

DEVELOPING INTERNAL HUMAN FACTORS EXPERTISE ON A HIGH-HAZARD SITE

Phil Joyner¹ and Ronny Lardner²

¹FIChemE, Human Factors Consultant, BP Grangemouth, Boness Road, Grangemouth, FK3 9XH, UK. tel (00 44) 1324 493329; e-mail JoynerP@bp.com www.bp.com

²CPsychol, The Keil Centre Ltd, 5 South Lauder Road, Edinburgh, EH9 2LJ, UK; tel (00 44) 131 667 8059; e-mail ronny@keilcentre.co.uk; www.keilcentre.co.uk

INTRODUCTION

This paper describes how BP's Grangemouth integrated petrochemicals site in Scotland, UK has taken learning from the EU-funded PRISM human factors project, and used this knowledge to strengthen their internal capacity to gain performance improvements in health and safety, and other aspects of their business performance.

ABOUT BP GRANGEMOUTH

BP's Grangemouth petrochemicals complex in central Scotland is one of their largest operating assets. It comprises an integrated crude oil stabilisation plant, oil refinery, chemicals plant and crude oil export terminal, and has over 2500 people working there. BP's Forties Pipeline System transports crude oil from the North Sea to BP Grangemouth for processing and separation. The separated gas is used as fuel and as petrochemicals feedstock. 20% of the stabilised crude oil is used as feedstock for the Grangemouth Refinery, and the remainder is loaded onto marine tankers and exported to other refineries.

WHAT ARE HUMAN FACTORS?

The UK Health and Safety Executive defines human factors as "the environmental, organisational and job factors, and human and individual characteristics which influence behaviour at work in a way which can influence health and safety. This includes the jobs people do, the individuals doing the jobs, and how they are organised and managed"¹.

Some health and safety experts have identified the current industry interest in human factors as a "paradigm shift" in thinking and practice, similar to the focus in the 1990's on safety management systems². It is considered a paradigm shift because of its significant change of emphasis in how to improve safety.

THE PRISM NETWORK

PRISM³ is a EU-funded project to improve safety in the process industries by disseminating state-of-the-art human factors knowledge, and tools and techniques. Its objectives are "the improvement of safety in the European process industries through raising awareness

of, and sharing experience in, the application of human factors approaches, and tools and techniques". In addition the network intends to stimulate the development and improvement of human factor approaches in order to address industry-relevant problems in batch and continuous process industries.

The network, which will last for 3 years and has the support of over 250 members from 14 countries in Europe, is open to any company, research organisation or individual with an interest in this exciting topic. Through a mixture of conventional meetings, this web-site and its discussion groups PRISM aims to create a world-wide network of companies & individuals who are interested in improving safety through an improved understanding of human factors.

So how does PRISM operate? It was recognised that the field of Human Factors is a very broad one, so for this reason four separate 'Focus Groups' were established within the network covering:

1. Cultural and organisational factors
2. Optimising human performance
3. Human factors in high demand situations
4. Human factors as part of the engineering design process.

The first author presented on improving safety culture at the first PRISM seminar in January 2001, and this served to deepen his interest in human factors, and its application at the Grangemouth site, and within the wider BP group.

WHY HUMAN FACTORS AT BP GRANGEMOUTH?

There were three main reasons for taking action on human factors at Grangemouth:

- Acceptance that human factors were involved in a significant proportion of accident causes. BP is no different from other process industry companies in this respect, and a number of recent incidents at BP Grangemouth⁴ had human factors issues amongst their causes;
- increased regulatory focus on human factors issues (e.g. COMAH⁵). The UK Health and Safety regulator now employs a specialist human factors team to advise their inspectors and industry, and requires inclusion of human factors issues in COMAH safety cases;
- recognition that developing a mature safety culture was complementary to improving other aspects of business performance. Capability to manage the human factor in the process industries will support all aspects of human performance, which may impact on plant reliability, availability, environmental performance etc.

HOW WAS HUMAN FACTORS EXPERTISE DEVELOPED?

