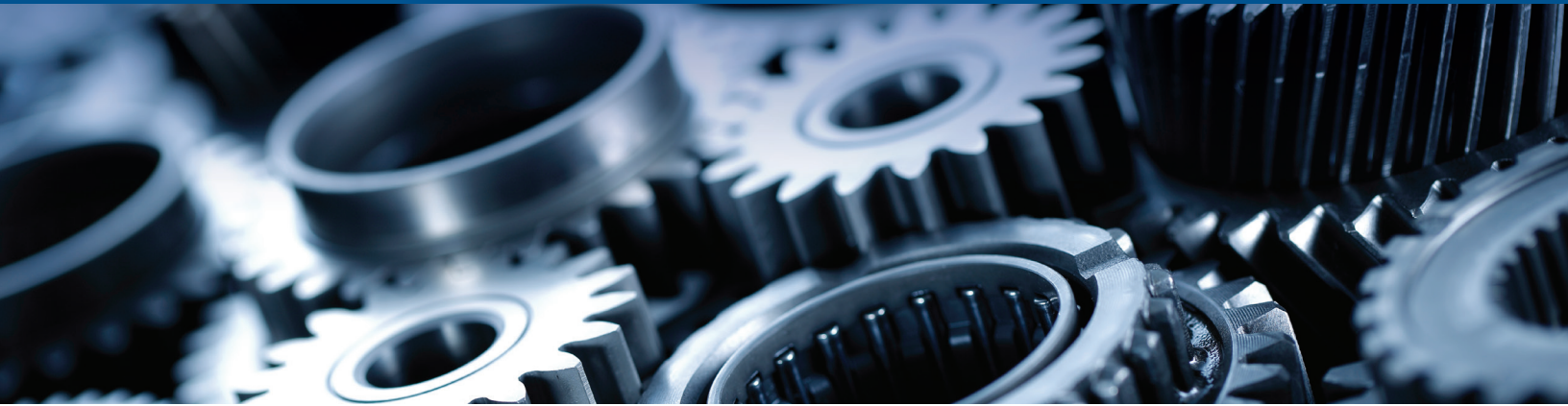




A FRAMEWORK FOR MANAGING HUMAN FACTORS



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Executive Summary

For organizations to achieve the full measure of success, senior executives must understand and effectively manage human factors in the workplace. Human factors appear in individuals as well as in larger systems and as such, they affect nearly every organizational output, from safety performance to productivity and company culture. Addressing them in a holistic way is a necessary precondition to peak organizational performance.

In the context of workplace safety, human factors management is an essential element to reducing incidents. In the past ten years, there has been a high volume of safety research and numerous advancements in safety management systems. And yet U.S. fatalities are up slightly at 3.5 per 100,000 workers, and non-fatal occupational injuries have been relatively static for 2006-2017 at roughly 2,800 per 100,000.¹ Furthermore, the inclusion of human factors elements within revised standards such as ISO 45001, ANSI Z10 and NFPA 70E ensure that further emphasis will be expected within the safety profession in the coming months and years.

Some specialist practitioners are acutely aware of the fact that without a dedicated effort to regulate human factors, safety success will be limited. Most notably, the nuclear and aviation sectors have spent several decades examining how humans and workplace systems interact—and what they can do to make those interactions safer.

Contemporary research supports this approach by showing that workplace safety should be located at the intersection of humans and systems. This means that workplace safety professionals and operations executives have to squarely contend with a complex and potentially confusing set of phenomena: human factors.

This paper will provide a definition for the term “human factors” that is applicable in almost any setting and that is supported by research on the subject. It will then make the case for developing a framework that synthesizes theoretical knowledge and decades of studies into a practical, usable format. After examining what that framework looks like, this paper will explain how it can be used by organizations to drive continuous improvements before concluding with a call for more real-world applications of the framework.

¹ 2017, U.S. Bureau of Labor Statistics

Defining Human Factors

Human factors are typically understood to be physical and psychological states that affect the cognitive processes for making decisions and taking action. And it is true that discrete, temporary phenomena that affect how we think and behave are considered to be human factors. When we're tired, we move more slowly and are more prone to making mistakes. When we're distracted, we're less likely to recognize the most important aspects of a situation.² In both of these situations, we can do something to address the human factor—get some rest or re-focus our attention—and the human factor has been mitigated.

