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Human Factors in Functional Safety Assessment

Assessment of Human Interactions and Behaviour

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Abstract

This paper provides a discussion on the physical and emotional factors which humans bring into the design, execution, and maintenance of a Functionally Safe System. It aims to bring these elements together in a structured manner and suggests potential assessment criteria for use by practitioners in this field to allow the assessment of Human Factors into an IEC 61508 or related safety system, though no limitation is intended as the basic methods may be modified for other fields. This paper does not go into specific applications, rather looks at a generic approach as a basis from which sector specific factors may be added. This paper provides a basis for the building of Key Performance Indicators to baseline, measure, and compare differing elements in the Human Factor assessment against a suggested target for a given Systematic Capability level. This is in the context of an audit-based assessment attempting to minimise the effect of bias on the process to bring the often-subjective elements into an objective and measurable format.

1 Introduction

Within functional safety there is an increasing understanding that the decisions and processes in the design and operational phases, which are not directly hands-on with the system, have an impact on the overall integrity of the system. This has led to an increasing focus on the techniques and measures used in the design, assessment and operation of systems, and has been crystallised into the concept of Systematic Capability (SC) levels in IEC 61508-2:2010 for hardware and IEC 61508-3:2010 for software. These standards however could still be seen as taking a mechanistic view of human working practices and cultures, and failing to account for systematic failures caused by physical and emotional factors such as stress, fatigue, or poor motivation. In this regard the cybersecurity sphere as defined in standards such as the IEC 62443 series has a greater understanding, as it looks at intentional human actions which cause harm. Whilst it is not implied that all or even most intangible systematic failures will be caused by deliberate actions, the basic approach has merit.

This paper discusses two types of human factor — the tangible and intangible. Tangible factors are those such as ergonomics, information loading and physical layout. In many cases, though, the poor design decision made leading to systematic issues may be caused by Intangible factors such as stress, fatigue, culture, and misunderstanding. Much of the work to date has focussed on the impact tangible factors have on people operating and maintaining a system, and not the intangible, though a poor appreciation of tangible factors will lead to issues caused by intangible factors in most cases.

Human factors assessments are often subjective in nature as what is clear or acceptable to one person is not to another. This may lead to unclear requirements or outcomes in the functional safety design and assessment process. It is the aim of this paper to account for this in the approach described and suggest the allocation of clear metrics to this field.

To accomplish the metrics-based approach this paper draws on the cybersecurity concept of a Key Performance Indicator (KPI) based framework and set of metrics as described in IEC TR 62443-3-1:2009, which may be taken as a starting point for building an assessment process and asking the correct questions to lead to understanding the human qualities in system design and implementation. It seeks to advise on the manner in which the assessment should take place and the focus of the assessment through the system lifecycle.

This paper, though, is not an exhaustive list of human factor considerations, nor a design guide to implementing Human Factors. Such guides and standards exist, and this should be read in conjunction with them and in the context of the application.

2 Types of Human Factors

Human interaction with a safety system is the most constant aspect in the system lifecycle. From the requirements definition to de-commissioning, human interaction exists. The nature of this interaction can fall into two categories, and hence types of factors to be considered in a system lifecycle:

- Tangible Factors (Section 8).
- Intangible Factors (Section 9).

Tangible Factors describes the humans' interaction with the physical system. This includes the design, ergonomics, information loading and work loading on the operator(s) created by the system and the ability of the operator to both understand what the system is telling them and to react in the correct manner to the information.

In the early stages of a system lifecycle this could also include the workstations being used by, for example, the engineers, analysts, and safety practitioners to create the designs and requirements for the system and interoperate the outputs of models and simulations being run as at the stage pre-realisation; this virtual interaction is a critical part of the system.

The Intangible Factors describe the interaction of humans with other humans, the culture, and the environment under which work is being undertaken. This factor is present throughout the system lifecycle but is especially prominent in the early phases and during phases where abstract work (such as theoretical analysis) is undertaken.

