Human factors role in supporting best practice

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SUMMARY

Encouragement for us to understand the reality of work is creating a focus on the circumstances in which tasks are performed rather than challenging the work itself or whether best practice is being achieved. Human factors has tools and deeper understanding that could be used to drive more fundamental improvement. However, in some sectors at least, catchy buzz words are causing distractions that mean that the opportunity for human factors to prove its worth being missed. The process industry is one example where frontline workers manage risks on a nearly continuous basis supported by engineers working more remotely who have clear technical bias. Human factors has achieved a toe hold but its scope is often limited. This may not be a universal issue but medicine seems to be another sector where human factors has yet to achieve what it could.

KEYWORDS

Best practice, recognised good practice, task analysis, buzz words, hierarchy of risk control

Systems approach

The ergonomics and human factors community can be quick to criticise others for not taking a systems approach, particularly when technical disciplines fail to acknowledge the positive contribution humans make to reliability and safety. A recent post from an engineer on LinkedIn provides evidence that the criticism is valid. The engineer wrote the following in relation to a recent accident – "never rely on a single human layer of protection against failure that can lead to disaster." When challenged that reliance on a single layer of protection of any kind is high risk, not just human they replied, "humans are error prone and much less reliable." There seemed to be very little interest from this engineer or others in the chat about the performance of socio-technical systems.

But does human factors follow its own mantra? In another post on LinkedIn a query about human factors in relation to reducing prescribing errors in medicine led to a debate on colour coding or use of symbols on medicine labels. Examples were referred to where small scale interventions like these had been successful for those isolated cases. These may be part of a systems approach, but only a small part. Could this type of discussion in a public forum perpetuate a view that human factors is primarily concerned with the circumstances of work and not more fundamental issues about the work itself?

Task analysis

Task analysis is widely recognised as a key tool in the human factors toolkit and is potentially very powerful when used by the right people for the right purpose. Experience shows that written procedures are rarely a true reflection of how tasks are performed in practice and the advice is that people with practical experience of the task, who may be described as Subject Matter Experts (MSE), as well as people with technical knowledge are fully involved in the analysis [CIEHF 2023].

One feature of the process industry that may not be the case is other sectors is that front line workers are actively involved in risk management on a nearly continuous basis. They have to deal with high levels of variability and often work with degraded technical systems that may not be tolerated elsewhere. They are supported by people with higher levels of technical expertise (engineers), which provides a level of independence that can be beneficial, but there are often issues with ineffective communication and different career goals. Shift team working is another feature of the process industry that contributes to inconsistency in the way work is carried out.

Experience from the process industry shows that there can be a significant difference between not only practical and technical experts, but also between task practitioners who perform the same task in different ways. Does this mean that some are right and some are wrong? Are some ways more 'right' than others? Could it be that they are all wrong? An 'average' view of the task based on the views of everyone, if such a thing could be determined, may be acceptable but would it be optimal?

Recognised Good Practice (RGP)

Methods, techniques, and approaches that are considered to be safe, effective, efficient and ethical by a recognised body may be documented as RGP. They are usually generic and intended to be applied widely. Whilst they go beyond minimum requirements for legal compliance, they can only provide guidance rather than providing detailed instructions on how tasks should be performed.

Comparing current practice with task relevant RGP often highlights differences. This may be rationalised by saying the RGP is only a guide and does not account for the reality of work. That is fair, but only if actual practice can be demonstrated to be at least as effective as if the RGP was followed. Is it reasonable to assume that the people performing work have taken into account every relevant aspect when deciding how to perform it? If an RGP is being deviated from, what benchmark can be used to confirm that the alternative method is correct?

An example from the process industry

The process industry handles many hazardous materials and conditions. Losing control of the hazard can cause serious harm to people, the environment and business reputation. During normal operations plant and equipment keeps the hazard physically contained. However, there are times when this containment is broken, typically to perform maintenance. To allow this to happen safely requires an isolation to be established between the source of the hazard and the break. Plant design includes valves that can be used for this purpose by creating a physical barrier. Valves are fairly simple devices but reliability can degrade over time, which can result in hazards being able to get past.

