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INDUSTRY OUTLOOK
Runway to Revenue
Unlocking Commercial Value with AI-Enabled Maintenance for Airlines
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CONTENTS

EXECUTIVE SUMMARY

In the face of strained market conditions and changing customer expectations, airlines must change their commercial approach and put Maintenance & Operations at the top of the agenda. AI is poised to overcome the challenges in Maintenance, Repair, and Overhaul (MRO) that withhold it from strategic importance, but the runway to AI enablement is not without its own blockers. This report explores the ways data and AI can invigorate maintenance processes to achieve new levels of fleet capability, focusing on the regulations, technological requirements, and the people at the center of it all: Maintenance and Engineering teams.

The opportunity is clear: AI-enablement shows the promise to overcome the capability bottlenecks caused by layoffs in the pandemic and help airlines recovered millions in lost revenue per year. In one major airline, Kubrick and Databricks are delivering a Maintenance Virtual Assistant that is already forecast to save $3 million per year by reducing 10% of ECAM-related delays, which will scale to over $27 million per year as the tool takes effect. As the FAA and other key regulatory bodies begin to embrace the possibilities of AI for the betterment of the industry at large, every airline has the chance at first mover advantage.

Our approach

This report combines industry research with the experience of Kubrick consultants delivering AI capability to maintenance teams in world-leading airlines. The discussion is guided by insights provided by an exclusive selection of data leaders and practitioners in the airline sector working in partnership with Databricks. The select body of leaders represent aviation organizations including JetBlue, United Airlines, Delta, and Heathrow. The sentiment of these discussions is sign-posted throughout this report as ‘Leaders’ Point of View’.

INTRODUCTION

THE STAKES AND OPPORTUNITY FOR MRO

The pendulum swings back

The sustained ‘boom’ of the Airlines sector, following the ‘bust’ of the COVID-19 pandemic, has begun to fizzle. Reports from across airlines and aviation agencies in Q1 2025 are the writing on the wall; the TSA reported a slight decline in passengers against the previous year[1] after continuous growth through 2024 while warnings of shrinking or frozen revenue gains echoed throughout the Quarterly Earnings calls of several notable airlines, including Delta and United.

[1] From 231,062,967 to 229,567,15; a –0.65% change
Source: Forbes

These receding earnings are emblematic of a constricting marketplace where the cushion of demand is diminishing, leaving airlines more vulnerable to even minor external challenges as margins tighten. This sentiment is unanimous within the pages of the 2024 Annual Reports [Form 10k] from major players released early this year, with concerns for rising or unstable fuel costs and other uncontrollable factors like adverse weather conditions and air traffic congestion impacting flight utilization and profitability[2]. The downstream impact is already tangible, as the likes of the world's largest airline, American Airlines, begin cutting year-round transatlantic routes and focus on seasonal demand[3].

Reimagining the commercial model

Despite the influence of external operational factors on profitability, the modern airline commercial model is designed with a top line tied to customer loyalty. The introduction of customer loyalty programs in the 1980's, advanced by credit card partnerships and the fragmenting of fare classes, took control of the direction of a then still embryonic and rapidly developing industry. While credit card partnerships bolster loyalty programs with predictable cash flow, the old structures are showing signs of losing their power. Research shows that free memberships and loyalty programs don't generate guaranteed loyalty, with airlines ranking as one of the lowest services for consistent loyalty (see fig i)[4].

How often people consider buying from a company outside their loyalty program membership (%)

