'HUMAN ERROR'
The handicap of human factors,

by Dr Steven Shorrock

"Oh my God. I told those guys at safety that it was dangerous and one day we would lose concentration and pay for it. I already told those guys at safety that it was very dangerous! We are human and this can happen to us. This curve is inhuman!"

We are human

These are the distressed words of the injured train driver moments after the train derailment in Santiago de Compostela, northern Spain on 25 July 2013. The driver can be heard pleading in sorrow, hoping for the safety of the passengers, "I have turned over. My God, my God, the poor passengers. I hope no-one is dead. I hope. I hope." Seventy-nine people died.

In the aftermath of the accident, initial investigations ruled out mechanical or technical failure, sabotage and terrorism. That appeared to leave only two possible explanations, 'human error' or 'recklessness', or both. When society demands someone to blame, the difference – whatever it might be – can seem trivial. What followed was a display of our instinct to find a simple

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explanation and someone to blame. Soon, the explanation and the blame pointed to the driver. The Galicia regional government president Alberto Nunez Feijoo stated that "The driver has acknowledged his mistake". Meanwhile, Jorge Fernandez Diaz, Spain's Interior Minister, said that there "were reasonable grounds to think he may have a potential liability" and confirmed he could face multiple charges for reckless manslaughter. While safety investigations are ongoing, the driver faces preliminary charges of 79 counts of homicide by professional recklessness and numerous counts of bodily harm.

Several claims appeared about the driver in the media, often without relevant context. It was reported that the driver "admitted speeding"[1]. The speed limit on the curve was 80kph and the train's black boxes showed that the train was travelling at 192kph moments before the crash. The implication was that the speeding was reckless. The media pounced onto an old Facebook post by the driver. One post, reported by Spanish media and attributed to the driver, stated: "It would be amazing to go alongside police and overtake them and trigger

off the speed camera", accompanied by a photo of a train's speedometer at 200 km/h (124 mph). This may be an unwise social media post, but such speeds are normal and fully permitted on the high-speed line sections.

However, there appears to be no evidence that the 'speeding' involved conscious disregard for, or indifference to, the dangers of the situation or for the consequences of his actions. This would have been an extreme act. Rather, it seems that the driver was unaware of the context. This hypotheses invoked 'human error' explanations, though carelessness was implied. It was reported that the driver himself told the judge that he was distracted and suffered a "lapse of concentration" as he approached the curve[2]. Just minutes before the derailment, the driver received a call on his work phone. The ticket inspector told El Pais that he had called the driver to instruct him to enter an upcoming station at a platform close to the station building to facilitate the exit of a family with children. The call lasted nearly two minutes; a long time when you are travelling at 192 km/h. Renfe employees are not allowed to use phones except in case of emergency, but ticket inspectors have

1- Spain train crash driver admits speeding in emergency call recording, Telegraph, 06/09/13
2- Spain train crash: Driver told judge he was 'distracted', Telegraph, 06/09/13
3- Spanish train wreck driver got warnings before crash, Reuters, 02/0813
4- Reckless' Train Crash Driver Held By Police, Sky News, 26/07/13

safety and justice

no access to the train cab. The driver told the court he lost a sense of where the train was during the call, and believed he was on a different section of the track. It was also reported that the "driver got warnings before crash"[3], having received three warning signals. By the time he had engaged the train's brakes, it was too late.

As is common in accidents and incidents, front-line staff immediately blame themselves, which does not mean they are to blame. Spanish press stated that immediately after the derailment, the driver allegedly said to officials at the railway station 3km from the crash "I ****** up, I want to die. So many people dead, so many people dead." [4]

In this case, the justice system will now need to determine if the driver's actions crossed the line into 'recklessness'. It is another issue as to whether or how justice will be served. But one only needs to look into the context of this accident to see that 'human error' or synonyms such as 'lapse of concentration' or even 'carelessness' do not seem reasonable to explain this terrible event. And if that is all it takes for such an outcome, then it could surely happen again. The 'human error' explanation does not seem to serve safety, so what does it serve? Perhaps it partly serves society's need for simple explanations and someone to blame, while absolving society itself for its demands.

Human error or an inhuman system?

