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DEMYSTIFYING HUMAN FACTORS & INTEGRATING IN MANAGEMENT SYSTEMS

Dr Suresh Bhardwaj[1]

Abstract

Human factors are the physical, psychological, and social characteristics that affect human interaction with equipment, systems, processes and other individuals. It is the people on our ships who actually make safety work. However human error still occurs in the interactions with conditions, systems, and other people. By addressing these interactions, we can reduce human error, thereby reducing incidents and improving reliability and productivity.

Keywords: Human factors, human error, human element.

1. INTRODUCTION

Often incidents are attributed to human involvement. This gives the impression that people cause incidents. A human-centred approach recognises that human error, actions, and decisions are often the result of the way the workplace is set up; how work, equipment and safeguards are designed, and how leaders influence the work culture. By making human factors' assessment fundamental to the work processes, it can systematically address the issues and latent conditions that influence errors, actions and decisions that cause risk or lead to harm.

Human Factors thus needs to be an integral part of any organization's strategy and a key enabler to further reduce safety, environment, security and health impacts within the maritime industry. That means that it must be part of any management system. This paper aims to 'demystify' human factors and help those involved gain confidence by successfully incorporating human factors in their management systems.

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2. HOW DO HUMAN FACTORS RELATE TO INCIDENTS?

Safety is usually defined as ‘freedom from incidents and accidents. So, is it then a “dynamic non-event,” noted more in its absence than its presence? If the measurement of safety is that nothing happens, then how do we understand how systems operate - to produce nothing?

In other words, since accidents are only probabilistic outcomes, it is a challenge to say for sure that the absence of accidents is by good design or by lucky chance! (Rasmussen, J. 2000).

The starting point for safety management traditionally is that either something has gone wrong or that something has been identified as a risk. The generic mechanism is the Causality Credo—a predominant belief that adverse outcomes (accidents, incidents) happen because something goes wrong, hence that they have causes that can be found and treated.

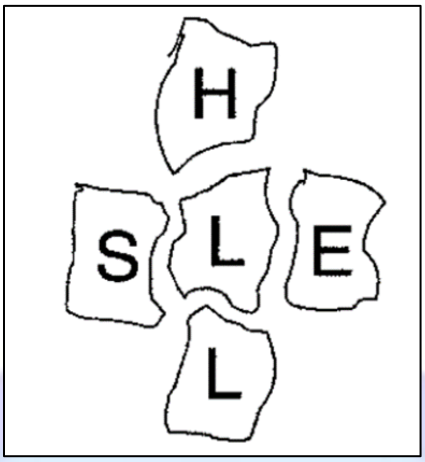
It is presumed that things go wrong because of identifiable failures or malfunctions of specific components: technology, procedures, the human workers and the organisations in which they are embedded. Humans—acting alone or collectively—are therefore viewed predominantly as a liability or hazard, principally because they are the most variable of these components.

However, in contemporary safety science, the concept of unsafe acts shifted from being synonymous with human error to the notion of deviation from the expected performance, and considers the contributing factors that lead to the performance deviation, in as much as considering failures of barriers or defences at all stages of the accident development as well as ‘latent conditions’ or dormant conditions that are present within the system well before there is any recognizable accident sequence (DOE, 2012).

Furthermore, today’s work environment on board the ships being very complex, SHEL Model: Liveware – L, Hardware – H, Software – S, Environment - E. is commonly depicted graphically to display not only the four components of work environment but also the relationships, or interfaces, between the liveware and all the other components.

A mismatch can be a source of human error and identification of a mismatch may be the identification of a safety deficiency in the system (IMO, 2000).

Figure 1: SHEL Mode



Investigations thus require delving into the basic organizational processes: designing, constructing, operating, maintaining, communicating, selecting, and training, supervising, and managing that contain the kinds of latent conditions most likely to constitute a threat to the safety of the system. The investigation focuses on understanding the context of decisions - and explaining the event ‘why people did what they did’, and this provides a much better understanding and thence the ability to develop solutions that improve operations.

2.1 Why understanding human performance matters:

People interact with each other, plants, and process as part of a complex system. Human beings are essential in maintaining our barriers and safeguards. They can, and often do, “save the day”. But we also know that people will make mistakes. Their actions are rarely malicious and usually make sense to them at the time. We know that mistakes are typically due to underlying conditions and systems. Understanding why mistakes happen can help us prevent or cope with them. Investigation is central to understanding why people did what they did. We use what we learn from investigation to design plants, tools, and activities to reduce mistakes and better manage risk. Finally, we know that leaders help shape the conditions that influence what people do. It matters how leaders respond when things go wrong (Conklin, 2019).