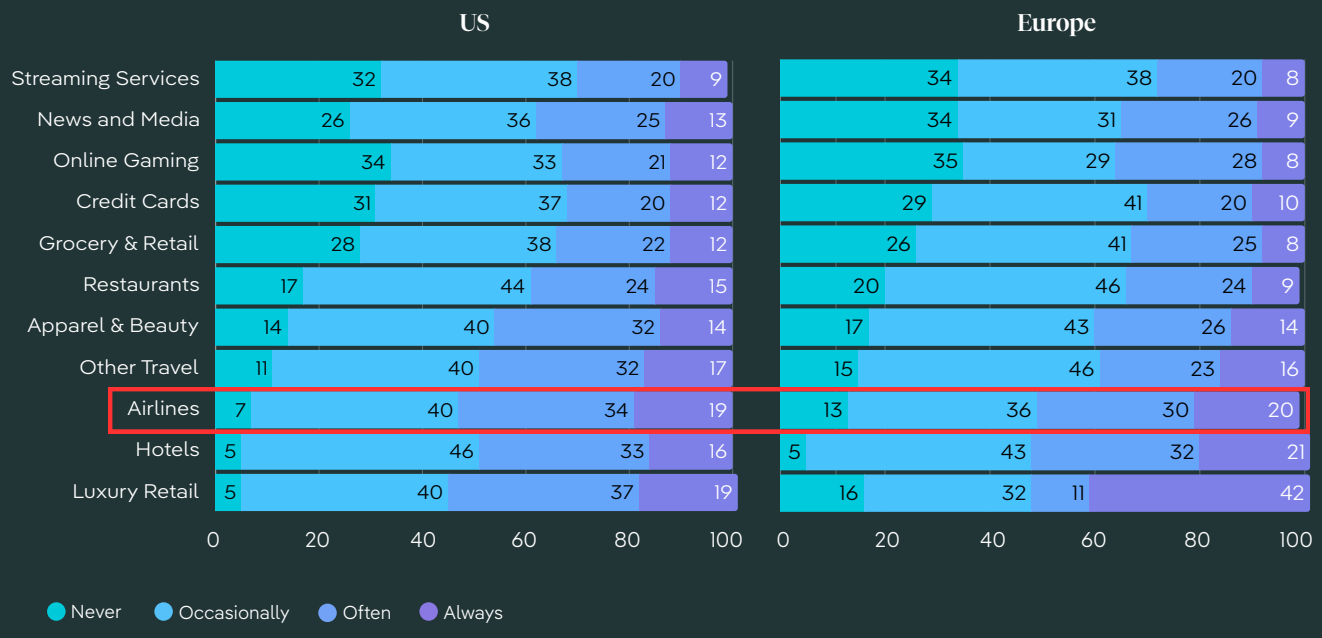


Figure i: Success of loyalty programs by industry [Source: BCG]

The decline in reliable loyalty is a challenge that could grow into a larger existential threat to airlines as younger generations become the new target customer. The Baby Boomers and Gen X-ers who first benefited from the rise of customer loyalty programs in the 1980's and into the 2000's are still heavily invested, with 89% and 80% of travellers enrolled in a program respectively[5]. The change in generational outlook is startling: just 70% and 65% of Millennials and Gen Z report being part of a program, favoring flexibility and fuelling

[2] For example, JetBlue 2024 10-K Filing
[3] One Mile At A Time
[4] BCG
5] OAG

a wider trend of brand reputation over loyalty (see fig ii)[6]. At the heart of this brand reputation is customer experience – an experience that is drastically affected by whether a flight is delayed or cancelled.

Figure ii: Influence of brand vs loyalty programs on customer recommendation [Source: McKinsey]

The role of MRO & data

An airline is only as strong as its most valuable asset: its fleet. Enter Maintenance, Repair, and Overhaul (MRO) as the underlying opportunity to bolster brand reputation while improving fleet utilization – and drive profitability. In theory, by improving maintenance efficacy and efficiency, airlines can enhance their P&L with minimized wasted spend while ensuring rapid defect diagnosis and resolution that keeps flights on time. In reality, maintenance teams are challenged to conduct accurate issue resolution with OEM maintenance manuals (AMM), illustrated parts catalogs (IPC), fault isolation manuals (FIM), wiring diagrams (WDM), service bulletins (SBs), and historical logbooks and work cards.

While the challenges of aviation safety and compliance make maintenance complex, the advent of AI has created an unforeseen advantage: strict reporting requirements mean airlines already hold vast, detailed data about every aircraft in their fleet: defects, repairs, parts used, inspection cycles, and more. Historically, this information has been trapped in paper work cards and disjointed IT systems, too fragmented to support real-time decisions.

Now, AI — and especially GenAI — can connect these silos and surface practical, human-friendly insights. Instead of leafing through manuals or piecing together defect history by memory, operators can ask plain-language questions and instantly see the best next action based on the full record of what's worked before[GE1] [CD2] . The challenge at hand for airlines is to turn data into their next best asset, working with technicians on the ground and the regulatory bodies above them to understand and enable the art of possible.

