HUMAN ERROR

(and its importance in the Risk Management Program)

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Rev.3

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1. INTRODUCTION

"Safety is our number 1 priority." Many companies not only agree with this statement but also recognize it as one of the critical values of their corporate culture. Although it is common to devote great attention and effort to process safety and occupational safety, the "human factor" is often neglected in the majority of safety and risk analysis.

It is quite common to consider human error to be the same as "operator error", i.e., the error of those on the front line of processes, and the focus is then erroneously placed on training, warnings, and even dismissals, missing the opportunity for a broader review of the root causes that originated the error. Even if there was a human error, its cause can almost never be attributed exclusively to the person who committed it.

The traditional focus on accident prevention and risk analysis most often emphasizes the solution of technological and operational aspects, giving little or no focus to human causes. However, it´s been shown that in the majority of industrial accidents there is a failure in the interface between man and the system in which he/she is inserted, and that system failures are, in turn, directly or indirectly related to humans (this is due to the fact that all technological systems are not only operated by people, but are also designed, built, organized, managed, maintained and regulated by human beings). The remaining 4% can be attributed to natural causes. Check the numbers below:

- According to the *National Highway Traffic Safety Administration* (NHTSA), an estimated 94% of motor vehicle accidents are caused by driver error.
- According to the *Worldmetrics.org Report 2024* for Human Error Statistics:
    - Human error causes an estimated 80% of workplace accidents.
    - Human error contributes to around 70-80% of aviation accidents.
    - Around 90% of data breaches are caused by human error.
    - Human error is a contributing factor in 60-80% of industrial accidents.
    - Human error accounts for approximately 75% of all train accidents.
    - Human error is responsible for up to 95% of workplace incidents in the construction industry.
    - a contributing factor in 60-80% of industrial accidents.

2. DEFINITION OF "HUMAN ERROR"

Every task performed by a human being is an opportunity for an error to occur. However, although the same person may not perform a task exactly the same way twice, small variations in the execution of that task are usually inconsequential.

However, when the limit of acceptability is exceeded, the variation can then be considered human error. Thus, we can say that human error can be defined as:

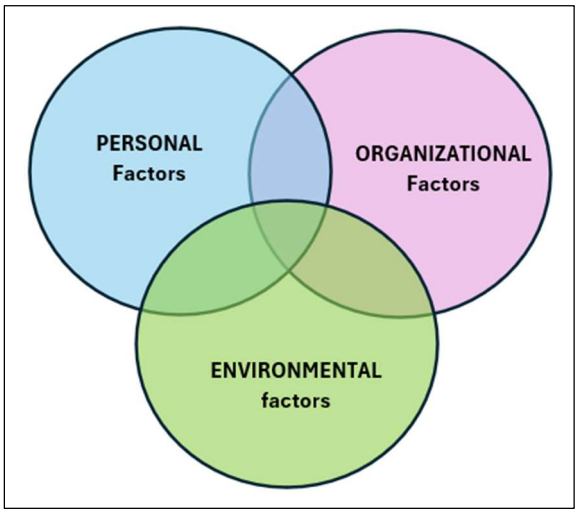
"Any human action (or lack thereof) that exceeds the limits defined by the system with which the human being is interacting"

3. TYPES & CAUSES OF HUMAN ERRORS

The reasons that lead humans to make mistakes are as diverse as possible, but they can be grouped into 3 main factors:

- Personal Factors
- Environmental Factors
- Organizational Factors

Most of the time, there is an interrelationship between 2 or more of these factors. For example, a person may become exhausted (Personal Factor) due to the ergonomic conditions (Environmental Factor) of their workplace; another person may lose motivation (Personal Factor) due to extremely rude management (Organizational Factor), and so on.