2.1.1 What are ‘Human Factors’?

‘Human Factors’ are simply those things that can influence what people do. They may include factors relating to the job people do (e.g., time available or control panel design) personnel factors (e.g., fatigue, capability) and organizational factors (roles, manning levels). This list of factors is often referred to as “Performance Shaping Factors”.

The goal of human factors (HF) in investigation is to understand what influenced the behaviours that were causal or contributory to the incident. Plants, tools, and activities can be designed to reduce mistakes and manage risk better.

2.1.2 Performance Influencing Factors (PIFs)

Performance Influencing Factors (PIFs) are the characteristics of the job, the individual and the organisation that influence human performance. Optimising PIFs will reduce the likelihood of all types of human failure.

<u>Job factors:</u>

- Clarity of signs, signals, instructions, and other information.
- System/equipment interface (labelling, alarms, error avoidance/ tolerance).
- Difficulty/complexity of task.
- Routine or unusual.
- Divided attention.
- Procedures inadequate or inappropriate.
- Preparation for task (e.g., permits, risk assessments, checking).
- Time available/required.
- Tools appropriate for task.
- Communication, with colleagues, supervise on, contractor, other.
- Working environment (noise, heat, space, lighting, ventilation).

<u>Person factors</u>:

- Physical capability and condition.
- Fatigue (acute from temporary situation, or chronic).
- Stress/morale.
- Work overload/underload.
- Competence to deal with circumstances.
- Motivation vs. other priorities.

Organisation factors:

- Work pressures e.g., production vs. safety.
- Level and nature of supervision / leadership.
- Communication.
- Manning levels.
- Peer pressure.
- Clarity of roles and responsibilities.
- Consequences of failure to follow rules/procedures.
- Effectiveness of organisational learning (learning from experiences).
- Organisational or safety culture, e.g., everyone breaks the rules.

Human performance isn't about apportioning blame. It's about identifying potential flaws in the systems that people are a part of (i.e., equipment, process, environment). Incidents can be avoided with a better understanding of the conditions that lead to the error. Human performance helps to recognise these flaws and takes steps to address them.

3. FROM PREVENTIVE TO PRODUCTIVE SAFETY

3.1 From Safety-I to Safety-II

In Safety-I, the starting point for safety management is either that something has gone wrong or that something has been identified as a risk. The generic mechanism of Safety-I is the Causality Credo—a predominant belief that adverse outcomes (accidents, incidents) happen because something goes wrong, hence that they have causes that can be found and treated.

In the normal course of work, seafarers perform safely because they are able to adjust their work so that it matches the conditions. Seafaring and ship operations by its very nature is made intractable by the bull-headed approach in this worst-case scenario of globalization. Given the uncertainty, intractability, and complexity of work, the surprise is not that things occasionally go wrong but that they go right so often. Yet as we have seen, when we try to manage safety, we focus on the few cases that go wrong rather than the many that go right. But attending to rare cases of failure attributed to 'human error' does not explain why human performance practically always goes right and how it helps to meet goals of safe voyages. Focusing on the lack of safety does not show us which direction to take to improve safety.

The solution to this is surprisingly simple: instead of only looking at the few cases where things go wrong, we should look at the many cases where things go right and try to understand how that happens. We should acknowledge that things go right because seafarers are able to adjust their work to conditions rather than because they 'work as imagined'. Resilience engineering acknowledges that acceptable outcomes and adverse outcomes have a common basis, namely everyday performance adjustments.

Safety-II is the system's ability to function as required under varying conditions, so that the number of intended and acceptable outcomes (in other words, everyday activities) is as high as possible. The basis for safety and safety management must therefore be an understanding of why things go right, which means an understanding of everyday activities.

3.2 'Work-As-Imagined' and 'Work-As-Done'

It is an unspoken assumption that work can be completely analysed and prescribed and that Work-As-Imagined therefore will correspond to Work-As-Done. But Work-As-Imagined is an idealized view of the formal task environment that disregards how task performance must be adjusted to match the constantly changing conditions of work and of the world. Work-As-Imagined describes what should happen under normal working conditions. Work-As-Done, on the other hand, describes what actually happens, how work unfolds over time in complex contexts.

But the more intractable environments that we have today means that Work-As-Done differs significantly from Work-As-Imagined. Since Work-As-Done by definition reflects the reality that people have to deal with, the unavoidable conclusion is that our notions about Work-As-Imagined are inadequate if not directly wrong.

