Time for more understanding and less judgment

To Err is Human…

On November 13, 2021, a propeller plane with 15 passengers and 3 crew members on board departed from the waters of Finolhu to Malé (Maldives). Due to insufficient lift to take off, the crew had to abort the takeoff. When they then failed to put the engines in reverse, they shut down both engines. However, due to its mass inertia, the airplane continued moving forward and collided with floating water bungalows. Both the airplane and the bungalows suffered significant damage. It turned out afterwards that during the aborted takeoff, the throttle had remained in 'flight idle', causing the engine to remain at idle speed. The RPM can only be lowered if the propeller levers are also fully forward. However, the crew had forgotten this, which prevented them from stopping in time and made a collision inevitable. There have been many accidents in aviation where human errors have been partly caused by a perceived time pressure. The term used for this is 'Hurry-up Syndrome': due to haste, a pilot's performance deteriorates.

By Gijs Verrest and Jeroen Bloem

Where there are people, mistakes are made. Take writing an email, for example, where you make a typo but are saved by automatic spell check. Not too late, but the mistake has already been made. Typos usually don't have major consequences, but on January 31, 2009 at 3:30 pm it was different. Google search worldwide stopped working: *every* website visited displayed the message "This site may harm your computer". All it took was a slash "/" that accidentally ended up on the list of harmful websites due to a human error. Since every web address contains slashes, all websites were marked as malicious.

Unfortunately, problems involving human aspects are often not adequately solved. Better solving begins with finding the real underlying cause because 'Human Error is not the Root Cause'. Simply labeling it as a 'human error' or 'not paying attention' is not enough. Without truly understanding how the mistake could have happened, solving it is at best treating symptoms. Statements like 'pay more attention in the future' or 'the person in question has been addressed' may sound familiar. But if you maintain the situation that may have caused the mistake, repetition is likely.

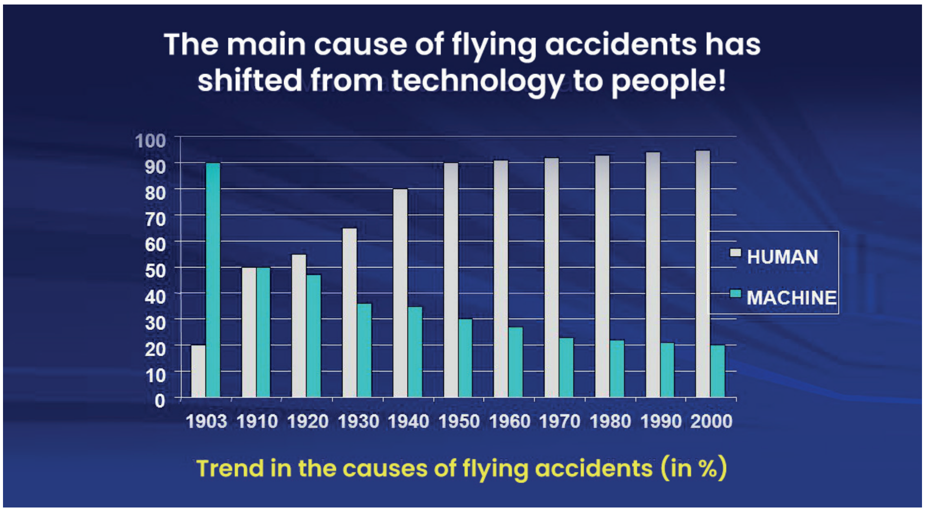

Figure 1: Why pay attention to Human Factors?