Here are some examples of factors that can lead to human error:

PERSONAL FACTORS

- Tiredness/Fatigue
- Stress
- Depression
- Return from vacation
- Lack of patience
- Neglect
- Low motivation
- Influence of alcohol and/or drugs
- Colour blindness
- Lack of psychomotor skills

ORGANIZATIONAL FACTORS

- Repetitive work, without rotation
- Time pressure for decision-making
- Lack of information
- Poorly written procedures
- Very complex procedures
- Little “on the job” training
- Complex control panels
- Lack of activity planning
- Fear of supervision/management
- Little/no supervision
- Lack of recognition policy
- Lack of knowledge/training
- Superior order
- Unrecorded Changes/Alterations
- Organizational Climate
- Inadequate work tools
- Overload of activities
- Communication problems

ENVIRONMENTAL FACTORS

- Repetitive alarms
- People talking loudly
- Constant interruptions
- Telephones
- Noisy environment (equipment, traffic)
- Jokes at work / horseplay
- Boredom
- Poor ergonomics
- Poor lighting

According to researcher J. Reason (1990), once an error has been committed, it can be classified into 2 categories: unintentional errors and intentional errors.

Unintentional Errors are those normally derived from the factors shown above and occur without the awareness that the error is being committed.

Intentional Errors, also called violations, are most often actions (or omissions thereof) made deliberately, but with a good intention to correct or improve a situation considered abnormal. They do not intend to cause harm to the system and usually involve a violation of procedure.

There is a specific type of Intentional Error – sabotage – where there is a clear intention to cause harm to the system or people. This type of error is quite difficult to predict and avoid, although the analysis of the 3 factors mentioned above, especially the Organizational Factor, can give an indication of the possibility of its occurrence. Some examples of factors that can lead to Intentional Error:

- “Optimization” actions (easier, faster, safer)
- Arrogance
- Stubbornness
- Personal Beliefs
- Hierarchical Order (“the boss ordered it”)
- Overconfidence

We will now delve a little deeper into some of the most common factors that contribute to human error:

3.1 – Attention/Memory Lapse

Attention or memory lapses are usually caused by fatigue. An operator who has to work two shifts in a row will be much less effective in the second shift than in the first.

Fatigue mainly affects those production processes that require a lot of attention from the operator to perform manual controls, where the operator's concentration is essential for the correct operation of the process.

3.2 – Attention Diversion

Some of the factors that can cause the operator to have his attention diverted from the control operations of a production process are:

- Intermittent alarms resulting from equipment failure;
- Interruptions caused by telephone, conversations unrelated to the operational process, radio or television present on site, etc.;
- Boredom can also, on the other hand, contribute to the operator making mistakes. If the operator has very little activity to perform, he may be distracted by various thoughts that will dominate his attention, potentially contributing to him missing something wrong in the operation.

3.3 – Environmental Factors

The operator’s workplace has a significant influence on the process of concentration on the work being performed. Working in an environment that is too cold, too hot, too humid, without adequate lighting, wall colouring, layout of control panels, etc., directly affect the operator’s ability to concentrate and can lead to operational errors. For example, a favourable environment in terms of operational comfort should have:

- Temperature between 22-26 °C
- Relative humidity between 40 and 60%
- Air speed less than 0,2 m/s

A point that is often overlooked refers to the operator's ability to identify colours. Operators in key positions where correct colour identification (e.g. on control panels) is necessary should be tested for possible colour blindness.

3.4 – Stress

An operator is more likely to make an operational error when under stress, particularly in emergency situations where the time for corrective action is short. Even if this operator has adequate training in emergency procedures and has been subjected to simulations of emergency events, he may panic when faced with a real situation where he knows the consequences will be very serious.

TABLE 1 below gives an idea of the probability of an operator's error in relation to the time it takes to take corrective action in the face of an emergency:

TABLE 1: Probability of error according to the time to act:

Time to act	Probability of error
0 – 1 minute	99%
Up to 5 minutes	70 – 99%
Up to 30 minutes	10%

3.5 – Displays

Instrument displays are the means by which process information is transmitted to the operator. Humans have five senses and displays can be used to act on any of them, depending on the occasion. For example, to attract attention, an audible and/or visual display may be most appropriate; quantitative information is usually displayed visually, etc.