But a complete picture of human factors is much larger, and considerably more complex. In our twenty years of experience in working with human factors, we've recognized that they play a much more pervasive role in workplace safety. And over the past year, our research team combed through the safety literature to examine a range of definitions of human factors and has corroborated these findings. Importantly, we confirmed that a much broader number of issues qualify as human factors than simply those that occur on an individual level.

The term “human factors” is defined in a variety of ways in the safety literature. Examples include human factors as the study of ergonomics,³ or human factors as the study of human error. There can be no dispute that the outputs of both of these areas of study can help keep workers safer and more productive. Nonetheless, neither is sufficient to solve for the full range of human factors that affect organizations. To set the context for the rest of this paper, we will use the following definition:

Human factors are the people elements of individual and system conditions that influence performance and reliability.

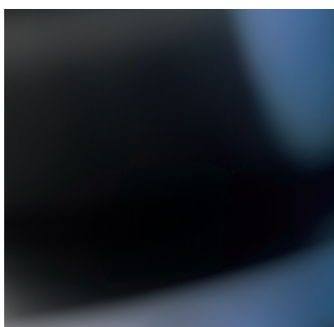
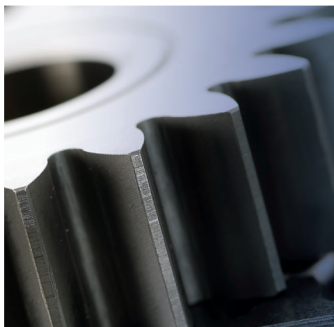
Our definition of human factors is distilled from dozens of different industry-specific definitions found in the literature. The goal was to develop a definition of human factors that struck the right balance between being rigid enough to withstand academic scrutiny but flexible enough to bend to different use cases; a definition that is nuanced and theory-based but practical enough to be applied by people on the job.

This definition encompasses the individual factors that affect human behavior, such as fatigue, distraction and stress. But it also recognizes that a complete definition of human factors includes more than personal states of mind that fluctuate in the moment. Because humans design and operate workplace systems, a variety of human factors are embedded in those systems. The inverse is also true, as systems and work environments can influence the physical and psychological states of individual workers.⁴

² World Health Organization, p. 102

³ Wilson, p. 1

⁴ Wachter, p. 122



It can be helpful to think of human factors not as causative but as multipliers of existing conditions. For example, an unusually fast work pace that is suddenly introduced to meet a production schedule may cause rushing and distraction; if an incident occurs, those states are not the cause, but rather they are multipliers of the deeper cause—the production conditions that were imposed by the system. Human factors can also compound. Rushing plus fatigue plus an institutionalized sense of complacency can make a situation much more dangerous than rushing alone.

Human factors is a neutral term, although it is more frequently used in a negative sense. But keep in mind that there are positive human factors that help workers focus on the task at hand and increase their own safety and productivity above the norm.⁵

“Human Factors” or “Human Error”?

Many in the safety industry are focused on preventing human error, and with good reason. Preventing errors that lead to injuries is undoubtedly a worthwhile pursuit.

With that said, there is a point at which focusing on error invites blaming or becomes too narrow a perspective. It is not only the prevention of error that keeps people safe, it is also the proactive, thoughtful actions that people take to do things better and safer.

Furthermore, as cognitive science advances, there is increasing evidence that some of what might previously have been called “human error” would be better ascribed to inherent cognitive habituation that occurs below the level of consciousness. This is an example of a human factor that may need to be addressed in some way, but which is not accurately described as an error.

The term “human factors” is used here with purpose, to broaden the focus to include human performance optimization, and to avoid the pitfall of labeling inherent cognitive processes as errors.

Our review of safety and organizational research led to the development of this inclusive definition of human factors. It also demonstrated the need for a framework that synthesizes the academic studies, documents how human factors function and helps organizations take actionable steps to manage human factors.

⁵ Re, p. 84



The Case for a Human Factors Framework

Over the past year, we looked at hundreds of studies and articles in the field of safety, organizational development and expertise/expert performance, and then selected about 120 studies for further examination. Twenty-two industries were represented, with an intentional focus on recent research while still including well-known safety thinkers from previous decades.