This constitutes a challenge to the models and methods that comprise the mainstream of safety engineering and human factors. It also challenges traditional managerial authority and how safety is managed in the shipping industry - through procedures and systems defined and controlled by the company. In the shipping industry this kind of control from the company is yet more accentuated because of the stringent mandatory regulations and far-reaching implications if the shore -management is seen to be in any fault.

A practical implication of this is that we can only improve safety if we get out from behind our desk, out of meetings, and into operational environments and with operational people. Today's work environments require that we look at everyday work or Work-As-Done rather than Work-As-Imagined, hence at systems that are real rather than ideal.

Such systems perform reliably because people are flexible and adaptive, rather than because the systems have been perfectly thought out and designed or because people do precisely what has been prescribed. Humans are therefore no longer a liability and performance variability is not a threat.

On the contrary, the variability of everyday performance is necessary for the system to function and is the reason for both acceptable and adverse outcomes. Because all outcomes depend on performance variability, failures cannot be prevented by eliminating it; in other words, safety cannot be managed by imposing constraints on normal work (Hollnagel, 2015).

The way we think of safety must correspond to Work- As-Done and not rely on Work-As-Imagined.

3.3 The Manifestations of Safety-II: Things that go right

In Safety – II, safety is defined by what happens when it is present, rather than by what happens when it is absent, and is thus directly related to the high frequency, acceptable outcomes. In other words, the more of these manifestations there are, the higher the level of safety is and vice versa.

Even though things go right all the time, we fail to notice this because we become used to it. Psychologically, we take it for granted. But since everyday performance is unexceptional, it can be explained in relatively simple terms.

For instance, everyday performance can be described as performance adjustments that serve to create or maintain required working conditions, that compensate for a lack of time, materials, information, etc., and that try to avoid conditions that are known to be harmful to work. And because everyday performance variability is ubiquitous, it is easier to monitor and manage.

Figure 2: Event Probability and Safety Focus (Kurzweil, 2018)

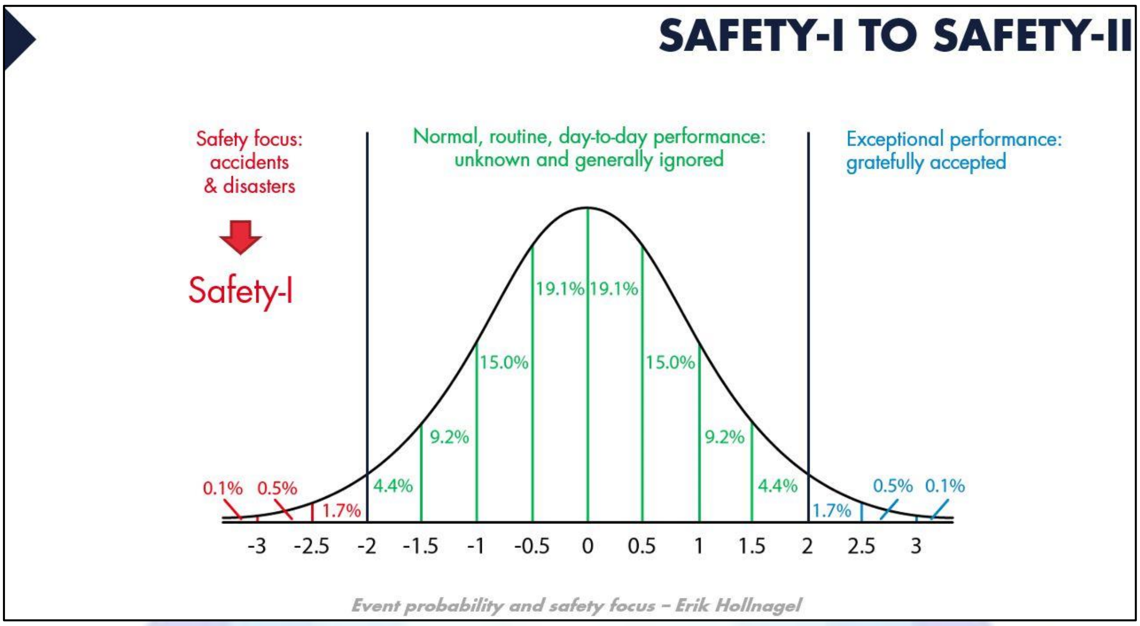


Figure 3: Difference between Safety-I and Safety-II (Kurzweil, 2018)

