Advanced Technology

The NFL is championing new developments in engineering, biomechanics and material science designed to better protect against injuries in sports and recreation, as well as for the military.

AP | Ben Liebenberg

OVERVIEW

Four years ago, GE and the NFL launched the Head Health Initiative, a multi-year research and development program and series of open innovation challenges. This dynamic collaboration spurred breakthroughs in concussion research, prevention, diagnosis and treatment, such as next-generation brain imaging technologies, groundbreaking diagnostic tools and impact-absorbing materials.

Leveraging this model, the NFL continues to stimulate the marketplace to support novel developments in sports safety. The NFL's latest research and development program, the Engineering Roadmap, is a comprehensive plan that engages the best minds in biomechanics and engineering to understand more about how head injuries happen on the football field, and use what is learned to catalyze the design of better protective equipment in the future.

1st and Future, the League's annual Super Bowl start-up competition, attracted some of the smartest minds in sports safety technology and engineering. This year, in Houston, TX, they competed for $50,000 from the NFL to be used to continue their innovative work, and a spot in the Texas Medical Center Accelerator.

THE NFL'S ENGINEERING ROADMAP

Using Science to Drive Progress Toward Better Protective Equipment

As part of the NFL's *Play Smart. Play Safe.* initiative, the League pledged $60 million toward the creation and funding of a five-year project called the Engineering Roadmap. It's a comprehensive effort to improve the understanding of the biomechanics of head injuries in professional football and to create incentives for helmet manufacturers, small businesses, entrepreneurs, universities and others to develop and commercialize new and improved protective equipment, including helmets.

Learn more about the Engineering Roadmap
http://annualreport.playsmartplaysafe.com/#advanced-technology

AP | Kevin Duo

Driven by Experts

Football Research, Incorporated (FRI), a nonprofit corporation formed and financially supported by the NFL, manages the Engineering Roadmap. The Board of Directors includes leading engineers and experts who advise FRI on how best to achieve the goal of advancing the understanding of biomechanics in football and creating an environment where new and improved protective equipment will be developed.

Jeffrey Crandall, Ph.D., chairman of the NFL's Engineering Committee, serves a leading role in managing the Engineering Roadmap. Dr. Crandall is the Nancy and Neal Wade Professor of Engineering and Applied Sciences at the University of Virginia and Principal Scientist and Consultant at Biocore, LLC. The Board also works closely with Dr. Kristy Arbogast and Dr. Barry Myers, consultants to the NFL Players Association, who are co-leads on essential elements of the Engineering Roadmap.

Geoff Ling, MD, Ph.D., Col. (Ret.)

Barclay Morrison III, Ph.D.

Alton (Al) Romig, Jr., Ph.D.

Jeffrey W. Runge, M.D.

"The goal is that in three years or so, we'll have seen advances in current helmets. And in five years, we'll be very sophisticated in understanding exactly the sorts of hits that particular players take, particular positions take, what the head feels when it's hit in a particular way on a football field."

Jeff Miller, NFL Executive Vice President of Player Health and Safety Initiatives

AP | Aaron M. Sprecher

Research: Measuring the On-Field Environment

Three dozen experts gathered on the field at Lucas Oil Stadium in Indianapolis, IN, during the fall of 2016 for a collaborative research effort focused on the future design of protective equipment.

With specialties that included forensic engineering, impact sensor technology, data acquisition, biomechanics and crash reconstruction, they put sensor-enabled crash test dummies through football-like hits. The action was filmed with eighteen 3D motion capture cameras and eleven high-definition game day cameras to capture impacts from dozens of angles around the field with the goal to better understand the forces and motions that occur when a player receives an impact.

These videos and reconstructions of injury-causing plays will be used to strengthen the understanding of the physics underlying concussion-causing impacts, and the resulting data will be shared with manufacturers, designers, innovators, entrepreneurs and universities to help inform improved future equipment design.

"Once we have a model that can represent motion of the head and brain under the most common concussion scenarios, what we can do is take those models and incentivize manufacturers to design a helmet model computationally that would better protect against those injuries… then they can design it physically and get that helmet on the field."

Jeff Crandall, Director of The Center for Applied Biometrics at The University of Virginia
Chairman of the NFL Engineering Committee

AP | Greg Trott

Education: Experts and Innovators Learning from Each Other

In November 2016, the NFL and FRI hosted a first-of-its-kind educational conference. Hundreds of world-class biomechanics and biomedical engineering experts gathered with innovators—from inventors to equipment manufacturers to engineering students—in Washington, DC, for "The HeadHealthTECH Symposium: Fundamental Biomechanics of Concussion in the NFL."