Shortly before the train crashed, according to reports, the Spanish train had passed from a computer-controlled area of the track to a zone that requires the driver to take control of braking and deceleration. Furthermore, there was no automatic braking system on the curve in question, the European Rail Traffic Management System automatic braking program stopped 3 miles

south of where the crash occurred. This placed responsibility on the driver significantly to reduce speed at a crucial time. The sharp bend was known to be "dangerous" and has previously been subject to debates and warnings. According to Spanish journalist Miguel-Anxo Murado, "There were arguments for having that section of the route remade completely, but Galicia's particular land tenure regime makes expropriations an administrative nightmare. So the bend was left as it was, and speed was limited there to 80km/h." The driver's recorded phone call indicated that he had foretold such an accident in a warning to the company's safety specialists:

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"I already told those guys at safety that it was very dangerous. We are human and this can happen to us. This curve is inhuman." The judge is now reportedly expanding the preliminary charges to include numerous top officials of the state railway infrastructure company, Adif, including rail safety senior officials, for alleged negligence [5].

Reminiscent of the Chernobyl inquiry, a small number of media reports broadened the focus to what might be called reckless expansion in society more generally: "I can't help feeling that, at some profound or superficial moral level, we also played our part in the tragedy as a society; that this was the last, most tragic episode of a decade of oversized dreams, fast money and fast trains", said journalist Miguel-Anxo Murado[6]. If this stretches the argument, it at least gives a counterbalance to the 'human error' or 'recklessness' explanations of this tragic event.

The error of psychology

There are thousands of pages of research in the psychology and human factors literature on the issues mentioned so far, including the 'reversion to manual' problem of automation, distraction, 'multitasking', situation awareness, and safety culture. But the popularisation of the term 'human error' has provided perhaps the biggest spur to the development of human factors in safety-related industries – with a downside. When something goes wrong, complexity is reduced to this simple, pernicious, term. 'Human error' has become a shapeshifting persona that can morph into an explanation of almost any unwanted event. It is now almost guaranteed to be found in news stories pertaining to major accidents.

This is very unsatisfactory to many psychologists and human factors specialists; the implication in research and practice was that human error is 'normal' and systems must be designed to avoid, reduce or mitigate error. But in the context of safety and in justice, 'human error' has been taken to mean something different – a deviation from normal, from rules, procedures, regulations and laws.
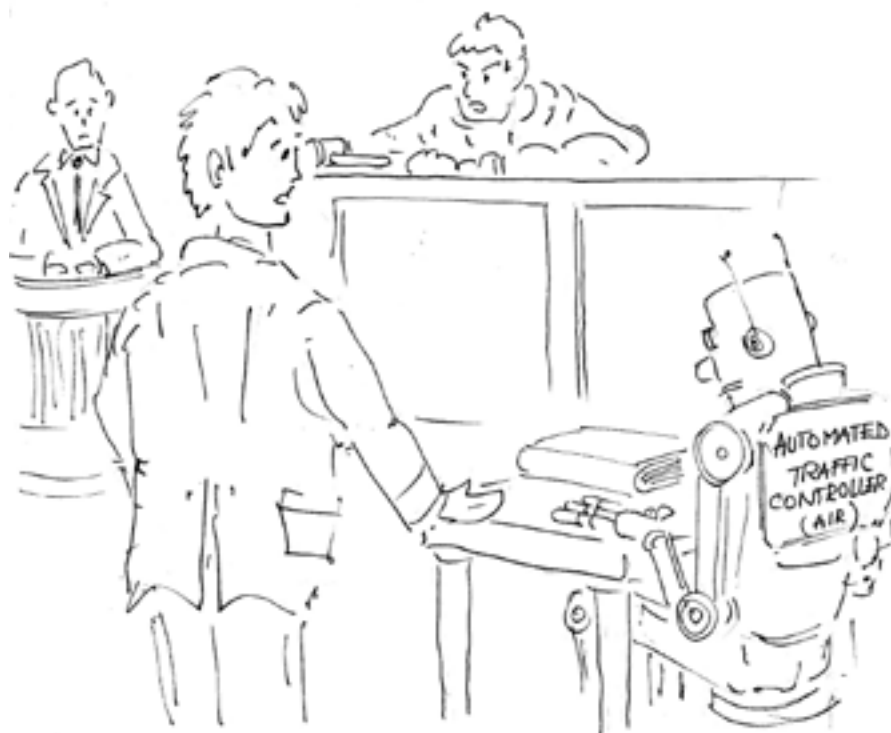
The demise of error

Despite decades of research, there has been little agreement on the meaning of the term, or whether it has any real meaning at all. While 'human error' has intuitive meaning in simple systems and situations, there are problems with the use of the term in complex systems such as ATC. These are now well documented in the literature, and the concept fell into disrepute[7,8].