[6] QAG

PART 1 CREATING AI-ENABLED TECHNICIANS

The capability challenge: A technician bottleneck & upskilling gap

The COVID-19 pandemic left airlines with a severe maintenance talent gap that's still widening. When borders closed and fleets were grounded, thousands of experienced line engineers, planners, and shop-floor technicians were let go — and their deep aircraft knowledge went with them. According to one expert at StandardAero, organizations like Delta TechOps lost as much as 30,000 years of cumulative experience[7].

Today, airlines are still rebuilding. American Airlines alone announced 500 new technician roles in late 2024, but training junior staff to diagnose and fix faults confidently still takes years. Meanwhile, the cracks are clear: delays and cancellations caused by issues within the airline's control have climbed from 5.2% in 2018 to 7.6% in 2023[8], costing millions in lost revenue and compensation payouts.

But throwing more people at the problem isn't enough. Aircrafts are more complex than ever, and the knowledge needed to maintain them doesn't just sit neatly in a manual. While OEM manuals (AMMs, FIMs, IPCs) provide the baseline for safe maintenance, they rarely cover the full real-world context; the quirks of individual tails, recurring defects unique to certain routes, or the non-standard fixes that experienced technicians develop over years on the line.

To bridge this, many airlines have invested heavily in homegrown maintenance databases, which contain vast collections of internal troubleshooting notes, work card tweaks, engineering bulletins, and lessons learned. For some carriers, these knowledge bases are decades in the making and represent a huge competitive advantage.

But there's a catch: these systems are hard to keep current, they often live in disconnected silos, and they're rarely easy to search at speed. For a new technician or planner joining during a period of high turnover or fast onboarding, the learning curve is steep. It can take years to fully absorb what's buried in those files - time that airlines simply don't have as retirements outpace recruitment.

Bridging the gap with GenAI

This is where Generative AI fundamentally changes the game. Most troubleshooting knowledge isn't neatly structured; it lives scattered across OEM manuals, handwritten work cards, old emails, chat logs, parts memos, and thousands of free-text defect reports, each with its own acronyms, shorthand, or typos. Troubleshooting a modern fleet means navigating a hidden archive bigger than the New York Public Library. Thus, if digitized, it is large enough to max out the storage on a typical airline's data center. Yet, it is mostly written in free text that no database can cleanly search.

[7] AlphaSense
[8] CBS News

Meanwhile, every decision happens in the context of a tight turnaround. A technician doesn't need data; they need the answer, matched to that tail, that configuration, and the real ground-time window, locked to the flight schedule. There's no time to scroll through almost endless PDFs at 2 a.m. when a cargo door fault is threatening a multi-million-dollar shipment. Simply surfacing raw information isn't enough. The real value is intelligent prioritization: using AI to read through the mess, interpret spelling quirks and acronyms, and return only what matters for this aircraft, this scenario, this shift.

> **This is about real-time context: the right insight, the right tail, the right fix, right now.**

Kubrick's Maintenance Virtual Assistant, built on Databricks, does exactly that: connecting live defect write-ups, OEM documentation, vast internal troubleshooting notes, historical repair logs, tail-specific data, and flight schedules in one intelligent layer. Instead of hunting for a needle in a haystack, the AI sweeps away the irrelevant hay and tells the technician if they even have time to fix it before the next departure.

At one major US airline, this approach has already cut troubleshooting time by up to 50%, helping junior technicians handle the same complex tasks as their senior peers and ensuring the institutional knowledge built up over decades flows forward to the next generation.

"We can't afford another mountain of static documents," says Lewis Allsop, an Associate Director at Kubrick specialized in AI solutions for complex asset maintenance. "This is about real-time context: the right insight, the right tail, the right fix, right now. And its working. A 50% reduction in trouble-shooting time makes the difference between meeting a day's quota of scheduled fixes or not and, ultimately, whether planes make it off the ground in time."

"The downstream influence on profitability is clear: just a 10% reduction in ECAM-related delays, as enabled by our tool, equates to $3mill in recovered revenue. The impact is then amplified by recovering $10mill from customer compensation and delays. The cumulative effect scaled across a fleet is staggering."

