant vigilance" and seek out bad news as well as good. Understanding human factors can turn organisational learning into preventative solutions.

People:



Leadership:

Setting of expectations, leading by example and decision making that takes safety into consideration is essential in creating a strong safety culture. This means taking personal responsibility for safety.

Maintenance, Inspection and Testing:

Maintenance is heavily reliant on human activity. The actions and decisions of maintenance personnel should not leave equipment or systems in an unsafe state. Even experienced, highly-trained, well-motivated technicians can make simple errors that can cause an incident. Human error in maintenance is largely predictable and therefore can be identified and managed.

Supervision:

Effective supervision has a significant positive impact on a range of human factors such as compliance with procedures, training and competence, safety critical communication, staffing levels and workload, fatigue and risk assessment.

Fatigue:

Fatigue refers to the issues that arise from excessive working time or poorly designed shift patterns. It can lead to errors, slower reaction times, and reduced ability to process information, memory lapses, absent-mindedness, and losing attention.

Managing Human Failures:

This topic is about predicting how people may fail through errors or intentional behaviours. If you are relying on people to prevent a serious accident, what would happen if they missed a step in a procedure? What would happen if they missed an alarm, or pressed the wrong button? If the consequences are serious then it is something you should manage.

Training and Competence:

Training gives people new knowledge and skills, but people need to apply and practice these to become competent. Training and competence can reduce errors caused by lack of knowledge and teach people behaviours that will keep them safe. This is not a universal safeguard though. Even the most experienced and competent individuals can make mistakes.

Behavioural Safety:

Behavioural safety is an approach which tries to promote safe behaviours and eliminate unsafe behaviours. Behavioural safety programmes typically involve observation of workplace practices followed-up by individual feedback and reinforcement of good practices.



Recognising ourselves in case studies

This report is designed to help you recognise where Human and Organisational Factors appear in your workplace. We have taken real incidents and looked at the human factors that lay at the root of them. The conclusions are not exhaustive: you will probably find other causes and solutions that we have not – that’s because you know more about human factors than you realise.

↘ **CASE STUDY 5**
Assumptions aren't always right...

Read the brief description of the incident. All are based on real events.

1 **What happened?**

The work-team were using a high pressure water jet cutting system to cut redundant steelwork and pipework. The job was additional work that had been added to the scope after the team had arrived at the platform. The work-pack made only a general reference to removing equipment in the area. The team were instructed to “cut all material in the area” and the toolbox talk did not indicate which items should be cut or left. Various pieces of steelwork and pipe were marked with red-and-white tape.

The team began cutting steelwork and pipes away from the deck-plate. Shortly after cutting a pipe an oily smell was noticed and the team stopped work. The area authority confirmed that they had cut through a live drain line.

In the absence of any other indication, the team had assumed that the red-and-white tape marked the lines and steel which needed to be cut. In fact it marked trip hazards on the worksite.

2 **What human factors were involved?**

What did people do intentionally?
 The team were asked to do work which was not in the original scope. The work was not in the original scope so had not been properly planned. Items of equipment to be cut were not clearly identified. There was no Management of Change.

The supervision did not communicate the scope and hazards properly
 The toolbox talk didn't discuss the items to be cut, or point out the hazards from the live lines in the area.

What did people do without meaning to?
 The team thought the red-and-white tape marked the items to be cut. Having been given the instruction to cut everything in the area, the team presumed that red-and-white tape marked the items to be cut.

Barriers

- Safety Critical Communication
- Procedures
- Risk Assessment

- Managing Human Failure

Understand what people did intentionally. What motivated them to act like this?

Understand what people did unintentionally. What caused them to make this error?

What barriers would help to prevent this incident?

Understand the human characteristics that lie at the root of the case, and how to manage them

What did you recognise?
What can you do?

5 **What can we learn from this incident?**

- The operations team assumed people would understand that red-and-white tape marked trip hazards. This wasn't confirmed with the workparty.
- When we make decisions we interpret the information available to us. Our interpretation is influenced by what has happened before, and what we expect to happen this time. This sometimes leads to incorrect conclusions.
- A clear work-pack is a good start, and an effective tool-box talk helps to get everybody clear on what needs to be done. Talk about the job at the worksite. Walk, point and mark the plant to be worked on. Those doing a job should be able to explain the job and their role in it.
- Late changes and additions often lead to incidents - that's why Management of Change processes are important. Those raising the change need to think carefully about the possible consequences, and work-teams should challenge work that comes in without good quality work-packs.

6 **What does this make you think of in your workplace?**
Take the first steps now...



You can use this report in different ways; we have made some suggestions below.

- In a tool-box talk
- In a team or safety meeting
- To engage safety leaders
- When planning a job
- To identify your first steps

CASE STUDY 1

People will put up with what they're given...



What happened?

A driller was operating a top drive drilling unit. There was a stand of drill pipe clamped in the slips, and the top drive was raised and held on the brake. The driller saw a roughneck step into a hazardous area of the rig floor, and reached for the microphone to tell the roughneck to step back. As he did so he slightly released pressure on the brake. The top drive descended, bending the drill pipe which fortunately did not spring out. A 27kg pipe-guide fell 90 feet to the floor, narrowly avoiding the roughneck.

Investigation found that at the time the incident occurred, the driller had all four limbs utilised. To stop personnel from entering the drill floor, the driller had to lean towards the microphone, use his left knee to operate the talk-back system, use his right foot on the manual brake, whilst still trying to maintain control of the top-drive using the hydraulic brake. The brake did have a "dead-man" position that applied the brakes if the handle was released. However, simply easing off hand-pressure actually removed the brake. This was a counter-intuitive design. The system was known to be difficult to operate.