After being fascinated by the concept since studying psychology in the early 1990s, I gradually and reluctantly accepted these arguments in the first few years of the 2000s. Reading the works of leading thinkers in the field, I abandoned the term. My own reasons followed the arguments of those Erik Hollnagel and others.

- **'Human error' is a mostly a post hoc social judgment.** A 'human error' can be hard to define in advance of it happening.
- **'Human error' requires a standard for 'correct' performance.** In ATC, there are many ways to get an acceptable result.
- **'Human error' points to individuals in a complex system.** System behaviour is driven by the goals of the system and the system structure. Controllers provide the flexibility to make it work.
- **'Human error' stigmatises actions that could have been heroic in slightly different circumstances.** The line between a 'heroic action' and a 'human error' often depends only on the end result.

"Human Error Your Honour! Human Error...
That's what expert said... How then we can blame this poor Automaton
for something which is beyond his own nature..."

- **'Human error processes are mostly vital for task performance.** You may find sometimes that you hear what you expect instead of what is said. However, without expectation, radiotelephony would be very inefficient.
- **'Human error' is an inevitable by-product of the pursuit of successful performance in a variable world.** The conditions of performance are often vague, shifting and suboptimal. The ability to adapt and compensate comes at a cost.

Still, the term 'human error' is used frequently in human factors and psychology. But over recent years, some practitioners have abandoned the use of the term, except to refer to the term itself. They recognise that the term itself is damaging. While psychology and human factors did not intend some of the simplistic meanings ascribed to the term, the genie is out of the bottle.

"Don't call me handicapped!"

Over roughly the same period, the term 'handicap' became seen as offensive in some English-speaking countries[9]. One reason is that it has been mistakenly associated with the phrase 'cap in hand', referring to beggars. This is a false etymology. The myth is that in 1504, after a brutal war in England, King Henry VII passed legislation that begging in the streets be legal for people with disabilities. In fact, handicap was shortened from 'hand in cap'; a game played in the 1600s with two

players and a referee that combined elements of barter and lottery. The game involved equalising the value of an exchange.

The word grew to refer to any action that worked to make a contest more equitable. From 1754, the word was used to describe horse races where weights were added under the saddle of faster horses. Subsequently, faster runners were made to start behind slower runners. The word evolved further to mean a physical limitation, first used in 1915 in the context of children. People of older generations may still use the word 'handicapped', and with good intent. But in several Anglophone countries, the term is unwanted and seen as unhelpful in any of its meanings. It has been replaced by 'disabled people' and 'people with disabilities'. Different terms have different connotations and encourage different ways of thinking.

'Human error' as handicap

Perhaps 'human error' has become the handicap of human factors. Semantically, 'human error' and 'handicap' have multiple meanings that have taken different evolutionary paths. 'Human error' as used nowadays often implies causality and agency (even guilt) with reference to adverse events. While the terms may be used with good intent by some, the plaintiff cry "That's not what we mean!" cannot undo modern connotations.

Metaphorically, just as weights were used in handicap racing to weigh down or limit a horse, 'human error' has limited the appreciation and application of human factors. Many people focus on the so-called 'human factor', rather than socio-technical system interactions, which is the real focus of human factors. 'Human error' limits our understanding of safety, and the term is captured by the legal system and translated to carelessness, or worse.

Socially, as the term 'handicap' is potentially stigmatising of disabled

5- Train crash judge summons track safety managers, Leader, 10/09/13
6- Spain train crash: human error over decades, not just seconds, Guardian, 25 July 2013
7- Hollnagel, E. and Amalberti, R. (2001). The Emperor's New Clothes, or whatever happened to "human error"? Invited keynote presentation at 4th International Workshop on Human Error, Safety and System Development. Linköping, June 11–12, 2001.
8- Dekker, S.W.A., (2006). The field guide to understanding human error. Ashgate.
9- Don't call me handicapped! BBC News, 4 October, 2004.

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people or people with disabilities, the term 'human error' is stigmatising of people caught up in systems failures, even if some 'mitigating circumstances' (such as fatigue) are permitted.