Co-creators, not users

An AI tool is only effective if it aligns properly with the process it is designed to augment. So, if senior maintenance engineers are the gatekeepers of institutional and experiential knowledge, it is critical to involve them from the very start in order to truly understand their pain points – and how to address them. This applies at all levels of the process: from the hands-on workflow down to the granularity of the data involved.

"Now that data and AI tools are put directly into the hands of end users, instead of sitting in the domain of IT, we must reimagine the entire technology delivery process", said Jessica Macleod, a Kubrick Associate Director delivering AI products across highly regulated industries. "The involvement of domain specialists at every stage of the agile product development cycle, from discovery and validation through to deployment and monitoring, ensures they are fit-for-purpose for regulation and for the existing workflow."

"A clear understanding of the pre-existing processes means we can create common goals for the products", Macleod continued. "Where data teams used to work in silo and focus on metrics for our products like latency, we must now get closer to our stakeholders to understand how our tools can achieve business-forward metrics like time saving, cost-saving, compliance, and competitive edge. We must invite our end users to take up the mantle of co-creators."

Trevor Gianetti, a Kubrick Manager responsible for delivering the Maintenance Virtual Assistant, has been working directly with technicians on the ground to achieve this way of working. "Our tool was strong in theory but made exponentially stronger when reinforced with input of real experiences. The more time I spent inside the hanger, understanding the complexities, time pressures, and general day-in-the-life of technicians, the more we could shape the tool to work for them", Giannetti said.

Leaders' Point of View:

User testing doesn't just improve solutions, it builds trust

For our panel of Airlines leaders, the number one factor in whether a tool has an impact is adoption. The importance of treating engineers and controllers as 'co-creators' is about more than fine-tuning models; it creates an awareness and explainability of the AI tool so that users both understand and trust it when it comes into their hands.

Dubbed 'the Ikea effect', our experts remarked on how early-stage involvement in tool design and development drives a buy-in for adoption, much as building flat-packed furniture creates a sense of reward and pride in the final outcome when we sit at our newly built table.

PART 2 THE DATA TO DO IT

Opportunity meets capability: a perfect storm

As market conditions and a systemic talent challenge continue to threaten Airline operations and profitability, MRO is proving to be ripe with opportunity for transformation with data and AI. The fuel that turns this opportunity into a reality is the data behind it. Despite the inherent challenges of regulatory standards (to be explored later), there is a silver lining that supports AI-enablement. Forced to keep decades of defect logs, standardized by ATA Chapters, MEL categories, and repeat inspection records, airlines are now sitting on an abundance of data that makes aviation MRO uniquely well-positioned for GenAI.

Indeed, industries which rely on complex assets but lack the same standardization requirements are failing to keep up. In one leading UK Utilities organization, a Kubrick project was unable to progress beyond the Proof of Concept stage because the maintenance data simply didn't exist in a digital form, let alone clean enough to train a model. The team could only source 200 data assets pertaining to the many thousands of machinery parts, compared to the millions of data assets which Kubrick's Aircraft Maintenance Virtual Assistant successfully utilizes.

While there is great potential within their data, airlines have to make it usable. To do so, they must tackle three practical but inevitable gaps:

1. Data Quality & Trust

Old work cards, handwritten notes, and free text need cleaning, merging, and reconciling. Teams must agree on common taxonomies, handle duplicate records, and verify what gets fed to the AI. High-quality, trustworthy data makes the difference between an accurate AI Co-Pilot and a misleading one.

2. Data Integration & Speed

Static data warehouses won't cut it. Maintenance scheduling and operations move quickly – and so must your data. Data teams must implement pipelines and models that can keep up with real-time flight schedules, parts inventory, MEL deferrals, and reliability trends as they happen, so the AI always works with the latest plan.

3. Human Feedback Loops

The final piece is continuous trust. Planners and technicians must test outputs, flag bad recommendations, and fine-tune the assistant. This real-world feedback is what trains a GenAI model to get better over time, not just repeat what's in the manuals.

Meeting users where they are

When it comes to realizing value from data and AI solutions, what matters is keeping costs low, meeting regulatory requirements, and driving end user adoption. These three principals are supported by focusing on leveraging existing systems and integrating with workflows - not disrupting them.