A practical example of the importance of displays is the case of the altimeters installed in old airplanes, which consisted of a display with 3 pointers. One of the pointers made 1 complete revolution every 300 meters, a second pointer every 3.000 meters and the third pointer every 30.000 meters, with an accuracy of around 15 meters. In the early 1960's, a Viscount Airlines plane crashed into the ground after the aircraft captain made an error in reading the altitude. It became clear that the design of the altimeter was not adequate and a new type of instrument, now with a 5-digit numeric display and only one pointer (which made 1 complete revolution every 30 meters) replaced the old instruments. A comparative study of the two instruments was made to assess the probability of error in the altitude reading, as shown below:

Type of altimeter	Time to read (seconds)	Probability of reading error above 3.000 metres
Altimeter with 3 pointers	7,1	11,7 %
Altimeter with a numeric display + 1 pointer	< 0,1	0,4 %

A good display should be:

• Easy to read: the numbers displayed should be large enough to be easily read. If the display has a scale, non-linear scales should be avoided, as they require more work to read and to interpret the data presented.

• Unambiguous: there should be no possibility of misinterpretation. Displays should work according to "common sense", i.e., according to what the operator expects to see. For example, increases in a given parameter should correspond to an "upward" or "clockwise" movement.

• Precise: the display's precision should be in accordance with the needs of the process and in accordance with the precision of the sensor that is making the measurement.

• Concise: the display should not present information with a degree of precision above that required by the process/operator. For example, an extremely subdivided scale, intended to provide greater precision to the reading, may actually hinder the correct visualization of the value to be displayed.

• Capable of indicating its own fault: any fault on the display must be indicated on the display itself and be easily identified by the operator.

• Distinguishable: it must be possible to identify a particular display among other displays.

Partial view of a complex control panel - Chernobyl

4. QUANTIFICATION OF HUMAN ERROR

Unfortunately, the vast majority of risk assessment tools for industrial facilities neglect the effect caused directly by human error. Much has been said about the frequency of equipment and accessory failures, but almost nothing about the frequency of human component failures.

In facilities and processes categorized as critical, where an isolated failure or combination of failures can cause a catastrophic event, it is essential to take into account human error data, in addition to data on equipment, accessory, control system failures, etc.

As previously explained, numerous reasons can lead to human error, and the quantification of these failures is influenced by such diverse and difficult-to-evaluate factors, such as an action taken by an individual from a Latin culture and another from a Nordic culture. In any case, the numbers presented in this section are a compilation of the experience acquired over the last hundred years in the most diverse activities, such as our daily routines (5), as shown in TABLE 2 below.

TABLE 2: Frequency of human error for everyday tasks

Error	Frequency
Letting milk spill	1×10^{-2}
Making a mistake when choosing an item in a vending machine	2×10^{-2}
Misreading a 5-letter word written in low resolution	3×10^{-2}
Mistyping 10 numbers on a telephone	6×10^{-2}
Leaving a light on	3×10^{-3}
Misreading a 5-letter word written in high resolution	3×10^{-4}
Letting a bathtub overflow while filling it	1×10^{-5}

In the industrial area, see for example the impact of human interference on a simple process, such as closing a valve:

- Failure to close a valve, WITHOUT human interference: 1×10^{-4} (0,0001 or 1 failure every 10.000 operations)
- Failure to close a valve, WITH human interference: 3×10^{-2} (0,03 or 1 failure every 33 operations)

As a general rule, automation drastically reduces the frequency of failures in industrial operations; however, human interference in the design of automation and selection of components to be used still occurs.

TABLE 3 below provides a list of the expected failure frequency for other types of activities in the industrial area:

TABLE 3: Frequency of human error for tasks in industrial areas

Error	Frequency (by event)
Failure to respond to an alarm	1×10^{-4}
Failure to isolate a power grid (in maintenance services)	1×10^{-4}
Error in reading alphanumeric information	2×10^{-4}
Error in reading a checklist or a digital display	1×10^{-3}
Placing a multi-position switch in the wrong position	1×10^{-3}
Incorrect calibration of a display, via potentiometer	2×10^{-3}
Failure to visually inspect a specific problem (e.g., checking for a leak)	3×10^{-3}
Choosing the wrong pushbutton among similar ones	5×10^{-3}
Error in reading an analogic indicator	5×10^{-3}
Error in reading a 10-digit number	6×10^{-3}
Leaving a light on	3×10^{-3}
Failure to reset a valve after a routine activity	1×10^{-2}
Recording information or reading a graph incorrectly during a routine activity	1×10^{-2}
Performing mathematical calculation incorrectly	2×10^{-2}
Making an error when entering 10 numbers	6×10^{-2}
Failure to recognize an abnormal situation during a roving inspection	1×10^{-1}
Failure to notice an incorrect valve position	5×10^{-1}
Failure to act correctly after 1 minute in an emergency situation	**9×10^{-1}**

Note that TABLES 2 and 3 show the expected failure frequency for each activity and thus, a value of 1 x 10^{-3} means that 1 error will occur every 1.000 opportunities. Similarly, a failure rate of 1 x 10^{-5} for letting a bathtub overflow while filling it means that for every 100.000 filling activities worldwide, 1 person will forget to fill the bathtub, causing it to overflow.

In general terms, the frequency of incidents in an industrial facility is between 2 x 10^{-5} per hour (general human error) and 1 x 10^{-6} (safety-related incident).

The human error tables only confirm that failure due to the "human factor" is real and inevitable. We do not perform well when tasks are structured in a way that requires a lot of attention, and human performance is particularly poor in complicated and non-routine activities. Add stress to all this and voila: we have a formula for disaster.

To estimate the probability of human error, Italian researchers Bello and Comumbari developed a technique called TESEO (*Tecnica Empirica Stima Errori Operatori*), used to empirically estimate the error of an operator in a control room. Although this technique appears analytical, a certain degree of subjective judgment is required to evaluate the various parameters used in the model, given below:

PEH = K1 * K2 * K3 * K4 * K5

Where:

PEH = Probability of Human Error

K1 = type of activity to be conducted

K2 = stress factor based on time to perform the activity

K3 = factor related to operator experience/training

K4 = factor related to the situation of the activity

K5 = factor related to the environment

The empirical values for the parameters of the equation are given in TABLES 4 to 8, as follows:

TABLE 4: Values for Factor K_1

Type of activity	Factor K_1
Routine activity, very simple	0,001
Routine activity, but requires attention	0,01
Non-routine activity	0,1

TABLE 5: Values for Factor K_2

Time available to take the action	Factor K_2
Up to 2 seconds – routine activity	10
Up to 10 seconds – routine activity	1
Over 20 seconds – routine activity	0,5
Up to 3 seconds – non-routine activity	10
Up to 30 seconds – non-routine activity	1
Up to 45 seconds – non-routine activity	0,3
Up to 1 minute – non-routine activity	0,1

TABLE 6: Values for Factor K_3

Qualification of the Operator	Factor K_3
Carefully selected, experienced, well trained	0,5
Average experience and training	1
Little experience, little training	3

TABLE 7: Values for Factor K_4

State of Anxiety	Factor K_4
Serious emergency situation	3
Potential emergency situation	2
Normal situation	1

TABLE 8: Values for Factor K_5

Environmental and ergonomic conditions	Factor K_5
EXCELLENT environmental conditions + plant interfaces	0,7
GOOD environmental conditions + plant interfaces	1
AVERAGE environmental conditions + plant interfaces	3
BAD environmental conditions + plant interfaces	7
VERY BAD environmental conditions + plant interfaces	10

As previously stated, it is necessary to make a subjective choice of the K values to be used. Intermediate values to those presented in the previous tables can be used, based on a more in-depth analysis to be carried out by the company's technical staff.

Whenever the resulting PEH value is greater than 1, it is assumed that the probability of the operator making an error is 100%. The following example illustrates a practical case:

“An operator must select a product transfer line between two tanks, opening a remotely operated valve. The valve position is not indicated on the panel in the plant's control room. The control room is noisy and poorly lit. The operator has slightly above-average experience and has five minutes to complete the valve opening operation before the tank overflows”.

