Next Generation Agile Manufacturing to Enable “Point of Use” Customization for Complex Vehicles

Consider this possibility: You are a crew chief for a helicopter based in a remote outpost, scheduled to fly a critical mission in the next 24 hours. The issue is that your aircraft needs a replacement part, and bad weather has just delayed that spare part arriving in time to complete your assignment. Today, the only choice is to find another aircraft, or another part, at a moment’s notice, a tough task in such a remote location.

Tomorrow, agile manufacturing turns this difficult situation into a routine task. Using a remote presence augmented reality system, you remotely connect to Sikorsky. Together, we develop a strategy to manufacture and process the part using the tools you have at your remote manufacturing center located to one side of your hangar. Once you and the Sikorsky experts have agreed on a strategy, using the loads data from the helicopter that its wireless Health and Usage Monitoring System (HUMS) has already uploaded to the manufacturer’s database, you connect your remote manufacturing center directly with Sikorsky servers. Without any input from you, the center machines securely transmit data on what materials are on hand and the tolerance capabilities of those machines on that day, given current maintenance and recent machine usage. Working in tandem with the automated system, Sikorsky experts generate a custom, virtual technical data package to support part manufacture at your site. An Integrated Computational Materials Engineering (ICME) discipline, running from the high performance computer locally at Sikorsky’s engineering site, is invoked to predict a flight hour life and ‘certify’ the part. As the machines at your site begin to print the part, the system instructs you to insert MEMS sensors in various locations to monitor the loads and usage of the part, eliminating the chance of catastrophic failure and ensuring that the ICME calculations are correct. Finally, a green light illuminates above the machine, and you take the now completed part to the aircraft for installation, your aircraft goes on to successfully complete the mission, and then you remove the part from the aircraft when the spare arrives. Depending on the sensor readings taken during the mission, the part can be stored for future use or recycled to produce other parts.

The above is closer than science fiction. Whether the need is for a critical spare or an optional feature for a specific mission, Sikorsky envisions a near future where modern manufacturing processes driven by digital data will provide customers the ability to rapidly and safely enhance their vehicles. A suite of complementary technologies to enable this approach includes:

- Digital data – Data no longer stops at the ‘design’ water line; a digital twin follows every part throughout its entire life, creating a future where aircraft configuration is not dictated by pre-set manuals but by the collection of parts currently comprising the system. This information is combined with usage based monitoring to a real-time, holistic view of the aircraft’s health.
- Advanced Simulation - ICME-like capability to optimize part geometry from the base model based on specifics of that aircraft (i.e. the reinforcement beam needs to be wider on one side to not put undue stress on a section of airframe that was recently repaired).
- Secure, Collaborative Data Exchange – A system to enable the manufacturer and remote sites to seamlessly share data securely, ensuring that part is printed to specification while tying directly in to the customer’s service contract to charge an appropriate fee.
- Distributed, Reconfigurable MEMS Sensor Network – Multi-functional, plug-and-play, interoperable sensors in a very small form factor that can augment the existing HUMS network, providing the capability to monitor these remotely manufactured parts to ensure quality and functionality.

Merging additional technologies to enhance this value proposition will also be presented.