The conference was the first in a series of educational efforts aimed at sharing the latest biomechanical and biomedical information and encouraging collaboration. Experts shared the latest knowledge regarding the causes of concussion in professional football, including the best tools available for assessing and optimizing the design and manufacturing of protective equipment.

These discussions are a key part of the NFL's Engineering Roadmap and an important step to educating and creating incentives for those in the marketplace to design and manufacture protective equipment that performs better than current models. Periodic symposia, webinars or other educational efforts will allow experts to share the most up-to-date biomechanical and biomedical information.

"The more we learn, the more we want to continue to push the envelope on materials and design."

Sarah Gholston, Vice President of Merchandising at Russell Athletic

Crowdsourcing: HeadHealthTECH Challenges Offer Incentives for Innovators and Entrepreneurs

The NFL's HeadHealthTECH Challenges are attracting innovative grant proposals from institutions, individuals and corporations that are interested in designing the next generation of protective equipment. These proposals range from concepts to commercially ready products for use by athletes.

The TECH Challenges are operated and managed by Duke University's Clinical and Translational Science Institute (Duke CTSI). Duke CTSI accepts and evaluates proposals, and assists some of these promising concepts to accelerate their development.

The TECH Challenges are structured to stimulate research and innovation, as well as to encourage connections with mentors and venture capitalists, with the goal of spurring developments in engineering, biomechanics, advanced sensors and material science. It's a "high-touch" program where experts in the field work closely with grant recipients to improve their products, and those recipients retain ownership over their ideas at all times.

HeadHealthTECH Challenge I Winners

GUARDIAN INNOVATORS
This family business in Georgia received a $20,000 grant to continue development of their Guardian Cap Technology, a soft-shell helmet cover that fits on the outside of any helmet. It's designed to reduce the severity of impacts and is primarily used during practice.

VYATEK SPORTS
An Arizona-based materials science company, Vyatek Sports received a $190,000 grant to support development and testing of its Zorbz technology, energy-absorbing modules on the outside of a helmet that are designed to perform more like a bicycle helmet upon impact.

HeadHealthTECH Challenge II Winners

2ND SKULL
Based in Pittsburgh, PA, this company received a grant of $100,000 to support gathering efficiency data on its 2ND SKULL® CAP—a thin, soft, flexible and breathable protective skull cap that fits under football helmets, designed to provide added protection against linear and rotational impacts.

BAYTECH PRODUCTS
This company out of Asheville, NC, received a grant of $178,000 to support the development of its youth helmet prototype—Hitguard—that is 30 percent lighter than most commercially available youth helmets and is specifically designed to address rotational acceleration.

WINDPACT
Located in Leesburg, VA. Windpact received $148,000 to support development and testing of a patented padding system designed to use air and foam to absorb and disperse impact energy to improve the performance of helmets and protective gear.

AP | Evan Pinkus

THE GE-NFL HEAD HEALTH INITIATIVE

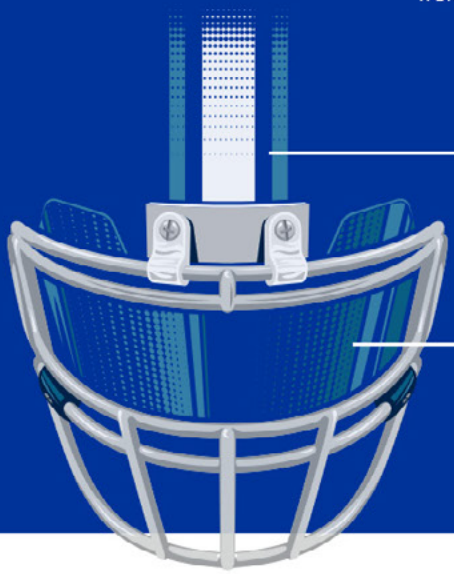
The NFL and GE launched the GE-NFL Head Health Initiative in 2013. This four-year, $60 million collaboration has accelerated innovations for improved prevention, diagnosis and treatment for traumatic brain injury.

One component of this initiative was a four-year, $40 million research and development program to develop next-generation brain imaging technologies. This includes substantial clinical trials at seven leading research centers across the country where individuals with head injuries participate in a rigorous test methodology to learn more about imaging and brain injury.

The second component of the initiative is the Head Health Challenge series, which has provided grants to scientists, academics, experts and entrepreneurs worldwide to help spur advancements to better understand, diagnose and protect against traumatic brain injury.

This four-year, $60 million collaboration **has accelerated innovations for improved prevention, diagnosis and treatment for traumatic brain injury**

The Head Health Challenge open innovation program is supported by the NFL, GE, Under Armour and the National Institute of Standards and Technology (NIST). This three-part challenge program has crowdsourced innovative ideas from experts around the world, ultimately generating more than 1,000 concepts submitted from experts in 30 countries.