The literature uncovered an array of tests, observations, confirmations and other information—more details than you could expect any busy safety professional to ever have time to absorb and apply. It became readily apparent that a mental model is required for thinking and talking about human factors in everyday terms while still enabling deeper drilldowns into the nuance found in the literature.

If safety managers, frontline supervisors and individual workers are going to make use of the insights from the numerous studies on human factors, then the research findings need to be presented based on practical results.

To that extent, we developed a framework for human factors in safety in order to connect high-level research and practical utility. Specifically, we had two goals in mind:

- to map out the complex ways that human factors affect people in the workplace; and
- to help organizational leaders take action on human factors in a more effective and decisive way, and with a greater degree of confidence.

This integrative framework will help organizations to better understand how human factors function in work environments. It can be deployed in a variety of live and training scenarios to help workers recognize how human factors function around them. As a result, lessons learned from using this framework allows organizations to manage human factors, and improve safety outcomes and worker reliability in the workplace.



A New Human Factors Framework

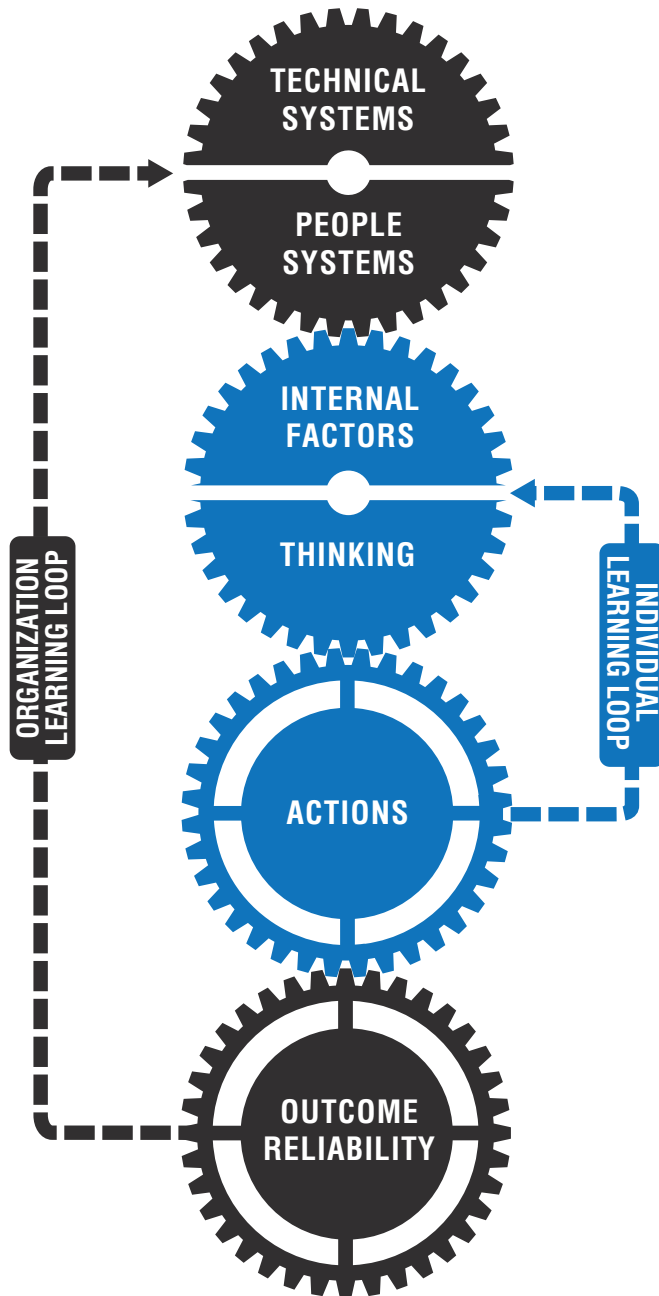
Dealing with human factors requires an approach that accounts for just how complicated they are. But overly theoretical safety systems don't work in real, day-to-day applications. To help organizations find actionable ways to manage human factors, we have developed the framework.