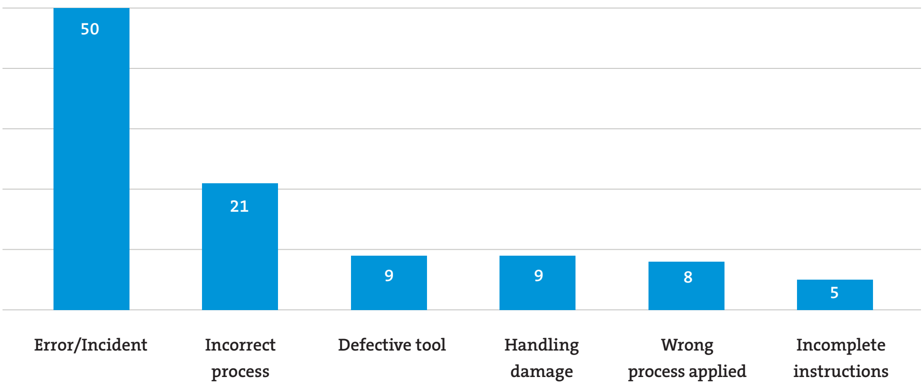

Figure 2: Number of defects.

The relevance of human factors keeps increasing

Within Fokker, there has long been a focus on truly solving problems and implementing technological improvements. Every deviation in the production process - a so-called non-conformity - is required to be registered and its cause analyzed. Potential deviations and so-called "near misses" are also receiving increased attention to further improve and prevent future problems. As a result, production processes have become more stable and reliable.

What also becomes apparent is that relatively more and more problems are caused by human errors where prescribed standards were not followed. This shift has been happening throughout the aviation industry for decades (see figure 1). According to the Federal Aviation Administration, about 80 percent of maintenance-related errors are attributed to human factors.

Within Fokker, as attention to human errors increases, simply dismissing them as mistakes is no longer accepted. When insufficient attention is paid to underlying causes, the risk of repetition or similar errors remains (see figure 2).

GKN Fokker Aerostructures

Fokker Technologies was founded in 1919 by aviation pioneer Anthony Fokker and was acquired by GKN Aerospace in 2015 - the world's largest supplier of systems and components for aerospace. With over 15,000 employees spread across 38 production locations in 12 countries, GKN Fokker Aerostructures engages in the production and assembly of custom-made composite structures and metal parts for, among others, the F-35 fighter jet. They also produce components for business jets, such as the tail parts of the Gulfstream G650. For more information, visit: https://www.gknaerospace.com.

GKN Fokker Aerostructures produces tail parts for the Gulfstream G650 business jet.

Increasing complexity of problems

As processes become more extensive and interdependencies grow, problems become more complex. Take a toothbrush, for example: where in the past a bundle of bristles on a stick was simple with little room for error, that's different with an electric toothbrush. The charging system, buttons, Bluetooth connection, different brush heads, phone apps, preferred settings - there's potential for failure at every step. Plus, these involve interaction with users; the human component. Where there are humans, mistakes are made.

This complexity can also be seen at Fokker: processes are intertwined and there are many (often invisible) interdependencies. For an operator, it's not always immediately clear what the impact of a specific problem is. A seemingly small mistake that causes a component worth just a few euros to end up in the trash can result in a delay later in the process, making it impossible to deliver to the customer on time.

Whose fault is it anyway?

The way we look at human errors is still too often focused on 'blame', even though there are almost never any bad intentions. The term 'human error' is actually incorrect because it implies that the system is good and that the fault lies solely with humans. In reality, humans are part of the system and we must take into account this human factor and its limitations. The organization must enable operators to produce without errors.

Although the responsibility for preventing human errors primarily lies with leaders, sometimes it's unclear who exactly the 'problem owner' is. Often, there isn't just one: a combination of certain design aspects, processes (both on paper and in practice), systems, applications, tools, user interfaces, etc., means they all have different owners. It's therefore important for organizations to take a broad approach where different factors that have contributed to human errors are analyzed integrally. Only then can we understand how things could have happened and how the system can be better aligned with the human factor.

A practical case at Fokker

Many aircraft components are custom-made using machining equipment. The parts are placed on a bed and held in place with clamps. The machine operator's task is to add extra clamps and remove other clamps at specific moments during machining. Sometimes the operator fails to do this correctly, resulting in a collision between the milling tool and a clamp. In addition to damage to the clamp, this can also cause damage to the often valuable part.