What human factors were involved?

What did people do intentionally?

People accepted the poor layout and controls, and got on with the job

As different items of equipment were added, controls were placed wherever they could be, without considering how they would have to be used together. Many different people knew about the problems in the dog-house, but a "can do" attitude meant that people just put up with poorly designed equipment and controls.

What did people do without meaning to?

The driller released hand-pressure on the brake control

If the brake-control had been entirely released the brake would have applied automatically. Unfortunately, a small release in hand-pressure was enough to remove the brake.

Keeping your arm steady during a task requires concentration and balance. Changing your position affects this fine-control. The movement towards the microphone reduced pressure on the brake and the top drive descended.

Barriers



- Human Factors in Design



- Risk Assessment



- Managing Human Failures

What can we learn from this incident?

- Older equipment has sometimes been subject to incremental change, without any thought to how changes will interact. Apply a good quality management of change process to each change, to identify these interactions before they become a problem.
- Our ability to carry out physical fine-control tasks is influenced by our body position and balance, and requires concentration. An ergonomist can advise on what people will be physically capable of in different situations.
- People will put up with poorly designed equipment and make the best of it. Designers can't foresee all situations. Speak up if there is equipment which is difficult to operate.
- Get experienced end-users involved in the design and commissioning of equipment.

What does this make you think of in your workplace?
Take the first steps now...

CASE STUDY 2

The best people DO make big mistakes...



What happened?

The most senior electrician on an installation was asked to perform a multi-point isolation on one of two gas turbines.

He took his permit, went to the switch-room and correctly identified the turbine to isolate. He was familiar with the switch-room and the layout of the turbine electrical systems. He began isolating the correct turbine.

He then received a call on the public address (PA) system to come to the galley, which he ignored because the job he was working on was important. A second announcement called him urgently to the galley. The electrician went to the galley where he found the chef standing next to an open fridge complaining that the fuse had blown. Annoyed that the chef had interrupted an important job with one that could have waited, the electrician replaced the fuse and then returned to the worksite.



He completed the remaining isolation points, but on the wrong turbine.

The error was discovered days later when the electrician had left the installation. When he was told of the mistake he immediately offered his resignation, which was not accepted. An investigation found that the distraction during an important job had led to the error, which in this case was discovered before any harm was caused.

What human factors were involved?

What did people do intentionally?

Intentional behaviours were not the main cause of this incident.

What did people do without meaning to?

The electrician applied the isolation to the wrong machine

The electrician made an error - he performed the right action (applying isolations) on the wrong equipment. This was made more likely to happen because he was distracted during a complex job. Becoming angry at being called away may also have contributed to the error.

Barriers



- Safety Critical Communication



- Managing Human Failure
- Supervision

What can we learn from this incident?

- Performing the right action on the wrong piece of equipment is a common problem in our industry.
- The most experienced and competent personnel are sometimes **more** prone to error because they can do things automatically without thought.
- When we get distracted we may forget things, e.g. where we were in a sequence of steps or a procedure. This can lead to mistakes with serious consequences.
- You can prevent this type of incident by double-checking against the permit or asking another person to confirm that you are working on the right equipment. When the job's complete, have it independently checked to detect errors.
- Supervisors can help by recognising those jobs which could have serious consequences if someone makes a mistake. Minimise distraction for those carrying out complex or critical tasks. Encourage people to have their work checked for errors.

What does this make you think of in your workplace?

8 Take the first steps now...

CASE STUDY 3

Managers are human too...



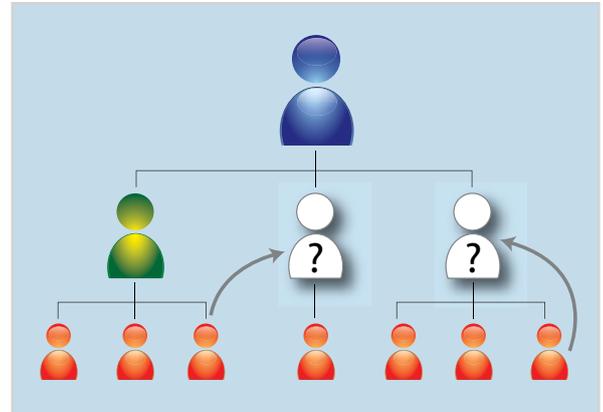
What happened?

After going through a difficult downsizing a company decided to restrict recruitment and personnel moves, in an attempt to avoid painful redundancies in the future.

At the time there was great demand for personnel in the oil and gas market. One installation lost a number of its operational leadership to another company. For a while the installation managed. It was able to maintain its minimum manning levels, and less experienced personnel were asked to step-up into leadership positions. The Offshore Installation Manager (OIM) and offshore engineer began micro-managing work on the installation.

Unfortunately the recruitment restrictions introduced lengthy delays into the process of replacing personnel. Twelve months later the installation was still without replacements. When the attention of the OIM and engineer was distracted by another major issue, those standing-in could not maintain the safety standards.

A cluster of serious incidents (including a large gas release) led to an investigation which revealed the situation. The company accelerated replacement of the missing personnel.



What human factors were involved?

What did people do intentionally?

Leaders made it difficult to recruit and move operations personnel

They did this with the best of intentions, to prevent people having to suffer the threat of redundancy in the future. Unfortunately this prevented the recruitment of new operations leaders to replace losses to other companies.

Site managers made the best of the situation

Whilst pursuing replacements, the OIM and engineer found a way to work through the problem by increasing the time they spent on site supervising and coaching.

What did people do without meaning to?