Lives are at stake when hazard containment is being broken. Relying on a single valve and assuming it is effective is not good enough. A double valve arrangement is commonly included in designs and instinctively people are reassured that this is more reliable and hence safer than relying on a single valve. However, there is some RGP [HSE 2006] that points out that this is not enough. It specifies that the effectiveness of both valves has to be proven independently and the valves have to be secured in place so that they cannot be operated in error. Fundamentally, the RGP is highlighting that when protecting against a significant hazard we need to make sure that there are multiple risk controls in place that are reliable, proven and independent.

Multiple task analyses have identified that current practices often fail to achieve the requirements of the RGP [Brazier 2013]. The people performing the task may have the right intentions and their experience may be generally positive (no accidents), but their practices are not as safe as they could or should be. This is often accepted because the RGP is viewed as being impractical due to plant design and arrangements. However, the tendency is to go with what is convenient rather than

looking for an alternative approach to achieve the lowest risk possible. Task analyses have often showed that the requirements of the RGP could be followed with some additional and would be effective at reducing the risk. Where that was not possible, other mitigations had to be implemented.

Goal setting legislation

A feature of legislation for the process industry, particularly in the United Kingdom, is that it is goal-setting rather than prescriptive. According to the Health and Safety Executive (HSE) the underlying principle is that "those who create risks are best placed to control them." [HSE 2017]. It means that compliance is not achieved by following clearly defined regulations but by demonstrating that risks are As Low As Reasonably Practicable (ALARP). Whilst being able to show that practices are consistent with RGP can be used as part of a demonstration, it is necessary to prove that the RGP is technically sound and relevant to the activity. However, because it is generic and high level it is rarely enough on its own to say risks are ALARP because an RGP is being followed.

Ultimately, the aim should be to adopt best practice, which is:

- Effective – the output will achieve specification;
- Safe – no one is going to get hurt;
- Efficient – the job will get done in a reasonable time;
- Profitable – resources required to achieve the above will be minimised;
- Reliable – the chances of success will be maximised;
- Practical – the task will actually be performed in that way.

Technical experts may have the knowledge to be able to deal with the first five of these criteria. Task practitioners are most knowledgeable about the sixth (practicality). Best practice requires all six.

First principles

RGP has its limitations and there are many critical tasks where there is no relevant RGP. If best practice is the aim an approach is required that provides a solid foundation for demonstrating that practices are as good as they can be.

Reasoning from first principles is a fundamental approach in science and philosophy that involves breaking down complex problems or concepts into their most basic and essential components. It provides foundations for theories and hypothesis, allowing innovation that can cross disciplines so that people from different fields can work together to understand the issue at hand. It is used where these is no agreed solution and to address preconceived or overly simplified approaches.

In the process industry the hierarchy of risk controls is highly regarded as a fundamental approach to evaluating safety. The image below from National Institute for Occupational Safety & Health in the United States [NIOSH 2023] illustrates the types of control available and effectiveness:

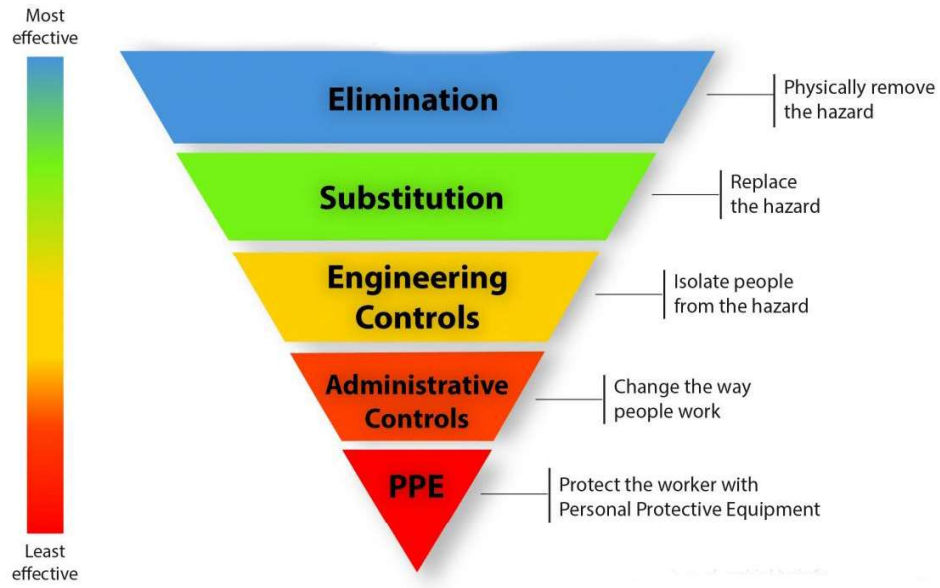

Figure 1 – Hierarchy of Risk Controls [NIOSH 2023 - https://www.cdc.gov/niosh/topics/hierarchy/default.html]

