

# CGE Risk

Case Study

**Civil Aviation Authority  
on 'Bowtie Models' for  
balanced risk overviews**



# Case Study

## Summary

How CAA's bowties unite and benefit the aviation system as a whole.

### The need

An all-encompassing overview covering each of the CAA's 'significant seven' safety issues.

### The solution

Bowtie Method training and BowTieXP implementation.


### The benefits

A balanced risk overview for the whole aviation system. Bringing together the UK and worldwide experts in the industry, to jointly develop BowTies for the benefit of all aviation stakeholders.

**The Civil Aviation Authority (CAA), UK's specialist aviation regulator, is developing BowTie models covering each of the CAA's 'Significant Seven' safety issues. Working closely together with the industry, the shared goal is a balanced risk overview for the whole aviation system.**

"It all started a few years ago, when we reviewed our safety data, both in terms of the fatal accident database containing all the fatal accidents occurring worldwide and the serious incidents in our own Mandatory Occurrence Reporting Scheme database," says Joji Waites from the Civil Aviation Authority. "When we combined the main accident and incident outcomes for commercial air transport from these two databases, we identified seven key safety issues."





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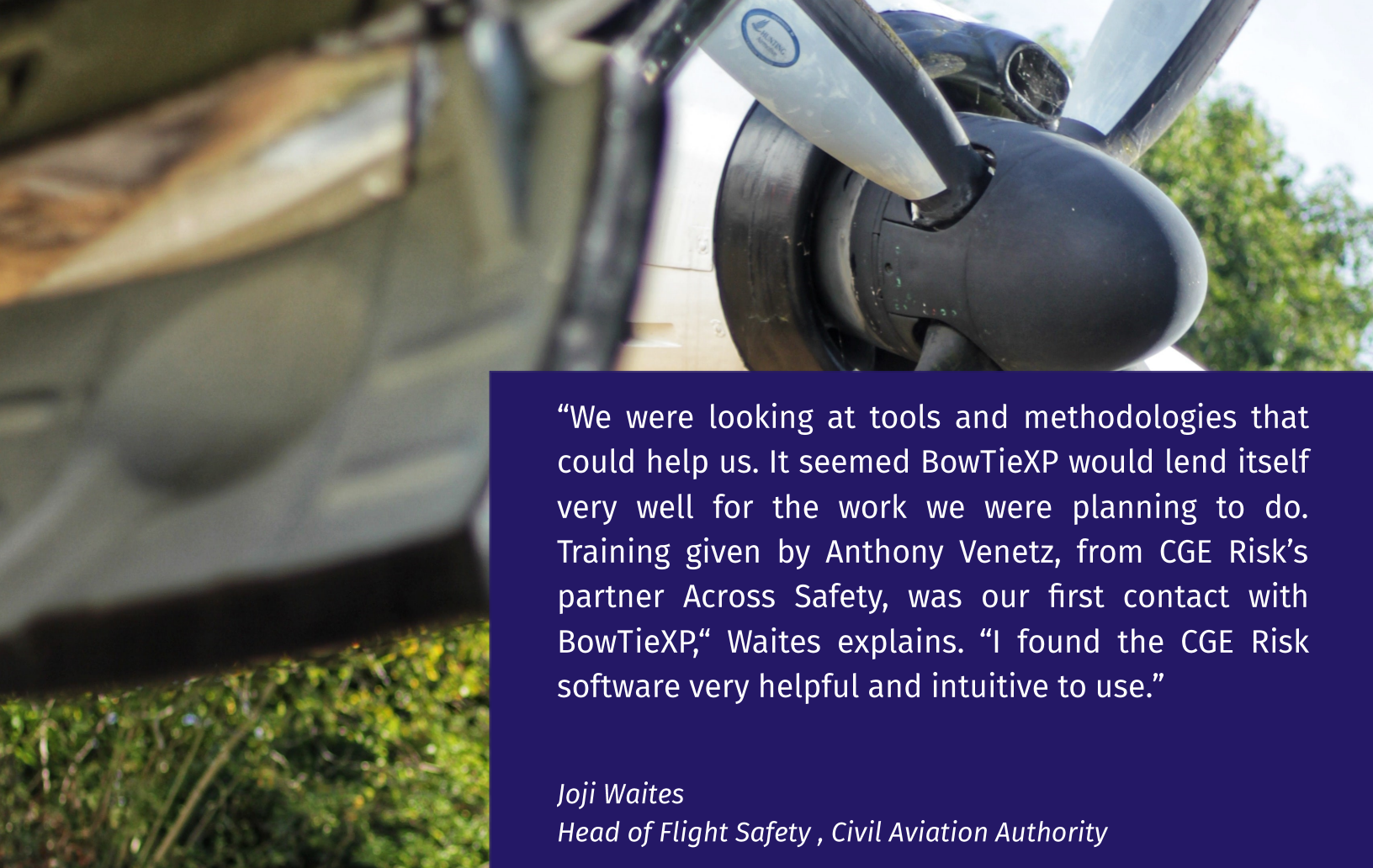
*Joji Waites*

