WORK AS DONE BY CONTROLLERS:
A PRACTICAL APPROACH IN THE OPS ROOM

When new technology is introduced, systems designers might imagine that users will use the technology in the same way. In practice, the design is not really finished on implementation, and the users 'finish' the design via their varied interactions and adaptations. In this article, **Guadalupe Cortés Obrero** explores how controllers at NATS use the iFACTS technology.

KEY LEARNING POINTS

1. Controllers adapt their use of iFACTS technology based on the different types of sectors, their experience of using it, and the benefits realised.

2. Controllers' acceptance and use of technology is driven by their mental model or understanding of it, the perceived understandability of the technology, the perceived benefits, and the technical behaviour of the system.

3. Training and the early interactions influence how controllers subsequently use technology.

4. The reactions of peers and instructors in relation to acceptance and use of technology influences acceptance and use.

How do controllers actually use advanced tools? For almost three weeks in April 2017, I had the opportunity to study how air traffic controllers at NATS' Swanwick Centre interacted with the iFACTS (interim Future Area Control Tools Support) system, an advanced automation decision-aiding tool.

iFACTS

iFACTS was introduced by NATS in 2011 to increase capacity and improve safety in en-route London Area Control airspace. The system supports the ATCOs' decision making by complementing the information provided by the radar system with support tools and visual aids. It calculates a predicted future position of an aircraft 18 minutes ahead using information in the flight plan route, controller-entered clearances, forecast meteorological data and aircraft performance data. iFACTS uses this information to predict and compare different flight trajectories to determine the closest point of approach.

IMPACT IN
18
MINUTES

Figure 1: Area Control Operations Room at Swanwick Centre. (Source: NATS)

The London Area Control Centre at Swanwick manages en-route traffic in the London FIR over England and Wales, and the airspace is divided into five local area groups (LAGs): North, South, Central, East and West. These LAGs are subdivided into sectors, and every sector is managed by an executive and a planner controller. Each controller is assigned to a workstation with iFACTS and radar displays installed.

Studying normal work

Traditionally, unsafe situations have been attributed to the unreliable human performance of individuals, instead of focusing on how systems fail. From operational experience and scientific research, we know that decision makers are constrained by limited information, limited capacity of the human mind and limited time.

Consequently, practitioners must face frequent trade-offs in their daily work when dealing with competing goals like safety versus efficiency. In this respect, Shorrock et al (2014) reflect on the importance of the 'local rationality' or local perspectives of the people who actually do the work, and their ability to vary their performance. It is precisely the ability of people to adjust their performance to contextual conditions that explains why systems actually work. Thus, recognising how practitioners face everyday adaptations is a way to understand how expertise is developed. The foundation of 'Safety-II' is that practitioners are a resource necessary for system flexibility and resilience, and that they continuously create safety. In NATS, there is an ethos that 'people create safety'.

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Air traffic controllers accept the need for automation so long as new tools are considered to be useful and reliable. By expanding the role of the automation, controllers must build new expertise and adapt their performance to the context and conditions. What actually happens under those conditions is defined as 'work-as-done' (WAD). This can be different from 'work-as-imagined' (WAI), which is the basis of how the work is designed to be done, and trained to be done.

Research approach and methodology

I wanted to explore whether controllers varied their WAD using iFACTS and, if so, to understand why, through considerations of everyday experience, individual and group differences, personal strategies and human factors implications. After an early familiarisation stage studying all available documentation, I completed the data collection process over 21 consecutive calendar days, on daily periods of eight hours, interacting with controllers from all watches. As I hold a valid ATCO licence myself, this helped me to recruit participants, establish rapport with them and understand the context of their work. I conducted 14 direct observations at the Ops Room and 26 semi-structured interviews with en route air traffic controllers working with iFACTS.

Controllers were divided in three groups according to the LAG they work: West, South, and a Dual Validation (South-West or South-Central). After the primary data-collection phase, I transcribed the interviews and analysed textual data to explore relationships and trends, to explain meaning and compare the perspectives of different participants. An interim template was developed based on the data, which was revised until the final template was obtained.

Findings and discussion

Performance variability

By introducing iFACTS, controllers have evolved their controlling techniques according to their working environment. South controllers used more radar-based techniques and used the iFACTS tools differently from West and dual-validation controllers. According to the participants, this is due to the different characteristics of the South LAG sectors, which are generally smaller and require more interaction with traffic than West and Central LAGs. Controllers with a dual validation (including South), use the tools differently than controllers valid only in South sectors, suggesting variety via adaptation.