	Safety-I	Safety-II
Definition of safety	That as few things as possible go wrong.	That as many things as possible go right.
Safety management principle	Reactive, respond when something happens or is categorised as an unacceptable risk.	Proactive, continuously trying to anticipate developments and events.
View of the human factor in safety management	Humans are predominantly seen as a liability or hazard.	Humans are seen as a resource necessary for system flexibility and resilience.
Accident investigation	Accidents are caused by failures and malfunctions. The purpose of an investigation is to identify the causes.	Things basically happen in the same way, regardless of the outcome. The purpose of an investigation is to understand how things usually go right as a basis for explaining how things occasionally go wrong.
Risk assessment	Accidents are caused by failures and malfunctions. The purpose of an investigation is to identify causes and contributory factors.	To understand the conditions where performance variability can become difficult or impossible to monitor and control.

What seafarers do in everyday work situations is usually a combination of Safety-I and Safety-II. The specific balance depends on many things, such as the nature of the work, the experience of the people, the organisational climate, management and time pressures, and other characteristics. Everybody knows that prevention is better than cure, but the conditions may not always allow prevention to play its proper role. It is a different matter when it comes to the ranks of policymakers, and management and regulatory activities. Here the Safety-I view dominates.

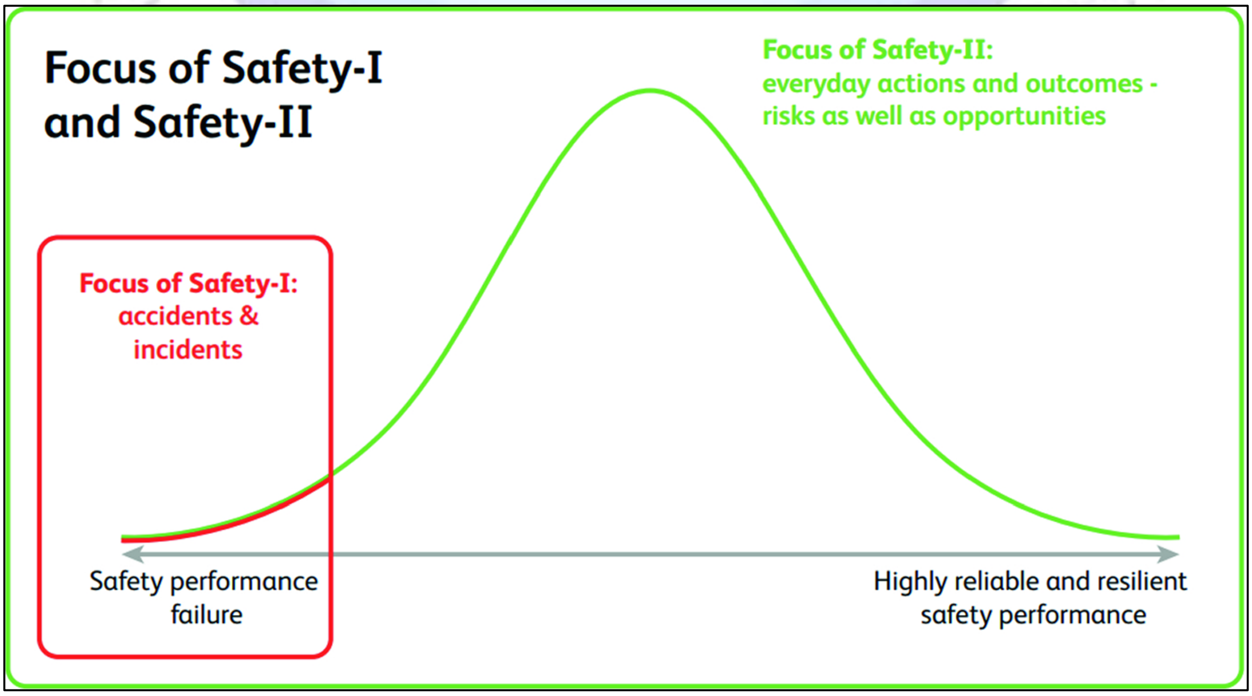
One reason is that the primary objective of policymakers, managers and regulators historically has been to make sure that there are no accidents. Another reason is that these levels are removed in time and space from the actual operation of the systems and services, and therefore have limited opportunity to observe or experience how work actually is done. A third reason is that it is much simpler to count the few events that fail than the many that do not—in other words an efficiency-thoroughness trade-off.

