

FIRE AND BLAST INFORMATION GROUP TECHNICAL NOTE

Human Factors Guide

Human Factors Guide for the Protection of Onshore Plants and Offshore Structures against Fires and Explosions

Technical Note 9

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FOREWORD

This Technical Note is the ninth in a series written for the members of FABIG to complement the Interim Guidance Notes. It is intended to provide FABIG members with a simple users guide in the area of human factors.

This document was written by Ed Terry (Sauf Consulting Ltd) and Ian Randle (Hu-Tech Ergonomics).

1. INTRODUCTION

This technical note has been prepared as a “simple to use” guide to assist the awareness and implementation of the Human Factors in the design and operation of oil and gas facilities both onshore and offshore.

Human Factors have been treated as a broad subject within this guide. The subject has been considered to cover all issues governing the way that individuals and teams may work, the influences defining their environment, (in terms of culture, knowledge as well as the physical environment). This includes how individuals and teams respond, learn and adapt to these imposed environments; the way in which their organisations plan and prepare for the tasks and activities to be carried out and the physical environment in which those tasks are done.

This guide has been developed with the range of FABIG members in mind as potential users and endeavours to relate Human Factors issues to normal project or asset activities and documents. It suggests different Human Factors requirements in relation to their application or to a demonstration to stakeholder and other discipline activities, and where appropriate tries

to list the influence both on and off the life-cycle phase of a development.

The technical note provides advice to potential users on ways to facilitate the inclusion of Human Factors in planning their activities.

The technical note has compiled public domain information to help demonstrate the benefits in moving from a compliance culture to understanding the needs and the context of the “end-user”.

The technical note also provides reference sources to enable an assessment of the typical costs associated with Human Factors issues, to assist those making a case for Human Factors activities. Some summary illustrations are included.

A brief description of the Human Factors tools and methods available to the potential users is provided. Selected project or development activities and deliverables are used to demonstrate how Human Factors may be used and where they would be reported.

The document comprises a brief review of emerging approaches available to the practitioner and provides sources of further information and a glossary.

2. OBJECTIVE

This Technical Note supports FABIG members by:

- Providing a summary of the reasons for and benefits of carrying out Human Factors studies
- Providing a quick reference source for key guides and standards that are available in the public domain
- Providing guidance on the tools and methodologies used in Human Factors studies and how they might be incorporated into design and operations
- Providing preliminary guidance on how to determine which of the Human Factors tools is the most appropriate to use under different circumstances
- Describing the role of Human Factors studies within risk management and in enhancing of operability in the onshore and offshore process industries

3. BENEFITS FROM THE APPLICATION AND IMPLEMENTATION OF HUMAN FACTORS

3.1 General issues

3.1.1 Introduction

Human Factors practitioners have seen great strides in the use of Human Factors (HF) studies but there remain major obstacles to incorporating Human Factors as a matter of course into the design process and operating practices. Some of this resistance is perceived to be an issue of cost (an uncertainty whether the benefit is worthwhile) and some resistance is perceived to be an issue of culture. In some sectors the Human Factors studies are still seen as peripheral although beneficial rather than central and essential.

A number of example benefits and issues are discussed below to illustrate drivers and benefits for the constructive implementation of Human Factors.

3.1.2 Compliance with standards and expectations

There are a number of reasons to achieve compliance with Human Factors standards and expectations and there are reasons for setting internal standards with which to comply.

The reasons for compliance with Human Factors standards and expectations fall into “hard” and “soft” categories, i.e. where there is direct measurable benefit or where the benefit is implicit but potentially measurable over a longer period.

Within the “hard” category, reasons would be;

- To improve accident rates
- To reduce the likelihood of human error provoking situations

Within the “soft” category, reasons would be;

- To reduce stress levels in the workforce
- To help the establishment of a leading indicator that should ultimately improve safety and operational performance

- To improve company relations with the regulator; many regulators currently push for Human Factors to be dealt with in a consistent and comprehensive manner (not least to improve minor accident rates)

3.1.3 Benefits to safety & health

Implementing Human Factors can eliminate or mitigate the impact of Major Accident Hazards and the effects of personal injury or illness (both chronic and acute disorders).

A key area where Human Factors can be beneficial is to set operational tasks within the limits of human operators by setting physical stress levels at acceptable levels, for example for turning, lifting, reaching activities, etc. By considering the more extreme working environments (in the broadest sense) within which personnel are required to work, steps can be taken to ensure that activities and actions are undertaken by personnel within more comfortable conditions, which would reduce the number of employees who might become unfit for work.

The psychological stress levels perceived by personnel throughout all life cycle phases of a development can also be reduced by the moderately straightforward application of Human Factors techniques to the presentation of information and the issuing of instructions or advice, so that all are obviously prioritised and less ambiguous, this would reduce the risk of trips and improve motivation.

All of the issues above also apply to Emergency Preparedness and Emergency Response. Human Factors techniques applied to planning for an emergency have direct potential to save lives and reduce the probability of injury.

