

## 21st Century Aircraft Design at Sikorsky Aircraft

Dr Andreas Bernhard, Director of Aircraft Design at Sikorsky, a Lockheed Martin Corporation Company, delivered an engaging talk on 27 November 2019 to a good turn-out of approximately 90 in the Senate Room, [University of the Witwatersrand](#) (Wits). [Bernhard](#) is a South African-educated engineer who has risen to the top of his field of helicopter design. His presentation combined some historical context of Sikorsky (the famous Russian-American [Igor Sikorsky](#), and the [company](#)), the main pillars of innovation at Sikorsky, key design paradigms and focus areas, and short case studies and insights into some of its 21<sup>st</sup> century designs. An accomplished speaker, Bernhard enthralled the audience for almost two hours with a mix of technical and anecdotal content.



Bernhard's passion for aviation was evident at a young age. He went on to graduate from Wits in 1992 (B.Sc. Aeronautical Engineering) and in 2000 from the University of Maryland with a Ph.D. (Aerospace Engineering). With his passion for "making things", he then joined Sikorsky and has enjoyed a highly successful 20-year career with the company.

The utility of helicopters in rescue and short-flight operations was recognised early on by Sikorsky, who famously said, "If you are in trouble anywhere in the world, an airplane can fly over and drop flowers, but a helicopter can land and save your life". This axiom is echoed by Sikorsky in the company's slogan, *We've been pioneering flight solutions that bring people home everywhere, every time since 1923*. Company records show that Sikorsky helicopters saved the lives of 1 636 people in 2018, and 2 729 people in 2017.

Innovation pillars at Sikorsky vest in three principles: speed, autonomy and intelligence, which are essential for incubation. These are matched by an emphasis on development, programme execution, and talent and processes.

In his role as Director of Aircraft Design, Bernhard holds to three essentials: first principles (to allow for free body diagrams); design elegance ("form follows function"); and tools (simulation and modelling). Technological advances such as the use of composites and additive manufacturing are in use for various helicopter models. He emphasises that advanced or integrated toolsets become essential in a big company to ensure that design data have "one source of truth". Another manufacturing principle is "build before you build", by which hundreds of work instructions are validated before the process commences, thereby enhancing efficiency.

Sikorsky aircraft are sought-after in both the commercial and military sectors. A highlight of the presentation was the development work by Bernhard and his team for the US Marine Corps on the CH-53K helicopter, an 'aerial truck' capable of carrying 12.200 kg external load over 204 km high/hot

conditions (33°C) at an altitude of 914m. He singles out as a career highlight his work as Chief Engineer as “taking two designs to their first flight in one year” – for the CH-53K and the S-97 Raider.

Bernhard confirms that the nature of the current threat faced by the military requires that helicopters have more “speed, range, survivability and autonomy”. He adds, “Development is difficult” on novel helicopters, such as those with double rotor systems, and the requirement for speed means that there must be “new ways to fly ... pilot efficiency is important as it allows for mission focus”.

The path to the future, concludes Bernhard, lies in the Future Vertical Lift (FVL) programme to shape the United States military’s helicopter fleet of the future. This is driving the development of so-called Future Attack Reconnaissance Aircraft (FARA), amongst others.

His advice to aeronautics students is to “make sure you have the maths” for first principles application and later use of design, simulation and modelling tools. “If you are keen to work abroad, plan your postgraduate study path to achieving a Ph.D. and make sure you understand the country-specific requirements to work in the US or other destinations,” he says.

Council member Kevin Jamison and fellow Wits alumnus summarised Bernhard’s presentation as “a great update on helicopter technology”. The AeSSA wishes Bernhard all the best for the future.