It is important to emphasise that Safety-I and Safety-II represent two complementary views of safety rather than two incompatible or conflicting approaches. Many of the existing practices can therefore continue to be used, although possibly with a different emphasis.

4. SAFETY-II IS THE HUMAN FACTORS APPROACH

It is necessary to understand how such everyday activities go well—how they succeed—in order to understand how they might fail. From a Safety-II view, they do not fail because of some kind of error or malfunction, but because of unexpected combinations of everyday performance variability.

Figure 4: Focus of Safety-I and Safety-II (Kurzweil, 2018)



Safety-II focuses on events in the middle of the distribution. These are ‘difficult’ to see, but only because we habitually ignore them in our daily activities. The ‘logic’ seems to be that if something works, then why spend more time on it? But the fact of the matter is that they usually do not work in the way that we assume, and that Work-As-Done may be significantly different from Work-As-Imagined. The events in the middle can be understood and explained in terms of the mutual performance adjustments that provide the basis for everyday work.

Because they are frequent, because they are small scale, and because we can understand why and how they happen, they are easy to monitor and manage. Interventions are focused and limited in scope (because the subject matter is uncomplicated), and it is therefore also easier—although not necessarily straightforward— to anticipate what both the main and the side effects may be.

In other words, it is our people on the ships, in the operations and support teams who make safety work. However, human error still occurs in the interactions with conditions, systems, and other people. By addressing these interactions, we not only reduce human error but also improve reliability and productivity.

Human Factors addresses the interaction of people with other people, with facilities and with management systems in the workplace. These factors have been shown to have an impact on human performance and safe operations. Human Factors is the application of what we know about human capabilities and limitations in order to maximize overall system performance. By giving careful consideration to the interactions between humans and technological and organizational elements of a system it is possible to significantly increase the system’s productivity and reliability.

Human Factors is about making it easy for people to do things right and hard to do things wrong.

- Fit the task, equipment, environment to the capabilities and limitations of Person.
- Not try to adapt or fit the person to the task.
- Ultimately, our goal is to make the human interaction with systems one that:
- Enhances performance.
- Increases safety.
- Increases user satisfaction.

Human factors involve the study of factors and development of tools that facilitate the achievement of these goals.

4.1 Areas where Human Factors have key role

- Design of tools, equipment and user interfaces in a way that augments the user's work performance.
- Human and organizational factors in risk assessments and emergency preparedness planning.
- Human behaviour and cognition in accident causation.
- Efficient decision making and teamwork in stressful or critical situations.
- Safety culture and safety behaviour improvement programs.

4.2 Human Centred Design

4.2.1 User Centred Design

A 'user-centred design' approach requires that the design of equipment and systems is based on understanding the needs and characteristics of its users. To make this happen, the design process needs to involve stakeholders in a continual process of identifying user requirements for tasks, testing the design, and iterating. This draws on all the available data on the purposes, needs, capabilities and limitations of humans.

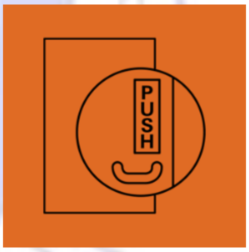
Involving users too late in the design process can be costly. Once a system is in development, correcting a problem where the design does not meet the needs of the users can cost an estimated ten times more than fixing it during design, but once a system is being used, it can cost 100 times more.

4.2.2 Principles of Workplace design

Four principles govern the workplace design. They may seem like common sense, but can be overlooked:

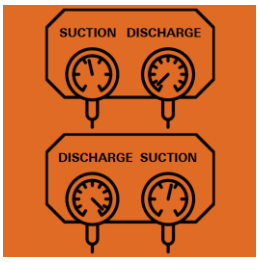
- Importance. Locate components that are essential to a safe and efficient operation in the most accessible positions. ‘Accessible’ refers not just to ease of reach, but also to visibility and audibility.
- Frequency of use. Make components that are used frequently the most accessible.
- Function. Locate components with closely related functions close to each other.
- Sequence of use. Locate components that are often used in sequence close to each other and in a layout consistent with the sequence of operation.
  - Access – When providing physical access, the design accommodates for neutral postures and provides space for the person to perform the work. The design also accounts for their clothing, or any protective covering worn by the worker and any equipment carried by the employee.

  - Shortcuts – If equipment is perceived by users to be too complex, or it requires more effort to operate or maintain than they believe is necessary, they may look for a 'shortcut', which could be perceived as being safe when it isn’t.
  - Expectations - If the equipment is not designed to operate as per the users’ cultural and stereotypical expectations, the chance for human error is significantly increased.