Based on the factors presented in TABLES 4 to 8, we have:

K1 = 0,01 (routine activity, requiring attention)

K2 = 0,5 (routine activity, with action > 20 seconds)

K3 = 2 (operator with slightly above average experience)

K4 = 2 (situation could potentially generate an emergency)

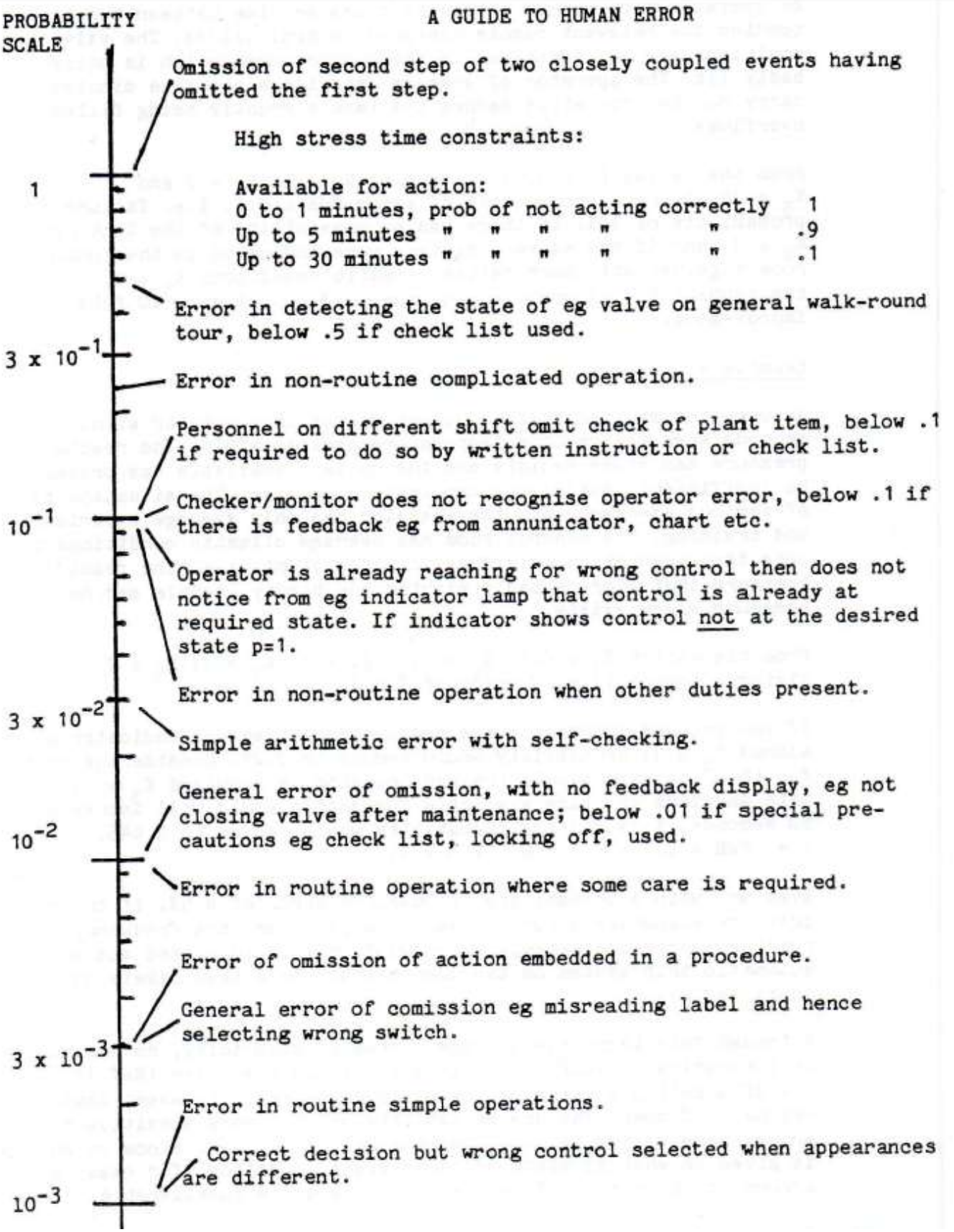
K5 = 10 (very poor environmental conditions)

PEH = 0,01 * 0,5 * 2 * 2 * 10 = 0.2 = 20%

In other words, there is a chance that the operator will make a mistake 1 time in every 5 operations, which is unacceptable.