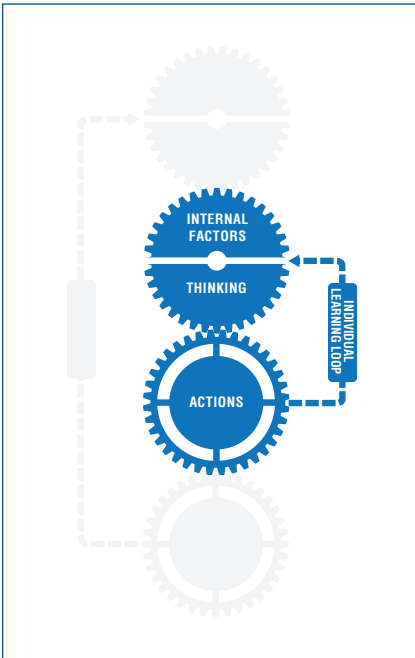
The framework consists of two segments. The first segment, depicted in blue, represents individual workers. Workers are at the heart of organizational systems, and they must be the focus of any effective approach to human factors. The second segment is the organizational system. Companies cannot effectively deal with human factors without addressing the ways in which their organizational systems exacerbate human factors in workers and are themselves shaped by human factors.

The framework connects the two segments to demonstrate their interrelationship, as individual performance and organizational performance are unavoidably intertwined.

Different elements of each segment are also connected in learning loops. These loops highlight the constant streams of information available at the individual and organizational levels. Workers have regular opportunities to learn from their actions and, for better or worse, to build habits that will inform future actions. Similarly, companies are capable of tapping into a continual flow of information that comes from worker input, supervisor and managerial insights, formal studies, KPIs, and any number of other metrics. Whether and how organizations make use of these learning opportunities will determine their future outcomes.

For example, if an organization's culture is to avoid drawing attention to near misses and minor injuries, it will be clear to workers that it is not in their interest to reveal that they were involved in either. Despite the known value of using both situations as indicators for preventing injury, that information will not be shared, which will negatively affect organizational reliability.





The individual learning loop

The individual learning loop demonstrates how physical and mental states affect the ways people process information, make decisions and carry out tasks. Information from individual workers ideally flows into the system loop, providing evidence for ways to improve the interaction between individuals and the system. A tired worker should manage their own behavior *and* provide information to management about workplace conditions that contributed to their fatigue.

Internal factors

How people think and feel affects how they act. The list below is a representative sample from the dozens of human factors culled from the research literature. When these human factors are present, individuals may behave outside their normal range and the likelihood of a workplace incident taking place may increase.

It is worth noting that a superficial understanding of internal human factors could lead organizations to blame workers for their own physical and mental states that contribute to incidents. The research on safety and employee engagement is in agreement that this is the wrong approach.⁶ Rarely does anyone come to work intending to do a lousy job or get injured. As humans, while we can learn to manage some human factors ourselves, we are also influenced by our environment—by the systems and people around us.

The temptation to blame workers for their own internal states should be tempered by asking two questions:

- Was there a failure in how the worker was educated about and/or supported regarding human factors?
- How did the system or culture amplify or fail to counteract the human factors that contributed to an incident?

By considering how the organization contributes to internal factors or fails to take steps to mitigate their effects, stakeholders can account for the true complexity of how internal factors relate to safety and performance and discover useful avenues for reducing the frequency and severity of workplace incidents.

Finally, we aren't completely at the mercy of human factors—the development of self-awareness and self-management can enable individual behavior change and lead to a stronger culture of workers looking out for each other,⁷ as can changes to systems, organizational structures and management techniques.⁸

Examples of Human Factors

Physical

- Fatigue
- Pace
- Illness
- Rushing

Mental

- Uncertainty
- Distraction
- Frustration
- Overconfidence
- Assumptions
- Decision fatigue
- Bias
- Complacency
- Boredom

⁶ Bevilacqua, p. 156

⁷ Re, pp. 83-4

⁸ Carayon, p. 1863

Examples of Types of Thinking

Conscious

- Attention
- Preventive habit development
- Awareness

Subconscious

- Inattention
- Ineffective habits
- Autopilot
- Snap decisions

Thinking

Cognitive processing is labeled as thinking, though it involves much more than that. In this framework, it includes conscious and subconscious decisions as well as habits and heuristics. The processes by which human brains habituate and automate have been well articulated in both academic and popular publications. Sometimes, the brain's habituation is helpful and frees up attention for more important activities. Other times, habituation makes us lose our ability to accurately perceive danger, or causes us to gloss over the information we should attend to.⁹