  - Simplicity – Reducing the number of activities the operator has to complete to lower the complexity of the task can reduce the chance for human error.
  - \Consistency – Humans expect consistency in the design and arrangement of their workplace. If a part of the workplace appears in more than one location in their work environment, operators will likely expect it to work the same way at every location.

    For example, if buttons are laid out in a particular way on one area of a control desk, but the same buttons have a different layout in another area of the desk, there is a risk of errors occurring.
  - Efficiency – If the design is felt to be inefficient by the user they may modify it, which will often solve the initial problem but may introduce other problems that may be as bad, or worse.



4.3 Closed-loop design and feedback

Humans perform best in a closed-loop design cycle. We are constantly working through this cycle of:

- Sensing information.
- Processing that information.
- Responding with action.
- Seeking feedback to decide if our action has had the result we were after – so we sense and process information again.

In this way the cycle continues. There should be no break in the cycle, especially between the action taken and the feedback provided. With our feedback systems we aim to show a person what the result of their action has been, not that they have triggered an action.

For example, an operator may trigger the opening of a valve. The feedback system may show that the operator has asked for the valve to be opened, but what if there is a fault and the valve jams shut? If the system only shows that the open command was given, it gives the operator a false impression

In another example, a technician may be required to provide a constant flow of fluid to test a new system, by controlling a valve. If there is no feedback system to show them the effect of the valve on flow, they cannot maintain the required rate.

In an ideal world, every product and system that is designed for use by humans would be developed with human factors in mind.

- A user centred approach to design can be a cost-effective way to make sure the characteristics and needs of the users have been addressed and the system is *usable.*
- By following the design principles and ensuring that our products and systems have the right design characteristics, we can make sure that human factors have always been incorporated into our designs.
- Proper user centred design can mitigate the opportunity for errors independent of competency and training, thereby relying on administrative controls for avoiding performance risks.

5. ERGONOMICS

Ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimise human well-being and overall system performance. Ergonomists contribute to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people. (IEA)

5.1 Why ergonomics?

It is a subject that continually incorporates information and technologies from other domains if they contribute to understanding and improving human performance.

It creates an awareness in industry of the importance of human factors when planning work and that the overall purpose of ergonomics is to increase the efficiency of human activity. (Murrell).

Source: Murrell, KHF (1965), *Ergonomics*. Chapman and Hall.

- Physical ergonomics is concerned with working postures, materials handling, repetitive movements, work related musculo-skeletal disorders, workplace layout, safety and health.
- Cognitive ergonomics is concerned with mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training.
- Organisational ergonomics is concerned with communication, crew resource management, work design, design of working times, teamwork, participatory design, community ergonomics, cooperative work, new work paradigms, virtual organisations, telework, and quality management.

5.2 Workload, Stress, and Fatigue

5.2.1 What is Workload?

Workload generally refers to the quantity of work people are expected to complete, but workload isn't just about the sheer amount of work. It may also refer to:

- How difficult the work is.
- How much the amount of workload varies (e.g., busy, and quiet periods).
- The extent to which staff have control over their workload and the way they choose to carry out their work.
- The novelty/variety of the work to those staff carrying it out.
- The length of time for which staff work at an intense rate without breaks.

Physical workload

Physical workload means the demands created by working in a particular posture (e.g., sitting, standing, or reaching at a workstation); manual labour (such as walking, using hand tools, carrying loads); or working in particular environmental conditions (e.g., extremes of temperature and humidity, or poor lighting).

Mental workload

Workload can also refer to the mental demands created by gathering sources of information and then processing the information, often against time pressure. Mental workload can be considerably increased by the feeling of additional pressure resulting from knowing the potential consequences of an error. It's unrealistic to expect that people will maintain high levels of concentration and vigilance for long periods of time. The intensity of the mental workload will reduce the time people are able to concentrate for.

5.3 Signs of Stress

Work that isn't challenging enough can cause boredom, so a healthy level of pressure is useful, but too much pressure can lead to stress. It's important to be aware of signs of stress, both in yourself and in others, as it can seriously impair ability to function.

Physical signs of stress include:

- Difficulty sleeping.
- Indigestion and abdominal pain.
- Headaches.

- Increased smoking or alcohol consumption.

Behavioural signs of stress include:

- Difficulty concentrating/lapses in attention.
- Emotional outbursts or becoming withdrawn.
- Frequent errors, even with simple tasks.

