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Future Combat Air System
Stopover: Reliability and Safety

AN INTERVIEW BETWEEN EXPERTS

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Allan Behrens
Hello. My name is Alan Berens. I'm from Taxal. We are industry analysts looking at the linkage between technology and manufacturing. So I'm now joined by Chris Stecki from PHM Technology. And Chris and myself are going to be talking about reliability, availability, maintainability and safety. Hello, Chris.

Chris Stecki
Hello

A.B. : Just before we get going, I just want to apologise to those listening if the sound from Chris is a tad quieter than previous recordings. Chris is actually remote. He's very kindly joined us. He's an Australian and this has been recorded as a remote session. So, thank you anyway, Chris and I appreciate your time. Chris, just explain yourself and why you're interested in these topics specifically related to the future combat air system.

C.S. : So, with any complex system, I guess the reliability, the availability, maintainability and safety all come back to a central concept around technical risk. And the challenge, I think, for new programmes is to understand and identify that technical risk as early as possible in the programme. Because the sooner you can do that, the sooner you can mitigate it. And it's really those technical risks that are either not well understood or analysed that lead to the biggest impact, negative impacts in terms of design schedule or cost of maintenance once you progress through to operations. So, the earlier you can identify that technical risk, the more efficient the design process will be and hopefully the more available and cost effective operation you will have when the system is in operations.

A.B. : Great. And your business focuses on that, is that right?

C.S. : Yes. So we've been developing technology now for close to 16 years, so we're almost an overnight success slowly creeping up on the industry. But, yeah, we've been looking at this for a long time and actually I'm one of the founders of the company. The other co-founders been looking at machine condition monitoring for close to 40 years now. So, I guess the disciplines of RAMS are well understood. What we've looked to do is to find new technologies that essentially help people transition away from generating data, to take advantage of technology that can generate that data for you, so that the engineers and the specialists can spend more time analysing and interpreting that data to make better decisions around the design.

A.B. : Okay. Now, why does it matter to those people listening in the world of aerospace, and in particular the future combat air systems community?

C.S. : So, technical risk is really the key. If you don't understand how your system can possibly fail, you can't put in place the appropriate mitigation, whether that's a different design configuration, whether that's adding redundancy to the design, or whether it's understanding what maintenance requirements you will have once you're in operations. And it actually extends a little bit further. I mean, there's a lot of interest at the moment around predictive maintenance and people being able to use diagnostics. All of these things come back to understanding how the system can fail and we're talking here about the technical risk. Pilot error is one thing, human factors is one thing to consider, but it's the physics, it's the engineering. If you understand how things can fail, you've got a better chance of mitigating that potential failure. If you don't, then you'll wear the consequences. And actually, there's a number of studies in the US, the GAO has just released a report around the problems with maintaining and sustaining aircraft across the US Air Force. And these are problems that manifest as billions of dollars and lead to significant deficiencies in being able to field the operational availability of fleets of aircraft. So, yes, it's a big opportunity, it's very important, not often front of mind for people, but if you don't fix it up front, you'll pay a higher price down the road.

A.B. : Right. I was going to ask you about examples because you must have some interesting anecdotes about failures or opportunities, should we say?

C.S. : Yes, so I guess one of the challenges you have working in the defence domain is you're not really supposed to provide too many case studies. It's a common occurrence across programmes, even outside aerospace, even in naval and ground systems, but particularly with aerospace, because it is such a safety critical environment that there are many constraints around fielding aircraft and it's the ability to understand and to forecast what those maintenance requirements will be. I mean, that dictates where you might have spares, where you need to position those spares. It's going to be a key indicator for what types of missions you're going to be able to perform and how regularly and efficiently. So, there are legion examples. I'm not really in a position to talk about any in particular. But I think for those that are in the industry, there's typically always a ... it's an interesting thing sorry. I digress a little bit. But it's an interesting thing that many of the people that have been in industry and aerospace for a long time. They know they have their own personal examples of. You know. We told the design crew that they should have done this or if only they had spoken to us about what that would mean in terms of maintenance. They could have designed it differently. It happens far more often than I think people would like to accept or tend to accept. But it's those two things. It's the cost of remediating those problems and it's quite difficult to get public access to that sort of information because people don't really want to lift the skirt around. They don't want to air their dirty laundry. But things like that GAO report from the US point towards they're talking billions of dollars that are created by these types of issues and it's across all fleets of aircraft in the use app. So, I don't think I'd like to say it's this particular programme or another. It's a common occurrence, more common than people would perhaps expect.

A.B. : Right. And you mentioned billions of dollars where things go wrong. What about the opportunities for using the types of technologies that you support and you deliver and develop for your customers? Where are the opportunities and what are they? Have you got examples of costs yourselves that you've been able to remediate?

C.S. : There are two elements to the cost component. One is the cost of the design and the second is of course, the cost of sustaining that platform. Once it's in service, it's a lot easier to get the metrics around the design side. And we're talking here about model based technologies, digital twins and so on. And what that does is it brings automation of analysis. Typically a lot of these analyses, I mean, they've been done since aircraft have been flown, but they've all been done through manually generating or authoring that analysis piece. It's orders of magnitude improvement in terms of being able to conduct these RAMS analyses. And it means that you can do it concurrently as well. So, there's a twofold benefit. One is the actual resource cost of conducting these analyses, it can be a factor of ten times cheaper. But importantly, what it means is you can do it concurrently because its model based, you can do it concurrently with some of these other design activities, which means that you also compress the design schedule. And that's another significant cost benefit.

