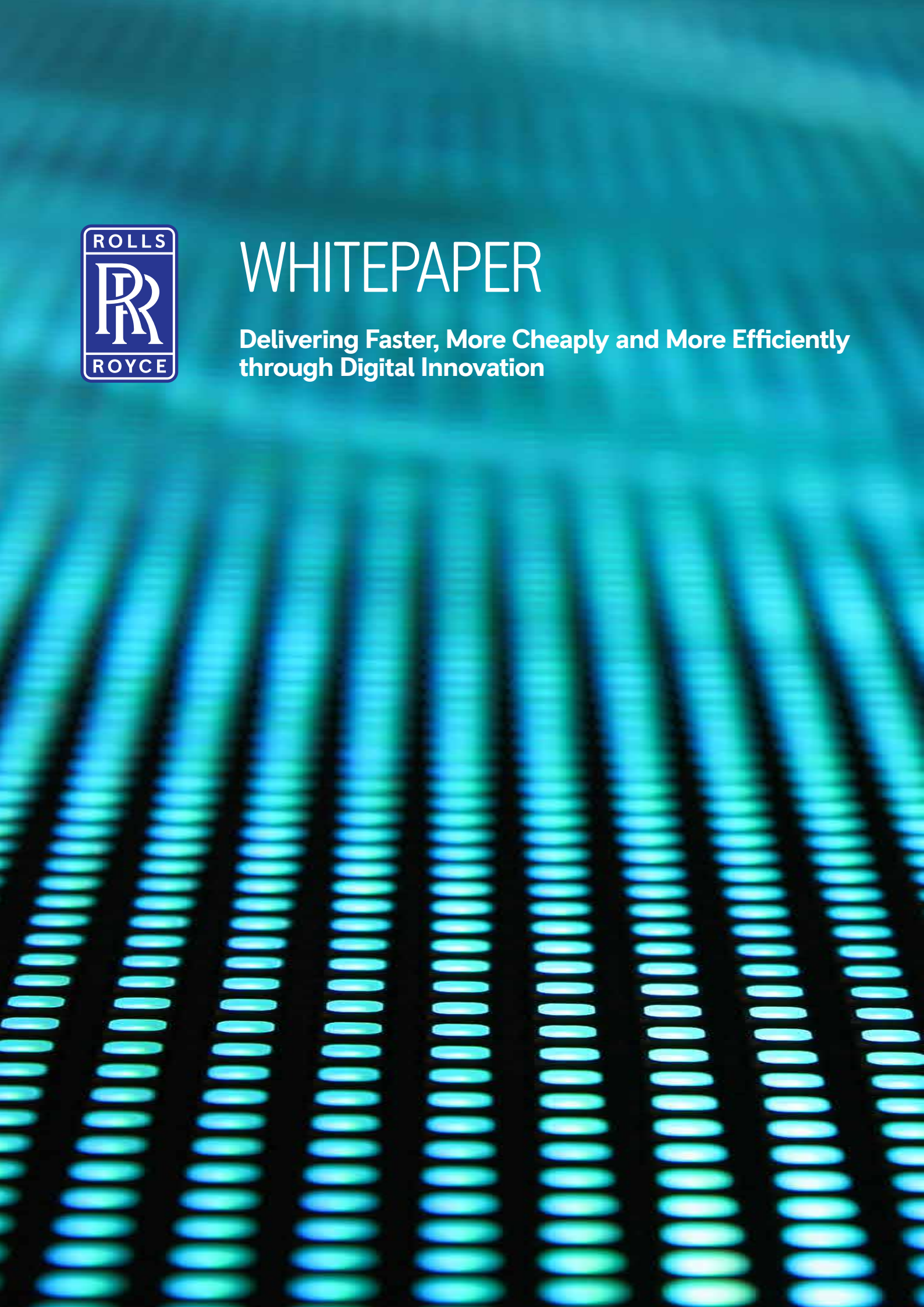


WHITEPAPER

Delivering Faster, More Cheaply and More Efficiently through Digital Innovation

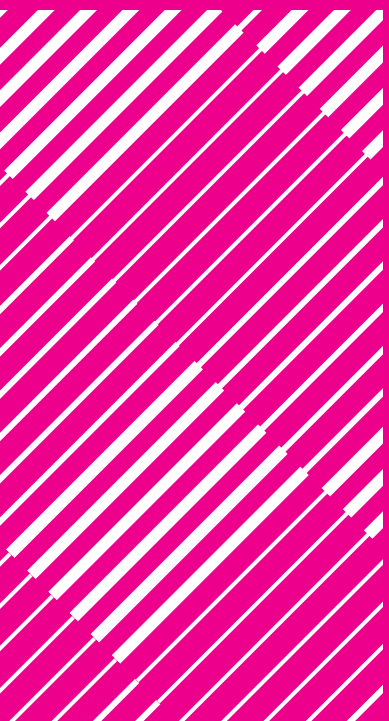
In an increasingly uncertain world, the need for a world-class Defence system is clearer than ever.

To meet this need ***"we must develop more capability, more quickly, for less. It is nearly 40 years since Typhoon was conceived; in that time technology has revolutionised all aspects of life from the arrival of the internet to the latest IT and smartphone technologies. Defence and the Combat Air sector must develop the tools and approaches to embrace the pace of technological change seen across all industrial sectors*** [1]."

Rolls-Royce is a world-leader in the design, manufacture and maintenance of Defence products, providing the power and support our customers' need to protect the planet, fulfil their missions and make it home. Now we are becoming world-leaders in the digital tools and technologies our customers need, embracing breakthroughs in Big Data, automation, Artificial Intelligence and the Internet of Things (IoT) [2] through our Digital Transformation.