If there is no possibility of the tank overflowing, K4 = 1; If the valve position is indicated on the control panel and the control room receives improvements in its lighting and noise conditions, K5 = 1. With these modifications, the new PEH value will be 0,01 = 1%, that is, a possibility of 1 error in every 100 operations.

The following figure provides a guide with estimated values of human error probability according to the activities performed. This figure was based on the document “Human Reliability Analysis by A.D.Swain – AIChE Journal, Vol. 20 No. 2 – March 1974”.


PROBABILITY SCALE
A GUIDE TO HUMAN ERROR
Omission of second step of two closely coupled events having omitted the first step.
High stress time constraints:
1
Available for action:
0 to 1 minutes, prob of not acting correctly 1
Up to 5 minutes " " " " " .9
Up to 30 minutes " " " " " .1
Error in detecting the state of eg valve on general walk-round tour, below .5 if check list used.
3 x 10-1
Error in non-routine complicated operation.
Personnel on different shift omit check of plant item, below .1 if required to do so by written instruction or check list.
Checker/monitor does not recognise operator error, below .1 if there is feedback eg from annunicator, chart etc.
10-1
Operator is already reaching for wrong control then does not notice from eg indicator lamp that control is already at required state. If indicator shows control not at the desired state p=1.
Error in non-routine operation when other duties present.
3 x 10-2
Simple arithmetic error with self-checking.
General error of omission, with no feedback display, eg not closing valve after maintenance; below .01 if special pre-cautions eg check list, locking off, used.
10-2
Error in routine operation where some care is required.
Error of omission of action embedded in a procedure.
General error of comission eg misreading label and hence selecting wrong switch.
3 x 10-3
Error in routine simple operations.
Correct decision but wrong control selected when appearances are different.
10-3

With the technological advances of recent years, it is increasingly rare to witness a failure specifically and solely associated with a piece of equipment, a process, software, etc. The problems faced by corporations regarding unreliable equipment, maintenance failures, and low productivity are almost always due to human errors committed in all sectors of the company, from its management team to the factory floor.

When assessing the criticality of human error in a given process or operation, it should be considered that humans can make mistakes in:

- Failures related to actions:
  - Omitted action
  - Incomplete action
  - Untimely action
  - Correct action on the wrong object
  - Wrong action on the correct object
  - Wrong action on the wrong object
  - Action too fast
  - Action too slow
  - Action too early
  - Action too late
  - Action in the wrong direction
  - Too little action
  - Too much action

- Failures related to choices:
  - Omitted choice
  - Wrong choice
  - Failures in planning
  - Omitted planning
  - Correct planning incorrectly executed
  - Wrong plan executed

- Failures related to checks:
  - Omitted verification
  - Incomplete verification
  - Correct verification on the wrong object
  - Wrong verification on the correct object
  - Wrong verification on the wrong object
  - Unclear verification
  - Verification too early
  - Verification too late

- Failure to obtain information:
  - Omitted information
  - Information incomplete
  - Information not obtained
  - Information obtained incorrectly
  - Information interpreted incorrectly

- Communication failure:
  - Communication omitted
  - Communication incomplete
  - Communication made with incorrect information
  - Communication unclear/ambiguous

5. WHAT CAN WE DO?

Reducing the number of human errors goes far beyond taking disciplinary action against individuals. There are a number of measures that offer more effective controls, such as good plant and equipment design, clear and precise operating procedures, a favourable work environment, staff training, etc.

The only protection we have against human error is to design and manage our businesses to protect them from ourselves. Human error frequency tables show that the number of errors decreases as we move from complicated and non-routine tasks (on the order of 1 error in 10 events) to routine tasks that require great attention (on the order of 1 error in 100 events), simple routine tasks (on the order of 1 error in 1.000 events) and finally to the simplest possible tasks (on the order of 1 error in 10.000 events).

Thus, it is clear that whenever we can simplify tasks and remove complications, we are moving towards reducing the possibility of human error.