3 Effect of Lifecycle

Through the lifecycle there is a shift in the human factors between the intangible to tangible. This can be seen as being due to the different types and focus of the interaction with the system. For an example, at the concept and initial design stages the system is, by and large hypothetical ideas and concepts. Therefore, the intangible factors play a greater role as a stress on the mind at this stage could lead to a critical error being introduced at an early stage. It is suggested that, at the beginning of a lifecycle, the concept phase is 10% tangible and 90% intangible factors; with the 10% representing factors such as workstation design and office layout. By operation there is a far greater focus on the physical interaction with an actual system. This shifts the focus to a suggested 80% tangible factors, such as the layout of the control stations, and 20% intangible for the culture and demands of the organisation operating the systems. The shift from intangible to tangible comes at system realisation. Errors, though, are often only detected at the point at which the system is operated for the first time. To counter this, an equal focus is placed on tangible and intangible factors at realisation.

As the system ages, human understanding of the system decreases with memories fading and the natural turnover of staff within an organisation creating an increased reliance on written records. This is seen as causing a rise in intangible factors in the latter stages of the system lifecycle. Modifications to the system, especially in the latter stages of the lifecycle, are therefore to be considered in a similar way to the initial concept and design phases in so much as the intangible consideration become higher as the process which leads to the modification is as important as the effect of the modification on the overall result. This is because there is often a high degree of conceptual re-engineering or reverse engineering to be done in addition to the modifications. Decommissioning is a specific case where the shift to focus on intangible factors occurs late in the lifecycle. Being the point farthest from the design phase, the system may have passed through multiple parties prior to decommissioning. This increases the probability that incorrect or convenient assumptions will be made in the decommissioning process, leading to additional risk of harm.

Table 1suggests an apportioning of tangible and intangible factors against the lifecycle stage as defined in IEC 61508-1:2010, Figure 2 “Overall Safety Lifecycle”.

Table 1 ~ Suggested Tangible vs Intangible Focus Through IEC 61508 Lifecycle

IEC 61508-1:2010 Stage		Tangible	Intangible
1	Concept	10	90
4	Overall Safety Requirements	20	80
10	Realisation	40	60
12	Overall Installation and Commissioning	50	50
13	Overall Safety Validation	50	50
14	Overall Operation Maintenance and repair	80	20
15	Overall modification and retrofit	50	50
16	Decommissioning or disposal	40	60

4 Information Flow

In understanding human factors, it is important to understand the flow of information passing through the human function being assessed. The first level is the tangible flow of information from the system to the person and from the person to the system, but there is also the flow of information between people to bring into account. A simplified framework is illustrated in Table 2, which suggests a flow of information from supplier to customer and from a supervisor/manager to a subordinate. This should be framed in terms of both a project or operational environment and an organisational environment to understand where potential conflicts and gaps exist. Table 2 defines the roles as singular, but this may refer to a team of people or multiple people. In many cases the Object Owner changes through the lifecycle with the supplier and customer being the previous or next in the chain. This is overseen by Process managers who often oversee the larger picture of a project or operation of a system. It is important these interactions are understood.

Table 2 ~ Simplified Interpersonal Information Flow Scenarios

Name	**Object Supplier**	**Process Manager**	**Object Owner**	**Object Customer**
Role	Defines starting points, prerequisites and input targets into system for Object Owner to work on. May also act as source of knowledge of Object Owner	Allocates and oversees the work by the object owner and coordinates activities with Object supplier and Object Customer.	Actions the required work within the defined process points by the object supplier and Process Manager.	Receives the completed work package from the object owner along with output points, prerequisites and targets
Interaction	Supplies information, and input targets to Object owner	Oversight, internal target setting	Specialist knowledge transfer with Owner or Supplier.	Progresses the information to the next stage in the process. May become the next Object owner.

