

KCF's self-powered wireless sensors will soon be outfitted on the CH-53K helicopter in collaboration with Sikorsky and LORD Corporation.



KCF TECHNOLOGIES, INC.

The U.S. Department of Energy estimates the cost of reactive maintenance on machinery to the U.S. Economy is \$2.5 trillion per year. Since reactive maintenance is only performed if and when there is a problem, the downtime and disruption of operations is costly and causes unsafe workplace conditions for many businesses. The U.S. military often takes a proactive yet preventative maintenance schedule, since failure of its machinery could equate to lives lost. However, preventative action is also costly and inefficient, as maintenance is performed on an aggressive schedule when it might not be needed at all. So is there a happy medium? KCF Technologies said yes, and responded to this need with its innovative platform of technologies that essentially gives machines a “voice.”

PHASE III SUCCESS

Over \$14M from technology originally funded under the SBIR program; more than 50% of revenue today is from commercial sales.

AGENCIES

DOE, DOD

SNAPSHOT

KCF's product line of wireless sensor technologies “gives machines a voice,” allowing users to move from reactive or preventive maintenance schedules to predictive condition-based maintenance.

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Take Navy and Army helicopter fleets for example – one of the platforms in which KCF has implemented its technology. Self-powered wireless sensors are mounted on the main rotor pitch links as a “Smart Rod End” to monitor the load, or the strain that passes through the pitch link. The stress to the rotor structure is determined and communicated wirelessly to an advanced Health Usage Monitoring System (HUMS) box on the helicopter. Energy is harvested from the load in the rod end to power the sensor, enabling battery-free and wire-free monitoring. The model is completely contained, and the operating life of the helicopter is extended. Since each helicopter experiences operational differences in flight conditions, maintenance can be scheduled based on each helicopter's need – not on a blanket assumption across the entire fleet. This technology was selected in 2015 to move into procurement on the CH-53K helicopter in collaboration with Sikorsky and LORD Corporation.

“With this technology that was originally funded by the DoE SBIR program, we have made a significant transition into the commercial marketplace,” explains Jeremy Frank, President of KCF Technologies. “While our original vision was for industrial machines, KCF's wireless technology is enabling breakthroughs in a series of applications with the Army and Navy, including rotorcraft, submarines and prosthetic limbs. KCF has established a strong track record of Phase III contracts with the Department of Defense.”

Commercially, KCF's product line is called SmartDiagnostics® – and can be found across the country in moving parts spanning various industries. These include upstream oil and gas well sites, to monitor pressure-pumping equipment. This was a completely unproven

application for machine condition monitoring, but KCF has broken the ground and is now achieving 10-20x ROI for its customers while also improving worker safety. The work has been pioneered in Pennsylvania with Universal Well Services of Meadville, PA and has now been deployed in five other states. The technology is also used in paper manufacturing plants, and is changing the rules for how machinery can be monitored in real-time and used simultaneously for maintenance and production teams. SmartDiagnostics® sensors leverage DARTwireless, KCF's highly efficient, proprietary wireless protocol, which is optimized to transmit a full dynamic vibration spectrum on a very small power budget. The sensors can operate for 10 years on a small battery, or can operate continuously with only the power available from KCF's energy harvesters. Product sales of SmartDiagnostics® began in 2012, and have grown at an average annualized rate of 148%. Responding to demand from the oil & gas industry, KCF launched its SmartDiagnostics® Sentry Service™ in 2014. This service allows a fully turn-key solution so customers don't have to worry about reading and interpreting the data. This outsourced predictive monitoring service gives users access to KCF's vibration experts, who will monitor and analyze the sensor data and provide actionable information to improve the uptime and safety of their client's machines. Revenues from this service have quadrupled in 2015, and are projected to double again by the end of the year.