A 'hands-on' approach can be literal. "One of the biggest hurdles to adoption for the Maintenance Virtual Assistant is getting technicians comfortable with how to engage with the tool – that is, picking up a tablet and typing with a chatbot interface, rather than thumbing through a manual", explained Giannetti. "For successful GenAI implementation, you need to be cognizant and empathetic to the changes you are bringing to a long-established process, considering how to make the integration as seamless as possible. While there may be some nostalgia for the 'old fasioned way', it didn't take long to show how much easier it is to get actionable insight from the Virtual Assistant than from scattered and missing paper manuals."

However, GenAI and other more complex tools aren't necessarily a silver bullet. Where maintenance planning teams work under tight timelines and within industry-standard systems like TRAX and AMOS, the quickest route to value can be streamlined analytics.

"Maintenance planning is an almost impossible task; weighing up the variables of flight schedules, parts inventory, immediate issue resolution, and regulation-mandated routine checks is an already complicated calculation made only more challenging by limited maintenance capacity and availability of personnel", commented Kiran Morrison, a Kubrick Senior Manager delivering a maintenance planning solution for a leading airline.

"The pressure to finesse this complicated equation is heightened by the consequences of an expensive aircraft swap, or an even more costly out-of-service event. In that light, our job is to deliver the optimized outcome as quickly as possible – no fancy UI or complicated dashboards, but strong data science delivered to their platform that eases the pain points and ultimately protects the bottom-line."

"And the impact is clear", he continued. "In the case of one client, they spend around $70 million a year just moving key parts and tools across their expansive network of international hubs to get them in place for incoming flights that need specific fixes. The value of leveraging the data we already have in existing systems is in the millions."

$70 millon

Reported annual spend on moving parts around airport network to complete maintenance

Leaders' Point of View:

The platforms to power performance

We have the data we require at our disposal – now we need the platforms to transform it into insight. Our panel of industry leaders agreed the difference between minor efficiency gains and transformative AI-enablement lies within the data tooling used to create solutions. To keep up with the pace and demand of flight scheduling and maintenance operations, data teams require modern data platforms that provide near-real time capability.

Once this capability is unlocked, data and AI teams can look beyond the live analytics that technicians and maintenance planners must otherwise conduct day-to-day; by leveraging historic logs, they can embark upon predictive and preventative operations that significantly minimize the potential of out-of-service events.

PART 3 INNOVATING WITH GOVERNANCE

Working together

Successful AI implementation is not a linear route between technology creation and end user adoption. In an industry as highly regulated as aviation, compliance with industry standards and legal restrictions completes the trifecta. "It can't be bypassed – it must be incorporated", declared one leader we interviewed in our expert panel. Moreover, regulators such as the Federal Aviation Administration (FAA) are preparing for the inevitable transformation AI will bring to their sector.

In the publication of the Roadmap for Artificial Intelligence Safety Assurance in July 2024[9], the FAA notes the associated risks to safety of improperly designed and governed AI but also emphasizes the opportunity for AI to improve overall safety for airline operations, stating 'Focus on Safety Assurance and Safety Enhancements' as one their 5 key principals.

[9] FAA

In order to achieve the goals of their principals, the FAA also outline 5 areas of action, with 'Collaboration' sitting at the top of the list – and invitation to government, other regulatory bodies, and individual players in the industry to partner for progress. Thus, rather than viewing regulators as a blocker, instead they should be treated with the same involvement as the technician end users, being brought on the journey from inception to create trust and clarity in understanding.

"When we first began working in this sector, we created our solutions in isolation from regulators, which created a lot of roadblocks and uncertainty as we awaited approvals", Allsop explained. "As we have sharpened our understanding of the domain, including the role and influence of regulators, we have also learned to incorporate communications and approvals into our roadmap, viewing them as another crucial stakeholder with which to collaborate towards the same shared vision."

Leading the way

Regulators' initial guidelines and roadmaps for AI must, of course, prioritize safety ahead of rapid innovation. However, technologists should not feel restricted as a result. Instead, product developers should feel empowered to create AI which showcases the reliability and governance of their tools through ethical AI best practices.

The FAA's initial roadmap, though still being developed, already outlines a couple of key points of stringency within AI deployment, such as a distinction in assurance methodologies between 'Learned' (ie static) and 'Learning' (dynamic) AI and their applications, as well as a guidance to 'take an incremental approach' to development and implementation. By demonstrating a strong understanding and application of these guidelines, alongside generalist AI principals of transparency, explainability, and the 'human in the loop' for decision-making, data and AI teams can help lead regulators towards clearer understanding and approvals of their tools.