Stand-ins didn't have the experience and skills to maintain standards

Often we take technically gifted people and promote them into a leadership position. However, the two roles often require very different skills. It's even harder for stand-ins who are in the role only temporarily, and may still feel a member of the team they are having to supervise. In this case temporary stand-ins could probably have been adequately supported over a short period of time, but this became difficult over the longer period.

Barriers



- Organisational Change
- Staffing Levels & Workload



- Leadership
- Supervision

What can we learn from this incident?

- The resourcing of the right people to your worksites is essential. There should be sufficient flexibility to allow your assets to have the right people at the right time.
- Managers and leaders are human too. It is difficult to see all the potential consequences of a decision or change.
- Equally, managers and leaders should be cautious of making blanket rules or decisions.
- Temporary personnel changes need to be monitored closely. Stand-ins are likely to require coaching and mentoring. The effect on supervisors providing this additional supervision also needs to be considered. Workload or job demands may need to be reduced, or more staff provided.

What does this make you think of in your workplace?
Take the first steps now...

CASE STUDY 4

Right job, wrong equipment...



What happened?

A work party unbolted the wrong valve on a flare line causing a large gas release.

Relief valves were being removed for recertification during a shutdown. Normally a “breaking-containment” permit would have been issued, but because the plant was hydrocarbon-free, this rule was relaxed, and a cold-work permit was issued for the task.

The recertification programme over-ran, and it was decided to complete the maintenance of some valves after the plant was back in production. However the rule requiring a breaking-containment permit, was not reinstated. The workscope was also handed over from project to operations leading to uncertainty of ownership and responsibilities.

The permit listed four valves. When the work team went to the site they found scaffolding erected next to relief valve PSV1068. They believed this to be the correct valve. Unfortunately it was not - they were supposed to be removing PSV1066 which was on the deck above.

They attempted to remove the bolts from the live-side of the valve, but the high pressure in the vessel prevented the bolts from releasing. Instead they removed all of the bolts from the flare-side of the flange. Gas was released as they split the two halves of the flange. They tried to remake the flange but could not as the valve had become misaligned with the pipe.

The control room was informed of the gas leak and several gas alarms triggered. A full plant blowdown was initiated by the control room operator. Several tonnes of gas were released from the open flange which, had an ignition source been present, would have generated a serious explosion.



What human factors were involved?

What did people do intentionally?

The permit rules had been relaxed and not reinstated

During the shutdown the rule requiring a breaking-containment permit was relaxed. It was not reinstated when the shutdown was complete.

Change of responsibility led to uncertainties of ownership

Uncertainty existed around who was responsible for the relief valve work post-shutdown i.e. production or maintenance supervisor.

What did people do without meaning to?

The work party selected the wrong valve

The permit stated that all the valves were on the same deck. The scaffolding access had been erected next to this valve. Furthermore, the valve tag was similar, and difficult to read. This was enough to suggest to the work party that they were working on the right valve.

Barriers



- Procedures
- Safety Critical Communication



- Maintenance, Inspection & Testing
- Managing Human Failure
- Supervision

What can we learn from this incident?

- Breaking containment on hydrocarbon systems is a high risk activity, involving people making judgements. Simple errors, assumptions or misjudgements can have disastrous consequences. Checking can catch errors.
- When breaking containment, you must confirm that you are working on the right equipment. You should also have a way of checking that the right steps have been taken before opening up the hydrocarbon system. When identifying equipment - walk - point - check!
- If something is not as you expected, step back and ask “why?”. The difficulty in removing the live-side bolts should have indicated that something was wrong. Applying basic principles in breaking bolted joints could have recovered this situation.
- Changing conditions, scopes of work and responsibilities must be managed to ensure responsibilities and ownership are clear at all times.

What does this make you think of in your workplace?

Take the first steps now...

CASE STUDY 5

Assumptions aren't always right...



What happened?

The work-team were using a high pressure water jet cutting system to cut redundant steelwork and pipework. The job was additional work that had been added to the scope after the team had arrived at the platform. The work-pack made only a general reference to removing equipment in the area. The team were instructed to “cut all material in the area” and the toolbox talk did not indicate which items should be cut or left. Various pieces of steelwork and pipe were marked with red-and-white tape.

The team began cutting steelwork and pipes away from the deck-plate. Shortly after cutting a pipe an oily smell was noticed and the team stopped work. The area authority confirmed that they had cut through a live drain line.

In the absence of any other indication, the team had assumed that the red-and-white tape marked the lines and steel which needed to be cut. In fact it marked trip hazards on the worksite.



What human factors were involved?

What did people do intentionally?

The team were asked to do work which was not in the original scope

The work was not in the original scope so had not been properly planned. Items of equipment to be cut were not clearly identified. There was no management of change.

The supervision did not communicate the scope and hazards properly

The toolbox talk didn't discuss the items to be cut, or point out the hazards from the live lines in the area.

What did people do without meaning to?

The team thought the red-and-white tape marked the items to be cut

Having been given the instruction to cut everything in the area, the team presumed that red-and-white tape marked the items to be cut.

Barriers



- Safety Critical Communication
- Procedures
- Risk Assessment

- Managing Human Failure

What can we learn from this incident?

- The operations team assumed people would understand that red-and-white tape marked trip hazards. This wasn't confirmed with the workparty.
- When we make decisions we interpret the information available to us. Our interpretation is influenced by what has happened before, and what we expect to happen this time. This sometimes leads to incorrect conclusions.
- A clear work-pack is a good start, and an effective tool-box talk helps to get everybody clear on what needs to be done. Talk about the job at the worksite. Walk, point and mark the plant to be worked on. Those doing a job should be able to explain the job and their role in it.
- Late changes and additions often lead to incidents - that's why management of change processes are important. Those raising the change need to think carefully about the possible consequences, and work-teams should challenge work that comes in without good quality work-packs.