Emotional signs of stress include:

- Feelings of depression or anxiety.
- Decrease in self-confidence.
- Feelings of anger or resentment.

5.4 Fatigue

Fatigue is different to stress and is the state of tiredness that can be associated with long hours of work, prolonged periods without sleep or with working when people would normally be resting. Fatigue can also be experienced due to sleep disorders such as:

- Obstructive sleep apnea (person stops breathing periodically during the night).
- Narcolepsy (the brain's inability to control its sleep/wakefulness cycles).

Other health conditions that create fatigue as a symptom include:

- An underactive thyroid.
- Diabetes.
- Depression.

5.4.1 Effects of fatigue

A person experiencing fatigue might be more likely to make errors and take risks and be less able to respond to unusual or emergency events.

Whether a person is experiencing fatigue can only be determined by an individualised assessment, but even under ideal conditions, night-time alertness will generally be less than daytime alertness.

Long working hours and long journeys to and from work can also lead to fatigue.

5.4.2 Fatigue risk factors

The three most important risk factors are:

- Insufficient or poor-quality sleep.
- Too much time awake and.
- Circadian rhythms (i.e., People are more prone to fatigue at certain times of the day).

5.4.3 Sleep debt

Acute fatigue will be experienced after an episode of sleep loss. Ongoing sleep disruption or lack of adequate sleep can lead to sleep debt and cumulative fatigue.

This means it's important that people have enough time between shifts to sleep properly.

5.5 Summary

- Workload can refer to both the physical and mental strain that workplaces on a person.
- A workload that is too high can lead to stress, which can manifest itself in a number of ways, including emotional problems, physical discomfort, and lack of attention at work.
- Fatigue is different to stress in that it's caused by long working hours and/or insufficient or inadequate sleep.
- It can lead to problems with attention or even falling asleep while working.

6. SITUATION AWARENESS

Situation awareness is being aware of what's happening around you, actively predicting what can happen next, and realizing whether anyone or anything is a threat to your health and safety.

Although situation awareness is down to the people working in the environment, there are steps you can take to set work up in a way that makes good situation awareness easier to achieve.

- *Good briefings*

All teams are provided with proper briefings on the work they're about to carry out and the possible risks it poses. Letting them know the types of problem they need to look out for makes them more attuned to signs of danger.

Team members regularly communicate with each other to keep everyone briefed on the current situation.

- *Rested and fit for duty*

It is obviously important that all staff are physically and mentally fit for work. Stress, physical discomfort, fatigue, and drug/alcohol impairment can all dramatically reduce people's situation awareness.

- *Minimize distractions*

Work processes can be set up to allow people to focus their attention more fully on certain tasks.

For example, letting colleagues know not to disturb someone performing those tasks and making sure that people aren't asked to be responsible for other areas at the same time.

- *Maintain accurate understanding of the situation*

Having technology, prompts, logs, and registers gives people a clear picture of the plant and the tasks and helps them to recognise changes when they emerge.

Be aware that, as situations evolve and change (e.g., due to unexpected equipment, staffing or environmental conditions), the risk may need to be reassessed.

- *Skills*

Skills that build situation awareness include team communication, problem solving and techniques recognising hazards and changes when they emerge etc.

People need to learn and practice these skills to achieve a high level of situation awareness. Adding checking behaviours into working practices may help people to systemically scan their environment for indications of danger.

6.1 Summary

- Situation awareness is about noticing, understanding, and forecasting the factors in your working environment that could pose a risk to you, your colleagues or the site.
- Situation awareness is a skill that can be learned and improved but also enhanced with proper design.
- Steps can be taken by managers to improve the situation awareness of their teams. These include checking whether staff are fit to work, providing proper briefings and setting work up in a way that minimizes distractions and encourages safety checking habits.

7. BEHAVIOUR BASED SAFETY

Behaviour-Based Safety (BBS) is a process used as part of a human performance programme. BBS is the process that focuses on peer-to-peer behavioural observations, respectfully discussing with the observed individuals what influenced their behaviour and analysing data collected during those observations to improve both personal and process safety performance.

- *Where does it come from?*

BBS is based on extensive behavioural science research. It helps improve safety performance in an operation by targeting and enabling risk-reducing behaviours.

- *How do we use it?*

BBS is one of the tools used in our human performance programme. This programme seeks to enhance risk management by looking at the human behaviour elements of people interacting with plant and complex work systems, as well as the importance of leadership and culture.