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Perhaps most importantly, both terms imply deviation from 'normal'. In the case of 'human error', for complex tasks such as air traffic control there is often no normal or ideal that can be precisely and exactly described (see Hollnagel, 2009). As is visible after only a few hours observing and talking to controllers, what controllers actually do depends on many things. These include traffic demand and the context and conditions, such as staffing in the ops room, who you are working with, the state of the procedures, the shift system, and the equipment in and out of the ops room. In fact, work by Chris Johnson on degraded modes of operation[10] suggests

10- See http://www.skybrary.aero/bookshelf/books/1055.pdf
11- This risk, and the comparison with terms for disability, was pointed out to me by a human factors colleague, which prompted this article.

that 'normal operation' is in fact abnormality; we get used to operating in various degraded modes of operation. This means that people must continuously adapt and respond to the context and work demands. What can be expected is variability and diversity, not deviation from a standard.

Words shape worlds

Does it all matter, if we still use the term 'human error' when we know what we mean? Do we risk falling onto a euphemism treadmill, skipping from one term to the next?[11] The argument presented here is that it does matter. Our language affects the way we view the world and how we approach problems. Even if we know what we mean when we talk about 'human error', and even if it does seem to fit our everyday slip-ups and blunders in life, the term reinforces unwanted con-

notations, especially when we are talking about complex systems. While we cannot put the genie of human error back in the bottle, we can use a new vocabulary to create a new understanding.

Left with a 'human error'-shaped hole in my vocabulary several years ago, I found an alternative concept thanks to Erik Hollnagel: performance variability. This is not simply a replacement term but a new way of thinking that acknowledges the reality of how systems really work. Performance variability, both at an individual level and at a system or organisational level, is both normal and necessary, and it is mostly deliberate. What controllers actually do varies, because it has to. We have to make efficiency-thoroughness trade-offs, as well as other tradeoffs. This flexibility is why humans are required to do the job. Also, people naturally have different preferred styles of working and there are several ways to do the same job. There is of course some leftover unwanted variability – you can't have without the other. But without performance variability, success would not be possible. It is not the aim of this article to explain this in more detail, but the reader
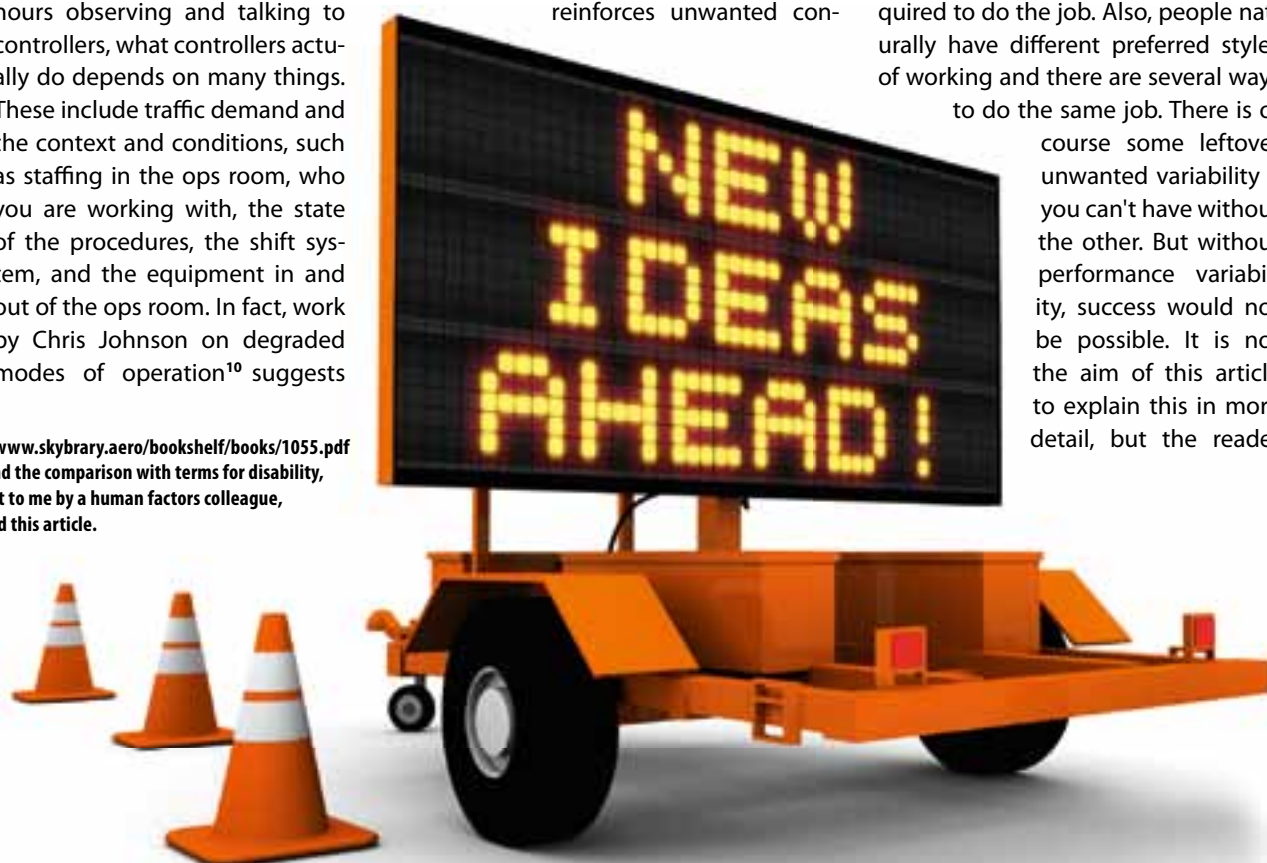
is encouraged to explore this further (see Hollnagel, 2009).