Elimination is always the best option. The hazardous chemical you do not have cannot leak. A rail junction that does not exist does not require a signal that can be passed at danger. A medicine that is not prescribed cannot cause an adverse reaction. It is understood that in many cases the hazard remains but if options to eliminate or substitute are not formally considered then opportunities to fundamentally reduce risk at source may be missed.

This hierarchy of risk controls can provide an approach for confirming whether an RGP is suitable and sufficient, and can fill gaps where an RGP does not exist or cannot be followed. It may not be suitable for every sector, but the general principles could be adapted.

Human factors in new projects

The process industry refers to Human Factors Engineering (HFE) as the application of human factors knowledge to the design and construction of socio-technical systems. Guidance from the Energy Institute [EI 2020a] states that "The objective is to ensure systems are designed in a way that optimises the human contribution to production and minimises potential for design-induced risks to health, personal or process safety or environmental performance." However, the guidance states that HFE is "primarily focused on the physical aspects of the workplace" and, whilst it suggests the use of task analysis in procedures, it does not advocate it as an approach for identifying improved, or implementing best practices. Also, it makes no reference to the application of the hierarchy of risk controls or a similarly structured approach to determine whether appropriate risk control strategies have been followed.

The current approach in process industry projects is that process engineers assess the hazards to determine whether they can be eliminated or substituted. Mechanical engineers design the physical hazard containment (passive engineered controls). Instrument and control engineers then design the safety instrumented systems (active engineered controls). Operations teams, with input from the process engineers, create procedures and training plans (administrative controls). HFE tends to happen quite late in the project. Any task analysis that is carried out takes the procedures as its input and is primarily focussed on evaluating Performance Influencing Factors (PIF). Often a high proportion of the HFE budget is spent by the human factors team attending design reviews (often

based on a 3D model of plant and equipment), which are almost entirely focussed on PIFS. This leaves little opportunity to assess the tasks themselves. Whilst important, PIFs are only a part of administrative controls, which are low on the hierarchy of risk controls.

Human factors of existing activities

The majority of task analysis in the process industry is carried out at existing facilities (i.e. after the project phase is complete). It is seen as making a valuable contribution to proactively managing risks. Guidance from the Energy Institute [EI 2020b] describes task analysis as a method of identifying improvements to task design, but sets out approaches that rely heavily on capturing information about how tasks are actually performed in practice and evaluating PIFs. Nothing is said about using task analysis to identify and implement best practice. Reference is made to the hierarchy of risk control when evaluating the effectiveness of existing controls, but not in determining if the method of work is as good as it could be.

The more recent guidance from the Chartered Institute of Ergonomics and Human Factors [CIEHF 2023] states that part of the task analysis process is to "agree how the task should be done, with specialist advice if required." The hierarchy of control is again referred to in relation to existing risk controls and RGP is mentioned, but only in relation to evaluating PIFs. Overall, this guidance is pointing toward task analysis being a tool to improve practices but does not provide much guidance on how this can be achieved.

A paper published from the healthcare sector [Sujan et al 2024] presented findings of task analysis for a clinical scenario. Participants in the study came from several different clinical roles and were actively involved in describing how the task was performed. Reference was made to a protocol related to the task, which was considered to specify some impractical requirements, particularly around the frequency of certain checks. Multiple references were made to PIFs but none to using the exercise to identify best practice or improve the protocol so that it provided effective support. The CIEHF white paper on human factors in health care [CIEHF 2018] describes a systems based approach that involves measurement, observations, conservations and understanding to determine how work is performed. The focus for improvements are on tools, software, furniture, workplaces and environments. There is no clear prompt to consider improving the work itself.

What more could human factors offer?

Human factors is in a good position to drive task improvement. Task analysis is the ideal tool for decomposing a task or activity into its constituent parts. Human factors recognises the importance of considering people an as integral part of systems and is independent from both the people who perform the task and the people who have the in-depth technical knowledge.