*Head of Flight Safety , Civil Aviation  
Authority*

These ‘Significant Seven’ are loss of control, runway excursion, controlled flight into terrain (CFIT), runway incursion, airborne conflict, ground handling and fire.” After identifying the key safety issues, the CAA wanted to have more detailed information about these issues. “We wanted to investigate further; not only the precursors to the ‘Significant Seven’, but also the safety barriers. What controls are we relying on, are they in place and do they actually prevent the events from happening?”

The CAA decided to start using the BowTie method and BowTieXP software to work on the ‘Significant Seven’. “We were looking at tools and methodologies that could help us. It seemed BowTieXP would lend itself very well for the work we were planning to do. Training given by Anthony Venetz, from CGE Risk partner Across Safety, was our first contact with BowTieXP,” Waites explains. “I found the CGE software very helpful and intuitive to use.”

Work has started on BowTies for runway excursion (on landing), runway incursion, airborne conflict and loss of control following a loading error. “The first BowTie we developed was for runway excursion. An aircraft touching down outside of its stable landing criteria is one of the key contributors to the risk of a runway excursion, so this was chosen to be the BowTie knot,” says Joji Waites. “Another example is the BowTie for airborne conflict, in which we look at potential mid-air collision scenarios in UK Class A airspace. This is quite a specific area, in which we had the widest support from the industry; including airlines and our main air traffic service provider.”



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*Joji Waites  
Head of Flight Safety , Civil Aviation Authority*

## Combining several issues in one BowTie

Other BowTies scheduled to start this year include loss of control following a wake vortex encounter, controlled flight into terrain (CFIT) following a ground proximity warning and helicopter post-crash fire. BowTies covering key scenarios associated with other ‘Significant Seven’ safety issues will be prioritized and managed as part of the BowTie program. “To better understand the risk associated with a crash on a helideck, we planned the BowTie for ‘helicopter post-crash fire’,” says Waites. “We have a lot of offshore helicopter operations with workers flying to

oil rigs. One of the big issues for these operations is the safety of the helideck environment. There are complex structures in place on a helideck; and combined with the often demanding environmental conditions, it can be quite a challenging operation. One of the outcomes that we are concerned with is an accident with a fire, due to inherent fire hazard on an oilrig. With this one BowTie we address two issues; our helicopter flight operations team have asked for this and it links into one of the ‘Seven’ with fire being one of the significant issues.”

“What is really useful, is that we started to categorize the controls; for example, those that rely on effective regulations, good operational procedures or equipment standards. We can now see there is quite a reliance on process, procedure and training. In this way, BowTies can be used to help identify questions that could be asked of companies by CAA inspectors during industry audits.”

*Joji Waites*

*Head of Flight Safety , Civil Aviation  
Authority*



“Another good example of combining several issues in one BowTie is ‘loading error’,” says Waites. “Loss of control is one of the largest concerns, while ground handling is also a major issue. Loading error compasses both ground handling and the possible outcome of loss of control as well. “

## Leading indicators of safety performance

The work is innovative in that it involves the categorization of safety barriers, the assessment of barrier effectiveness using real safety data and expert opinion and the identification of data that should be collected to measure their performance, including leading indicators of safety performance.

“For the BowTie covering airborne conflict, we can identify the key threats; for example, a system failure or communication problems between the aircraft and the ATC center. We can identify the key controls and covering measures. What is really useful, is that we started to categorize the controls; for example, those that rely on effective regulations, good operational procedures or equipment standards,” says Waites.

“After grouping those controls, we can now see there is quite a reliance on process, procedure and training. We know from experience that some companies are very good at managing the risk associated with these issues through their Safety Management System, whilst others need further support. In this way, the BowTies can be used to help identify questions that could be asked of such companies by CAA inspectors during industry audits.”