In a recent case of significant damage, a milling program was different from three similar parts. The operator incorrectly assumed that - just like with these programs - there was no need to remove the clamp. The system did display a message that required action by the operator, but due to the standard appearance of many messages (which the operator has to dismiss to proceed), this particular message went unnoticed.

Challenges in finding root causes

First and foremost, an organization must have a desire to improve. That may sound obvious, but many organizations have a firefighting culture. Once the fire is extinguished, attention to the problem disappears as well: 'Band-aid applied? Workaround available? Problem solved.' This often leads to hasty attributions of cause. This is where leaders come in: they need to make it important. Invest time and attention in understanding problems better and solving them at the source.

A second challenge in analyzing human factors is overcoming the 'blame game'. It's not about blame, but about understanding how it happened. In this regard, involving the person involved is often essential. However, reluctance to admit mistakes by an operator or ultimately being reprimanded make it difficult to uncover the true nature of events. An objective approach is therefore crucial.

Thirdly, using a suitable method to analyze the situation in which the error occurred is necessary. Often, a methodical approach is lacking, leaving things unclear. A well-known approach used in the aviation industry, among others, is the Dirty Dozen (see sidebar): a classification system of common causes. As a first step, this system provides value and insight into where causes often lie. However, for more complex causes, the approach still remains too superficial.

Take the earlier example of a typographical error. The cause can be attributed to various factors: language and spelling knowledge, concentration on the task at hand, clarity of user interfaces, keyboard quality, autocorrect functionality, etc. Besides not everything being easily categorized into one of the twelve 'boxes', there are often combinations of factors involved.

The Dirty Dozen

Gordon Dupont, formerly employed by Transport Canada, identified the 'Dirty Dozen' in 1993 as a response to an Air Ontario crash. He came up with twelve human factors that reduce people's capacity to perform effectively and safely:

1. Poor Communication
2. Lack of Resources
3. Stress
4. Fatigue
5. Complacency
6. Distraction
7. Pressure
8. 'Destructive' Workplace Norms
9. Lack of Knowledge
10. Lack of Assertiveness
11. Lack of Teamwork
12. Lack of Awareness

In analyzing incidents where collision occurred between the milling tool and clamp on the machining equipment, two factors from the Dirty Dozen play a role. It became apparent that the operator was not sufficiently aware of the difference between this milling program and those of three similar parts. Additionally, distractions caused by numerous standard messages appearing onscreen were an issue. Now that better understanding has been achieved, measures have been taken to prevent this error from recurring.

Analyzing human factor problems

To find more methodical causes of human errors, two approaches are valuable:

1. **Visualize how one thing leads to another. Map out cause and effect, circumstances and "broken barriers" (e.g., using a KT Incident Map).**

In many situations, there's a certain combination of circumstances: a combination of factors leads to a deviation; multiple things go wrong; a safety measure doesn't work; one solution leads to another problem; and so on. Soon enough, the situation becomes complex and difficult to understand and communicate. By visualizing the different factors in relation to each other, clarity is achieved and solutions become possible.

2. **Map out the situation in which the error occurred. A so-called Performance System Analysis helps identify the factors that played a role.**

Human behavior is complex. By looking through the lens of the performance system (see sidebar on the KT Performance System), factors that contributed to the error become visible. Some of the many questions available are: How clear were the expectations/instructions? To what extent did the person possess the right knowledge and skills? Is the desired behavior actually encouraged or is it actually 'punished'? What kind of feedback is provided?

Challenges in problem solving

Here too, an organization must have a desire to improve and accept the related consequences. "First do it right, then do it fast" is easier said than done because breaking free from Hurry-up Syndrome is difficult. Deadlines, delivery times, queues, productivity KPIs - much indicates that speed is important and people start behaving accordingly. However, you can't speed up a Formula 1 car pit stop by being more hurried. That's when things go wrong. It's important for leaders to provide the right signals and space to go beyond quick fixes.

Every mistake is an opportunity to improve. This often requires a cultural change where making mistakes is allowed. "Whoever reports is a hero" as they say at Fokker. By making evaluation part of the process, making improvements visible, and rewarding them, a more positive attitude towards mistakes can be fostered.