See in TABLE 2 that the frequency of errors due to misreading a 5-letter word can be reduced by 100 times (3×10^{-2} to 3×10^{-4}) by simply improving the resolution of the letters. All we have to do is make sure that our documents are clear, well-written and easy to read, using letters of an appropriate size. See:

Example of writing in Arial 12
Example of writing in Arial 10

Another common example in industrial areas is the failure to recognize an abnormal situation during a roving inspection, which is on the order of 1×10^{-1} (1 error every 10 events). In this case, the person is intentionally looking for abnormal situations and still fails to notice them. But the frequency of making a mistake in a visual inspection to look for a specific problem (for example, a leak) is around 3×10^{-3} (1 error every 333 events). Therefore, if we make our staff use checklists with specific criteria to be checked, instead of doing what they remember that needs to be done, we will have a probability of having 300 times fewer errors.

We can also see the effect of stress on tasks. For complex and non-routine activities, the frequency of failure increases 2,5 times when the stress component is added to the equation.

The message is always the same when it comes to reducing human error: make things as simple as possible and make sure there is enough time to perform the task without rushing (this can be a very interesting topic for companies that force the limit of reducing the time to perform tasks, in the name of increasing productivity). Once situations become stressful, it is guaranteed that there will be a significant increase in the frequency rate of human errors.

An extremely important point taken from TABLE 3: do everything possible to avoid an emergency situation, because within two minutes of the emergency breaking out, it is almost certain that the decisions made will be wrong.

For intentional errors (violation), if the company has a historical record of the types of errors that have occurred in the past, some suggestions for mitigating actions are presented below:

- For errors resulting from **routine violations**, that is, those that normally occur in the workplace, influenced by the tolerance of supervision/management and the lack of recognition of the validity of the rules imposed:
    - The leadership must be trained to clarify the rules in such a way as to develop a belief in their necessity.
    - A complete review of the rules adopted by the company must be carried out. Those that do not make sense or are outdated must be eliminated.
    - The non-tolerance of inappropriate behaviour must be clearly communicated, from the moment the employee is integrated. There can be no doubt between what is right and what is wrong.
    - It is recommended that behavioural assessment programs be held on a regular basis. Tolerant leaders must be replaced. The company's behavioural policy must be followed from top management to the factory floor.

- For errors resulting from **situational violations**, that is, those that occur when procedures are impossible to follow, or there are conflicting tasks, or the employee thinks it is more dangerous to do the way they are being asked to do, or the environment or space is problematic:
    - Work conditions should be improved, especially in relation to ergonomics, lighting, etc.;
    - Suggestions regarding methods and procedures in use should be sought directly from factory floor employees, which should be analysed by a specific, multifunctional work group. In addition to valuing operational labour, many simple and inexpensive ideas can be found for improvements in production processes and working conditions. Obviously, proposals that are unfeasible from an operational, safety and cost point of view will also arise, but the company should ensure that feedback is given to all of them.

- There should be active supervision to be able to intervene immediately and prevent a situational violation; o Promote clarification on the “right to refuse” (NR 9 – item 9.6.3, NR 10 – item 10.14.1, NR 22 – item 22.3.4, etc.)

- For errors resulting from **exceptional violations**, i.e., those typical when a person tries to solve a problem in an unusual way, involving a high risk:
  - Identify, through risk analysis tools, all scenarios considered catastrophic and define the actions to be taken in each of these scenarios. Never forget to take human errors into account during these assessments.
  - Constantly reinforce the need to follow procedures in cases of encountering unusual problems.
  - Provide adequate resources and support so that people can deal with unusual situations.

- For errors resulting from **optimizing violations**, i.e., those where people try to make work less tedious, less repetitive, or even try to explore the limits of the system because they consider it too restrictive or out of mere curiosity:
  - Reinforce through internal programs the need to respect the procedures defined by the company.
  - Review operational procedures versus reality through programs such as “Job Cycle Checks”.
  - Implement a risk perception program to clarify the dangers inherent in the system and reduce the feeling of invulnerability.
  - Assess the time pressure/speed required to complete certain tasks, as well as the workload imposed on personnel.