The first author, a chemical engineer, has worked for BP for most of his career, and at the Grangemouth site for 12 years. Previous roles included refinery and exploration operations management, human resource management and a period in BP's engineering centre. In the

late 1990's he was involved in three projects with the second author, an experienced human factors psychologist, which concerned (1) improving communication at shift hand-over^{6,1} (2) enhancing teamworking amongst shift teams at a tanker loading facility and (3) involving employees in developing their local safety culture and performance⁷. Initially these projects were not considered by the first author as “doing human factors” — they were simply what he as an operational manager believed was necessary to optimise the performance of people and the process technology they work with.

In February 2001 the first author was appointed the Grangemouth site's Safety, Emergency Response and Security Manager, sought after for this role because of his operational track record in delivering performance improvement through people, particularly in the area of health and safety performance. At that time, many consultancies were approaching the site by offering a variety of human factors expertise and products. A strategic decision was taken to develop some internal human factors expertise so key members of BP staff could, at a minimum,

- act as an informed buyer of human factors products and services which were fit for purpose
- engage in an informed debate with the health and safety regulatory authorities about improving human factors in health and safety.

HUMAN FACTORS SUPPORT GROUP

The first step was to form a Human Factors Support Group (HFSG). This group of six people included the first author, four health and safety specialists including a process safety expert, and a member of the site human resources department. Over six half-day sessions, the HFSG gained an overview of the main human factors topics and methods via a course involving expert input, practical exercises, case studies and group discussion delivered by the second author and his colleagues. The course was structured round the UK Health and Safety Executive's industry human factors guidance. Course topics included safety culture, human error analysis, behavioural safety, ergonomics and work-related stress.

Once the HFSG had completed their course, they reviewed key course topics against current site activities and priorities, and prepared a forward plan on how they were going to further develop the site's human factors capability during 2003.

EXTENDING HUMAN FACTORS AWARENESS

One element of the forward plan was to extend an awareness of human factors topics and techniques beyond the specialist membership of the HFSG, to operational managers and employee representatives. This was achieved by designing a one-day human factors awareness course for up to twenty delegates at a time. To date five such courses have been run on site, resulting in a high proportion of senior managers and professionals having an awareness of the potential for a human factors approach to optimise their performance, and knowing how to contact members of the HFSG for further advice.

HUMAN FACTORS IMPLEMENTATION

In September 2003 the first author was appointed as the full-time site Human Factors Consultant, an 18 month appointment to a role which aims to integrate consideration of human factors into all aspects of the Grangemouth site's operations. This is the first such site role within the BP Group. Through the PRISM network³ of industry human factors experts, the first author learned of the work already conducted by ExxonMobil to promote human factors in their organisation. Of particular interest were ExxonMobil's principles for human factors implementation⁸, namely:

- addressing specific needs and opportunities for performance improvement
- building HF into management systems, standards and practices
- providing HF resources and tools
- promoting employee awareness and involvement in HF
- clearly defining roles and responsibilities
- evaluating results and sharing benefits and effectiveness.

These six principles, supplemented by "influencing and supporting supporting the BP Group" were adopted by BP Grangemouth, and were used to structure their human factors implementation. Specific BP Grangemouth examples under each principle include:

ADDRESSING SPECIFIC NEEDS AND OPPORTUNITIES FOR PERFORMANCE IMPROVEMENT

The first author has been involved in acting as a human factors advisor to those investigating accidents and high-potential incidents on site. The focus of his advice has been on understanding why people involved in the critical factors which led to the event behaved as they did, whether intentionally (a violation) or unintentionally (an error). A new method for investigating human factors causes of accidents being developed by the BP Group has been trialled on site, and the results used to fine-tune the method for wider operational use. Feedback from site investigators has been that the provision of human factors advice has led to a much better appreciation of why people behaved as they did, identification of the organisational factors which shaped their behaviour, and formulation of recommendations which are more likely to lead to safe behaviour in the future. These methods have been used to investigate accidents and commercial losses alike. Site leadership now recognise the benefit of including human factors analysis in incident investigation, and this will become mandatory in the future.