The Performance System model

The Performance System model helps understand human behavior; for root cause analysis of Human Factors and for continuous performance improvement. The elements in short:

Situation
How clear are the performance expectations and how well are they understood?
How clear is the signal to exhibit desired behavior?
How well does the work environment support the desired behavior?

Performer
How capable is the performer of exhibiting the desired behavior?

Response
What is the observed behavior? How does it compare to the desired behavior?

Consequences
How (positively or negatively) do consequences stimulate behavior?

Feedback
How adequate is feedback and how well is it used to influence behavior?

An example of a complex problem at Fokker is the occurrence of surface cracks (crazing) in paint. In 2020, this deviation occurred frequently in production. This prompted a root cause team to investigate. Together with the painting department and specialists, a cause-and-effect diagram was created. It revealed that there were not one but two different deviations: *cracking* (large cracks) and *crazing* (hairline cracks), each with its own cause.

Cracking was found to have a technical cause: process-related and dependent on the primer material batch. By organizing the process in such a way that drying becomes more predictable regardless of primer material variation, this problem was subsequently resolved.
Crazing was found to be operator-dependent: analysis showed that this deviation occurred with only 8 out of 29 painting operators (and thus not with over 70 percent). To better understand the situation and find causes, individual conversations were conducted with all operators, and team leaders and inspectors were interviewed. It became clear that painters did not always receive feedback because crazing occurred during paint drying after they had completed their work. Without direct feedback, they were unaware of the consequences of their working method. At the same time, differences between two teams in terms of cracking occurrence were identified by looking further into their performance systems. Ultimately, all operators were trained in proper product preparation and correct paint mixing. If the deviation were to occur again in the future, the operators would certainly be involved.

An important step in better solving human errors is actively involving performers. Offer people a platform to be heard and participate in problem-solving. Explain why certain requirements exist and why processes need to be followed according to prescribed methods. This can lead to mutual clarity and understanding, such as understanding the importance of desired behavior. Moreover, self-confidence and motivation increase: people continuously ask themselves questions like 'can I do this?', 'do I want this?', 'can I succeed here?'.

Prevention is better than cure

A problem that is prevented doesn't need to be solved. It starts with anticipating possible mistakes as early as possible in the process. Once a mistake is embedded in the design, it cannot be solved at the source during production. In Fokker's case, this means collaborating with the customer from the design phase and performing risk analyses (FMEA) on design, tools, and processes.

The clearer the expectations are, the greater the chance that the work will be performed correctly. By standardizing activities, breaking down work instructions, and displaying them clearly on screens during execution, the environment supports desired behavior. Within Fokker, more and more of these standard operating procedures are being implemented per workstation/operation.

It can also help to designate certain tasks as competencies and train employees in them, audit their performance, and provide training repetition. At Fokker, craftsmanship of experienced production workers and best practices are documented in training standards. The 'Training Within Industry' approach is followed to train people in specific tasks within a short period of time.

Ultimately, the goal is to create a balanced Performance System. On one hand, by organizing production processes in such a way that mistakes cannot or hardly occur anymore. On the other hand, by seeing mistakes as something valuable: an opportunity to gain insight and an invitation to learn from them and improve.

About the authors

Gijs Verrest is a senior consultant at Kepner-Tregoe and market leader for KT Netherlands. He has been active as an advisor, trainer, and facilitator for 25 years and helps organizations gain better control over problems. He has worked with many (inter)national clients ranging from aerospace and pharma to semiconductors and ICT. Within Fokker, he has been actively involved in improving problem-solving approaches for over ten years.
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The Kepner-Tregoe methodology provides structure for simple to extremely complex situations and facilitates collaboration within organizations. Silos are broken down: from management teams to the shop floor, the same language is spoken. The approach makes it clear where to start, what to do, and asks the right questions at the right time. An article by Gijs Verrest on how to gain better control over problems was previously published in an edition of Kwaliteit in Bedrijf.
See www.kwaliteit-in-bedrijf.nl/grip

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