Acceptance, trust and patterns of use

In addition to sector characteristics, a strong connection was found between controllers' acceptance of automation and their use of iFACTS. Higher trust levels in iFACTS, and the perceived benefits from using it, seemed to affect the controllers' dependence on it. West and dual-validation controllers interact more fluently with iFACTS than South controllers partially because they trust the automation more. This is also influenced by diverse factors such as: the controllers' understanding of the system; the perceived understandability of the technology; perceived technical competence; design; degree of familiarity; understanding of limitations; and the controller's attitude towards it.

When the system is perceived as reliable and accurate, controllers are more eager to trust the tools. Similarly, when they feel they understand the system, they are more eager to trust it, even if it is not completely reliable (see Hilburn, 2003). Participants also claimed that they trust the system as long as the human is responsible for the ultimate decision (see also Bekier, Molesworth and Williamson, 2012). Past experiences, comments from colleagues and direct observations at the simulator, even before the system was implemented, were reported to influence the controllers' experience as users of iFACTS. Controllers' expectations about iFACTS were revised after their first personal experiences and continuous interaction with the system, forming an overall subjective impression towards the technology.

Training and experience

Training and the controllers' early interactions with iFACTS were also found to influence how they subsequently used the system. With the implementation of iFACTS, controllers needed to develop a new set of critical competencies to successfully perform their jobs. This was achieved not only by adapting past experiences and expectations but also by adjusting their own skills through training. The training for iFACTS recognised that the tools would provide

different levels of benefit in different types of sectors. The training was delivered based on functions and was not prescriptive. It allowed controllers to understand the functions of the system and to adapt their use of these functions as appropriate to the sectors. Consequently, controllers have adapted and diversified their usage of iFACTS.

Trainee characteristics together with training design and work environment are considered to be crucial for the learning, retention, generalisation and maintenance of skills. Some controllers concluded that the transfer of training was facilitated because they were motivated to learn during the training process and because they perceived the training as useful. In these cases, they reported the transfer of knowledge to be related to observing others interacting with iFACTS, and to extensive and intentional practice.

Teamwork and culture

The influence of controllers' attitudes on the use of automation is more relevant when analysing this phenomenon from a cultural perspective. In the case of air traffic control centres such as Swanwick, controllers are assigned to different watches, functioning as a community with a lot of shared values and working strategies. To be

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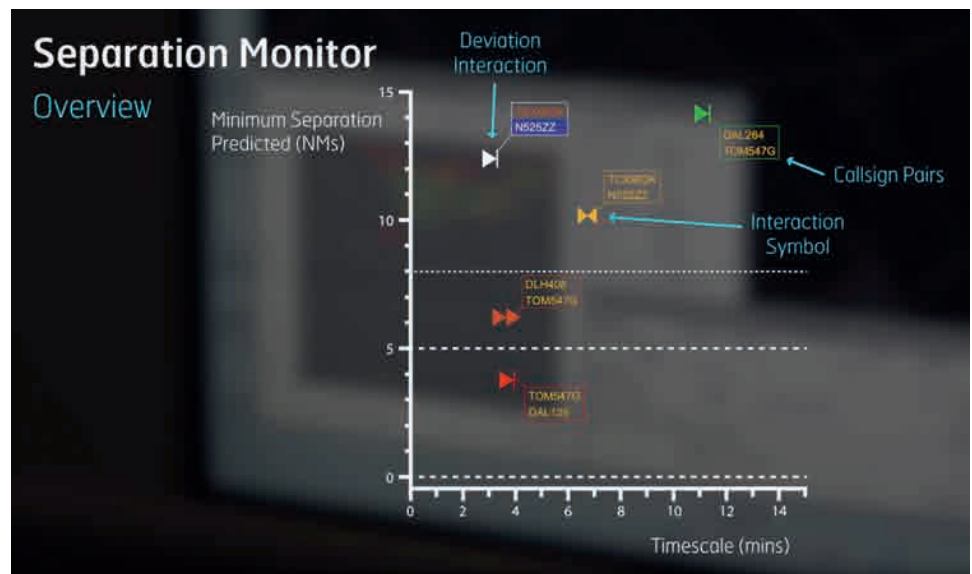
Figure 2: Separation Monitor overview. (Source: NATS)

accepted as a member of the team, "each controller must not only conform with its ways of behaviour, but also adopt its attitudes" (Hopkin, 1995, p.345). Traditionally, informal accepted leaders tend to guide less experienced controllers in both professional and social issues, and their opinion is highly respected among the group. Thus, the ascendency of peers in relation to acceptance and use of iFACTS becomes a relevant factor. Peers that understand and use the system will convey that view to their colleagues either formally (under training) or informally (daily work at the sector). In this context, the role of instructors is essential, because they can impact not only how controllers understand and interact with the system but also their opinion and predisposition about it.

Conclusion

iFACTS entails an innovative operational ATM concept in advanced automation and decision-making support for air traffic controllers. Technology has changed the nature of the controllers' job in a number of ways, and they adjust and adapt their work-as-done when using technology.

