FALLIBILITY AND BRILLIANCE

For over 70 years, it has been recognised that people and technology need to be designed to work well together. **Sarah Sharples** explores some of the implications of introducing technologies into complex work settings.

In 1951, Paul Fitts, the first director of the Psychology Branch of the Aerospace Medical Research Laboratory at Wright Field, produced a list which compared the capabilities of people and technologies. This became known as Fitts' list, or MABA-MABA ('men are better at, machines are better at', in 1950s language). While much has changed since then, one of the things I often say to my students when describing my work as a human factors professional is that "humans are brilliant and humans are fallible". We need to minimise the impact of human fallibility, and maximise the opportunity for human brilliance. But the idea applies equally well to technology.

Integrating people and technology

Over the past two and a half decades, I've worked on projects that have explored the implications of introducing technologies into complex work settings. The range of ways that we have seen aspects of work designed to combine novel digital technologies and people is vast. This is especially true in manufacturing. An interesting example is the production of high quality mirrored metallic products, where the majority of the manufacturing process is automated. Despite the degree of automation in the process, one element depends on tactile feedback and skilled variation of pressure and movement – the metal polishing task. This remains best completed by an expert person.

In a healthcare context, medical image recognition, such as cancer screening, has benefitted from the gradual improvement in computer vision and algorithms resulting in technology to speed up scan interpretation processes. In rail transport, we see many examples of people and technologies working together on route setting tasks. The underpinning timetabling information enables the majority of routes to be managed through automated route setting, but in case of disruption or non-routine routes, the operator is required to maintain active control.

Each of these examples presents challenges. In metal polishing settings, the job can be lonely. The person is in a setting dominated by machines, and skills retention and succession planning for such a highly skilled and practised task can lead to concerns around system resilience. In the medical screening setting, questions are raised about accountability of decisions, and the impacts on learning and familiarity with the task of interpretation of images. And in the rail setting, we frequently see operators choosing to override automatic route setting technologies, not only to improve system performance, but also due to their own preference for the way that they complete the task, being keen to remain 'in the loop'.

The changing human role

A key lesson is that, very often, digitalisation does not completely replace a person. Instead, it changes their task, job or role. In her seminal paper 'Ironies of Automation', Lisanne Bainbridge noted that we tend to automate those elements of a process that are easy to automate. This can lead to the phenomenon of 'leftover automation', where there is a piecemeal set of tasks, and associated impacts on situation awareness, job satisfaction and performance.

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This leads to questions about what we can do together, as professional experts involved in aviation and other sectors, to ensure that we maximise the potential brilliance of people and technologies, and minimise the impact of fallibility. In human factors practice, we have always embraced the philosophy of 'fitting the job to the person'. Perhaps this is now better described as 'fitting the work to the people', or even, 'fitting the system to people and technologies'. Whatever approach we take, retaining our curiosity is key.

Living laboratories

In my current role, embedding scientific thinking in transport settings, we see some great examples of 'living laboratories' where technologies are tested in real-world settings. The real world, and the multiple ways that different users interact with technologies is very hard, if not impossible, to mimic in a laboratory or simulated setting. This is especially clear when we see interactions between different data sets or people with different purposes. Deploying technologies in particular environments can help us to iterate technology and design solutions to meet people's needs, whether it is an app to deliver an active travel solution, or data to support transport management and decision making.

The key is to ensure that we learn from these settings, capturing both quantitative and qualitative data to understand what is working, and what needs to be changed. This can be done with the help of structured conversations with users, and expert observations to learn from the tacit expertise of users in their workplace settings, understanding the complex interactions of different activities and work contexts. To supplement such data, we can use data derived from the technology itself, and measure physiological responses, such as heart rate variability, face temperature, blood flow in the brain, or eye movements.

In learning from real-world technology deployments, developing theories of human-technology partnership is also important. Theoretical concepts and frameworks – such as workload, situation awareness, joint cognitive systems, and affordances – provide descriptions and explain patterns which we see in multiple settings. These theoretical frameworks help us to conceptualise complex systems, and enable us to transfer learnings between different work settings and industries.

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Systems thinking and innovation

Most complex work settings involve multiple people, multiple settings, multiple roles, and multiple technologies. With digitalisation, we have different actors responsible for different parts of the system, from design through control and maintenance. It is not enough to learn from each system element. We also need to understand how they interact. It is therefore critical to take a systems perspective. It is challenging to study work and represent it in a way that captures that complexity, whilst enabling understanding by others who may be responsible for designing and implementing technologies. But it is only through understanding and embracing complexity that we can deliver the best value from digitalisation.

In doing this, we need to get the right balance between understanding the 'here and now' and thinking differently about the future. 'Design blindness' can limit our ability to think beyond the familiar. This is best typified by the mythical Henry Ford quote that if he had asked people what they want, they would have said "faster horses". This probably applies beyond just design. We all need to look at the world differently and think differently to understand how people and technology work together as a joint system, minimising the impact of fallibility and maximising the opportunity for brilliance. Whatever our role we all have a crucial part to play. S

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