So, in fact, if I was to think purely around the cost, I think the key benefit is around the ability to truncate or accelerate that design process by conducting a lot of these analyses concurrently with other streams of the overall product design. That's the immediate cost benefit in terms of a return on investment and that's the most demonstrable. The other element is really cost avoidance and that's always a little bit more difficult to quantify. But if you get the RAMS right, it will cost you less to maintain the aircraft. It's very difficult to say that it's going to be x dollars cheaper per hour because of the RAMS, but it's certainly from industry feedback that we've had and from looking at programmes that people are operating, the key challenges around mitigating failures or maintenance events that weren't planned for during the design process. I think there's an accepted industry norm that says if you find the problem and you solve it early-stage design, it cost you ten or $100. Each stage of design, it costs you another order of magnitude higher. So, it's fix it early design, it's $10. Fix it in production, it's $100. Fix it in sustainment, it's $1000 or $10,000. So obviously the earlier you can identify and mitigate this risk, the better off you're going to be.

A.B. : Right. Understood. Who in the audience is affected by this? What are the people you talk to generally who's concerned about these problems and who's involved in the rectification and application?

C.S. : It's interesting, I think the way industry used to be structured, those that had responsibility for design focused on performance and didn't really feel the responsibility for maintenance of sustainment. And so what they do is finish the design. The expression was you throw it over the fence and then the sustainment people have to look after it. There's been a real trend, I think, over the last 15-20 years, driven a lot by the DoD around bending the sustainment cost curve. And what that means is looking at the total cost of ownership of a programme, including that sustainment piece. So obviously we deal primarily with systems engineers, reliability, safety and maintainability. But there is now an increasing awareness of the programme management component which has the responsibility for overall cost. I'm not going to say that RAMS is becoming more mainstream, but I think it's the mouse that roars. So, I think what is interesting is that more recognition of the consequence of not doing RAMS efficiently is better understood by both programme managers and particularly owners. If we're talking future combat air system, it's the MOD that's ultimately going to pay the price. And I think what we've seen from a variety of technical conferences and papers is that they well understand that cost curve and they understand that the earlier that you can impact or determine the trajectory of that cost curve, the better it will be for them.

A.B. : Right. What about implementation? What's the process for actually applying it and how does it happen? What's your suggested route forward for a company?

C.S. : It's interesting that in an industry, in the engineering industry generally, model based and simulation technologies have been taken up, have been broadly accepted across the spectrum. RAMS is really sort of the last bastion of manually generated analysis and I think that's because it's a rather complex problem to solve. But increasingly, again, I keep referring to the US DoD that they sort of set the benchmark for a lot of this stuff and they're looking now at model exchange of data and information rather than analysis outputs. They want the actual model. So, the important thing is to be able to start to generate these models, these digital twins, if you will, that relate to risk and diagnostics and availability as early as possible. And it is becoming easier because if everything's model based, you're able to integrate with other models and there are technologies that allow and enable you to do that. I think the key thing is that, particularly for a new programme, you want to try and implement a technology that you're not going to have to refresh at some stage later. And I think it's widely accepted that model based is the way to go for all the obvious reasons for engineers. And so, the key thing is really for programmes to investigate what would be the benefits of a model-based approach for their programme, and we are yet to find one that doesn't believe that a model-based approach is better, which is, I guess, is good for us.

A.B. : And what determines success how do you measure or how do the people that you work with measure success?

C.S. : Well, obviously there's the cost component and that's probably the easiest to identify on the design side. But success really is about developing the best product that you can. And so there are many other disciplines that are focusing on performance. As I said before, there are many aspects to a successful aircraft programme. We represent one of those domains. I think success is the ability to integrate the RAMS component, integrate the RAMS piece into the broader digital thread, to combine it with and leverage the outputs from RAMS across other domains in engineering, be it systems engineering, what sort of performance you can expect in the field, and so on. But I think success really means deciding or implementing an appropriate technology which for future combat air systems, 6th and eventually you'll have 7th generation. It's about having a technology that you'll be able to develop and mature as your aircraft and your understanding of it matures as well.

A.B. : Very interesting, very interesting. I suppose in elements of conclusion. I mean, what would your opening or closing suggestion be in terms of customers? What should they do now? What are they going to be interested in trying to look at?

C.S. : So there's a lot of talk around digital twins, and I think many different definitions of a digital twin. Digital twins are like models. I think what people need to look at is how they can employ model-based technologies and simulation across all of the engineering domains. And of course, we look at RAMS. So, for us it's about how can you apply a model-based or a simulation approach to the RAMS environment specifically? If you can put that in place, it future-proofs you and it gives you a number of tangible costs and availability benefits, but also a lot of intangibles digitising your domain knowledge, being able to effectively share information and data across different disciplines in the design enterprise and with your partners and with your customers. So, I think the key thing is you need to really go model-based and where possible, some form of digital twin is the key recommendation we would make.

A.B. : In terms of next steps for a company interested in investigating this further, what would you suggest?

C.S. : I think the good and the bad is we're dealing with engineers and we know that engineers like to do their own research. I would encourage people to look at some of the state-of-the-art literature that's available from some of the advanced technical conferences that are around, or to speak to companies that have developed some products that are based on those trends in engineering. And obviously we think we're one of those. I think it's important. The key thing is that you have a technology, a model based digital twin that will allow you to interact with the other parts of your design enterprise. So, I think it's important, particularly for complex aerospace programmes, you don't want to have too many vendors, you want to try and keep everything within one stream, if you will. I think digital thread is the way that people talk. I think it's important to orchestrate all the technologies within the context of the broader design enterprise. But if you ask particularly about RAMS, that's pretty obvious. You need to come and talk to us.

A.B. : Great. Chris Stecki, thanks very much.

C.S. : Thank you.