“The world’s most valuable resource is no longer oil, but data”

The Economist



To remain at the cutting edge and deliver better products to our customers faster and cheaper, we must make use of our most valuable resource:

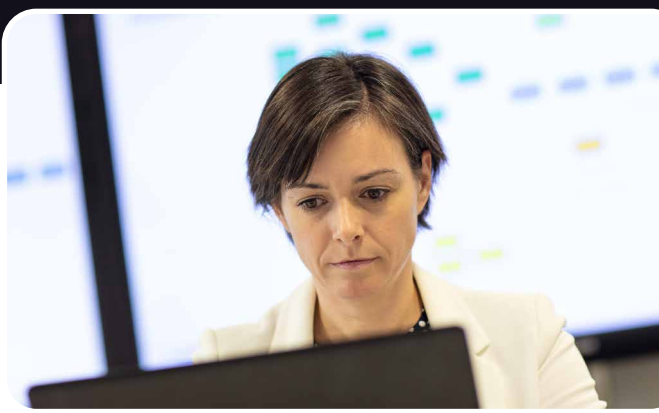
Data

We are doing this by working to ensure that our data is accessible, trusted and continuously mined for actionable insight. This will not only ***"improve how we work today, but is the foundational capability to create digital first capabilities and products such as the digital twin and the Model Based Enterprise"*** [3]. We have invested in teams of data engineers, software engineers and data scientists, and are also supporting our engineers to up-skill in Machine Learning, Deep Learning, Neural Networks, Big Data Analytics, Natural Language Processing and data visualisation through channels such as our new Digital Pioneers scheme.

We aim to equip all engineers with a foundational understanding of these techniques and eventually will ensure there is at least one Digital Pioneer with advanced knowledge in place in every team. ***"The Digital Pioneer role is that of a project leader and it is critical that they be passionate about driving digital change into the business and committed to their own continued development to remain current with the latest digital tools and best practices... so that the business is able to maximise the benefits realised from... digitally focussed improvements and project work"*** [2].

This Digital Transformation journey is a key enabler to delivering our next generation power and propulsion systems to our customers within the timescales and budget required.

Big Data Analytics



We are leveraging our data to make better decisions and to drive innovation in areas such as IoT and automation through Deep Learning: a subsection of Artificial Intelligence / Machine Learning. A Deep Learning algorithm is system of neural networks which draws inspiration from the interconnecting neurons in the human brain. A Deep Learning network is able to learn through data in the same way as a human child learns. As with a human child, this relies on huge quantities of data.

This data must be stored appropriately such that the right data is accessible to the right people at the right time. We aim to do this by storing our data in structured databases with API (Application Programming Interface) access, allowing applications to 'talk' to one another. We will begin to do this on a case-by-case basis, working in an agile way to deliver value at every step. The data management capability will grow organically through the delivery of these small projects into a data platform [3].

Prior to this, it might have taken an engineer two months to find legacy data in various formats across various systems. Now, with a modern solution, the engineering team will have access to that data through a secure API, within minutes [3]. The data will be automatically pushed to visualisation platforms such as Power-BI in real-time, supporting engineers in identifying patterns and correlations in complex data and delivering actionable insight. This will create a competitive advantage for our customers through informed, data-driven decision making during operations, and increased asset capability through data analytics in the design stage. This means that the more our customers operate their assets, the more data is produced, and therefore greater value is created through opportunities unlocked by Big Data Analytics.

Digital Twins

"Through the adoption of digital twins, we are looking to move Defence norms and values away from documents and towards data"

Huge volumes of data are required to deliver value. This data might be in the traditional, structured format or in other, less structured formats such as images. The amount of data will constantly grow, with new information communicated through various sources, from sensors on engines to data outputs of test and manufacturing machines. These high volumes of data in various formats delivered at high velocity is the definition of Big Data. Through Big Data, we will be able to deliver the concept of the digital twin: ***"at its most fundamental level a digital twin is simply the representation of the physical world of atoms in the digital world of bits*** [2]***."***

"The real value of digital twins goes beyond our current digital models and lies in unlocking better understanding of a system to make better, data-driven, decisions. Imagine a world where the most subtle change in a running parameter can be automatically compared against the build tolerance data for a specific asset, using specific customer operational data to prognose impending component failure. This could empower a decision to carry out a maintenance check early whilst having already automatically scheduled the replacement parts for delivery [4]***."***

The value delivered by digital twins is not just limited to our in-service products, however. Through Big Data, it will be possible to design parts entirely in the digital world, informed by real-world data. We will be able to delay the build-stage later and later in the overall process until we need only build the final part and get it right-first-time: saving our customers time and money. ***"digital twins are valuable because they reduce business friction, can optimise delivery of Defence support, enable decisions to be made more effectively and speed up investment decision making*** [5]***."***

Through adopting this Digital First, data centric approach we will deliver value to our customers through digital twins at the Production, Component, Product, Fleet and Enterprise levels. Our Enterprise Modelling tool is already delivering insight on customer operations minimising aircraft downtime, reducing life cycle cost and optimising future performance against our customers' KPIs. Through creating digital twins of our power and propulsion systems, we will reduce testing time, cost, and emissions – helping to meet the key requirements from governments worldwide. This ability to create a 'product' digital twin has already been demonstrated in our Civil Aerospace business, with a fully validated blade-off simulation saving over £20M whilst also increasing safety by demonstrating acceptable performance under more conditions than a one-off test is able to do. We are building component twins through digital design and inspection, improving overall power and propulsion performance as well as increasing understanding of component degradation and behaviour.

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REF: VCOMB 4052