This study found that there are variations in how technology is used in practice, for a variety of reasons including acceptance, trust, patterns of use, training, experience, teamwork and culture.

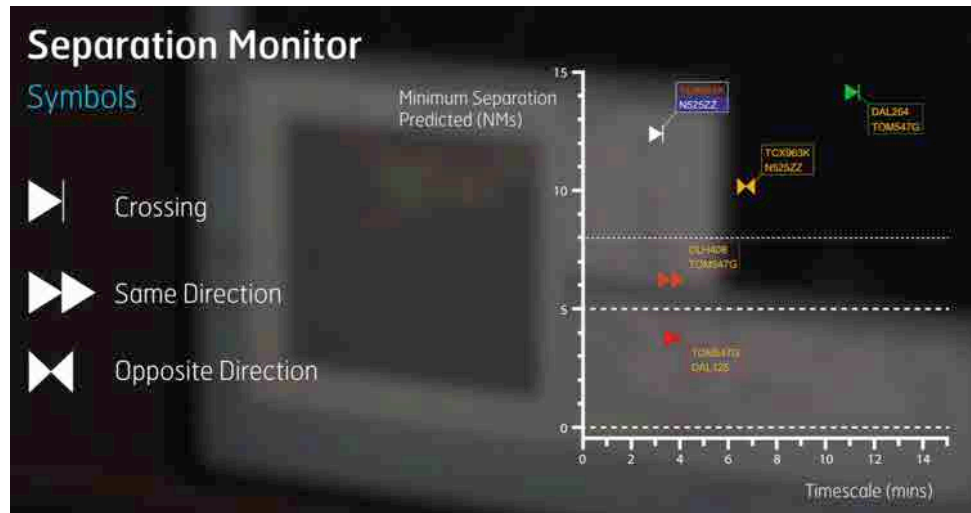It is never just about the technology. It is about the people. ⑤
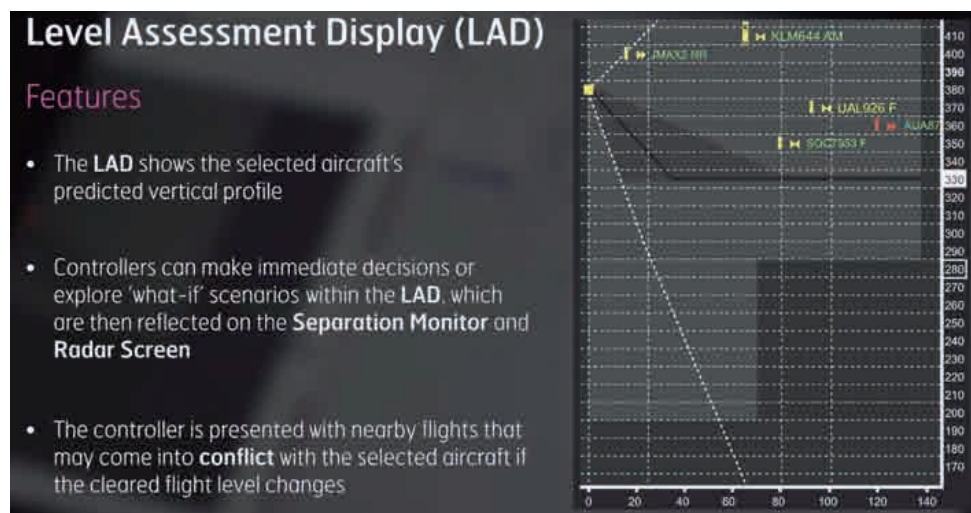

Figure 3: Separation Monitor symbols. (Source: NATS)

Figure 4: The Level Assessment Display (LAD). (Source: NATS)

References

■ Bekier, M., Molesworth, B. R., & Williamson, A. (2012). Tipping point: The narrow path between automation acceptance and rejection in air traffic management. *Safety Science, 50*(2), 259-265.

■ Shorrock, S., Leonhardt, J., Licu, T., & Peters, C. (2014). *Systems thinking for safety: Ten principles. A white paper*. Brussels: EUROCONTROL. www.bit.ly/ST4SAFETY

■ Hilburn, B., & Flynn, M. (2001). Air traffic controller and management attitudes toward automation: An empirical investigation. In *Proceedings of the 4th USA/Europe Air Traffic Management Research and Development Seminar*, Santa Fe, NM.

■ Hopkin, V. D. (1995). *Human factors in air traffic control*. London: Taylor and Francis.

■ Lee, J. D., & See, K. A. (2004). Trust in automation: Designing for appropriate reliance. *Human Factors, 46*(1), 50-80.

■ Woods, D. D, Dekker, S., Cook, R., Johannesen, L., & Sarter, N. (2010). *Behind human error*. Farham: Ashgate