There are techniques that individuals can use to mitigate the potentially dangerous effects of some types of information processing such as going on autopilot. Additionally, organizational systems can be designed to help individuals process information in ways that reduce their risk of injury.¹⁰

Actions

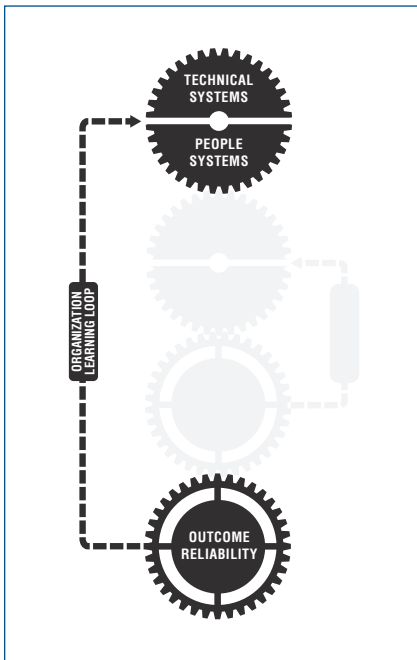
Actions are what people do. This definition sounds simple, but the scope is large.

Not only are actions the specific tasks that people carry out, but they're also the decisions people make to improve their thinking and internal processes (such as building safer habits) and to provide potentially valuable information for improving larger work systems (for example, by filling out a near-miss report or identifying a structural failure point to a supervisor).

Actions are a crucial element in the human factors framework. Noticing and assessing the impact of what people are doing enables positive actions on tasks that help prevent risk in the near term, while also providing information that can prevent future ineffective actions.

⁹ Han, p. 04018117-7

¹⁰ Wachter, p. 121



The organizational learning loop

The larger loop in the human factors framework represents the ways bigger units of people (such as multi-level work hierarchies) function in an organization, the technical systems put in place to guide workplace operations, and how information passed on through the learning loops (such as surveys and near-miss reports) is processed and used.

When things work well, an organization improves its systems on an ongoing basis in order to reduce risk over the long term and to continuously improve performance. If learning never makes it out of the individual loop—if it is only about each person’s self-management—then organizations are unable to make necessary systemic changes and the level of safety improvement and performance will not be as high.

Open communication between the two feedback loops is essential for improvement in both safety and performance. Actively seeking out data in each segment of the model can be a useful way to identify gaps and catch things that might have been missed by less rigorous safety assessments.

Technical systems

Human factors aren’t only physical and mental states that are located in individual workers and fluctuate from one moment to the next. They are also embedded in workplace management systems. In many cases, they are byproducts of system design. In other instances, they are found in systems that have drifted from their initial design based on daily workplace realities.

Systems can cause human factors to proliferate. Consider the example of an ambitious production schedule that requires workers to push themselves to work faster or longer than the norm. In this case, the system of production generates both a higher volume of work and a higher degree of rushing, fatigue and potentially other human factors.

Conversely, consider a system that has codified ample supervision, rest breaks and safety reminders for workers on a night shift. This is an instance where unavoidable human factors—the physiological side effects of shiftwork—have been recognized and accounted for. In short, with proper management, human factors can become a feature rather than a hindrance.



People systems

Even relatively small organizations contain a range of people systems. This element of the framework includes pan-organizational systems such as company culture. It also consists of smaller people-related systems such as the safety climates of specific work crews and shifts.

People systems are also understood to encompass a variety of interpersonal skills, communication patterns and general work habits. Every individual will vary in how they relate to their coworkers or, in the case of supervisors and managers, communicate with subordinates. But broadly speaking, organizations have specific modes of relationships that function horizontally between coworkers and vertically through management hierarchies, and these modes can exacerbate either potentially dangerous or beneficial human factors.

Improving skills among a segment of an organization—such as training supervisors on practical communication techniques—can improve how people systems operate and how human factors are managed.

Outcome reliability

When the learning loops are working well and information from both loops is acted on in order to make positive changes, the result will be improved reliability in safety, quality, culture and performance.