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Head of Flight Safety, Civil Aviation Authority



“Also, we have identified whether we collect the right data for our safety performance monitoring purposes. In some cases we found that we did not collect certain data, which would be helpful in the assessment of barrier effectiveness. For example, if there is a control that involves certain training, the percentage of people undergoing that training is a good leading indicator for the performance of that control. The industry will have these data, so we are now thinking of how best to obtain this information.”

## Top tips for starting a BowTie

When asked for lessons learned during the development of BowTies, Joji Waites is glad to share CAA’s experiences. “We actually want to create a ‘Top Tips’ document, like a best practice guide with advice about what you should do if you’re about to start a BowTie.”

He provides three tips: “Firstly, think about getting the right individuals involved. In the second BowTie we identified the right people, but in the first one we just wanted to get sheer numbers of people participating. These weren’t necessarily the right people.

Secondly, be clear about the terms and definitions you use. In BowTieXP sometimes the terms are slightly different from those used for other safety risk management methods. If we are clear about the terms from the start, it helps the people that are using the software.

Thirdly, explain carefully how controls acting on the threats work in the BowTie. Not only do we want the controls coming into play once the threat happens, we also want to look at things to stop it from happening in the first place. People tend to think that a control placed to the right side of the



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threat in a BowTie means the threat has already happened, while in fact it doesn't necessarily mean that.”

### **An effective visual picture**

Joji Waites sees two major benefits of using the BowTie method and software. “One of the big advantages of BowTieXP is a direct result of what the BowTie is. Having a visual picture makes it so much easier to convey a safety issue and the risk that it poses. Some people were a bit skeptical, until we did one. They could actually see the progression of the threat, through the top event, ultimately ending up with the undesirable consequence, and what controls are in place to prevent this.

If we had to do exactly the same in a text document, it would have to be a very large document to cover the same information. The BowTie format is very effective.”

“Another major benefit is driving of safety performance indicators. In the past we identified a whole bunch of indicators that were driven by what was easy to measure, based on available data, rather than those that covered the key risks. Having the BowTies, we can now actually say which controls are the most critical for a given safety issue and therefore which measures need to be in place to most effectively monitor their performance. “



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## Balanced risk overview for the whole aviation system

In developing the BowTie models, the CAA is working in close partnership with the industry and other National Aviation Authorities. Their shared goal is to jointly develop BowTies for the benefit of all aviation stakeholders, contributing to the establishment of a balanced risk picture for the total aviation system. It brings together UK and worldwide experts in the industry. “We wanted to bring in people from our industry, as they were thinking along the same lines. They just needed one organization to start pulling it all together,” explains Joji Waites.

Completed BowTies will be actively shared with the industry, so that organizations can use them as part of their SMS to help mitigate themselves against the risk of the ‘Significant Seven’. This will be particularly useful for smaller or less well resourced organizations that are unable to produce BowTies of their own. “One of the activities we will soon be launching is sharing the completed BowTies with the industry. As we created these in partnership with the industry, we already have an element of support. We’ve just started a survey of feedback to see what’s being done with them,” says Waites. “We also want to share these BowTies with a broader audience. Smaller companies, who



The Civil Aviation Authority (CAA) is the UK's specialist aviation regulator. Through its skills and expertise it is recognized as a world leader in its field. The CAA regulates:

- Active professional and private pilots (50,000)
- Licensed aircraft engineers (12,400)
- Air traffic controllers (2,350)
- Airlines (206)
- Licensed aerodromes (141)
- Organizations involved in the design, production and maintenance of aircraft (950)
- ATOL holders (2,400)
- Aircraft registered in the UK (19,000)

### Software used:



understand the concept of BowTies, but are not able to create them. The BowTie for airborne conflict is a good example. Whilst the smaller companies might not fly in class A airspace, perhaps they can adapt the BowTie to the type of airspace in which they do fly; many of the controls will be similar. This way they can benefit from the advantages of a BowTie without having to do it from scratch.”

Waites is very positive about the role of CGE Risk and its partner Across Safety. “Having decent software to do this work makes such a difference. Also, CGE Risk has been very helpful in their support. Being able to discuss with Antoinette van Antwerpen of CGE Risk some of our ideas about how the software could be developed has been very positive. Whenever I come across an organization that wants to improve their safety risk management process, I recommend the BowTie methodology, and BowTieXP as a suitable piece of software.”

“Finally, our intention is that completed BowTies will contribute to best practice guidance material for safety risk management at an operational and regulatory level for all organizations involved,” Joji Waites concludes.

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## CGE Risk

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