**What does this make you think of in your workplace?
Take the first steps now...**

CASE STUDY 6

Knowing that a hazard is there DOESN'T always protect you...Fact.

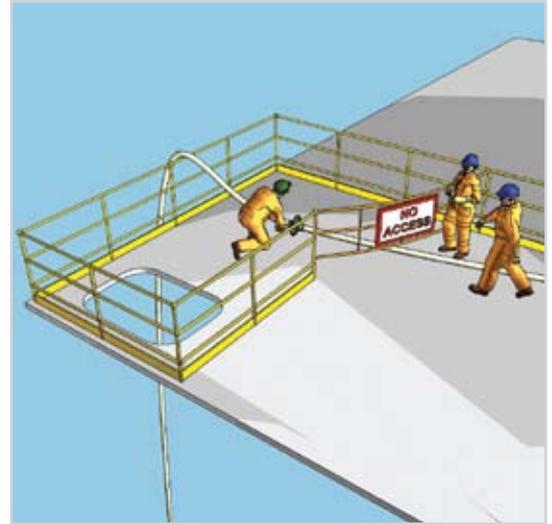


What happened?

During installation of a temporary piping system an employee sustained serious injuries when he stepped through an opening in the deck and fell 35 feet to the deck below. The deck opening was fully enclosed by a scaffolding barrier at the time of the accident.

A new drilling service team were working on the platform. It was not clear whether operations or drilling were responsible for monitoring the work. Consequently no-one checked what was happening at the work-site. It later emerged that the team were regularly violating rules and procedures.

A supervisor was preparing light-weight plastic pipe to clean up a spill. He needed help to run the pipe across the barriered area. The employee crossed the scaffolding barrier with the supervisor's knowledge. As the work proceeded the employee gradually moved closer to the opening. Whilst the employee was moving the pipe he took a step backwards and fell through the opening.



What human factors were involved?

What did people do intentionally?

The supervisor allowed him to cross the barrier

Within this team barriers may have been crossed routinely without any comment from supervisors.

The employee crossed the barrier

The supervisor was involved in the job and asked the employee to help. When the boss asks you to do something people may not even think to say "no".

What did people do without meaning to?

The employee stepped back into the opening

The employee knew the opening was there but believed he could avoid it. When his attention became focused on the job he stopped thinking about the hazard from the opening. The brain ignores information which is "irrelevant" to the immediate task, so it can concentrate mental resources on the job.

Barriers



- Human Factors in Design



- Contractors
- Risk Assessment



- Leadership
- Supervision
- Managing Human Failure

What can we learn from this incident?

- People falling through openings that they "know" about is a common and often fatal incident.
- Paying very close attention to one thing means we pay less attention to other things - like nearby hazards. Don't rely on people "paying attention" to prevent a serious hazard.
- We are all influenced by the behaviours of our managers, supervisors and team mates. Leaders and supervisors that allow unsafe actions or conditions send a strong message to others that this is acceptable.
- A worksite may have the best safety culture in the world, but you can't rely on that culture "rubbing off" on a new team. Keep an eye on new teams to verify that your high standards are being adopted.

What does this make you think of in your workplace?

Take the first steps now...

CASE STUDY 7

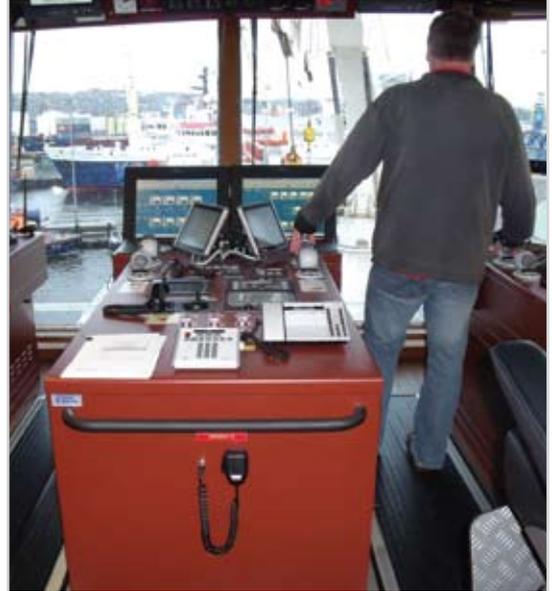
Controls don't always do what you expect them to do...



What happened?

A new supply vessel was being delivered from its manufacturing shipyard in China to the North Sea. On its voyage across the ocean the crew discovered a quirk in the control system. Under manual control the ship's thrusters could be controlled using a joystick. However, the joystick had been configured to apply the thrusters in the direction that the joystick was pushed. This meant that if the joystick was pushed right, the thrusters were applied to the right, and the boat moved to the left. If the joystick was pushed left, the thrusters were applied to the left, and the boat moved to the right. Having discovered this, the crew decided this was acceptable and continued to use this control on several occasions throughout the voyage.

The ship was working off a fixed installation when it struck the jacket at some speed. The vessel had started to move towards the installation and the Master tried to move the vessel away by moving the joystick away from the vessel. Unfortunately this applied thrust in the opposite direction, accelerating the ship into the installation. The ship struck the installation leg, but no damage was caused.



What human factors were involved?

What did people do intentionally?

The crew accepted the non-intuitive controls

Although the joystick didn't behave as they expected, they believed that they would get used to moving it in the opposite direction and put up with it. This should also have been detected in acceptance trials.

What did people do without meaning to?

The Master pushed the joystick in the "natural" direction

When the Master was focused on maintaining the ship on station he automatically pushed the joystick in the direction that "made sense" to him.