At each stage and level described in the flow of information there is a point of handover and interaction. These points are often set by:

- Time Constraints (imposed or required, e.g. shift changes),
- Geographic constraints,
- Knowledge constraints,
- Business demarcation.

The full and complete handover of decisions and knowledge at each stage is a critical step to be monitored. That this is not done under conditions where parties are under pressure due to time, workload, or interpersonal conflicts should be considered. The Process Manager should be aware of this and looking out for potential points of stress in the inter-personal system as well as withheld information. The assessment of human factors should pay particular attention to these points in the process and the transfer point as a key indicator of the health of a system.

Examples of regular transfer points may be a shift change or the phase move from one part of the lifecycle to another (department changes). Changes in Process Management should also be looked at as a shift.

At the higher level, the Object Supplier and Customer may be separate stakeholders within the process. The flow of information between, for example, the team implementing the safety system and the end users is often through many layers of people. These interpersonal information flows are another source of stress which should be paid attention when assessing the quality of the Human Factors.

5 Nature of the Human Factors Assessment

Translating human factors requirements and considerations into measurable and meaningful outcomes is achieved through an assessment process. With human factors there may be a high degree of subjectivity in the results. This precludes a mechanistic assessment in many cases as a ranking done by a single practitioner, especially if there is a relationship between the assessor and the assessed, may reflect the bias and opinion of that person. This is not a deliberate action, rather a case of unconscious bias. The assessment of human factors therefore should be done by a group of assessors, where each may be from a different background (business role, profession, culture, etc.) better to give a diverse view of the inputs given. The group nature of the assessment lends itself to an audit process to determine the effectiveness of the approach being taken.

Auditors should be knowledgeable in the subjects, and as independent as required from the process being audited. IEC 61508-1:2010, 8.2.17 Tables 4 and 5 set out recommended levels of independence for functional safety assessment. These represent a good framework, although it is suggested that the factors for determination of X1 and X2 as per IEC 61508-1:2010 8.2.16 are considered in terms of:

- Greater degree of organisational complexity;
- Lack of experience in similar field;
- Greater degree of organisational novelty; and
- Greater degree of design novelty.

It is important to be mindful that many of the subjects being audited are sensitive and therefore great care should be taken to not breach confidentiality or cause undue stress, which could bias the audit results. There are counter-arguments as to the effect of independence on the results. These are that, whilst the familiarity with the people can relieve the stress of discussing sensitive subjects with strangers at the greater degrees of independence; the fact that they *are* strangers balances this by lessening the likelihood that the auditee feels that the information disclosed will leaked. It is considered that these factors broadly balance overall, and have a lesser impact that may at first be foreseen.

It is suggested that, in addition to compliance to IEC 61508-1:2010 Clause 8, audits are conducted in accordance with ISO 19011:2018, or a similar recognised format. Two auditors and ideally at least one observer should be present, with the observer there to arbitrate and ensure a fair process. Audits should be conducted ideally on an individual basis, unless there is a need for a group discussion. This should be determined in advance and communicated. All information must be kept in confidence and results anonymised to prevent the results being traced to individuals. The latter encourages honest views to be expressed over the tendency to say what is expected by the organisation.

6 KPI Target Levels

6.1 KPIs

Using KPIs is a structured approach to the targeting and assessment of information within the context of performance parameters. The following is derived from IEC TR 62443-3-1:2009, with modifications to the wording to suit the safety domain. These are further drawn from ISO 22400-1:2014. This is felt an expedient means, as these are both industry recognised and transferrable between safety and security domains should the need arise.

KPIs should be structured in a manner which is:

- Measurable;
- Repeatable;
- Specific to the assessment context;
- Contain achievable and specific outcomes;
- Quantifiable / Comparable; and
- Meaningful to all parties.

The process for building performance metrics starts with the understanding of the purpose of the assessment. This allows the analysis of what each requirement is asking in context with the safety objectives structure and other related requirements.