When it comes to taking an 'incremental approach' to AI integration, the FAA also encourage airlines to 'leverage the Safety Continuum', acknowledging that there is a spectrum of risk to use cases in different areas of aviation. Where regulators are largely concerned with the ethics and safety of AI-led decision-making for pilots, at the far end of the continuum, MRO is a safer aspect of aviation in which to incubate AI innovation and drive value. Furthermore, by prioritizing the data and AI use cases within MRO that demonstrate their value through metrics tied to enhanced safety, reliability, and accountability, airlines can emphasize their alignment with and commitment to the priorities of regulators.

Accelerating Approvals: Top Tips

- Focus on use cases that demonstrate increased reliability and safety through AI
- Begin with 'Learned' AI, don't jump to 'Learning' - and make your AI models explainable
- Evidence your journey from POC to MVP and User Testing to prove an 'incremental approach'
- Demonstrate how MRO use cases sit at the beginning of the 'Safety Continuum'

Leaders' Point of View:

Create the space for unified discussion

Fulfilling the mutual interests of both airlines and regulators for safe AI practices requires the right channels for discussion. Our panel of industry leaders expressed a need to create better industry consortia dedicated to the role of AI in aviation – a space to present, interrogate, and collaborate on AI development.

The benefit of these forums is multifaceted and symbiotic. In the first instance, they allow airlines and third parties developing AI to share their successes and prove their safety measures so as to gain buy-in – and eventual approvals – from regulators. In doing so, they would enable other organizations to learn and adopt similar practices in order to advance wider industry capability. Meanwhile, regulators will gain the benefit of feedback on their safety roadmaps and principals, supporting their development and alignment with real-world use cases.

CONCLUDING THOUGHTS

THE FUTURE OF MRO FOR AIRLINES

The opportunity for MRO to incubate and drive AI-led innovation within airlines is tangible – and the returns on the balance sheet are already beginning to show. As tools like Kubrick's Maintenance Virtual Assistant can save $3 million per year with every 10% reduction ECAM-related delays, the size of the impact is directly correlated to the success of user adoption. The ultimate goal is something greater than the sum of its parts: every out-of-service event prevented by enhanced maintenance scheduling equates to greater customer satisfaction and loyalty.

Day-to-day operational excellence is just the start. There is even more value to play for; the airlines who improve their inhouse MRO capability can reduce their reliance on costly third-party MRO services, where rising costs and uncertain supply chains can be mitigated using AI. The next step is taking more of the market share, by enhancing revenue streams as a provider of MRO services to airlines who do not have the inhouse capacity. The demand is abundant,as major players like Delta and Lufthansa continue to invest in their offerings (Delta TechOps and Lufthansa Technik).

Despite the challenges to unbridled AI innovation that regulators impose, the structures and guidelines they put in place point towards MRO as the optimal starting point for safe, effective, and impactful AI incubation. This sentiment is compounded by the systemic talent challenge within airline maintenance, whereby augmentation with AI provides the solution to increasing the capacity and capability of new and experienced technicians alike.

It's time to begin: to embrace AI as the disruptor to traditional MRO and rethink the role of maintenance and operations within Airlines as a whole. Together, leveraging partnerships across the industry and with specialist guidance from technologists, we can create the runway to revenue.

Get in touch

Let's transform through data and AI.

To get started with a discovery call with one of our AI Maintenance specialists, get in touch.