Barriers



- Human Factors in Design



- Risk Assessment



- Managing Human Failures

What can we learn from this incident?

- Well-designed controls should "map" onto the things they control. For instance, some cooking stoves have four rings controlled by a line of switches down one side. Others have the switches positioned in the same pattern as the rings so that you can easily see which switch operates each ring.
- Controls should make "natural sense". If you want it to go left, push the joystick left. In this case the joystick control did not map onto the direction that people would normally expect the control to take them.
- Operator interfaces are often the last things to be installed, and some suppliers have been known to cut corners in order to meet delivery deadlines. Clients should specify requirements for well-designed, usable operator controls in the contract, and ensure these are met in acceptance tests.
- Don't put up with non-intuitive controls, change them and apply management of change.

What does this make you think of in your workplace?
Take the first steps now...

CASE STUDY 8

Close-enough procedures aren't close enough...



What happened?

Burning fluids ran down the outside of the lit flare stack after a knock-out drum filled with crude oil.

While preparing for a shutdown, a drain valve was opened to depressurise a meter skid. The operator didn't realise that the meter skid was still connected to the process via an open skid discharge valve which he should have isolated. Crude oil flowed into the skid through the open drain valve and into the flare line. It overflowed the flare knock-out drum and passed on into the lit flare.

There was no procedure for draining the skid so the supervisor asked the operator to use a maintenance procedure. The steps required to isolate and drain the skid were in different parts of the document. The supervisor and operator discussed which parts of the procedure could be used. The operator misunderstood the instruction and started at the wrong step. He missed the step where the outlet valve was closed.

The high level trip on the drum should have shut down the process. Unfortunately the switch had been incorrectly calibrated, and allowed liquid into the flare where it was ignited.



What human factors were involved?

What did people do intentionally?

The supervisor asked the operator to use a procedure which was not suited to the task

Although the procedure could be used to drain this skid, it included lots of other unnecessary steps which were likely to cause confusion.

What did people do without meaning to?

The operator opened the vent valve without realising the outlet valve was open

The operator became confused about where to start the procedure, and picked the wrong place.

Barriers



- Procedures
- Safety Critical Communications



- Training & Competence
- Supervision

What can we learn from this incident?

- Procedures should be specific to the task being done.
- The sequence is vital, so anything which disrupts that sequence (such as jumping from one section to another) increases the chance of error.
- Where a procedure is not right, take time to amend it. Do a risk assessment to ensure that you know what hazards you need to control. Involve the people that have to carry out the job and technical staff who understand the process hazards that the procedure should address.
- Don't rely on automatic shutdowns to protect you. Safety systems can fail in all sorts of unpredictable ways - many associated with human error!

What does this make you think of in your workplace?

Take the first steps now...

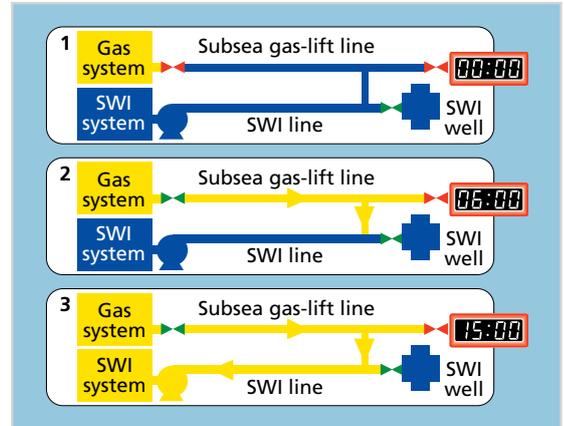


What happened?

An offshore installation suffered a gas release after gas from a Third Party subsea system was accidentally allowed into the Platform Seawater Injection system (SWI). The SWI pumps high pressure seawater into the reservoir and is not designed for hydrocarbon gas.

Engineers planned to empty a subsea gas-lift flowline that had been filled with water for maintenance (Figure 1). The plan was to push water out of the line and down a seawater injection well using production gas. It was calculated that 6 hours of gas-flow would be required to push the water into the SWI well at a well-head pressure of 35 barg (Figure 2).

A procedure was written by the Third Party, and provided shortly before the job was due to start. There was no time made available to review the procedure and it was considered “routine” as a similar type of operation had been done, previously. Buried in the middle of the procedure was a warning that the gas-flow should not exceed 6 hours.



Operators started the gas flow, but then it took 9 hours to get the 35 barg well-head pressure. Operators then continued flushing for a further 6 hours. Consequently, gas flowed for 15 hours rather than the 6 hours intended (Figure 3). After the water was flushed out a volume of gas flowed back into the seawater system and remained undetected for several weeks whilst the system was offline for maintenance.

On the day of the incident an operator opened a drain valve whilst restarting the SWI. Gas blew out of the drain, setting off gas alarms in the vicinity. The operator immediately shut the valve and the module was made safe.

What human factors were involved?

What did people do intentionally?

The procedure was not reviewed

The procedure was supplied at the last moment, and had not been reviewed by a competent person, even though this was an unusual operation. It hadn't been written with those doing the job, and no review or HAZOP (Hazard and Operability Study) was carried out.

The operators didn't stop the job and take time to get the procedure reviewed

They had not been involved in writing the procedure, and had no assurance that the procedure was correct. However the job had been planned for some time and they were reluctant to delay it.

What did people do without meaning to?

The operators did not detect the warning

Although the operators did use the procedure, their actions didn't reflect the engineers intention to only flow gas for 6 hours. The crucial information was buried in the text of the procedure.

Barriers



- Human Factors in Design



- Procedures
- Safety Critical Communications
- Contractor Interface



- Managing Human Failures

What can we learn from this incident?