3.1.4 Benefits to operability

A key activity which can make significant benefits if applied early and in a logical and justifiable manner is to optimise the allocation of system tasks and functions between humans and technology. It should be emphasised that taking tasks away from personnel is not always the best

solution; a number of considerations are involved. To name just a few;

- The potential consequences of human failure
- The flexibility that the human can bring to the situation
- The long-term well-being of the human, the feeling of “being valued and needed”
- Interest levels and boredom thresholds (leading to enthusiastic engagement to the task or potentially dangerous disengagement)

3.2 Cost-Benefit Analysis

There are a number of models for calculating or estimating the cost-effectiveness of programme elements or interventions (such as human factors studies) within the life-cycle of a plant or installation. The main accounting/economic models look at Return on Investment (ROI) as the means to determine the case for or against the inclusion of programme elements.

All cost-benefit analyses attempt to match the costs (usually financial) against the expected benefits of the programme. In the context of Human Factors the benefits may be translatable into financial savings, such as reduced manning level or reduced maintenance time, but some benefits, such as increased worker satisfaction, may be difficult to quantify.

Appendix C lists a number of potential benefits from including Human Factors studies in a development programme, all of which are potentially measurable.

An area where Human Factors can have a significant impact is in reducing accident risks, both major and minor. However demonstrating cost-effectiveness in this context can be problematic because the key benefit is the absence of an accident, loss or injury.

The UK Health and Safety Executive have researched the cost-effectiveness of good health and safety management and published guidance documents which attempt to quantify the costs to

business of accidents (e.g. *The costs of accidents at work*, HS(G)96).

In addition, on the HSE website is an area with tools and guidance on calculating the cost-effectiveness of health and safety, which the HSE have called the *Ready Reckoner* (www.hse.gov.uk/costs).

It is worth emphasising the benefits that industry has estimated may arise from improved treatment of Human Factors.

By way of illustration, application to a \$400 million petrochemical project can:

- Reduce capital expenditure by 0.25–5%.
- Reduce total engineering hours by 1–10%.
- Reduce life-cycle operational and maintenance costs by 3–6%. (Source-Shell)
- Reduce accidents, noting that in one project, of the accidents that occurred during Operations and Maintenance, more than 50% were traced to seriously flawed engineering design. (Source-BP)

Also, based on some 600 ‘well documented’ failures of offshore structures, some important insights have been developed:

- Approximately 80% of the major failures were directly due to Human and Organisational Factors and the errors that developed as a result of these factors; only 20% were regarded as being natural or inherent to the system. Of the 80% of failures due to Human and Organisational Factors, about 80% occurred during Operations and Maintenance. The Operations and Maintenance activities frequently interacted in an undesirable way.
- Of the approximately 64% (80% x 80%) of accidents that occurred during Operations and Maintenance, more than 50% were traced to seriously flawed engineering design. (Source-BP)

4. APPLICATION OF HUMAN FACTORS STUDIES

The presence of feedback from past successes and failures has been limited in many areas of oil and gas development and unfortunately the application of Human Factors has been no exception. The role of the end-users is the key to this aspect; for various reasons, the end-users have rarely collated feedback and then been able to provide input to Human Factors practitioners. Overcoming this reticence will be a major contribution to achieving a high standard of Human Factors appreciation and achievement.

When discussing the potentially wide range of application of Human Factors applications and

where they might be of use, it is useful to confirm during which life cycle phase they might be useful. To this end, figure 1 reiterates the full range of the life cycle of an oil or gas development. It has been assumed that the stages are roughly similar for both on and offshore oil and gas developments; the life cycle phases cover from very early granting of licenses and agreeing a development basis with a national or regional government up to decommissioning and removal.