To analyse the standard requirements and derive metrics for each of them, the following steps are defined:

- Identify the Steps;
- Evaluate the context;
- Identify the actions and owners; and
- Identify follow up actions required.

KPIs are derived from performance metrics based on assessment context and objectives, or elements' structure. This process is well described and documented in multiple sources. ISO 22400-1:2014 is an industry recognised industrial method for building KPIs; it is essential that a recognised method is utilised in building KPIs.

Some performance metrics alone have enough weight and priority that they are worthy to track individually as a KPI. In some other cases, tracking a group of related performance metrics as one KPI may be more meaningful. Whatever the case, this approach allows for the use of either method. After completing the performance metrics for each of the safety requirements or objectives, the project team should then proceed to build KPIs. These indicators will be created based on either an individual performance metric or a group of them as per the identified risk reduction objectives. The process and criteria for each KPI should be recorded to assure consistency and repeatability.

The KPIs should be set in the context of the lifecycle phase under consideration, and actioned items be achievable within the same phase. Where a KPI crosses phases, separate measures across the different phases should be established and actioned accordingly. It is best that each phase can close out all outstanding actions. Carry-over actions can confuse the end of phase transfer, as these could be either due to cross phase KPIs or the failure to achieve a KPI. By keeping each KPI and actions within a set period this is a clearer process with clear ownership.

Once established, KPIs should be regularly reviewed for achievement, relevance, and quality of both the KPI and the outcomes. Where needed, changes are made to KPIs so as to improve the safety outcomes.

6.2 KPI Target Levels

When setting KPI performance targets one difficulty is creating a uniform assessment criterion. To do this within the context of functional safety a simple 1 to 5 scale may be adopted. This allows the targets to be integrated with other factors in standard 5x5 risk tables.

The suggested targeting levels are as per Table 3:

Table 3 ~ Human Factors Consideration Levels

Level	Description
L1	Limited consideration. Top level only with minimal risk reduction requirements.
L2	Detailed consideration. Target should aim to mitigate the top 25% of risks to an acceptable level
L3	Detailed Consideration. Targets should aim to mitigate the top 50% of risks to an acceptable level.
L4	High consideration. Targets should aim to mitigate the top 75% of risks to an acceptable level
L5	Very High consideration. Targets should aim to mitigate the top 90% of risks to an acceptable level.

7 Using a Structured Approach to Human Factor Design

The use of a structured approach to Human Factors design is critical to identifying key points and ensuring these are acted upon. This should be referenced to the questions:

- Who will be using the system?
- How will the system be used?
- When will the system be used?

The use of appropriate standards and guidelines is strongly advised at all levels. Standards such as ISO 9241-210:2010, IEC 62366-1:2015+A1:2020, and EN 614-2:2000+A1:2008 describe this subject and the necessary precautions to be taken. When human factors is being considered in both the design and assessment it is critical that this is in a structured manner and integrated into the technical design to prevent elements being missed or causing conflicts down the line which may be resolved in an ad-hoc manner.

When being assessed, the use of standard methods and a structured integrated approach should be credited for both tangible and intangible factors, as this ensures that human stress and the room for induced errors is minimised.

8 Tangible Human Factors

8.1 Preface

Tangible and intangible human factors have been described briefly up to this point in the overall context of a functionally safe system. In the next two sections it is intended to flesh these out in more detail with key focus areas. These are generic and consideration should be given towards the nature of the role being undertaken, the working environment and mobility of the operator need to be accounted for in the correct detail. The following areas are though headings to be used as starting points to determine the detailed factors.

8.2 Clarity

The attributed clarity of a system describes the clarity with which functional information and controls are presented to the operator. This may in terms of both the system process steps and the operator cognitive steps.

Examples are a control panel lid laid out in a form of a process flow, or a start and stop button being co-located and clearly labelled or marked with an infographic. In the design phase this may also involve tools being used guiding the practitioner through the steps of the process.