- There have been several very serious incidents involving gas being accidentally routed into plant not designed to cope with it.
- Procedures need to be prepared in advance and reviewed by a competent person(s).
- Describe possible “abnormal situations” in procedures and clearly state what actions should be taken if they occur.
- Conventional hazard assessment techniques like HAZOP can detect errors made by designers and predict errors by operators. Specific HAZOP checklists may ask what would happen if a step is omitted or done out-of-order, or too late.
- Interfaces (communication and procedures), between Third Parties and the Operator, can be a weakness, recognise this and manage the associated risk.

What does this make you think of in your workplace?

Take the first steps now...

CASE STUDY 10

When sleep comes nothing can stop it...



What happened?

A drilling company was to drill its first High Pressure High Temperature (HPHT) well. A significant amount of new equipment had been fitted to the drill rig for HPHT service. The company found it hard to recruit tool pushers with HPHT experience in the UK as not much HPHT drilling had been done before in the North Sea. They were able to recruit one tool pusher experienced in HPHT equipment from the US and one from the UK with experience of the standard rig and UK procedures but without HPHT experience. The plan was for the one with HPHT experience to work as day tool pusher and the one without to work as night tool pusher.

Once drilling started it soon became clear that the only way they could work the equipment was for both to be on duty with one maintaining the drill operations while the other concentrated on the HPHT equipment. They came up with a plan that they would both work 20 hour shifts and take alternate 4 hour breaks. They managed this for three days before one fell asleep at a critical stage and they lost control of the well.



What human factors were involved?

What did people do intentionally?

The tool pushers worked longer shifts believing they could remain alert and in control of the situation

The tool pushers thought that the work was so hazardous and demanded so much concentration that it was bound to keep them awake. They underestimated the impact on their mental and physical capabilities. Relying on each other to stay awake was doomed to failure.

The tool pushers decided to continue with the work pattern even though they recognised they were getting very tired and may fall asleep.

What did people do without meaning to?

One of the tool pushers fell asleep

Nobody has conscious control over the point when they fall asleep.

Barriers



- Risk Assessment
- Staffing Levels & Workload



- Fatigue
- Leadership

What can we learn from this incident?

- People aren't superhuman. Organisations and individuals need to understand how mental and physical limitations can impact on safe activities. Manning levels must be properly assessed to ensure safe operations. New equipment and processes may require a temporary over-manning and increased levels of supervision.
- We know that it is possible to fall asleep while driving, even though the consequences are severe. Often we push on despite the warning signs. Once the body decides to sleep we have very little conscious control. Falling asleep is not the only consequence of fatigue. Fatigue also reduces a person's mental capabilities and makes them more prone to making mistakes and poor decisions.
- If you are doing a safety critical job or task and are at risk of falling asleep – stop, get some help and get some rest.
- There is a lot of good advice on how much rest to get, how to improve the quality of sleep and how to assess working patterns for fatigue risk.

What does this make you think of in your workplace?

Take the first steps now...

CASE STUDY 11

Find a way to do it - by hook or by crook...



What happened?

Whilst replacing lifting “runway” beams, the willingness of a rigging crew to get the job done endangered their own lives.

A beam was being removed from the module roof by the rigging crew. A supervisor was inspecting the site and noticed that the chain blocks being used to lower the beam had been attached to the beam by using a technique known as “back-hooking” (i.e. wrapped around the beam and hooked back on itself). This was a technique prohibited on the site because there had been incidents when the hook had twisted and released the load. Operations were not being carried out according to the lifting plan for the job.



Work was stopped immediately and the load made safe. The supervisor highlighted that back-hooking was unacceptable practice and the work-party agreed. However, in their opinion, there was no other way to do the job. When they looked again at the job there were safer ways of completing the lift and these were written into a new lifting plan.

Had the hook released, one of the rigging crew could have been killed.

What human factors were involved?

What did people do intentionally?

The work party decided to use a technique which was prohibited

When challenged, they realised that the technique was not safe, but believed it was the only way of getting the job done.

What did people do without meaning to?

Unintended behaviours were not the main cause of this situation.

Barriers



- Risk Assessment
- Procedures



- Supervision
- Managing Human Failures

What can we learn from this incident?

- We love to find a way to do the job we're given. Sometimes we will accept greater risk to achieve the goal.
- We often have to solve problems in our job. However, when we're about to do the job with the materials available to us, we often make unwise compromises - compromises we wouldn't make when we are planning the job.
- When we think about risks as a group, we can end up taking bigger risks than we would as an individual. This is called “groupthink”. We reassure each other and give each other confidence to do something that we wouldn't do alone.
- When planning a job, assess the practical problems you will encounter and how you will deal with them. Test whether this is something that you would take responsibility for if you were doing it alone.

What does this make you think of in your workplace?
Take the first steps now...

CASE STUDY 12

Helpful guys get hurt...



What happened?

The hand of a member of the catering crew was badly damaged when it became trapped beneath a heavy steel plate.

An engineering contractor work party was working on fitting a new bed plate for an industrial spin drier in an installation's laundry. The team were lifting the heavy bed plate (weighing around 200kg) onto the six raised securing points. The work had been going on for two days, under a Work Permit. The catering crew were aware of the nature of the work and the need to take care in the vicinity.

One half of the plate was supported on stacked planks. The other half was being lowered onto the securing points by three of the work-party. The laundryman rushed forward to assist just as the plate was being lowered. His hand became trapped between the plate and the raised securing points. The crush amputated the laundryman's middle finger.



What human factors were involved?

What did people do intentionally?

The laundryman rushed in to help

Although he wasn't part of the job and hadn't been involved in the risk assessment and preparation for the job, he rushed in to help without thought.