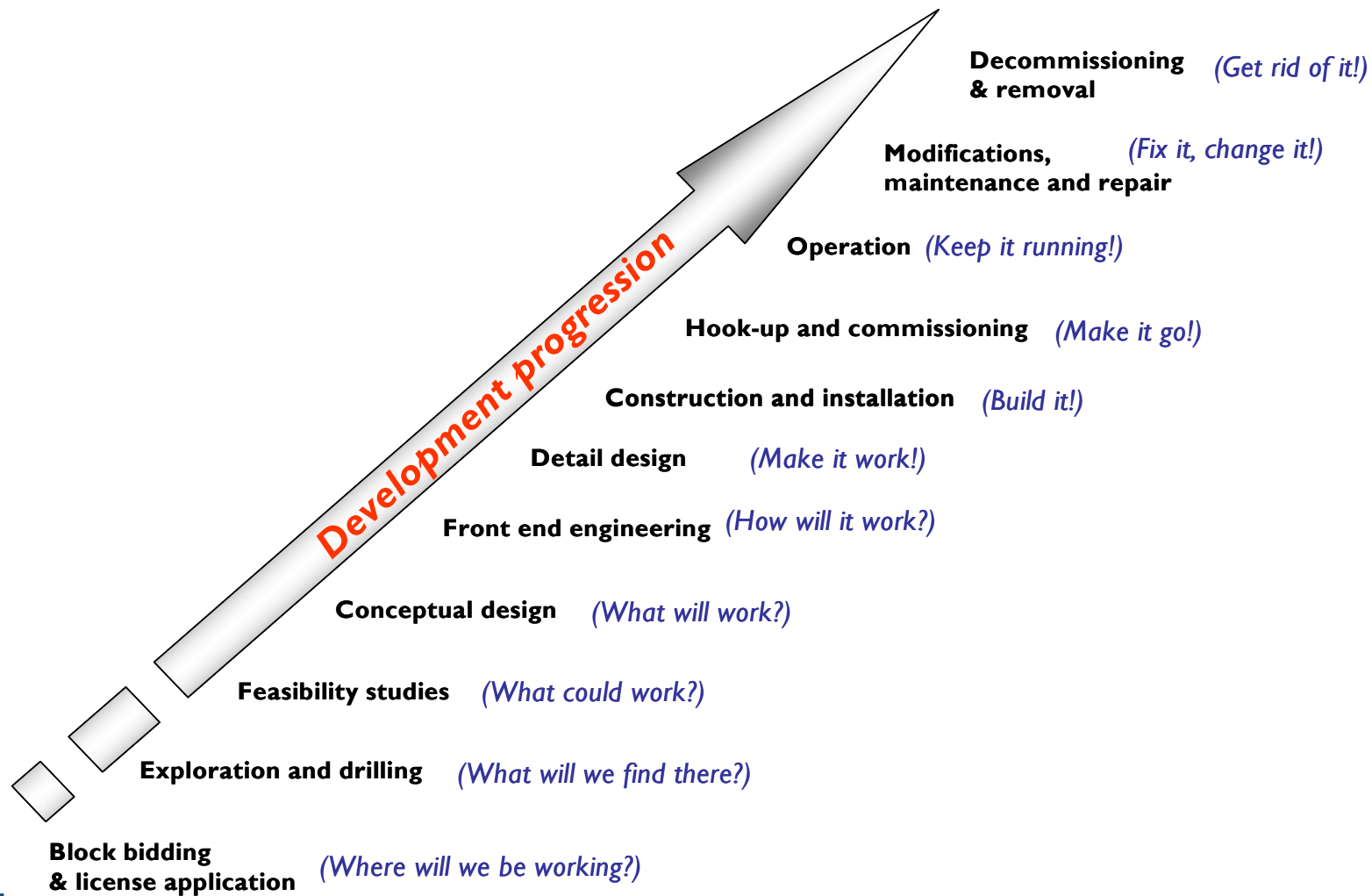


Figure 1 Life cycle phases in the development progression

A number of benefits accruing from the use of Human Factors techniques have been discussed and there are further examples in Appendix C. However, it should be realised by the Human Factors practitioner that there will be different customers with each organisation or development. Each customer will have different

drivers, incentives and interfaces. Understanding the needs of each customer will enable the most appropriate and successful application of Human Factors techniques. Figure 2 below provides a simplistic illustration of the interests of a number of groupings within a development and their major interests.

