Sociologist Tanja Fink-Cvetnic explains her studies alongside Professor Fritz Böhle on the automation of air travel systems, and how human pilots will continue to have a role in the cockpit.

Could you start by introducing yourself and your role within the project?

Professor Böhle, Head of the Socio-Economics of Work research group, was my thesis supervisor and is currently my PhD supervisor. At the moment, I’m working on finishing my doctoral dissertation, and I’m also involved in the project ‘Work in the aircraft cockpit’. Within the project, I’m my own boss and responsible for all interviews and participant observations. In addition, I evaluate all material, draw up reports and I have introduced the project in various lectures. Böhle’s research provides me with the scientific basis on which I have built my studies on the work of pilots.

Are there any unique aspects that must be taken into account when considering a fully automated aircraft as opposed to any other automated means of transport?

In the area of transport, the first and foremost aspect to consider is safety. This applies to a fully automated train as much as it does to a fully automated aircraft. However, in the case of a possible fault, the biggest difference is the fact that a subway train may perform an emergency stop at any time and support staff, such as technicians or firefighters, can climb aboard. There is also the possibility to evacuate passengers at this time. This is not possible with an aeroplane in flight. The limited supply of fuel makes a quick solution necessary – and one which relies only on the resources that are already available on board. A flight is always time-critical and largely insulated from external aid processes.

What technical imponderables and non-standard situations can occur during air travel?

Whenever one hears of the uncertainties and insecurities involved in the mechanisation of air traffic, one thinks first of spectacular incidents and accidents with disastrous results. The uncertainties that successful pilots overcome every day are, in fact, rarely observed. This behaviour can include anything from the reset of a computer that typically goes crazy in certain situations to readjusting the automatic air conditioning. Admittedly, however, there are also more complicated scenarios that can arise – such as weather-dependent situations that outfox the autopilot system, prompting the autopilot to say to the human pilot: ‘Take control, I do not know what to do here!’ In such situations, of course, the pilot must have the ability to make impromptu decisions and correct the automatic system; at least, in principle.

At what stage of the project are you currently? What still remains to be achieved?

The project is well advanced. Currently, we are in the evaluation phase, and expect to be able to finish this year. Some unclear points still require us to perform a few clarifying interviews but, as regards our theses, we can already assert that we have steered our research in the right direction. Passenger traffic is also offering many more open questions which may be of value to the study.

Are there limits to the substitution of human work? Can anything ever be fully automated?

I can’t tell if it will ever be possible to automate everything. However, we have certainly not yet developed any substitute for the human ability to solve problems technically in unknown situations. So far, all technical systems work in such a way that they must theorise in advance and translate all variables into parameters before a certain situation can be mastered. For these familiar situations, technical systems offer amazing results. The whole situation is different, however, when unknown circumstances occur. Especially in a complex work environment, such as that experienced by airline pilots, many independent variables clash; even the weather is not exactly predictable in its effects. Therefore, unpredicted situations can arise very often.

Will you be attending any forthcoming events, conferences or workshops related to the project?

There are the annual events held by the Interdisciplinary Research Center for Pilot Training (FHP). The FHP is a non-profit organisation with the primary aim of contributing to the improvement of aviation safety. Members of the group are drawn from a number of disciplinary backgrounds; scientists, airline pilots, flight instructors, employees of airlines, pilot associations, aviation administration and air traffic control staff from German-speaking countries.
Flying solo

A group based at the University of Augsburg in Germany has been conducting research into the changing relationship between humans and machines in professional processes, especially the flight of planes.

The relationship between skilled human workers and machines in professional environments is a long one, and continues to be fraught with tension. The introduction of labour-saving machines to the textile industry during the Industrial Revolution famously met with resistance from the Luddite movement, and ever since a dialogue has existed between skilled workers unhappy at the prospect of being replaced by machines, and employers unhappy at the prospect of paying a team of skilled workers when a machine and an unskilled worker would do their job just as well – if not better.

The advent of automation really began in the 20th Century; during the 1940s, feedback controllers became widely adopted in manufacturing processes, leading ultimately to fully automated factories. Although this continued to be the subject of some debate, it was widely agreed among economists by this time that automation created more jobs than it eliminated; even if it did cause disruption to individual workers and companies. The prevalence of automated systems has been growing ever since, and is likely to continue to do so as automated applications in retail, agriculture, waste management and travel are increasingly realised.