Innovative ideas from **experts in 30 countries**

More than 1,000 concepts submitted

Head Health Challenges

Head Health Challenge III: Advancing Materials Science

In August 2017, the NFL, the U.S. Commerce Department's National Institute of Standards and Technology (NIST), GE and Under Armour, announced the grand prize winner of the third and final challenge in the Head Health Challenge series.

The $500,000 grand prize winner, Dynamic Research Incorporated, led a research team that created a new material system for protective gear for athletes, first responders, military personnel and others who face potential impact injuries. The team is a collaboration between two companies that specialize in protection: **Dynamic Research, Inc. and 6D Helmets, LLC.**

Head Health Challenge III was designed to spur the discovery, design and development of advanced materials to better absorb or mitigate force within helmets, pads and other sports equipment, and consumer products that protect against traumatic brain injury.

"I congratulate the winning team and the Head Health Challenge III partners for looking for technological solutions to this important national problem. The new materials developed through this competition will have broad applications, protecting everyone from students to athletes to soldiers."

Wilbur Ross
U.S. Secretary of Commerce

DYNAMIC RESEARCH, INC. AND 6D HELMETS, LLC.

Terry Smith (left) and Scott Kebschull (right) of Dynamic Research.

This year also saw significant developments from winners from Head Health Challenges I and II:

Head Health Challenge I: Accelerating Diagnosis - BrainScope

BrainScope AP | David J. Phillip

A Head Health Challenge I grand prize winner, BrainScope, developed a hand-held device designed to provide "a rapid, objective assessment of the likelihood of the presence of traumatic brain injury in patients who present with mild symptoms at the point of care." In 2016, the Food and Drug Administration cleared the company to market the device called Ahead 300.

Head Health Challenge II: Improving Prevention - VICIS

VICIS AP | Mark Lennihan

VICIS, a Head Health Challenge II grand prize winner, developed a helmet designed with both a soft shell that acts like a car bumper and vertical struts inside the helmet that bend and buckle. The Zero1 helmet, developed by VICIS and its academic partner, the University of Washington, is designed to mitigate the forces that may lead to concussions. The Zero1 helmet received certification from the National Operating Committee on Standards for Athletic Equipment (NOCSAE) and is being worn by NFL and collegiate players this season.

View full list of challenge winners:
https://www.playsmartplaysafe.com/focus-on-safety/advanced-technology/head-health-initiative/

Imagining the Future

This year, GE received approval from the U.S. Food and Drug Administration to make the SIGNA™ Premier available for sale. SIGNA™ Premier is a new magnetic resonance imaging (MRI) system developed through the GE-NFL Head Health Initiative, which aimed to develop new imaging tools, particularly to aid in the detection of biomarkers for the potential diagnosis of mild traumatic brain injury.

The GE-NFL Head Health Initiative has fostered the development of several novel magnetic resonance hardware and software imaging technologies aimed at acquiring high-resolution images of the brain to better understand physiology, function and structure.

SPURRING INNOVATION THROUGH COMPETITION

The NFL's Annual Start-Up Competition Heats Up During Super Bowl Week

Some of the smartest minds in technology and engineering gathered in Houston, TX, this year for "1st and Future," the NFL's annual start-up competition.

The NFL teamed with the Texas Medical Center (TMC) for a competition focused on advancing sports technology and athlete safety. More than 200 companies submitted applications in three categories: Communicating with the Athlete, Materials to Protect the Athlete and Training the Athlete.

Participating entrepreneurs and innovators appeared in front of competition judges and an exclusive audience, including NFL team owners and executives and representatives from the Houston Super Bowl Host Committee and Texas Medical Center.

Winners were awarded tickets to Super Bowl LI, $50,000 from the NFL to be used to continue their innovative work and a spot in the Texas Medical Center Accelerator (TMCx).

Winners of the 2016 1st and Future Competition

GoRout in Rochester, MN, created a piece of on-field wearable technology designed to streamline the communication between football coaches and players. With it, players receive digital play diagrams and data from coaches on the sideline.

Mobile Virtual Player in Lebanon, NH, developed a self-righting, remote-controlled mobile tackling dummy designed to allow coaches to teach and train players effectively while reducing player-to-player contact on the practice field.

Windpact in Leesburg, VA, developed the Crash Cloud padding system that uses air and foam designed to absorb and disperse impact energy inside the helmet. It's an innovation designed to improve the performance of helmets and protective gear.

Watch a highlight video of the event:
https://youtu.be/-fqzPPRuaLs

AP | Daniel Gluskoter