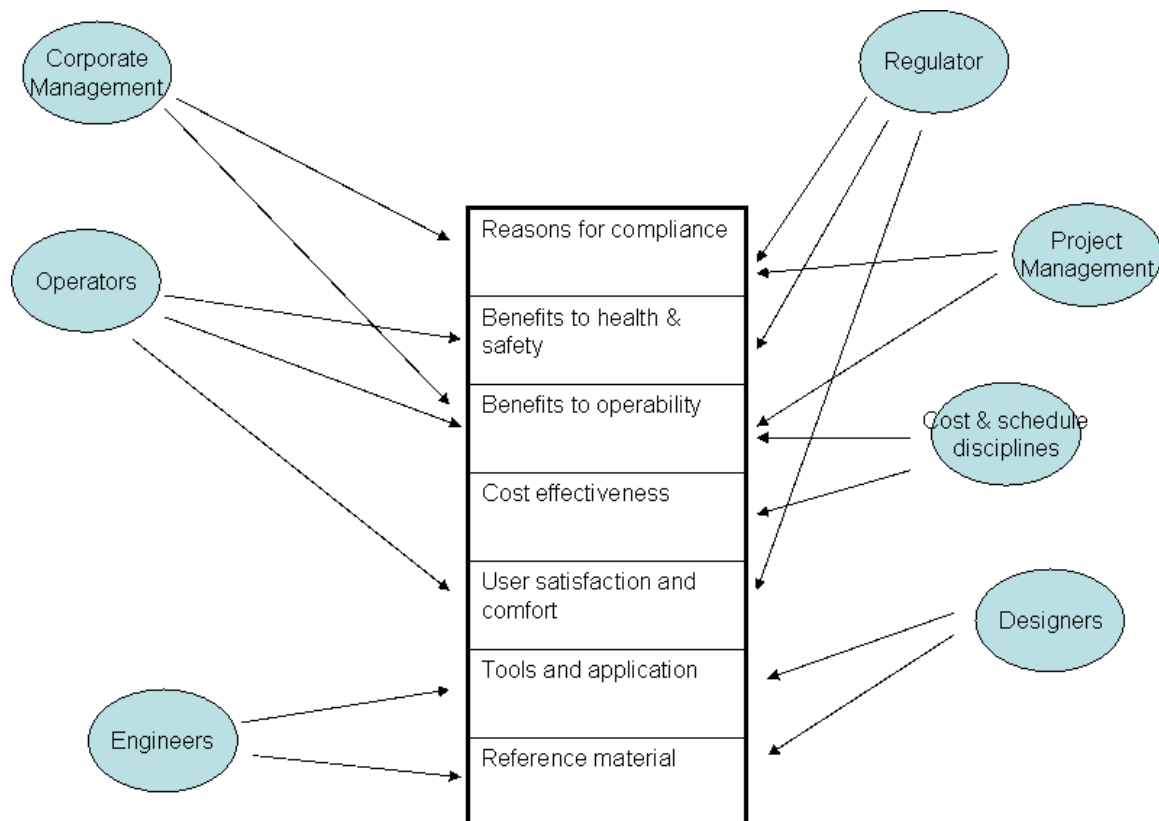


Figure 2 Stakeholder interests in HF application and achievement

5. TOOLS AND METHODOLOGIES

5.1 Currently available tools and methodologies

Over the past two decades Human Factors tools and methods have increased significantly in both complexity and their field of application. This section identifies some of the most useful and commonly applied methods in the fields of engineering design and safety.

It is not intended as a detailed instruction manual on each method; that level of information can be found in the listed source documents. The intention is to give the reader a basic understanding of what the different methods achieve and how they are used.

The methods applicable to any given project can only be determined by setting up a Human Factors team and devising a Human Factors plan at the earliest stages of the project. This will determine the agenda for HF activities throughout the project. Typically an engineer or HF specialist will be appointed as the project HF lead or champion, but representatives of the main engineering disciplines should also be represented, particularly in larger projects. It is important that all members of the HF team have received appropriate HF awareness training and understand the process of building the HF plan.

Table 1 below presents a listing of the human factors activities which may typically be carried out within the key design stages of a development.

Engineering Design Stage	Human Factors Tasks
Conceptual Design	• System Requirements Analysis • Function analysis • Allocation of function • Identify potential scope of human interventions • Identify Users and Stakeholders • User Requirements Analysis • Human Factors specification • Manpower planning – personnel numbers and outline skill levels • Job function planning • Task description / synthesis
Detailed Design	• Ergonomics of design equipment / Interfaces • Task design • Ergonomics of design workplace /workspace • Mock-up / prototyping • Human error and reliability analysis • Manpower planning – job definitions, teams, organisational structure, skills and training needs • Design of user manuals / training programme
Testing & Commissioning	• User training • User trials
Operation / Maintenance	• User training • Post-design/implementation evaluation • Feedback to designers on usability and safety issues. • Human error and reliability analysis

Table 1 Typical HF tasks by project phase

By way of illustration of how tasks may be used in these project phases, a selected number of methods are outlined below in more detail.

1. Allocation of Function
2. Hierarchical Task analysis
3. Human Error Analysis
4. Human Reliability Analysis
5. Link Analysis
6. Distributed Cognition

5.1.1 Allocation of Function

The objective is to allocate system functions between technology and human operators to achieve maximum system efficiency. This technique also helps to determine manpower and skills requirements in the early phases of design.

Information required

Functional descriptions of the system integrating all potential hardware requirements. Fitts list (e.g. Singleton, 1974).

Links to other techniques

HTA, Link analysis, Human Error Analysis

References:

Singleton, W.T. Man-Machine Systems. Harmondsworth; Penguin Books, 1974

Chapanis, A. On the allocation of functions between men and machines. Occupational Psychology, 39, 1-11. 1965

General Description

This technique is concerned with the distribution of system functions between technology and human operators, as some tasks are best performed by machines and others by people.

The process involved is to describe all system functions and then whether these functions are best carried out by human, machines or a combination of the two. The characteristics of humans and machines and their respective strengths are described in Singleton 1974, and is known as a Fitts list.

5.1.2 Hierarchical Task Analysis (HTA)

HTA is one of the most widely used forms of task analysis. It is used to represent the relationships between goals, tasks and sub-tasks. It provides a diagrammatic representation of the tasks; it is highly adaptable and presents tasks in a logical manner.

The method involves defining an overall goal, such as 'carry out drilling', breaking this down into tasks (such as tripping, drilling etc.), sub-tasks (e.g. changing the drill-bit), and at the lowest level of description, activities (e.g. close valve). These are represented usually diagrammatically in a hierarchical format. The relationship between a set of sub-ordinate tasks (or operations or sub-tasks) and their parent goal (or task or sub-task) is defined by a plan. There are a number of plan types available, which can describe most types of relationships. Stopping rules exist to decide how far to decompose the task.

References:

Shepherd, A. Hierarchical Task Analysis. Taylor & Francis, 2001

Kirwan, B. and Ainsworth, L.K. A Guide to Task Analysis,

Information Required

Knowledge of how the task is achieved, and why it is done in a particular way, is required. This is usually gained from a mixture of documentation and discussions with task experts (i.e. practised operators or trainers).

HTA can be used with most of the other HF techniques. It is particularly useful when analysing tasks for human error potential or for assessing operator workloads. It can also be a useful tool for task training, as the task steps are represented on a diagram.

Description

HTA produces a hierarchy of tasks – these are the physical or mental operations that people do within an overall job or system. The method and order of the operations are described as *plans* – these are statements of the conditions which are necessary to consider under these operations. Since the resultant task description is hierarchical, the analysis can be developed in as little, or as much detail, as is necessary to deal

with a particular task. HTA provides an effective means of stating how work should be organised to meet a system's goal.