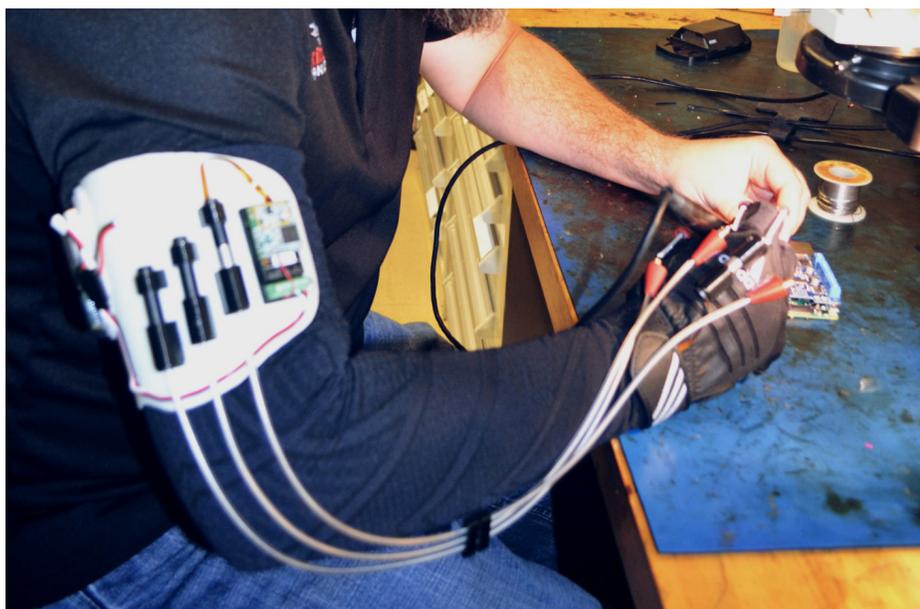
Building upon the foundation from the DOE STTR program, KCF is excited to continue to collaborate on innovations that will help achieve the agency's sustainable energy goals. Ubiquitous wireless sensors will have huge benefits across every manufacturing sector as part of the "Internet of Things." KCF's turnkey solution of wireless sensors, cloud capability, and analysis service is already achieving gains in industrial reliability and safety. An ongoing relationship with the DOE Advanced Manufacturing Office is accelerating adoption related to efforts such as ISO 50001 and Superior Energy Performance, which focus on industrial energy efficiency.

For its work with the Army, KCF has developed a series of prosthetic and orthotic technologies to support improved functionality for injured soldiers, which began as an STTR project in 2006. KCF completed a Phase III Army MEDCOM project entitled "Self-Powered Prosthetic Limb Technology." The project spawned three new separate products/licensed technologies that are now being delivered to injured warfighters and other patients. Revenue from this project alone has totaled \$7 million. The work is continuing this year with additional Phase III contracts and clinical trials with UPMC in Pittsburgh, PA, on smart sensing prosthetic limbs, hand orthotic actuators, and energy harvesting.

"We sometimes call the SBIR program our Shark Tank," adds Frank. "We are a company bursting with brilliant ideas and engineers that have the ability to change the world, but in the early stages when we are evangelizing a new capability, it is extremely hard to fund those early steps. SBIR is uniquely positioned to help us with that and we are so grateful."

Frank also attributes KCF's geography as a key factor to its success. Situated directly across the street from Penn State – one of the largest research institutions in the world, and the institution in which KCF originated in 2000 – the company has easy access to a deep talent pool and the ability to collaborate with the university. Most of the Mid-Atlantic and East Coast industrial base is within a 3-4 hour drive of State College, which enables easy access to huge industrial markets. KCF has also twice been funded by Ben Franklin Technology Partners, a Pennsylvania organization that helps early-stage companies penetrate new markets. Today, KCF is a 30-person operation, and the team is extremely clear on what their vision is for the future.

"Our place in the world is to help companies become predictive and proactive which includes saving money, improving safety, and reducing downtime," added Frank. "They can do this by capitalizing on these new technologies and services, and the strongest success comes from a collaborative working relationship between KCF and our customers."



LEFT KCF's SmartDiagnostics® wireless sensors built in Pennsylvania and deployed to improve US industrial manufacturing. **RIGHT** Prototype actuator glove to improve rehabilitation and assist function for injured warfighters (Army Phase 1 SBIR).