- *How does it work?*

BBS is primarily used to improve safety performance through positive feedback in areas that are targeted as ripe for improvement.

Observations in the field can also provide leading indicators for safety.

7.1 Summary

- BBS is the process we use to focus on observing workforce behaviour.
- Once behaviour has been observed, there is a discussion on what contributed to the incident.
- The data collected in those observations is analysed to improve both personal and process safety information.
- BBS is not a replacement for reporting hazards or near misses, removing those hazards or completing field safety audits.

8. CREW RESOURCE MANAGEMENT (BRM ERRM)

Crew resource management (CRM) refers to a training and development approach to developing non-technical skills, with the aim of reducing the potential for, and impact of errors that could have catastrophic consequences.

8.1 What are non-technical skills?

Non-technical skills are skills that complement the technical skills required for the safe and efficient execution of operator tasks. These non-technical skills include communication, decision making, leadership, teamwork, situation awareness (the ability to maintain awareness and anticipate risks in a dynamically changing situation), and personal resources including an ability to recognise the signs of stress and fatigue.

8.2 So, what are the skills that CRM aims to improve?

8.2.1 Situation awareness

This includes:

- Gathering information.
- Understanding information and risk status.
- Anticipating future state/developments.

8.2.2 Decision-making

This includes:

- Identifying and assessing options.
- Selecting an option and communicating it.
- Implementing and reviewing decisions.

8.2.3 Communication

This includes:

- Briefing and giving feedback.
- Listening.
- Asking questions.
- Being assertive.

8.2.4 Teamwork

This includes:

- Understanding your own role within the team.
- Co-ordinating tasks with team members/other shifts.
- Considering and helping others.
- Resolving conflicts.

8.2.5 Leadership

This includes:

- Planning and directing.
- Maintaining standards.
- Supporting team members.

8.2.6 Performance Shaping Factors – stress and fatigue

This includes:

- Identifying signs of stress and fatigue.
- Coping with the effect of stress and fatigue.

8.3 Summary

- CRM is a set of training procedures, that can help us to avoid human error in situations where errors could have a high negative impact.
- CRM focuses on improving non-technical skills and behaviour.
- Many companies currently use CRM training in simulated environments.
- CRM can be used to improve a number of situations and activities but is most useful when multiple operators are working together.

9. CONCLUSIONS

The *new SIRE 2.0 regime by OCIMF* is expected to become operational in late 2022. Much of SIRE2 deals with process and focuses on human performance. The SIRE2 changes will involve a lot of additional work and a significant amount of learning for inspectors, crews, and Operators.

Mapping the SIRE2 questions to the TMSA3 elements is a very welcome inclusion. This will permit Operators to analyse the detailed reports now that the measuring tool (SIRE2) is formally linked to the management tool (TMSA3). Analysis of report results can be made together with associated TMSA3 elements and to the SMS as well. This will identify hot spots, TMSA and SMS shortcomings, and initiate prompt remedial action. Doing this in real time will deliver a dynamic and detailed sitrep across the entire fleet and initiate appropriate actions without delay.

‘’However, a Human Factors element cannot be implemented overnight – it takes time for companies to become familiar with the concepts and understand how to apply them practically.’’, commented OCIMF Managing Director Rob Drysdale.

Company and their technical teams need to ensure safety by achieving TMSA3 compliance. Continuous improvement of Ship Management Systems is supported through developed phased improvements, determined from self-assessment and audit results. So, to improve, companies need to perform regular self-assessment reviews and compare results against TMSA key performance indicators. Companies must then align their policies and procedures with industry best practices thus achieve performance improvement alongside high standards of safety and pollution prevention.

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REFERENCES

Conklin, Todd. (2019). 5 Principles of Human Performance; USA.

DOE (2012). US Department of Energy: Accident and Operational Safety Analysis Handbook. Washington D.C.

Hollnagel E., Wears R.L. and Braithwaite J. (2015). From Safety-I to Safety-II: A White Paper. The Resilient Health Care Net: Published simultaneously by the University of Southern Denmark, University of Florida, USA, and Macquarie University, Australia.

IMO (2000). International Maritime Organization: Resolution A.884(21). London.

Kurzweil, L., Rehor, V (2018). SAFETY II and other recent trends in SMS. Magazine of Aviation Development 6(3):6-11, 2018, ISSN: 1805-7578 DOI: 10.14311/MAD.2018.03.01

Rasmussen, J. & Svedung, I. (2000). Proactive risk management in a dynamic society. Karlstad, Sweden: Swedish Rescue Services Agency.

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