The technique resembles a flowchart, but the boxes are laid out hierarchically in a top-down fashion, going from a top level goal (e.g. carry out drilling), to the various tasks which together fulfil that goal (e.g. operating mud control; drilling; pulling out of the hole; etc.), to the actual physical and mental actions that are required to carry out the task (e.g. operate brake; monitor mud volume etc.). Three 'levels' in the HTA is usually the minimum, with seven as a practically-recommended maximum; the required depth of the HTA depends on the depth of analysis and the complexity of the task, e.g. drilling might utilise five levels, evacuation three, etc.

In addition to the goals, tasks, and operations, a critical part of any HTA is the 'plan' at each node in the HTA which states 'when' each of the tasks or operations below it are to occur. These plans represent the real expertise of any task, since a novice usually knows the basic operations that make up the task, but an expert knows not only the sequence of the operations, but also the different permutations that will be required depending upon what is happening in the situation, and such information or 'deep knowledge' can be captured in the plans. The HTA is usually also numbered for easy and reliable reference to the various tasks/operations and levels in the task analysis representation. Transfer from one page of HTA to another is achieved via transfer boxes as in fault tree analysis. The process for construction of an HTA is shown in figure 3 overleaf.

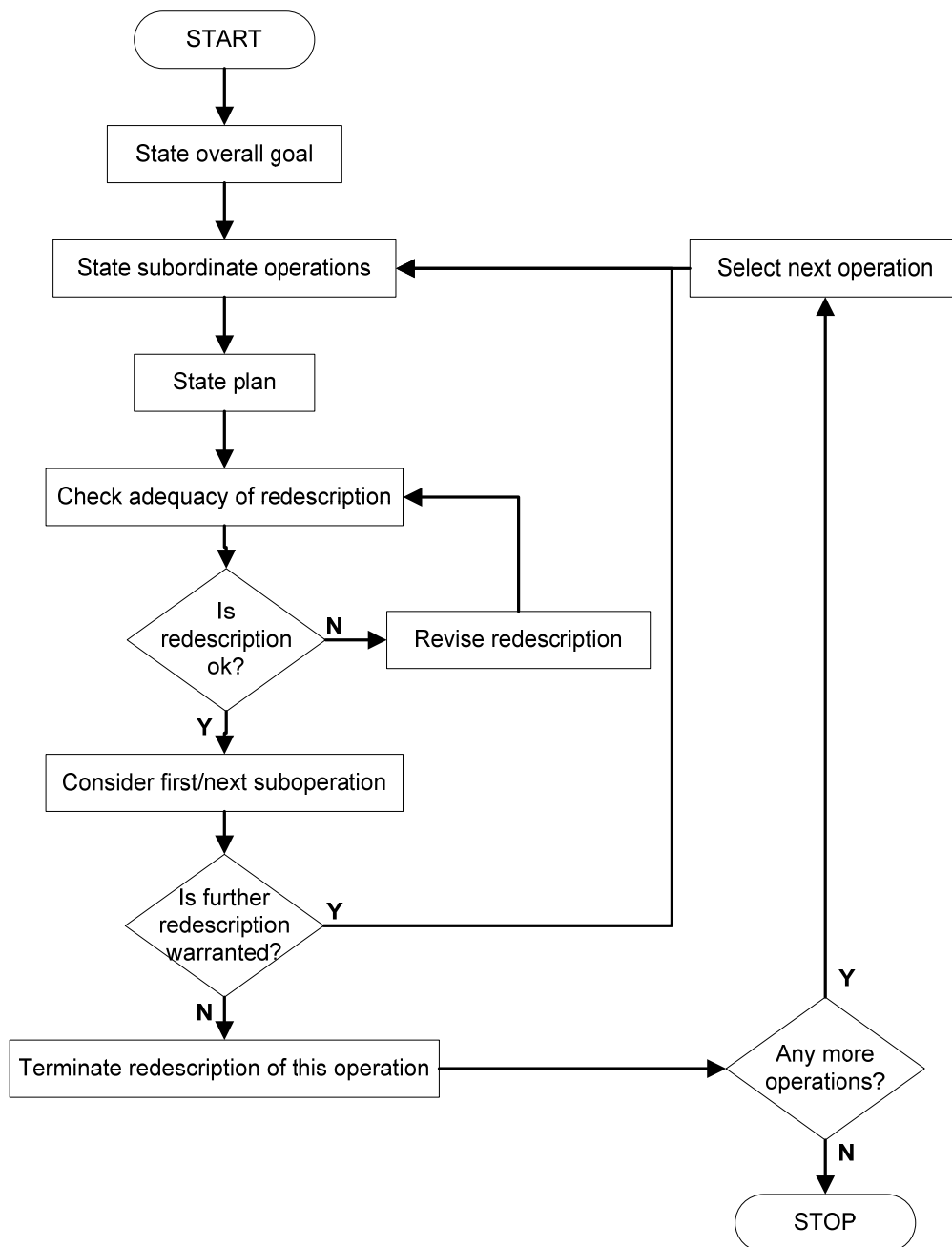


Figure 3 HTA construction process

5.1.3 Human Error Analysis (HEA)

The objective of HEA is to identify where and when human errors may occur that can lead to accidents and system failures, and to determine ways of preventing or recovering from them.