The same human factors analytical tools have been used to reinvestigate one incident where it was felt that the initial investigation had not probed deeply enough. This led to new findings and recommendations, and a commendation from the local health and safety inspector for the thoroughness of the human factors investigation.

BUILDING HF INTO MANAGEMENT SYSTEMS, STANDARDS AND PRACTICES

Four examples follow where HF has now been built into management systems, standards and practices.

Process safety review — the site has a rolling programme of reviewing the safety and operability of existing process plant. A series of checklists, audits and questionnaires are used to gather data on how process safety and plant operability can be improved. These methods now incorporate consideration of human factors issues (e.g. opportunity for human error, staffing levels, ergonomics etc. One example of a human factors process safety improvement concerned better access to infrequently-used valves, whose immediate use is essential during emergencies. The human factors considerations were based on existing human factors guidance⁹.

Operating instructions — site guidance which was being written for the site on how to prepare operating instructions now contains human factors considerations such as readability, layout, accessibility to the user, usability, based on existing human factors guidance¹⁰.

Terms of reference for investigations — investigations into high severity accidents or a near miss with high potential will include in their terms of reference the need for specific consideration of the relevant human factors causes, using the human factors analytical tools described above.

Management standards for preventing work-related stress — these were developed by the BP Group in partnership with the UK health and safety regulator, and are in use at the Grangemouth site¹¹.

PROVIDING HF RESOURCES AND TOOLS

Shift handover log — a new standard electronic log book for use by process operators and shift supervisors was being designed for use throughout the site. This opportunity was taken to provide human factors input on the design of the computer interface, and inclusion of key human factors topics (e.g. miscommunication of maintenance which continues over the shift change), which has been a causal factor in several serious process industry accidents¹².

Stress risk assessment — following provision of training for selected site employees, several areas of the site have used StressTools¹³, a stress risk assessment method, to assess and control key work-related stressors, thus taking a preventative approach to managing this key occupational health issue.

PROMOTING EMPLOYEE AWARENESS AND INVOLVEMENT IN HF

Safety culture assessments — the site wanted to adopt a range of proactive human factors techniques to enhance its safety culture and performance. Several areas of the site conducted Safety Culture Maturity^{®a} assessments⁷, which involve a cross-section

^aSafety Culture Maturity is a Registered Trade Mark of The Keil Centre Ltd

of employees at all levels in identifying and implementing practical actions to enhance their local safety culture.

Human factors courses — over 100 employees have completed a 1-day human factors awareness course, as previously described, including most members of the site leadership team and a number of employee safety representatives. This has led to the identification of many areas where a human factors approach has the potential to bring performance improvements. These are then handled locally, or with support from the first author.

Awareness of *why* safety management systems exist — working with those responsible for implementing a new incident-reporting and action-tracking database, to specify training methods which involved users in understanding the purpose, nature and benefits of the system.

Preventing work-related stress — In 2002 the Grangemouth site's Applied Technology Group won a European Health and Safety Award for preventing work-related stress¹⁴. The award commended the high levels of employee involvement in developing solutions. In addition, the site has developed and is currently implementing a competency model for the prevention and management of stress.

CLEARLY DEFINING ROLES AND RESPONSIBILITIES

Deep and integral — a central aspect of the site's strategy is that "HSE is integral to every business decision and owned deep in the organisation". It therefore follows that human factors must also be deep and integral, and not purely the domain of internal or external experts. The first author's role is therefore to support and advise operational managers, and develop their capability to manage the human factors, not to be "an extra pair of hands" who takes ownership of resolving their human factors issues.

EVALUATING RESULTS AND SHARING BENEFITS AND EFFECTIVENESS

Within BP Group — the first author is now part of an informal worldwide internal BP network of human factors experts, and has provided help and advice to many centres including BP Norway and BP International.

Elsewhere in the process industries — the first author accepted an invitation to chair a committee of the American Institute of Chemical Engineers tasked with writing a textbook guide to human factors in the process industry.

INFLUENCING AND SUPPORTING THE BP GROUP

Providing internal consultancy to other BP sites — acting as the human factors advisor on a corporate audit, and responding to ad-hoc queries.