6. THE IMPORTANCE OF THE ROLE OF SUPERVISION & MANAGEMENT

Company leaders, including senior management, management, supervision and leadership, play a fundamental role in the effort to reduce human error within their corporation.

It is possible to reduce errors by properly addressing behavioural issues, the way people perceive risks, how they communicate, how they learn to deal with unforeseen situations, and how they deal with internal rules and guidelines. Lives can be saved if greater attention is paid to violations in safety and reliability programs.

It may seem like an administrative “cliché”, but it is absolutely true that companies are made by the people who are part of them. A company does not exist on its own: its existence depends on its leaders, who define the principles, rules and procedures for its consolidation. Thus, for its perpetuation, a company needs, above all, good leaders who must be active and participative.

The leader is seen as an example to be followed and plays a fundamental role in transmitting the principles of any company and in obtaining the expected results from his subordinates. For this to be effective, it is essential that he always be close to his subordinates. Remote management is the surest path to failure.

In most human errors, we can always look for the roots of an accident in issues involving leadership and the management system itself. Some examples of how leadership and/or the system contribute to violations:

- The leader needs or depends on a certain person for his high competence and achievement of results. This leads him to tolerate behaviours of this person that are below standards.
- The recruitment and selection process fails to detect the profile of a new employee, averse to rules and regulations.
- The corporation values obtaining results at any cost, even if it exposes personnel to great risks.

- The accident investigation process does not provide adequate learning. Recommendations generally only address superficial causes and do not analyse the role of the leader and the management processes.
- The behavioural safety program only addresses deviations, without delving deeper into understanding and addressing the origins of the violations.
- The “Rambo” or “Leave it to me” profile is valued in the organization.
- There is no consequences policy that addresses violations fairly and quickly.
- Poorly written, erroneous, incomplete, and imprecise procedures force people to improvise.
- Safe and appropriate behaviour is not clear to people.
- The leader does not set an example when making decisions or even walking through production areas.

Specifically regarding the influence of supervision on events related to human error, there are four main categories of poor supervisory performance:

- Inadequate supervision
- Poorly planned operations
- Failure to correct problems
- Violations by supervisors

Inadequate supervision: The role of the supervisor is to promote the possibility of success for his or her personnel. To do this, the supervisor must provide guidance, training opportunities, leadership, motivation, and serve as a role model, regardless of his or her level of supervision. Unfortunately, this is not always the case. How many times have we come across situations where almost no training has been given to an operator or team member? Imagine this person with little training being subjected to extreme stress, such as in an emergency situation. Inadequate supervision can also be associated with the supervisor's failure to identify a hazard, recognize and address the risk, and provide guidance/training so that his or her personnel do not make a human error that leads to an accident.

Poorly planned operations: Occasionally, the operational schedule is planned in such a way that it puts people under unacceptable pressure. This type of inadequate planning, although debatable in emergency situations, is not appropriate in normal, routine operations. Also included in this issue is the poor sizing of work teams and the poor distribution of personnel in terms of professional experience. This is common in situations of staff reduction, which can result in situations where inexperienced personnel are subjected to tasks for which they are not yet fully qualified. On the other hand, having too many employees – although uncommon – is also harmful, as it can lead to a climate of demotivation, anxiety about possible staff reduction, too much free time for conversations, etc. In all of these topics, the supervisor plays a fundamental role in the outcome of the evaluations in his/her area.

Failure to correct problems: these are situations where the supervisor is aware of a lack of personnel, equipment failure, lack of training or even a situation related to operational safety, but they are allowed to continue to occur. For example, failure to consistently take disciplinary action or correct inappropriate behaviour certainly leads to a climate of neglect among the staff due to a lack of leadership.

Violations by the supervisor: these are cases where the supervisor intentionally disregards rules and procedures, such as allowing a person to operate a forklift without having the necessary training. This includes the cases of “turning a blind eye” mentioned above, in the example of where the supervisor depends on a certain person for their high competence and achievement of results, which leads to tolerating substandard behaviour.

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