An HEA may be presented in a tabular format and for each task step considers what errors could occur (e.g. Slips, lapses, mistakes, violations), and what recovery potential exists. Error reduction can be identified in terms of

procedures, training and design recommendations.

References:

- Kirwan, B. 1992. A Guide to Practical Human Reliability Assessment. Taylor & Francis, London
- Reason, J. Human Error. Cambridge University Press, 1991

Information Required

Task analysis (e.g. HTA), procedures, schematics of workplace layouts etc.

Links to other techniques

HTA, and Link analysis can all feed into Human Error Analysis. Human error analysis can be used prospectively to assess for human error potential in a new system during the design process. The effect of human error on the system safety can be modelled so that appropriate preventive or protective measures are designed in.

The technique can also be used on existing systems to help determine the causes of human error and determine preventive measures.

Description

There are many types of human error analysis, and the most widely used are presented in the reference documents above.

Most start from a task analysis, (usually an HTA) and then consider each task step for possible error types, likelihood and consequence. Also noted are recovery and prevention mechanisms.

Error consequences may come from a fault-tree type of analysis, and error likelihood can be estimated from generic human error probabilities from the literature. These can be modified to take account of local and situational conditions, such as fatigue, lack of training, poor lighting, badly designed controls etc. These are known as performance shaping factors (PSFs).

Some expertise or guidance is needed in carrying out an HEA, but improvements to design, training and procedures are usually easy to identify.

5.1.4 Human Reliability Analysis

The objective of HRA is to calculate the probabilities for human errors and error recoveries, so that these may be entered into QRA logic trees (fault and event trees). This then allows the quantitative estimation of the human error contribution to risk.

A number of different techniques exist, of which the major four, Absolute Probability Judgement (APJ), Human Error Assessment and Reduction

Technique (HEART), Technique for Human Error Rate Prediction (THERP), and Success Likelihood Index Method (SLIM), are outlined below. Two of these techniques (THERP and HEART) rely on an analyst modifying Human Error Probabilities (HEPs) in a database to reflect the various Performance Shaping Factors (PSF) evident in the human error scenario. They are therefore tools which should be used by those with knowledge or expertise and the output should be interpreted with caution. The other two (SLIM and APJ) are expert judgement techniques and involve a small group of experts with significant relevant experience in estimating the HEPs.

References:

Kirwan, B. 1992. A Guide to Practical Human Reliability Assessment. Taylor & Francis, London

Information required

Detailed human error analysis information is needed (from HEA), together with the information from task analyses (e.g. HTA).

Links to other techniques

HEA; HTA.

General Description

Human Reliability Analysis entails the quantification of Human Error Probabilities, according to the following simple formula:

$$\frac{\text{Number of errors occurred}}{\text{Number of opportunities for error to occur}}$$

Thus, for example, if during normal operations a certain push-button must be pushed 300 times per year, and 3 times the wrong button is pushed, then the HEP is $3/300$, or 0.01. Typically HEPs are in the range from 1.0 for very complex tasks under severe and stressful conditions and time pressure, to 0.0001 for a well-trained crew with excellent interface, training and procedure, etc.

Two techniques, Absolute Probability Judgement (APJ) and the Success Likelihood Index Method (SLIM) must make use of the knowledge and experience of those familiar with tasks under analysis to assist the estimation of HEPs.

The basic assumption, which should be considered on a case-by-case basis, is that the experts will have an experienced-based 'feel' for how often the errors are likely to occur. APJ is a group approach which is fairly unstructured, and usually the experts discuss each error in turn and then either agree on an estimate, or else make their own estimates which are then mathematically aggregated. SLIM asks the experts to identify the significant PSF for the scenarios under investigation and, having weighted these in importance, the influence of each PSF on success likelihood is estimated. These estimates are then calibrated using two or more real human error data points (from the limited human error database that exists) to derive new HEPs for the errors being considered.

Both methods are resource-intensive, but are particularly useful for 'non-standard' error types, e.g. APJ for rule violations and SLIM for cognitive errors (misdiagnosis or mistakes).

The Human Error Assessment and Reduction Technique (HEART) has a limited database of 'generic' HEPs, which can then be modified by PSF considerations (each of which had its defined own maximum effect on the HEP – equivalent to the weighting used in SLIM), to generate HEPs. The Technique for Human Error Rate Prediction (THERP) makes less use of PSFs, but has a more extensive database. THERP's database was developed based on Nuclear Power Plant operators, who are given far more training, procedural, and interface support than is found in most offshore situations. Hence THERP's applicability to the offshore situation is most often justified by using the higher (more pessimistic) values for individual HEPs in the THERP database when being used in offshore/petrochemical assessments.

HEART and THERP generally require less resources than SLIM and APJ, and so are used more routinely in assessments. HEART and SLIM are particularly useful if it is likely that error reduction is to be carried out, as they both offer a means to prioritise such error reduction measures, based on PSF considerations.

5.1.5 Link Analysis

The objective of link analysis is to help determine the optimal layout of workplaces, equipment and workstations. The technique can

equally be applied to the layout of controls and displays on a console, or the layout of workstations in a control room.