SAFETY FIRST

Today, the key issue in this process is not whether it is ethical or profitable to further automate processes, but whether it is safe to do so. In some areas, the rise of automation has led to interactions of incredible complexity between highly developed automatic systems and skilled workers – often, with very high stakes placed on the efficacy of that interaction. This is especially true in the case of automated transport systems. In air travel, automated systems such as the flight computer have already revolutionised the process of flying an aeroplane, but the presence of a human pilot and co-pilot in the cockpit is still necessary. Planes represent a unique form of transport, in that they are not accessible once in transit; in terms of safety, the relationship between pilot and autopilot is all-important.

In order to move forward with the design of new and potentially more fully automated means of air transport, it will be necessary to gain a better understanding of the functional nature of this relationship. Towards this end, a team based at the University of Augsburg, Germany, has been conducting a study into the interaction between human and technological agents in the cockpit. The endeavour, which is led by Tanja Fink-Cvetnic, aims to discover the flight coordination processes that have been brought about by this interaction, as well as uncovering the potential for further automation and its expected impacts on safety.

IRRATIONAL INSPIRATION

In order to explore this complex relationship, the Augsburg group has conducted a number of interviews with pilots and associated professionals, with special attention devoted to the role of experience, practical knowledge and intuition in flight: the skills that only humans can take advantage of. One problem the researchers contend with in this area is the paradox of human labour: the better technical uncertainties are balanced by human labour, the less obvious they are. This means that the greatest pitfalls of further automation are also the hardest to detect; skilled workers make their jobs look easy, and in so doing create the illusion that the technological system they interact with is flawless.
The job of a pilot cannot be understood in terms of rational tasks alone

Previously, scientific investigations into the practicability of further automation in flight systems have failed to detect these subtle yet fundamental interactions, and have fallen short with regard to other important aspects of the pilot-autopilot relationship as well. Generally, Fink-Cvetnic explains, important forms of non-formalizable knowledge and action are neglected in these studies on the basis that they are not quantifiable. She contends, however, that they are quantifiable as experience-based subjectifying actions, a dialogic-interactive and exploratory work approach defined by Professor Fritz Böhle, also at the University of Augsburg. Using this approach, the new study is hoped to give a more complete picture of the state of cockpit automation.

COOPERATING WITH COMPUTERS

At first glance, it appears that the human role within the cockpit is very basic. There are few manual adjustments or control tasks for the human pilot and co-pilot to perform; nearly all of these tasks are undertaken by the machine. The pilot's main responsibility seems to be programming the flight computer, which then automatically fulfills the requirements for a safe flight. Based on this, a fully automated flight operation would already be conceivable – excluding takeoff, air traffic management and landing, which could potentially be managed remotely. However, the information that Fink-Cvetnic's study has collected reveals that the pilot's job is rather more complex in reality.

In fact, the relationship between the pilot and the flight computer is not simple, nor is it one-way; it is a cooperative effort. Professor Dr. Werner Rammert from the Technical University of Berlin has termed this new relationship between man and machine 'distributed agency'. Fink-Cvetnic explains: "In hi-tech systems such as the cockpit, you can't say 'only the person acts, and the technology itself is the product of human industry. Likewise, the computer has some ability to prevent the pilot from entering erroneous information – so the relationship is a dialogic one.

EXPECT THE UNEXPECTED

Although not yet complete, the Augsburg study already provides ample demonstration that the job of a pilot cannot be understood in terms of rational tasks alone. The surveys showed that pilots tended to characterize their work activities into two groups: methodical, cognitive-rational and purposeful tasks, and tasks relying on the professional's 'felt' perception. For example, respondents suggested that it was important to get a feel for an individual plane, to feel the movement of the plane as a feedback mechanism, and to feel the discrepancy between two different sensory feeds when one existed. Often, these perceptions constitute an early warning system allowing pilots to rectify potentially dangerous processes before they otherwise would.

Similarly, pilots report that the ability to override the flight computer in the event of a non-standard situation is one they regularly exercise; the computer can become 'confused' by any number of phenomena, and in ways that are not necessarily predictable. As early as 1987, sociologist Charles Perrow identified the correlation between the complexity of a system and its unpredictability, along with the risks inherent in that. Furthermore, obstacles to the predictability of a fully automated flight system exist in the form of air traffic, birds, passenger behaviour, physical wear and a number of other variables. These are issues that the human pilot is uniquely qualified to deal with.

THE FUTURE OF FLIGHT

The professional relationship between a pilot and the flight computer is unique; in no other environment is a worker so closely integrated into the mechanical system they work with, dependent upon its function for the preservation of their life. Fink-Cvetnic's study is an important step towards understanding that unique relationship, and a vital indicator of the possible future for air travel.