Contributing to Group initiatives — e.g. behavioural safety, accident investigation. Since the first author's appointment, the BP Group has established two new posts: a human factors specialist and a behavioural safety adviser. The first author supports these post-holders on an informal basis.

BRIEF CASE STUDIES

Table 1.

Engineering controls

A number of incidents had occurred involving road tanker lids being left open prior to departure, resulting in product spillage. A human factors investigation identified the cause of these errors, and a simple, low-cost engineering solution which prompted operators to remember to check all lids were closed.

Management systems

The need for human factors input into the design or modification of plant has now been built-in to the project design process.

Behaviours

As part of their safety improvement plan, the site “re-inducted” over 3500 employees and contractors, with the emphasis of the re-induction sessions being on the right and duty of all personnel to challenge each other’s safety behaviour.

OUTCOMES

During the life of the HFSG, the site’s health and safety performance has improved dramatically, although the HFSG would not wish to claim this is solely due to their efforts. (See Figure 1).

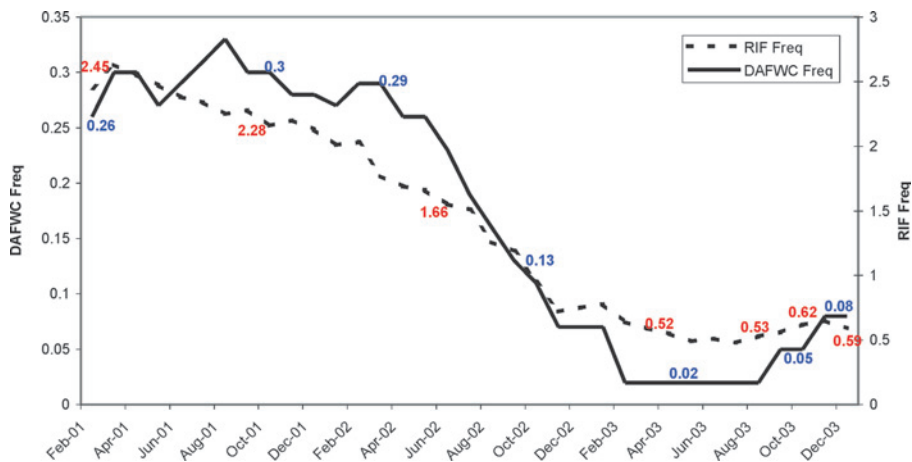


Figure 1. 12 month rolling for OSHA reportable injuries (RI) and days away from work cases (DAFWC) (per 200,000 manhours and DAFWC are unable to work on the day/shift)

LESSONS LEARNED

One objective of this paper was to describe in detail the challenges involved in promoting human factors using internal expertise, with examples of successes and failures. This knowledge will be useful to other organisations thinking about implementing human factors initiatives.

Significant successes include:

- tapping into a significant demand and level of enthusiasm for harnessing human factors concepts and techniques to improve performance, aided by the credibility of the first author and the HFSG
- deeper learning from accidents and less repeat incidents, attributed to identifying underlying human factors causes
- linking human factors to all aspects of performance, not just health and safety
- appropriate use of external expertise to develop internal capability, and work in partnership to help direct resources towards those areas most relevant to the site's needs

Key learning includes:

- Patience is needed to see results delivered. Some managers expect a “quick fix”, which is not realistic. Such expectations need to be managed if disappointment is to be avoided.
- Patience is also needed to spot opportunities to promote human factors, offer human factors solutions, and integrate human factors into new initiatives.

With the benefit of hindsight, the promotion of human factors using internal expertise could have been enhanced by:

- inclusion of others on the HFSG, for example employee health and safety representatives
- further emphasis on the potential for commercial benefits.

CONCLUSION

It has proved possible to develop internal human factors expertise on this high-hazard site, and thus contribute to enhanced site performance. Human factors knowledge is being integrated into safety management systems and practices, and awareness is being developed amongst the wider workforce. On this site, and within the wider BP organisation, there is a strong appetite to continue to harness human factors knowledge, tools and techniques to improve all aspects of performance, not just health and safety performance.

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