All system components are identified and a diagram is drawn showing the various links between these components, including functional, visual, auditory and physical links, taking account of the work process, frequency of use and importance.

This is used to ensure that the most frequently used items are conveniently placed and items which are used in a sequence are arranged logically.

References:

- Kantowitz, B.H. and Sorkin, R.D. Human Factors: Understanding
Kirwan, B. and Ainsworth L.K. A Guide to Task Analysis, London;

Information Required

List of all system components, layout of equipment, operational sequence, linkages.

Links to other techniques

HTA.

General Description

Link analysis is a technique which is used to define relationships between people and components of the system. What constitutes a part of the system will depend upon the task, and could range from individual instruments to other operators or an overview display. The core of link analysis is a representation technique, providing the means to record and represent the nature, frequency and/or importance of links within a system. However, it allows some statistical analysis, usually using frequency data of the relationships between system components.

The link analysis can be represented in a tabular form, or as a layout diagram with the links superimposed over the layout of the equipment or control room, or as a schematic, with symbols representing the different components and lines representing links, but without the schematic necessarily representing the geographical layout of the items.

The number of links does not always reflect the importance of the links; e.g. the emergency stop

button would not be expected to be used frequently, but would deserve a primary location in the layout considerations for any workstation. The analyst must therefore interpret the results of a link analysis with a view of the functions of the various links, and not merely their frequency.

5.1.6 Distributed Cognition

Distributed Cognition is a technique that analyses in detail how distribution fails in both engineering and operating processes. The analysis of failure of “distribution” works in two main ways:

- a) It helps organisations, teams or individuals to anticipate failures in their own processes (e.g. mainly in project reviews).
- b) It helps them anticipate how users (of their product) will fail when operating their designs and how engineering firms can anticipate such failures.

The technique assists users to identify which of their practices are based on assumptions (their own or others) and advises how they may test their assumptions by applying a number of categories and challenging the basis of their knowledge.

Information required

A description of the processes being undertaken identifying the knowledge bases routinely send to assist the decision making process..

Links to other techniques

Link analysis, Human Error Analysis

References:

Busby J.S., Hughes E.J., Sharp J.V., Strutt J.E., Terry E.,
'Distributed Cognition and Human Factors Failures in Operating and Design Processes', Hazards XVI conference, UMIST, 2001

General Description

This technique is concerned with the distribution of knowledge utilised by organisations and human operators. It has been based on analyses of accidents and flaws in assumed knowledge that have led to accidents or near misses have been classified.

The process involved is to create the “business process” being undertaken and identify the knowledge required to support that process. The application of the categories of “flawed assumptions” allows the analyst and the organisation to interrogate which are valid and which need further investigation. The technique can be used predictively and as an investigative tool.

5.2 Developing approaches

Human Factors tools and methods continue to be developed for both specialist practitioners and non-experts. Some recent developments are discussed below.

- Human Factors Integration, (HFI) – HFI is the systematic consideration of HF requirements throughout the lifecycle of a system. This philosophy now forms an integral part of military systems procurement and is increasingly being used in transportation, particularly aviation and rail. HFI covers six key areas, or domains: manpower, personnel, training, HF engineering, system safety, and health hazards. These can vary according to the area of application. The HFI process ensures that each of these domains is embedded within the design and procurement process to achieve the optimum integration of the human with all other aspects of the system.
- Shifting emphasis from major hazards to Workplace Ergonomics – The main emphasis of Human Factors activity in petrochemicals and other high hazard industries in the past two decades has been focussed on the prevention of major accident hazards. Human error and reliability studies have formed part of the risk analyses supporting the safety case submissions but such studies have often not included detailed ergonomic design input. However there has been a shift in emphasis, partly driven by the regulators, to consider workplace ergonomic factors in greater detail. Accidents and injuries due to manual handling, slips trips and falls, and work in harsh environments, remain a significant source of lost time, particularly in offshore work. The source of these accidents and injuries often lies in poor workplace ergonomics. Greater consideration is now

being given in the design process of installations to end-user tasks, including maintenance operations, taking account of the capabilities and limitations of the workers and requirements for access, layout and appropriate mechanisation. This is particularly important in regions where great environmental extremes create additional constraints on the abilities of the human operators.

- CAD tools – The sophistication of CAD modelling has continued to improve, allowing greater modelling of workplaces and human interventions in earlier phases of design. Human mannequins can be imported into CAD packages to model physical space requirements, access and egress, lines of sight and even range of joint motions and force capabilities to ensure that the workplace can be designed to meet the needs of end-users.
- Emerging regulations - there is an increasing emphasis from regulators on occupational health issues (including stress and musculo-skeletal disorders), and an increasing requirement to show that such factors have been adequately covered in the design and operation of facilities. Human Factors and ergonomics techniques are playing an increasing role in workplace and job design to help meet the developing standards.

5.3 Integration of Human Factors tools and methodologies

As noted in the first bullet point of section 5.2, one of the key approaches promoted by this guidance is to integrate the HF studies and practices listed in Table 1 into existing project documents and deliverables. The list in Appendix A describes some of the key issues, the associated stakeholders, the key activity to be undertaken and manner in which HF can assist the solution or completion of the activity. The final column shows the affected documents and activities.