More generally, if we wish to understand and improve how systems really work, we need to enrich our vocabulary with systems concepts, and use these in preference of simplistic notions of failure directed at sharp-end operators. This is not to say that people are not responsible for their actions – of course they are. But normal variability in human performance is not 'recklessness', and labeling either as 'human error' is not helpful.

It's time to evolve ideas

'Human error' has long outlived its usefulness in systems safety, and has now become the handicap of human factors, safety and justice. We can't expect society to change the way it thinks and talks about systems and safety if we continue in the same old way. It's time to evolve ideas and think in systems, but for that to happen, our language must change. Overcoming 'human error' in our language is the first hurdle. ⌂

Further reading

Dekker, S.W.A., (2006).
The field guide to understanding human error. Ashgate.

Hollnagel, E. (2009).
*The ETTO principle:
Efficiency-thoroughness trade-off.*
Ashgate.

Meadows, D. (2009).
Thinking in systems.
Routledge.

HERE IS THE NEWS

Human error causes crash – "…two KTX trains collided with a Mugunghwa train around Daegu Station the previous day. The crash was caused by human error after the conductor of a Seoul-bound train neglected to check the train's proper track, causing the collision with a passing KTX train". The Hankyoreh, 02/09/13.

Cebu ship collision likely due to human error – "The Maritime Industry Authority on Thursday said the collision between passenger vessel M/V St. Thomas Aquinas of 2GO Group Inc. and cargo ship Sulpicio Express Siete in Cebu last August 16 was likely due to human error." ABS-CBN News, 22/08/13.

China Everbright Securities blames human error for mistaken bond trade – "Everbright Securities, the Chinese brokerage caught up in mistaken trades on Friday and again this week, said human error was responsible for a mistaken bond trade on Monday morning". Reuters, 19/08/13.

Exam paper mistakes 'human error' – "The higher than usual number of mistakes in state exam papers was due to human error, a report has found." Independent, 19/08/13.

'Railway accidents happen because someone makes a mistake' – "Human error cannot be eradicated even with the best warning systems, experts say after two major rail accidents within two weeks in Europe." Guardian, 25/07/13.

Human Error Seen in Nigeria Air Crash – "The world's deadliest air disaster last year—a crash in Nigeria that killed all 153 people aboard and helped deflate the country's booming airline industry—was likely caused by a pilot's failure to turn on certain fuel pumps or valves, according to people familiar with the joint investigation by U.S. and Nigerian officials." Wall Street Journal, 11/02/13.

Human error blamed as state's road toll adds up to 15 deaths in 15 days – "HUMAN error is being blamed for the state's sickening road toll, which yesterday climbed to 15 deaths in as many days." Courier Mail, 16/01/13.

Indonesia Sukhoi plane crash 'human error' – "Investigators in Indonesia have blamed pilot error for a plane crash in May that left all 45 people on board dead." BBC News, 18/12/12.

Rackheath gas blast caused by human error, report finds – "An explosion that badly damaged a Norfolk industrial estate was caused by a gas cylinder switched on in error, an investigation has found." BBC News, 20/09/12.

'Tiredness' & 'human error' led to wrong procedure, consultant tells medical inquiry – "The consultant at the centre of the Medical Council inquiry into the wrong operation being performed on a two and a half year old girl, has said "human error" and being "quite tired" led to him writing down the wrong procedure in the medical records." RTE, 18/09/12.