On the individual level, programs to equip workers with techniques for self-awareness, building positive habits, and mitigating risk-inducing habituation have been shown to improve safety and performance outcomes. At the system level, effective communication and employee engagement can drive culture change that contributes to more reliable outcomes.

Behaviors and culture that create higher reliability in safety outcomes are also the behaviors that influence overall organizational performance on the “hard” metrics such as production and quality. From an organizational development perspective, this means that effective human factors management has a strongly positive trickle-down effect.

The choice and application of specific reliability techniques vary depending on where in the framework they occur, but they tend to have a carry-over effect that generalizes from one learning loop to the other.



When documented and fed into the system loop, reliability improvements in the individual learning loop can be used to drive both individual and organizational performance outcome reliability. For example, increasing individual workers' self-awareness and helping them manage their internal factors has an impact on their own personal actions, and it also affects how they interact with teammates. This typically increases the extent to which workers are willing to have each other's backs and take action to help a peer calm down or take a break when necessary.

These may sound like small, localized changes, but in aggregate they can shift a company's culture, as we have seen in our case studies over the past twenty years. Our clients who have implemented a fully integrated approach to using both individual and system learning to drive better reliability have achieved dramatic improvements in their culture, safety and performance outcomes.

The Power of Managing Human Factors

Now that we have introduced the human factors framework, and discussed the reason each component is important and how they interact, the next step is to consider how this knowledge can be useful to organizational leaders and safety professionals.

The first benefit is the value of having a common language to analyze and discuss what is going on in the organization. For example, identifying an issue in communication between the two learning loops creates the language to describe where a gap is. Being able to articulate a problem clearly is a significant step towards identifying appropriate solutions. Furthermore, the concepts and language can be integrated into existing safety programs and recalibrated where needed in order to get everyone rowing in the same direction.

The importance of human factors and the framework for managing them will be of value to senior executives and operational performance leaders. It provides a clear rationale for sorting safety and performance data using a human factors lens. It enables the identification of complete solutions that address both the organization and individuals, and provides additional ways to assess any given situation more deeply. For example, a simple analysis such as considering which physical and mental conditions are being created by the job process design could lead to a whole new approach to an engineering process. Thus, the human factors framework provides an evaluative process that tackles system and work design in an integrated manner.



Of additional benefit is the generalization effect. When employees share a common language and a clear structure for achieving more reliable safety outcomes, their improved communication and analytical skills will tend to spread into other areas of their work and improve a number of outcomes, including productivity and overall engagement.

Given that this framework uses a systems approach and values the insights of frontline workers, it can be used to get worker representatives on board. Labor members are understandably concerned when human factors labels are used to blame workers. By explicitly outlining the interconnection between system factors and individual factors, the human factors framework uses worker input to create positive change, not to blame and shame.

Conclusion

In this paper, we have presented the rationale for taking human factors management seriously in organizational safety and operations. We also discussed the need for a holistic framework for human factors management, and outlined the core elements of the framework as well as how they interact to influence improvements in outcome reliability. Finally, we offered some of the benefits of using the framework to drive safety, culture, performance and engagement at all levels.

We will conclude this paper by noting that the human factors framework is a starting point. We developed it to document the complicated web of relationships in the workplace and to demonstrate how human factors are located at the heart of workplace systems and individual actions.

We have tested the framework in numerous real-world situations and are engaged in new applications for a diverse array of workplace settings. As we continue to examine the ways that this framework can be used to amplify beneficial human factors while suppressing negative outcomes, we encourage senior executives and safety professionals to reach out to us if they are interested in studying specific use cases. It is our hope that together we can further determine how this framework can be best deployed to increase organizational competency of human factors management.

To learn more about human factors, discover how to manage human factors in your organization, or to inquire about how to make use of this framework, go to safestart.com/framework.

Bios



Pandora Bryce holds a Ph.D. from the University of Toronto. Her doctoral research areas included peak performance and adult education. Dr. Bryce has developed empirically based enterprise leadership and performance training for large corporations and now works in the safety industry.



Colin Duncan is a seasoned executive who creates performance cultures based on engagement and collaboration. He specializes in change management, safety excellence, culture change and sustainable performance improvement and is Chairman of the SafeStart Board of Directors.



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