What did people do without meaning to?

The laundryman placed his hand in a trap point

He was unaware that there were raised supports against which his hand would be trapped.

Barriers



• Risk Assessment



• Behavioural Safety
• Supervision

What can we learn from this incident?

- We employ many good, enthusiastic and well-meaning people in our workplaces. People will rush in to help without a second thought. Lifting operations are particularly prone to this: something goes wrong, everyone takes a step back, but the novice steps forward.
- "Recognition-based problem solving" is a feature of human beings. We recognise something we think we can fix or help with and we go straight into action without any thought.
- Don't jump in to help and don't allow people to jump in and help. In this case a tape barrier may have been enough to stop the laundryman from getting involved.

What does this make you think of in your workplace?

Take the first steps now...

How others have taken the first steps...



Tackling human factors is simpler than you think and there are all sorts of ways you can make a difference. The examples below show how companies have tackled some of their human factors issues.

Plant and Equipment



Getting it right in control rooms

A company operated a number of fixed oil and gas platforms with 20-year old control rooms. Many had been modified and upgraded over time. This was causing difficulties for Control Room Operators (CROs). A review found that the layout of the controls, displays and annunciators made it difficult for CROs to understand developing situations. Control rooms were hot and noisy making concentration difficult. Lighting caused glare and reflection on display screens. Alarms weren't prioritised making it possible for operators to miss a crucial alarm. There were too many alarms during normal operations many of which were "nuisance" alarms. The company redesigned the control room layout, lighting and air conditioning. Alarms were prioritised so that important information was easier to spot and nuisance alarms were engineered out. The company recognised that the control room was compromising the CROs ability to guarantee the integrity of the systems barriers. Poor human factors in the design of successive control room modifications was corrected with a complete redesign to strengthen the system barrier.

Processes



Learning HF lessons through an Accountability Framework

To improve the human factors learning from incidents/near-misses, a company introduced an "Accountability Framework", which provided a consistent method for interpreting human factors issues, as well as management system failings. The framework helped investigation teams to better understand not only what happened, but why it happened. Drawing on published HSE guidance on human factors, the framework provided a clear and logical approach to the characterisation of unsafe acts and their underlying causes. This is leading to better outcomes in terms of corrective actions and the subsequent learning from events. The offshore workforce has also welcomed the consistency and transparency that the framework brings.

People



Making hydrocarbon leaks important

A company wanted to change a culture of tolerating hydrocarbon leaks. It had a good record of reducing personal injuries but struggled to tackle leaks. The company adopted a simple four-part model of the ingredients of a good safety culture: management commitment, two-way communication, wide participation and organisational learning. Using the model the company designed a programme that prioritised leak reduction, consulted with the workforce on areas to improve and involved all the departments of the business. It also learned from other operators about how to reduce releases. There was a 25% reduction in leaks in the first year, and an 80% reduction during the second. This is great human factors behaviour on the part of the employees of this company. When a leak occurs both mechanical and systems barriers have been breached and only the final barrier, the human, stands in the way of a potential major incident. Let us all do everything we can to keep dangerous substances contained.

What does this make you think of in your workplace?
Take the first steps now...



Publications

Step Change in Safety have produced a number of publications that link into human factors.

These include:

Personal Responsibility for Safety - Guidance
ISBN 978-1-905743-01-8

Look this Way - Safety Observational System
Guidelines

Changing Minds - A practical Guide for Behavioral
Change in the Oil and Gas Industry

Task Risk Assessment Guide
ISBN 978-1-905743-12-4

Hydrocarbon Release Reduction TOOLKIT
ISBN 978-1-905743-14-8

Fatality Report - How will you be making your next
trip home?
ISBN 978-1-905743-03-2

Web

Health and Safety Executive

Find out more about the HSE's Human Factors key topics and available resources on their website:
www.hse.gov.uk/humanfactors

International Association of Oil & Gas Producers

Guidance, case studies & tools
<http://info.ogp.org.uk/hf>

Energy Institute

Guidance on many HF topics relevant to the oil & gas industry
www.energyinst.org.uk/humanfactors/

Institute of Ergonomics & Human Factors

Guidance on finding an expert who can help with your specific problem
www.ergonomics.org.uk

Petroleum Safety Authority Norway

Advice on HF topics from the Norwegian Regulator
www.ptil.no/hto-human-factors/category140.html

