COLLABORATIVE ADAPTATION IN A CONSTRAINED SYSTEM: GETTING THE BALANCE RIGHT

Controllers actively manage the traffic system, often collaboratively, by adapting processes and procedures. This ability to adapt and adjust in a collaborative way is critical to both safety and efficiency. But collaborative adaptation can come at a cost, in time, effort or specific risks. How can we get the balance right?
Don Gyles and Chris Bearman explore the issue and offer some practical advice.

KEY POINTS

1. **Controllers actively manage ATC safety, often collaboratively, by adapting processes and procedures.**
2. **Additional elements of coordination to enable an adaptive plan can add time, risk and uncertainty, and should give proportionate benefit.**
3. **A back up plan should be available in case collaborative adaptation does not work out as expected.**
4. **Global implications of local adaptations should be considered. Everyone affected by collaborative adaptation should be aware of how they are involved or affected.**

Imagine you have diligently completed your basic ATC course in a world-class training facility, complete with high fidelity simulation. You duly arrive for day one of your on-the-job training. You have learnt and been examined on all the necessary knowledge elements applicable to your chosen ATC role, have been coached and examined in the real time application of this knowledge and developed a sound foundation of competencies on which to build your capabilities during your allocated period of on-the-job training.

Day one of training on a radar surveillance approach position and you receive your first piece of incoming coordination. It comes from the adjacent controller with whom you share a common final approach centreline, regarding an arriving aircraft. The hotline opens and what transpires leaves you speechless. The other controller says:
"ABC is requesting change of runway 15 [was programmed for runway 21], *my separation with DEF* [one of your aircraft that would conflict with the new flight path proposed], *stays with me with your concurrence* [the aircraft will transit through your airspace to track to the new runway], *my coord with the Tower."*

This wasn't any variation on any coordination you ever received in your simulator training or ever saw elaborated in the ops manual. So how did all that theory and simulator-based training fall so far short of the mark in this instance?

This situation (which comes from a real example) is not uncommon in the Australian context. In our training institutions what we primarily focus on is the application of the basic rules, policies and procedures that govern air traffic movement in a given jurisdiction. This is what Morel, Amalberti and Chauvin (2008) referred to as the elements of our 'constrained system'. In contrast, the controller initiating the coordination in our example has gone 'off-script' in order to actively 'manage' system safety outcomes. This is an example of ordinary operational collaboration of the sort that any controller will recognise.

Active management of the system is used to address anomalous system behaviour not thought of by the system designers or procedure developers, or to take advantage of opportunities to better optimise system efficiency. While this is often what makes our system work in practice, the problem for our trainee controller is that we typically don't formally recognise this collaborative adaptation, or teach people about it.

Historically, we have sought to manage risk in complex systems like air traffic control through the application of constraints, such as standardised rules, procedures and practices. This limits controllers' scope of action in order to protect against specific hazards. These activities have helped to establish a system that has a very high level of safety.

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to neglect how controllers are actively and collaboratively managing the system to ensure safety and efficiency. In our study (Gyles & Bearman, 2017), we found that nearly 1/3 of interactions between controllers were concerned with modifying standard plans in order to actively manage the system. While people can learn ad-hoc and informal ways of collaborating to actively manage the system during on-the-job training, is this really how we should be managing safety? There is a need to identify and recognise these strategies in the formal system, but also to determine the limitations of these strategies.

From our observations we have identified a number of issues that can occur when people are actively, collaboratively and adaptively managing the system rather than executing the standard plans that form our formally constrained system. This is by no means exhaustive but helps to point out some of the most common issues, and solutions.

Negotiating with other controllers to modify standard plans can take time and add additional workload. Situations can unravel very quickly if insufficient consideration is given to the time required and resulting workload demands. Controllers should be aware of the potential time commitment, build in sufficient time, and always have a back-up plan or strategy to allow reinstatement of the standard procedures if it becomes clear that they won't be able to complete all the necessary negotiations.

When moving away from standard procedures everyone involved needs to understand the new plan. Many air traffic incidents have involved controllers making assumptions about what other people know. It is important

to actively ensure that everyone is on the same page when shifting to a more collaborative style of controlling where the emphasis shifts to achieving safety through managed rather than constrained activity. It is also important to reinforce the new arrangements over time as staff change. For example, once incoming staff have completed their handovers and settled into their roles, it's a good idea to reiterate the arrangement explicitly again via normal coordination channels.

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There is also a temptation that we have observed on many occasions for controllers to try to over-optimise the system. For example, a controller might cancel a SID in response to a pilot request to provide minimal track shortening (1-2nm) and forego the protection of the SID height requirements (which facilitate separation with inbound traffic) to save the aircraft 30-40 seconds of time. Controllers often perceive procedures to be unnecessary, overly restrictive and a means of further removing the opportunity for creativity and the development of expertise. But modifying standard plans can remove some of the protections provided by the procedurally or structurally constrained system of operations and can increase uncertainty and risk. Taking an aircraft off an established air route requires the controller to actively scan for conflicts in a much more resource intensive manner than simply confirming that aircraft are on SIDs and STARs. But any gains from modifying the plan must be balanced against the increased level of uncertainty and risk that this can create.

Actively managing the system at a local level can also have dramatic negative effects on a global level that controllers may be unable to perceive. While it may seem reasonable at a local level to take an aircraft off the published route structure for track shortening, it might lead to an aircraft flying through an entire continental airspace off-route and four hours later coming into conflict with another aircraft as they track inbound on an outbound route. As a rule of thumb, if a modification to the standard procedures will involve more than three people, it would be wise to seek additional supervisory support.

While we have discussed the constrained system and active management of the system separately up to this point, they are in fact two sides of the same coin. Constraint-based safety-related procedures and processes provide a framework for work – the scaffold within which people are able to manage the system. However, formal procedures (as the main artefact of our constraint-based system) need to be carefully crafted to enable people to manage the system actively within these constraints. The boundaries of safe performance need to be clearly delineated with an indication of the scope or range of acceptable adaptation, which helps us to better manage the potential pitfalls inherent in actively managing the system.

Summing up

In summary, controllers often actively manage the system rather than relying on standard plans. This is typically not part of the formal management system and can have implications for safety. Based on our observations we identify a number of pitfalls that suggest a list of simple considerations for better active management of the system:

- Acknowledge that you may be increasing risk and uncertainty.
- Make sure that the benefits are worth the increased risk and uncertainty.
- Make an accurate assessment of the time and workload requirements for the change.
- Make sure you always have a default plan to fall back on.
- Make sure everyone understands what the new plan is.
- If a modification to a standard plan or practice involves more than three people, consider supervisory support.

References

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Disclaimer

The views expressed in this paper are those of the authors only and are not intended to imply endorsement or consideration by Airservices Australia who enabled the research activity.

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