It is hoped that the tabulation in Appendix A will assist those new to HF assessment to understand the benefits that HF can bring, and suggest where the actions may be reported or felt.

In either case, the tables should assist projects when providing an auditable trail of studies undertaken and actions implemented. The documents and activities listed are those undertaken within most projects during their normal progression and should provide a familiar framework to project and development teams.

5.4 Further Sources of Information

This section lists some further useful sources of information on human factors methods, Standards and guidelines.

- The UK Health & Safety Executive have published a number of research reports and guidance material on human factors, particularly within the major hazards context. Much of this material is available on their website at www.hse.gov.uk/humanfactors/index. A list of HF related research reports is given at www.hse.gov.uk/research/subject/h/humanfactors

One important report is the following:

- o ‘Research Report 001, Human Factors Integration: Implementation in the onshore and offshore industries, HSE, 2002, ISBN 0 7176 2529X’.
- The following textbook gives a useful summary of HF techniques and methods:
 - o Human Factors for Engineers, Ed. Carl Sandom and Rogers S Harvey, The Institution of Electrical Engineers, London, 2004, ISBN0 86341 329 3.

There are also some useful ISO standards which describe the process of integrating human factors into the design process:

ISO 6385	Ergonomic principles in the design of work systems
ISO 13407	Human-centred design processes for interactive systems
ISO 16982	Ergonomics of human-system interaction

GLOSSARY OF TERMS, ABBREVIATIONS AND ACRONYMS TERMS

Term	Definition	Term	Definition
3D	3-Dimensional	Carpal Tunnel Syndrome (CTS)	A special case of hand-wrist trauma caused by an increase of fluid pressure within the tight compartment of the tunnel, which results in compression of the median nerve. The first symptom is generally numbness and tingling in the distribution of the median nerve.
Aerobic work	Muscular work in which the foodstuffs are broken down to carbon dioxide and water in the presence of oxygen.	CCR	Central Control Room
Allocation of function	The main aspect of man-machine system design, where the functions are allocated between the operator and the machine. Humans are generally better at decision making with flexibility for the unexpected. Machines are highly efficient computing, integration, and differentiation devices which are reliable and predictable.	Cognitive	The processing of information or data by the brain
Anaerobic work	Muscular work in which carbohydrates and sugars are broken down in the absence of oxygen. The accumulation of lactic acid as a waste product causes muscle fatigue	CRT	Cathode Ray Tube as used in computers and televisions
Anthropometrics	The branch of ergonomics which deals with body measurements	CTD -Cumulative Trauma Disorder	Term used in North America to describe work-related musculoskeletal disorders of the neck, shoulder and upper limb
APJ	Absolute Probability Judgement	DFI Resume	Design, Fabrication and Installation Resume (An as-built record index for the installation, as required by some standards bodies, e.g. Norsok, ISO)
Biomechanics	The analysis of the actions of bones and joints, interpreted in terms of complex systems of levers and motions	DIS	Draft ISO Standard
CAD	Computer Aided Drafting or Design	DSE	Display Screen Equipment – any alphanumeric or graphic display screen, regardless of the display purpose involved
CAPEX	CApital EXpenditure	Dynamic anthropometry	Deals with compound measurements of the moving human being, e.g. reach and the angular ranges of various joints.
		Dynamic work	Where motion of the body, or a part of the body, accompanies muscular tension such as when lifting a load with the arms.

Term	Definition	Term	Definition
Effectiveness	Accuracy and completeness with which users achieve specified goals	GUI	Graphical User Interface – the intention is to achieve optimum usability by utilising graphical feedback to the user
Efficiency	Resources expended in relation to the accuracy and completeness with which users achieve goals	HAWS	Hand Arm Vibration Syndrome. A disorder caused by the complex interaction of vibration from a hand held tool and force applied by the person to use the tool.
EMG	ElectroMyoGraphy – recording the electrical potentials produced by the different muscles as a means of measuring muscle activity	Hazard	Something with the potential to cause harm
ENVID	ENVironmental hazard IDentification	HAZID	HAZard IDentification
Epidemiology	Medical science concerned with the awareness and distribution of disease in human populations	HAZOP	HAZard and OPerability study
Ergonomics	From the Greek: ergon = work; nomos = natural laws. The science of work: of the people who do it and the ways it is done; the tools and the equipment they use, the places they work in, and the psychosocial aspects of the working situation	HCI	Human Computer Interaction - The discipline concerned with the design, evaluation, and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them
Ergonomist	A practitioner in ergonomics. The role of understanding how people behave at work, how they interact with their environment and their machines at both physical and emotional levels, to create working environments that do not require more of the operator than the operator can reasonably give.	HEA	Human Error Analysis
		HEART	Human Error Assessment and Reduction Technique
		HEPS	Human Error Probabilities
		HF – Human Factors	Human Factors - The terms ergonomics and human factors can be interchangeable. Some define human factors as being more concerned with perceptual and cognitive processes and ergonomics being more about workplace and equipment design.
Eyestrain	Also known as visual fatigue. It is caused by the performance of demanding visual tasks for long periods – commonly under unfavourable viewing conditions	HFE	Human Factors Engineering – Can be used interchangeably with Human Factors
FABIG	Fire And Blast Information Group		
GFT	General Failure Types		