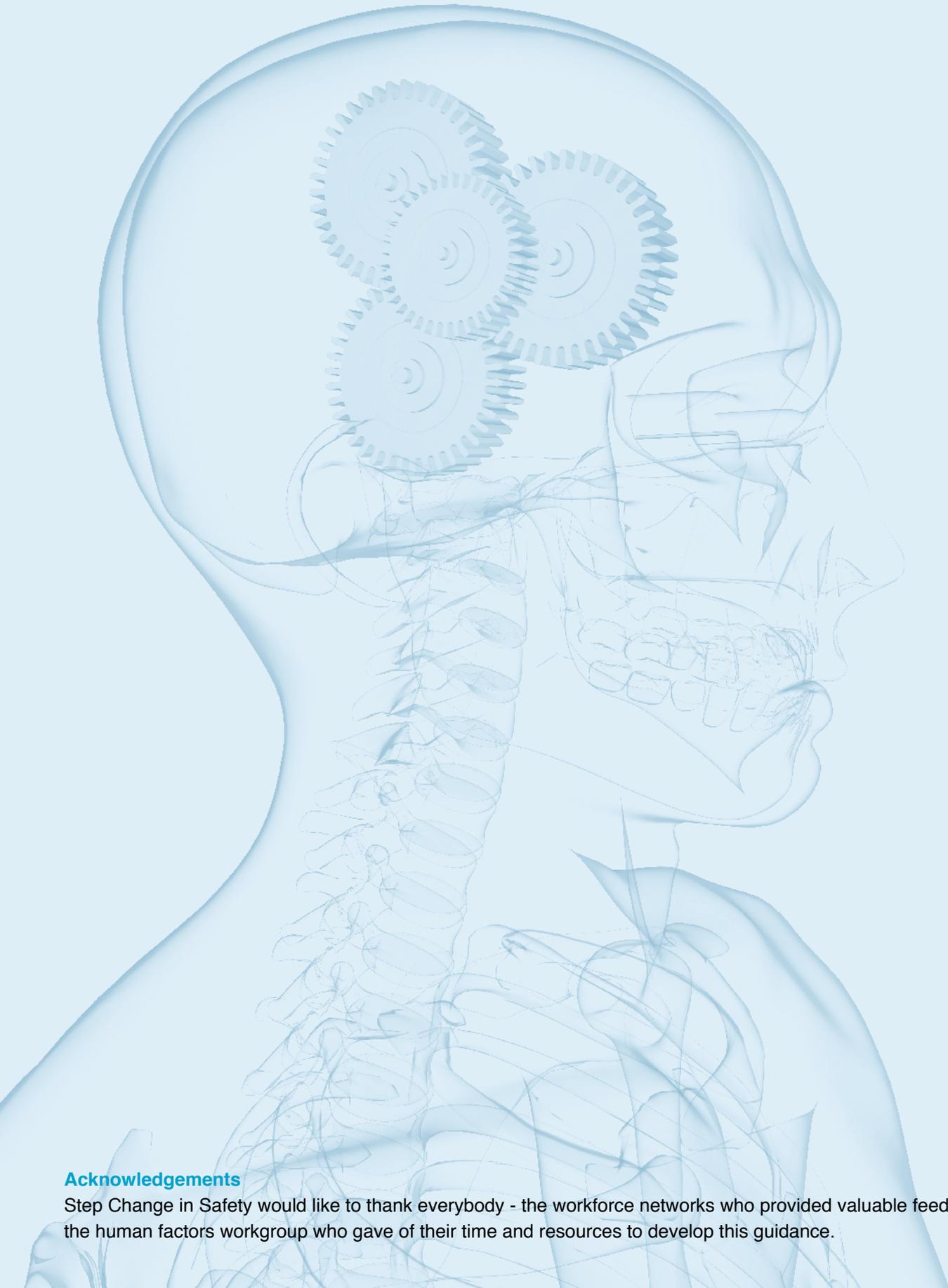
Training

Institute of Chemical Engineers

Human Factors in Health & Safety - training targeted at people who will be HF Champions
www.icheme.org/human_factors/



Don't forget to take those first steps...start now



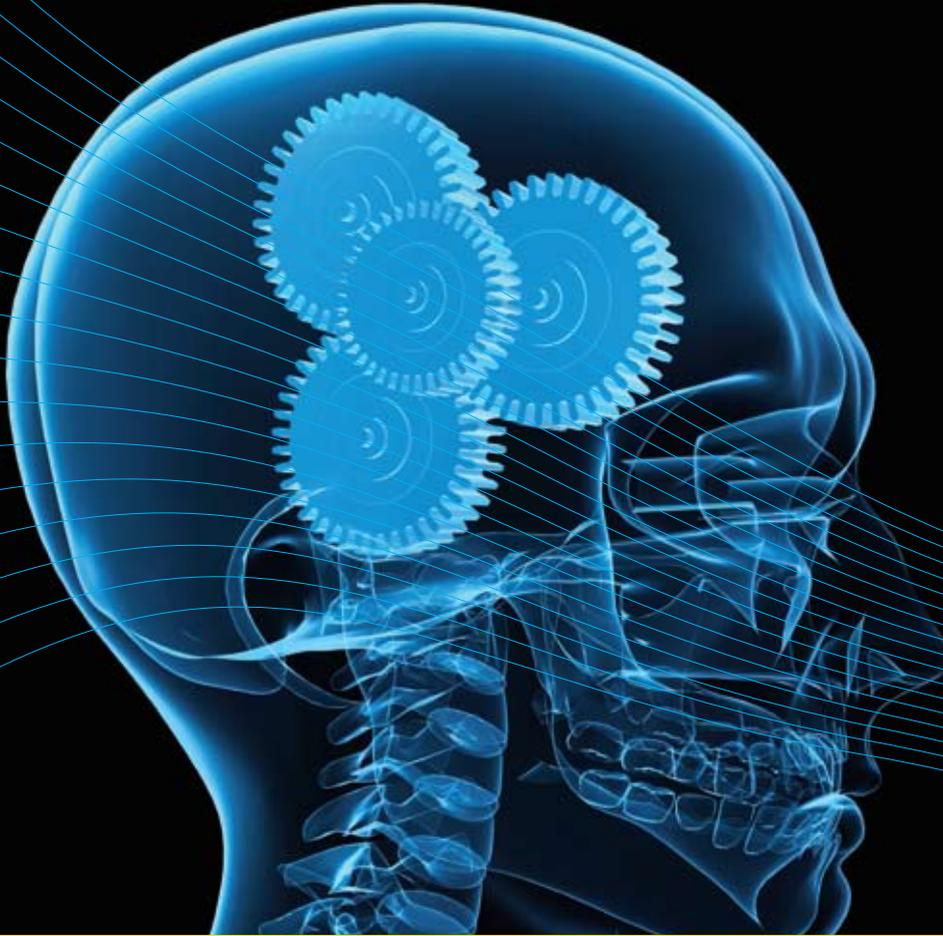
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