An immediate opportunity for expansion of the role of human factors is to be more actively involved in the identifying and implementing best practice. Task analysis is an effective tool for doing this if people who have practical and technical knowledge are actively involved and encouraged to accept change. Where relevant RGP exists it should be a key reference during the analysis but other first principle approaches (e.g. hierarchy of risk control) are required to be sure that best practice has been identified.

Another opportunity is to change the perception that humans are inherently unreliable and get acceptance that human performance can be relied on as a risk control in the right conditions. The CIEHF White Paper on Barrier Management [CIEHF 2016] identified that some types of risk control rely on a combination of engineered and human actions (e.g. response to an alarm). However, the engineering community has been very reluctant to give credit to the human actions. The result in the process industry is an increasing burden being place on engineered risk controls

that result in more complicated requirements from mechanical devices such as key-interlocks [Brazier 2017] and automated instrumented systems to the point where the net affect may be detrimental [Dearden and Brazier 2023].

Making the hierarchy of risk control an integral part of task analysis provides further opportunities if analysts are prompted to query whether every opportunity to eliminate hazards when a task is performed has been taken and whether engineered controls have been set up to support best practice rather than simply to protect against failures. This would have to be done in a constructive way but would allow human factors to demonstrate it can have significant role in driving improvement.

Supporting people to follow best practice

Some of the 'new' views of safety have encouraged us to be aware of differences between how people assume tasks are performed and how they are performed in practice. The implication has been that these differences are an inherent risk. However, a risk only occurs when a task is performed and so the main concern should be that people follow best practice, noting that this may be different to current practice.

Business management gurus appear to agree with their messages about striving for excellence. However, it is important to recognise that the majority of individuals are, at most, quite good or mediocre in their various endeavours. Even those renowned for excellence, such as top fighter pilots, brain surgeons, or sports stars, possess a finite set of skills in which they excel and may struggle in certain facets of their profession. If we want people to follow best practice they need to have suitable support.

This is another reason why human factors, with its insight into human performance, should be taking a lead. At present systems are often set up to take individuals from novice to acceptable (mediocre) levels of performance. The subsequent process of supporting 'normal' people to follow best practice appears to receive little attention.

Conclusion

A view has emerged that differences between the way work is done in practice compared with what may be assumed or expected is a significant problem. As a result people who perform a task may be viewed as the experts, whilst the knowledge of others should be updated so that they understand the realities of work. Task analysis in the process industry has shown that current practice often falls short of recognised good practice, with little evidence to suggest that people performing work are being supported to attain best practice, which must surely be the goal whenever critical tasks are performed..

Human factors provides tools and approaches that can identify best practice and the support people will need perform their work in line with it. However, in some sectors at least, human factors has been restricted to examining the circumstances in which work is done rather than the work itself. Improved knowledge of recognised good practice can be an enabler to drive improvement but it is rarely sufficient to define the detail of how tasks should be performed; and often there is none available. A first principles approach is required to fill the gaps, and the hierarchy of risk controls is one example of what could be used in a wide range of situations.

Human factors can influence system design when it is considered from the start of a project, when options to eliminate and substitute hazards are being considered. Engineered risk controls introduce human factors issues that are often overlooked. People need to be able to confirm that the controls are reliable, proven and independent at the time they are performing critical tasks. The way those tasks will be performed in the operations phase is often determined by design decisions made early in a project, so waiting until procedures are developed, at which point the design has already been

fixed, is too late to have a significant effect. Human factors may already be working in this way in some sectors but for others including the process industry the main focus is currently on the circumstances of work (e.g. performance influencing factors) rather than the work itself.

At existing facilities human factors has the opportunity to move beyond capturing how work is carried out in practice to identifying how it should be done and the support people that need to implement it. Interventions have to be sensitive and not perceived as judgemental. But it should be possible to acknowledge that people behave as they do because of the circumstances they are put in whilst also pointing out that they could and should do things differently in the future. The objective should be to provide people performing critical tasks with the support needed to attain best practices. Someone must facilitate the process to ensure the realisation of best practices. Human factors seems well placed to do this due to its tools and wider understanding, but is it really a good fit? On the other hand, if human factors does not do it who will?

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