Considerations for clarity can include:

- Logical layout of relevant information.
- Appropriateness of information being displayed considering both the task being undertaken and the location of the display relative to the task inputs.
- Ambiguity of information display to the operator. This may be the use of unclear language or symbols. Examples include where the operators first language is not the one the system works in.
- The size and readability of data. This may include size, font contrast and colours used. Considerations including undiagnosed visual impairments such as mild colour blindness should be made here.

8.3 Ergonomics

The ergonomics describes the attribute od control location, expected function and work loading on a human operator. The Health and Safety Executive (HSE 2013) in the United Kingdom describes this as:

> *Taking account of ergonomics and human factors can reduce the likelihood of an accident. For example, in the design of control panels, consider:*
>
> - *The location of switches and buttons — switches that could be accidentally knocked on or off might start the wrong sequence of events that could lead to an accident.*

- *Expectations of signals and controls — most people interpret green to indicate a safe condition. If a green light is used to indicate a 'warning or dangerous state' it may be ignored or overlooked.*
- *Information overload — if a worker is given too much information, they may become confused, make mistakes, or panic. In hazardous industries, incorrect decisions or mistaken actions have had catastrophic results.*

8.4 Interaction

Interaction describes level of required operator input. This may be for control inputs or for inspection inputs, e.g. monitoring CCTV.

Assessment starts with the level of input required. Too much input may lead to operator overload and a step being missed. Too little or repetitive input may lead to inattentiveness and the operator not noticing a vital warning requiring attention.

It is often desirable to have multiple operators in a safety context. This leads to additional interactions between the operators and the operators and the system. Both should be considered. When using multiple people, each role needs to be clearly defined with understood overlaps if these exist. This prevents one leaving the role to the other, or both attempting the same task.

8.5 Cognitive Step

Cognitive step attributes describe the amount of mental processing needed to take a command and execute the correct next step. This could also include a requirement for specialist training and knowledge of the system which must be learned. A clear warning and controls may be provided but, if the response requires many years of training and an easily misjudged response, a high degree of cognitive step is required to respond.

Each additional cognitive step potentially leads to errors due to human judgement, learning or emotional response. It is therefore desirable that the number of cognitive steps to implement a safety action should be at a minimum. Factors in assessing cognitive step could include:

- Intuitive nature of controls;
- Level of human judgement needed to maintain control;
- Number of different methods to achieve the same aim; and
- Level of process understanding needed.

In many security systems a level of cognitive step is used as a part of the authentication process. This requirement should be considered along with the needs of safety in any assessment.

8.6 Tangible Human Factors — Level Targeting

To be able to specify proportionate and targeted KPIs for tangible human factors, it is important to have an easy to use and understand system. To this end, this document proposes a "TH Level" linked back to the desired SIL[1] level of risk reduction through

[1] Safety Integrity Level

systematic capability. The use of the SC levels is described in IEC 61508-2:2010 and IEC 61508-3:2010 as the means to reduce systematic errors arising in the design operation and maintenance of the system.

Bringing out the top-level targets, it is important to determine the target for each factor under consideration. This is to ensure that each is assessed both individually and as a part of the overall assessment. Suggested TH Levels are as Table 4.

Table 4 ~ Tangible Human Factors Target Levels (TH-L)

Metric	SC1	SC2	SC3	SC4
Clarity	TH L2	TH L3	TH L4	TH L5
Ergonomics	TH L2	TH L3	TH L4	TH L5
Interaction	TH L2	TH L3	TH L4	TH L5
Cognitive Step	TH L3	TH L4	TH L5	TH L5
Structured Approach	TH L2	TH L3	TH L4	TH L5

8.7 Tangible Human Factors — Level Assessment

When reviewing the KPIs and performance, a simple method of assessing the achieved TH level is important. This should be assessed alongside the target mitigation level and target SC level, thus as the severity of the consequence rises so the required outcome is higher.