George Eaton
Head of US Clients
georgeeaton@kubrickgroup.com

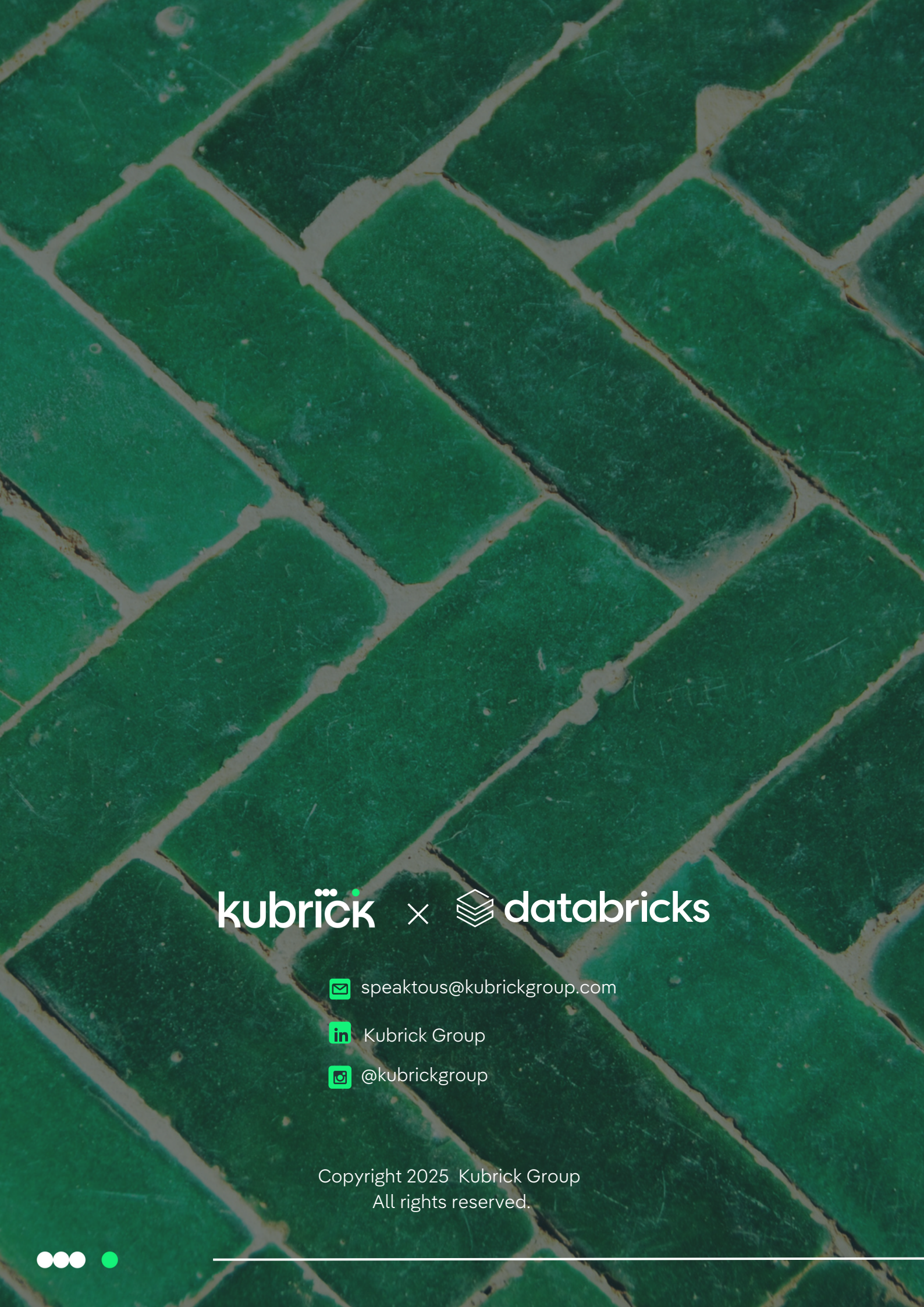
Lewis Allsop
Associate Director, Aviation, Manufacturing & Mobility
lewisallsop@kubrickgroup.com

ABOUT KUBRICK

Kubrick exists to transform lives through data & AI. We help global organizations realize lasting value from data and AI with a workforce we build ourselves, in partnership with Databricks.

We deliver data and AI solutions for organizations that minimize operational cost, strengthen resilience against risk, and uncover revenue opportunity. Our clients can retain our people to drive lasting adoption while futureproofing their workforce with exceptional talent.

Since 2016, we've created over 3,000 data & AI specialists by removing the systemic barriers to the tech industry. We find incredible minds from all backgrounds to train in today's most sought-after skills and platforms, including Databricks, creating a diverse team of experts. We're the preferred partner of Databricks to accelerate delivery and co-create revolutionary solutions for airlines and manufacturing.



kubrick × databricks

speaktous@kubrickgroup.com

Kubrick Group

@kubrickgroup