For each outcome the maximum level achievable is that set as L. Where a non-compliance is found this can be used to deduct the L level as suggested in Table 5. This may be linked to a 5x5 risk matrix through Table 5.

Table 5 ~ Tangible Human Factors Compliance Levels

Assessed Compliance						
None	**5**	No L	No L	No L	No L	No L
Low (<50%)	**4**	L-3	No L	No L	No L	No L
Moderate (50–75%)	**3**	L-2	L-2	L-2	L-3	L-3
High (76-98%)	**2**	L-1	L-1	L-1	L-2	L-3
Very High (>98%)	**1**	L	L	L	L-1	L-1
		1	**2**	**3**	**4**	**5**
		Severity				

An example is that the TH-L KPI is targeted to a TH-L4 in order to achieve SC3 for Ergonomics. Achievement KPI is assessed as being High however the severity of the gaps identified is moderate (3), this means that the Actual achieved level which can be claimed is TH-L3 for ergonomics.

9 Intangible Human Factors

9.1 Preface

The intangible factors describe the interaction of humans with other humans, the culture of the place and the environment of the place. This is often a subjective matter though indicators of issues are available for observation.

9.2 Stress

(HSE 2023) defines stress as: "*the adverse reaction people have to excessive pressures or other types of demand placed on them*". Workplace stress may be a result of stress accumulated both in the workplace and outside the workplace. It is important to recognise stress in the workplace and take this into account. The HSE further describes this:

> *Workers feel stress when they can't cope with pressures and other issues. Employers should match demands to workers' skills and knowledge. For example, workers can get stressed if they feel they don't have the skills or time to meet tight deadlines. Providing planning, training and support can reduce pressure and bring stress levels down. Stress affects people differently — what stresses one person may not affect another. Factors like skills and experience, age or disability may all affect whether a worker can cope.*

9.3 Environment

Environment describes the area in which the worker is conducting the activities relating to functional safety which impact the ability of the worker to conduct the duties required. There are two aspects to the environment.

First is the physical. Is the physical space suitable in terms of:

- Space;
- Temperature;
- Noise;
- Light;
- Access to welfare (toilets, washbasins, etc);
- Safety of environment; and
- Tangible human factors surrounding the workstation?

The second is the intangible factors of pressure and practice which can lead to:

- Bullying;
- Discrimination; and
- Demeaning.

9.4 Organisational Culture

According to (HSE 2019). Culture can be best understood as "*the way we do things around here*". Culture forms the context within which people judge the appropriateness of their behaviour. An organisation's culture will influence human behaviour and human performance at work. Poor safety culture has contributed to many major incidents and personal injuries.

The culture of an organisation may be looked at in terms of

- Buy-in and action on safety at all levels.
- Allowance for diversity of opinion.
- Decisions being made on a rational or evidence basis.
- Whistleblowing of poor practice and actions being taken.
- A proactive and measured approach to implementation of safety.

9.5 Misunderstanding

Misunderstanding seeks to describe the level to which the workers at all levels are appropriately trained and informed on the work they are undertaking. The training element encompasses:

- Formal learning;
- Vocational learning; and
- Practical and theoretical understanding of the functional safety principles.

For learning to be effective, it is essential that information on the system application, requirements, and other working areas is distributed adequately. Working with a lack of information and communication could lead to inconsistent decisions being made between teams and a misunderstanding of what the aims of the system are. Practices such as:

- Silo or Over-the-wall working;
- Inter-team communication both verbally and written;
- Regular and well-mannered communications;
- Stockpiling of information;
- Systems to allow collaboration being used, but not over-relied on;
- Linguistic barriers;
- Cultural barriers; and
- Distance, including remote working.

9.6 Policy Implementation

Many, if not all, organisations will have policies covering these areas. From the point of view of safety, it is critical to understand that a policy is a statement of intent. The key question to be asked is, “Is this being enacted?”. When looking at intangible human factors, the reality must be assessed, and not just the intention of a policy or procedure.

The presence of a policy is a good sign, and must not be discounted in the overall assessment. It is recommended, though, that the assessment assumes in the first instance that there is no policy and no process. This leaves a set of questions:

- Is the leadership proactively setting the correct tone and goals?
- Are the workers working responsibly and appropriately?
- Is the workplace suitable for the task being undertaken?
- Are all personnel adequately informed and educated?

- Are the goals realistic considering the above?

Evidence for evidence-based policy and decision making may be found in reference to implementation of standards such as ISO 27500:2016, ISO 26000:2010 and, in a more limited capacity, ISO/IEC38500.

9.7 Performance Targeting

As with tangible human factors, intangible factors may be targeted into 5 levels based on the required systematic capability (SC). For Intangible factors these are the IH levels shown in Table 6. KPIs should be set to target the required IH level in each area, and aim to achieve total compliance. There is in these areas, though, a strong desire to drive improvement. KPIs which have longer term objectives may be set, but these must not lose sight of the basic functional safety requirements. Suggested IH Levels are as Table 6.

Table 6 ~ Intangible Human Factors Target Levels (IH-L)

Metric	SC1	SC2	SC3	SC4
Stress	IH-L2	IH-L3	IH-L4	IH-L5
Environment	IH-L2	IH-L3	IH-L4	IH-L5
Culture	IH-L2	IH-L3	IH-L4	IH-L5
Misunderstanding	IH-L3	IH-L4	IH-L5	IH-L5
Policy	IH-L3	IH-L4	IH-L5	IH-L5

9.8 Intangible Human Factors — Level Assessment

Assessment of compliance for IH Levels is different from the TH levels. This is because it is very difficult to assesses the impact severity of each factor in isolation as, for example, the culture may drive stress and misunderstanding. To this end, the frequency that a particular factor is seen versus the KPI level should be assessed. Table 7 provides suggested guidance on this and the means to convert to a 5x5 risk assessment.

Table 7 ~ Intangible Human Factors Compliance Levels

Assessed Compliance						
None	**5**	No L	No L	No L	No L	No L
Low (<50%)	**4**	No L	L-3	L-3	L-3	L-2
Moderate (50–75%)	**3**	L-3	L-3	L-2	L-1	L
High (76-98%)	**2**	L-2	L-1	L-1	L	L
Very High (>98%)	**1**	L-1	L	L	L	L
		1	**2**	**3**	**4**	**5**
		50%	**75%**	**85%**	**92%**	**98%**
		Frequency				

An example is that the TH-L KPIs are targeted to an IH-L3 to achieve SC2 for Stress. Achievement KPIs is assessed as being to a Moderate degree in all cases, High degree in 9.5 out of 10 cases, and Very High degree in 9 out of 10 cases. Therefore, the assessed level is IH-L3.

Where goal setting KPIs are used, this method may equally be used to assess progress and the current position in relation to the desired end goal. The assessment, though, must be against the current position and current safety targets, and not consider any future developments as these may or may not happen.

10 Conclusion

The impact of people in functional safety requires greater attention than it currently receives if systematic capability metrics are to improve. This document draws attention to the potential areas of concern and proposes a method to assess the impact of human factors and behaviour but does not propose that this is the definitive method rather a framework into which a definitive method and metrics can be derived.

The results of the process described within this document could be seen as an addition to IEC61508-2:2010, Annex B or IEC 65108-3:2010, Annex A as an additional technique and measure to ensure Functional Safety.

Initially, it will be for individual practitioners to assess the impact based on the application being assessed, fill in this framework, and set appropriate KPIs and targets. Longer term though, further work is needed involving experts in functional safety, human factors, and human behaviour. This work needs to involve original equipment manufacturers, system integrators, end users, and policy makers across industry sectors to provide a rounded and consistent approach to this issue and integration into the Functional Safety process.

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